1 Ensuring infrastructure resilience to natural disasters is a global priority

As climate change continues to alter natural hazard patterns, there is an urgent need to strengthen infrastructure resilience to natural disasters. Technology, data and collaboration, enabled by adequate financing, investment, technical expertise and regulatory frameworks, are key to increase prevention, reaction and rebuilding capacities. While building resilience to natural disasters is a global challenge, developing countries, particularly Small Island Developing States (SIDS) and Least Developed Countries (LDCs) are among the most vulnerable and require targeted support. Increased international partnerships and enhanced efforts from development banks are imperative to bolster infrastructure resilience in developing countries and support their journey towards sustainable development.

Introduction

Natural disasters are extreme events caused by natural processes of the Earth. They include phenomena such as earthquakes, tsunamis, hurricanes, tornadoes, floods, wildfires, volcanic eruptions, landslides and droughts. These events are characterised by their sudden onset and unpredictability, making preparedness, mitigation, and response efforts essential for minimising their impact on the economy and society.

In the absence of effective prevention, reaction and rebuilding capacities, these events can result in significant damage to existing assets and impact on human lives, profoundly affecting the economy and society. Often, it is the poorest people and areas that endure the most severe consequences.

This introductory chapter of the *Compendium of Good Practices on Quality Infrastructure 2024* outlines the global priority of considering resilience to natural disasters in infrastructure projects. It underscores the relevance and urgency of this issue, particularly in developing countries and it provides a framework to guide policy actions aimed at ensuring infrastructure resilience to natural disasters.

This edition of the Compendium focuses on competitiveness-related infrastructure (e.g. transport and digital networks, energy systems) (Box 1.1). This choice is due to two main reasons: first, these infrastructures play a pivotal role in enabling growth and in shaping the economic attractiveness and development potential of a given location in national, regional and international markets; second, both advanced and developing economies face major pressures to upgrade and update these infrastructures. In particular, advanced economies need to upgrade their existing infrastructure to make it resilient to natural disasters. Conversely, developing countries face the pressure to close their infrastructure gaps to sustain their development and industrialisation aspirations. It is essential to undertake this task in a way that prevents them from being locked-in to poor-quality infrastructure, with limited capacity to withstand the growing impact of natural disasters.

Box 1.1. Defining competitiveness-related infrastructure

Competitiveness-related infrastructure refers to assets, facilities and systems that have a direct effect on the economic performance and competitive capabilities of a given location. It includes transportation networks (roads, ports, airports, railways), energy facilities (power plants, grids), telecommunication networks and data centres.

Source: Authors' elaboration.

Competitiveness-related infrastructure plays a crucial role in determining international competitiveness and local development opportunities. Ensuring that competitiveness-related infrastructure is resilient to climate change and to natural disasters is essential to foster sustainable growth, business development, foreign direct investment, innovation, and a seamless flow of goods and services.

This chapter is structured in three sections. The first outlines the growing risks associated with natural disasters, the second identifies the three areas in which governments, the private sector and civil society need to develop capabilities to ensure infrastructure resilience to natural disasters: prevention, reaction and re-building. The third section identifies the drivers and enablers of preparedness and response efforts, notably: data, collaboration and technology, enabled by adequate financing, investment, technical expertise and a comprehensive regulatory framework.

Natural hazards are rising in frequency and intensity

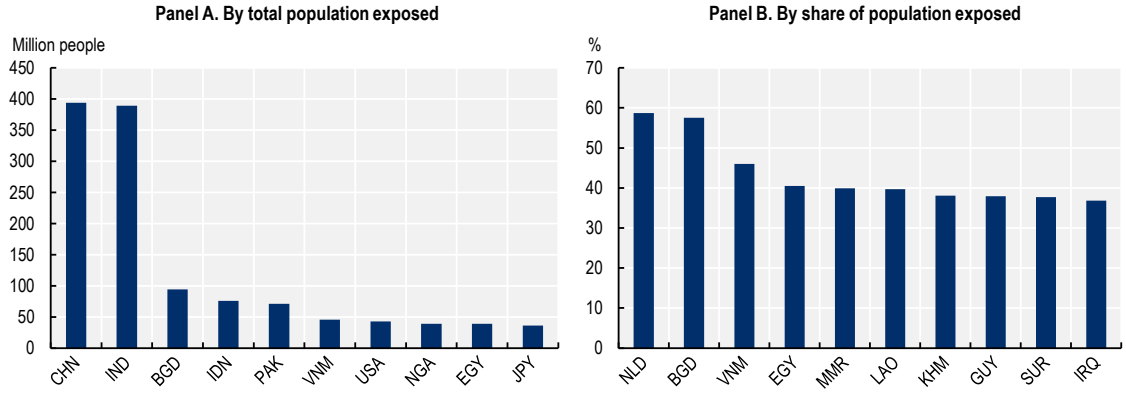
The world is witnessing an increase in the frequency and intensity of natural hazards, mostly due to climate change, which is affecting extreme weather event patterns across the globe. The number of reported natural disasters more than doubled during 2000-19 compared to the previous two decades (UNDRR, 2020[1]). In Japan, the Japan Meteorological Agency has documented a notable increase in the frequency of heavy rain events, partly attributed to the rise in sea surface temperatures (JMA, 2023[2]). Notably, flood damage statistics, particularly in 2019, surged to a record high, amounting to JPY 2 180 billion (Japanese Yen) (USD 16.5 billion) (MLIT, 2021[3]). This figure underscores the pressing need for resilient infrastructure capable of mitigating the adverse effects of such disasters.

While the rise in frequency and intensity of natural hazards is growing globally, developing countries are particularly affected due to the compound effect of multiple factors.

- **Geographic vulnerability.** Many developing countries are located in regions prone to climate-related hazards, such as coastal areas susceptible to hurricanes and typhoons, or regions prone to floods, droughts, hurricanes and heatwaves, which are exacerbated by climate change (Figure 1.1).

Figure 1.1. Developing countries are particularly exposed to floods, 2020

Top 10 countries with highest exposure to floods, by exposed population and by share of exposed population to national total, 2020

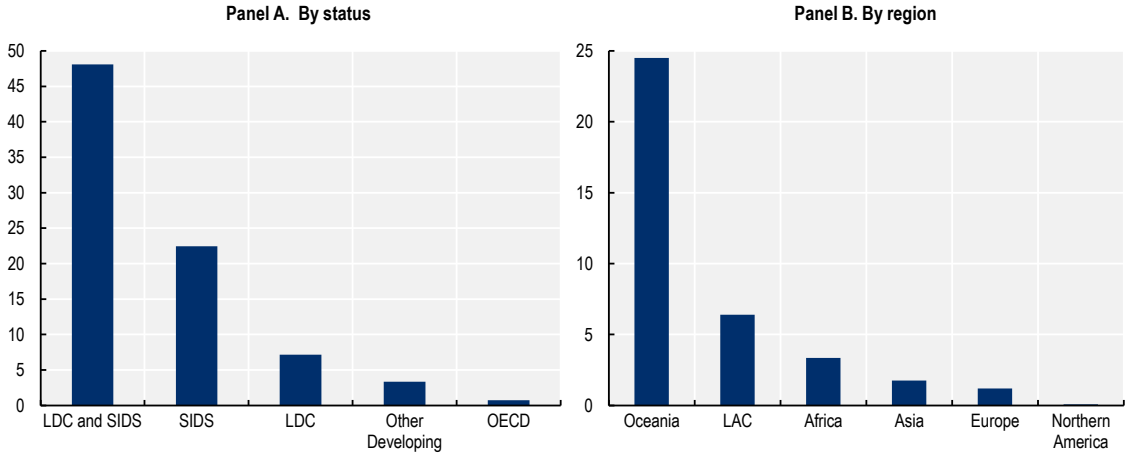


Note: People directly exposed to inundation depths of over 0.15 meters in the event of a 1-in-100-year flood. It considers people's exposure to all current flood risks—that is, pluvial, fluvial and coastal flooding.
Source: Authors' elaboration based on Rentschler, Salhab and Jafino (2022[4]), *Flood exposure and poverty in 188 countries*, https://doi.org/10.1038/s41467-022-30727-4

- **Climate change vulnerability.** Among the developing countries, Small Island Developing States (SIDS) and Least Developed Countries (LDCs) are those most severely affected by climate change (IPCC, 2022[5]). Between 2000 and 2020 SIDS and LDCs exhibited an average of 23 and 7 natural disasters per 1 000 square kilometres, respectively (Figure 1.2). This translates to between 10 and 30 times more disasters compared to OECD countries.

Figure 1.2. SIDS and LDCs have the highest global exposure to climate change and natural disasters

Average number of natural disasters per 1 000 sq Km, 2000-20

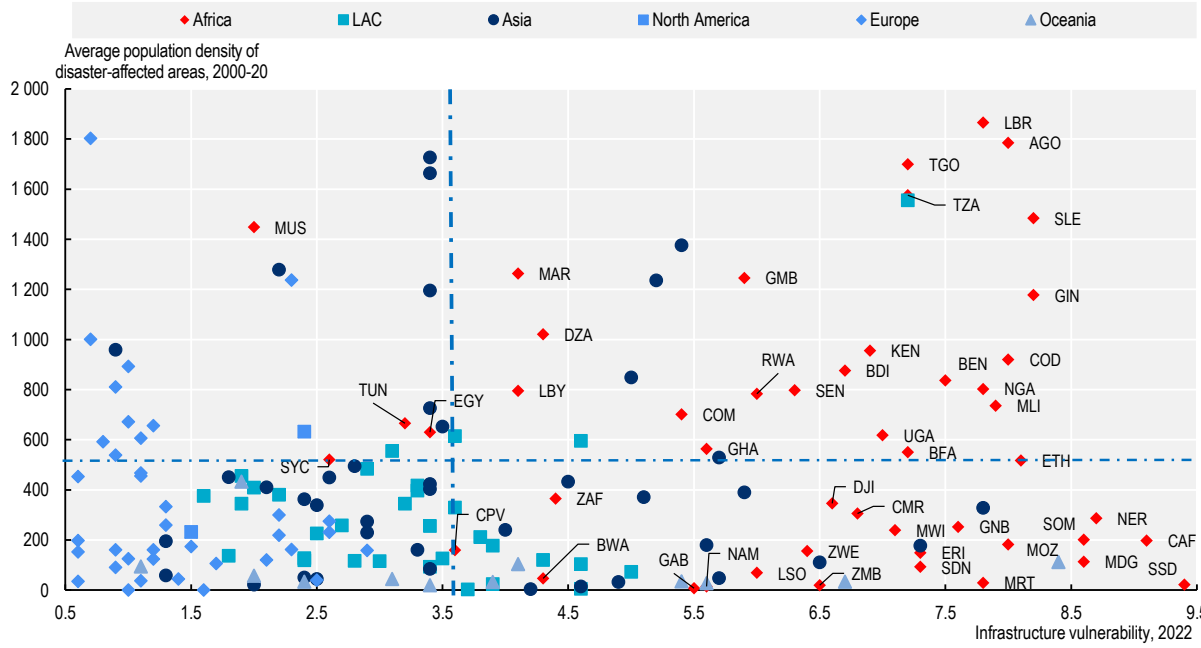


Note: Panel A. 1) The categories are not mutually exclusive 2) Other Developing countries include all DAC recipient countries that are non-LDCs including low middle-income and upper middle-income countries. Analysis follows the UN Geographical and Income Classification System https://unstats.un.org/unsd/methodology/m49/.
Source: Authors' elaboration based on EM-DAT (2023[6]), *International Disaster Database*, https://www.emdat.be/ and World Bank (2023[7]), *World Development Indicators*, https://data.worldbank.org.

- **Economic vulnerability.** Developing countries tend to be **dependent on sectors and activities highly influenced by natural disasters. For instance,** they rely heavily on climate-sensitive sectors such as agriculture, fisheries, forestry and tourism. Natural disasters, exacerbated by climate change, can strongly affect these sectors, leading to food insecurity, loss of income and economic instability.
- **Poor infrastructure.** The vulnerability of developing countries to natural disasters is exacerbated by the high population density of the most affected areas and poor infrastructure. This is particularly evident in Africa where natural disasters occurred in areas with high or very high infrastructure vulnerability, as measured by the European Commission's INFORM index (Figure 1.3). Climate-resilient infrastructure is in even shorter supply in developing countries. This is infrastructure that is planned, designed, constructed and operated in a way that anticipates, prepares for and adapts to the changing climate, while it can withstand and recover rapidly from disruptions caused by changing climatic conditions throughout its entire lifetime. It concerns new assets and existing ones, which may need to be repurposed or operated differently to account for climate change impacts (OECD, 2018[8]).

Figure 1.3. Poor infrastructure coupled with population density increases vulnerability to natural disasters

Average population density of areas most affected by natural disasters and infrastructure vulnerability, 2000-20

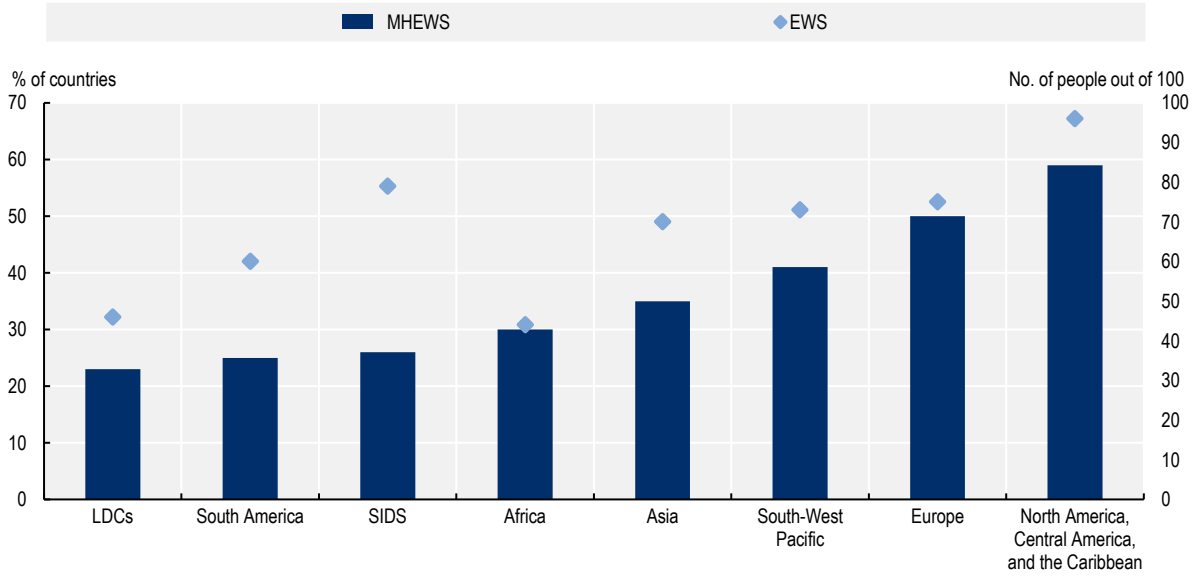


Note: The dotted lines reflect the global averages of the respective variables. The average population density is calculated within a 1 km radius of the disaster event. Infrastructure vulnerability is the normalised arithmetic average of three categories that give equal weight to 11 indicators including: access to electricity, internet users, adult literacy, road density, access to water sources, access to health facilities, health expenditure per capita, and population density. It takes a value between 1 to 10, with 10 being the most vulnerable.
Source: OECD/UN/UNIDO/ITC (forthcoming[9]), *Production Transformation Policy Review of Togo*, based on INFORM GRI 2022: Index for Risk Management. European Commission 2022, https://drmkc.jrc.ec.europa.eu/inform-index and SEDAC Gridded Population of the World, Version 4 (GPWv4), https://cmr.earthdata.nasa.gov/search/concepts/C1597158029-SEDAC.html.

- **Limited access to early warning systems.** Most developing countries lack access to timely and accurate climate information and early warning systems, hindering their ability to prepare for and respond to natural disasters. Inadequate infrastructure and limited institutional capacity to address risks upfront and react to disasters, coupled with high population density of the areas most affected by climate change-related natural disasters further impede effective disaster risk management. Developing countries have limited capacities in the use of early warning systems (EWS) and multi-hazard early warning systems (MHEWS). MHEWS address multiple hazards simultaneously and are key to increasing countries' prevention capacities. Only 11 LDCs have a MHEWS in place, and 46 out of 100 people are covered by EWS. In terms of regions, South America has the lowest share of countries reporting the existence of a MHEWS (25%), followed by Africa (30%) (Figure 1.4). Innovative technologies can further maximise the investments in EWS infrastructure. For instance, artificial intelligence (AI) can assist in developing early warning systems for extreme weather events, enabling better preparedness. In particular, EWSs can help in identifying and assessing vulnerabilities in communities and infrastructure, provide real-time information on weather patterns, and improve the accuracy and precision of climate models, allowing for more effective policy responses (Jain et al., 2023[10]).

Figure 1.4. Developing countries lag behind in access and use of early warning systems (EWS)

EWS coverage (number of people out of 100, secondary axis) and MHEWS coverage (share of countries, primary axis), 2019



Note: EWS: Early warning systems; MHEWS: Multi-hazard early warning systems.
Source: Adapted from WMO (2020[11]), *2020 State of Climate Services: Risk Information and Early Warning Systems*, WMO-No. 1252.

- **Financial constraints.** Developing countries face important resource shortages and the cost of access to capital is relatively higher for them, hindering their ability to build quality infrastructure (OECD, 2022[12]; Lardé, 2021[13]; ICA, AfDB and NEPAD-IPPF, 2022[14]). Closing the financing gaps for quality infrastructure in developing countries is crucial to build, adapt and operate the necessary infrastructure to support their development in a forward-looking manner. Targeting investment to the right areas and projects, and mobilising private resources will be crucial to advance towards sustainable, inclusive and resilient growth models.

Preventing, reacting and re-building capacities are key areas to ensure infrastructure resilience to natural disasters

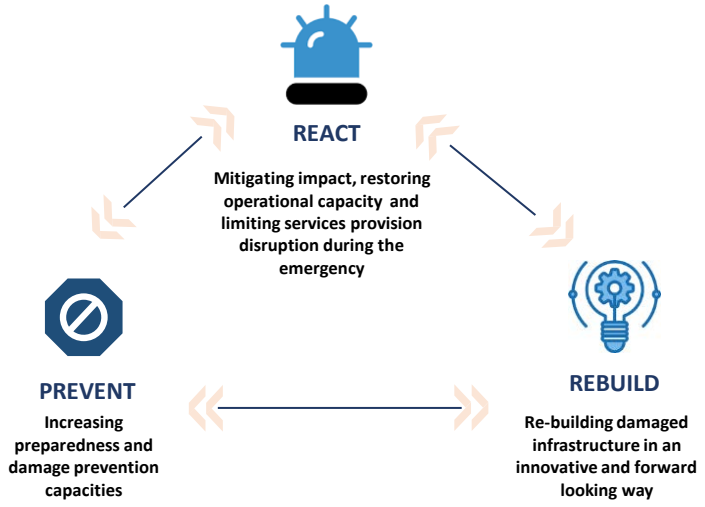
As the intensity and frequency of natural disasters increases, it is of pivotal importance to increase infrastructure resilience to natural hazards (OECD, 2024[15]). Governments, the private sector and civil society will have to pay attention to three key and interconnected areas (Figure 1.5):

- **Preventing**: This area is linked to actions, tools and physical characteristics of the infrastructure that enable damage prevention and/or minimisation of the impact of natural disasters, including disaster risk assessments from the early stage, disaster risk management, early warning systems, social safety nets, strategic preventive maintenance as well as structural measures and novel infrastructure designs, including construction of levees for flooding. Increasing anticipation capacities in governments is a key factor, as current modelling tools need to be updated to take into account the impacts of climate change.
- **Reacting:** This area is linked to the actions taken and tools used in response to a natural disaster to restore operational capacity and mitigate service provision disruption, by providing short-term

countermeasures such as alternative infrastructure options and services. This also includes regulatory and economic instruments that facilitate the implementation of disaster risk management in a timely manner, including access to emergency finance for the swift recovery of social and economic functions and services to minimise the severity and duration of disruption.

- **Re-building:** This area is linked to actions, tools and plans, including changes in the physical characteristics of the infrastructure that shape how the disrupted infrastructure is rebuilt in effective, efficient and forward-looking ways. It also includes the building of new infrastructure assets, as well as the repurposing of existing infrastructure done in a forward-looking and disaster-resilient way. This includes deployment of advanced, efficient and low-emission technologies, changes to infrastructure design, actions to protect and restore ecosystems and new forms of stakeholders' engagement to ensure that re-building efforts go beyond the traditional restoration logic and allow for innovation and improvements in resilience, access and quality of the infrastructure.

Figure 1.5. A three-pillar action framework for infrastructure resilience to natural disasters

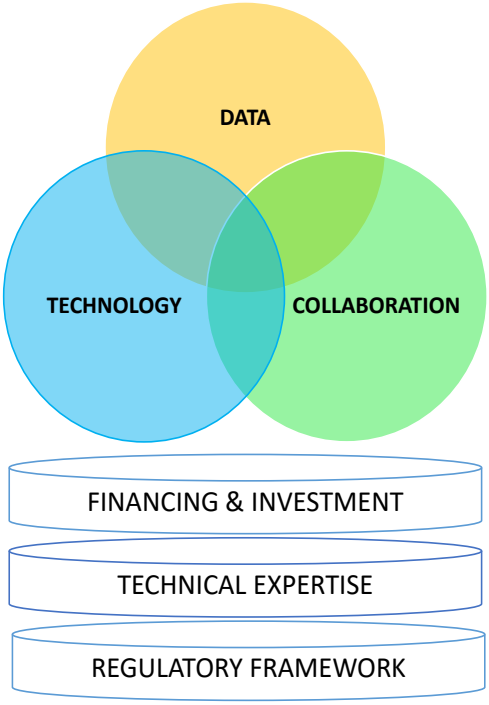


Source: Authors' elaboration.

Collaboration, data and technology shape the effectiveness of prevention, reaction and rebuilding efforts

Three factors are pivotal in determining the effectiveness of prevention, reaction and re-building efforts: collaboration, data and technology. These factors are highly context-specific and are enabled by adequate financing and investment, technical expertise, and regulatory frameworks (Figure 1.6). Together these drivers and enablers form the foundation for building infrastructure resilience to natural disasters. By ensuring adequate funding, harnessing technical knowledge and skills, and implementing robust regulatory frameworks, communities can best leverage on collaboration, technology and data to develop infrastructure that is better able to withstand and recover from the impacts of natural disasters, ultimately enhancing the safety, sustainability and resilience of their economic development pathways.

Figure 1.6. Drivers and enablers of prevention, reaction and re-building efforts



Source: Authors' elaboration, based on the discussions held during the 2nd preparatory meeting for the Compendium of Good Practices on Quality Infrastructure - Thematic Focus: Planning, Financing, and Building Infrastructure Resilient to Natural Disasters that took place on 7 September 2023.

Collaboration enables the mobilisation of funding sources and technical assistance through partnerships, reduces the financial burden on individual stakeholders, and facilitates the transfer of knowledge and best practices. Moreover, clear allocation of responsibilities across actors ensures streamlined decision-making and implementation processes, leading to more robust and adaptive infrastructure systems. Effective collaboration among stakeholders from diverse sectors and countries is essential for pooling resources, sharing expertise, and co-ordinating efforts to enhance prevention, reaction and re-building efforts (Box 1.2).

Technology shapes resilience in preparation, construction, operation and maintenance. New materials influence infrastructure resilience. Digital technologies enable advanced monitoring, real-time data analytics and predictive capabilities that can help identify vulnerabilities, assess risks and respond swiftly to emerging threats. Through the integration of smart technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and machine learning (ML), infrastructure becomes more adaptive and self-modifiable, capable of autonomously responding to changing environmental conditions and potential hazards (Box 1.2).

Data, underpinned by high-quality information and analysis, serves as the bedrock for informed decision making and proactive risk management. Comprehensive data collection mechanisms and analytical tools enable stakeholders to assess the potential impact of natural disasters, identify relevant uncertainties, and incorporate risk factors into infrastructure planning and design. Access to timely and accurate data empowers stakeholders to anticipate challenges, develop effective prevention and response strategies, and optimise resource allocation for resilience-building efforts. By harnessing the power of collaboration, technology and data, infrastructure can be fortified to withstand and recover from various natural disasters, safeguarding communities and promoting sustainable development (Box 1.2).

Box 1.2. Data, collaboration and technology are key to ensure infrastructure resilience to natural disasters: Examples from Japan, Panama and the Inter-American Development Bank (IDB)

Investing in improving the availability and use of data for infrastructure resilience through collaborations in Japan

Japan is investing in data for resilient infrastructure by:

- Enhancing Satellite Observation Data Utilisation. The collaboration between the Japan Aerospace Exploration Agency (JAXA) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) aims to optimise the utilisation of satellite observation data. This includes leveraging data on global precipitation, heavy rains, droughts, hydrological circulation simulations, soil moisture levels, ground elevation, and land use maps. The objective is to furnish comprehensive and high-quality data crucial for assessing water-related disaster risks, particularly in Asian countries. By enhancing the accuracy and accessibility of such data, the collaboration aims to bolster the effectiveness of decision-making processes in disaster management.
- Climate Change Prediction and Data Integration. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) collaborates with universities and research institutes globally to conduct joint research on climate change projection using Japanese climate models. Furthermore, MEXT partners with MLIT to provide data integration and analysis services through the Data Integration and Analysis System (DIAS). This collaboration facilitates water-related risk-assessment activities in targeted countries and enhances the quality of outcomes through continuous feedback mechanisms.

Undertaking comprehensive risk assessments in the Panama Canal

In the case of the Panama Canal, a comprehensive risk analysis was conducted during the design phase, identifying over 175 potential risks associated with various natural disasters. These risks were meticulously assessed with assigned probabilities, and a Monte Carlo simulation was employed to prioritise the most critical ones necessitating mitigation measures. The outcome of this exercise enabled the anticipation and proactive management of numerous challenges inherent to the canal's construction and operation.

For instance, one notable aspect of the risk mitigation strategy was the consideration of a technical failure near the canal. To address this, the canal was engineered with a security level suitable for a seismic event of magnitude 10.0. This exemplifies a forward-thinking approach, where potential risks were not only identified but also incorporated into the design, aligning with contemporary technological standards. While such anticipatory measures may entail additional costs, they underscore a decision-making process informed by thorough risk analysis.

Leveraging advanced modeling tools and systems for water resource management by IDB

HydroBID, an initiative led by the Inter-American Development Bank (IDB), aims to address water-related challenges in Latin America and the Caribbean (LAC) through improved water management and decision-making processes. This initiative leverages advanced hydrological modeling tools and geographic information systems (GIS) to enhance water resource management across the region.

HydroBID focuses on providing decision makers with accurate and timely information regarding water availability, quality and usage, thereby enabling more effective planning and resource allocation. By utilising data-driven approaches and innovative technologies, HydroBID supports evidence-based policy making and facilitates the implementation of sustainable water management practices.

One of the key objectives of HydroBID is to strengthen the resilience of water infrastructure and services in LAC countries, particularly in the face of climate change and increasing water-related risks. Through capacity-building activities, knowledge sharing, and the development of customised tools and methodologies, HydroBID aims to empower local stakeholders to better manage water resources and mitigate the impacts of water-related disasters. Overall, HydroBID represents a comprehensive effort to improve water security, enhance environmental sustainability, and promote inclusive development in Latin America and the Caribbean by harnessing the potential of data-driven solutions and collaborative partnerships.

Source: Official information from the Ministry of Land, Infrastructure and Transport (MLIT), Japan, the Association of Caribbean States and the Inter-American Development Bank (IDB).

Adequate **financial resources** are essential for investing in resilient infrastructure projects, which often require substantial upfront costs for construction, maintenance and upgrades (OECD, 2023[16]). Without sufficient funding, infrastructure projects may lack the necessary features and measures to withstand natural disasters, leaving communities vulnerable to significant damage and disruption. To increase resilience to natural disasters such as floods, tsunamis and earthquakes, exploring innovative financing mechanisms can be an option. Among the different possibilities, one is to consider allocating a given share of tax revenues for disaster management budgets. For instance, infrastructure projects like the STAR highway in the Philippines, the Tashguzar–Baysun–Kumkurgan (TBK) railway connection in Uzbekistan and Kyushu high-speed rail line in Japan have been shown to lead to increased tax revenues post-implementation due to improved economic activity (Yoshino and Abidhadjaev, 2017[17]; Yoshino and Abidhadjaev, 2017[18]). Allocating a portion of these potential additional tax revenues to disaster management and future preparation efforts can provide a dedicated funding source for enhancing resilience against natural disasters (Azhgaliyeva, Seetha Ram and Yoshino, 2023[19]; Avellán et al., 2022[20]).

Technical expertise plays a vital role in designing, building, operating and maintaining resilient infrastructure. Engineers, architects and other technical professionals bring specialised knowledge and skills to assess risks, develop mitigation strategies, and incorporate resilience measures into infrastructure projects. Their expertise ensures that infrastructure is built to withstand the impacts of natural disasters, reducing the likelihood of damage and enhancing the overall resilience of communities.

Regulatory frameworks provide the legal and institutional reference to promote and enforce resilience-building measures in infrastructure development. Effective regulations and standards ensure that infrastructure projects comply with best practices and incorporate resilience considerations into planning, design, construction and operation (OECD, 2019[21]). Regulatory frameworks also play a crucial role in establishing accountability mechanisms, allocating responsibilities among stakeholders, and providing incentives for investing in resilient infrastructure (ITF, 2018[22]). They are also essential to ensure that data and information are effectively used to take informed actions. Mandatory inclusion of climate risk assessment in project preparation is essential. This involves evaluating the potential climate-related hazards, exposure, vulnerabilities and impacts that infrastructure assets may face over their life cycle. The regulatory framework should ensure and enforce compliance with climate resilience standards and requirements through monitoring, inspection and enforcement mechanisms. Regulatory authorities oversee the implementation of climate and natural disaster resilience measures in infrastructure projects, ensuring that developers and operators adhere to prescribed standards and guidelines. Non-compliance should result in fines as penalties, incentivising stakeholders to prioritise resilience in infrastructure development. It is important to clarify the responsibilities in terms of who needs to carry out the risk assessment and who is in charge of implementing the necessary actions based on the information gathered through the risk assessment study. Failing to clarify who has the responsibility for implementing actions might result in an underutilisation of the risk assessment analysis.

Increasing infrastructure resilience to natural disasters is a global priority. But it is even more urgent in developing countries as they suffer from severe infrastructure gaps. In particular, the following three factors are paramount for increasing infrastructure resilience to natural disasters in developing countries:

- **Increasing government anticipation and adaptation capacities.** In the face of uncertain and changing climate risks, it is important that the regulatory framework includes provisions for adapting rules when needed, while ensuring the stability and security of economic operations.
- **International partnerships** and collaboration are of critical importance to developing countries as they lag behind in terms of financing, technical and regulatory capabilities, as well as in access to data and technology.
    - Developing countries often face limited financial resources and capacity constraints, making it difficult to invest in resilient infrastructure projects. International partnerships can mobilise funding from donor countries, international financial institutions, and private sector investors, supplementing domestic resources and supporting the implementation of infrastructure projects that enhance resilience.
    - International partnerships can facilitate the transfer of technical expertise and knowledge in a wide range of areas, including engineering, risk assessment, disaster management and regulatory frameworks. By leveraging the technical knowledge and experience of international partners, developing countries can enhance their capacity to plan, design and implement resilient infrastructure projects that are tailored to local needs and conditions.
    - Collaborative initiatives between governments, international organisations and other stakeholders can facilitate the exchange of best practices, standards and guidelines for incorporating resilience considerations into regulatory frameworks and policies. Additionally, capacity-building programmes supported by international partnerships help strengthen the institutional capacities of developing countries to develop, enforce and monitor regulatory frameworks related to infrastructure resilience.
- **Multilateral development banks (MDBs), Development Finance Institutions (DFIs) and National Development Banks (NDBs)** are key players in increasing developing countries' capacities to plan, build and operate infrastructure resilient to natural disasters. Development banks provide a wide array of services beyond direct financing, including de-risking and risk assessment tools (Box 1.3).

Box 1.3. Development banks are fundamental players in enabling infrastructure resilience to natural disasters

- **Financing**, through a variety of instruments, including loans, grants and guarantees. They often offer concessional terms and flexible financing options to support projects that incorporate climate resilience measures, such as climate risk assessments, adaptation strategies and resilience-enhancing technologies. Additionally, development banks can leverage their financial resources to attract co-financing from other sources, including the private sector and international climate finance mechanisms.
- **Technical assistance and capacity building.** Development banks offer technical assistance and capacity building support to enhance the readiness and implementation of climate resilient infrastructure projects. Also, international and national development banks actively structure and prepare infrastructure projects, which includes providing technical expertise in climate risk assessments, engineering design, project management, and monitoring and evaluation. Development banks also facilitate knowledge exchange and best-practice sharing among

countries facing similar climate challenges, helping to build local capacity and expertise in climate resilient infrastructure development.

- **Policy and regulatory support.** Development banks play a crucial role in shaping policy and regulatory frameworks that promote climate resilient infrastructure development. They work closely with governments to strengthen regulatory standards, codes and guidelines related to climate resilience in infrastructure planning, design and construction. Development banks also advocate for policy reforms that incentivise investment in climate resilient infrastructure and integrate climate risk considerations into national development strategies and sectoral plans.
- **Project screening and due diligence.** Development banks conduct rigorous screening and due diligence processes to ensure that the infrastructure projects they could finance are climate resilient and environmentally sustainable. This includes assessing climate risks and vulnerabilities, evaluating the resilience of proposed infrastructure designs and technologies, and considering the long-term climate impacts and adaptation strategies. Development banks also incorporate climate resilience criteria into project appraisal and approval processes, guiding investment decisions towards projects that enhance resilience and reduce vulnerability to climate change.
- **Knowledge sharing and innovation.** Development banks facilitate knowledge sharing and innovation in climate resilient infrastructure by supporting research, pilot projects and knowledge exchange platforms. They invest in research and development of innovative technologies and approaches that enhance climate resilience in infrastructure, such as green infrastructure, nature-based solutions, and resilient urban planning. Development banks also promote learning and capacity building through workshops, seminars and conferences, fostering a culture of innovation and continuous improvement in climate resilient infrastructure development.

Source: OECD (2024[15]), *Infrastructure for a Climate-Resilient Future*.

Conclusions

Ensuring that infrastructure is planned, built and operated in a way that is resilient to natural disasters is a global priority due to the rise in frequency, intensity and impact of natural hazards and extreme weather events. It fosters development by:

- Contributing to economic stability, by reducing the risk of infrastructure damage and disruptions caused by extreme weather events. This stability is crucial for attracting long-term investment and fostering sustained economic growth. Investors are more likely to commit resources to countries with resilient infrastructure that can withstand climate shocks, ensuring the continuity of operations and returns on investment.
- Safeguarding critical assets and services, such as transportation networks, energy systems, water supply and telecommunications. For example, reinforcing coastal infrastructure, such as seawalls and flood barriers, protects ports and transportation routes from sea-level rise and storm surges, ensuring the uninterrupted flow of goods and services.
- Minimising life cycle costs by reducing the need for frequent repairs and emergency maintenance due to climate-related damages. By investing upfront in resilient design and construction techniques, developing countries can avoid costly retrofitting and reconstruction efforts.
- Reducing the risk premium. Insurance companies and risk assessors increasingly consider the resilience of infrastructure assets when underwriting policies and assessing risk exposure. By

investing in climate-resilient infrastructure, developing countries can reduce insurance premiums and financial liabilities associated with climate-related risks.

- Fostering innovation and technological development. Prioritising resilience to climate change in infrastructure drives the development of new materials, design approaches and construction techniques that enhance resilience. This fosters a culture of innovation and entrepreneurship, creating opportunities for the growth of local industries and the adoption of cutting-edge technologies in infrastructure development. By preserving ecosystems as wetlands, forests and natural waterways and by integrating nature-based solutions into infrastructure design, such as green roofs, permeable pavements and natural drainage systems, it fosters bioeconomy development and generation of sustainable economic value from natural assets.
- Increasing integration and partnerships with global markets. Adhering to international standards, regulations and agreements aimed at addressing climate change and promoting sustainable development enhances credibility and reputation on the global stage, facilitating access to international financing, partnerships and co-operation. It is essential that developing countries participate in the definition of global climate resilience standards for infrastructure. These are norms, codes and guidelines that govern the design, construction and operation of infrastructure projects. They define the minimum requirements for infrastructure resilience, including considerations such as climate risk assessments, adaptive design strategies, durability and maintenance requirements.
- Increasing social equity and inclusion. Vulnerable and marginalised communities often bear the brunt of disasters' impacts and are disproportionately affected by inadequate infrastructure, hampering their economic inclusion prospects, therefore perpetuating poverty cycles. Infrastructure projects must be designed and implemented in a way that ensures resilience to natural disasters and at the same time promotes social equity, ensures access to essential services for all, and empowers local communities to actively participate in decision-making processes. It is important to take into account gender perspectives in this respect (OECD, 2023[23]).

To ensure resilience to natural disasters, national and local governments need to increase their prevention, reaction and re-building capacities through effective collaboration, smart use of data and deployment of new technologies, enabled by access to finance and technical expertise and in the presence of conducive regulatory frameworks that incentivise taking into account resilience to natural disasters in all project phases and that clearly establish responsibilities and accountability mechanisms.

For developing countries, international partnerships and development banks are key partners in achieving resilience to natural disasters in infrastructure projects. Both should be scaled up to be able to rise to the challenge of closing infrastructure gaps to match development aspirations of emerging and developing economies and to do it in a way that is future-proof and resilient to climate change and natural disasters. Chapter 2 presents seven good practices to make infrastructure resilient to natural disasters and Chapter 3 discusses seven concrete infrastructure projects in prevention, reaction and rebuilding efforts.

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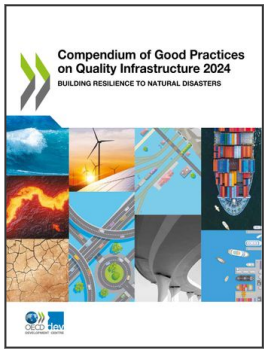

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