

Loss and damage in practice

Disaster risk management insights for technical assistance from the Santiago Network regional workshops

November 2026



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Authors

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Abbreviations

DRM	disaster risk management
DRR	disaster risk reduction
EWS	early warning system
GIS	geographic information system
LDCs	least developed countries
OBNEs	organizations, bodies, networks and experts
RAG	retrieval-augmented generation
SIDS	small island developing states
UNCCD	United Nations Convention to Combat Desertification

Executive summary

Purpose of this report

This report provides options and recommendations, to be considered by the Santiago Network for loss and damage, for technical assistance that can strengthen national disaster risk management (DRM) systems for five climate hazards: floods, droughts, tropical cyclones, sea level rise and land degradation. It highlights areas where targeted support may be valuable and points to countries where organizations, bodies, networks and experts (OBNEs) could be drawn on to provide relevant expertise.

Countries have developed a range of DRM measures and strategies, yet challenges remain in areas such as integration, financing, technical capacity and long-term planning. Addressing these challenges offers opportunities to reinforce existing systems and further reduce loss and damage. Drawing on national documents and perspectives from regional workshops, the report provides the Santiago Network with a structured overview of needs, opportunities and sources of peer-to-peer support. The analysis is intended to complement – not replace – country-driven processes, contributing to the robustness of the Network.

Methodology

The analysis underpinning this report was developed in two main stages: (i) constructing a database of DRM measures across hazards and countries; and (ii) analysing that database to identify needs and opportunities for technical assistance.

The database combined two main sources of information: survey responses gathered during three regional scoping workshops on loss and damage under the Santiago Network (2023) and documentary evidence from publicly available sources (around 1,600 documents). The assessed documents included national plans, strategies and legislation,

supplemented by international, development-partner and academic sources. To process the large volume of material consistently and transparently, the team applied a retrieval-augmented generation (RAG) system, which uses semantic indexing to extract relevant information from documents and generate structured outputs with full source traceability. These outputs were then systematically reviewed by researchers to verify their accuracy and relevance and were compared with the survey responses to ensure complementarity.

Once the database was completed, a structured analysis was undertaken in four steps. First, the database was scanned to determine for which countries the selected DRM measures were reported as present, explicitly absent or not mentioned (unknown), without assessing their quality or effectiveness. These results were disaggregated by region, income group and special denomination. Second, the most frequently reported DRM measures per hazard were selected, based on the number of countries reporting them as present and the detail provided on related technical needs. These needs were then grouped into clusters and analysed across countries. Third, examples of good practice were identified to showcase where robust systems are already in place and could serve as sources of peer-to-peer expertise. Finally, a cross-hazard analysis was carried out to distinguish systemic challenges that affect multiple hazards from those that are hazard-specific.

This process enabled the development of a consolidated evidence base that combines country perspectives with documentary insights. While the methodology provides structured and comparable outputs, the results remain indicative, reflecting the quality and availability of accessible documents. They are therefore intended as a contribution to the broader body of evidence available to the Santiago Network, complementing and reinforcing its country-driven processes.

Key findings and recommendations

Hazard	Key findings	Technical assistance opportunities	Potential sources of expertise (OBNEs)
Floods	Widespread early warning systems (EWS) and communication measures; needs in forecasting, communication reach and system integration; relief centres exist, but inclusiveness/logistics are limited.	Enhance forecasting and integration of EWS; improve design and logistics of relief centres.	Bangladesh, Philippines (advanced EWS and outreach); India, Philippines (relief centres, logistics); Indonesia (integration, regulatory frameworks).
Droughts	Strong preparedness (EWS, resilience plans, water bodies); fewer recovery measures; needs in technical EWS, livelihood transition and water governance.	Strengthen EWS technical capacity; develop policy frameworks for livelihood programmes; improve water governance efficiency.	Bangladesh (multi-platform EWS, policy integration); Mauritania (livelihood diversification with policy/finance links); Malaysia (data-driven water governance).
Tropical cyclones	Crisis response dominant (relief, emergency teams, EWS); limited recovery measures; needs in EWS modernization, dissemination and livelihood/service recovery.	Modernize and integrate EWS; expand forecast-based financing; support livelihood and service recovery planning.	Bangladesh (Cyclone Preparedness Programme); Philippines (service restoration, tech-driven risk communication); Viet Nam (inclusive multi-channel EWS); Mozambique (livelihood recovery); India, Cuba (legal and institutional frameworks).
Sea level rise	Strong hazard assessments/resilience planning; relocation, zoning and social protection are rare; needs in scaling pilots, governance, localized studies and financing.	Scale and institutionalize pilot projects; embed sea level rise into governance and budgets; expand localized studies and community engagement.	Bangladesh (hazard assessments, financing continuity); Cuba (Tarea Vida implementation); Philippines (policy/land-use integration); Viet Nam (multi-level coordination); Mozambique (community adaptation, livelihoods).
Land degradation	Preventive strategies are common (plans, monitoring); recovery is scarce; needs in methodologies, monitoring, institutional capacity, financing and training.	Standardize assessments and monitoring; expand institutional capacity and training; integrate land degradation into land-use and legal frameworks.	Colombia (participatory assessments); Uzbekistan, Uganda (advanced monitoring); Chile, India (long-term monitoring, digital tools); Ethiopia, India (community-driven land restoration); Kenya (land-use planning); Namibia (training, technical tools).
Cross-hazard	Shared needs: policy integration, coordination, institutional capacity, sustainable financing, data systems; equity and inclusion are less systematically embedded.	Support integration of policies and institutions; align financing; build workforce capacity; embed equity and inclusion in DRM.	India, Mexico, Brazil, Ethiopia, Chile and the Philippines (integration models, operationalization of multi-hazard DRM).

Conclusions

The key findings reveal a dual reality. On the one hand, many DRM systems already have significant foundations – for example, widespread EWS for floods, droughts and cyclones; strong hazard assessments for sea level rise; and resilience planning frameworks for land degradation. On the other hand, these systems often struggle with gaps in integration, financing, institutional capacity and equity, with needs varying across hazards. Rapid-onset hazards such as floods and cyclones require stronger forecasting, response logistics and recovery planning, while slow-onset hazards such as sea level rise and land degradation demand long-term governance integration, monitoring and institutionalization of pilots into sustained systems. Cross-hazard analysis further underscores the value of hazard-agnostic technical assistance on issues such as policy coherence, capacity development, financing alignment and inclusive governance.

For the Santiago Network, these insights translate into clear opportunities to expand its outreach strategy and mobilize relevant OBNEs as technical partners. The analysis highlights countries and institutions with proven expertise that could serve as peer-to-peer providers of technical assistance. For instance, Bangladesh, the Philippines and Viet Nam stand out for advanced EWS; India, the Philippines and Cuba for relief centres and legal frameworks; Mauritania, Chile and Ethiopia for livelihood and land restoration strategies; and Cuba and Mozambique for long-term adaptation planning. By curating and connecting this network of expertise, the Santiago Network can leverage existing DRM strengths within the Global South and beyond to address specific gaps and enhance resilience.

Ultimately, the report shows that technical assistance under the Santiago Network could adopt a balanced approach: hazard-agnostic support to tackle systemic challenges in governance, financing and capacity, alongside hazard-specific interventions tailored to the unique temporal dynamics and vulnerabilities of each hazard. By doing so, the Santiago Network can ensure that its support is both strategic and responsive, strengthening national DRM systems in ways that directly minimize and address loss and damage. The methodological framework and findings presented here thus provide a concrete road map for the Santiago Network to build a dynamic, evidence-based network of OBNEs that not only responds to current needs but also enhances global cooperation and peer learning in addressing climate hazards.



1. Introduction

This report presents an analysis of the results from a global database on DRM systems addressing five climate-related hazards of particular relevance to loss and damage: floods, droughts, tropical cyclones, sea level rise and land degradation. The database compiles responses from countries across Africa, Latin America and the Caribbean, and the Asia-Pacific region.

The database was constructed by combining two complementary sources:

- Regional scoping workshops on loss and damage under the Santiago Network (2023). Convened by the interim secretariat of the Santiago Network, the workshops brought together national representatives from 84 countries across Africa (41), Latin America and the Caribbean (19) and Asia-Pacific (24) to share information on existing DRM systems and identify country needs.
- Literature review. To complement and expand upon the information collected during the workshops, a desk-based review of publicly accessible documents describing DRM systems at the country level was undertaken. These included national plans, strategies and legislation, supplemented by international, development-partner and academic sources.

The database was structured based on a survey around DRM measures, broadly defined to encompass the full spectrum of systems, subsystems, programmes, actions, and planning and implementation mechanisms considered essential in DRM practice to reduce harm and protect lives and assets. To capture the different temporal dimensions of DRM, these measures were organized into three stages:

- Pre-event measures (prevention, preparedness and risk reduction)
- Short-term post-event measures (emergency response and short-term relief)
- Medium- and long-term post-event measures (recovery, reconstruction and resilience building).

In addition, a set of cross-cutting considerations – such as governance, finance, and data and information systems – was integrated across the three stages. Figure 1 provides an illustrative example of the DRM measures and cross-cutting topics applied for flood events; a similar logic was used for the other four hazards analysed in this report.



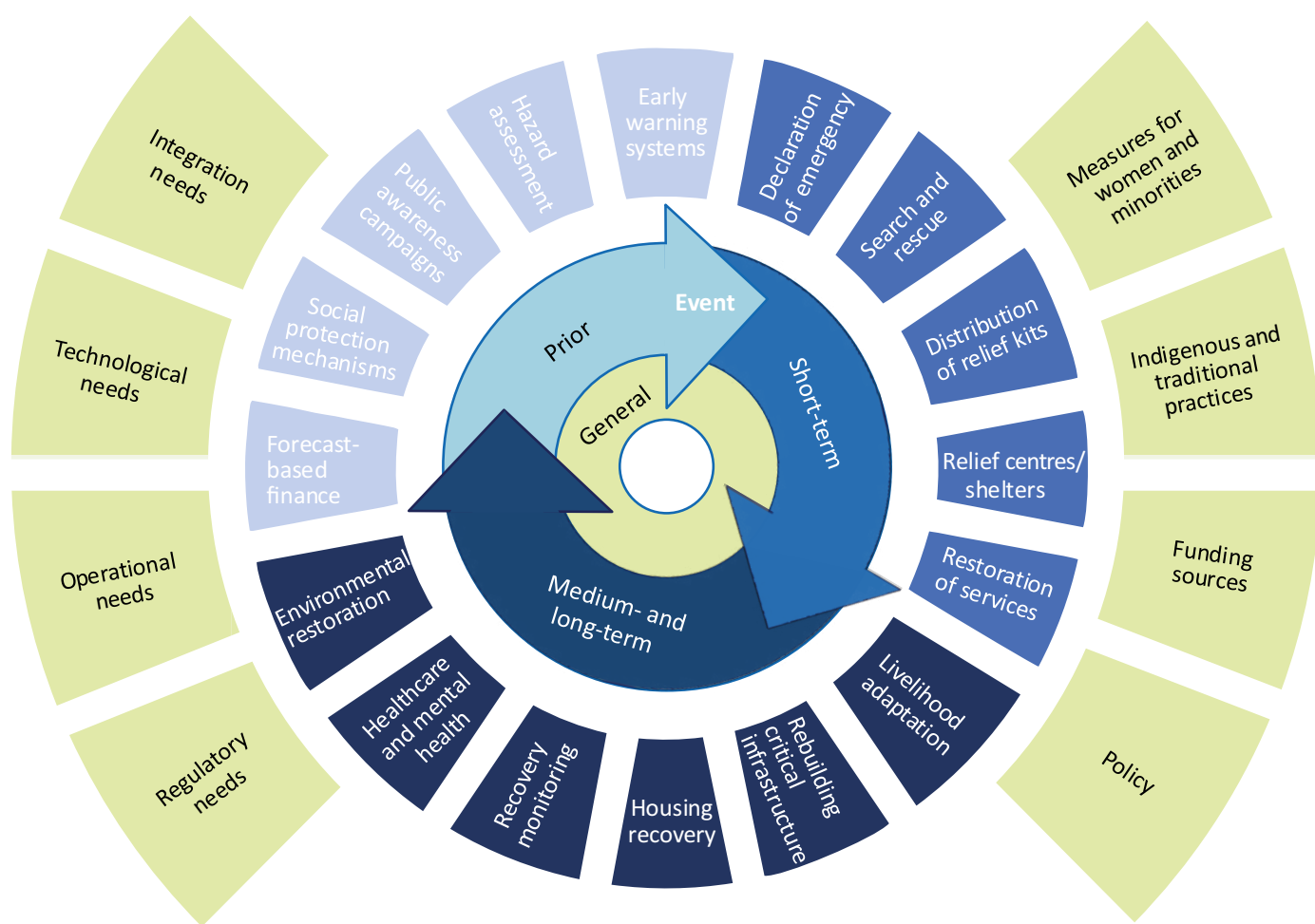


Figure 1: Illustrative example of distribution of flood DRM measures across the temporal dimension

The overall aim of the analyses presented in this report is to provide the Santiago Network secretariat with concrete examples of technical assistance that can strengthen national DRM systems in relation to climate hazards. By addressing identified gaps and leveraging existing opportunities, such assistance can play a central role in helping countries minimize

and address loss and damage. The recommendations drawn from this analysis are also intended to inform the outreach strategy of the Santiago Network, targeting relevant OBNEs that could provide the specialized technical support required to meet the needs observed in the surveyed DRM systems.



2. Methodology

As presented in Figure 2, the methodology applied for this report is presented in two main phases: (i) the construction of a comprehensive database combining survey responses with complementary information extracted through automated and manual review; and (ii) a text-based analysis of this database to identify structural gaps, needs and strengths in national DRM systems.

2.1. Database construction

The first stage of the methodology focused on assembling a data set that integrates workshop survey responses with systematically extracted evidence from publicly available sources. The process consisted of six steps.

Step 1: Selection of countries per hazard

The sample of countries was drawn from those represented in the three regional workshops. Selection was based on three main criteria: (i) inclusion of least developed countries (LDCs) and small island developing states (SIDS); (ii) relevance of the hazard

to the country; and (iii) representation across income levels within each region.

A final selection applied two additional criteria: (iv) maximizing the number of hazards represented per country to strengthen both slow- and rapid-onset hazard analysis; and (v) ensuring the broadest possible inclusion of workshop countries to integrate expert insights. A scoring system was used to balance these factors and revisit the initial criteria, resulting in a sample designed to ensure diversity, relevance and statistical robustness.

Country variable classifications (income group, LDC and SIDS status) were based on 2021 data – or the closest available year in exceptional cases (e.g. Bolivarian Republic of Venezuela, which did not disclose income data). The year 2021 was chosen as the most comprehensive and reliable baseline to enable consistent cross-comparison across all groups.

In total, 55 countries were assessed for floods, 58 for droughts, 56 for tropical cyclones, 21 for sea level rise, and 20 for land degradation. Across all hazards, the Asia-Pacific region accounted for the largest share

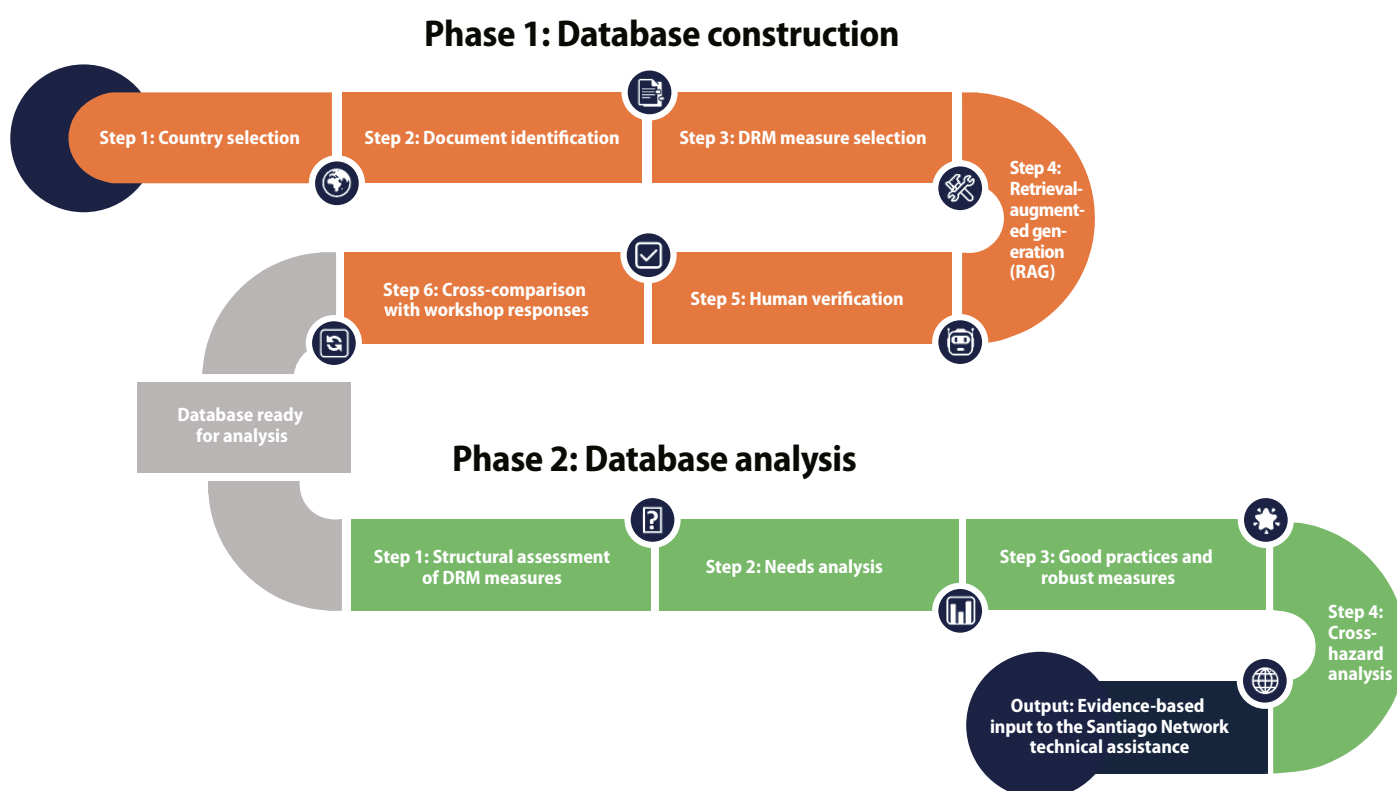


Figure 2: Two-phase approach implemented for data completeness and analysis

of countries (40 per cent), followed by the Americas (32 per cent) and Africa (29 per cent). With respect to special groups, SIDS represented 33 per cent of the countries and LDCs 27 per cent, while middle-income countries (both lower- and upper-middle) made up over 70 per cent of the cases assessed.

An overview of the country selection is presented in Figure 3, which shows the distribution of sampled countries by global region (Africa, the Americas and Asia-Pacific), World Bank income group (low, lower-middle, upper-middle and high), and denomination (SIDS, LDCs, both or neither). Several countries were assessed for more than one hazard. The complete list of countries, per hazard, is presented in Annex 1.

Originally, 60 countries were selected for floods, tropical cyclones and droughts, following the criteria outlined above to ensure cross-compatibility and diversity. However, as data collection progressed, some countries had to be excluded due to poor data quality or technical issues with document formats. In particular, certain PDFs – although not image-based – contained complex or non-standard character encodings that could not be reliably processed, even after attempts to re-encode them in unicode. As a result, large portions of data from these countries could not be translated into the database and were excluded. Five countries were excluded from the flood assessment, four from the tropical cyclone assessment, and two from the drought assessment. For sea level rise and land degradation, sample size was also driven by the limited availability of detailed, country-specific documentation. As shown in Figure 3, these reductions had limited effects on country-type representation: SIDS and/or LDCs remained comparably or more strongly represented than countries with neither denomination across the hazards. Regional representation was also broadly comparable, except for sea level rise, where the greater representation of Asia-Pacific reflects the location of most SIDS.

Step 2: Identification of documents per country

A desk-based review was conducted to identify documents describing DRM systems for each hazard. To ensure comparability and quality, documents were subject to three filters:

- Language: only documents that were in English or could be automatically translated (using tools such as DeepL) were included.
- Country and hazard specificity: each document had to refer to a single country and hazard, avoiding broader regional reports and multi-hazard assessments.

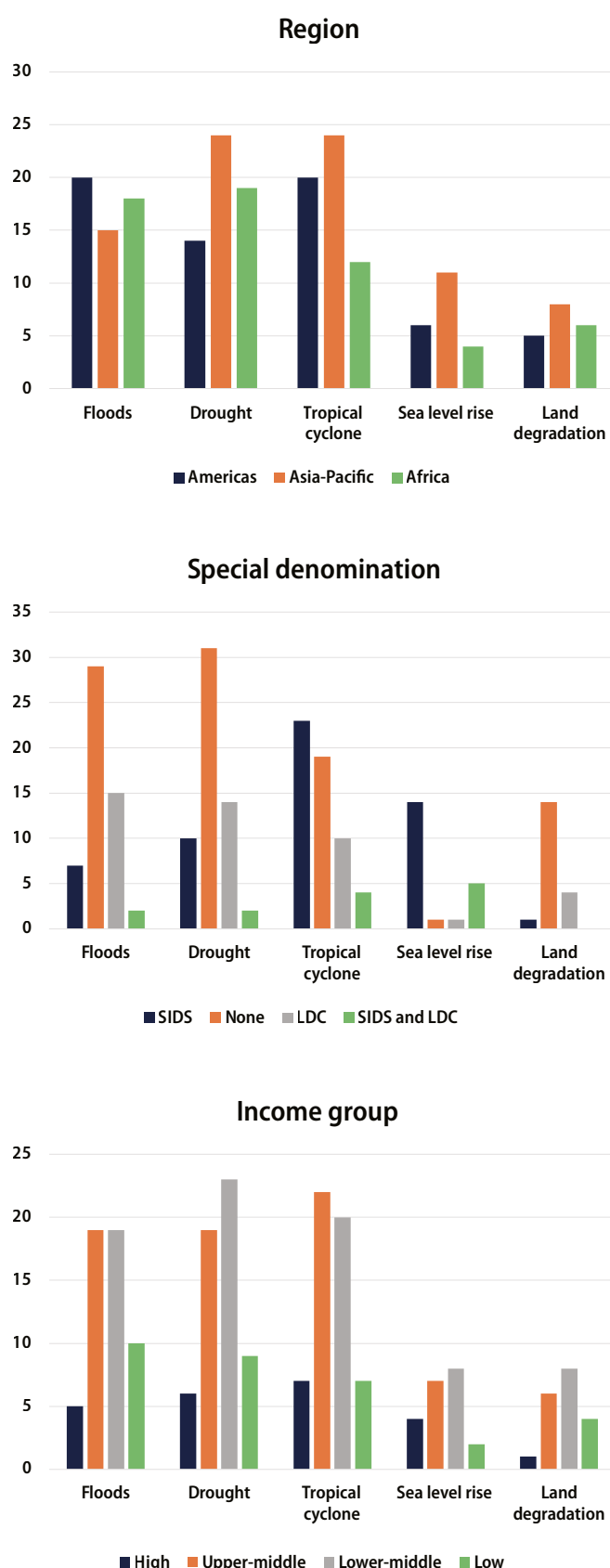


Figure 3: Overview of the distribution of sampled countries

- Source priority: preference was given to nationally published documents such as disaster management strategies, climate adaptation plans or national legislation. However, where national documents were lacking, third-party sources from international organizations, development partners or academic studies were also used.

Document availability varied considerably by hazard; the largest volume of documents related to floods and droughts, followed by tropical cyclones. Fewer documents were available on land degradation and sea level rise, where country-specific documentation was often limited. The review aimed to include at least 10 documents per country-hazard combination. Fewer documents were accepted only when they provided sufficient high-quality information from reliable sources, as in the case of land degradation neutrality plans supported by the United Nations Convention to Combat Desertification (UNCCD). The lowest number accepted was three; otherwise, the country-hazard combination was excluded. In total, 1,585 documents were reviewed using the approach described in this section.

Step 3: Selection of disaster risk management measures per hazard

The survey and document review were organized around a common set of DRM measures (measures, systems, policies and instruments) defined at the country level but adjusted to reflect hazard-specific features. The selection was aligned with the regional workshop questionnaires, with the African questionnaire serving as the main reference due to its greater level of detail. The framework was later refined through consultation with experts from the United Nations Framework Convention on Climate Change and the United Nations Office for Disaster Risk Reduction. This emphasized the need to maintain a manageable scope for large-scale text processing, while incorporating cross-cutting considerations such as the inclusion of vulnerable groups (e.g. women, Indigenous peoples). At this stage, DRM measures were clustered into two categories: (i) DRM measures, organized by subject and temporal phase; and (ii) cross-cutting DRM measures, referring to systemic needs such as integration, operational, technical and regulatory gaps.

The framework was then adapted to reflect the unique characteristics of each hazard, with measures added, removed or rephrased to account for differences such as the prolonged timescales of sea level rise, the rapid onset of floods or the long-term planning demands of sea level rise and land degradation. These refinements were guided by a literature review and

expert input. The final selection of DRM measures ensured both comparability across hazards and relevance to national contexts, while embedding cross-cutting priorities such as equity, inclusion and governance into the analytical framework.

Step 4: Use of retrieval-augmented generation

To process the large volume of country- and hazard-specific documents, the analysis relied on a RAG system. This system was intentionally designed to be lightweight, rapid and accurate with minimal training, making it suitable for extracting DRM information from hundreds of sources to build the database. Unlike keyword-based approaches, RAG uses semantic indexing, which organizes documents by meaning and nuance. This approach allows it to recognize when different terms describe the same concept – such as “forecast-based financing” and “anticipatory funding” – and ensures that subtle but relevant information is captured.

The workflow begins with processing the document intake, where the PDFs for each country and hazard are parsed into small text segments (“chunks”), each tagged with metadata including filename and page number. These chunks are then embedded into a dense retrieval index using ColBERTv2 semantic indexing, developed by a team at Stanford University, which enables precise meaning-based searches while preserving full traceability to the source. When a preset question is posed (e.g. “What EWS are in place?”), the system retrieves relevant text chunks and passes them to a large language model. The model generates a structured answer that includes a clear explanation, up to three supporting quotes, and full citation details with page numbers.

The outputs are automatically compiled into Excel files organized by country and hazard, providing concise summaries, reasoning and direct evidence for later human verification. During calibration, the system was tested to confirm that supporting quotes originated from the provided source documents rather than being generated or drawn from external sources. This approach ensured transparency while building the database, as it could be verified where the information came from, while also reducing the risk of “black box” artificial intelligence (AI) or hallucinated outputs. The design prioritizes efficiency, scalability and evidence-linked reporting, enabling comparisons across countries and hazards using only trusted sources.

Limitations of retrieval-augmented generation

RAG results should be used with an understanding of how the tool functions and where expert judgment remains essential. Because RAG depends on the

quality and relevance of the sources it retrieves, its outputs should always be considered indicative rather than definitive. In climate risk and DRM contexts, where small regional or institutional differences can have major implications, RAG outputs are most useful as a starting point that requires expert validation and contextualization.

The two-step structure of RAG – document retrieval followed by answer generation – means that results combine both source selection and model interpretation. Users should therefore treat outputs as synthesized representations of the available material, not as exhaustive or final accounts. This fact is especially important in DRM, where the meaning and relevance of measures can shift significantly depending on geographies, institutional maturity or hazard-specific needs.

When reviewing outputs, users should also pay attention to the underlying data landscape. Sparse, vague or unevenly distributed information can limit the depth of insights that RAG can generate. Even when responses appear coherent, they may reflect the gaps or biases of the available sources. Results should therefore be cross-checked against authoritative references and, where possible, supplemented with local expertise.

RAG is also best interpreted as a tool for surfacing connections rather than defining hierarchies. While it can link measures or parameters across contexts, it may not capture institutional or policy structures in their full complexity. Users should therefore approach its outputs as complementary insights that require further interpretation within established frameworks.

Finally, because RAG draws on external data sets, users should remain aware of data governance issues, including the timeliness, accuracy and compliance of sources. Interpreting outputs with these considerations in mind ensures that they inform, rather than substitute, professional judgment.

Step 5: Human verification

Every extracted quote underwent systematic human verification. Where an extracted passage lacked sufficient context or required clarification, the quote and its surrounding text were checked in the original document. The verification process also involved examining each quote individually to:

- Assess its relevance to the targeted DRM measure
- Dismiss errors where the excerpt was irrelevant or misclassified (source document included references to other hazards or countries)

- Identify contradictions between answers with similar scope
- Report systematic issues, such as repeated errors across certain questions
- Classify the outcome as either confirming the existence of the DRM measure, indicating its absence, or providing inconclusive evidence.

Certain questions proved more prone to errors. For example, those concerning traditional knowledge or advanced solutions, such as forecast-based financing, often generated quotes with limited relevance. In other cases, the RAG system returned citations that referenced needs identified in the documents or examples from other countries, which could not be used to confirm or deny whether the measure was present in the study country.

Step 6: Cross-comparison with workshop responses

The final step compared the enriched database with the original responses from workshop participants. This triangulation allowed for three possible outcomes:

- Contradictory responses. In cases where RAG-derived evidence conflicted with workshop statements, both were retained in the database to reflect the divergence.
- Complementary responses. Where RAG outputs added detail or nuance to participant responses, the information was combined to provide a fuller picture.
- Preference for RAG outputs. When workshop responses were vague, incomplete or difficult to interpret, the RAG evidence was prioritized.

This approach ensured that the database captured both the direct insights from country representatives and the corroborating or supplementary evidence from documents, while transparently documenting inconsistencies or unresolved gaps.

The final database is composed of AI-generated text derived from the quotes extracted from documents and the outcomes of the workshops. As such, it does not reproduce the full original sources but rather consolidates verified outputs aligned with the survey questions. For transparency, this report is provided as an addition to the database, along with the complete list of documents used in its construction.

2.2. Text analysis of gaps and needs

The second stage of the methodology focused on analysing the enriched database in order to extract insights that could guide recommendations for technical assistance under the Santiago Network. This process was carried out in four steps.

Step 1: Structural assessment of disaster risk management measures

The first step contrasted the presence, absence or unknown status of DRM measures across countries, disaggregated by region, income group and special denomination (SIDS and LDCs). This generic analysis helped identify which measures were most commonly reported as missing and where technical assistance could enhance reporting and documentation on unreported components. This step does not assess the quality or effectiveness of the DRM measures themselves; it only records whether documents reference them as present, absent or unknown. The analysis of quality is undertaken in the following step.

While information gaps remain across DRM measures in all studied hazards, most documented measures were recorded as present – although often with significant variation in their conditions, scope or quality. Only exceptionally did sources explicitly report a measure as absent. While some unknowns (unreported) may indicate absence, treating all unknowns as absent would be misleading, as the lack of documentation may concern measures that were unsuccessful, discontinued or associated with adverse outcomes. Unknowns were therefore retained as a separate category. Moreover, explicit absence generally indicates that the source authors viewed the measure as a need or potential solution, and for unknowns such assessment cannot be made.

A further layer of analysis considered the temporal dimension of the present measures, as well as the cross-cutting considerations most frequently documented (e.g. governance, finance and data systems). This approach allowed the identification of important descriptive patterns specific to certain regions, income groups or denominations.

Step 2: Needs analysis of specific measures

The second step examined in greater depth a set of the most frequently reported DRM measures per hazard. The selection of measures for this analysis was based on the number of countries reporting them as present and the level of detail provided

on related technical needs. Once selected, the database was reviewed in two stages. In the first review, all individual topical needs raised in the responses were recorded, grouped and sorted into clusters. In the second review, each response was revisited and tagged with the relevant clusters to ensure consistency, after which descriptive trends were assessed across regions, income groups and special denominations. Patterns were highlighted when a large share of the assessed countries within a group showed consistent findings concerning the existence of DRM measures, associated issues or cross-cutting needs.

In addition, this step incorporated the general needs explicitly inquired about in the survey – namely integration (horizontal and vertical), technical/technological, operational and regulatory needs. As these were not tied to a single DRM measure, they were clustered separately to ensure proper alignment within each category. The final output contrasted the needs identified with potential technical assistance options for the Santiago Network.

Step 3: Identification of good practices and robust measures

The third step identified countries where the evidence suggested robust implementation of DRM measures or the successful resolution of cross-cutting challenges. These examples of strength and good practice highlight opportunities for the Santiago Network to draw on expertise from within the Global South. By pointing to countries with demonstrated capacity in specific areas, the analysis supports the strategic inclusion of relevant OBNEs into the Santiago Network and encourages peer-to-peer exchanges that can strengthen resilience and loss and damage responses across regions.

Step 4: Cross-hazard analysis

Finally, a cross-hazard analysis was undertaken to assess how DRM measures common to multiple hazards were reported differently across contexts. This analysis, presented in detail in Section 3, disaggregates some of the report's findings into hazard-specific (which require targeted approaches) and wider systemic challenges that could be addressed through multipurpose interventions with broader benefits for climate resilience. While some DRM measures that were reported as functioning effectively in hazard-specific approaches could also benefit from a multi-hazard frame, this report emphasizes those presenting recurring issues across several hazards, highlighting opportunities to enhance them collectively.

In sum, the approach followed in this report combines structured survey design, systematic document analysis and the application of advanced text-processing tools to produce a database that integrates country perspectives with complementary evidence. The subsequent analysis, carried out in four steps, enables both hazard-specific insights and the identification of cross-cutting challenges and opportunities. This methodological framework

not only reveals where DRM measures are present, absent or underdeveloped, but also highlights explicit and implicit needs, as well as examples of robust practice that could inform peer learning. Together, these results provide the Santiago Network with a solid evidence base to prioritize technical assistance, mobilize relevant OBNEs and strategically strengthen DRM systems in support of minimizing and addressing loss and damage.



3. Hazard-specific insights

3.1. Floods

Key takeaways (per cent of countries)

- **Information availability.** The most commonly reported flood DRM measures are upstream risk-understanding and communication measures (hazard assessments 70 per cent, EWS 84 per cent, public awareness 73 per cent, pre-event public communications 88 per cent). However, a large share of measures remains undocumented (35 per cent overall).
- **Measure-specific needs.** For EWS, the most reported needs are forecasting (43 per cent), communication reach/effectiveness (41 per cent) and system structure/integration (35 per cent), with resource and workforce gaps reported less often. For relief centres, the leading issue – although reported by a minority – is adequacy for affected populations (17 per cent), indicating design and inclusion shortfalls even where centres exist.
- **Cross-cutting gaps.** Integration needs are led by policy integration (85 per cent), followed by cooperation/coordination (46 per cent) and knowledge systems (44 per cent). Operational gaps are concentrated in institutional capacity (70 per cent), targeted funding (68 per cent) and expertise/training (62 per cent). Regulatory gaps are dominated by disaster risk reduction (DRR) law revisions (42 per cent), alongside land-use planning (21 per cent) and building standards (13 per cent).
- **Key opportunities for Santiago Network technical assistance.** Integrate EWS forecasting and systems; strengthen inclusive relief centre design and surge logistics; back national integration strategies, data-sharing platforms and financing alignment; and scale targeted training (with equity lenses for LDCs/SIDS) to convert plans into operational capability.
- **Potential sources of expertise (peer-to-peer OBNEs):**
 - Bangladesh and the Philippines for EWS (advanced forecasting and inclusive, last-mile communication and legal/operational integration)
 - The Philippines and India for relief centres (purpose-built shelters, legal mandates, pre-positioned supplies and standardized management)
 - Indonesia for integration and regulatory frameworks (law, spatial planning and financing instruments) that embed risk reduction across sectors.

3.1.1. Presence, absence or unknown status of disaster risk management measures

The database results provide insight into which DRM measures related to floods are present, absent or unknown across the sampled countries. As described in the methodology, the analysis captures only the existence of measures, not their quality or operational state. Thus, a measure reported as present may still face technical challenges; these are examined in later subsections.

Figure 4 illustrates the overall distribution of flood-related DRM measures by reported status – presence, absence or unknown – across the country sample. The

number next to the name of the measure represents the temporal dimension in which it was identified (1: prior, 2: short-term after, 3: medium- and long-term after, and 4: general).

Present measures

Reported measures in flood DRM systems show a consistent emphasis on both risk-understanding and communication measures and short-term response mechanisms. The widespread presence of these measures underscores their foundational role in managing flood impacts, although regional differences remain, particularly in preparedness and shelter provision. Together, these findings highlight

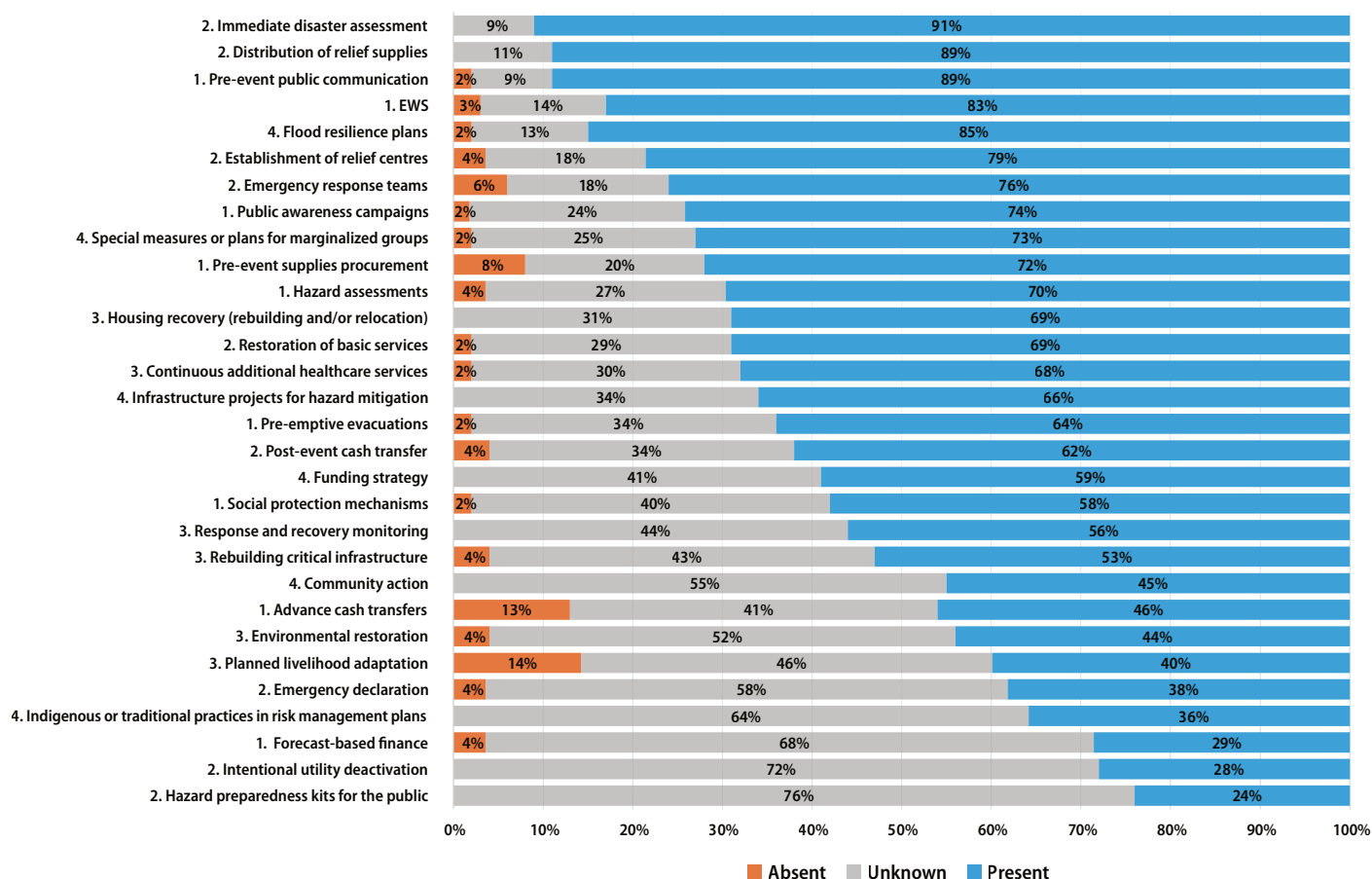


Figure 4: Flood DRM measures reported in sample countries

opportunities for the Santiago Network to target technical assistance where common strengths can be reinforced and persistent gaps addressed.

Measures related to understanding loss and damage risk, and public communications, are highly present across most countries. Hazard assessments (70 per cent) and EWS (84 per cent) play a central role in collecting and disseminating risk information to authorities and communities. These are reinforced by public awareness campaigns (73 per cent) and pre-event communications to the public (88 per cent), which encourage informed decision-making and protective behaviour. As upstream measures, these functions underpin many downstream DRM actions – risk reduction, emergency response and recovery – while also feeding into policy adjustments and long-term planning. Because of their centrality, strengthening hazard assessments, EWS and communication measures through technical assistance offers system-wide benefits, enhancing the effectiveness of DRM regardless of institutional structures, resources or methodologies.

Short-term response measures are also widely reported, including deployment of emergency response teams, distribution of emergency supplies and establishment of emergency relief centres. These

functions are critical for managing the immediate impacts of floods and represent strong entry points for technical assistance due to their visibility and operational familiarity. However, regional differences are notable. For example, relief centres are nearly universal in the Americas and widespread in Africa (84 per cent) but are less consistently reported in Asia-Pacific (60 per cent). These patterns suggest that, while response measures are generally present, their coverage and effectiveness vary significantly by region.

Taken together, these findings show that flood DRM systems have a strong foundation in both risk communication and emergency response, but gaps remain in how these measures are distributed and implemented. For the Santiago Network, this creates opportunities to provide targeted technical assistance: reinforcing universally present measures such as EWS and risk communication to ensure quality and inclusivity, while addressing regional gaps in preparedness and shelter management. By doing so, the Santiago Network can strengthen both the consistency and the equity of flood DRM systems across countries, ensuring that common strengths are scaled up and persistent limitations are systematically reduced.

Absent measures

The database indicates that absent DRM measures are exceptional, with only 1.58 per cent of all entries reported as absent. Among flood measures, the highest shares of absence were for plans for livelihood transition (14 per cent) and advance cash transfers (13 per cent). By phase, most absences were reported for pre-event measures, followed by medium- and long-term recovery measures. This pattern suggests that countries are more aware of their gaps in those periods. However, it does not necessarily mean that they are the only ones missing, considering the high number of unknowns, or that addressing them would have the greatest impact on reducing loss and damage.

Enhancing awareness of such gaps is essential for moving towards comprehensive risk management. Identifying DRM measures that are absent within national systems provides an opportunity to supply countries with clearer information for prioritizing investments and capacity-building efforts. By addressing these absences proactively, countries can reduce reliance on reactive measures, shift emphasis towards prevention and ensure that post-event recovery follows a “build back better” approach, ultimately reducing the burden of future loss and damage.

Unknown measures

The analysis shows that unknown reporting remains a significant gap in flood DRM systems, with 35 per cent of measures classified as unknown. In other words, for over a third of reported measures, the database could not confirm whether they were present or absent, underscoring the limited documentation and systematic monitoring. Two main trends stand out within these unknowns, both of which signal important opportunities for technical assistance.

The first trend is that short-term response measures are underreported. Three of the seven measures with more than 50 per cent unknown reporting – hazard preparedness kits (75 per cent), utility deactivation protocols (71 per cent) and emergency declarations (57 per cent) – fall within the immediate response phase. While immediate response systems are generally considered well-established, these figures suggest that important operational details around preparedness and rapid decision-making are not consistently documented. Strengthening monitoring and reporting in this phase would help countries better capture their capacities and identify where external technical support could be most effective.

The second trend is that community-based and traditional approaches lack visibility. Measures such

as community action (54 per cent unknown) and Indigenous or traditional practices in risk management (63 per cent unknown) are frequently unreported, indicating that they are either undervalued in formal DRM assessments or insufficiently integrated into national systems. This gap underscores the need for technical assistance that helps countries recognize and document these approaches and embed them in DRM frameworks as complementary tools alongside institutional measures.

In summary, the high proportion of unknowns highlights the need to improve documentation, monitoring and integration of both operational response mechanisms and community-based practices. Addressing these blind spots through targeted technical assistance would not only enhance transparency and accountability but also broaden the range of tools available to countries. By strengthening short-term preparedness mechanisms and elevating local and traditional knowledge, the Santiago Network can help countries build flood DRM systems that are more inclusive, resilient and evidence-based.

3.1.2. Support needs assessments for the top measures

This section examines trends within three flood-related DRM measures. As outlined in the methodology, the selection of measures was based on two criteria: (i) those with the highest percentage of countries reporting their presence; and (ii) those with the largest number of countries providing sufficiently detailed information on technical needs. Based on these criteria, EWS and the establishment of relief centres were selected for analysis.

The following subsections present the findings, key insights and implications for technical assistance opportunities.

Early warning systems

EWS play a critical role in flood DRM systems. They underpin pre-event decision-making, trigger immediate response actions and – through weather data and sensing – inform long-term planning and adaptive flood management strategies. Technical gaps in EWS, therefore, have significant downstream effects on the overall effectiveness of DRM systems. The identified needs in EWS were clustered into several groups and are presented in Table 1. The values in parentheses are the share of countries reporting EWS that expressed a given type of need.

Analysis of EWS shows recurring gaps across countries, mostly regarding forecasting accuracy and communication effectiveness. Resource access and

Table 1: Types of needs reported for EWS

Type of need (% of countries reporting such needs in EWS)	Definition
Communication effectiveness or reach (41%)	Need to improve EWS-to-stakeholder communications to reach all populations effectively, and vulnerable groups via improved communication timing, spatial reach or communication clarity
Resource limitations (16%)	Need to increase access to financial or physical resources (e.g. tools or equipment) to support EWS operations
System structure and integration (35%)	Need to improve the organizational structure and normalize guidelines and methodologies across the system
Technical forecasting capabilities (43%)	Need to improve forecasting capabilities regarding forecast accuracy or forecast lead time via hardware, model or software improvements
Workforce and inclusion (16%)	Need to improve staffing structures, staff training or staff inclusion, especially missing Indigenous considerations for more effective and EWS functioning

system structure needs are more context-specific: resource shortages are reported more frequently in low-income countries (30 per cent) than in other income groups, while structural issues are more prevalent in low-income countries (60 per cent) and LDCs (47 per cent), compared with non-LDCs (29 per cent) and higher-income countries. Regional differences are also evident, with Asia-Pacific countries reporting the highest needs overall, particularly in forecasting (57 per cent) and integration (43 per cent).

For the Santiago Network, these findings highlight key opportunities. First, provide cross-cutting support for forecasting and system integration, as these are relevant across all contexts. Second, deliver tailored assistance in low-income and LDC settings, focusing on capacity-building, resource mobilization and structural improvements. Taken together, this

differentiated approach would enable the Santiago Network and its OBNE partners to provide context-sensitive technical assistance that addresses immediate EWS gaps while also contributing to long-term resilience.

Relief centre establishment

Relief centres are a critical component of flood DRM systems, providing immediate shelter, safety and essential services to displaced populations during and after flood events. They not only reduce loss of life and protect vulnerable groups in the short term but also serve as hubs for aid distribution, coordination and transition from emergency response to longer-term recovery. The identified needs in relief centres were clustered into several groups and are presented in Table 2. The values in parentheses are the share

Table 2: Types of needs reported for relief centres

Type of need (% of countries reporting such need in relief centres)	Definition
Adequacy for the affected population (17%)	Need for more shelters to accommodate the entire affected population
Capacity/stocked supplies (9%)	Need for adequately stocked shelters with sufficient food, housing and health supplies
Organizational challenges (4%)	Need for effective management, coordination and equitable resource distribution in relief centres
Policies for shelter use (2%)	Need for clear policies requiring shelter use during flood emergencies
Shelter security (4%)	Need for structurally safe shelters capable of withstanding severe flood conditions

of countries reporting establishing relief centres that expressed a given type of need.

The establishment of relief centres reveals some structural and operational gaps in shelter systems, although overall reporting levels are low. Even so, the issues highlighted are indicative of challenges that can undermine both immediate relief and longer-term recovery. The most frequently reported concern – adequacy of shelter for affected populations (17 per cent) – points to shortcomings in designing shelters that are inclusive, culturally appropriate and responsive to community needs. These findings suggest that while many shelter systems are functioning, gaps in adequacy remain an area where technical assistance could add value.

Regional differences provide additional insight. Asia-Pacific countries (22 per cent) emphasize challenges in scaling infrastructure and logistics to match population needs. In comparison, African countries (19 per cent) report a broader range of issues, including policy and organizational gaps that point to governance limitations.

Across income groups, high- and middle-income countries (19–25 per cent) most often point to difficulties in meeting population needs, while lower-income countries (9–13 per cent) report fewer challenges, which may reflect underreporting or limited monitoring rather than stronger systems.

Technical assistance opportunities for the Santiago Network include supporting inclusive and culturally appropriate shelter design that considers demographic, accessibility and gender-based needs, as well as enhancing logistical planning and surge capacity through scalable stockpiling and supply management. By addressing these areas, the Santiago Network can help countries move beyond short-term shelter

provision and towards the development of safe, adaptive and dignified relief centres that better serve communities during floods and throughout recovery.

3.1.3. Support needs assessments for the cross-cutting needs

This section examines trends within cross-cutting needs, directly captured from the reviewed documents, that are not linked to specific DRM measures.

Integration needs

In flood DRM systems, integration needs refer to the gaps that hinder coherent and coordinated action across institutions and sectors. They include the need for clear policies and frameworks, effective cooperation and coordination, robust knowledge systems, sustainable resource management and a skilled workforce. Addressing these needs is essential to ensure that flood preparedness, response and recovery measures are not fragmented but instead operate as part of a connected, well-resourced and inclusive system that strengthens overall resilience. The identified integration needs were clustered into several groups and are presented in Table 3.

The analysis shows that policy integration is the most consistent need across all regions and country groups, reflecting widespread challenges in aligning DRM with broader development strategies. Africa stands out for integration gaps in resource management (44 per cent), double the level of other regions, pointing to systemic challenges in financing and sustaining cross-sectoral flood responses. At the same time, LDCs (67 per cent) and SIDS (57 per cent) report the highest overall knowledge-sharing issues compared with non-LDC (35 per cent) and non-SIDS (42 per cent), reflecting limited institutional capacity.

Table 3: Types of integration needs reported

Type of need (% of countries reporting such integration needs)	Definition
Cooperation and coordination (46%)	Needs for joint action, partnerships and aligned roles across sectors and levels
Knowledge (44%)	Needs for data, mapping, indicators and information systems to guide DRM
Policy (85%)	Needs for coherent laws, frameworks and strategies integrating DRM into sectoral development plans
Resource management (29%)	Needs for financing, funds, insurance and resource allocation to sustain DRM actions
Workforce (13%)	Needs for staff training, capacity-building and support to strengthen institutional disaster response

For the Santiago Network, these findings highlight several avenues for technical assistance. Key actions include supporting national integration strategies that embed flood DRM into sectoral development planning and ensure coherence across ministries and agencies, as well as strengthening data-driven integration through cross-sectoral platforms for knowledge exchange, hazard mapping and joint monitoring. In Africa in particular, there is a need to expand coordination and financial alignment by developing integrated financing frameworks and resource allocation tools. Tailored support is also critical in LDCs and SIDS, as it improves access to data and harmonizes governance across sectors and levels.

Operational needs

In flood DRM systems, operational needs capture the practical requirements for making measures effective. They span expertise and training, institutional capacity, timely funding, logistical support and technical upgrades. Meeting these needs is essential to ensure that policies and plans translate into reliable action during crises, enabling systems such as early warning, response and relief centres to function effectively and protect vulnerable populations. The identified operational needs were clustered into several groups and are presented in Table 4.

The analysis shows that operational gaps are systemic across all regions, income levels and country groups – with expertise, institutional capacity and flexible funding consistently reported as priority needs. Asia-Pacific countries emphasize specialized workforce skills (75 per cent) and technical system upgrades (58 per cent), while African countries focus most strongly on institutional strengthening (79 per cent). In the Americas, the highest reported operational challenges were related to targeted funding

(74 per cent). Interestingly, logistical support appears less frequently reported, which may reflect either stronger existing systems or underreporting due to limited assessment frameworks.

Denominations also highlight differentiated needs. LDCs emphasize the need for basic institutional development (86 per cent), workforce training (93 per cent) and financial responsiveness (79 per cent) significantly more often than non-LDCs. SIDS stands out for acute dependence on institutional and funding support, which (in nearly all cases) reflects both geographic vulnerabilities and resource constraints.

For the Santiago Network, these findings point to differentiated technical assistance priorities across regions and country groups. In Africa and LDC contexts, the focus could be on strengthening institutional frameworks, coordination mechanisms and workforce training, while also developing responsive funding systems and logistics preparedness. In Asia-Pacific countries, priorities include investing in specialized workforce development, digital and technical upgrades, and coordination platforms to enhance operational readiness. In the Americas, support could target platform enhancements, technical training and overall system optimization. Finally, in SIDS, efforts could prioritize financial delivery systems, institutional streamlining and regional resource-sharing models to address scale and resource limitations.

Regulatory needs

In flood DRM systems, regulatory needs refer to the laws, standards and planning frameworks that ensure risks are managed in a consistent and enforceable way. They include building codes, revisions of DRR laws and land-use regulations in hazard-prone areas.

Table 4: Types of operational needs reported

Type of need (% of countries reporting such operational needs)	Definition
Expertise (62%)	Needs for professional skills, specialized training and technical knowledge to improve disaster response
Institutional capacity (70%)	Needs to strengthen governance structures, coordination mechanisms and organizational effectiveness in disaster management
Logistical support (6%)	Needs for supplies, infrastructure and operational systems to ensure effective emergency response
Targeted funding (68%)	Needs for timely, flexible and adequate financial resources to sustain disaster operations
Technical enhancements (44%)	Needs for upgraded tools, systems and technology to improve preparedness and response

Table 5: Types of regulatory needs reported

Type of need (% of countries reporting such regulatory needs)	Definition
Construction and building standards (13%)	Needs for defined procedures and mandates ensuring coordinated DRM
DRR law revisions (42%)	Needs for updated, enforced codes and resilient practices in building and infrastructure
Land-use planning (21%)	Needs for zoning, spatial regulation and settlement planning in hazard-prone areas

These frameworks are critical because they provide the governance backbone that embeds resilience into infrastructure, urban development and settlement planning, ensuring that technical and operational measures are applied systematically to reduce flood risk. The identified regulatory needs were clustered into several groups and are presented in Table 5.

The analysis of regulatory needs highlights that DRR law revisions are the most widespread concern, reported by 42 per cent of all countries, although there are clear disparities. Among LDCs, 62 per cent cited this need, compared with 34 per cent of non-LDCs, underscoring a governance gap that constrains institutional resilience. Regional contrasts are also pronounced: Africa (53 per cent) and Asia-Pacific (40 per cent) emphasize foundational reforms to strengthen national legal frameworks, while the Americas (25 per cent) report more on building standards and land-use planning, pointing to more technical, enforcement-oriented challenges. SIDS stand out for facing a broader range of regulatory gaps, with consistent reporting on DRR law revisions (50 per cent), construction standards (33 per cent) and land-use planning (33 per cent), in contrast to narrower needs reported by non-SIDS.

For the Santiago Network, these findings suggest several technical assistance priorities. In LDCs,

the focus could be on legal reform, institutional strengthening and capacity-building to update and enforce DRR laws. In Africa and Asia-Pacific, support is needed for comprehensive policy reform and alignment of national strategies. At the same time, in the Americas, assistance could emphasize enforcement through resilient construction codes and risk-informed land-use planning. For SIDS, technical assistance could prioritize the development of resilient building standards, tailored land-use frameworks for small geographies and stronger regulatory enforcement mechanisms. Collectively, these measures would help countries move towards more coherent and enforceable regulatory systems, strengthening the backbone of flood DRM governance.

Technical needs

In flood DRM systems, technical needs refer to the practical enablers that ensure systems can function effectively, equitably and sustainably. The identified technical needs were clustered into several groups and are presented in Table 6.

The most common technical need expressed across countries is targeted training (59 per cent), underscoring that capacity-building remains a widespread gap in flood DRM systems. While this need is broadly shared, disparities emerge by denomination. LDCs (67 per cent) and SIDS (71 per cent) report

Table 6: Types of technical needs reported

Type of need (% of countries reporting such technical needs)	Definition
Equitable access (8%)	Needs to ensure fair availability of resources, services and information for all communities
Functioning resources (20%)	Needs for reliable infrastructure, equipment and systems to enable effective disaster response
Targeted training (59%)	Needs for specialized skills, capacity-building and awareness to strengthen preparedness and resilience

significantly higher levels of training needs compared with non-LDCs (56 per cent) and non-SIDS (57 per cent), indicating that while training is universally important, the demand is particularly acute in vulnerable contexts where sustained capacity-development systems are often lacking.

Beyond training, other technical gaps appear more context-specific. Equitable access to resources and knowledge is reported twice as often in LDCs (13 per cent) and SIDS (14 per cent) than in non-LDCs (6 per cent) and non-SIDS (7 per cent). Although these figures are relatively low overall, they highlight an equity dimension that may be underreported in national assessments, pointing to the need for closer monitoring and further study.

For the Santiago Network, these findings suggest clear priorities. First, targeted training initiatives could be expanded across all regions, with a particular focus on LDCs and SIDS, where institutional and workforce capacities are most constrained. Second, equity considerations could be integrated into technical assistance design, ensuring that access to tools, systems and knowledge reaches marginalized and vulnerable groups. Together, these measures would not only address immediate skill and knowledge gaps but also contribute to more inclusive and resilient DRM systems.

3.1.4. Good examples of measure implementation

This section highlights examples drawn from the database that demonstrate the successful implementation of flood DRM measures in certain countries. These cases illustrate how gaps commonly reported elsewhere – such as low integration, limited operational capacity, technical shortcomings or regulatory constraints – can be effectively addressed through well-designed systems. For the Santiago Network, these examples point to opportunities for outreach efforts to engage OBNEs from the identified countries, enabling peer-to-peer learning and the replication of effective practices in contexts facing similar challenges.

Early warning systems – the Philippines and Bangladesh

The analysis of EWS shows persistent gaps in forecasting accuracy, system integration and communication effectiveness, particularly in low-income countries and LDCs. Resource shortages and structural challenges limit the reach and reliability of these systems, with Asia-Pacific countries reporting especially high needs in forecasting (57 per cent) and integration (43 per cent).

Interestingly, two countries in the Asia-Pacific region offer valuable examples of how these issues can be successfully addressed. In Bangladesh, the Flood Forecasting and Warning Centre combines advanced hydrological modelling with community-based communication channels, ensuring alerts reach even the most vulnerable groups, supported by strong institutional coordination and community trust. In the Philippines, a combination of impact-based forecasting, legal mandates for nationwide alert dissemination, and continuous training of local governments has created a highly integrated system that bridges national and local levels. Together, these cases illustrate how technical capacity, inclusive communication, legal frameworks and community participation can converge to deliver EWS that directly address the common gaps reported by many countries.

Relief centre establishment – the Philippines and India

The analysis of relief centres shows that although many systems are in place, gaps remain in adequacy, inclusivity and logistical capacity. The most frequently reported issue – shelters not meeting the needs of affected populations (17 per cent) – points to shortcomings in design and preparedness, while regional patterns highlight scaling challenges in the Asia-Pacific region and governance gaps in Africa.

The Philippines and India provide strong examples of how these gaps can be addressed. In the Philippines, purpose-built evacuation centres mandated by law, supported by pre-positioned relief goods and empowered local government units, demonstrate how legal frameworks and logistical systems can ensure adequacy and rapid response. India's nationwide network of multipurpose cyclone and flood shelters, guided by the National Disaster Management Authority's minimum standards of relief and managed by local committees, shows how standardized guidelines combined with community-centred governance can deliver inclusive, well-equipped shelters. Together, these cases highlight potential sources of expertise that the Santiago Network could mobilize as OBNE partners to help other countries strengthen their relief centre systems.

Cross-cutting needs

Several countries have built advanced flood management systems that address integration, operational capacity, technical systems and regulatory frameworks – offering valuable lessons for the Santiago Network.

In the Philippines, flood risk management is anchored in strong governance and integration. The National

Disaster Risk Reduction and Management Council and the National Disaster Response Plan clearly define responsibilities across government levels. At the same time, platforms such as GeoRiskPH provide real-time hazard mapping to support decision-making. Financing mechanisms such as the Local Disaster Risk Reduction and Management Fund and catastrophe bonds enable rapid response, and continuous training ensures that capacity extends to all levels of the system.

Indonesia demonstrates how integration and regulation can reinforce each other. Coordination between the National Agency for Disaster Countermeasure and the Local Disaster Management Agencies is supported by platforms such as inaRISK and PetaBencana, which merge official and community data for a more complete risk picture. DRR is embedded in national development planning, while the Disaster Pooling Fund secures pre-arranged financing. Complementary laws on disaster management and spatial planning, alongside updated building codes, further institutionalize resilience in development processes.

India's system highlights the importance of operational readiness. The National Disaster Response Force and the National Disaster Management Authority coordinate actions across all governance levels with standardized protocols. Recovery is guided by Post-Disaster Needs Assessments, while dedicated funds ensure resources are available when needed. Ongoing investments in forecasting, geographic information system (GIS)-based mapping and resilient infrastructure have significantly strengthened preparedness and response capacities.

Bangladesh offers a model of technical capacity focused on inclusivity. The Flood Forecasting and Warning Centre operates a nationwide forecasting network that delivers warnings through SMS, radio and trained volunteers, ensuring that information reaches even the most vulnerable communities. Consistent investment in both technology and community engagement has made its EWS both advanced and widely trusted.

Taken together, these cases demonstrate that no single approach is sufficient, but each provides transferable expertise. By facilitating peer-to-peer learning, the Santiago Network can connect this knowledge to countries seeking to strengthen their own systems, in ways that are both context-sensitive and grounded in proven practice.



3.2. Droughts

Key takeaways (per cent of countries)

- **Information availability.** Drought DRM shows strong foundations in preparedness – EWS (86 per cent), hazard assessments (74 per cent), resilience plans (81 per cent) and water management bodies (76 per cent) – but recovery measures remain scarce, and over 64 per cent of measures are undocumented, particularly those on relocation, household preparedness and monitoring.
- **Measure-specific needs.** EWS gaps centre on technical capacity (58 per cent), coordination/communication (32 per cent) and policy integration (22 per cent). Livelihood programmes most need policy frameworks (64 per cent) and capacity-building (58 per cent), followed by guidance (52 per cent) and accessibility (45 per cent). Water management bodies mainly require stronger policies (52 per cent) and efficiency (39 per cent), with fewer citing infrastructure needs (9 per cent).
- **Cross-cutting gaps.** Integration is led by policy (88 per cent) and coordination (81 per cent) issues, while operational gaps centre on funding (79 per cent), training (59 per cent) and institutional capacity (48 per cent). Regulatory needs emphasize climate risk assessments (64 per cent) and law revisions (53 per cent), and technical gaps focus on functioning resources (79 per cent) and targeted training (77 per cent), with equity largely overlooked (13 per cent).
- **Key opportunities for Santiago Network technical assistance.** Strengthen EWS technical systems and integration; design inclusive livelihood transitions with policy and training support; expand water governance reforms and efficiency measures; advance policy coherence and inter-agency coordination; mobilize targeted funding and capacity development; embed climate risk into regulatory frameworks; and ensure training systems and resources are both functional and equitable.
- **Potential sources of expertise (peer-to-peer OBNEs):**
 - Bangladesh for EWS (multi-platform forecasting, inclusive communication and policy integration)
 - Mauritania for livelihood change (policy-driven diversification, inclusive targeting and adaptation finance)
 - Malaysia for water management (data-driven governance, efficiency and sustainability)
 - India, Mexico, Ethiopia, Brazil, Bangladesh and Chile for cross-cutting integration, operational models and regulatory frameworks.

3.2.1. Presence, absence or unknown status of disaster risk management measures

Figure 5 illustrates the overall distribution of drought-related DRM measures by reported status –presence, absence or unknown – across the country sample. The number next to the name of the measure represents the temporal dimension in which it was identified (1: prior, 2: short-term after, 3: medium- and long-term after, and 4: general).

Present measures

The survey results show that many DRM measures for droughts are already in place across the sample countries. Of the eight measures reported as present in more than 60 per cent of cases, four fall under general categories, three are linked to pre-event preparedness, and one to short-term response.

None are associated with medium- or long-term recovery. Expanding the scope to the 13 measures reported by over 50 per cent of countries, only one relates to recovery. This pattern underscores a clear gap: while preparedness and immediate response are relatively well established, long-term resilience measures remain limited, presenting an opportunity for technical assistance to support recovery-oriented planning.

Countries demonstrate a solid foundation in hazard understanding and communication. EWS are reported by 86 per cent of countries, hazard assessments by 74 per cent and public awareness campaigns by 64 per cent, while 38 per cent reference government communication measures. Future-oriented planning is also widely present, with 81 per cent reporting hazard resilience plans such as national drought plans, 76 per cent establishing

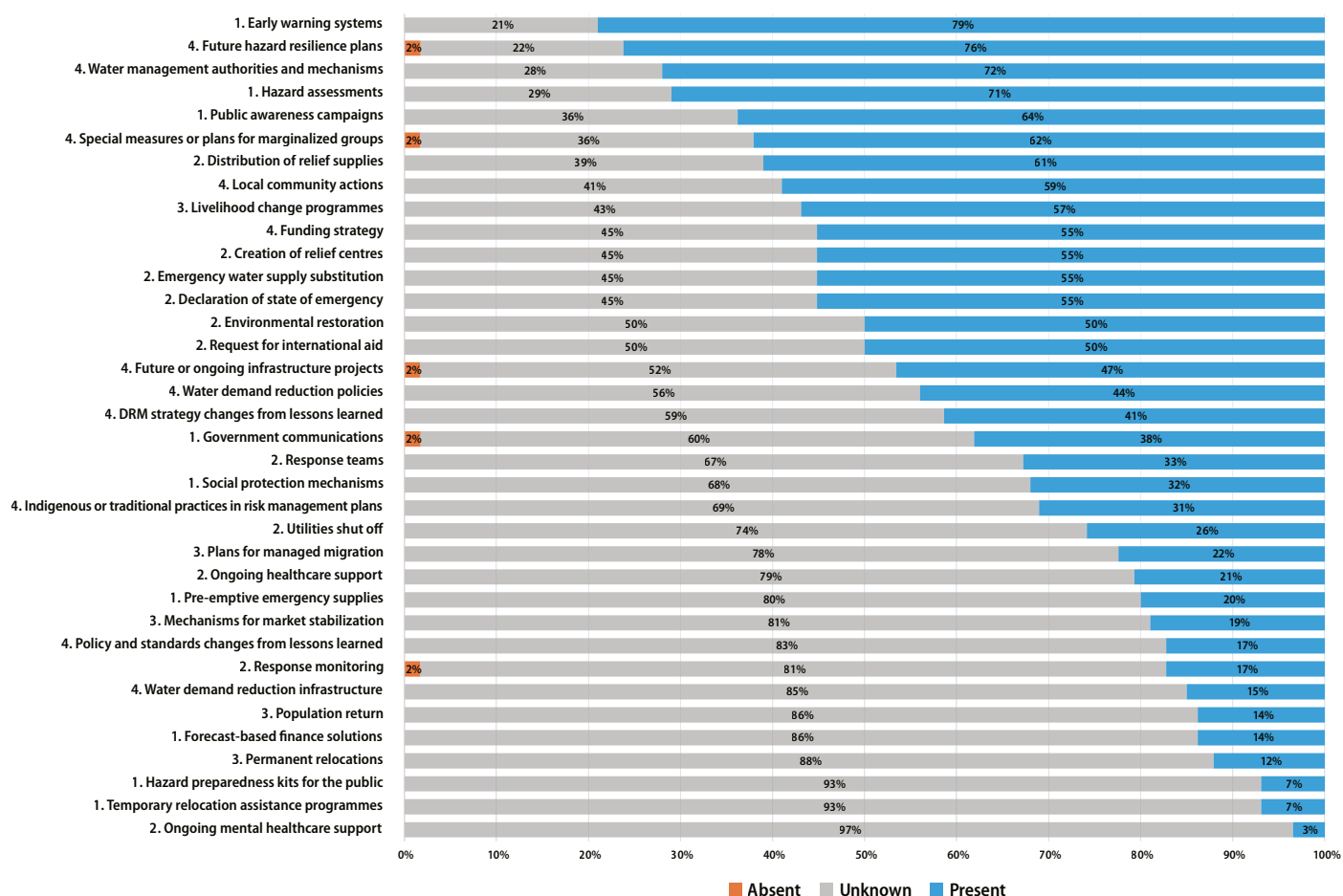


Figure 5: Drought DRM measures reported in sample countries

water management authorities or mechanisms, and 62 per cent introducing dedicated measures for marginalized groups. However, only 33 per cent report social protection mechanisms, suggesting limited capacity to safeguard vulnerable populations during droughts. Overall, while pre-event and institutional preparedness are strong, the scarcity of medium- and long-term measures highlights the need for additional resources, monitoring systems and targeted support to build comprehensive drought resilience.

Regional patterns highlight important contrasts. In the Americas, emergency water supply substitution (73 per cent) and the incorporation of lessons learned into DRM strategies (60 per cent) are among the most frequently reported, showing an emphasis on short-term crisis management and incremental improvements. Africa has the largest share of measures reported by more than half of countries, but nearly all focus on immediate relief. Relief centres (74 per cent) and aid requests (68 per cent) are reported far more often here than elsewhere, reflecting a heavy reliance on emergency measures. Yet fewer than two thirds of African countries report authorities with drought-specific mandates, suggesting a governance gap where technical assistance could be

strategic. In contrast, the Asia-Pacific region reports higher levels of planning that integrate women and minority groups (75 per cent), alongside more frequent references to community-led actions (75 per cent). Public awareness campaigns are also reported at higher levels here (79 per cent), indicating a stronger emphasis on outreach and inclusivity.

Analysis by income group shows subtler differences. The only groups where emergency water substitution efforts, such as water trucking, are ranked among the top five measures are high- (83 per cent) and upper-middle-income (65 per cent) countries, reflecting greater resource capacity. High-income countries also report wider use of public awareness campaigns (83 per cent), while upper-middle-income countries lead in social protection mechanisms (40 per cent). Lower-middle-income countries report the greatest number of measures present in more than half of the sample, suggesting relatively robust DRM systems, although with a stronger focus on short-term responses. Within this group, measures for marginalized groups (83 per cent), integration of Indigenous knowledge (43 per cent) and community-based actions (78 per cent) are reported most frequently. Low-income countries most often

report funding strategies (78 per cent), aid requests (78 per cent) and relief centres (78 per cent), but lag in long-term planning such as livelihood diversification programmes (33 per cent).

Differences also emerge by denomination. LDCs are broadly consistent with the non-LDC sample of countries, although they report higher levels of future resilience plans (95 per cent), requests for international aid (71 per cent) and response teams (43 per cent). SIDS stand out for environmental restoration (67 per cent) and government communication efforts (56 per cent), both reported more often than average, while non-LDC and non-SIDS countries show stronger incorporation of lessons learned into DRM systems (60 per cent). Mental health measures, although rarely referenced overall, appear only in the latter group, suggesting that LDCs and SIDS face greater challenges in initiating such efforts.

An example of visible disparities in present measures is drought monitoring efforts. Only 13 per cent of countries in the Americas reported drought response monitoring systems, compared with 21 per cent in both Asia-Pacific and Africa, suggesting lower regional emphasis on evaluating response performance in the Americas. By income group, low-income countries reported no monitoring systems at all, while some countries in higher income brackets – high, upper-middle and lower-middle income – reported at least partial systems to track drought response and recovery. By denomination, LDCs lacked any reported response monitoring, while SIDS and other non-LDC countries included some references. This disparity highlights the possibility that resource and institutional limitations in LDCs – rather than a lack of recognition – hinder the adoption of monitoring systems for drought response and rehabilitation.

Absent measures

The survey results indicate extremely rare cases where explicit absence of drought-related DRM measures was reported, accounting for less than 0.2 per cent of all responses. Among the few measures reported as absent are future hazard resilience plans, special measures for marginalized groups, future or ongoing infrastructure projects, government communications and response monitoring. Despite a very small number of countries reporting these gaps, this suggests that future-oriented and inclusive planning is widely established globally, offering a substantial opportunity for capacity and experience exchange in these areas. Where gaps remain, they are likely linked to capacity limitations, financial constraints or competing national priorities, rather than to a lack of proven approaches. Given the broad uptake of these

measures, regional exchanges and targeted capacity-building initiatives could help accelerate adoption in the minority of countries that still lag.

One important exception is response monitoring, which remains either underreported or, in some cases, absent. Unlike other measures where a strong global base exists, response monitoring appears to be less systematically integrated into national DRM systems. This limited visibility suggests fewer established practices and a lack of widely shared models. Strengthening global knowledge and best practices in this area may therefore be critical to support more consistent adoption and improve drought management worldwide.

Unknown measures

For over 64 per cent of the drought-related DRM measures found in the overall survey, the status remains unknown. For more than two thirds of the measures, over 50 per cent of the countries lacked publicly available information to confirm whether measures were in place, implemented or planned. This low reporting reflects a mix of challenges, including gaps in documentation, limited dissemination of information on existing measures, and scarce monitoring and evaluation systems to track DRM implementation. The lack of verified information constrains the ability of governments, donors and international partners to identify priorities and direct investments or technical assistance where they are most needed.

The measures with the highest levels of reporting as unknown are concentrated in preparedness and longer-term recovery. Ongoing mental health support (97 per cent), temporary relocation assistance (93 per cent) and hazard preparedness kits for households (93 per cent) were rarely mentioned in documents, suggesting that psychosocial support and household-level readiness are not systematically documented. Similarly, permanent relocation (88 per cent) and population return processes (86 per cent) are seldom referenced, indicating that medium- to long-term recovery strategies remain limited in official planning. Without reliable evidence on the existence and functionality of these measures, countries risk leaving critical gaps in their ability to prepare for, respond to and recover from drought. Closing this information gap will require more systematic documentation, stronger monitoring systems and integration of these measures into national drought strategies.

Regional and income-level patterns provide further insights. In the Americas, temporary relocation was not mentioned in any reviewed document, while Africa lacked references to both mental health support and

preparedness kits. High-income countries reported little on health and mental health support, Indigenous knowledge or permanent relocation. Upper-middle-income countries made fewer references to response teams, pointing instead to an emphasis on cross-cutting approaches. Low-income countries did not reference water demand reduction policies and reported fewer recovery-oriented programmes, such as livelihood adaptation initiatives, as well as having lower emphasis on public awareness campaigns.

Denominational groups show additional contrasts. LDCs report fewer policies promoting water savings and public awareness, which may indicate reliance on external support rather than locally driven action. SIDS lag in declaring emergencies, establishing relief centres and mobilizing response teams, while also falling behind in implementing social protection mechanisms. At the same time, their lack of references to monitoring and evaluation systems suggests an opportunity to strengthen long-term efficiency and accountability. Countries outside the LDC and SIDS categories, by contrast, were less likely to report measures addressing the needs of marginalized groups, pointing to a different kind of gap in inclusion.

3.2.2. Support needs assessments for the top measures

As stated in the methodology, a more in-depth analysis was done for DRM measures that were often reported by countries and where sufficient information on concrete needs was found. In the case of droughts, we assess such needs for EWS, livelihood change programmes, and water management bodies and mechanisms.

Early warning systems

EWS are the cornerstone of drought risk management, enabling governments and communities to anticipate and respond to drought conditions before the impacts

escalate into crisis. The identified needs in EWS were clustered into several groups and are presented in Table 7. The values in parentheses are the share of countries reporting EWS that expressed a given type of need.

The assessment of technical assistance needs for EWS reveals persistent gaps across all regions and income groups. Technical capabilities emerge as the most widely reported need, underlining the importance of reliable data and scientific tools in effective drought early warning. Globally, this issue is highlighted by 69 per cent of countries in the Americas, 60 per cent in Asia-Pacific and 47 per cent in Africa. Other areas of concern include coordination and communication – reported by 46 per cent in the Americas, 41 per cent in Africa and 15 per cent in Asia-Pacific – which points to challenges in integrating local knowledge and ensuring that hazard information is effectively disseminated. Operational capacity gaps are also evident, particularly in the Americas (38 per cent) and to a lesser extent in Africa (12 per cent) and Asia-Pacific (20 per cent), with similar trends in policy-related needs (31 per cent in the Americas, 24 per cent in Africa and 15 per cent in Asia-Pacific).

Regional patterns show distinct priorities. The Americas report high needs across all categories, suggesting an effort to strengthen multidimensional EWS that combine technical platforms, coordination mechanisms and operational delivery. In Africa, an emphasis on coordination (41 per cent) and technical gaps (47 per cent) points to foundational challenges in system design and implementation. In Asia-Pacific, relatively low reporting across coordination (15 per cent) and policy (15 per cent) categories may reflect blind spots in documentation rather than stronger capacity, highlighting the need for deeper diagnostics in the region.

Differences also emerge across income levels. Low-income countries report the most acute gaps in technical capabilities, with 71 per cent citing issues in

Table 7: Types of needs reported for EWS

Type of need (% of countries reporting such needs in EWS)	Definition
Coordination and communication (32%)	Need for sustainable operations integrating local knowledge and effectively using hazard information
Operational capabilities (22%)	Need for improved stakeholder coordination and effective information dissemination
Policy (22%)	Need for stronger policymaker engagement, clear guidance, focused priorities and regular policy updates
Technical capabilities (58%)	Need to strengthen EWS maturity, data quality and system effectiveness

data quality and forecasting capacity. Their priorities are establishing basic technical infrastructure and promoting data-sharing systems. In contrast, high-income countries report their greatest challenges in coordination and communication, with 60 per cent highlighting deficiencies in sustainable operations and effective use of hazard information. These countries may benefit from stronger inter-agency coordination and international knowledge exchange, including South–North and triangular cooperation.

By denomination, non-LDCs report consistently higher levels of need across all categories, with the most prominent being technical capabilities (69 per cent), reflecting both stronger assessment mechanisms and higher performance expectations. LDCs, in contrast, report fewer needs, which may not indicate stronger systems but rather limited monitoring and diagnostic capacities. This observation suggests that while non-LDCs are more effective in identifying gaps, LDCs may require external diagnostic support to uncover and address underlying limitations.

Livelihood change programmes

Livelihood change programmes aim to help communities adapt to drought by diversifying skills, strengthening institutional support and creating enabling policy frameworks. The analysis highlights four key dimensions of need: capacity development, guidance, accessibility and policy. These reflect the importance of training for communities and implementing agencies, practical support for drought management, inclusion of vulnerable groups, and strategies to address governance and policy gaps. Taken together, the findings point to the need for more comprehensive livelihood change programming that combines technical competence with strong institutional backing and meaningful community engagement. The clusters, the share of countries

reporting each type of need and the definitions are presented in Table 8.

Regional patterns highlight varying levels of need for livelihood change programmes. In the Americas, the most prominent gap lies in policy, with 100 per cent of surveyed countries reporting deficiencies in governance, coordination or strategic frameworks. In Asia-Pacific, the greatest needs are linked to guidance (75 per cent) and policy (75 per cent), reflecting demand for structured approaches to livelihood transitions. In Africa, overall reporting levels are comparatively lower, which may reflect underreporting or early stages of programme development rather than stronger capacity. Still, capacity development stands out, with 58 per cent of countries identifying the need for training and awareness-raising initiatives to support more inclusive, community-led transitions.

By income group, livelihood change programming emerges as a multidimensional challenge. Low-income countries report the lowest levels of identified needs, which likely reflects gaps in programme maturity and diagnostic capacity rather than lower vulnerability. Lower-middle-income countries emphasize accessibility (47 per cent) and policy (67 per cent), pointing to institutional and equity barriers that hinder programme delivery. Upper-middle-income countries prioritize guidance (64 per cent), highlighting the need for structured planning frameworks. In comparison, high-income countries show strong demand for capacity development (100 per cent), guidance (75 per cent) and policy support (75 per cent), reflecting the difficulty of aligning complex systems with evolving resilience goals.

Differences also appear by denomination. Non-LDCs consistently report higher needs across all dimensions, with technical capacities (67 per cent) to identify gaps contributing most strongly. LDCs,

Table 8: Types of needs reported for livelihood change programmes

Type of need (% of countries reporting such needs in livelihood change programmes)	Definition
Accessibility (45%)	Need to ensure inclusive support targeting women and poor, rural and vulnerable populations
Capacity development (58%)	Need for targeted training, technical assistance and sustained capacity-development initiatives
Guidance (52%)	Need to guide communities in hazard management and risk reduction to strengthen commitment
Policy (64%)	Need to address policy and governance gaps in coordination, communication and scientific assessments

by contrast, report lower levels of need, which likely reflects fewer monitoring and diagnostic systems rather than reduced vulnerability. In LDCs, priority could therefore be given to building foundational policies, participatory planning tools and technical capacity to enable effective livelihood transitions. Across both groups, accessibility remains a shared challenge, with 60 per cent in non-LDCs and 36 per cent in LDCs reporting gaps, highlighting the importance of inclusive approaches and opportunities for joint learning. For non-LDCs, assistance could focus on refining and scaling policies, guidance and advanced training strategies, while in LDCs, more basic institution- and capacity-building support will be essential to strengthen resilience.

Water management bodies and mechanisms

Water management bodies and mechanisms play a central role in reducing drought vulnerability, by ensuring that water resources are effectively governed, allocated and used during periods of scarcity. The assessment indicates that technical assistance needs in this area include strengthening the resilience of water infrastructure, improving governance and accountability, enhancing coordination and data use, addressing conflicts over competing water demands, and promoting the long-term sustainability of water resources. Meeting these needs requires addressing both technical and institutional challenges, through integrated approaches that support water security in drought-prone contexts. The identified needs were grouped into categories and are presented in Table 9, with values in parentheses showing the share of countries with water management bodies and mechanisms that reported each type of need.

Regional trends indicate that policy and efficiency are the most frequently reported needs across all three regions, reflecting common challenges in governance, coordination and institutional alignment. In the Americas, policy gaps are especially pronounced (67 per cent), alongside needs in efficiency (33 per cent) and conflict resolution (17 per cent). A smaller share of countries also highlight sustainability (8 per cent), suggesting early but limited uptake of long-term planning. In Africa, the strongest emphasis is on policy (58 per cent) and efficiency (33 per cent), complemented by significant reporting on infrastructure gaps (17 per cent), pointing to challenges in basic systems. Asia-Pacific reports greatest needs in efficiency (45 per cent) and policy (40 per cent), underscoring demand for operational reforms and institutional coherence. Together, these findings suggest targeted support could focus on infrastructure and efficiency improvements in Africa, as well as on operational reforms and policy alignment in Asia-Pacific, while in the Americas, attention could also include conflict-sensitive governance.

Across income groups, policy and efficiency remain the dominant concerns, revealing systemic challenges in coordination and regulation. Low-income countries report the highest levels of need among all income groups in infrastructure (33 per cent) and efficiency (67 per cent), underscoring basic service delivery and coordination challenges. Lower-middle-income countries emphasize policy (44 per cent) and efficiency (33 per cent), pointing to institutional and regulatory barriers. In upper-middle-income countries, policy (63 per cent) stands out as the leading gap, while efficiency is also significant (31 per cent). High-income countries, meanwhile, report policy

Table 9: Types of needs reported for water management bodies and mechanisms

Type of need (% of countries reporting such needs in water management bodies and mechanisms)	Definition
Conflicts (5%)	Need to address conflicts arising from competing and contested water use
Efficiency (39%)	Need to overcome coordination, documentation, data, communication and prioritization inefficiencies
Infrastructure (9%)	Need to improve the management, maintenance and resilience of water infrastructure
Policy (52%)	Need to strengthen government policies, accountability and internal structures for effective water governance
Sustainability (5%)	Need for sustainable, long-term water governance ensuring resource security and equity

(50 per cent), efficiency (50 per cent) and conflict resolution (25 per cent) as key needs, showing that even advanced systems face governance complexities and contested water use. These patterns suggest that technical assistance in low-income countries could focus on building infrastructure resilience and basic coordination systems, while higher-income countries may require support in regulatory refinement and conflict-sensitive governance approaches.

Analysis by denominational group reveals further differences. Both LDCs and non-LDCs report efficiency as a major concern (40 per cent and 38 per cent, respectively). LDCs also highlight infrastructure gaps (13 per cent), pointing to deficiencies in basic operational capacity and service delivery. In contrast, non-LDCs report stronger emphasis on policy (62 per cent), reflecting the need for regulatory refinement and institutional reform. These outcomes suggest that while LDCs would benefit most from foundational infrastructure development and capacity-building, non-LDCs require support to upgrade governance systems, improve regulatory alignment and integrate conflict-sensitive planning.

3.2.3. Support needs assessments for the cross-cutting needs

This section examines trends within cross-cutting needs, directly captured from the reviewed documents, that are not linked to specific DRM measures.

Integration needs

Effective and sustainable DRM depends on strong integration across multiple dimensions. These dimensions include improved cooperation and coordination through joint action, partnerships, and clearly defined roles across sectors and levels of governance. It also requires the integration of

financial strategies to ensure that adequate resources are secured and allocated to risk reduction and resilience-building priorities. Equally important is the integration of knowledge, so that research, data and cross-sectoral insights inform decision-making and practice. At the policy level, greater coherence is needed to embed DRM into laws, frameworks and sectoral development plans. Finally, resource management integration could align financial and physical resources more effectively within DRM systems. Collectively, these needs underscore the importance of a comprehensive and well-coordinated approach to managing disaster risks. The identified integration needs have been grouped into categories and are presented in Table 10.

Across all regions, policy coherence, cooperation and coordination stand out as the most prominent needs, reflecting systemic challenges in aligning DRM with broader governance systems. Policy gaps were reported by 83 per cent of countries in the Americas, 88 per cent in Africa and 91 per cent in Asia-Pacific, while cooperation and coordination were also high (92 per cent, 65 per cent and 87 per cent, respectively). These findings point to the importance of prioritizing technical assistance that strengthens policy integration and inter-agency coordination. Knowledge integration is a more moderate but still significant need, reported by 33 per cent in the Americas, 35 per cent in Africa and 35 per cent in Asia-Pacific, suggesting scope to expand multisectoral information systems and decision support tools. In contrast, financial strategy alignment was scarcely mentioned – 9 per cent in Asia-Pacific, 24 per cent in Africa and not at all in the Americas – indicating either that this dimension is underprioritized or that awareness of it remains limited. While regional differences exist, the overall pattern shows strong and consistent demand for enhanced integration to build DRM systems capable of addressing the impacts of climate change.

Table 10: Types of integration needs reported

Type of need (% of countries reporting such integration needs)	Definition
Cooperation and coordination (81%)	Needs for joint action, partnerships and aligned roles across sectors and levels
Financial strategies (12%)	Needs to integrate financial strategies
Knowledge (35%)	Needs for data, mapping, indicators and information systems to guide DRM
Policy (88%)	Needs for coherent laws, frameworks and strategies integrating DRM into sectoral development plans
Resource management (33%)	Needs for financing, funds, insurance and resource allocation to sustain DRM actions

Integration needs also vary across income levels. High-income countries report the highest overall levels, with 100 per cent identifying policy integration as a gap and 80 per cent highlighting knowledge integration. This suggests an emphasis on refining governance systems, enhancing coordination mechanisms and linking knowledge more effectively to policy and practice. Low-income countries place more weight on financial strategies (38 per cent) and resource management (38 per cent) than other income levels, reflecting challenges in aligning budgets and resource allocation with DRM priorities. Lower-middle-income countries show lower reporting of financial integration (9 per cent) but relatively higher emphasis on policy (91 per cent) and cooperation and coordination (82 per cent), suggesting that greater awareness and stronger embedding of DRM into sectoral and financial planning could help address these gaps.

By denomination, non-LDCs report consistently high needs across almost all integration dimensions, with particularly strong emphasis on policy (100 per cent) and coordination (94 per cent). LDCs, by contrast, show relatively lower reporting across most categories but highlight financial strategies (21 per cent) as a more common concern, pointing to difficulties in aligning public budgets and investment planning with DRM. Lower reporting from LDCs could be interpreted not as lower need, but rather as limited capacity to diagnose or document integration challenges. Technical assistance across all groups could therefore emphasize not only strengthening integration mechanisms, but also improving documentation and monitoring, so that a clearer evidence base guides institutional reforms and resource planning.

Operational needs

Operational needs in DRM refer to the systems, capacities and resources required to ensure effective implementation. The most frequently identified needs include developing expertise through human capacity-building across relevant actors, strengthening institutional capacity so that governments and agencies can fulfil their responsibilities, and providing sufficient logistical support to maintain operations. Sustained and flexible funding is also essential to ensure continuity of DRM functions, while technical enhancements – such as upgrading of EWS – are critical for improving performance. These operational needs have been grouped into categories and are presented in Table 11.

The analysis shows that targeted funding is the most pressing operational need, reported by 80 per cent of countries in the Americas, 83 per cent in Africa and 74 per cent in Asia-Pacific. Demand is especially high in low-income (89 per cent) and high-income (83 per cent) countries, with similarly strong reporting among middle-income groups. Non-LDCs (89 per cent) identify funding gaps more often than LDCs (62 per cent), reflecting stronger diagnostic capacity. Technical assistance could therefore focus on integrated financing frameworks, access to climate and risk finance, and improved resource mobilization, especially in LDCs.

By contrast, logistical support is the least reported need – 7 per cent in the Americas, 11 per cent in Africa, 13 per cent in Asia-Pacific and 5 per cent in LDCs – likely pointing to diagnostic blind spots. Support for supply chain resilience, contingency stockpiling and scalable logistics systems could help address these gaps.

Table 11: Types of operational needs reported

Type of need (% of countries reporting such operational needs)	Definition
Expertise (59%)	Needs for professional skills, specialized training and technical knowledge to improve disaster response
Institutional capacity (48%)	Needs to strengthen governance structures, coordination mechanisms and organizational effectiveness in disaster management
Logistical support (11%)	Needs for supplies, infrastructure and operational systems to ensure effective emergency response
Targeted funding (79%)	Needs for timely, flexible and adequate financial resources to sustain disaster operations
Technical enhancements (54%)	Needs for upgraded tools, systems and technology to improve preparedness and response

Expertise and institutional capacity are consistently reported across regions, with expertise noted by 60 per cent in the Americas, 50 per cent in Africa and 65 per cent in Asia-Pacific, and institutional capacity by 43–56 per cent. Lower-middle-income countries emphasize expertise (71 per cent), highlighting governance and workforce challenges. Assistance could strengthen training, academic partnerships and coordination platforms.

Needs for technical enhancements are more prominent in the Americas (67 per cent) and Asia-Pacific (61 per cent) than in Africa (33 per cent), particularly in lower-middle-income countries (67 per cent) and non-LDCs (69 per cent). Digital modernization, interoperable early warning platforms and improved monitoring tools are clear opportunities for support.

Overall, non-LDCs report higher needs across funding, expertise and technical improvements, while the lower reporting by LDCs likely reflects limited diagnostic systems. For the Santiago Network, priorities could differ by context: foundational systems and capacity in LDCs, modernization and upgrades in middle-income countries, and efficiency-focused governance and financing in high-income settings.

Regulatory needs

Regulatory frameworks are essential for ensuring that drought risk reduction and management are systematically enforced and implemented. The analysis identified gaps in clear DRR and DRM protocols, as well as in regular DRR law revisions, both of which are essential for operationalizing standard procedures while ensuring that legislation is consistently updated based on lessons learned and evolving risks. Another need is for climate risk assessment that integrates hazard and climate data into the regulatory framework. There is a global need for further land-use planning that incorporates risk reduction into zoning and development rules

to prevent settlement in drought-prone areas. The identified regulatory needs were clustered into several groups and are presented in Table 12.

Regional patterns reveal distinct priorities in strengthening regulatory frameworks. In the Americas (67 per cent) and Africa (53 per cent), the most pressing need is the establishment of clear DRR and DRM protocols, highlighting gaps in defining and implementing governance structures. Technical assistance in these regions could therefore prioritize institutional protocol development, risk-informed planning, and support for legal and regulatory frameworks. In contrast, the Asia-Pacific region places greater emphasis on climate risk assessments (74 per cent), reflecting a drive to update regulations based on improved hazard data. Here, support could focus on embedding climate assessments into regulatory frameworks and advancing law revision processes.

Patterns across income groups point to legal reforms as a widely shared priority. Low-income countries (86 per cent) and high-income countries (67 per cent) report significant needs in regular DRR law revisions, suggesting challenges in systematically updating legal frameworks with lessons learned. Technical assistance could therefore focus on legal development and regulatory modernization, especially in relation to slower progressing hazards such as drought. Middle-income countries also report high demand for climate risk assessments (68 per cent in lower-middle and 60 per cent in upper-middle), alongside high-income countries (83 per cent), indicating that evidence-based policymaking is increasingly prioritized across these groups. These trends highlight opportunities to expand protocol development, policy coordination and risk-informed planning.

By denomination, non-LDCs consistently report higher needs, with 56 per cent requiring clear DRM protocols and 75 per cent identifying gaps in climate risk assessments. This suggests both stronger

Table 12: Types of regulatory needs reported

Type of need (% of countries reporting such regulatory needs)	Definition
Clear DRR and DRM protocols (47%)	Needs for defined procedures and mandates ensuring coordinated DRM
Climate risk assessments (64%)	Need to include climate risk assessments in regulatory frameworks
Land-use planning (16%)	Needs for zoning, spatial regulation and settlement planning in hazard-prone areas
Regular DRR law revisions (53%)	Needs for continual review and updating of disaster laws and policies

Table 13: Types of technical needs reported

Type of need (% of countries reporting such technical needs)	Definition
Equitable access (13%)	Needs to ensure fair availability of resources, services and information for all communities
Functioning resources (79%)	Needs for reliable infrastructure, equipment and systems to enable effective disaster response
Targeted training (77%)	Needs for specialized skills, capacity-building and awareness to strengthen preparedness and resilience

diagnostic capacity and greater recognition of the importance of integrating risk data into planning and legal systems. LDCs report lower levels – 32 per cent for clear protocols and 42 per cent for climate risk assessments – but likely face underreporting due to limited monitoring and diagnostic capacity. For these countries, priorities could include enhancing risk assessment systems, establishing protocols, and strengthening legal frameworks to ensure that drought and other climate-related risks are systematically integrated into DRM governance.

Technical needs

Technical needs in DRM focus on strengthening capacities and ensuring that systems and tools function effectively. Priorities include equitable access to training so that actors at all levels can build skills, maintain and repair critical equipment and resources, and provide targeted training tailored to specific technical roles. Addressing these needs is essential to ensure inclusive, well-equipped and effective DRM operations in the context of drought. These groups of needs and definitions are presented in Table 13.

The analysis of technical needs shows that the foundations of drought DRM – both human and material – require significant strengthening. Functioning resources are one of the most widely reported gaps, highlighted by 79 per cent of countries in the Americas, 89 per cent in Africa and 71 per cent in Asia-Pacific, and reaching 100 per cent in both low- and high-income countries. Similarly, targeted training is consistently emphasized, reported by 71 per cent in the Americas, 78 per cent in Africa and 79 per cent in Asia-Pacific, with particularly high levels in lower-middle-income countries (87 per cent) and high-income countries (80 per cent). These results point to a shared challenge: while countries start from very different levels of capacity, they converge around the need for reliable equipment and well-structured training systems. Technical assistance that builds durable infrastructure and expands access to

specialized training would therefore provide broad benefits across all contexts.

In contrast, equitable access to training remains far less visible, reported by only 14 per cent in the Americas, 11 per cent in Africa and 13 per cent in Asia-Pacific, and rarely exceeding 20 per cent across income groups. This underreporting may suggest that equity considerations are not systematically assessed or integrated into technical planning. Supporting countries to embed equity-focused diagnostics and inclusion strategies into their technical training and capacity programmes could ensure that vulnerable groups are not left behind.

Differences also emerge by denomination. Non-LDCs report higher needs overall, with 86 per cent identifying functioning resources and 83 per cent targeted training, compared with 65 per cent for both in LDCs. Still, the distribution of needs is similar across groups: equitable access is consistently underreported, while training and equipment gaps dominate. This outcome suggests that LDCs may underreport not because the needs are absent, but because diagnostic and reporting systems are limited.

Taken together, these findings highlight two clear priorities: strengthening infrastructure and training systems to ensure functioning DRM capacities, and enhancing diagnostic and inclusion frameworks so that equity is fully integrated. Supporting regional knowledge exchanges and scaling successful models could accelerate progress and provide countries with proven approaches to close these technical gaps.

3.2.4. Good examples of measure implementation

Across the Global South, countries have pioneered effective drought management solutions that reflect specific DRM measures and their respective needs. These countries demonstrate leadership in resilience, with practices that already fill policy gaps, enhance technical systems and strengthen governance. This

section presents some examples identified that can serve as models for other nations, and where expertise can be found to offer technical assistance.

Early warning systems – Bangladesh

The analysis of EWS shows persistent gaps in technical capacity, policy integration and communication. Limited forecasting and data systems remain a major challenge, reported by countries in all regions. Policy integration is also scarce, especially in Africa and the Asia-Pacific region, while coordination and communication are pressing issues in the Americas and Africa, even in high-income countries.

Bangladesh demonstrates how these gaps can be addressed. Its multi-platform, satellite-based EWS – developed with support from the Bangladesh Meteorological Department, the Bangladesh Water Development Board and the World Meteorological Organization – strengthens forecasting capacity and embeds climate risk into national planning through the National Adaptation Plan. By using SMS, radio and volunteer networks, the system ensures warnings reach vulnerable populations, while the integration of local knowledge builds trust and inclusivity.

Mobilizing Bangladeshi institutions as OBNE partners could help other countries improve technical forecasting, integrate EWS into policy frameworks and design inclusive communication strategies that reach all at-risk groups.

Livelihood change programmes – Mauritania

The analysis of livelihood change programmes shows that while many countries are advancing policies and initiatives, significant gaps remain in governance, guidance and capacity. The most frequently reported issues include the absence of coherent policy frameworks (in the Americas) and limited capacity development (in Africa), while Asia-Pacific countries highlight the need for structured guidance to support transitions. Accessibility also emerges as a cross-cutting challenge, particularly in lower-middle-income countries and among LDCs.

Mauritania provides a strong example of how these gaps can be addressed. Through a policy-driven approach, the government has promoted drought-resilient crops, improved seed systems and modernized irrigation schemes, while also expanding income-generating activities for vulnerable groups. Supported by the Adaptation Fund, these programmes deliberately target women, youth and persons with disabilities, ensuring inclusivity and equity. By combining agricultural innovation with diversified livelihoods, Mauritania has strengthened adaptive capacity and reduced dependency on climate-sensitive sectors.

By mobilizing institutions and practitioners in Mauritania as OBNE partners, the Santiago Network could help other countries strengthen policy frameworks, expand training and design inclusive livelihood transitions that directly respond to the common gaps identified in the global assessment.

Water management bodies and mechanisms – Malaysia

The analysis of water management bodies and mechanisms shows that although systems exist, gaps remain in policy, efficiency and infrastructure. Policy limitations are most evident in the Americas and in upper-middle-income countries, while efficiency challenges are widespread, especially in low-income countries and the Asia-Pacific region. In Africa, infrastructure gaps highlight limits in basic service delivery. Even high-income countries report governance and coordination issues, including contested water use.

Malaysia provides a strong example of how these gaps can be addressed. Its water governance system uses centralized data centres and real-time monitoring tools to enhance coordination, efficiency and drought preparedness. By embedding inclusive mechanisms that link national institutions with local communities, Malaysia strengthens accountability and ensures that policies reflect local needs. Long-term strategies also prioritize sustainability and equitable access, supporting resilient infrastructure and fair distribution of water resources.

This experience highlights Malaysia as a potential source of expertise and support for the development of inclusive, data-driven and sustainable water management systems.

Cross-cutting needs

Several countries have advanced drought management practices that together illustrate how integration, operations, technical capacity and regulatory frameworks can be strengthened – and how the Santiago Network could mobilize this expertise.

India has combined policy and technology through its district-level contingency plans, the India Drought Monitor portal and the Indian Council of Agricultural Research – Central Research Institute for Dryland Agriculture. These systems offer valuable lessons on science-driven planning and operational readiness, even as challenges remain around inter-state coordination and equitable access to financial mechanisms such as the Pradhan Mantri Fasal Bima Yojana crop insurance scheme. Mexico complements this with governance integration under the national drought programme PRONACOSE, which aligns

ministries, municipalities and basin councils through drought prevention and mitigation programmes linked to financing strategies. Its experience demonstrates how coordinated institutions and funding can embed drought management into governance structures.

Ethiopia shows the power of linking early warning to early action. The Livelihood, Early Assessment and Protection tool and the Productive Safety Net Programme automatically trigger funding and local responses, while early action protocols and multisector analysis hubs ensure coordination between meteorological, food security and humanitarian actors. This model highlights how forecast-based financing can turn risk information into timely interventions. Brazil, meanwhile, brings operational and community expertise: Operation Carro Pipa institutionalizes emergency water delivery, the Drought Monitor standardizes drought diagnostics, and the One Million Cisterns Programme strengthens household water security – together illustrating how logistics and community-based adaptation can build resilience from the ground up.

On the regulatory side, Bangladesh and Chile showcase how laws and institutions can anchor drought risk management. Bangladesh's Disaster Management Act and Standing Orders on Disaster ensure structured procedures for preparedness and response, while its National Adaptation Plan links climate risk and land-use planning. Chile has modernized its disaster governance through the creation of the National Service for Disaster Prevention and Response and the Climate Change Framework Law, complemented by reforms to the Water Code and the Urban Wetlands Law that embed climate resilience across sectors.

Together, these experiences demonstrate that no single model is sufficient, but each offers transferable lessons. By connecting this expertise through peer-to-peer learning, the Santiago Network can help countries strengthen their own systems in ways that are both context-sensitive and grounded in proven practice.

3.3. Tropical cyclones

Key takeaways (% of countries)

- **Information availability.** Tropical cyclone DRM remains focused on crisis response – relief supplies (89%), emergency teams (84%), community actions (82%) and EWS (79%) dominate – while recovery measures are rare, and over half of measures (52%) remain undocumented.
- **Measure-specific needs.** There are EWS gaps in technical capacity (47%) and dissemination (40%), alongside scarce planning and hazard estimation, limiting trust and reach. Basic service restoration struggles with governance (20%), completeness (28%) and transport recovery (12%), especially in Africa and the Asia-Pacific region. Livelihood recovery plans face deficits in policy (61%), capacity (39%) and financing (29%), leaving communities exposed to repeated vulnerability cycles.
- **Cross-cutting gaps.** Integration needs are led by policy (98%) and coordination (83%), operations by funding (82%) and institutional capacity (61%), regulation by clear protocols (78%) and law revisions (54%), and technical systems by functioning resources (87%) and training (70%), with equity almost absent (6%).
- **Key opportunities for Santiago Network technical assistance.** Modernize and integrate cyclone EWS to improve accuracy, dissemination and operational planning; strengthen governance and infrastructure for basic service restoration; design livelihood recovery strategies that combine policy, financing and community resilience; expand forecast-based financing and household preparedness tools; and support regulatory modernization to embed building codes and land-use planning into DRM frameworks.
- **Potential sources of expertise (peer-to-peer OBNEs):**
 - Bangladesh for integrated EWS and volunteer outreach (Cyclone Preparedness Programme)
 - The Philippines for service restoration and technology-driven risk communication (Project NOAH, GeoRiskPH)
 - Viet Nam for inclusive, multi-channel EWS
 - Mozambique for livelihood recovery planning
 - India and Cuba for legal frameworks, institutionalized resilience and operational discipline.

3.3.1. Presence, absence or unknown status of disaster risk management measures

Figure 6 illustrates the overall distribution of tropical cyclone-related DRM measures by reported status – presence, absence or unknown – across the country sample. The number next to the name of the measure represents the temporal dimension in which it was identified (1: prior, 2: short-term after, 3: medium- and long-term after, and 4: general).

Across the 56 surveyed countries, an average of 48 per cent of DRM measures are reported as present, 0.4 per cent as absent, and 52 per cent as unknown. This outcome suggests that fewer than half of the possible DRM measures are consistently documented as existing, while more than half remain undocumented, signalling significant information and reporting gaps.

Present measures

Reported measures within tropical cyclone DRM systems reveal critical gaps in pre-disaster preparedness, particularly with respect to the provision of preparedness kits and advance cash transfer mechanisms. By contrast, short-term post-disaster response measures – such as the distribution of relief supplies, deployment of emergency response teams and declaration of states of emergency – are consistently present across most countries. More general measures, including community-based actions, establishment of funding strategies and formulation of targeted plans for marginalized groups, are reported by over 70 per cent of countries, reflecting a growing emphasis on inclusivity and the long-term sustainability of DRM systems.

Regional patterns in tropical cyclone DRM measures reveal both common limitations and distinct regional priorities. Across all regions, pre-disaster financial

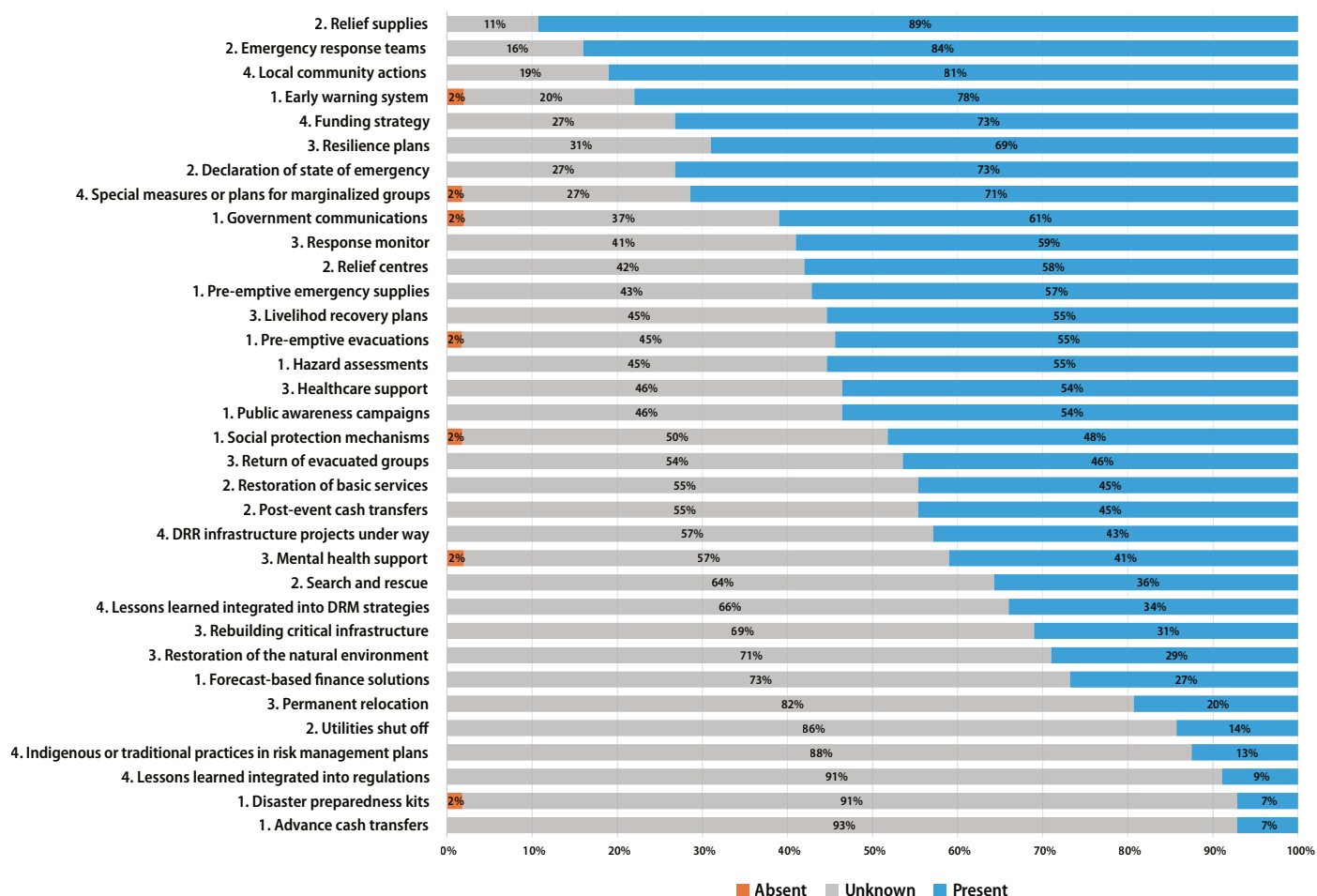


Figure 6: Tropical cyclone DRM measures reported in sample countries

mechanisms such as advance cash transfers and forecast-based financing remain largely absent, with fewer than one third of countries documenting their use. This indicates that early action is often limited to issuing warnings, without adequate investment in enabling households and communities to act effectively on those warnings. In Africa, institutional measures demonstrate comparatively strong recognition of marginalized groups (83 per cent), yet the complete absence of reported incorporation of Indigenous knowledge highlights a critical gap in leveraging local expertise. The Americas display strength in formal crisis-control mechanisms – such as emergency declarations (85 per cent) and funding strategies (85 per cent) – but lag in integrating Indigenous practices (10 per cent) and incorporating lessons learned into policy frameworks (10 per cent), suggesting a top-down approach. By contrast, Asia-Pacific countries place greater emphasis on integrating Indigenous or traditional practices (21 per cent), and all countries report distribution of relief supplies (100 per cent). However, they show the least presence of medium- and long-term measures, with low reporting of permanent relocation (13 per cent), restoration of natural environment

(25 per cent) and rebuilding of critical infrastructure (29 per cent). Together, these findings suggest that while institutional frameworks for crisis management are gradually strengthening, household-level resilience and the systematic integration of local knowledge remain underdeveloped across all regions.

Analysis of tropical cyclone DRM measures across income groups reveals a shared emphasis on short-term, post-disaster response, with all groups reporting over 57 per cent coverage, and low-income countries reporting the highest share (62 per cent). This trend confirms a global reliance on reactive coping rather than proactive or long-term strategies. Pre-disaster measures show modest uptake across all groups (43–51 per cent), with high-income countries slightly ahead, reflecting their stronger institutional systems and EWS. In contrast, medium- and long-term recovery measures remain consistently low across all income groups (40–42 per cent), underscoring the persistent neglect of reconstruction, relocation and ecosystem restoration efforts. General measures such as community actions and provisions for marginalized groups are most prominent in lower-middle-income countries (54 per cent), highlighting their comparative strength in grass-roots inclusion and resilience

planning. Upper-middle-income countries, however, underperform in this category (40 per cent), signalling limited engagement with community-based or Indigenous knowledge despite stronger institutional and financial planning capacities. Overall, high- and upper-middle-income groups demonstrate strengths in formalized and financial mechanisms, while lower-income groups emphasize social protection and inclusion but remain heavily constrained by their reliance on reactive, short-term disaster management.

Analysis of tropical cyclone DRM measures by country groupings highlights both shared vulnerabilities and distinct strengths. LDCs report the highest presence of pre-disaster measures (51 per cent), reflecting strong reliance on institutional monitoring and the influence of international support in strengthening preparedness. They also reference comparatively innovative approaches, such as mental health support and forecast-based finance, although livelihood recovery plans and other standard medium- to long-term strategies remain less developed. SIDS stand out for their comparatively higher adoption of short-term response measures (63 per cent) and for integrating healthcare, marginalized groups and Indigenous knowledge into DRM systems. This finding reflects both their acute exposure to cyclone risk and the need for socially inclusive, people-centred strategies. Countries outside both denominational categories (neither LDC nor SIDS) generally mirror global averages, but with a relatively stronger emphasis on pre-emptive emergency supplies and limited integration of lessons learned into institutional frameworks. Taken together, these trends suggest that while denominational contexts shape DRM priorities, across all groupings the medium- and long-term recovery phase remains consistently underdeveloped, with presence levels hovering around 36–45 per cent.

Absent measures

Absent measures were only marginally mentioned, with just seven countries explicitly reporting the non-existence of a DRM measure. Five of these seven absent measures fall under the pre-event category, underscoring systemic scarcity in anticipatory and preventive planning. The fact that governments have identified these gaps suggests that they are aware of shortcomings in early preparedness and could represent a clear demand for targeted technical assistance to strengthen preventive capacities. Since all of the absent measures are related to pre-disaster actions, this reinforces the tendency of DRM systems to focus on reactive rather than anticipatory approaches. Countries reporting absent measures include the Maldives, Antigua and Barbuda, Brazil, Colombia, Honduras, Kiribati and Timor-Leste, with no clear geographical pattern beyond several cases in South America.

Unknown measures

With more than 50 per cent of all DRM measures for tropical cyclones not found in the large set of documents reviewed, the analysis highlights several critical gaps in DRM systems. From the analysis, three priority areas for support emerge. First, pre-disaster financial and household preparedness remains almost invisible in country documentation, despite its critical role in reducing household vulnerability. This finding points to an urgent need for technical support in designing, piloting and mainstreaming such tools, as well as capacity-building in systematic reporting. Second, institutional learning and knowledge integration are severely underdeveloped, with limited uptake of post-disaster reviews and limited incorporation of Indigenous knowledge. These gaps undermine the adaptive capacity of DRM systems. Third, recovery and resilience measures are rarely tracked and are often politically sensitive, leaving them sidelined compared with short-term responses. Strategically, the high proportion of unknowns (>50 per cent) could be viewed not just as an implementation gap but as a systemic reporting deficit, making data collection and monitoring capacity an essential entry point for support.

3.3.2. Support needs assessments for the top measures

This section examines trends within three DRM measures related to tropical cyclones. As outlined in the methodology, the selection of measures was based on two criteria: (i) those with the highest percentage of countries reporting their presence; and (ii) those with the largest number of countries providing sufficiently detailed information on technical needs. Based on these criteria, basic service restoration, EWS and livelihood recovery plans were selected for analysis.

The following subsections present the findings, key insights and implications for technical assistance opportunities.

Basic service restoration

Basic service restoration is a core DRM measure that becomes critical in the aftermath of tropical cyclones. This measure covers three components: governance, completeness and transportation, as presented in Table 14. The values in parentheses are the share of countries reporting the measure of basic service restoration that expressed a given type of need.

Across regions, Africa consistently demonstrates the highest support needs for basic service restoration following tropical cyclones, with governance

Table 14: Types of needs reported for basic service restoration

Type of need (% of countries reporting such needs in basic service restoration)	Definition
Completeness (28%)	Need to accelerate sectoral restoration and ensure complete post-hazard recovery
Governance (20%)	Need to address governance weaknesses, including vulnerability reduction, corruption and discrimination
Transportation (12%)	Need to restore road access and make transport infrastructure resilient to follow-up hazards

(33 per cent), completeness (33 per cent) and transportation (17 per cent) all prominently cited. This finding indicates persistent challenges in coordinating recovery, ensuring services are fully restored and securing transport infrastructure against recurrent hazards. Asia-Pacific countries show equally high concern for completeness (33 per cent). However, they report even greater needs in transportation (22 per cent), reflecting the strain of frequent and high-intensity cyclones in densely populated areas with critical infrastructure gaps. In contrast, the Americas report lower needs overall, with governance and completeness each at 20 per cent and transportation not reported at all. This absence could suggest that transport is either less vulnerable in the region or is not being systematically documented as a gap. Taken together, the data point to Africa and Asia-Pacific as priority regions for technical assistance, particularly to strengthen governance, improve completeness of recovery and build resilient transport systems.

When disaggregated by income level, low-income countries report the greatest needs, with half explicitly identifying completeness as a gap, alongside governance (25 per cent) and transportation (25 per cent). This finding illustrates how institutions with limited resources and fragile infrastructure often compound difficulties in achieving systemic recovery planning. Lower-middle-income countries show fewer governance needs but still emphasize completeness (29 per cent) and transportation (29 per cent), highlighting the importance of integrating systems and ensuring they function under cyclone stress. Upper-middle-income countries report no transportation needs, but governance and completeness remain at 23 per cent, suggesting that even in more resource-endowed settings, gaps in coordination and recovery continuity persist. High-income countries report no significant needs across the three components, likely reflecting stronger baseline systems and institutional capacity, although this does not indicate immunity from cyclone impacts. This analysis suggests that

technical support could be differentiated: systemic recovery planning and institutional strengthening for low-income countries, transport and governance integration for lower-middle-income contexts, and targeted governance diagnostics for upper-middle-income countries.

LDCs report the highest overall needs in basic service restoration, particularly in completeness (43 per cent), where post-cyclone recovery often leaves essential services only partially restored. Governance and transportation needs, both at 14 per cent, are less frequently cited but reveal persistent institutional and infrastructural vulnerabilities. For this group, technical assistance could prioritize comprehensive restoration strategies that go beyond piecemeal interventions, ensuring that utilities, health, education and transport services are restored in an integrated and equitable manner. By contrast, non-LDCs show fewer needs overall, with emphasis shifting towards reinforcing governance mechanisms and coordination frameworks to achieve efficient and inclusive recovery. This distinction underscores the importance of tailoring support: while LDCs require broad-based, system-wide restoration approaches, non-LDCs benefit more from strengthening the institutional underpinnings of recovery processes.

Early warning systems

Cyclones bring sudden-onset hazards such as extreme winds, storm surges and flooding, making the reliability and inclusiveness of warnings vital for saving lives and protecting assets. Effective EWS in this context require more than sophisticated technology: they depend on communication that reaches vulnerable groups, clear and consistent dissemination of alerts, accurate estimation of cyclone intensity and trajectory, strong operational planning, and robust technical capacity for monitoring and maintenance. Failures in EWS not only reduce public trust but also undermine the system's protective value, making targeted support essential to ensure that cyclone EWS function as truly life-saving tools.

Table 15: Types of needs reported for EWS

Type of need (% of countries reporting such needs in EWS)	Definition
Accessibility (11%)	Need for inclusive communication addressing gender and vulnerable groups, and avoiding jargon
Dissemination (40%)	Need for effective public information dissemination with clarity and consistency
Hazard estimation (16%)	Need to strengthen hazard estimation accuracy and avoid issuing false warnings
Planning (27%)	Need for standard operating procedures, motivated staff and comprehensive hazard mitigation plans
Technical capabilities (47%)	Need to overcome technical limitations through maintenance, verified EWS, dense monitoring and updated equipment

The identified needs in EWS were clustered into several groups and are presented in Table 15. The values in parentheses are the share of countries reporting EWS that expressed a given type of need.

Across all regions, gaps in technical capabilities and dissemination emerge as the most pressing challenges for EWS. In Africa, dissemination is the most acute need (75 per cent), followed by technical capabilities (50 per cent), suggesting that warnings often fail to reach at-risk communities and that existing infrastructure can suffer from maintenance and equipment deficiencies. Hazard estimation (13 per cent) and planning (13 per cent) are rarely reported, but they signal limited forecasting capacity and limited response procedures. In the Americas, technical shortcomings (47 per cent) and planning gaps (29 per cent) dominate, with dissemination (24 per cent) and accessibility (12 per cent) also present, suggesting that systems require modernization and more consistent operational frameworks. Asia-Pacific reflects a similarly critical situation, with major gaps in technical capabilities (45 per cent), dissemination (40 per cent) and planning (30 per cent), showing that system upgrades and staff capacity for operational coordination are urgently needed. Taken together, the regional picture reveals strong demand for infrastructure investments, technical system upgrades and enhanced operational planning, while also underscoring the need for Africa-specific attention to outreach and dissemination.

Disaggregating the data by income level shows how EWS gaps evolve with system maturity and resource availability. Low-income countries highlight dissemination (67 per cent) and technical capabilities (33 per cent) as their primary challenges, while accessibility and hazard estimation go unreported, pointing to either minimal recognition

or limited documentation. This finding underscores fragile communication channels and insufficient infrastructure. Lower-middle-income countries demonstrate systemic challenges across all components, with consistently high needs in dissemination (57 per cent), hazard estimation (36 per cent), planning (43 per cent) and technical capabilities (57 per cent), pointing to the necessity for multidimensional support packages that address governance, technical and operational shortcomings simultaneously. Upper-middle-income countries report fewer gaps overall but still identify issues with accessibility (11 per cent), planning (17 per cent) and technical systems (28 per cent), showing that their EWS remain uneven and incomplete. High-income countries, unexpectedly, report the highest technical capability needs (86 per cent), as well as gaps in dissemination (43 per cent) and planning (29 per cent), which reflects the challenge of keeping advanced systems modern, interoperable and trusted by the public. These results suggest that support could be tailored by income level, ranging from scaling and outreach in low-income contexts to targeted integration and modernization efforts in middle- and high-income countries.

When analysed by denomination, it emerges that LDCs face particularly significant challenges, especially in dissemination (67 per cent), planning (42 per cent) and accessibility (17 per cent), all of which highlight limited communication channels and fragile institutional frameworks. Technical capacity (50 per cent) is also a critical concern, pointing to compounded risks where systems lack both reliable infrastructure and effective outreach. Non-LDCs, by comparison, report their greatest gap in technical capabilities (45 per cent), suggesting that while outreach and institutional foundations may

be stronger, the modernization and integration of equipment, monitoring networks and interoperability remain central concerns. This division highlights the importance of differentiated technical assistance strategies: for LDCs, strengthening system operationalization, inclusive communication and governance frameworks is paramount, while for non-LDCs, the focus could be on system refinement and technical specialization to ensure resilience and long-term sustainability.

Livelihood recovery plans

Livelihood recovery plans are a critical component of DRM, designed to help communities rebuild their economic and social foundations after a hazard. These plans address not only the immediate restoration of income and employment but also the long-term resilience of households and communities. In the aftermath of tropical cyclones – where livelihoods are disrupted by destroyed crops, damaged infrastructure and interrupted markets – these plans become indispensable. Without robust recovery strategies, communities risk being locked into cycles of vulnerability, unable to regain stability before the next storm arrives.

The identified needs in livelihood recovery plans were clustered into several groups and are presented in Table 16. The values in parentheses are the share of countries reporting livelihood recovery plans that expressed a given type of need.

Across regions, the Americas report the highest intensity of livelihood recovery needs, particularly in policy (73 per cent), capacity development (64 per cent) and financing (36 per cent). This finding reflects a strong recognition that livelihood recovery requires systemic reform and institutional strengthening. The absence of logistics needs

(0 per cent) aligns with the trend that transportation is generally addressed under basic service restoration rather than livelihood recovery frameworks. Africa shows comparatively lower reported needs, with policy (50 per cent) and technical gaps (33 per cent) standing out. This underreporting may reflect limited diagnostic coverage or the prioritization of immediate survival measures, which risks obscuring deeper structural challenges, particularly in financing and logistics. Asia-Pacific countries demonstrate a more balanced yet still demanding profile, with policy (57 per cent), financing (36 per cent) and capacity development (29 per cent) all strongly represented, alongside moderate technical (29 per cent) and some logistical needs (7 per cent). These findings suggest that the Santiago Network could prioritize cross-regional support in policy and capacity-building while also providing targeted financing and technical toolkits in the Americas and Asia-Pacific, as well as engagement strategies to help African countries identify underreported livelihood recovery needs.

When disaggregated by income level, the intensity and nature of needs vary significantly. Low-income countries primarily emphasize logistics (25 per cent) and technical support (25 per cent), indicating bottlenecks in operational delivery such as aid distribution, recovery organization and technical expertise. Here, technical assistance could begin with foundational diagnostics and strengthening of delivery mechanisms to move recovery beyond ad hoc responses. Lower-middle-income countries display broader gaps, with policy (47 per cent), financing (33 per cent) and capacity development (20 per cent) all reported, signalling a need for comprehensive support packages that integrate governance reforms, financial tools and technical delivery. Upper-middle-income countries report the highest overall intensity, with policy (100 per cent), capacity development

Table 16: Types of needs reported for livelihood recovery plans

Type of need (% of countries reporting such needs in livelihood recovery plans)	Definition
Capacity development (39%)	Need for capacity development in efficiency, gender-sensitivity and pre-event assessment
Financing (29%)	Need for adequate financial systems ensuring targeting, planning, transparency and acceptance
Logistics (6%)	Need to address logistical, organizational and transportation challenges
Policy (61%)	Need for inclusive DRM policies with clear structure, implementation, evaluation and long-term planning
Technical (23%)	Need for technical improvements in assessments, assistance and system upgrades

(78 per cent) and financing (44 per cent) all flagged as major challenges. Their diagnostic maturity suggests readiness for system optimization, long-term planning and embedding of inclusivity and sustainability into livelihood recovery strategies. High-income countries show moderate needs in policy (67 per cent), capacity development (33 per cent) and technical dimensions (33 per cent), indicating that while their systems are comparatively stronger, they still face optimization challenges and hold potential to serve as regional leaders by sharing expertise with lower-income peers.

The denomination-based analysis highlights clear distinctions in livelihood recovery priorities. LDCs report fewer gaps overall but emphasize logistics and technical capacity, indicating fragile operational delivery and underdeveloped systems for organizing and sustaining recovery. This finding suggests that systemic issues in policy and financing may be underreported, masking structural vulnerabilities that hinder comprehensive livelihood recovery. Non-LDCs, by contrast, report higher and more diverse needs across policy, capacity development and financing, reflecting both stronger diagnostic capacity and greater readiness for systemic reform and integration. Technical assistance for LDCs could therefore focus on foundational diagnostics and strengthening of delivery capacity, while support for non-LDCs could prioritize optimization, long-term sustainability and integration of financial and governance mechanisms into inclusive livelihood recovery strategies.

3.3.3. Support needs assessments for the cross-cutting needs

This section examines trends within cross-cutting needs, directly captured from the reviewed documents, that are not linked to specific DRM measures.

Integration needs

Integration needs are an essential part of DRM, in ensuring that coherent structures, resources and skilled human capacity support disaster response and recovery efforts. They encompass five core components: (i) cooperation and coordination, which bring together actors across sectors and governance levels; (ii) knowledge, which relies on data, mapping and risk indicators to guide decision-making; (iii) policy, which embeds DRM into broader development frameworks; (iv) resource management, which secures financing, funds and insurance to sustain action; and (v) workforce, which builds the skills and institutional capacity to deliver effective response. In the context of tropical cyclones, integration is particularly important, as the impacts span health, infrastructure, housing, agriculture and social systems simultaneously. When storms disrupt multiple sectors at once, fragmented responses quickly fail – strong coordination, clear policies, sustainable resources and trained staff are indispensable for reducing losses and enabling resilient recovery. The identified integration needs were clustered into several groups and are presented in Table 17.

Integration needs are most pronounced in the Americas, where policy (100 per cent) and cooperation and coordination (94 per cent) are almost universally reported, alongside significant gaps in knowledge (44 per cent) and resource management (39 per cent). This pattern reflects the region's assessment capacity and recognition that fragmented governance and limited alignment across institutions undermine effective disaster response and recovery. Asia-Pacific countries also report considerable needs, with policy (88 per cent) and coordination (82 per cent) identified as pressing gaps, complemented by moderate challenges in knowledge (38 per cent) and resource

Table 17: Types of integration needs reported

Type of need (% of countries reporting such integration needs)	Definition
Cooperation and coordination (83%)	Needs for joint action, partnerships and aligned roles across sectors and levels
Knowledge (42%)	Needs for data, mapping, indicators and information systems to guide DRM
Policy (98%)	Needs for coherent laws, frameworks and strategies integrating DRM into sectoral development plans
Resource management (33%)	Needs for financing, funds, insurance and resource allocation to sustain DRM actions
Workforce (6%)	Needs for staff training, capacity-building and support to strengthen institutional disaster response

management (25 per cent). Here, strengthening of policy coherence and institutional collaboration could be prioritized, while elevating knowledge and workforce as enabling functions. Africa shows lower levels of reported needs, with policy (67 per cent) and coordination (63 per cent) most frequently cited, but much more limited reporting on knowledge (25 per cent), resource management (25 per cent) and workforce (8 per cent). This underreporting suggests that integration challenges may be insufficiently assessed, potentially masking structural issues. For Africa, support could focus on enhancing assessment capacity, building institutional coordination platforms and reinforcing operational enablers such as financing and workforce development.

Integration needs vary across income levels, reflecting both assessment capacity and system maturity. Low-income countries report the highest gaps in coordination (80 per cent) and policy (71 per cent), showing that even at early stages, fragmented governance structures and incoherent frameworks hinder effective DRM. Support in these contexts could focus on building foundational systems, ensuring that coordination frameworks and policy structures are established before fragmentation becomes entrenched. Lower-middle-income countries report very high levels of issues with policy (90 per cent) and coordination (83 per cent), with additional gaps in knowledge (40 per cent), indicating recognition of systemic issues but difficulty translating intent into operational practice. Priorities for technical assistance could therefore include harmonizing legal frameworks, enabling cross-sectoral budgeting and aligning governance structures with implementation. Upper-middle-income countries, while reporting somewhat lower levels of need in policy (77 per cent) and coordination (83 per cent), nonetheless reveal persistent gaps in knowledge (27 per cent), signalling the need to refine integration mechanisms and ensure that policies translate into practice. High-income countries report the greatest needs in policy (100 per cent), coordination (86 per cent) and knowledge (57 per cent), alongside resource management (29 per cent), underscoring the complexity of advanced integration processes. These countries would benefit from support focused on evidence-based coordination, advanced system refinement and institutionalization of knowledge-sharing, while also serving as regional leaders to transfer lessons to lower-income peers.

The denomination-based analysis shows that both LDCs and non-LDCs struggle with integration, although in different ways. LDCs report significant needs in coordination (77 per cent) and policy (65 per cent), which reveal foundational challenges

in governance coherence and institutional alignment. Their comparatively lower reporting across other components likely reflects limited assessment mechanisms and underrecognition of systemic enablers, rather than resilience. For this group, priorities for technical assistance could be building core institutional frameworks, developing basic assessment frameworks and establishing basic data and budget systems to strengthen integration. Non-LDCs report greater integration needs overall, particularly in coordination (100 per cent) and policy (92 per cent), reflecting their ability to identify and assess complex governance fragmentation and systemic challenges. At the same time, both LDCs and non-LDCs report resource management gaps, highlighting that financial alignment and cross-sector budgeting remain a universal challenge. Workforce consistently emerges as the least reported component across both groups, likely representing a blind spot, as human resource capacity is often the decisive factor in implementing integrated systems. Support for non-LDCs could therefore emphasize advanced policy coherence, system integration and knowledge management, complementing the foundational assistance required in LDCs.

Operational needs

Operational needs represent the practical backbone of DRM, ensuring that strategies and plans translate into effective action when hazards strike. They encompass five critical components: (i) expertise, in the form of professional skills and specialized training to strengthen response capacity; (ii) institutional capacity, with robust governance structures and coordination mechanisms; (iii) logistical support to secure supplies, infrastructure and operational systems; (iv) targeted funding, providing the financial flexibility and adequacy to sustain disaster operations; and (v) technical enhancements, which upgrade tools, systems and technology to improve preparedness and response. In the context of tropical cyclones, these needs are particularly urgent: storms often overwhelm institutions, cut supply chains, drain financial resources and expose gaps in technology and trained personnel. Without strong operational systems, even the best early warnings or recovery plans can fail to protect lives and assets. Strengthening operational needs, therefore, ensures that responses to cyclones are timely, coordinated and equipped to meet the scale of the challenge. The identified operational needs were clustered into several groups and are presented in Table 18.

Operational needs vary considerably across regions, but funding and institutional capacity consistently emerge as central barriers. Africa reports the greatest

Table 18: Types of operational needs reported

Type of need (% of countries reporting such operational needs)	Definition
Expertise (47%)	Needs for professional skills, specialized training and technical knowledge to improve disaster response
Institutional capacity (61%)	Needs to strengthen governance structures, coordination mechanisms and organizational effectiveness in disaster management
Logistical support (18%)	Needs for supplies, infrastructure and operational systems to ensure effective emergency response
Targeted funding (82%)	Needs for timely, flexible and adequate financial resources to sustain disaster operations
Technical enhancements (45%)	Needs for upgraded tools, systems and technology to improve preparedness and response

overall needs, with targeted funding (89 per cent) and institutional capacity (78 per cent) revealing important governance and structural financing shortfalls that constrain effective cyclone response. Asia-Pacific also reports substantial gaps, particularly in targeted funding (83 per cent) and technical enhancements (58 per cent), combined with institutional (58 per cent) and expertise (46 per cent) needs. This finding indicates recognition of the urgency of technological modernization and improved tools, but persistent financing and institutional constraints threaten to limit progress. The Americas, although reporting fewer overall needs, still face significant challenges in targeted funding (78 per cent) and expertise (50 per cent), alongside logistical gaps (28 per cent). For this region, technical assistance could focus on workforce training, logistical planning and innovative emergency financing. Together, the data suggest that while Africa and Asia-Pacific require broad institutional and financial strengthening, the Americas face more specific capacity gaps tied to expertise, logistics and resource mobilization.

When examined through an income lens, operational needs reveal distinct stages of system development. Low-income countries face the most acute governance and financing challenges, with institutional capacity (83 per cent) and targeted funding (83 per cent) representing foundational issues. Their lower reporting in other areas likely reflects diagnostic gaps, underscoring the need for support in building basic structures and financing systems to move beyond ad hoc responses. Lower-middle-income countries present considerable needs across nearly all clusters, particularly expertise (63 per cent) and technical enhancements (68 per cent), highlighting the dual challenge of scaling operations while still

building professional and digital capacities. Upper-middle-income countries show more balanced but persistent needs, especially in logistics (26 per cent), suggesting the importance of strategic planning and system integration. High-income countries, despite stronger resource bases, report institutional capacity (86 per cent) and targeted funding (71 per cent) as key limitations, pointing to issues of system coherence, agility and flexible financing, rather than simple resource scarcity. These patterns demonstrate that operational gaps persist across all income levels, but the nature of support required differs: it is foundational in low-income contexts, multidimensional in lower-middle-income, and optimization-focused in upper-middle- and high-income countries.

Clear distinctions also emerge between LDCs and non-LDCs. LDCs report fewer overall needs, particularly in technical dimensions such as expertise and enhancements, but this likely reflects limited assessment capacity rather than resilience. Their consistently significant gaps in institutional capacity and targeted funding, however, confirm systemic fragility in governance and financing. Non-LDCs report greater needs across nearly all clusters, reflecting both greater assessment capacity and the complexities of managing advanced systems under higher expectations. Technical enhancements are especially pronounced in non-LDCs, suggesting these countries are moving into a system modernization phase, while LDCs remain focused on establishing basic institutional and operational readiness. Technical assistance could therefore be differentiated: for LDCs, support could prioritize strengthening institutional frameworks, ensuring financial access and building core operational capacity. For non-LDCs, assistance

could emphasize modernizing tools, aligning financial systems strategically and advancing technical training to refine and sustain operational systems.

Regulatory needs

Regulatory needs form the legal and institutional backbone of DRM, ensuring that coherent, enforceable rules and procedures guide preparedness, response and recovery. They cover four key components: (i) clear DRR and DRM protocols, which define responsibilities and mandates for coordinated action; (ii) construction and building standards, which safeguard infrastructure and housing against hazard impacts; (iii) land-use planning, which regulates settlement and development in high-risk zones; and (iv) regular DRR law revisions, which ensure that disaster policies remain relevant to evolving risks.

In the context of tropical cyclones, issues in these areas can significantly amplify losses: poorly enforced building codes lead to collapsed homes, inadequate land-use planning places communities in storm surge zones, and outdated laws leave governments without the tools to act decisively. Strengthening regulatory frameworks is therefore critical to create resilient systems where policies are modernized, risks are integrated into planning, and protective standards are consistently applied, reducing the destructive impact of cyclones on people, infrastructure and livelihoods. The identified regulatory needs were clustered into several groups and are presented in Table 19.

Regional analysis highlights important differences in regulatory framework needs. In Africa, the most acute gaps lie in construction and building standards (42 per cent) and protocols (42 per cent), reflecting both limited enforcement capacity and the absence of clear institutional foundations. This finding leaves populations highly exposed to cyclone-related structural damage and governance failures. The Americas, by contrast, report their greatest needs

in clear protocols (75 per cent) and law revisions (45 per cent), suggesting that while frameworks exist, they are under pressure to adapt to increasingly complex and cross-sectoral risk environments. Asia-Pacific countries report significant needs in protocol clarity (67 per cent) and law revisions (58 per cent), pointing to recognition of governance gaps that demand modernization. Although construction standards (17 per cent) and land-use planning (4 per cent) are reported at lower levels, these likely mask underdiagnosed challenges in small island and rapidly urbanizing contexts. Technical assistance could therefore differentiate between regions: strengthening baseline regulatory systems in Africa, modernizing and harmonizing laws in the Americas and Asia-Pacific and universally integrating spatial planning and construction standards as underaddressed but critical priorities.

Distinct patterns also emerge when regulatory needs are viewed by income group. Low-income countries report the largest gaps in construction standards (43 per cent) and clear protocols (43 per cent), underscoring the fragility of their governance systems and the absence of safe building practices. Land-use planning is absent from their reporting, indicating either assessment gaps or limited integration into DRM strategies, despite its clear importance in hazard-prone areas. Lower-middle-income countries show broader needs, particularly protocol clarity (60 per cent) and law revisions (40 per cent), reflecting a shift towards evolving but still fragmented governance systems. Upper-middle-income countries report even higher levels of demand for protocol clarity (68 per cent) and law revisions (55 per cent), pointing to the complexity of coordinating multiple actors within more mature systems. High-income countries stand out with considerable needs reported on protocols (86 per cent) and law revisions (57 per cent), alongside greater recognition of issues with construction standards (29 per cent) and land-

Table 19: Types of regulatory needs reported

Type of need (% of countries reporting such regulatory needs)	Definition
Clear DRR and DRM protocols (78%)	Needs for defined procedures and mandates ensuring coordinated DRM
Construction and building standards (28%)	Needs for updated, enforced codes and resilient practices in building and infrastructure
Land-use planning (11%)	Needs for zoning, spatial regulation and settlement planning in hazard-prone areas
Regular DRR law revisions (54%)	Needs for continual review and updating of disaster laws and policies

use planning (29 per cent) than any other group, suggesting that advanced systems struggle not with the basics but with maintaining adaptive, integrated and forward-looking frameworks. These patterns highlight that low-income countries need foundational legal and regulatory systems, middle-income groups require harmonization and modernization, and high-income systems must focus on agility, integration and cross-sector coherence.

Regulatory needs also diverge between LDCs and non-LDCs. Non-LDCs consistently report greater needs across all categories, reflecting both more advanced diagnostic capacity and the complexity of maintaining modern systems under evolving risks. Their strongest emphasis is on law revisions and protocol clarity, highlighting the demand for coherence, adaptive governance and regular updating cycles. LDCs, by contrast, report fewer overall needs, particularly in technical areas such as expertise, construction standards and land-use planning – the latter being completely absent. This underreporting suggests a diagnostic and capacity gap rather than genuine resilience, since spatial planning is often a front-line defence against cyclone risks but remains poorly integrated into DRM strategies in these contexts. For LDCs, technical assistance could prioritize building core legal foundations, developing basic regulatory instruments and establishing entry-level capacity for land-use planning. For non-LDCs, assistance could emphasize strengthening law revision cycles, modernizing and enforcing regulations, and embedding construction standards and spatial planning into coherent and adaptive DRM frameworks.

Technical needs

Technical needs refer to ensuring that systems are not only well designed but also equipped and capable of functioning effectively when hazards strike. In the case of tropical cyclones, these needs become especially urgent, as storms often expose inequities in access to emergency services, strain or destroy existing infrastructure, and test the limits of human and institutional capacity. Without fair distribution of

resources, reliable systems and adequately trained personnel, cyclone responses risk leaving the most at-risk populations behind. Addressing technical needs is therefore critical to ensure that disaster response and recovery efforts are inclusive, reliable and capable of reducing long-term vulnerability. The identified technical needs were clustered into several groups and are presented in Table 20.

Regional patterns reveal that functioning resources and targeted training are consistently the most pressing technical needs, although the intensity and framing differ. In the Americas, gaps are especially notable in functioning resources (90 per cent) and targeted training (85 per cent), suggesting that systems are well positioned to diagnose inclusion challenges and are increasingly recognizing the need for specialized capacity. Africa reports similar challenges, with functioning resources (75 per cent) and targeted training (58 per cent) underscoring fragile infrastructure and limited operational capacity, while the absence of reporting on equitable access (0 per cent) reflects a significant blind spot in inclusion. The Asia-Pacific region mirrors these findings, with functioning resources (83 per cent) and training (58 per cent) dominating, but equity again absent, which is particularly concerning given the region's high cyclone exposure and concentration of vulnerable populations. Technical assistance could therefore be tailored regionally: reinforcing infrastructure and training in Africa and Asia-Pacific while embedding equity frameworks, and in the Americas expanding advanced capacity and piloting inclusive approaches that could serve as transferable models.

When examined by income group, technical needs illustrate clear gradients of system maturity. Low-income countries report challenges mainly in functioning resources (71 per cent) and training (29 per cent), highlighting fragile infrastructure and rising workforce development. Lower-middle-income countries show similarly high pressure on resources (75 per cent) but much greater attention to training (80 per cent), suggesting they are actively scaling their human capacity alongside system expansion.

Table 20: Types of technical needs reported

Type of need (% of countries reporting such technical needs)	Definition
Equitable access (6%)	Needs ensuring fair availability of resources, services and information for all communities
Functioning resources (87%)	Needs for reliable infrastructure, equipment and systems to enable effective disaster response
Targeted training (70%)	Needs for specialized skills, capacity-building and awareness to strengthen preparedness and resilience

Upper-middle-income countries report the highest overall strain on functioning resources (95 per cent) and substantial training needs (68 per cent), reflecting growing demands on infrastructure systems even in relatively advanced contexts. High-income countries also report high levels of functioning resources (86 per cent) and training (71 per cent), pointing to the burden of maintaining and upgrading ageing systems while sustaining advanced technical expertise. Equity concerns remain consistently underreported across all groups but appear most in upper-middle- and high-income contexts, indicating that inclusion is recognized but not systematically addressed. Assistance priorities could therefore focus on infrastructure baselines and workforce systems in low-income settings; modernization and professionalization in middle-income contexts; and upgrading, advanced training and embedding of equity into frameworks in high-income countries.

Denominational analysis underscores that technical needs cut across all development categories, although their nature varies. Both LDCs and non-LDCs report major challenges in resource allocation, reflecting that infrastructure reliability and operational readiness are universal bottlenecks. Non-LDCs, however, are far more likely to report targeted training needs, showing stronger diagnostic capacity to identify skill gaps and a greater institutional focus on workforce development. By contrast, the relative absence of training needs reported in LDCs suggests not resilience but limited ability to capture and articulate these needs, further reinforced by the complete lack of reporting on equity. This finding underlines a systemic risk of exclusion, particularly in fragile contexts. For LDCs, technical assistance could therefore prioritize building basic operational systems, establishing structured training pipelines and embedding equity into frameworks from the outset. For non-LDCs, support could focus on refining operations, scaling targeted training and institutionalizing equitable access mechanisms within existing systems.

3.3.4. Good examples of measure implementation

The identified good practices highlight how countries are advancing DRM by combining proactive planning, technological innovation and strong institutional frameworks. They demonstrate that effective cyclone response and recovery requires more than immediate relief – it depends on resilient livelihoods, reliable EWS and coordinated restoration of basic services.

Basic service restoration – India and the Philippines

The analysis of basic service restoration following tropical cyclones shows persistent gaps in governance, completeness and transport recovery. Africa reports

the greatest governance and coordination challenges, while Asia-Pacific emphasizes transport and service completeness. Needs are particularly acute in low-income countries and LDCs, where restoration often remains partial and fragmented.

India and the Philippines provide strong examples of how these gaps can be addressed. In India, the National Cyclone Risk Mitigation Project and the National Disaster Management Authority enable cross-sectoral recovery planning, with Post-Disaster Needs Assessment tools and the Incident Response System ensuring continuity and clear responsibilities. In the Philippines, the National Disaster Risk Reduction and Management Council and the Department of Public Works and Highways deploy quick response teams supported by geotagged reporting to accelerate road clearance and utility restoration, backed by institutional capacity and Post-Disaster Needs Assessment frameworks.

By mobilizing institutions and practitioners from India and the Philippines as OBNE partners, the Santiago Network could help priority countries to strengthen governance frameworks, improve restoration completeness and build resilient transport systems that directly address the needs identified in the global assessment.

Early warning systems – Viet Nam

The analysis of EWS shows persistent gaps in technical capabilities, dissemination and planning across regions, with Africa and LDCs facing the most acute challenges in communication outreach, and middle- to high-income countries struggling with modernization and system integration. These findings highlight the need for differentiated technical assistance, ranging from scaling and outreach in low-income contexts to system refinement in higher-income settings.

Viet Nam provides a strong example of how these gaps can be addressed. Its EWS combines radar-based forecasting with synchronized data flows from regional to local levels, ensuring accuracy and timeliness. Multiple dissemination channels – including SMS, community radio, door-to-door notifications and local announcements – expand reach to at-risk groups, while institutional connectivity ensures seamless coordination between forecasting, monitoring and response agencies.

By mobilizing Vietnamese institutions and practitioners as OBNE partners, the Santiago Network could help other countries to strengthen technical forecasting, diversify dissemination pathways and improve institutional integration. This would directly support LDCs in addressing fragile outreach systems

and assist non-LDCs in refining and modernizing their technical infrastructure, tailored to the differentiated needs identified in the global assessment.

Livelihood recovery plans – Mozambique

The analysis of livelihood recovery shows that while gaps vary across regions and income groups, common challenges centre on policy reform, capacity development and financing, with logistics and technical delivery emerging as key issues in low-income and LDC contexts. The Americas demonstrate the highest demand for systemic reform, while Asia-Pacific highlights the need for financial and technical toolkits. Africa's comparatively lower reporting suggests underdiagnosed challenges, particularly in financing and structural reform.

Mozambique provides a strong example of how these gaps can be addressed. Its livelihood recovery strategy combines climate-adapted agricultural techniques with diversified income-generating activities, ensuring that recovery efforts reduce dependency on climate-sensitive sectors. Reconstruction is linked with improved building standards to strengthen resilience, while communities are also supported in transitioning livelihoods when necessary. For example, internally displaced persons formerly reliant on cyclone-exposed fishing are systematically assisted in shifting to safer farming-based activities, with training, seed support and access to markets. This planned livelihood transition reduces exposure to recurrent hazards while creating pathways to long-term recovery.

By mobilizing Mozambican institutions and practitioners as OBNE partners, the Santiago Network could support other countries in developing integrated livelihood recovery strategies. Mozambique's expertise in combining agricultural adaptation, alternative livelihoods and resilient reconstruction could directly assist low-income and LDC contexts in building delivery capacity, while helping middle- and upper-income countries strengthen policy frameworks, embed financing tools and scale inclusive, sustainable recovery systems.

Cross-cutting needs

Several countries have advanced cyclone risk management practices that together illustrate how integration, operations, technical capacity and regulatory frameworks can be strengthened – and how the Santiago Network could mobilize this expertise.

Bangladesh has become a global reference point through its Cyclone Preparedness Programme, which combines government leadership, a partnership with the Bangladesh Red Crescent Society and more than 55,000 trained volunteers. By embedding early warning, evacuation and response within coherent

DRM policies and sustained workforce mobilization, the Cyclone Preparedness Programme demonstrates how community-based integration can save lives at scale. The Philippines complements this with Project NOAH, a technology-driven platform that delivers real-time hazard maps, multi-channel early warnings and strong community engagement. These systems show how knowledge, policy and people can be woven together to manage cyclone risks more effectively.

Cuba brings a disciplined operational model through its Civil Defense System, built on regular nationwide drills, decisive evacuations and reliable forecasting that together keep casualties low. Bangladesh, again through the Cyclone Preparedness Programme, provides lessons in rapid mass evacuations, pre-positioned supplies and an extensive shelter network. Both models show how readiness and coordination can translate into operational success, while also highlighting ongoing needs for climate-resilient shelters, robust communications, and sustainable funding for volunteers and equipment.

On the regulatory side, India and the Philippines demonstrate how legal and policy frameworks can institutionalize resilience. India anchors cyclone risk management in the Disaster Management Act of 2005, supported by the National Disaster Management Plan, cyclone-resilient building codes and rules on coastal regulation zones for risk-informed siting. The Philippines operationalizes the Disaster Risk Reduction and Management Act of 2010 through the National Disaster Risk Reduction and Management Council and local government units, integrating DRR and climate adaptation into land-use planning with tools such as GeoRiskPH. These frameworks illustrate how laws, standards and plans can align national systems while empowering local action.

Technical capacity is equally vital. Bangladesh continues to strengthen its communication systems and shelter networks to ensure equitable access, while Odisha in India has built a robust state-level system through the Odisha State Disaster Management Authority, combining advanced early warning networks with targeted training for local responders. Together, these approaches show how technical systems can be kept functional, accessible and trusted by communities.

Taken as a whole, these experiences demonstrate that no single approach is sufficient, but each offers transferable lessons. By connecting the expertise of Bangladesh, the Philippines, Cuba and India through peer-to-peer learning, the Santiago Network can help countries strengthen their own systems in ways that are both context-sensitive and grounded in proven practice.

3.4. Sea level rise

Key takeaways (% of countries)

- **Information availability.** Sea level rise responses focus on early measures – hazard assessments (95%), environmental protection (90%) and resilience planning (81%) – while relocation (<20%), zoning and insurance (14%) and social protection (≤5%) are rare. Over two thirds of measures lack clear reporting, leaving major evidence gaps.
- **Measure-specific needs.** Hazard assessments show gaps in institutional capacity (30%), data quality (30%), financing (5%) and localized studies (15%). Future resilience planning struggles with implementation (59%) and monitoring (29%), with limited community involvement (24%) and scenario planning (33–38%).
- **Cross-cutting gaps.** Countries are strong on diagnostics but have issues with governance, financing and social protection. Africa emphasizes infrastructure (100%) but little retreat planning (25%); Asia-Pacific shows community retreat (73%) but limited governance integration; and the Americas recognize sea level rise in policy (50%) but lack financing and engagement (33%). SIDS pilot awareness (75%) and retreat (33%) but lack scaling, while LDCs show some monitoring and awareness (25%) but little policy integration (~90% absent).
- **Opportunities for the Santiago Network.** Move from monitoring to decision-making with thresholds; institutionalize aid-funded pilots; embed sea level rise into laws, budgets and governance; expand technical training and financing; and strengthen community engagement and ecosystem-based planning.
- **Potential sources of expertise (peer-to-peer OBNEs):**
 - Bangladesh for hazard assessments and financing continuity (Bangladesh Climate Change Trust Fund, digital elevation models)
 - Cuba for translating long-term strategies into implementation (Tarea Vida and MI COSTA initiatives)
 - The Philippines for integrating sea level rise into policy and land-use planning (GeoRiskPH, Disaster Risk Reduction and Management Act)
 - Viet Nam for multi-level coordination and inclusive dissemination
 - Mozambique for community-centred adaptation and livelihood diversification.

3.4.1. Presence, absence or unknown status of disaster risk management measures

Sea level rise differs from the hazards analysed in previous sections in that it unfolds over much longer time frames and does not follow cyclical patterns. While risk management for floods, droughts and tropical cyclones can focus on discrete events that recur with some frequency, sea level rise and land degradation are slow-onset processes. Their impacts accumulate gradually until reaching critical thresholds that cause lasting and continuous effects on livelihoods and socioecological systems.

For this analysis the authors use this inflection point, where impacts shift from gradual to critical, as a reference for defining temporal dimensions. These dimensions – grouped in other sections into prior, shortly after, and medium- and long-term after an event – are applied here under the assumption that

most measures to address the consequences of slow-onset processes are triggered only when high-impact thresholds are reached. It is important to note, however, that this framing is used only for analytical consistency. The survey results themselves were not constrained by this interpretation.

Figure 7 illustrates the overall distribution of sea level rise-related DRM measures by reported status – presence, absence or unknown – across the country sample. The number next to the name of the measure represents the temporal dimension in which it was identified (1: prior, 2: short-term after, 3: medium- and long-term after, and 4: general).

Present measures

Evidence of measures addressing sea level rise reveals a consistent global pattern: while governments increasingly acknowledge the hazard, concrete

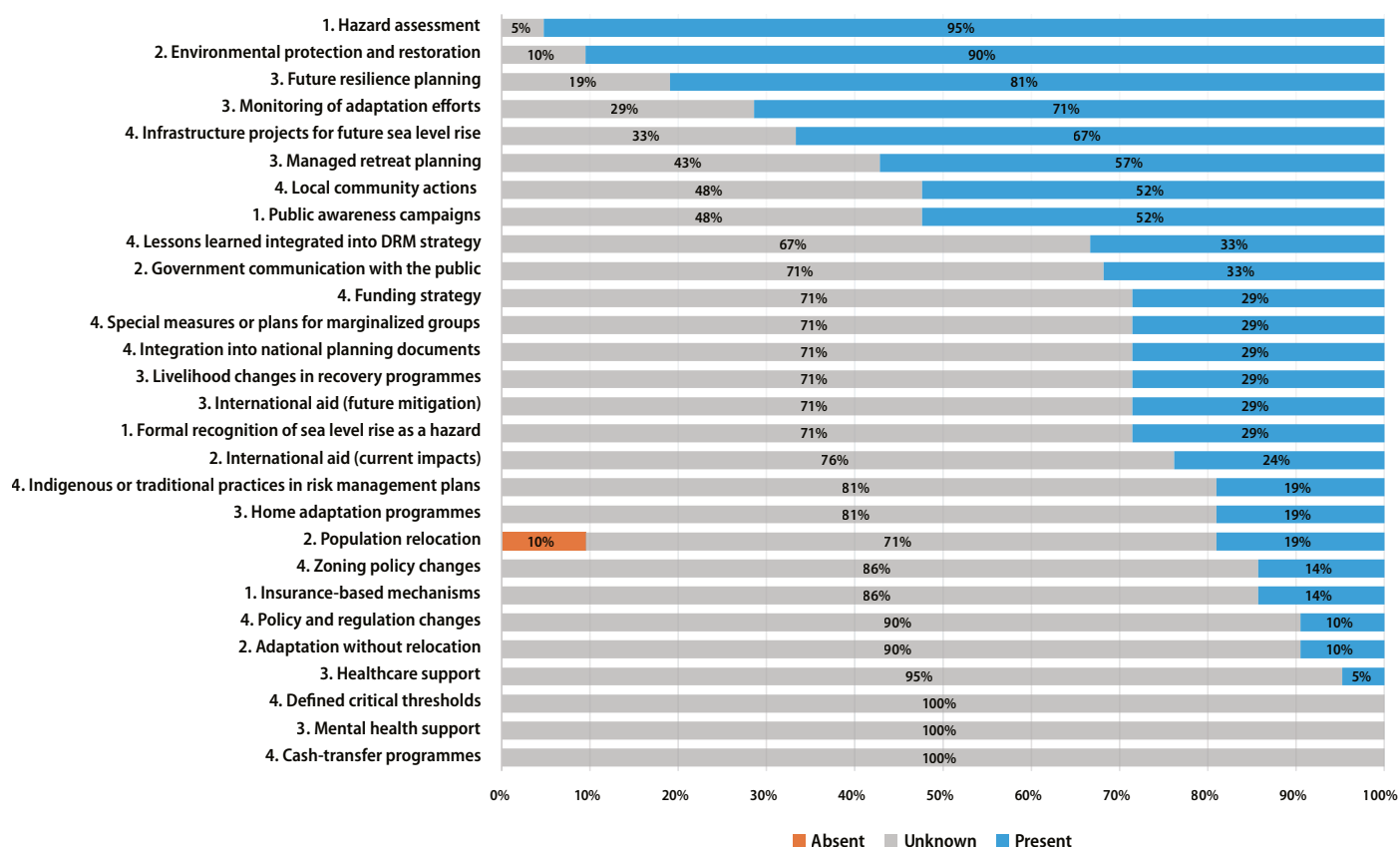


Figure 7: Sea level rise DRM measures reported in sample countries

implementation remains uneven. The majority of reported actions are concentrated in the early phases of risk management – such as assessments, monitoring and broad resilience planning – while fewer countries have advanced towards governance reforms, financial mechanisms or socially complex measures such as relocation and social protection. This imbalance reflects systems that are diagnosing risks but not yet translating them into durable, comprehensive responses.

Most countries report measures related to diagnostics and early planning. Hazard assessments are the most widely adopted and are present in 95 per cent of cases, while environmental protection and restoration are reported in 90 per cent and resilience planning in 81 per cent. These findings indicate that governments are actively investing in understanding sea level rise and mapping potential strategies.

However, the focus on knowledge generation and planning is not matched by progress in implementing measures that would directly reduce risks to people, assets and livelihoods. Actions that involve difficult trade-offs or long-term commitments are far less common. Planned relocation is reported in fewer than 20 per cent of countries, while zoning reforms and insurance-based mechanisms appear in only 14 per cent.

Patterns vary by income level and region, pointing

to distinct entry points for support. Upper-middle-income countries show greater recognition of sea level rise, with stronger references to relocation (43 per cent) and funding strategies (43 per cent), suggesting readiness for technical assistance to operationalize plans and strengthen inter-agency procedures. All high-income countries in the sample perform monitoring efforts but often fail to link observations to decision-making, indicating the need for threshold-based triggers and governance mechanisms. Lower-middle-income countries rely more heavily on international aid (50 per cent) but report no regulatory anchors, highlighting the importance of institutionalizing externally funded pilots into national frameworks.

Regionally, Asia-Pacific demonstrates strong community mobilization around managed retreat (73 per cent), but these efforts are not well integrated into governance. All African countries in the sample emphasized future infrastructure investment without equivalent recognition or retreat planning, raising concerns about long-term management. The Americas often include formal recognition of sea level rise in policy (50 per cent), but financing pipelines and social engagement lag behind. SIDS frequently run awareness campaigns (75 per cent) and pilot relocation initiatives (33 per cent) but

lack systematic frameworks for scaling. LDCs show progress in monitoring and awareness (25 per cent and 25 per cent), but policy integration remains scarce, leaving project-level evidence underutilized.

Overall, the findings highlight a global imbalance: governments are building knowledge and strategies but have not yet embedded sea level rise into the governance systems, financing arrangements and social protection measures required for long-term resilience. Technical assistance through mechanisms such as the Santiago Network can help bridge this gap. Priority areas include supporting upper-middle- and high-income countries to move from monitoring to decision-making; assisting lower-middle-income countries to institutionalize aid-funded pilots; and enabling SIDS, LDCs and regions such as Africa and Asia-Pacific to connect community momentum and infrastructure investments with regulatory frameworks, financial tools and rights-based processes.

Absent measures

In the sea level rise sample, 2 out of 21 countries – Samoa and Nauru, both classified as SIDS – explicitly reported not having implemented population relocation, although both identified it as a potential measure for the future. While direct reports of absent measures were rare in the reviewed material, their presence highlights important entry points for technical assistance, as countries often face difficulties when attempting to implement such measures for the first time. Only four countries reported having undertaken relocation efforts due to the risk of sea level rise, leaving limited opportunities for peer learning from existing experiences. For all other measures in the sea level rise survey, no countries explicitly reported non-implementation, and in three cases no references were found at all across the sample.

Unknown measures

Across the 28 measures assessed, more than two thirds had few or no references in most countries, making it difficult to determine whether they are being implemented, planned or entirely absent. This information gap points to a critical barrier: while recognition of sea level rise is increasing, there is limited visibility on how awareness is being translated into systematic action to reduce or avoid loss and damage.

The most notable gap concerns social protection. No references were found across the sample for measures such as cash transfers, mental health support and definition of critical thresholds for action. Healthcare support was scarcely documented (5 per cent), and policy or regulatory changes in relation to sea level

rise appeared in fewer than 10 per cent of cases. These findings show not only that progress in people-centred measures is limited, but also that basic data on their status are missing. Without clear information, it remains uncertain whether these measures are absent, overlooked or simply undocumented.

Relocation and adaptation present a similar challenge. Although population relocation was the only measure explicitly noted as not implemented by two countries, structured relocation policies or guidelines remain largely undocumented. Other adaptation measures, such as non-relocation strategies for managing exposure, also show minimal evidence of reporting. The absence of references here reflects the broader uncertainty around whether governments are exploring politically sensitive and socially complex options, or whether information has not been made available.

Overall, the review underscores how little information is available on sea level rise responses beyond initial recognition and planning. This lack of evidence makes it difficult to assess readiness, compare progress across countries or identify lessons that could inform others. Technical assistance could therefore not only address implementation gaps but also prioritize improving the documentation, monitoring and reporting of sea level rise measures.

3.4.2. Support needs assessments for the top measures

This section examines trends within two DRM measures related to sea level rise. As outlined in the methodology, the selection of measures was based on two criteria: (i) those with the highest percentage of countries reporting their presence; and (ii) those with the largest number of countries providing sufficiently detailed information on technical needs. Based on these criteria, hazard assessment and future resilience planning needs were selected for analysis.

The following subsections present the findings, key insights and implications for technical assistance opportunities.

Hazard assessment

Hazard assessments are the foundation for addressing sea level rise, yet current practices show clear gaps in data quality, institutional capacity and financing. In many cases, assessments remain isolated exercises with limited influence on planning, budgeting or land-use decisions. To strengthen DRM, hazard assessments need to evolve into routine systems with clear ownership, standardized methods, scheduled updates and direct connections to decision-making processes such as zoning, public investment

and procurement. The identified needs in hazard assessment were clustered into several groups and are presented in Table 21. The values in parentheses are the share of countries reporting hazard assessment that expressed a given type of need.

Asia-Pacific stands out for acknowledging a wide spectrum of technical gaps, particularly in institutional capacity (45 per cent) and data quality (36 per cent). This recognition highlights the need for technical assistance that builds institutional analysis capacity, supports localized assessments (27 per cent) and expands training on sea level rise modelling, ensuring that assessments feed directly into planning cycles. In Africa, needs are defined by shortages of financing (25 per cent) and skilled staff (25 per cent), showing that hazard assessments struggle to be sustained over time. Here, support could prioritize financing mechanisms, strengthening institutional capacity and improving access to usable data (25 per cent) and targeted training. In the Americas, fewer needs are reported overall – data quality is the only issue identified (20 per cent) – but this may reflect underreporting rather than higher baseline capacity. Further diagnostic work is necessary to

confirm whether gaps in financing and localized analysis are being overlooked.

Patterns also vary by income group. Lower-middle-income countries consistently report the strongest demand, with particular needs for institutional capacity (63 per cent), data quality (38 per cent) and localized assessments (38 per cent), highlighting the need for both physical system development and training infrastructure to build long-term self-sufficiency. Upper-middle-income countries focus more on data precision (43 per cent) and institutional training (14 per cent). Across all contexts, improving hazard assessments means linking technical outputs to DRM processes in a way that ensures evidence is consistently applied to reduce and address loss and damage.

Future resilience planning needs

The identified needs in future resilience planning were clustered into several groups and are presented in Table 22. The values in parentheses are the share of countries reporting future resilience planning that expressed a given type of need.

Table 21: Types of needs reported for hazard assessment

Type of need (% of countries reporting such needs in hazard assessment)	Definition
Data quality (30%)	Need for accurate, high-resolution bathymetry, topography and elevation data for reliable assessments
Financing (5%)	Need for sustained funding and resourced authorities to conduct, expand and maintain sea level rise assessments
Human and institutional capacity (30%)	Need for skilled experts and institutions to implement, oversee and apply hazard assessments
Localized assessments (15%)	Need for locally tailored studies addressing small islands, land subsidence and land-use changes

Table 22: Types of needs reported for future resilience planning

Type of need (% of countries reporting such needs in future resilience planning)	Definition
Community-level involvement (24%)	Need for participatory, equitable planning with strong community engagement and awareness
Monitoring and data quality (29%)	Need for reliable, detailed data and monitoring to guide effective resilience planning
Plan to implementation (59%)	Need for clear pathways, funding and mechanisms linking plans to implementation
Projections for planning (41%)	Need for strategies addressing uncertainties in sea level rise projections and coastal impacts

Future resilience planning is a priority across countries, but the types of support needed differ by income level. Lower-middle-income countries report the strongest needs, particularly in moving from planning to implementation (88 per cent). This finding highlights structural gaps in institutional capacity and execution: plans may exist on paper, but governments often lack the strategies, budgets and institutional arrangements required to carry them out. Upper-middle-income countries, by contrast, focus more on data systems and monitoring infrastructure (50 per cent). This observation reflects a more advanced stage of planning, where strategies are already in place, but stronger evidence is needed to guide investment and evaluate results over time. Here, the priority is not the existence of plans, but ensuring that they are supported by robust technical foundations that allow for evidence-based adjustments.

Across both these groups, scenario planning (upper-middle: 33 per cent, lower-middle: 38 per cent) and community involvement (upper-middle: 33 per cent, lower-middle: 25 per cent) are seen as important measures, yet their application remains limited. The moderate uptake of these practices suggests that while there is recognition of their value, they are not yet fully embedded in planning routines. Broader adoption could help ensure that resilience plans are both forward-looking and grounded in community realities.

Technical assistance could therefore be differentiated. For lower-middle-income countries, support could prioritize execution – developing implementation strategies, aligning budgets with planned actions and strengthening institutions so that plans are effectively delivered. For upper-middle-income countries, assistance could emphasize monitoring systems, technical projections and integration of data into long-term planning frameworks. For both groups,

promoting inclusive practices such as community involvement and anticipating future climate risks through scenario planning is key to ensuring that resilience planning translates into durable improvements in DRM.

3.4.3. Support needs assessments for the cross-cutting needs

This section examines trends within cross-cutting needs, directly captured from the reviewed documents, that are not linked to specific DRM measures.

Integration needs

The identified integration needs were clustered into several groups and are presented in Table 23.

One of the most consistent gaps across countries is the integration of sea level rise into wider governance systems. Policy needs dominate across all regions, underscoring the difficulty of building coherent approaches that cut across institutions and sectors. Coordination also emerges as a key challenge. Asia-Pacific shows the broadest recognition of these gaps, citing needs in planning (20 per cent), financial strategies (10 per cent) and policy frameworks (90 per cent). Africa and the Americas report fewer items overall, but both highlight coordination and legal frameworks as priority areas. Importantly, adaptation planning and financial integration are rarely mentioned in all regions, suggesting these are not absent in practice but remain blind spots in reporting.

By income level, policy frameworks emerge as a common and urgent need across all groups, reflecting systemic governance challenges. Upper-middle-income countries report the most diversified set of

Table 23: Types of integration needs reported

Type of need (% of countries reporting such integration needs)	Definition
Adaptation planning (12%)	Need to integrate sea level rise into long-term, cross-sectoral adaptation and risk strategies
Cooperation and coordination (47%)	Needs for joint action, partnerships and aligned roles across sectors and levels
Financial strategies (6%)	Need for embedded funding mechanisms and economic instruments in resilience and integration frameworks
Knowledge (12%)	Needs for data, mapping, indicators and information systems to guide DRM
Policy (94%)	Needs for coherent laws, frameworks and strategies integrating sea level rise into sectoral development plans

needs, with significant references to coordination (57 per cent), financing (14 per cent) and institutional knowledge (14 per cent), indicating a transitional stage in which financing and organizational learning are becoming increasingly important. Lower-middle-income countries emphasize policy frameworks heavily, but report little on institutional or financial measures, a pattern that points either to capacity gaps or to underreporting. Even high-income countries report persistent needs for coordination (50 per cent) and policy (100 per cent), showing that integration challenges are widespread and not limited to resource-constrained settings.

From a DRM perspective, integration needs are especially critical because they determine whether hazard assessments and resilience plans translate into sustained, system-wide action. Without legal and institutional anchors, sea level rise measures risk remaining fragmented and temporary. Technical assistance could therefore focus on supporting cross-sectoral policy reforms and legislative updates, building institutional capacity for both vertical and horizontal coordination, and promoting the mainstreaming of sea level rise into long-term plans, budgets and governance structures. In regions or income groups where reporting is sparse, assistance could also help countries identify hidden integration needs, ensuring they become explicit priorities in national DRM agendas.

Operational needs

The identified operational needs were clustered into several groups and are presented in Table 24.

Across all regions, countries report difficulties in financing, institutional coordination and maintaining technical systems, showing that even when plans exist, the ability to deliver them remains limited. All African countries in the sample emphasize funding constraints,

which reflect the broader problem of implementation bottlenecks tied to resource access. In the Americas, reported needs focus on institutional (67 per cent) and technical systems (50 per cent), pointing to the importance of strengthening organizational capacity to manage and execute programmes. Asia-Pacific spreads its needs more evenly, highlighting gaps in system integration and in direct implementation support across financing (64 per cent), institutional capacity (55 per cent) and expertise (36 per cent), suggesting pressures to scale existing initiatives.

Income-level patterns also present some relevant insights. Lower-middle-income countries report the widest range of operational gaps, particularly in institutional capacity (86 per cent) and funding (86 per cent), as well as in expertise (57 per cent). This finding indicates foundational challenges that must be addressed before strategies can translate into results. Upper-middle-income countries focus more narrowly on upgrading systems and addressing specific institutional (43 per cent), financial (43 per cent) or technical (57 per cent) limitations, showing that while structures exist, they are uneven and require targeted improvements. High-income countries continue to report needs as well, particularly around financing continuity (100 per cent) and governance (50 per cent), underlining that operational challenges persist even where baseline systems are stronger.

From a DRM perspective, these gaps matter because they highlight the missing link between planning and delivery. Without predictable financing, clear institutional responsibilities, and procedures that connect technical outputs to budgets and procurement, operational systems remain fragile. Technical assistance could therefore prioritize institutional strengthening, alignment of financing, and integration of operational tools into national systems. For lower-middle-income countries, this

Table 24: Types of operational needs reported

Type of need (% of countries reporting such operational needs)	Definition
Expertise (45%)	Needs for professional skills, specialized training and technical knowledge to improve disaster response
Institutional capacity (55%)	Needs to strengthen governance structures, coordination mechanisms and organizational effectiveness in disaster management
Targeted funding (70%)	Needs for timely, flexible and adequate financial resources to sustain disaster operations
Technical enhancements (40%)	Needs for upgraded tools, systems and technology to improve preparedness and response

means investing in core institutional capacity and basic funding structures. For upper-middle-income countries, assistance could focus on technical upgrades, targeted integration of financing and structured knowledge transfer. For high-income countries, the priority could be bridging the gap between planning and implementation by ensuring dedicated and sustained funding streams and by refining governance mechanisms to oversee delivery.

Regulatory needs

The identified regulatory needs were clustered into several groups and are presented in Table 25.

Across regions, countries identify significant regulatory gaps, especially around land-use planning and legal updates. Asia-Pacific (73 per cent) and the Americas (67 per cent) stand out for actively recognizing the need to revise laws to integrate coastal risk management, while Africa emphasizes risk assessments as a foundation (100 per cent). This pattern suggests that in some contexts, evidence generation still precedes regulatory reform, while in others institutional systems already exist but require modernization and alignment.

The differences linked to income level are equally clear. Lower-middle-income countries report the most comprehensive set of regulatory needs, particularly in land-use planning (75 per cent) and DRR law revisions (88 per cent). This observation reflects both significant gaps and momentum for reform, as countries seek to create the legal conditions to embed sea level rise into governance systems. Upper-middle-income countries focus more on climate risk assessments (71 per cent), emphasizing the need for robust technical evidence to guide future legal and policy development. High-income countries highlight the importance of protocol clarity (50 per cent) and targeted legislative updates (75 per cent), suggesting that while governance systems are mature, they may be outdated or inconsistent in addressing emerging risks.

From a DRM perspective, these needs are central because regulatory frameworks provide the rules and standards that make technical measures operational. Without updated laws, land-use plans and clear protocols, hazard assessments and resilience plans cannot be systematically applied. Technical assistance could therefore aim to support countries in aligning legal frameworks with sea level rise risks, harmonizing protocols across institutions and promoting systematic updates to DRM laws. For lower-middle-income countries, this means enabling the initiation of spatial planning and legal reforms. For upper-middle-income countries, support could emphasize the use of risk assessments as inputs for policy design. For high-income countries, assistance could focus on updating and clarifying protocols to ensure existing governance systems remain fit for purpose.

Technical needs

The identified technical needs were clustered into several groups and are presented in Table 26.

The technical needs for addressing sea level rise focus on ensuring that systems and people are equipped to adapt effectively. First, there is a critical need for functioning resources, including operational infrastructure, monitoring tools and resilient systems that can track and manage the impacts of rising seas (Americas 67 per cent, Africa 100 per cent, Asia-Pacific 82 per cent). Without reliable physical and technological assets, responses remain fragmented and reactive. Equally important is the need for targeted training, providing specialized skills and sustained capacity-building for practitioners, policymakers and communities (Americas 50 per cent, Africa 75 per cent, Asia-Pacific 64 per cent). Such training ensures that all actors – from engineers and planners to local stakeholders – can apply technical knowledge in designing, implementing and maintaining adaptive measures. Together, these needs highlight that successful management of sea level rise requires both robust systems and well-prepared human capacities.

Table 25: Types of regulatory needs reported

Type of need (% of countries reporting such regulatory needs)	Definition
Clear DRR and DRM protocols (29%)	Needs for defined procedures and mandates ensuring coordinated DRM
Climate risk assessments (43%)	Needs for comprehensive, data-driven assessments guiding adaptation and risk management strategies
Land-use planning (38%)	Needs for zoning, spatial regulation and settlement planning in hazard-prone areas
Regular DRR law revisions (62%)	Needs for continual review and updating of disaster laws and policies

Table 26: Types of technical needs reported

Type of need (% of countries reporting such technical needs)	Definition
Functioning resources (81%)	Needs for reliable infrastructure, equipment and systems to enable effective disaster response
Targeted training (62%)	Needs for specialized skills, capacity-building and awareness to strengthen preparedness and resilience

All three regions report significant technical needs to manage sea level risks. Africa consistently shows the highest levels of need, both in technical functionality (100 per cent) and training (75 per cent). In line with this, lower-middle-income countries consistently report the greatest need for both infrastructure (88 per cent) and training (88 per cent). Asia-Pacific also demonstrates substantial need, with 82 per cent citing functioning resources and 64 per cent targeted training, while the Americas report fewer but still meaningful needs (67 per cent and 50 per cent), suggesting a greater focus on targeted improvements. Across all regions, functioning resources were identified more often as a need than training, with upper-middle-income countries reporting 86 per cent for functioning resources compared with 43 per cent for training, and high-income countries showing 75 per cent versus 50 per cent.

Overall, technical assistance could focus on system development and workforce training to build foundational operational capacity. Especially for African and lower-middle-income countries, investments in both physical system development and training infrastructure to build long-term self-sufficiency are necessary.

3.4.4. Good examples of measure implementation

Hazard assessments – Bangladesh

The analysis of hazard assessments shows that while many countries are investing in diagnostics, persistent gaps remain in institutional capacity, financing and data quality. Asia-Pacific highlights limited institutional analysis (45 per cent) and data quality (36 per cent), Africa points to shortages of financing and skilled staff (25 per cent each), and lower-middle-income countries report the strongest demand across all areas, including localized assessments (38 per cent). These patterns indicate that while awareness exists, systems to sustain and apply hazard assessments are often missing.

Bangladesh provides a strong example of how these gaps can be addressed. Through agencies such as the Ministry of Disaster Management and Relief and

the Bangladesh Meteorological Department, and in collaboration with universities and research institutes, the country has developed localized data systems, including digital elevation models. Supported by the Bangladesh Climate Change Trust Fund, these systems ensure financing continuity, technical expertise and institutional ownership. By embedding hazard assessments into agriculture, water and infrastructure planning, Bangladesh has demonstrated how technical evidence can be systematically applied to decision-making.

By mobilizing Bangladesh's institutions and practitioners as OBNE partners, the Santiago Network could help other countries strengthen institutional capacity, secure financing arrangements and expand localized assessments that directly respond to the gaps identified in the global review.

Future resilience planning – Cuba

The review of future resilience planning highlights a divide between planning intent and practical execution. Lower-middle-income countries report the strongest need to move from planning to implementation (88 per cent), underscoring institutional gaps in strategies, budgets and delivery capacity. Upper-middle-income countries emphasize data systems and monitoring (50 per cent), reflecting a more advanced stage of planning but one that requires stronger technical foundations to guide investment and track progress. Across both groups, scenario planning (33–38 per cent) and community involvement (25–33 per cent) remain underutilized, suggesting that while their value is recognized, these approaches are not yet fully embedded into planning routines.

Cuba's Tarea Vida (Life Task) plan provides a strong example of how these challenges can be addressed. Adopted in 2017, the plan integrates coastal ecosystem protection, community relocation, legal reforms and awareness campaigns into a single, long-term strategy. Crucially, it connects national policy with local implementation, ensuring that resilience objectives are translated into tangible actions. Projects such as MI COSTA (My Coast) illustrate

how community participation and ecosystem-based solutions are mobilized under this framework, addressing gaps in participation, monitoring and execution that many countries continue to face.

Cuba's experience offers direct opportunities for technical assistance. For lower-middle-income countries, lessons from Tarea Vida can help in designing implementation strategies that link plans to budgets and institutional responsibilities, while incorporating relocation and ecosystem restoration as practical tools for resilience. For upper-middle-income countries, Cuba's model shows how monitoring systems and participatory approaches can complement existing strategies, strengthening the evidence base for adaptive decision-making. More broadly, Cuba's integrated framework demonstrates how policy, law and community engagement can be combined into a coherent long-term strategy, offering transferable lessons to countries struggling to turn resilience planning into durable action.

Cross-cutting needs

Several countries have advanced management practices for sea level rise that together illustrate how integration, operations, technical capacity and regulatory frameworks can be strengthened – and how the Santiago Network could mobilize this expertise.

Kiribati has become a reference point through the Kiribati Adaptation Program, which mainstreams sea level rise into national development planning through long-term adaptation strategies, participatory community engagement and multi-level coordination between government agencies, international partners and local stakeholders. By embedding sea level rise into policy frameworks and securing dedicated funding, the Kiribati Adaptation Program demonstrates how integrated governance can address coastal erosion and vulnerability at scale. Fiji complements this with its use of nature-based solutions – such as coral reef and mangrove restoration – as cost-effective protection measures. Its pioneering of green bonds to finance climate-resilient initiatives further shows how financial innovation can strengthen long-term resilience.

Bangladesh brings an operational model anchored in the Bangladesh Delta Plan 2100, the National Adaptation Programme of Action, and the Strategic Program for Climate Resilience. These frameworks embed sea level rise into infrastructure planning, coastal protection and land-use management, supported by investments in resilient agriculture and water systems. Kiribati, through its Joint Implementation Plan and Climate Change Policy, reinforces this by strengthening institutional capacity and cross-sectoral coordination, and by securing sustained technical and financial support for planned relocation and coastal defence. Together, these models illustrate how planning, financing and institutional coordination can translate into operational readiness.

On the regulatory side, Bangladesh has established robust frameworks through the Disaster Management Act, the Standing Orders on Disasters and the Delta Plan, which integrate sea level rise into land-use planning, infrastructure development and coastal protection. Kiribati has similarly advanced with the Disaster Risk Management and Climate Change Act (2019), complemented by its Climate Change Policy and Land Planning and Development Act. These instruments define institutional responsibilities, promote zoning regulations and unify climate governance – demonstrating how legal frameworks can institutionalize resilience.

Technical capacity is equally vital. Fiji – through the Pacific Sea Level and Geodetic Monitoring network under the Climate and Oceans Support Program in the Pacific – maintains permanent tide-gauge stations and trains regional practitioners on data collection and analysis. These systems provide continuous monitoring and build local expertise in sea level rise services. Kiribati, also part of the Pacific Sea Level and Geodetic Monitoring network and supported by the Kiribati Adaptation Program, has enhanced its technical capacity through specialized training for coastal protection and monitoring, ensuring that adaptation measures are implemented and maintained effectively.

Taken as a whole, these experiences demonstrate that no single model is sufficient, but each offers transferable lessons. By connecting the expertise of Kiribati, Fiji and Bangladesh through peer-to-peer learning, the Santiago Network can help countries strengthen their own sea level rise systems in ways that are context-sensitive and grounded in proven practice.

3.5. Land degradation

Key takeaways (% of countries)

- **Information availability.** DRM responses to land degradation emphasize long-term and preventive strategies – hazard assessments (52%), resilience plans (95%), hotspot identification (90%) and long-term monitoring (90%) – while short-term and recovery measures are scarcely documented (0–14%). Across categories, a very high share of measures remain unknown (46–66%), underscoring limited data and possible underreporting.
- **Measure-specific needs.** Hazard assessments face gaps in capacity (36%), methodology (36%) and information management (29%), while ongoing monitoring systems show major needs in methodology (63%) and coverage (42%). Long-term project monitoring suffers from methodological (50%) and coordination (28%) challenges, alongside limited capacity (28%) and management (22%). These patterns confirm systemic limitations in standards, institutional capacity and implementation.
- **Cross-cutting gaps.** Integration needs are dominated by policy (100%) and coordination (80%), reflecting fragmented governance. Operational needs are led by funding (85%) and institutional capacity (65%), with expertise (50%) and technical upgrades (40%) also recurring. Regulatory systems lag in law revisions (90%) and land-use planning (60%), while technical gaps focus on functioning resources (85%) and training (95%), with equity largely overlooked (10%).
- **Opportunities for the Santiago Network.** Standardize monitoring and assessment methods; strengthen short-term and recovery responses; expand institutional capacity, financing and training; embed land degradation into legal and land-use frameworks; and integrate equity and social protection.
- **Potential sources of expertise (peer-to-peer OBNEs):**
 - Colombia for robust, participatory hazard assessments (World Overview of Conservation Approaches and Technologies, Land Degradation Assessment in Drylands)
 - Uzbekistan and Uganda for advanced monitoring systems and integrated socioenvironmental data
 - Chile and India for long-term monitoring, transparency and digital integration
 - India and Ethiopia for integrated, community-driven land restoration and institutional capacity
 - Kenya for embedding risk into land-use planning and policy frameworks
 - Namibia for applied training and user-friendly technical tools.

3.5.1. Presence, absence or unknown status of disaster risk management measures

Similarly to sea level rise, land degradation differs from rapid-onset events in that it is a process that unfolds over long time frames. Unless strong measures are taken, its impacts accumulate gradually until they reach critical thresholds that cause lasting and continuous effects on livelihoods and socioecological systems. For analytical consistency, this review applies the same temporal framing used for sea level rise – prior, shortly after, and medium- and long-term after – under the assumption that most measures are triggered only once high-impact thresholds are reached. As with the sea level rise section, this framing is used for comparability, while the survey results themselves were not constrained by it.

Figure 8 illustrates the overall distribution of land degradation-related DRM measures by reported status – presence, absence or unknown – across the country sample. The number next to the name of the measure represents the temporal dimension in which it was identified (1: prior, 2: short-term after, 3: medium- and long-term after, and 4: general).

Present measures

The assessment of present DRM measures for land degradation reveals a strong emphasis on medium- and long-term strategies, with 49 per cent of measures in this category reported as present, compared with just 33 per cent for short-term interventions. Pre-event measures also show a relatively higher presence (52 per cent), underscoring a preventive orientation

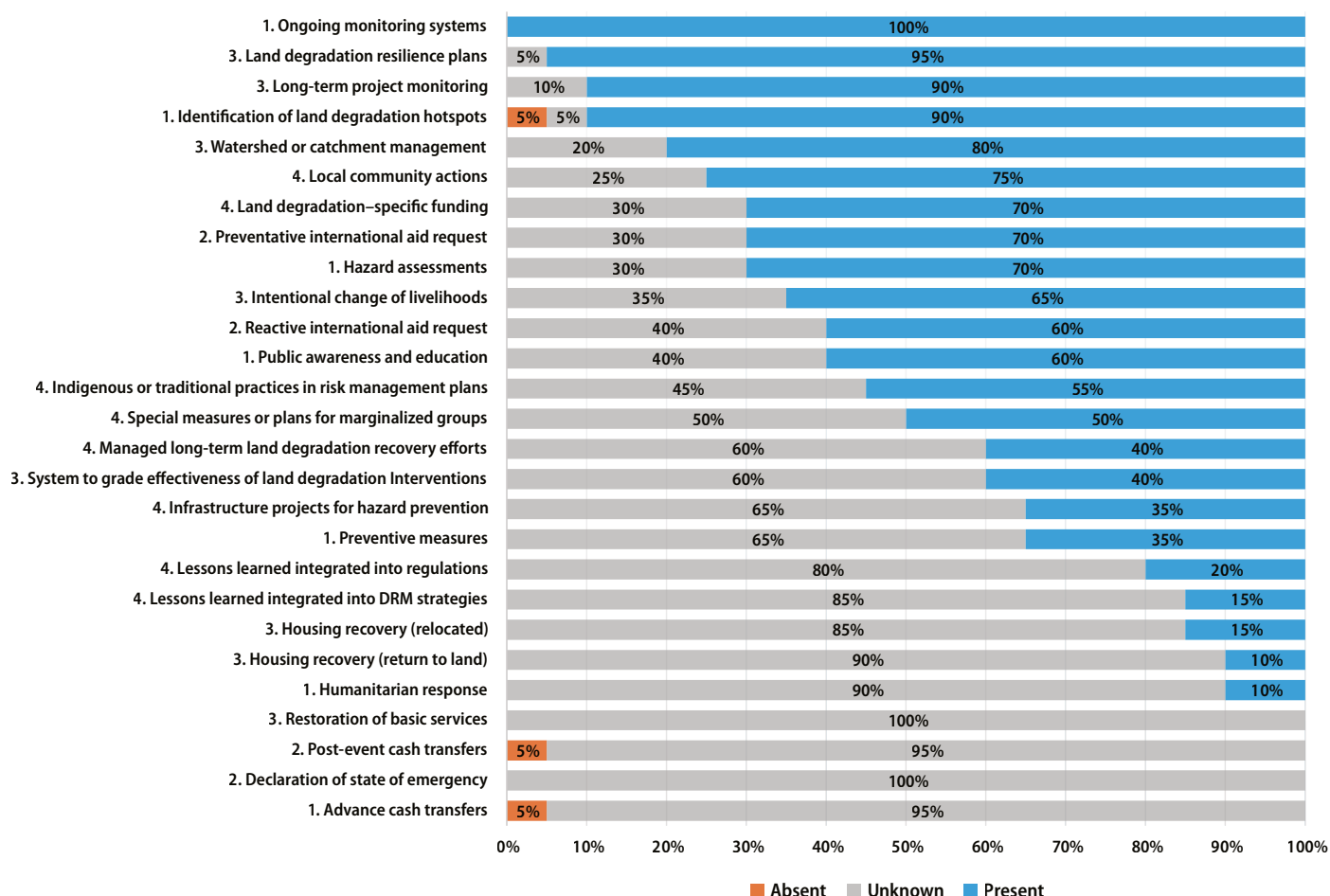


Figure 8: Land degradation DRM measures reported in sample countries

rather than reactive action. At the same time, a strikingly high proportion of measures across categories remain classified as unknown (ranging from 46 per cent to 66 per cent), reflecting both data limitations and potential underreporting of existing efforts.

Among the measures explicitly reported as present, the top five – ongoing monitoring systems (100 per cent), resilience plans (95 per cent), long-term project monitoring (90 per cent), identification of degradation hotspots (90 per cent) and watershed or catchment management (80 per cent) – are overwhelmingly structural and process-oriented, aligning with the slow-onset nature of land degradation. Importantly, none of these measures fall into the short-term response phase, confirming that immediate interventions after the critical point of land degradation are scarce. This imbalance suggests that while planning and monitoring frameworks are relatively well established, implementation remains uneven, particularly for short-term measures that could reduce immediate losses. Moreover, the high presence of resilience planning in the data set likely reflects the availability of UNCCD land degradation neutrality plans rather than widespread implementation, signalling a possible

false-positive bias in reported coverage. Overall, the results point to critical gaps in short-term DRM responses to land degradation, underscoring the need for greater investment in actionable, near-term interventions to complement the dominant focus on monitoring and long-term planning.

The regional assessment of DRM measures for land degradation reveals distinct priorities and gaps that point to opportunities for cross-regional learning. In the Americas, Indigenous and traditional practices (80 per cent) and preventive measures (80 per cent) feature prominently, underscoring the integration of local knowledge into DRM. Yet recovery and adaptation efforts – such as housing recovery and managed long-term land degradation recovery – are rarely embedded in national government plans, raising concerns about fragmented governance and scarce institutional alignment. Africa stands out for being the only region to report cash transfer schemes (advance 14 per cent; post-event 14 per cent) and systematic integration of lessons learned into future plans (DRM strategies 43 per cent; regulations 29 per cent), highlighting innovations in social protection and adaptive governance that could inform other regions.

In Asia-Pacific, by contrast, all countries in the sample report embedding land degradation resilience plans, long-term project monitoring and identification of land degradation hotspots into national planning frameworks, and mobilizing international aid requests (preventive 100 per cent; reactive 88 per cent), reflecting formalized institutional processes. However, it lags behind the Americas in preventive action (12 per cent versus 80 per cent). Taken together, the findings suggest that while each region demonstrates clear strengths – Indigenous knowledge and prevention in the Americas, social protection and learning in Africa, and institutional integration in Asia-Pacific – limited documentation was found regarding measures in short-term recovery and reactive humanitarian response (Americas 0 per cent; Asia-Pacific 12 per cent; Africa 14 per cent), which could undermine comprehensive DRM for land degradation.

The assessment of DRM measures for land degradation across income groups highlights divergent strengths shaped by resources and context. Upper-middle-income countries lead in preventive measures (83 per cent) and local community action (100 per cent), reflecting stronger financial capacity. Yet they underreport recovery-oriented and inclusive measures such as support for marginalized groups (33 per cent). Lower-middle-income countries, largely from the Asia-Pacific region, mirror that region's emphasis on short-term responses, with high reporting of land degradation resilience plans (100 per cent) and long-term project monitoring (100 per cent), but reveal limited pre-event hazard assessments (38 per cent). Low-income countries stand out for universal hazard assessments (100 per cent) and prioritization of lessons learned in strategies (60 per cent), with some even reporting relocation plans in response to land degradation impacts (40 per cent) – a critical but underexplored development. Overall, these findings suggest that while financial capacity drives prevention in upper-middle-income countries and resource limitations shape lower-income contexts, blind spots in recovery and inclusivity remain systemic across all groups.

The comparison of DRM measures for land degradation between LDCs and non-LDCs shows broadly similar overall coverage but with notable differences in emphasis. LDCs stand out for stronger attention to marginalized groups (67 per cent) and the integration of lessons learned into DRM strategies (50 per cent) and regulations (17 per cent), signalling a degree of inclusivity and adaptive learning absent in other groups. At the same time, they lag in preventive measures (17 per cent), long-term recovery such as managed land degradation recovery efforts (17 per cent) and infrastructure projects for hazard mitigation (17 per cent), reflecting constraints in

sustained implementation. Non-LDCs, by contrast, prioritize structured planning frameworks such as universal resilience plans (100 per cent) and long-term monitoring (92 per cent) but show critical gaps in socially responsive and recovery-oriented measures, with lower attention to marginalized groups (39 per cent) and no reporting of integration of lessons learned into DRM strategies. Overall, while LDCs offer breadth with limited depth, non-LDCs display institutional strength but lower inclusivity and recovery capacity.

Absent measures

Among the 27 surveyed DRM measures for land degradation, three were explicitly reported as absent: advance cash transfers, post-event cash transfers and identification of hotspots. The two cash transfer measures – advance cash transfers (5 per cent absent) and post-event cash transfers (5 per cent absent) – were also among the five most frequently unreported or unknown measures, indicating limited documentation and implementation. Their explicit mention as absent nonetheless suggests growing recognition of their importance among countries facing land degradation.

In contrast, the identification of hotspots, while reported absent by 5 per cent of countries, was present in 90 per cent of cases, making it one of the most widely adopted measures overall. This contrast – between low reported absence and high overall adoption – points to opportunities for peer learning and knowledge exchange to help countries that still lack systematic hotspot identification.

Unknown measures

Among the countries surveyed, none reported having systems in place for declaring a land degradation emergency (100 per cent absent) or for the restoration of basic services (100 per cent absent). This suggests that these stages are either not commonly reached or that the impacts are not yet sufficiently recognized to warrant systematic approaches. Several factors may explain this finding: such events may not be occurring at scale, or they may not have reached levels that prompt significant public or government action.

Similarly, measures addressing the social impacts of land degradation are largely absent. Few references were found to migration-related responses (housing recovery) or to financial mechanisms such as advance or post-event cash transfers. Taken together, these gaps indicate that for most countries in the sample, land degradation has not yet been framed as a critical emergency requiring structured response systems, or that awareness of its broader impacts remains limited, contributing to underreporting.

3.5.2. Support needs assessments for the top measures

This section reviews three DRM measures related to land degradation, selected based on: (i) the highest share of countries reporting their presence; and (ii) the largest number providing detailed information on technical needs. Hazard assessment, ongoing monitoring systems and long-term project monitoring needs were prioritized for analysis. The following subsections present findings, insights and implications for technical assistance.

Hazard assessment

Hazard assessments are key components of land degradation risk management, shaping how countries identify vulnerable areas, anticipate soil erosion and design interventions. Needs cluster around four dimensions: policy, information management, capacity and methodology. The identified needs in hazard assessment were clustered into several groups and are presented in Table 27. The values in parentheses are the share of countries reporting hazard assessment that expressed a given type of need.

In Africa, 29 per cent of countries reported policy gaps, compared with 0 per cent in the Americas. This lack of mention may reflect limited prioritization in official documents, gaps in institutional monitoring or lack of recognition of the issue as a formalized need. As a result, the omission itself only suggests that policy alignment may not yet be a central focus in national land degradation strategies.

For the remaining clusters, the Americas consistently reported 25 per cent across information management, capacity and methodology, suggesting moderate recognition of technical and procedural challenges. Africa showed similar levels, with 14 per cent for information management and 29 per cent each for capacity and methodology, highlighting a parallel set

of challenges across technical and institutional fronts. No data were available for Asia-Pacific in this measure, making regional comparisons incomplete.

By income group, low-income countries reported more gaps across most clusters: 40 per cent for policy, capacity and methodology, and 20 per cent for information management. Lower-middle-income countries reported more modest but balanced needs, with 33 per cent each for information management, capacity and methodology, while policy was not mentioned. Upper-middle-income countries mirrored this pattern, with 40 per cent each for information management, capacity and methodology, and 0 per cent for policy, reinforcing the point that policy gaps may exist but are not being systematically flagged in reporting. Furthermore, no high-income countries were part of the land degradation data set, limiting the analysis to low- and middle-income contexts.

Differences between LDCs and non-LDCs follow a similar gradient. LDCs consistently reported 20 per cent for policy, capacity and methodology, while information management was not mentioned. Non-LDCs, in contrast, reported higher figures across technical areas – 44 per cent for information management, capacity and methodology, and 11 per cent for policy. This outcome suggests that non-LDCs have a greater ability to diagnose and report detailed needs, while LDCs may lack the institutional or evaluative capacity to surface the same issues. Importantly, the lower percentages in LDCs could be interpreted not as lower vulnerability, but rather as underreporting due to limited monitoring, evaluation and planning resources.

Overall, the evidence indicates that hazard assessments for land degradation face widespread challenges in methodology, technical capacity and information management, while policy integration

Table 27: Types of needs reported for hazard assessment

Type of need (% of countries reporting such needs in hazard assessment)	Definition
Capacity (36%)	Need for technical expertise and regular updates to ensure validated, current hazard assessments
Information management (29%)	Need to integrate satellite, expert and field data for consistent interpretation and decision-making
Methodology (36%)	Need for aligned, transparent assessment methods and comprehensive indicators covering all degradation types
Policy (14%)	Need to incorporate hazard assessments into broader frameworks such as land management and climate adaptation

remains inconsistently recognized. Strengthening these areas will be crucial to ensuring that assessments can effectively guide land degradation risk reduction. These findings on hazard assessments highlight persistent methodological and information management gaps. A similar pattern emerges in ongoing monitoring systems, where challenges in coverage and methodological coherence remain especially prominent.

Ongoing monitoring systems

Ongoing monitoring systems are critical to tracking the progression of land degradation and ensuring that responses are guided by up-to-date data. Reported needs focus on three dimensions: policy, coverage and methodology. The identified needs in the ongoing monitoring system were clustered into several groups and are presented in Table 28. The values in parentheses are the share of countries reporting ongoing monitoring systems that expressed a given type of need.

In the Americas, policy gaps were not mentioned, while 40 per cent of countries cited coverage, and 80 per cent pointed to methodological limitations. These needs were not acknowledged or prioritized in available reports, reflecting either gaps in documentation or an absence of focus on monitoring policies. In Africa, the figures shared a similar pattern but were lower overall, with policy gaps not mentioned, 14 per cent for coverage, and 43 per cent for methodology, suggesting a similar pattern of deficiencies across monitoring systems. The Asia-Pacific region reported 14 per cent for policy, but much higher needs were found in coverage (71 per cent) and methodology (71 per cent), highlighting that even where policy frameworks may exist or go unreported, countries continue to struggle with the technical reach and consistency of monitoring approaches.

When examined by income group, similar patterns emerge. Low-income countries did not report issues related to policy, but 20 per cent for coverage and 40 per cent for methodology, reflecting basic but

persistent shortcomings in establishing reliable systems. Lower-middle-income countries reported 14 per cent for policy, but much higher levels of 57 per cent for both coverage and methodology, indicating a clearer recognition of limitations as monitoring frameworks become more developed. Upper-middle-income countries also did not report policy challenges, but 50 per cent for coverage and 83 per cent for methodology, making methodological challenges particularly acute in more advanced systems. As with hazard assessments, no high-income countries were included in the data set for land degradation.

The comparison between LDCs and non-LDCs again shows a divide in reporting detail. LDCs reported uniformly low figures, with 17 per cent across all three categories. By contrast, non-LDCs reported 0 per cent for policy, but much higher levels for coverage (54 per cent) and methodology (85 per cent). This finding mirrors the pattern seen in hazard assessments, where LDCs underreport needs across clusters, not because the issues are absent but because limited institutional capacity constrains their ability to identify, document and prioritize such gaps. Non-LDCs, with more advanced diagnostic processes, report higher percentages, reflecting a sharper recognition of systemic issues.

An interesting cross-cutting finding is the consistently high percentages for methodology across regions and groups – from 43 per cent in Africa to 80 per cent in the Americas, 71 per cent in Asia-Pacific and 83 per cent in upper-middle-income countries. This outcome replicates what was seen in hazard assessments, where methodological limitations were also prominent. The recurring pattern suggests that for land degradation, the absence of shared standards and consensus approaches is one of the most significant bottlenecks in both hazard assessment and monitoring. Addressing these methodological shortcomings could therefore generate benefits across multiple DRM measures simultaneously. The limitations in monitoring systems also carry over

Table 28: Types of needs reported for ongoing monitoring systems

Type of need (% of countries reporting such needs in ongoing monitoring systems)	Definition
Coverage (42%)	Need for regional monitoring coverage with indicators adapted to local and national contexts
Methodology (63%)	Need for consensus monitoring methods, balanced data sources and robust, reliable indicators
Policy (5%)	Need to implement existing policies and integrate monitoring with early warning and land management

into long-term project monitoring, where countries report difficulties in sustaining data integration and methodological consistency over time.

Long-term project monitoring

Long-term project monitoring plays a vital role in sustaining land degradation interventions, by ensuring that projects are not only implemented but also tracked for their effectiveness, integration and long-term outcomes. Needs reported under this category are spread across coordination, capacity, management, methodology and policy. The identified needs in long-term project monitoring were clustered into several groups and are presented in Table 29. The values in parentheses are the share of countries reporting long-term project monitoring that expressed a given type of need.

Regionally, coordination needs were identified in 25 per cent of countries in the Americas, 33 per cent in Africa and 25 per cent in Asia-Pacific, indicating modest but persistent challenges in aligning monitoring systems with land management strategies. For capacity, the Americas and Africa reported lower levels (25 per cent and 17 per cent respectively), while Asia-Pacific was notably higher at 38 per cent, reflecting differences in human and technical resource gaps. Management-related needs varied sharply: no countries in the Americas reported this need, while 33 per cent of African countries and 25 per cent in Asia-Pacific cited a lack of updated data and integration of monitoring information. Methodological issues, however, stood out as a universal challenge, with 50 per cent of countries in each region reporting gaps in standardization and traceability. Policy gaps were less frequently mentioned, but still surfaced in 17 per cent of African countries and 13 per cent in Asia-Pacific, while the Americas did not acknowledge this need.

The data show an interesting progression by income group. Low-income countries recorded the highest share of management-related needs (50 per cent), alongside 25 per cent for coordination and policy, 25 per cent for capacity and 50 per cent for methodology. Lower-middle-income countries clustered around similar patterns, with 38 per cent for capacity, 25 per cent for management and 50 per cent for methodology, but only 13 per cent for policy, showing less emphasis on regulatory aspects. Upper-middle-income countries, by contrast, reported higher coordination (40 per cent) and methodology (60 per cent) needs. Still, no policy or management gaps were mentioned, pointing to systems that are relatively strong on paper but still challenged in aligning and standardizing their monitoring approaches. Once again, no high-income countries were included in the data set for land degradation, limiting the scope of analysis.

A divide is also evident between LDCs and non-LDCs. LDCs reported 60 per cent for methodology but much lower levels for coordination and capacity (20 per cent). Management needs were particularly pronounced, with 40 per cent of LDCs citing deficiencies in data integration, compared with only 15 per cent of non-LDCs. Non-LDCs, meanwhile, reported higher coordination (38 per cent) and capacity (31 per cent) needs, but much lower levels for policy (8 per cent) and management (15 per cent). This finding reinforces the finding from earlier measures: LDCs often identify fewer categories of need overall, but where they do report gaps, the percentages can be high, reflecting acute limitations in specific areas rather than across the board.

What stands out most in this category is the prominence of methodology, which was cited by 50 per cent of countries in the Americas, Africa and

Table 29: Types of needs reported for long-term project monitoring

Type of need (% of countries reporting such needs in long-term project monitoring)	Definition
Capacity (28%)	Need for human, technical and financial capacity to sustain long-term monitoring systems
Coordination (28%)	Need to integrate monitoring with land management strategies and strengthen institutional collaboration
Management (22%)	Need for updated data and integration of monitoring into management and decision-making
Methodology (50%)	Need for consensus monitoring methods and tracking progress towards land degradation neutrality
Policy (11%)	Need to enforce environmental laws, raise awareness and integrate principles into monitoring frameworks

Asia-Pacific, rising to 60 per cent in upper-middle-income countries and 60 per cent in LDCs. The fact that methodological issues reappear as the dominant need across hazard assessments, ongoing monitoring and long-term project monitoring underscores a systemic barrier: countries consistently lack standardized, transparent and reliable methods for evaluating land degradation interventions over time. This repetition across categories suggests that strengthening methodological standards and building consensus on long-term monitoring frameworks could be a central priority for technical assistance. While monitoring systems emphasize technical and methodological gaps, integration needs shift the focus to institutional and policy alignment. Here, nearly all countries acknowledge fragmentation across governance and planning processes.

3.5.3. Support needs assessments for the cross-cutting needs

This section examines trends within cross-cutting needs, directly captured from the reviewed documents, that are not linked to specific DRM measures.

Integration needs

Effective land degradation management requires strong integration across governance levels, sectors and resources. Needs in this area are among the most universally recognized across the data set, underscoring that fragmented systems remain a central obstacle. The identified integration needs were clustered into several groups and are presented in Table 30.

Policy integration stands out as a nearly universal challenge: 100 per cent of countries in the Americas, Africa and Asia-Pacific identified it as a need, echoed consistently across all income groups. Even in the

denomination analysis, both LDCs (83 per cent) and non-LDCs (100 per cent, due to data variation but effectively universal) reported policy integration gaps. This outcome points to a structural problem: while many countries have sectoral strategies for land management, they lack coherent frameworks that embed land degradation risk reduction into national laws and planning.

Beyond policy, cooperation and coordination were also commonly reported: 80 per cent of countries in the Americas, 100 per cent in Africa and 63 per cent in Asia-Pacific flagged this as a priority. It was also reported by 63 per cent of low-, 100 per cent of lower-middle- and 83 per cent of upper-middle-income countries, showing that coordination issues cut across all development levels. This finding echoes the earlier findings for hazard assessments and monitoring systems, where methodological challenges frequently highlighted the absence of common standards. In the case of integration, however, the challenge is institutional alignment rather than technical coherence.

Other integration needs were more uneven. Financial strategies were underreported overall, with only 20 per cent of countries in the Americas, 14 per cent in Africa and 13 per cent in Asia-Pacific mentioning this dimension. Neither LDCs nor low-income countries referred to financial integration, suggesting not that the need does not exist but that it remains outside the scope of diagnostic reporting. Lower-middle- and upper-middle-income countries (ranging from 17–25 per cent) showed slightly higher levels, indicating a growing recognition of financial planning as a gap in more advanced contexts. Similarly, knowledge integration showed more modest reporting, with 20 per cent of countries in the Americas, 29 per cent in Africa and 13 per cent in Asia-Pacific citing gaps. Interestingly, 40 per cent of low-income countries reported knowledge integration needs – the highest

Table 30: Types of integration needs reported

Type of need (% of countries reporting such integration needs)	Definition
Cooperation and coordination (80%)	Needs for joint action, partnerships and aligned roles across sectors and levels
Financial strategies (15%)	Needs for embedded funding mechanisms and economic instruments in resilience and integration frameworks
Knowledge (20%)	Needs for data, mapping, indicators and information systems to guide DRM
Policy (100%)	Needs for coherent laws, frameworks and strategies integrating land degradation into sectoral development plans
Resource management (30%)	Needs for greater integration of financial and physical resource management within the aspects of the greater DRM system

share across groups – likely reflecting the importance of linking scientific knowledge and local practices where resources are most constrained.

Resource management integration presented an intermediate challenge in 20 per cent of countries in the Americas, 43 per cent in Africa and 25 per cent in Asia-Pacific. By income level, needs clustered between 25 per cent and 40 per cent, and by denomination, both LDCs (33 per cent) and non-LDCs (29 per cent) reported similar levels. This outcome suggests that while not universally flagged, resource integration remains a recurring theme where monitoring, planning and funding are misaligned.

Taken together, integration needs reveal a striking contrast: policy integration and coordination are widely recognized as priorities across all groups, while financial, knowledge and resource integration are less often mentioned, although still significant. The uneven reporting of these latter categories may reflect diagnostic blind spots rather than the absence of need – a pattern also observed in hazard assessments and monitoring systems, where “0 per cent” often meant omission rather than actual strength. The universality of policy integration gaps suggests it is the clearest entry point for assistance. Still, targeted support for financial and knowledge integration will be necessary to close systemic gaps that countries are not yet consistently diagnosing. Operational realities compound integration challenges. Even where coordination frameworks exist, countries struggle to secure the expertise, capacity and especially the targeted funding needed to make these systems effective.

Operational needs

Operational needs reflect the day-to-day requirements for implementing land degradation measures, from developing skilled personnel to ensuring adequate funding and modernized systems. The identified operational needs were clustered into several groups and are presented in Table 31.

Among these, targeted funding emerges as the most pressing and universal requirement. It was cited by 80 per cent of countries in the Americas, 86 per cent in Africa and 88 per cent in Asia-Pacific, with income groups showing an even stronger picture: 100 per cent of low-income, 88 per cent of lower-middle-income and 67 per cent of upper-middle-income countries in the sample flagged financial gaps. Both LDCs (83 per cent) and non-LDCs (86 per cent) reported similarly high levels, suggesting that access to sustainable funding remains one of the clearest operational bottlenecks across all contexts. This finding reinforces the earlier pattern seen in integration needs, where financial strategies were rarely mentioned explicitly, showing that while financial integration is often overlooked in planning, operational financing gaps are recognized everywhere as a substantial barrier.

Gaps in institutional capacity were also widely reported, particularly in Africa (71 per cent) and Asia-Pacific (75 per cent), compared with a more modest 40 per cent in the Americas. Income-level analysis shows that 80 per cent of low-income and 75 per cent of lower-middle-income countries cited limited institutional capacity, compared with 50 per cent of upper-middle-income countries, pointing to a heavy reliance on institutional strengthening in the early and middle stages of development. By denomination, 67 per cent of LDCs and 64 per cent of non-LDCs reported capacity challenges, highlighting that the challenge of ensuring governments have the structures and staff to manage land degradation is nearly universal, although more acute where institutional frameworks are underdeveloped.

Human expertise and technical enhancement needs were reported at lower but still meaningful levels. For expertise, 60 per cent of the countries in the Americas and 57 per cent in Africa flagged needs, while Asia-Pacific lagged at 38 per cent. This outcome aligns with income patterns, where 60 per cent of

Table 31: Types of operational needs reported

Type of need (% of countries reporting such operational needs)	Definition
Expertise (50%)	Needs for professional skills, specialized training and technical knowledge to improve disaster response
Institutional capacity (65%)	Needs to strengthen governance structures, coordination mechanisms and organizational effectiveness in disaster management
Targeted funding (85%)	Needs for timely, flexible and adequate financial resources to sustain disaster operations
Technical enhancements (40%)	Needs for upgraded tools, systems and technology to improve preparedness and response

low-income countries reported expertise gaps, falling to 33 per cent in upper-middle-income countries, suggesting that human capacity development is particularly urgent in less developed systems. Technical enhancement gaps, meanwhile, were noted by 60 per cent of countries in the Americas, 43 per cent in Africa and just 25 per cent in Asia-Pacific, with income levels again showing variation (40 per cent in low-, 25 per cent in lower-middle- and 50 per cent in upper-middle-income countries). The denomination breakdown shows 33 per cent of LDCs versus 43 per cent of non-LDCs, reflecting a slightly higher demand for modernization in more advanced systems.

The most striking pattern in operational needs is the nearly universal recognition of funding gaps. Unlike hazard assessments or monitoring systems, where methodological limitations dominate, the emphasis is clearly financial here. That said, institutional capacity and expertise also surface prominently, demonstrating that without stronger governance structures and skilled personnel, even well-financed systems may struggle to deliver. The overlap between operational funding needs and institutional issues highlights the need for comprehensive technical assistance that not only secures sustainable resources but also ensures that those resources can be effectively managed and deployed – the lack of funding and institutional capacity links directly to regulatory limitations. Countries consistently stress that without updated laws, land-use planning and clear DRM protocols, operational systems cannot function effectively.

Regulatory needs

Regulatory frameworks are essential to provide the legal and institutional foundation for land degradation risk management. The identified regulatory needs were clustered into several groups and are presented in Table 32.

Across regions and groups, gaps appear consistently in four areas: clear DRM protocols, climate risk assessments, land-use planning and regular law revisions. Among these, law revisions emerge as the most widely cited challenges, with 80 per cent of countries in the Americas, 86 per cent in Africa and 100 per cent in Asia-Pacific reporting needs. By income group, both lower-middle-income countries (100 per cent) and upper-middle-income countries (83 per cent) acknowledged shortcomings in updating laws, while 80 per cent of low-income countries reported the same. This outcome suggests a global challenge in keeping regulatory frameworks current with evolving knowledge and risks. Both LDCs (83 per cent) and non-LDCs (93 per cent) flagged this need, making it one of the clearest entry points for technical assistance.

Land-use planning was another frequently cited area of concern: 40 per cent of countries in the Americas, 71 per cent in Africa and 63 per cent in Asia-Pacific recognized deficiencies in incorporating risk considerations into land-use policies. By income level, needs were especially high in low-income countries (80 per cent), pointing to difficulties in aligning development planning with risk-sensitive practices. Similarly, 67 per cent of LDCs and 57 per cent of non-LDCs noted gaps, suggesting that while more advanced systems may have planning frameworks in place, challenges remain in enforcing or integrating them effectively.

By contrast, needs for clear DRR and DRM protocols were less frequently mentioned, by 40 per cent in countries in the Americas, 29 per cent in Africa and just 13 per cent in Asia-Pacific. Low- and lower-middle-income countries also reported lower levels (20 per cent and 13 per cent respectively) than upper-middle-income countries (50 per cent). This uneven pattern suggests that while protocols may formally exist, they may not always be fully operationalized or consistently applied.

Table 32: Types of regulatory needs reported

Type of need (% of countries reporting such regulatory needs)	Definition
Clear DRR and DRM protocols (25%)	Needs for defined procedures and mandates ensuring coordinated DRM
Climate risk assessments (15%)	Needs for comprehensive, data-driven assessments guiding adaptation and risk management strategies
Land-use planning (60%)	Needs for zoning, spatial regulation and settlement planning in hazard-prone areas
Regular DRR law revisions (90%)	Needs for continual review and updating of disaster laws and policies

Gaps in climate risk assessments were the least reported: 40 per cent in countries in the Americas, 13 per cent in Asia-Pacific and none in Africa. Similarly, 0 per cent of low-income countries and LDCs cited this as a need, which could be interpreted not as an absence of gaps but rather as a reflection of diagnostic blind spots. The fact that only 21 per cent of non-LDCs reported this issue suggests that while risk assessments are critical to informed policymaking, they are not yet systematically embedded into regulatory frameworks across contexts.

The most significant trend here is the dominance of law revision and land-use planning needs, both of which were consistently flagged across regions, income levels and country groups. This finding reinforces a recurring pattern: much as with operational needs, where funding gaps were nearly universal, in regulatory frameworks the absence of regular legal updates stands out as the most urgent and widely recognized barrier. Integrating climate risk assessments into these frameworks remains underreported but is no less critical, suggesting an important opportunity for targeted technical assistance to ensure that future revisions are evidence-based and risk-informed. Finally, these governance and legal gaps translate into concrete technical needs. Across all regions, the lack of functioning resources and targeted training stands out as nearly universal, while equitable access remains underreported, reflecting a persistent blind spot.

Technical needs

Technical needs are central to ensuring that land degradation measures can be implemented effectively, as they determine whether governments and institutions have the tools, equipment and training required to act. Three dimensions were assessed: equitable access, functioning resources and targeted training. Of these, needs in functioning resources and targeted training were the most prominent, while equitable access was rarely reported. The identified

technical needs were clustered into several groups and are presented in Table 33.

Across regions, 100 per cent of countries in the Americas and Africa highlighted the need for functioning resources, such as repaired equipment and maintained technical infrastructure, with 63 per cent of countries in Asia-Pacific also reporting this gap. For targeted training, the figures were similarly high: 100 per cent in the Americas and Asia-Pacific, and 86 per cent in Africa. By contrast, equitable access was barely mentioned, with 0 per cent of countries in the Americas and Africa reporting this need, and only 25 per cent in Asia-Pacific doing so. As with earlier findings, these 0 per cent values could be interpreted not as evidence of no underlying need; rather, they reflect omissions in documentation and the fact that equitable access is not yet systematically assessed or prioritized in reporting frameworks.

By income level, the same trend is clear: 100 per cent of low-income countries reported needs for functioning resources and targeted training, but 0 per cent for equitable access. Lower-middle-income countries identified slightly lower but still high levels – 75 per cent for functioning resources and 88 per cent for targeted training, while 25 per cent mentioned equitable access. Among upper-middle-income countries, 83 per cent reported needs for functioning resources, and 100 per cent for targeted training, but again 0 per cent for equitable access. This pattern suggests that while technical infrastructure and training are universally recognized gaps, the issue of equitable access – ensuring that all actors, including marginalized groups, benefit from these resources – remains overlooked.

The comparison between LDCs and non-LDCs reflects the same pattern. Both groups reported significant needs for functioning resources (83 per cent of LDCs and 86 per cent of non-LDCs) and targeted training (83 per cent of LDCs and 100 per cent of non-LDCs). Yet neither LDCs nor non-LDCs reported equitable

Table 33: Types of technical needs reported

Type of need (% of countries reporting such technical needs)	Definition
Equitable access (10%)	Needs ensuring fair availability of resources, services and information for all communities
Functioning resources (85%)	Needs for reliable infrastructure, equipment and systems to enable effective disaster response
Targeted training (95%)	Needs for specialized skills, capacity-building and awareness to strengthen preparedness and resilience

access at meaningful levels. This finding mirrors the broader underreporting of equity considerations seen across other measures, highlighting a blind spot in diagnostics that is especially concerning given that marginalized groups are often the most affected by land degradation.

The overwhelming recognition of needs in functioning resources and training, nearly universal across all categories, contrasts with the lack of reporting on equity. Taken together, these findings suggest that technical assistance could not only continue to prioritize the provision of equipment and targeted capacity-building but also deliberately address the equity dimension that countries are not yet consistently identifying. Without this, technical improvements risk reinforcing existing inequalities in access to resources and training.

3.5.4. Good examples of measure implementation

Hazard assessments – Colombia

The analysis of hazard assessments for land degradation shows persistent gaps in methodology, technical capacity and information management, with policy integration inconsistently recognized. These challenges are most pronounced in low- and lower-middle-income countries and LDCs, where underreporting reflects limited institutional and evaluative capacity rather than reduced vulnerability. Strengthening methodological rigour, building technical skills and improving information systems are therefore critical to making hazard assessments effective tools for risk reduction.

Colombia's experience with the World Overview of Conservation Approaches and Technologies and the Land Degradation Assessment in Drylands methodologies directly responds to these needs. By combining satellite observations with local knowledge and statistical validation, Colombia has developed assessments that are both technically robust and socially grounded. This approach addresses methodological transparency, ensures the use of comprehensive indicators and builds local capacity for producing validated and current hazard assessments.

Appropriate technical assistance could therefore involve Colombia sharing its expertise through peer learning, training and regional exchanges. Support could focus on helping countries strengthen methodological frameworks, integrate local and scientific data sources, and establish systems for transparent, validated hazard assessments. Such assistance would directly tackle the widespread

gaps in methodology and information management identified in Africa and among LDCs, while also helping to build the institutional capacity needed to sustain long-term monitoring and evaluation.

Ongoing monitoring systems – Uzbekistan and Uganda

Monitoring systems for land degradation show persistent limitations in methodology (43–83 per cent across regions and income groups) and coverage (up to 80 per cent in the Americas and 71 per cent in Asia-Pacific). Policy gaps are rarely reported, likely due to underdocumentation rather than absence. LDCs consistently underreport needs, reflecting limited institutional capacity. Overall, methodological shortcomings stand out as a systemic bottleneck, undermining hazard assessments, monitoring and long-term project tracking.

Uzbekistan addresses these gaps through the UNCCD Land Degradation Neutrality framework, combining normalized difference vegetation index (NDVI) satellite monitoring, land-cover data sets and soil carbon sampling to strengthen both coverage and methodological consistency. Uganda complements this with integrated socioeconomic and environmental monitoring, using global and local data sets alongside permanent sample plots to provide reliable, balanced indicators.

Drawing on these experiences, technical assistance could focus on peer-to-peer exchanges to share Uzbekistan's expertise in biophysical monitoring and methodological standardization, and Uganda's integrated socioenvironmental approaches. Together, they offer practical pathways for improving monitoring coverage, harmonizing methods and building institutional capacity, especially in LDCs.

Long-term project monitoring – Chile and India

The assessment of land degradation monitoring systems highlights persistent gaps in methodology (50–60 per cent across regions and income groups), alongside recurring challenges in coordination (25–40 per cent), capacity (17–38 per cent) and management (up to 50 per cent in low-income countries and 40 per cent in LDCs). Policy gaps are less frequently acknowledged but still present in Africa (17 per cent) and Asia-Pacific (13 per cent). Methodological limitations stand out as the most systemic barrier, repeatedly surfacing across hazard assessments, ongoing monitoring and long-term project tracking. This finding points to the absence of standardized, transparent and reliable approaches for evaluating interventions and aligning them with governance and policy frameworks.

Chile offers a model for bridging institutional and policy gaps through its online Sustainable Land Management monitoring system and decision-support platform. By embedding monitoring into national policies, Chile shows how environmental principles can be integrated with governance processes, directly responding to countries struggling to align monitoring with regulatory frameworks. India, in turn, addresses methodological and accountability gaps through social audits, third-party monitoring and its web-based Integrated Management Information System. These tools strengthen transparency, enable real-time oversight and ensure project data are both standardized and actionable.

Appropriate technical assistance could mobilize Chile's expertise in policy integration and institutional alignment alongside India's strengths in methodological transparency and digital monitoring platforms. Peer-to-peer exchanges, regional training and joint pilot projects could help other countries standardize long-term monitoring approaches, improve accountability and ensure that monitoring results are effectively linked to policy and planning. Together, these models directly address the core needs identified – methodology, coordination and management – while supporting countries in building monitoring systems that are consistent, transparent and policy-relevant.

Cross-cutting needs

Several countries have advanced land degradation management practices that together illustrate how integration, operations, technical capacity and regulatory frameworks can be strengthened – and how the Santiago Network could mobilize this expertise.

India has emerged as a leader in integrated approaches, through initiatives such as the National Innovations in Climate Resilient Agriculture and the National Agroforestry Policy. These programmes link agriculture, forestry, water and livestock management into coherent strategies, while projects such as the Mid-Himalayan Watershed Development Project demonstrate successful multi-level cooperation between government agencies, local communities, research institutions and non-governmental organizations. By combining participatory planning with GIS-based monitoring and innovative financial mechanisms, India shows how fragmented systems can be aligned to restore degraded land and improve livelihoods.

Ethiopia complements this with its long-standing experience in community-led, multisectoral approaches. Through the Sustainable Land Management Program and Managing Environmental

Resources to Enable Transitions, the country has built extensive field expertise in soil and water conservation, supported by institutional leadership from the Ethiopian DRM Commission. With financing from the World Bank, the International Development Association and the Productive Safety Net Programme, Ethiopia demonstrates how inclusive, community-driven restoration can be scaled when paired with ring-fenced financing and national coordination. Together, India and Ethiopia highlight how institutional capacity and grass-roots action can reinforce each other in tackling land degradation.

On the regulatory side, India has developed a robust framework through the National Policy on Disaster Management, the National Action Plan to Combat Desertification, and the recently updated Guidelines on Community-Based Disaster Risk Reduction. These instruments embed climate and land degradation risk into national planning, while GIS-based risk mapping tools ensure land-use decisions are hazard-informed. Kenya has also advanced its regulatory landscape through the Physical and Land Use Planning Act 2019 and its successive Climate Change Action Plans, which align spatial planning, zoning and risk assessments with resilience goals. Together, these frameworks show how law and policy can provide the institutional backbone for land degradation risk management.

Technical capacity is equally vital. India leverages its Desertification and Land Degradation Atlas and the Indian Space Research Organisation platform Bhuvan to provide practitioners and local authorities with geospatial data and training for monitoring and planning. Namibia – through initiatives such as the Namibia Integrated Landscape Approach for Enhancing Livelihoods and Environmental Governance to Eradicate Poverty and partnerships with the German Development Agency GIZ and the Namibia Biomass Industry Group – focuses on hands-on training and user-friendly tools such as biomass calculators, land-use manuals and cost-planning guides for farmers and restoration practitioners. These approaches demonstrate how technical systems can be kept functional, accessible and relevant to local users.

Taken as a whole, these experiences demonstrate that no single approach is sufficient, but each offers transferable lessons. By connecting the expertise of India, Ethiopia, Kenya and Namibia through peer-to-peer learning, the Santiago Network can help countries strengthen their land degradation management systems in ways that are both context-sensitive and grounded in proven practice.



4. Cross-hazard insights

This section analyses trends and patterns across all hazards, distinguishing between slow-onset and rapid-onset processes to highlight differences linked to their temporal characteristics. It is organized in two

parts: the first compares response patterns across DRM measures, while the second examines the cross-cutting needs that were directly enquired about for all hazards.

Key messages

- **Shared gaps.** Across hazards, only a few DRM measures – such as hazard assessments and awareness campaigns – are widely documented, while institutional learning and integration of Indigenous knowledge remain limited. These common challenges point to the value of hazard-agnostic technical assistance to strengthen governance, inclusivity and knowledge integration.
- **Hazard-specific differences.** Management of floods and cyclones shows stronger operational and institutional systems, while droughts face limited planning integration, sea level rise struggles to move from diagnostics to action, and land degradation emphasizes livelihoods but lacks recovery and infrastructure measures.
- **Temporal dynamics.** Management of slow-onset hazards (sea level rise and land degradation) stresses long-term planning and land-use regulation, whereas that of rapid-onset hazards (floods, cyclones and droughts) prioritizes early warning, relief and response. Assistance should reflect these different timelines.
- **Regional and income nuances.** Asia-Pacific stresses policy integration, whereas Africa highlights foundational gaps in financing and capacity. LDCs report fewer needs, likely due to limited diagnostic capacity, while higher-income countries emphasize advanced technical systems.
- **Implications for technical assistance.** DRM systems show both shared and hazard-specific needs. Technical assistance should combine hazard-agnostic approaches (e.g. policies, financing and capacity-building) with hazard-tailored interventions, adapted to regional, income and LDC contexts.

4.1. Presence, absence or unknown status of measures across all hazards

The survey of DRM measures across five hazards highlights both commonalities and differences. Out of 12 measures applied to all hazards (see Figure 9), only two – hazard assessments and public awareness campaigns – were documented in more than half of the countries, both linked to preparedness activities undertaken before an event. By contrast, integration of lessons learned into regulation and incorporation of Indigenous and traditional knowledge into DRM strategies and plans were far less frequently referenced. Floods recorded the highest number of responses across most measures, while sea level rise showed the lowest. Land degradation also showed relatively high reporting, although this may partly reflect the influence

of UNCCD land degradation neutrality plans, which consolidate extensive information without necessarily indicating stronger implementation.

Looking across hazards, differentiated needs emerge. For floods, policy integration (69 per cent) was relatively well documented, pointing to established institutional frameworks, but fewer references to livelihood programmes (45 per cent) and requests for international aid (27 per cent) suggest that social and financial aspects of preparedness remain less developed. Tropical cyclones showed high reporting of national response triggers and funding strategies (73 per cent each), reflecting strong operational readiness, but much lower levels of documentation for governance mechanisms such as institutional learning (9 per cent) and use of community knowledge (13 per cent). In droughts, hazard assessments were widely reported (74 per cent), yet integration into national planning (31 per cent) and uptake of

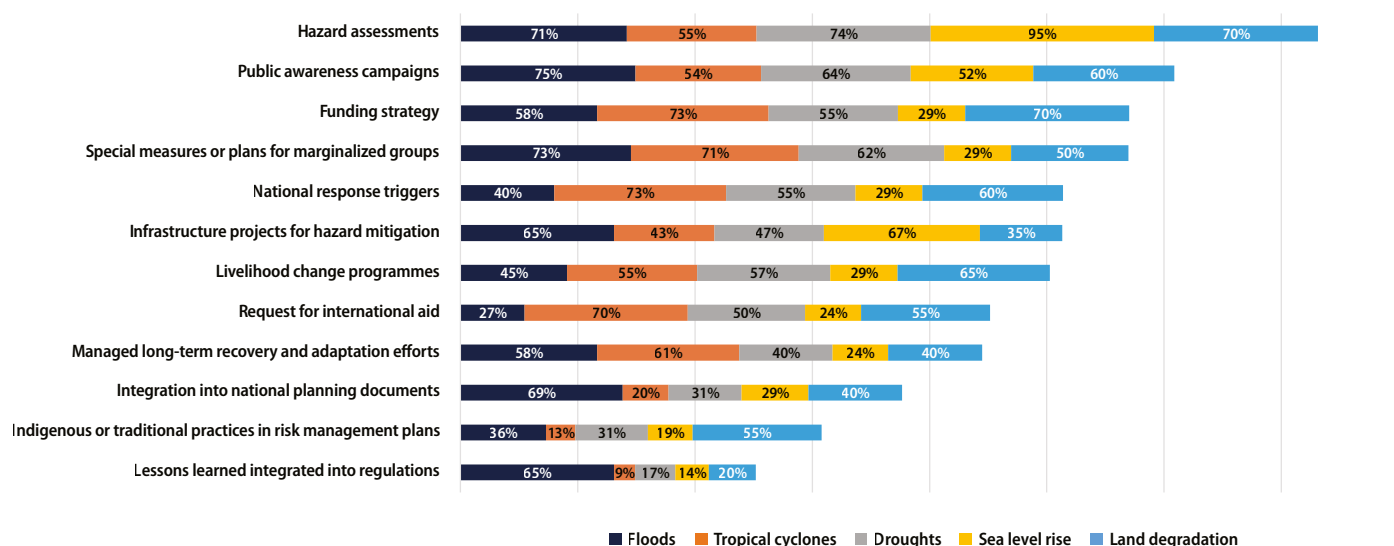


Figure 9: Surveyed measures for all five hazards

localized practices (31 per cent) were less frequent, underlining the challenge of embedding long-term and community-based responses for a slow-onset hazard.

Sea level rise presents a distinct profile: while nearly all countries report carrying out assessments (95 per cent), fewer than 30 per cent reference other measures such as funding strategies (29 per cent) or planning for marginalized groups (29 per cent). This imbalance suggests that while diagnostic work is progressing, there are persistent difficulties in translating recognition of the hazard into wider institutional or financial responses. Land degradation shows a more balanced but still uneven picture, with livelihood change programmes (65 per cent) and hazard assessments (70 per cent) relatively well covered, but fewer references to infrastructure

mitigation (35 per cent) and managed recovery (40 per cent), pointing to implementation constraints.

A closer look at the measures surveyed only for floods, tropical cyclones and droughts provides further insights (see Figure 10). Of the common measures examined, only three – EWS, distribution of relief supplies and relief centres – were reported in more than half of the countries. Patterns showed strong alignment between floods and tropical cyclones, reflecting both their rapid-onset nature and the frequent link between cyclones and flooding. Droughts, by contrast, showed fewer references to such emergency-focused measures, consistent with their slower progression and longer time frames. These findings suggest that in areas exposed to both cyclones and floods, responses are often addressed

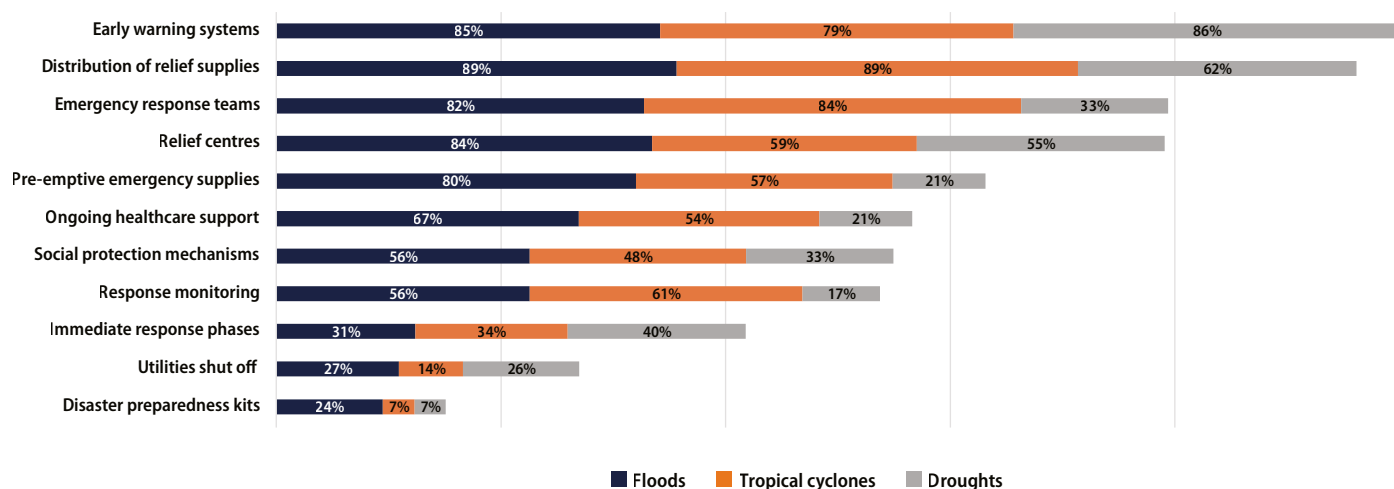


Figure 10: Surveyed measures for floods, tropical cyclones and droughts

in a combined manner rather than through separate systems. In such contexts, technical assistance could help build multi-hazard approaches that strengthen complementary measures such as utility shut-off and preparedness kits, where fewer references were found.

Taken together, the findings point to significant variation in the maturity of DRM systems across hazards. Floods and cyclones are comparatively well documented in operational and institutional measures, while droughts and especially sea level rise reveal more limited evidence of integration into governance and financing. Land degradation shows higher reporting overall, although this may not always reflect greater practical application. More broadly, the limited reporting of institutional learning and integration of Indigenous knowledge across most hazards highlights systemic challenges in embedding experience and local practices into DRM systems. Addressing these gaps will require both hazard-specific support – for instance, financing for sea level rise, governance strengthening for cyclones or planning integration for droughts – and cross-cutting assistance that reinforces institutional learning, inclusivity and community knowledge, while promoting multi-hazard strategies where risks overlap.

4.2. Cross-cutting needs assessment

In addition to the measure-specific questions, the survey included open questions on integration, operational, regulatory and technical needs across all hazards. As expected, these needs were more frequently identified in the documents reviewed through RAG than the individual measures. Figure 11 shows the distribution of these needs, which appears more even across hazards compared with Figure 8, where differences were more pronounced.

As explained in Section 2.2, all survey responses on cross-cutting needs were analysed manually, and the identified needs were clustered into groups. These clusters were not identical across hazards; this section highlights those that were common to all.

Integration needs

Three clusters were identified as common to integration needs: (i) cooperation and coordination; (ii) knowledge; and (iii) policy. While the specific issues within each cluster varied, the overall themes were consistent. Policy-related needs were the most frequently reported, with land degradation showing the highest share and sea level rise the lowest. Regionally, Asia-Pacific had the largest number of countries referencing policy needs, while Africa had the fewest. No major differences were observed across income groups, although LDCs reported considerably fewer than non-LDCs.

Cooperation-related needs were referenced less frequently overall and were relatively evenly distributed across regions, with the Americas reporting slightly more. However, notable differences emerged among hazards: floods and sea level rise were associated with fewer references to cooperation compared with the other hazards. Knowledge- and skills-related integration needs were expressed at a much lower rate than the other two clusters, with little variation by region, income level or country group. The main distinction appeared between hazard types, with rapid-onset events (floods, tropical cyclones and droughts) receiving fewer references than slow-onset processes (sea level rise and land degradation).

These findings have direct implications for technical assistance. The fact that policy integration is a common priority across hazards suggests scope for shared approaches, such as the development of model regulatory frameworks or coordination platforms that can be adapted to different contexts. At the same

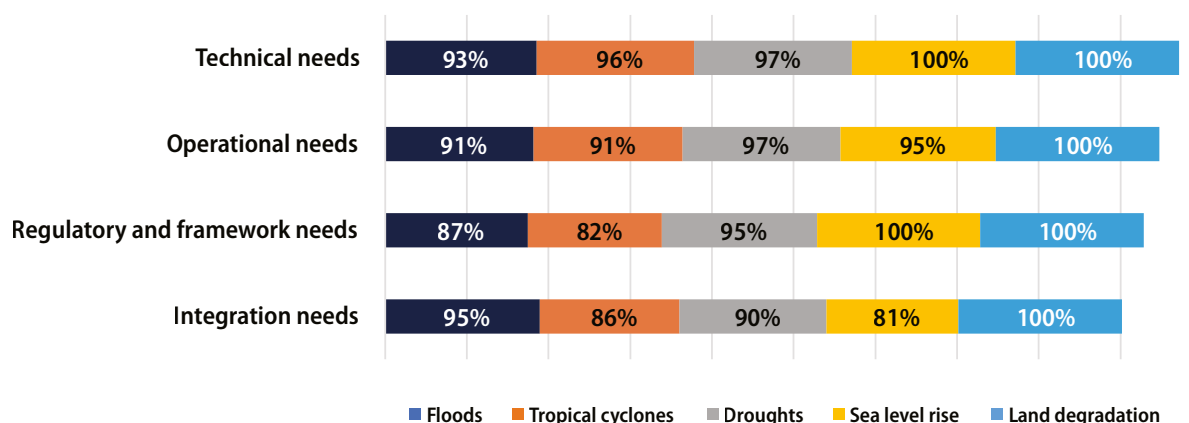


Figure 11: Cross-cutting needs identified across hazards

time, differences in how cooperation and knowledge needs appear across hazards point to areas where more tailored interventions are required – for example, strengthening cooperative mechanisms for rapid-onset hazards, or building long-term knowledge and skills for slow-onset processes such as sea level rise and land degradation. Regional patterns also matter: the relatively high emphasis on policy in Asia-Pacific compared with Africa suggests the need for differentiated support, with the former focusing on policy refinement and the latter on foundational system-building. Similarly, the lower reporting by LDCs indicates potential constraints in documenting or institutionalizing needs, underscoring the importance of providing not only technical solutions but also support for capacity to identify and articulate priorities.

Operational needs

For operational needs, four common clusters were identified across all hazards: targeted funding, institutional capacity, expertise and technical enhancements. Among these, targeted funding emerges as the most frequently mentioned, while technical enhancements are the least. Differences appear not only between hazards but also across regions and income groups, pointing to the importance of both shared and tailored approaches to strengthening operational systems.

Targeted funding was referenced most often in relation to land degradation and tropical cyclones, whereas floods and sea level rise were associated with fewer mentions. Africa presents an exception: all countries in the sea level rise sample identified funding as a critical need. This suggests that while the prominence of financial requirements differs by hazard, funding challenges remain a widespread concern, particularly in resource-constrained contexts.

Institutional capacity needs were documented most frequently for floods and least frequently for droughts and sea level rise. Again, Africa appears as an outlier, with fewer references to institutional capacity for sea level rise compared with other regions. This variation may reflect differences in the ability to identify and document needs rather than their actual prevalence, as institutional gaps are likely to affect all hazards.

Operational expertise was more often reported for floods and droughts. Differences by income group were notable: LDCs cited more expertise-related needs for floods than non-LDCs, while the opposite was true for droughts, where non-LDCs identified more needs. This suggests that LDCs may have a clearer understanding of operational gaps for rapid-onset hazards, whereas non-LDCs may be better positioned to recognize expertise needs in managing slow-onset processes.

Technical enhancements – such as upgraded tools, systems and technologies to improve preparedness and response – were less frequently documented overall. However, they featured more prominently in relation to tropical cyclones and in non-LDCs, where nearly all countries referenced them – almost three times as often as in LDCs. This indicates that more advanced technical improvements tend to be prioritized where baseline systems are already in place.

Taken together, these findings suggest that technical assistance could combine common approaches with hazard- and context-specific support. The consistency of funding and institutional capacity needs across hazards highlights the potential for shared solutions, such as developing financial strategies and institutional strengthening programmes that can be adapted to multiple contexts. At the same time, the differentiated reporting points to areas requiring tailored interventions – for example, advanced technical systems for cyclone-prone countries or sustained financing for land degradation responses. Regional and income-group variations further underline the need for flexible assistance models: African countries and LDCs often emphasize foundational needs, while non-LDCs focus more on upgrading tools and systems. Ensuring that technical assistance reflects both common priorities and context-specific conditions will be key to building effective and equitable operational capacity.

Regulatory needs

Regulatory needs in DRM systems show both common patterns across hazards and important differences linked to hazard type, region and country group. Land-use planning emerged as the most widely reported regulatory priority, particularly for slow-onset processes, while other needs – such as building code enforcement and revisions of DRM/DRR systems – were reported more unevenly. These patterns highlight how regulatory frameworks form a cornerstone of DRM, but the focus and depth of needs vary significantly across contexts.

Land-use planning was the most consistently identified need, especially in relation to land degradation and, to a lesser extent, sea level rise. Overall, low- and lower-middle-income countries were more likely to emphasize this requirement, while for sea level rise, it was more often highlighted by non-LDCs than LDCs. This reflects both the importance of spatial planning for managing long-term risks and the varying capacities of countries to integrate such measures into their regulatory systems.

Beyond land-use planning, countries also called for revisions of DRM and DRR systems. Such needs

were documented across regions and income groups, though they were most pronounced in Africa, LDCs and low-income countries, where regulatory and institutional foundations are less established. In the Americas and Asia-Pacific, land-use planning again featured strongly, pointing to demand for embedding spatial considerations into national DRM frameworks. Calls for stronger or updated building codes were most frequent in Africa, LDCs and countries affected by sea level rise, underlining the global significance of safe construction standards and the institutional frameworks that support them.

The emphasis on climate risk integration was most apparent for slow-onset processes. Countries reporting on land degradation and sea level rise consistently highlighted the need to incorporate climate risks into laws, standards and planning instruments. For sea level rise, coastal planning was identified as a particularly critical element of future risk reduction. By contrast, rapid-onset hazards such as floods placed greater emphasis on resilience measures, especially through improved construction standards and building codes designed to reduce the impacts of sudden events.

These findings suggest that technical assistance could adopt a dual approach, combining shared and hazard-specific strategies. The broad demand for land-use planning and stronger building codes points to opportunities for cross-hazard initiatives, such as developing model policies, training programmes and regional exchanges. At the same time, hazard-specific priorities require tailored solutions – for example, coastal planning for sea level rise or hazard-sensitive construction standards for floods. Regional and income-group variations also call for differentiated support: while higher-income and non-LDC countries may benefit from refining existing regulatory systems, low-income countries and LDCs often need foundational assistance to establish basic laws, frameworks and enforcement mechanisms.

Technical needs

Two common clusters of technical needs were identified across hazards: functioning resources and targeted training. Both were reported at similar levels overall, although training needs were referenced more frequently for land degradation than for other hazards. In contrast, needs in training and functioning resources were less commonly reported for floods.

References to functioning resources – covering reliable infrastructure, equipment and systems for effective disaster response – were more common for tropical cyclones, particularly in high- and upper-middle-income countries, while they were less frequently mentioned in low- and lower-middle-income contexts. Overall, functioning resource needs were cited more often by non-LDCs than LDCs.

Training and skills development emerged as the most consistently reported need across hazards, regions, income groups and country categories. In low-income countries and LDCs, the emphasis was largely on building the capacity of front-line responders, while in high-income countries and non-LDCs, the focus shifted towards specialized technical staff. Needs related to system reliability and functioning resources were broadly referenced in Africa and Asia-Pacific, and among low- and lower-middle-income groups, underscoring their importance across diverse contexts. References to equity and inclusive access were less common; when they did appear, they were most often associated with LDCs. This may indicate underreporting in other contexts, rather than the absence of such needs, pointing to opportunities to more systematically integrate equity and inclusion into technical assistance frameworks.

These findings suggest that technical assistance could combine shared approaches with hazard- and context-specific support. The widespread reporting of training needs across all hazards highlights the potential for common capacity-building initiatives that can be tailored by region and income group – for example, focusing on front-line responder training in LDCs and low-income countries, while prioritizing specialized technical expertise in higher-income settings. Similarly, the demand for functioning resources points to opportunities for shared infrastructure and system-strengthening programmes, although hazard-specific support is needed where demands differ, such as cyclone-prone contexts where advanced equipment and systems are particularly critical. Regional and income-level variations further highlight the need for differentiated approaches: countries in Africa and Asia-Pacific emphasize basic system reliability, while non-LDCs focus more on technological upgrades. By reflecting these similarities and differences, technical assistance can address common needs efficiently while also ensuring that hazard- and context-specific priorities are met.



5. Conclusion

The objective of this report has been to provide the secretariat of the Santiago Network for loss and damage with concrete examples of technical assistance that can strengthen national DRM systems in relation to key climate hazards. The report aims to support the Santiago Network OBNE mobilization strategy, underscoring key technical assistance opportunities and contrasting them with examples of success cases of countries minimizing and addressing loss and damage.

To achieve this, the report applied a two-stage methodology. First, a comprehensive database was constructed by combining the outcomes of the regional scoping workshops on loss and damage under the Santiago Network with systematically extracted documentary evidence. A RAG system was used to process nearly 1,600 country-hazard documents, producing structured, citation-linked outputs that were subsequently verified by human review and triangulated with survey responses. Second, the enriched database was analysed through four steps: (i) a structural assessment of DRM measures; (ii) a needs analysis of specific measures; (iii) identification of good practices; and (iv) a cross-hazard analysis to distinguish hazard-specific from systemic challenges. This combination of approaches ensured both consistency across countries and hazards, and depth in identifying actionable opportunities.

The key messages emerging from this analysis point to both hazard-specific and cross-cutting opportunities for technical assistance. Rapid-onset hazards such as floods and cyclones require strengthened forecasting, last-mile communication, surge logistics and inclusive shelter systems. Slow-onset hazards such as sea level rise and land degradation demand long-term governance integration, standardized monitoring and embedding of pilots into laws, budgets and policy frameworks. Across all hazards, systemic gaps are evident in policy integration, institutional capacity, financing alignment and equity considerations. These findings indicate that the Santiago Network could pursue a dual strategy: supporting hazard-agnostic measures that strengthen governance, knowledge systems and institutional frameworks, while simultaneously facilitating hazard-specific interventions adapted to distinct temporal and regional contexts.

Concrete opportunities for the Santiago Network include drawing on peer-to-peer expertise from countries already demonstrating robust DRM practices. For example, OBNEs from Bangladesh and the Philippines can support improvements in EWS; OBNEs from India and the Philippines provide models for inclusive relief centres; OBNEs from Cuba and Mozambique offer lessons in long-term adaptation planning; and OBNEs from Mauritania, Ethiopia and Chile present scalable approaches for livelihood resilience and land restoration. By strategically engaging such OBNEs, the Santiago Network can enhance its network, create avenues for South-South learning and provide targeted technical assistance that builds on existing national strengths.

At the same time, the approach used here can be further strengthened. The RAG system relied on documents publicly available online, often from repositories such as PreventionWeb, which means coverage was uneven and, in some cases, limited. Direct access to official government documents – laws, strategies or technical reports – would significantly increase the accuracy, granularity and policy relevance of the outputs. Similarly, the questionnaires used for the workshop surveys could be refined and expanded in future iterations by drawing on the expertise of the Santiago Network and its Board, ensuring closer alignment with evolving country priorities and technical requirements.

Finally, it is important to emphasize that this approach was designed to complement, not substitute, the country-led processes of the Santiago Network. The insights generated here aim to enhance the Santiago Network's ability to respond effectively to country needs by providing a structured evidence base and identifying potential OBNE partners. They do not replace national decision-making or shape priorities on behalf of countries, but rather support the Network in delivering timely, targeted and relevant assistance in line with its mandate.

Annex 1. Categorization of sample countries

Country/Territory	Region	Income group	Special denomination	Floods	Drought	Tropical cyclones	Sea level rise	Land degradation
Antigua and Barbuda	Americas	High	SIDS	X		X		
Argentina	Americas	Upper-middle	—		X			X
Bahamas (The)	Americas	High	SIDS			X		
Bangladesh	Asia-Pacific	Lower-middle	LDC	X	X	X	X	X
Barbados	Americas	High	SIDS	X		X	X	
Belize	Americas	Upper-middle	SIDS			X		
Benin	Africa	Lower-middle	LDC	X				
Bhutan	Asia-Pacific	Lower-middle	—					X
Bolivia (Plurinational State of)	Americas	Lower-middle	—	X				
Botswana	Africa	Upper-middle	—		X			
Brazil	Americas	Upper-middle	—	X	X	X		
Cambodia	Asia-Pacific	Lower-middle	LDC	X	X	X		
Chile	Americas	High	—		X			X
China	Asia-Pacific	Upper-middle	—					X
Colombia	Americas	Upper-middle	—	X	X	X		X
Comoros (the)	Africa	Lower-middle	SIDS, LDC			X	X	
Costa Rica	Americas	Upper-middle	—	X		X		
Cuba	Americas	Upper-middle	SIDS	X		X	X	
Dominica	Americas	Upper-middle	SIDS			X		
Dominican Republic (the)	Americas	Upper-middle	SIDS	X	X	X		
Ecuador	Americas	Upper-middle	—	X				
Egypt	Africa	Lower-middle	—					

Country/Territory	Region	Income group	Special denomination	Floods	Drought	Tropical cyclones	Sea level rise	Land degradation
El Salvador	Americas	Lower-middle	—	X	X	X		
Ethiopia	Africa	Low	—	X	X	X		X
Fiji	Asia-Pacific	Upper-middle	SIDS			X	X	
Grenada	Americas	Upper-middle	SIDS			X		
Guatemala	Americas	Upper-middle	—					X
Guinea Bissau	Africa	Low	SIDS, LDC	X	X		X	
Guyana	Americas	Upper-middle	SIDS			X		
Haiti	Americas	Low	SIDS, LDC	X		X	X	
Honduras	Americas	Lower-middle	—	X	X	X		
India	Asia-Pacific	Lower-middle	—	X	X	X		X
Indonesia	Asia-Pacific	Upper-middle	—	X	X	X	X	
Iran (Islamic Republic of)	Asia-Pacific	Lower-middle	—	X	X			
Iraq	Asia-Pacific	Upper-middle	—		X			
Jamaica	Americas	Upper-middle	SIDS	X		X		
Kazakhstan	Asia-Pacific	Upper-middle	—	X	X			
Kenya	Africa	Lower-middle	—					X
Kiribati	Asia-Pacific	Lower-middle	SIDS, LDC	X	X	X	X	
Lao People's Democratic Republic (the)	Asia-Pacific	Lower-middle	LDC	X	X	X		
Liberia	Africa	Low	LDC	X				
Madagascar	Africa	Low	LDC	X	X	X		X
Malawi	Africa	Low	LDC	X	X	X		X
Malaysia	Asia-Pacific	Upper-middle	—	X	X	X		
Maldives	Asia-Pacific	Upper-middle	SIDS			X		
Mali	Africa	Low	LDC		X			
Marshall Islands (the)	Asia-Pacific	Upper-middle	SIDS			X		
Mauritania	Africa	Lower-middle	LDC	X	X			
Mauritius	Africa	Upper-middle	SIDS	X	X	X	X	
Mexico	Americas	Upper-middle	—	X	X	X		

Country/Territory	Region	Income group	Special denomination	Floods	Drought	Tropical cyclones	Sea level rise	Land degradation
Micronesia (Federated States of)	Asia-Pacific	Lower-middle	SIDS		X	X	X	
Mongolia	Asia-Pacific	Lower-middle	—	X	X			X
Morocco	Africa	Lower-middle	—	X	X			
Mozambique	Africa	Low	LDC	X	X	X		
Myanmar	Asia-Pacific	Lower-middle	LDC		X	X		
Namibia	Africa	Upper-middle	—	X	X			X
Naoero	Asia-Pacific	High	SIDS		X		X	
Niger (the)	Africa	Low	LDC	X				
Oman	Asia-Pacific	High	—	X	X	X		
Palau	Asia-Pacific	High	SIDS			X		
State of Palestine (the)	Asia-Pacific	Lower-middle	—		X			
Panama	Americas	Upper-middle	—	X	X	X		
Papua New Guinea	Asia-Pacific	Lower-middle	SIDS			X		
Paraguay	Americas	Upper-middle	—	X	X			
Peru	Americas	Upper-middle	—	X				X
Philippines (the)	Asia-Pacific	Lower-middle	—	X	X	X		X
Saint Lucia	Americas	Upper-middle	SIDS		X	X	X	
Saint Vincent and the Grenadines	Americas	Upper-middle	SIDS	X	X		X	
Samoa	Asia-Pacific	Lower-middle	SIDS		X	X	X	X
Senegal	Africa	Lower-middle	LDC	X	X			
Seychelles	Africa	High	SIDS		X	X	X	
Solomon Islands	Asia-Pacific	Lower-middle	SIDS, LDC			X	X	
Somalia	Africa	Low	LDC	X	X	X		X
South Africa	Africa	Upper-middle	—	X	X	X		
Sri Lanka	Asia-Pacific	Lower-middle	—		X	X		
United Republic of Tanzania (the)	Africa	Lower-middle	—	X	X	X		
Thailand	Asia-Pacific	Upper-middle	—	X	X	X		
Timor-Leste	Asia-Pacific	Lower-middle	SIDS		X	X	X	

Country/Territory	Region	Income group	Special denomination	Floods	Drought	Tropical cyclones	Sea level rise	Land degradation
Togo	Africa	Low	LDC	X	X			
Tokelau	Asia-Pacific		SIDS					
Tonga	Asia-Pacific	Upper-middle	SIDS		X	X	X	
Trinidad and Tobago	Americas	High	SIDS	X	X	X	X	
Uganda	Africa	Low	LDC					X
Uruguay	Americas	High	—	X	X			
Uzbekistan	Asia-Pacific	Lower-middle	—					X
Vanuatu	Asia-Pacific	Lower-middle	SIDS				X	
Venezuela (Bolivarian Republic of)	Americas	Upper-middle	—	X	X			
Viet Nam	Asia-Pacific	Lower-middle	—	X	X	X		
Yemen	Asia-Pacific	Low	LDC	X	X	X		
Zambia	Africa	Lower-middle	LDC	X	X	X		
Zimbabwe	Africa	Lower-middle	—	X	X	X		

Sample countries by special denomination

	Floods	Drought	Tropical cyclone	Sea level rise	Land degradation
SIDS	8	11	23	14	1
LDC	15	14	10	1	5
SIDS, LDC	3	2	4	5	0
None	29	31	19	1	14
Total	55	58	56	21	20

Sample countries by income group

	Floods	Drought	Tropical cyclone	Sea level rise	Land degradation
High	5	6	7	4	1
Upper-middle	20	20	22	7	6
Lower-middle	19	23	20	8	8
Low	11	9	7	2	5
Total	55	58	56	21	20

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