

Introduction

The Coalition for Disaster Resilient Infrastructure (CDRI) is a platform set up with the aim of galvanizing action by national governments, international development and financing institutions, private sector, academia and civil society to strengthen the resilience of new and existing infrastructure. This endeavour surfaced a number of questions on the lexicology of key concepts that shape and focus the conversations around disaster resilient infrastructure (DRI). What comprises infrastructure? Does a single standpost in rural flood-prone hinterland qualify as infrastructure? Does the provision of boats for telecom operators so that they can supply fuel to run generator sets that power telecom towers during city-wide floods have anything to do with resilience? What about the designed failure of smaller power installations in the path of a cyclone to secure the integrity of the larger network? What is the difference between the established domain of “disaster risk (reduction) finance” and the emerging domain of “disaster resilience finance”? What is meant by “system of systems” with reference to infrastructure and what is the relevance of this approach for promoting resilience?

There are existing glossaries developed by experts within the international community that support the disaster risk and climate change domains, but there are gaps in explaining how the central concepts in these domains apply specifically to infrastructure. This gap led to the practical imperative of building upon the foundational work in those glossaries, to develop a globally accepted “Lexicon for Disaster Resilient Infrastructure”.

It is now well recognized that “disaster risk” is mostly systemic in nature and that development must be risk-informed to be sustainable. This has significant implications on the ongoing effort to achieve the 17 United Nations Sustainable Development Goals (SDGs), many of which have a direct relationship with infrastructure development.

For instance, SDG 7 (Access to affordable and clean energy), SDG 9 (Building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation) and SDG 11 (Making cities and human settlements inclusive, safe, resilient and sustainable) can be best realized if countries take a resilience approach to infrastructure development. Other SDGs that can be achieved through disaster resilient infrastructure investments are SDG 3 (Good Health and Well-being), SDG 12 (Responsible Consumption and Production) and SDG 13 (Action to Climate Change and its Impacts). Many of these SDGs also have strong positive correlations with each other (Fonesca et al., 2020 and Krellenberg & Koch, 2021).

In 2015, the Sendai Framework for Disaster Risk Reduction (SFDRR) was endorsed by the UN General Assembly. The SFDRR recognizes that to meet the SDGs there is a need to minimize disaster damage to critical infrastructure and disruption of services, by developing their resilience. SFDRR has seven strategic global targets that directly or indirectly depend on access to resilient infrastructure.

Targets (a) and (b) are aimed at achieving substantial reductions in global disaster mortality and the number of people affected globally in the decade 2020-2030 compared to 2005-2015. Target (c) is aimed at reducing disaster economic loss in relation to gross domestic product (GDP) by 2030. Meeting these targets is contingent on infrastructure development being resilient and providing uninterrupted critical services. Finally, Target (d) has a direct interest in promoting DRI as it explicitly seeks to reduce substantial damage to critical infrastructure and disruption of basic services, by developing resilience.

The Paris Agreement is a legally binding international treaty on climate change. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels

(UNFCCC, 2015). Resilient infrastructure systems must respond to the climate mitigation agenda while simultaneously increasing social equity, public health, and human well-being (IPCC, 2022). The whole idea of “resilience” of infrastructure hinges on the adaptation of infrastructure development to future climate scenarios.

Our vision for the DRI Lexicon Project is to provide a common and consistent set of reference definitions that apply the core concepts of resilience, sustainability, risk and disaster risk management (among others) to infrastructure; and in so doing, to help countries and their stakeholders to use the opportunity of DRI to achieve the SDGs, deliver on the expectations of SFDRR, and fulfill the mandates of the Paris Agreement.

A glimpse into the complex world of DRI

Access to infrastructure is foundational to the human pursuit of greater well-being. It provides better, faster and more equitable access to economic and social development. By its very nature, infrastructure works like a network: it has both nodes and connections. It can be lineal, when dealing with services such as energy, transport, communications, potable water and sewage; or point located when dealing with education, health, and government services. It can be provided by government, the private sector, or civil society and/or a community for itself.

Infrastructure operates at different spatial scales, i.e., it can serve local, regional, national, or international markets or demands. No matter the scale of planned provision, most infrastructure is linked in some way to systems that serve other scales (for example, local road networks and local health frameworks link to regional and national scale service provision; while national road, energy, or telecommunication networks link at the international level).

Thus, most infrastructure is constituted as systems; particular systems link to other service systems in many ways. For example, some lineal service systems follow similar land routes and even use similar underground access. Energy, water and sewerage systems link to the needs of different point-located service providers. Some service-generating infrastructure can have multiple users and demands such as hydroelectric energy providers where dams and associated infrastructure also serve to control water supplies for irrigation and flood control downstream. Whichever way we look at it, infrastructure, together with the services it provides, is a complex, systemic endeavor, requiring advanced planning and execution.

Infrastructure, along with its services, is tightly connected to development and economic growth. On the one hand, infrastructure provides a means for growth and development (human, economic, environmental, etc.). On the other hand, the level and quality of development and economic growth have significant impact not only on the scale and quality of infrastructure, but also on the levels of differential access to the services it provides. Economic growth, as well as human and social development, can only be promoted and permanently expanded and improved if infrastructure systems and the services provided are safe and secure, and if they include provisions for redundancy. The measure of success of an infrastructure system is its ability to provide quality services to a broad and egalitarian-based market. Such an infrastructure system should not only be well-maintained and cared for, but also be permanently in expansion and improvement, and safe against possible interruptions and damage due to foreseen or unforeseen disaster triggers such as earthquakes, floods, civil unrest, war, or even financial crises.

This is why any discussion of infrastructure systems and the services they provide must connect with the broader well-established vocabularies

of human, social and economic development, and their modalities, and challenges. Themes of sustainability, resilience, resistance, crisis and disaster, quality, equality and inclusion, are among the most prevalent. These are all themes that the overall concept of DRI must encapsulate as well. Sustainability underpins the notion of resilience conceptually and practically, and the idea of resilience is firmly related to themes such as disaster risk management, adaptation to climate change, innovation, and transformation.

While development provides the backdrop, crises and disasters are increasing in impact and saliency, as we encounter more complex hazard contexts and try to deal with the growing exposure and vulnerability of people, businesses, and territories. However, we remain more reactive than proactive in our response. Post-impact crisis or disaster interventions and planning take up increasing amounts of finance and human energy in disaster response and reconstruction. While the call for “build back better” is common, in practice we do not follow this practice often enough, and our financial outlays remain largely reactive, increasing rapidly over time, and failing to promote sustainable recovery and transformation. Such processes increase social inequality, and vulnerable groups often remain the most susceptible to disaster risk and its consequences.

This renews the call for the more proactive approaches of risk-safe development, risk prevention and risk mitigation, rather than simply focusing on response and reconstruction. An emphasis on sustainability and resilience is at the center of such efforts, and infrastructure and service provision are key to their attainment.

Methodology of developing the Lexicon

In a multidisciplinary field such as DRI, a lexicon can serve as a boundary object – that is, function as a

bridge between different specialist communities to provide shared meanings and common ground so that they can collaborate effectively. In this sense, the DRI Lexicon can be a valuable instrument for promoting consistency and common understanding for use by the public, by governments, by specialists in different domains, and by practitioners from different disciplines. CDRI’s goal with the Lexicon is to facilitate the creation and use of a common vocabulary on key terms and concepts of the DRI field. Its objectives include:

- to consolidate a more systematic, comprehensive, and consistent understanding of the domain;
- to promote effective communication and coordination across multiple stakeholder groups; and
- to support research, learning, and the creation and sharing of new knowledge in a rapidly developing field of practice.

This resonates with CDRI’s aim to work collaboratively with partners and stakeholders to co-create a common and internationally recognized knowledge resource, accommodating broadly agreed definitions and facilitating a common understanding of the DRI terminologies while respecting their multidisciplinary origins.

The process of creating this kind of Lexicon posed a number of challenges:

- This is a wide, multidisciplinary field – how should we set boundaries and define its scope, and set criteria for inclusion or exclusion?
- There are multiple potential beneficiaries who would find such a resource useful – which beneficiary groups would benefit most, how might they use the Lexicon, and what features should it have to benefit them?
- What kind of balance should we strike between promoting standard, generalized terms and

definitions, while also respecting the specificity of the many diverse contexts in which DRI concepts are applied (disciplinary, geographic, socioeconomic)?

- How do we balance the need for breadth and comprehensiveness, with the pragmatic goal of getting a core Lexicon out within a defined timeframe, while also ensuring that it has a structure that can be scaled?

These were addressed in the Lexicon through a co-creation approach. Over a period of 10 months (from April 2022 – January 2023), the panel of subject matter experts identified from the government, the private and non-profit sectors, and academia representing different geographies and varied disciplines including engineering and architecture, spatial planning, finance, social sciences and knowledge management engaged with the CDRI Secretariat to develop the definitions of priority terms relevant for DRI. The group began by identifying key notions and concepts now in use for DRI. As an initial entry point, the group referred to the CDRI's stated objectives, and listed 270 terms that were potentially relevant, relatable to these objectives, and to CDRI's priority programmes and action areas. Some other terms such as sustainable development that are relevant but did not require further interpretation/explanation for DRI have not been included in the DRI Lexicon for ease of reference by users.

While the panel focused on just the DRI aspect of this complex picture, they defined and annotated the concepts included here against that larger picture of sustainable and resilient infrastructure. More generic concepts are explained or annotated in relation to how they manifest in an infrastructure context. Terms relating to specific aspects of infrastructure are connected to the broader themes of disaster resilience, sustainability, and systems. The hope of the CDRI panel is that users of the Lexicon will be able to appreciate how DRI

connects to a much broader landscape, and why it is so important that our colleagues working in infrastructure do plan and implement with those connections in mind.

As a method for focusing on the most relevant terms, the working group characterized use cases for different potential users of the Lexicon. A range of specific use cases was mapped out, relating to different stakeholders within the infrastructure, disaster resilience, and climate resilience domains. The panel developed different scenarios of activities performed by the stakeholders, with example task descriptions to illustrate how the stakeholders might want to use the DRI Lexicon, and what features would be valuable to them. This mapping exercise helped the working group to consider how the DRI Lexicon can respond to users' requirements, and it generated insights into additional features providing added value. For example, it became clear that for several user groups, it would be valuable to map associations between terms, so that users might be directed from one term and definition to another term and definition, and thereby use the Lexicon to build up an understanding of the DRI landscape. The use cases also helped the working group to determine which terms would be most useful to different types of users.

The working group then discussed and ranked what would make good indicators of the quality and usefulness of the terms and definitions, and decided they should be comprehensive, complete, unambiguous, simple, and – where relevant – indicating to users where there are important context-specific variations in understanding or interpretation. The working group used a poll to select five initial types of users for the first phase of the Lexicon. The chosen user types were: (i) Academia and research think tanks; (ii) Multilateral development banks and infrastructure banks; (iii) professional practitioners; (iv) government institutions; and (v) NGOs undertaking DRI and reconstruction work.

With these user groups in mind, the working group was asked to rank terms from the original master list as follows:

- “low priority” (terms that already have widely understood standard definitions, so it is not clear how the Lexicon would add value);
- “medium priority” (terms that have definitions in the literature but their definitions need enhancement to contextualize them to DRI, or terms that are necessary in order to make the Lexicon comprehensive); and
- “high priority” (terms which do not currently have standard widely-accepted definitions but which represent important concepts in the DRI domain for these user groups).

To provide assurance of completeness and comprehensiveness, the idea of “buckets” was used to classify the medium and high priority terms into subject areas. Besides ensuring coverage of the whole domain and identifying gaps, this was a helpful method for thinking about how related terms could be grouped together, making connections between them, associating new terms and definitions with established ones, and linking them with other terms which were placed in other “buckets”. In a sense, these “buckets” provided a form of mental scaffolding designed to ensure the Lexicon is comprehensive, has no obvious gaps, and can be scaled in multiple directions that guides its development and will not be obvious to the Lexicon’s users.

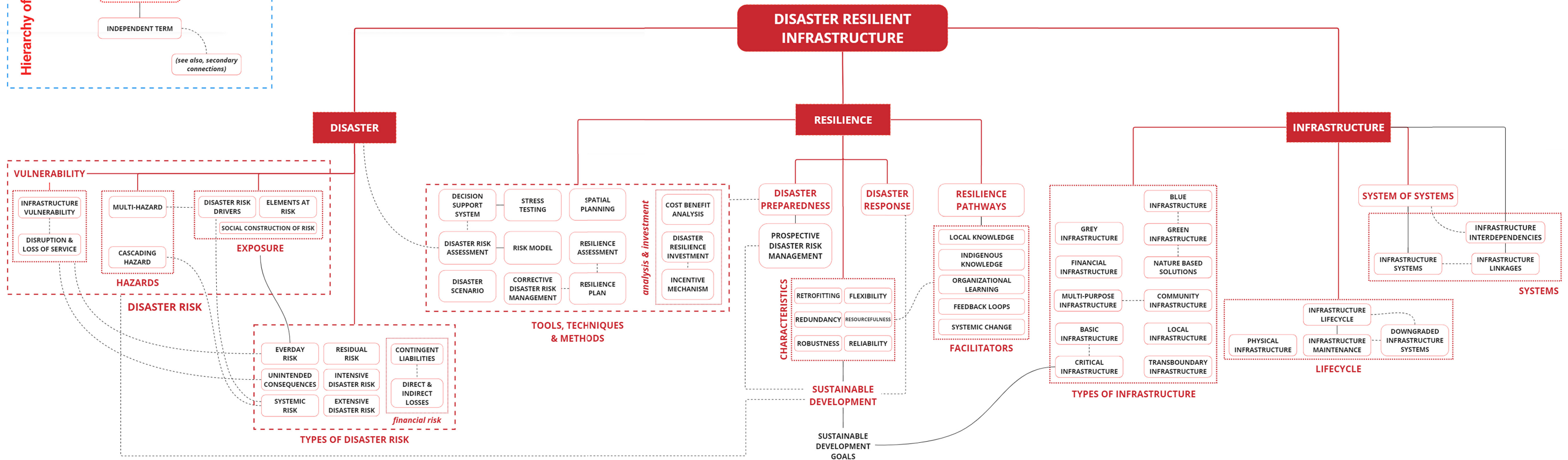
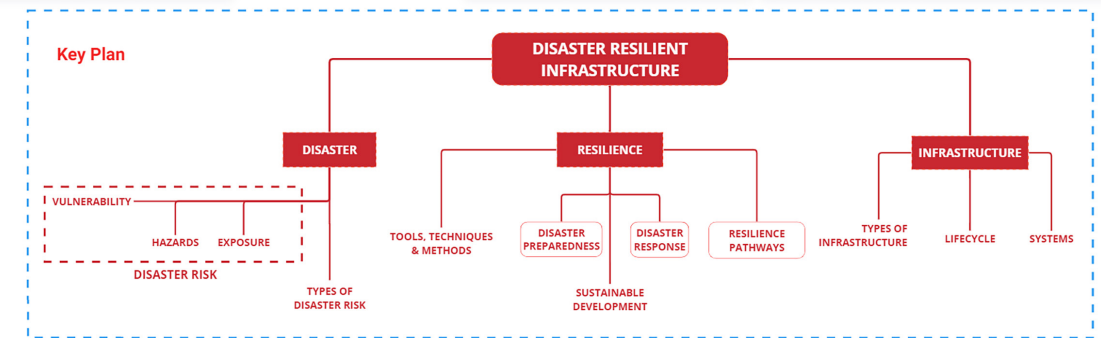
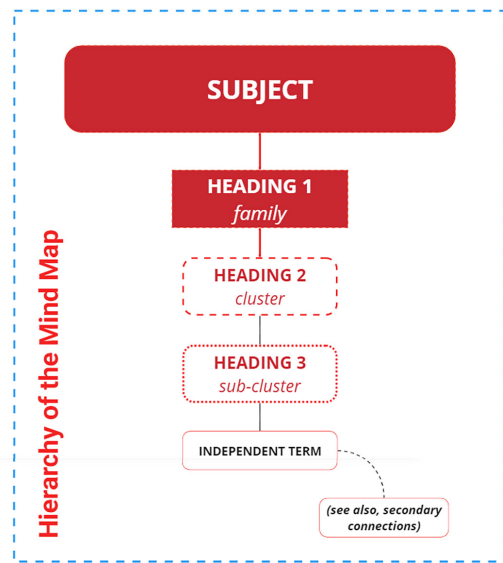
The “buckets” guiding the Lexicon are concepts relating to:

- Analyzing or evaluating risk and its components
- Decision-making criteria and methods for disaster risk management (DRM) and resilience

- Disaster impacts and effects (realized risk)
- Learning, capacity, and capacity building
- Resilience policy, planning and strategy
- Resilient infrastructure components and goals
- Risk factors and components with respect to infrastructure
- Risk: characteristics, attributes and process
- Social actors and people-centred approaches
- Types of actions and instruments for DRM, climate change action, and resilience

Following the classification of terms into the buckets according to their priority, the list was narrowed down or in some buckets supplemented to 116 terms. The CDRI staff and working group identified, drafted or fine-tuned definitions for each term, examining various existing definitions and suggesting whether to merge them, to select one definition over others based on its relevance to DRI, or to adapt or re-write them. Towards this end, it was a conscious endeavour to not duplicate terms and their definitions that were already widely accepted and did not require redefinition from a DRI perspective. Documents such as the UNDRR Sendai Framework Terminology on Disaster Risk Reduction, Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) Glossary served as easy references for this purpose. Where applicable, adequate references have been provided; at all other places definitions have been drafted by the Working Group as part of CDRI’s Lexicon Project.

The final coverage of terms in this Lexicon evolved to grouping around “Disaster”, “Resilience” and “Infrastructure”.



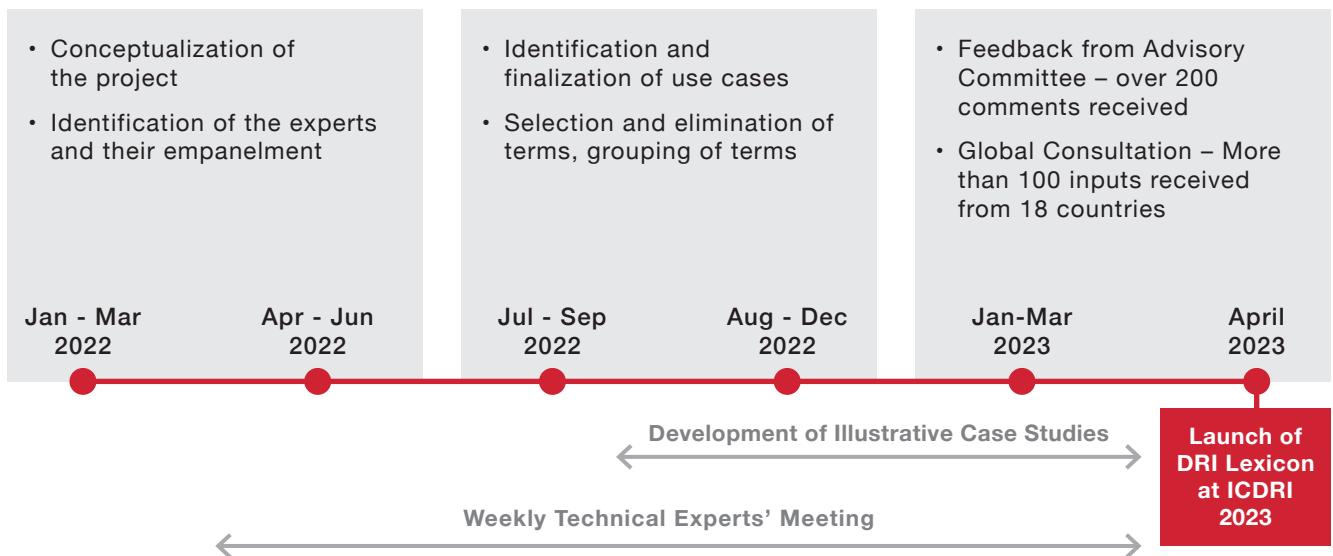
In the process of developing the Lexicon, it became obvious that these terms are not merely neutral or technical, but also represent values, priorities, approaches, and political stances. Terms may acquire different meanings, depending on whether they are considered from a macroeconomic perspective, explored as part of an inequality debate, or examined from a social or community-based approach. By integrating such differentiations into the term definitions, the working group highlights the (often competing) interests and priorities of the multiple social actors and stakeholders involved, and this underscores the fact that the meanings of terms in usage are socially constructed as well as changing and evolving over time.

This fluidity highlights the important role of the definitions and their accompanying notes in providing contextual guidance and linking concepts together, so that users of the Lexicon can build up a nuanced and useful understanding of the domain and its various actors. While the principle was and is to begin with widely accepted and authoritative definitions that have already been through some form of consensus building or peer review process, if it is to deliver value to its users, the Lexicon must also add contextually relevant remarks, and help users to understand the broader landscape of DRI.

For example, we use infrastructure as a broad category to include green/grey/blue infrastructures(s) as well in relation to nature-based solutions. Upon defining the terms and phrases in their broad categories, we have added notes to show linkages between concepts, as well as examples and applicable concepts to strengthen each term. We recommend that each term be read considering the accompanying notes and cross-references to maximize its applicability. Like terms and definitions, the notes are also searchable in the online version of the Lexicon.

The Lexicon has benefitted from the strategic guidance and inputs by an Advisory Committee, consisting of representatives from member organizations of the Coalition including the Asian Development Bank (ADB), The World Bank, United Nations Office for Disaster Risk Reduction (UNDRR) and members of the Appraisal and Steering Committee (ACS) for CDRI Knowledge Initiatives. Over 185 strategic inputs were received which were discussed and incorporated by the Experts Panel. Following which, the final draft compilation of terms and their working definitions were put out for Global Consultation to receive feedback from professionals and practitioners with all levels of understanding about disaster resilience and infrastructure, across the world. Over 100 comments were received from 18 countries during the Global Consultation.

MILESTONES



The DRI Lexicon and its relevance

The Lexicon is intended to strengthen a common conceptual understanding of infrastructure-related terms and phrases. It provides a set of globally applicable references to concepts and phrases that can provide a better understanding of the domain, act as a guide to research and understanding, and aid in infrastructure-related decision making of governments, academia and financial institutions, among others.

The DRI Lexicon:

- May be used as a starting point for incorporating preparedness, response, or recovery-related concepts and actions within infrastructure projects, and that are often not currently included in action plans. For example, to create initial awareness of the value of disaster resilience finance within projects.
- Should help standardize concepts between agencies, governments, institutions, etc.

Its adoption will be key in encouraging clear, concise, and comprehensible communications and understanding between organizations at local, national, and international levels.

- Will be capable of being applied by search engines, analytical software, and other information technology, in addition to being used as a dictionary resource.
- Can be a powerful tool that not only simplifies and clarifies concepts but communicates their inter-relationships and their intended use. Rather than being viewed as simply a list of terms and their textbook definitions, it must be emphasized that the notes, annotations, and examples and references included here are intended to enhance the reader's ability to understand and apply the topics in a practical and integrated way.

We hope to see the Lexicon adopted and used as it was intended, to bring people together to work and build knowledge effectively around one of the most pressing challenges of our time.