The Economist Intelligence Unit

Towards disaster-risk sensitive investments
The Disaster Risk-Integrated Operational Risk Model

A study by The Economist Intelligence Unit

Commissioned by the United Nations Office for Disaster Risk Reduction

Contents

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About this report

This document contains the methodology and key findings of a policy-benchmarking framework that assesses country-specific policies and institutions for disaster-risk management. The analysis and content of this report cover the period from January to April 2016. The research programme was undertaken by The Economist Intelligence Unit (The EIU) and supported financially by the United Nations Office for Disaster Risk Reduction (UNISDR). The views and opinions expressed in this publication are those of The EIU and do not necessarily reflect the official position of UNISDR.

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For further information, please contact:

The Economist Intelligence Unit

Leo Abruzzese, Project Director: leoabruzzese@eiu.com
Stefano Scuratti, Engagement Manager: stefanoscuratti@economist.com
Jennifer Wells, Marketing Executive: jenniferwells@eiu.com

United Nations Office for Disaster Risk Reduction (UNISDR)

Andrew Maskrey, Coordinator, Global Assessment Report on Disaster Risk Reduction, UNISDR: maskrey@un.org
Bina Desai: Risk Knowledge Section, UNISDR: desaib@un.org
Jonathan Fowler, Public Information Officer, UNISDR: fowlerj@un.org

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About The Economist Intelligence Unit

The Economist Intelligence Unit (EIU) is the research arm of The Economist Group, publisher of *The Economist*. As the world's leading provider of country intelligence, it helps governments, institutions and businesses by providing timely, reliable and impartial analysis of economic and development strategies. Through its Public Policy, Economics, and Politics Consulting practice, The EIU provides evidence-based research for policymakers and stakeholders seeking measurable outcomes in fields ranging from gender and finance to energy and technology. It conducts research through interviews, regulatory analysis, quantitative modelling and forecasting, and displays the results via interactive data-visualisation tools. Through a global network of more than 350 analysts and contributors, The EIU continuously assesses and forecasts political, economic and business conditions in over 200 countries. For more information, visit www.eiu.com.

About the United Nations Office for Disaster Risk Reduction (UNISDR)

UNISDR was established in 1999 as a dedicated secretariat to facilitate the implementation of the International Strategy for Disaster Reduction (ISDR).It is mandated by the United Nations General Assembly resolution (56/195), to serve as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among the disaster-reduction activities of the United Nations system and regional organizations and activities in socio-economic and humanitarian fields. It is an organisational unit of the UN Secretariat and is led by the UN Special Representative of the Secretary-General for Disaster Risk Reduction.

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As part of the research process for this project, in-depth interviews were conducted with policymakers and disaster-risk experts from multilateral and consulting institutions. We would like to express our thanks to all of the experts for their advice and input. The research programme was led by Leo Abruzzese (project director) and Stefano Scuratti (engagement manager). The following researchers, country analysts and specialists contributed to this study and we thank them for their support: Diane Alarcon, Kate Allard, Kim Andreasson, Maria-Luiza Apostolescu, Andrei Franklin, Camilo Guerrero, Tom Felix Joehnk, Jaekwon Lim, Susana Martinez, Marlon Martinez, Julie McGehee, Emma Mitrotta, Solon Molho, Robert Powell, William Shallcross, Lisa Teubner, Yoshie Ueno, and Natalie Yuan. The expert panel that gathered in London to discuss the analytical framework included: Leo Abruzzese, Omar Dario Cardona, Domenico Del Re, Maíta Fernández-Armesto, Marc Gordon, Louis Gritzo, Debarati Guha Sapir, Jan Kellett, Allan Lavell, Mabel Cristina Marulanda Fraume, Andrew Maskrey, Robert Muir-Wood, Miroslav Petkov, Stefano Scuratti, Fiona Shaw, Pablo Suarez, and Lisa Teubner. We would like to thank them for their valuable contributions. We would also like to thank Andrew Maskrey and Bina Desai for their comments on the report and overall input into the research programme.

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Executive summary and key findings

The impact of disasters is growing over time, and the need to consider disaster risk as a core element of a comprehensive and coherent business strategy is increasingly compelling. Nonetheless, disaster risk is often still considered as a stand-alone component of business risk, often a "tail-risk", hard to measure and, therefore, overlooked. In 2014 UNISDR launched R!SE (now ARISE), a global initiative under the umbrella of the UN, with the objective of fostering a transition from managing disasters to managing risks and promoting the creation of "risk-resilient societies". One of the objectives of ARISE is to shift this paradigm and make disaster risk a fundamental aspect of business planning.

The scientific evidence, reinforced in September 2013 by the Intergovernmental Panel on Climate Change (IPCC), is aligned with the economic case for action: unprecedented loss of life and infrastructural damage in recent years caused by disasters in the US, Japan, the Philippines and Thailand, among others, emphasise the importance of effective disaster risk-reduction (DRR) strategies. Yet, investment continues to be made, on a regular basis, in disaster-prone areas, such as river basins and low-lying coastal regions.

Factoring risk into investment decisions does not imply that disaster-prone locations need be ignored by the business community. Rather, businesses should consider a region's DRR strategy and preparedness, its capacity to respond effectively to disasters, and its ability to promote post-disaster recovery. This puts the role of policymakers, regulators and the emergency services at the forefront of the DRR effort, and underlines the importance of collaboration between private and public actors in advancing preparedness.

The Disaster Risk-Integrated Operational Risk (DRIOR) model is an important step in the promotion of a better understanding of disaster-related risks in the context of business planning, and represents a sustained effort to promote disaster-sensitive investment. The model looks at policies, regulations and institutions, as well as the broader business operating environment in 20 pilot countries, providing metrics for both policymakers and businesses, with the aim of promoting a better understanding of how to measure risk. The DRIOR model was developed by The EIU, through substantial engagement with the United Nations Office for Disaster Risk Reduction (UNISDR) and a team of subject-matter experts. Building on five domains, 23 indicators and 82 sub-indicators, both qualitative and quantitative, the DRIOR model makes a substantial contribution to mainstreaming disaster risk, and aims to open a dialogue on what is needed to foster the transition to "risk-resilient societies".

The DRIOR framework is built around five pillars, which provide a holistic assessment of countries' operational risk levels, with a specific focus on disaster risk:

- **Institutional framework:** This domain explores a country's institutional capacity by assessing its disaster risk management institutions, their operation (including staffing, access to resources,

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reporting structure), and a country's political economy, which influences overall institutional effectiveness.

- **Disaster risk-reduction policy, preparedness and response**: This domain explores a country's disaster risk-reduction strategies and policies at national and sub-national levels, its budgetary processes in the area of disaster risk, and the extent to which disaster risk has been incorporated into national development plans and other policies. It also assesses the national government's disaster preparedness and response capabilities, in particular contingency planning for disasters, hazard monitoring, early-warning systems and other steps that enable an effective disaster response.

- **Economic resilience**: This domain explores economic resilience—a crucial aspect of a country's capacity to build disaster resilience and absorb the short- and longer-term economic impacts of disasters. The economic-resilience domain assesses a country's economic structure and macroeconomic stability, its degree of openness to trade, its access to insurance markets, and the state of economic development.

- **Societal resilience**: This domain explores societal resilience—a measure of how societies respond to and are able to cope with the impact of disasters. The domain assesses this resilience by looking at 17, mostly quantitative, indicators. They cover areas that are crucial for a society to absorb effectively the negative impact of disasters: the ability to maintain public order, the capacity to provide public services (especially in the area of health), the provision of basic needs, and proxy indicators for social cohesion and women's empowerment.

- **Resilience of the physical environment:** This domain explores the resilience of a country's physical environment. To gauge this, we assess 16 qualitative and quantitative indicators. We look at how countries protect their physical assets, the rules and regulations to make them safer, and the general quality of infrastructure and environmental governance.

The development of the DRIOR model has generated insight into common trends and differences between the 20 countries that are included in this pilot. By measuring policies in terms of how extensive and coherent they are, the model reveals a range of behaviours, strategies and approaches, used by a diverse set of countries to manage disaster risk and provides a benchmark that is valuable, both in terms of helping other countries to identify good practices, and in directing businesses to make more sustainable investments.

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Figure 1: Key findings, domains[1]

	Overall Preparedness	Institutional Framework	Disaster Risk Reduction Policy, Preparedness and Response	Economic Resilience	Societal Resilience	Resilience of the Physical Environment
Australia	Mature	Mature	Mature	Mature	Mature	Developed
Bangladesh	Developed	Developed	Mature	Emerging	Emerging	Nascent
China	Developed	Developed	Mature	Developed	Developed	Emerging
Greece	Developed	Developed	Mature	Developed	Mature	Developed
Haiti	Emerging	Emerging	Developed	Emerging	Emerging	Nascent
Honduras	Emerging	Developed	Emerging	Developed	Emerging	Emerging
India	Developed	Mature	Mature	Developed	Developed	Emerging
Italy	Developed	Developed	Emerging	Mature	Developed	Emerging
Japan	Mature	Mature	Mature	Developed	Mature	Developed
Laos	Emerging	Developed	Developed	Emerging	Emerging	Nascent
Madagascar	Emerging	Developed	Emerging	Emerging	Nascent	Nascent
Niger	Emerging	Developed	Emerging	Emerging	Nascent	Emerging
Papua New Guinea	Emerging	Emerging	Developed	Emerging	Nascent	Nascent
Peru	Developed	Mature	Mature	Developed	Developed	Emerging
Philippines	Developed	Developed	Mature	Developed	Developed	Emerging
Russia	Developed	Mature	Mature	Developed	Developed	Developed
South Korea	Mature	Mature	Mature	Mature	Mature	Developed
Taiwan	Developed	Developed	Developed	Mature	Mature	Developed
Tajikistan	Developed	Developed	Developed	Emerging	Developed	Emerging
USA	Mature	Mature	Mature	Mature	Developed	Developed

Several key findings emerged from this exercise, including the following:

A shift in emphasis, from disaster response to preparedness, is under way.

Governments are, with greater frequency, recognising the critical role of disaster mitigation and preparedness. Most have adopted new technologies, education campaigns, and other non-structural measures to protect their at-risk populations and physical assets. Naturally, engineering solutions and post-event response, focusing on relief and recovery, still have a significant role to play, but, this notwithstanding, forward-looking solutions that focus on preparedness and modifying behaviour have been gaining traction. The majority of countries have a national agency tasked with monitoring natural hazards, and have national contingency measures enshrined in their laws or strategic plans.

Political leadership plays an important role in effective disaster-risk management (DRM).

Political leadership is key to the prioritisation of DRM and the passage of relevant legislation. The vast majority of leaders in our sample expressed active support for DRM, and level of commitment is a determinant of operational effectiveness. Political leadership is instrumental in securing resources,

[1] Countries were grouped in four categories, based on their performance in the DRIOR model. Scores were normalised on a 0-10 scale and banded accordingly. Scores were based on the following banding. 0-2.5: Nascent; 2.5-5: Emerging; 5-7.5: Developed; 7.5-10: Mature.

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passing laws and implementing disaster-risk policy. Often, a country's institutional set-up reflects the importance that the head of state attributes to DRM. In nearly all countries, the principal national entity responsible for DRM reports directly to a line ministry or the presidency.

Budget allocations for DRM are rising in many countries, but dedicated budgets are not the norm.

Fiscal prudence demands a dedicated budget for disaster risk. The costs of disasters, especially in countries where losses are not insured against, can have a severe detrimental effect on the public finances. Unfortunately, governments often face fiscal constraints and competing priorities, and may have incomplete information concerning the probability of occurrence and potential cost of disasters. As a result, dedicated budgets for DRM are not the norm. High-income countries, such as Japan and the US, allocate billions of dollars to DRM annually. More often than not, however, governments earmark money for, and spend it primarily on, post-event response and recovery, especially in low- and middle-income countries. Our research shows that funds for DRR, increasing preparedness and response capabilities and infrastructure, are available in most high-income countries, as well as in countries such as Bangladesh, China, Peru and the Philippines.

Disaster risk is highest in countries where vulnerable societies and high exposure to natural hazards coincide.

Resilience of societies and that of the physical environment show a higher correlation than any other two domains (at 0.91). In other words, countries with populations most at risk from the consequences of disasters tend to be those with the most vulnerable societies, and the reverse is also true. Our model shows that nine countries, which rank in the bottom half on societal resilience, also face the greatest exposure to the adversities of the physical environment.

The resilience of the physical environment dictates much of a country's overall disaster-risk preparedness.

The resilience of the physical environment is strongly correlated with countries' overall disaster-risk preparedness. The findings underline the importance of investment in infrastructure, steps to protect ecosystems and human health, as well as preventive and corrective measures and contingency planning. Our research shows that infrastructure is lacking or inadequate in 12 countries (with a documented lack of necessary infrastructure, such as dykes, levees, anchorage, drainage and snow nets). In the remaining eight countries, some types of infrastructure are lacking or inadequate. In 17 out of 20 countries, there are extensive human settlements in areas that are at risk of disaster.

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The research programme

Disaster risk-sensitive investments and the Sendai Framework for Disaster Risk Reduction

Disaster-risk management has become an increasingly high priority for the UN. UN resolution 42/169 declared the 1990s the international decade of disaster reduction, recognising "the importance of reducing the impact of natural disasters for all people, and, in particular, for developing countries". A key step in operationalising this was the adoption of the Hyogo Framework for Action 2005-2015 (HFA) at the Kobe UN World Conference on Disaster Risk Reduction (WCDRR) in 2005, with a programmatic commitment to "substantially reduce disaster losses by 2015, by building the resilience of nations and communities to disasters". The HFA outlines five priorities for action, and offers guiding principles and practical means for achieving disaster resilience:

- Ensuring that disaster-risk reduction is a national and local priority, with a strong institutional basis for implementation.
- Identify, assess and monitor disaster risks and enhance early warning.
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- Reduce the underlying risk factors.
- Strengthen disaster preparedness for effective response at all levels.

Resolution 67/209 of 2013 called for a third World Conference on Disaster Risk Reduction, to be held in Japan in 2015, to review the implementation of the Hyogo Framework for Action, and to adopt a post-2015 framework for disaster-risk reduction. The result of this conference was the agreement on the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework), subsequently endorsed by the UN General Assembly. The Sendai Framework is a 15-year, voluntary, non-binding agreement, which gives governments primary responsibility for reducing disaster risk, while acknowledging that overall responsibility should be shared with other stakeholders, including local governments and the private sector. The Sendai Framework consists of seven global targets and four priorities for action:

- Understanding disaster risk.
- Strengthening disaster-risk governance to manage disaster risk.
- Investing in DRR to augment resilience.
- Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

The first priority of the Sendai Framework is to promote research that fosters the development of a better understanding of disaster risk. Policy plays a crucial role in ensuring that disaster-risk

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management structures have the necessary support to succeed, and that they fully leverage different actors in an effective and coordinated fashion. A structured approach to disaster-risk management (DRM) policy analysis, through clear and measurable indicators, can ensure that these policies operate at full capacity.

In 2014 UNISDR launched R!SE (now ARISE), a global initiative under the umbrella of the UN, with the objective of fostering a transition from managing disasters to managing risks and promoting the creation of "risk-resilient societies". One of the key priorities of ARISE is to facilitate multi-stakeholder initiatives that make investments risk-sensitive. This reflects a recognition that no actor can singlehandedly address such a complex issue and, in line with this principle, ARISE leverages six interconnected communities: business, investors, insurance, civil society, education and the public sector. The initiative builds on eight activity streams: strategies for global business, risk metrics for economic forecasting, industry sector certification, education, principles of responsible investing, resilience of cities, insurance, and resilience of UN programming. This platform promotes a holistic approach to the creation of risk-resilient societies, as well as multi-stakeholder engagement.

Making risk information available and accessible, as part of the supporting argument for investing in societal resilience, is a key component of ARISE's vision. Specifically, making information about disaster risk available to policymakers and business leaders can ensure that both existing and future investments are disaster-resilient. The EIU's DRIOR model was built to respond to this prerogative. Encompassing five domains, 23 indicators and 82 sub-indicators, both qualitative and quantitative, the DRIOR model provides a holistic assessment of 20 countries' disaster risk-integrated operational-risk levels.

Definitions and components of disaster risk

UNISDR defines a disaster as a "serious disruption of the functioning of a community or a society, involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources". By extension, disasters are understood to be the result of a combination of factors, including: exposure to a hazard; the conditions of vulnerability; and the capacity or measures taken to reduce or cope with the potential negative consequences. Disaster risk is defined as "the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period". Underlying disaster risk is the concept of natural hazard, which UNISDR defines as "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage".

The conditions that make disasters possible are, by definition, man-made. That is to say that, for an extreme weather event to actually bear consequences, assets must be affected. Assets are, in the main, man-made, and typically include infrastructure, settlements, and other complex systems. An extreme weather event becomes a disaster when there is, for example, a high concentration of buildings in disaster-prone areas, a lack of protective measures (for example, dykes), or the absence of building codes. The core contention guiding this study is that a disaster-prone region with appropriate DRM

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capabilities and measures in place be regarded as an investment destination that is equally as viable as a region that is not disaster-prone, but has no measures in place. In other words, we assess risk based on a combination of "exposure" and "preparedness".

A key innovation in the DRIOR framework is the mainstreaming of disaster risk into operational risk. Traditionally, disaster risk has been a stand-alone component of operational risk. Due to the difficulty of measuring it and its "tail-risk" nature (that is, its severe potential impact, but relatively low likelihood of occurrence), disaster risk has often been neglected in business planning. The purpose of our work is to bring measures of disaster risk front and centre in business and policy planning. To achieve this, we look at disaster risk through an "operational-risk" filter, with the objective of assessing the extent to which businesses are likely to be affected by disasters, the key question being:

"What is the likelihood of business disruptions and how significant is the potential impact?"

The framework does not focus on predicting the occurrence of natural hazards and the potential ensuing damage. However, it combines average annual loss (AAL) metrics with a policy and macro assessment that focus on augmenting capacity and implementing measures designed to reduce and cope with the negative consequences of disasters. In UNISDR's definition, AAL (also known as the *pure risk premium*, when normalised by exposed value or capital stock), is the expected average loss per year, considering all the events that could occur over an extended time frame. AAL takes into account all the disasters that could occur in the future, including very intensive losses over long periods. AAL provides a proxy for countries' levels of exposure. The DRIOR analytical framework assesses countries' preparedness, taking into account a wide-ranging set of issues, including political stability, industrial relations, macroeconomic stability, quality of bureaucracy, as well as DRM-specific measures.

The universe of analytical frameworks on disaster-risk management

Private-sector and public-sector frameworks

The universe of risk-assessment models is varied. Different organisations, in both the private and public sectors, have attempted to create frameworks to quantify risk and provide decision-makers with meaningful insight. Risks are categorised differently, largely reflecting various theoretical approaches and purposes. Content, methodology and depth of analysis can vary. Cross-sector collaboration has,

Figure 2: Provision of country risk-assessment frameworks: internal versus external focus

Internal focus	External focus
Private-sector organisations	Public-sector organisations
● Market prioritisation	● Socio-economic development
● Risk management and stress testing	● Market stability
● Internal knowledge development	● Fundamental research
● Predictive assessment	● Knowledge exchange

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to date, remained minimal, and models are typically developed to serve specific audiences. Models developed by private-sector bodies tend to target a private-sector audience, while those developed by international organisations and public bodies target a broader audience.

Risk-assessment frameworks and the private sector

Insurance providers have been leading the development of predictive models, with the primary purpose of placing the right premium on insured assets. These models often combine predictive analytics with geospatial elements and focus on individual assets, rather than systemic issues. Others (Allianz Risk Barometer, for example) provide a more extensive (albeit rather qualitatively biased) picture by gauging overall business sentiment. Consulting companies are also active in the development of similar tools; their emphasis tends to be on supply chain-risk assessment, risk monitoring and general business planning. Contrary to insurance companies, which produce assessments of exposure of existing assets or individual assets under development, the role of these models is to provide a global, high-level overview of key risks. Some of these models are less detailed, but have a greater scope, often taking a global approach. Others adopt client- and sector-specific frameworks, which can generate in-depth, tailored insights (for example, dealing with specific supply-chain risks). Risk-assessment frameworks are also extensively used by the financial sector. New regulations have seen a surge in risk modelling to assess credit, market, enterprise and operational risk, often incorporating stress-testing models. Many of these models offer ratings that give an indication of the solvency and performance of countries and private-sector entities. Given the commercial nature of private-sector organisations, their risk models are not publicly accessible, and only a fraction of their knowledge is made available for external use.

Risk-assessment frameworks and the public sector

Public sector-developed risk-assessment frameworks are mostly intended to promote knowledge development and exchange. They strive to enhance access to information, with a specific focus on developing economies, where information is less readily available. Focusing on financial risk, the IMF Global Financial Stability Report is a clear example. This semi-annual publication provides an assessment of the global financial system and markets, and highlights systemic issues that could pose a risk to financial stability. Other models are intended to compile historical data to enable future analysis and raise awareness of specific topics. In the case of disaster-risk preparedness, the Emergency Events Database (EM-DAT) has been collecting and collating data on disasters dating back to 1900, with the primary objective of informing humanitarian action at national and international levels and helping to rationalise decision-making for disaster preparedness. Collaboration on the development of these models is significant, and information is generally made publicly available, the intention being to enable governments, research organisations and other actors to engage in further research and knowledge exchange. The United Nations Environmental Programme (UNEP) PREVIEW Global Risk Data Platform, a multi-agency effort to share spatial data on global risk from natural hazards, is an example of how these models often rely on cross-organisational collaboration for their development. Similarly, UNISDR coordinates a multi-hazard Global Risk Assessment in partnership with leading scientific and technical organizations and UN agencies. Probabilistic risk models have

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been developed for earthquake, tropical cyclone wind and storm surge, tsunami and river flooding worldwide, for volcanic ash in the Asia-Pacific region and for drought in parts of Africa. The results for the risk of economic losses are expressed in terms of annual average losses and probable maximum losses, making them applicable to investment planning and policymaking. The open-source multi-hazard risk platform CAPRA is used to quantify risks.

Integrating operational and business risk

Disaster risk and generic business risk have traditionally been analysed as separate entities. Despite the existence of models and datasets including both risk categories, disaster risk is seldom embedded into overall business-risk assessments, and our review of nearly 20 models and datasets highlights a dearth of frameworks that adopt an integrated approach. As a result, disaster risk is either not incorporated when analysing business risk, or it is analysed as an independent, stand-alone category.

Generic business risk-assessment frameworks

Generic business risk-assessment frameworks incorporate a range of risk categories, including security, political stability, government effectiveness, legal and regulatory, macroeconomic, foreign trade and payments, financial, tax policy, infrastructure and labour-market risks. For generic business-risk assessment, impact modelling and scenario analysis are important, and entail the utilisation of comprehensive statistical data. In addition, qualitative insight provided by analysts and experts can add depth and capture softer risk elements. This approach is taken, to varying degrees, by a number of consultancies, with The EIU's Risk Briefing being an example.

Disaster risk-specific assessment frameworks

Some disaster-risk assessments are based on hard scientific evidence, examining the characteristics of extreme weather events in order to forecast likelihood of occurrence and potential impact. Predictive modelling is commonly used in this type of assessment, and the focus is on specific disaster categories. Risk categories covered include geological, climatic/hydro- meteorological, biological and indirect (man-made) risks. A good example of this broad category of disaster-risk assessment is the Unites States Geological Survey (USGS) Earthquake Hazard Program. An important advantage of this type of analysis is its evidence-based approach, which gives reliable quantitative information about the causes and effects of natural hazards. A disadvantage is that the applicability of scientific information to business strategy is limited, due to the combination of complexity and a perceived difficulty in factoring these assessments into investment decisions. Although the economic effects of natural disasters are included in some frameworks, such as the Oasis Loss Modelling Framework, this information is mostly limited to the destruction of sites and is difficult to translate into business impact modelling.

Data-driven and survey-driven frameworks

Data-driven approaches

Data-driven risk assessments focus on predictive modelling of catastrophes, or on impact modelling; that is, an estimation of the economic and social impact of a disaster once it has occurred. This approach is adopted by insurers, enabling them to utilise data on losses from previous catastrophes.

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Data-heavy frameworks, focusing only on disaster risk, often provide estimates of potential economic losses (as does, for example, the Oasis Loss Modelling Framework). Official statistical data can also create the basis for the assessment of generic business risk, such as the stability of financial systems and markets.

Survey-based approaches

Existing frameworks combining generic business risk and disaster-risk assessments often employ a survey-based approach. Such frameworks cover a country's exposure to business risk (as well as natural hazards) by assessing business leaders' perceptions and knowledge. They often include secondary analysis of risks that a firm faces, expert interviews, workshops and surveys. Survey questions tend to be open (for example, "Which risks do you think will affect your business?"), with the aim of ensuring that an extensive range of risks is considered. Examples of frameworks that use this approach are the Allianz Risk Barometer and the WEF Global Risks Report, which cover a large range of risk categories and countries. Survey-based approaches offer a snapshot of current perceptions, but do not necessarily offer an evidence-based decision-making tool for business leaders.

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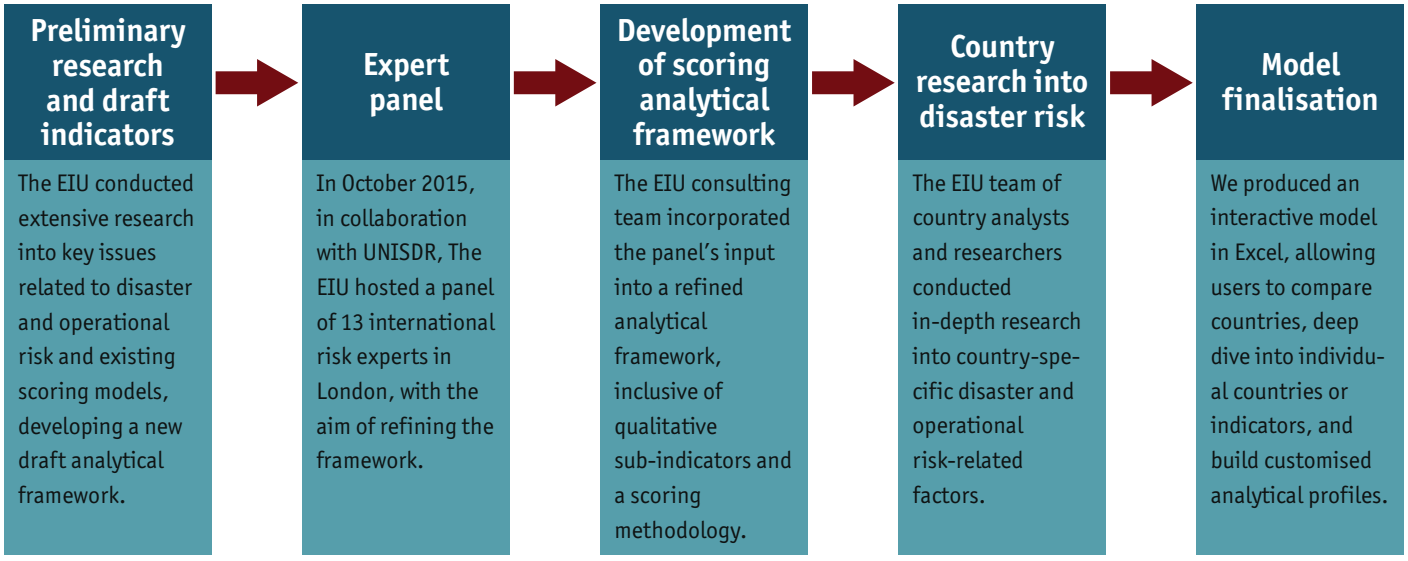
Developing the Disaster Risk-Integrated Operational Risk Model

Research phases

The development of the Disaster Risk-Integrated Operational Risk (DRIOR) model followed a multi-step process. After conducting secondary research on existing operational and disaster-risk assessment frameworks, The EIU developed a draft analytical framework, integrating disaster risk and operational risk. In October 2015, a panel of technical experts met in London to attend a day-long workshop, with the aim of refining this framework. The panel agreed on the five domains that constitute the backbone of the DRIOR model, as well as the key indicators for each domain. These insights were incorporated into the development of a full scoring model (see Annex I), inclusive of 82 quantitative and qualitative sub-indicators and a full evaluation methodology.

Figure 3: The research process



EIU analysts and researchers conducted extensive research into country-specific disaster risk and operational-risk factors, and produced qualitative scorecards to inform the evaluations. This research was modelled through an interactive workbook, allowing for country comparisons and identifying best practices, trends and insights. The outcomes of this research represent the basis of the thematic-analysis section of this report.

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Country selection

The DRIOR model includes 20 countries, providing a broad cross-section of disaster-exposure profiles and geographic scope. These countries were selected in conjunction with UNISDR, in order to maximise the opportunity to test the framework across a variety of institutions and government types, and to assess the validity of the framework as a suitable tool for a global cross-country comparison.
The countries were selected on the basis of two main elements:

- Overall magnitude of losses from disasters.
- Magnitude of losses from disasters relative to total assets.

The key metric used for the country selection is the multi-hazard Average Annual Loss (AAL), which is the long-term expected loss per year, averaged over many years. In isolation, this metric produces a country selection skewed towards advanced economies, due to greater asset concentration relative to smaller economies. To offset this, a second criterion was introduced: AAL as a share of capital stock. This allows for the inclusion of smaller economies with significant exposure. A population criterion (population in excess of 5m) is also present, in order to provide a more diversified sample, avoiding overrepresentation of small countries. The selection is equally representative of both criteria. Due to overlap of countries across both lists, and in order to get a more geographically diversified country sample, Niger and Papua New Guinea were added.

Figure 4: Country selection

Australia	Honduras	Madagascar	Russian Federation
Bangladesh	India	Niger	South Korea
China	Italy	Papua New Guinea	Taiwan
Greece	Japan	Peru	Tajikistan
Haiti	Laos	Philippines	United States

To assess disaster risk across countries of different sizes and income levels it is helpful to think in terms of damage relative to the size of the economy, rather than in nominal dollar terms. A hurricane hitting both Haiti and Florida would result in substantially higher insured losses in Florida in dollar terms, but the impact of the disaster may be far more severe in Haiti. Figure 5 shows that, after adjusting for wealth, the countries with lower preparedness levels face higher risk levels and countries with higher preparedness levels face lower risk levels.

[2] Preparedness is the composite overall score from the DRIOR model, on a scale from 0-10 where 10=best prepared; disaster risk is computed as average annual loss over capital stock and normalised on a scale of 0-10 where 10=highest risk

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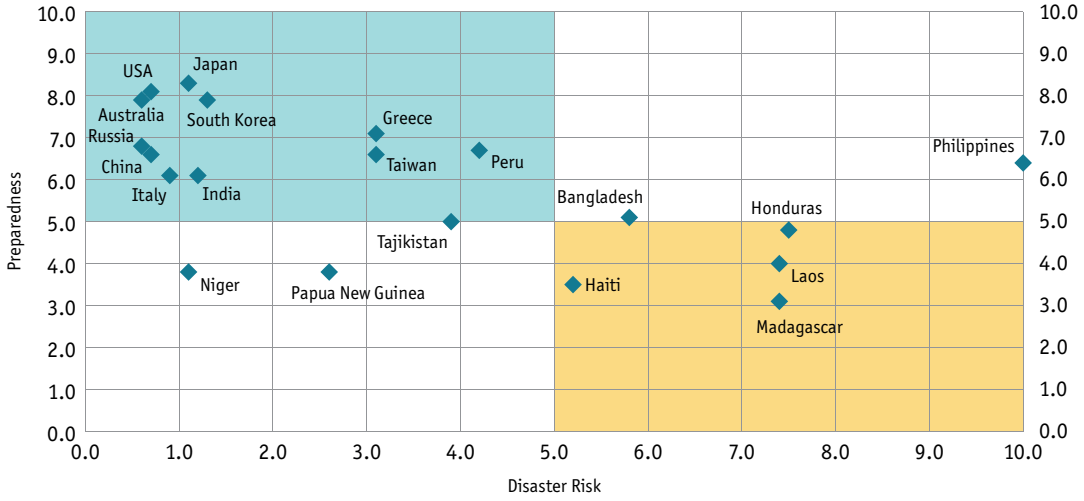
Figure 5: Preparedness vs. disaster risk



Source: The Economist Intelligence Unit.

Framework development

The DRIOR framework is built around five pillars, which provide a holistic assessment of countries' operational risk levels, with a specific focus on disaster risk:

- **Institutional framework:** This domain explores a country's institutional capacity by assessing its institutions of DRM, their operation (including staffing, access to resources, reporting structure), and a country's political economy, which influences overall institutional effectiveness.

- **Disaster risk-reduction policy, preparedness and response:** This domain explores a country's disaster risk-reduction strategies and policies at national and sub-national levels, its budgetary processes in the area of disaster risk, and the extent to which disaster risk has been incorporated into national development plans and other policies. It also assesses the national government's disaster preparedness and response capabilities, in particular contingency planning for disasters, hazard monitoring, early-warning systems and other steps that enable an effective disaster response.

- **Economic resilience:** This domain explores economic resilience—a crucial aspect of a country's capacity to build disaster resilience and absorb the short- and longer-term economic impacts of disasters. The economic-resilience domain assesses a country's economic structure and macroeconomic stability, its degree of openness to trade, its access to insurance markets, and the state of economic development.

- **Societal resilience:** This domain explores societal resilience—a measure of how societies respond to and are able to cope with the impact of disasters. The domain assesses this resilience by looking at 17, mostly quantitative, indicators. They cover areas that are crucial for a society to absorb effectively the negative impact of disasters: the ability to maintain public order, the capacity to provide public services (especially in the area of health), the provision of basic needs, and proxy indicators for social cohesion and women's empowerment.

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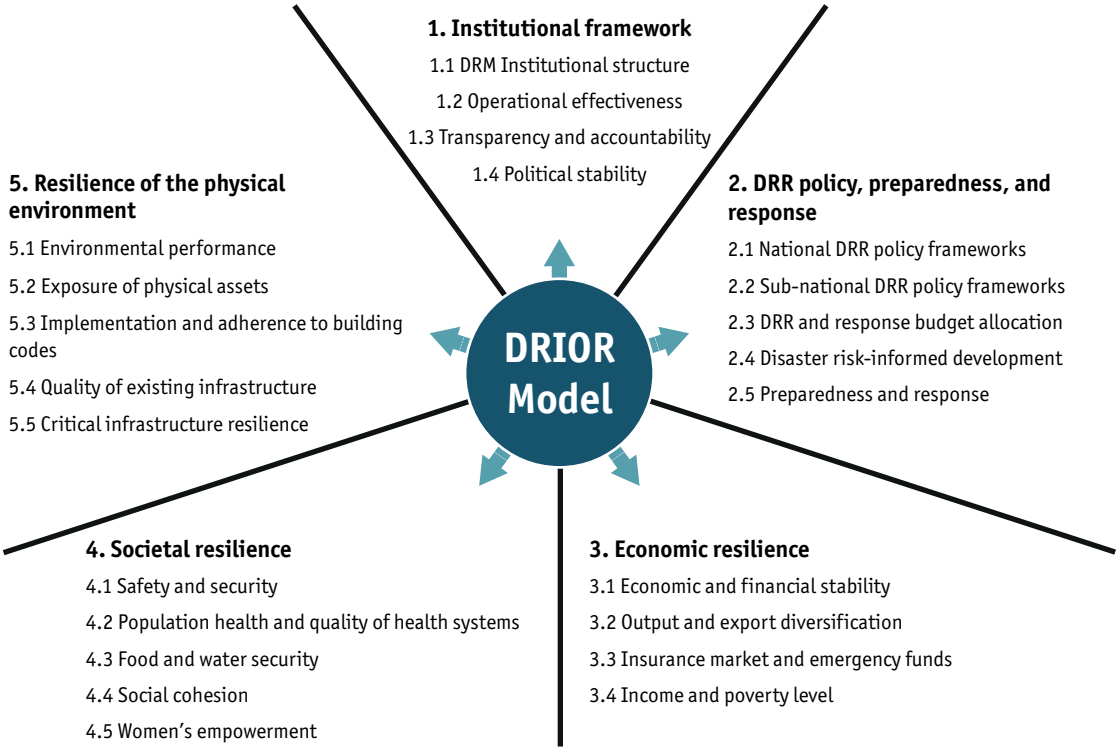
● **Resilience of the physical environment:** This domain explores the resilience of a country's physical environment. To gauge the resilience of a country's physical environment, we assess 16 qualitative and quantitative indicators. We look at how countries protect their physical assets, the rules and regulations to make them safer, and the general quality of infrastructure and environmental governance.

The framework operates on an aggregation structure, with neutral weighting (that is, all domains are considered equally important in assessing a country's overall DRM capabilities). Within each domain, all indicators—as well as the sub-indicators that determine them—also have equal weight. Results are presented through bandings that quantify the overall level of institutional development, ranging from nascent to emerging, developed and mature.

Figure 6: The DRIOR framework



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Thematic analysis

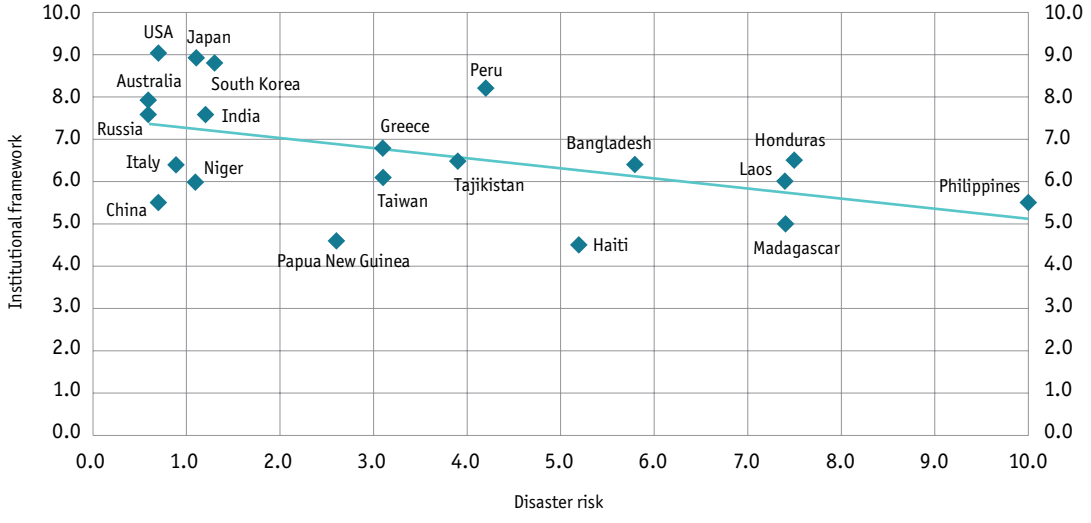
Domain one: Institutional Framework

The quality of institutions for DRM is a crucial aspect of a country's capacity to mitigate risk and prepare for and respond to disasters. The Institutional Framework domain explores a country's institutional capacity by assessing its institutions for DRM capacity, operational capacity (including staffing, access to resources, and reporting structure), and the state of the political economy, which influences overall institutional effectiveness.

The quality of the Institutional Framework is measured across four indicators:

- DRM institutional structure.
- Operational effectiveness.
- Transparency and accountability.
- Political stability.

Figure 7: Institutional framework vs. disaster risk



Source: The Economist Intelligence Unit.

All countries have at least one national-level entity responsible for DRM

A country's institutional framework for DRM is a key determinant of its capacity to mitigate disaster risk and enhance preparedness, and to respond to disasters. In the most advanced settings, the institutions in charge of DRM and DRR are empowered by law to develop plans and policies, ensure

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access to financial and other resources at all levels of government, and possess the legal instruments to enforce disaster risk-related laws.

The quality of institutional framework varies greatly between countries. It is important to note that our set of 20 countries includes advanced economies with average annual incomes of more than US$50,000 per head, emerging economies with half that income level, and countries where the average annual income per head is less than US$1,000. According to the World Bank's classification of countries by income, our dataset includes eight high-income countries, two upper middle-income, seven lower middle-income and three low-income countries.

All countries have at least one national-level entity explicitly responsible for dealing with DRM and response measures. As is to be expected, there is a close link between the quality of countries' institutional framework for DRM and their state of economic development (the correlation between the institutional framework and a country's income and poverty level indicator is 0.71). The US, Japan and South Korea have the most robust institutional frameworks for DRM—all three are stable democracies with high average-income levels. All of them have dedicated sub-national entities, empowered to co-ordinate disaster-risk reduction, preparedness and response, and have institutionalised mechanisms that give non-government stakeholders, especially those in the private sector, a voice in influencing the direction of DRM (either through a national platform or a committee). Crucially, the institutions responsible for DRM in these countries have an unambiguous legal mandate, permanent staff and access to financial resources. They are also required by law to report regularly on their activities.

A country's level of economic development, however, is not always a reliable guide to the quality of institutions for DRM. Bangladesh and India—where average income per head is around US$3,500 and US$6,000, respectively— punch above their weight when it comes to DRM capacity. Their extensive bureaucracies are far from perfect. However, together with these countries' "noisy" democratic traditions, they provide a structure that lends itself to a bottom-up, participatory approach to DRM. In both these countries, DRM institutions report directly to the prime minister, who also acts as the head of the highest decision-making body on disaster risk (in India, the prime minister is the ex-officio chairperson of the National Disaster Management Authority; in Bangladesh, the prime minister heads the National Disaster Management Council). In these countries DRM is a policy area with high visibility, one where the fortunes of political leaders can be made.

Countries with a weak or nascent institutional framework tend to be less affluent, politically unstable or have weak governance structures. In Madagascar, for instance, the absence of effective sub-national level disaster-risk institutions is an obstacle to DRM, as is a lack of dedicated funds. In Haiti, the Civil Protectorate under the Ministry of Interior is the main entity mandated with DRM, but it exists only under an organic law and lacks legal status. In Papua New Guinea, the National Disaster Centre comes under the purview of the Department of Provincial and Local Government Affairs, and there is no monitoring body to ensure its independence. In many low-income countries, DRM institutions exist largely at the national level, where they are often an annex of powerful government ministries (such as the home ministry), and lack a clear legal mandate and are not subject to legally enforced institutional accountability and transparency.

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Institutional quality and type of governance differ

Countries with federal structures that empower sub-national DRM institutions (for example, Australia, India and the US) naturally perform well on the *overall quality of institutional framework*, because a well-developed institutional capacity at the sub-national level of government is essential for effective DRM overall. Under Australia's constitution, for instance, emergency management is a state matter and states are required to have institutions and budgets in place to deal with disasters. The same is true for most representative democracies in our sample, although the degree of decentralisation varies. By contrast, in countries where there are no clear, established and accepted constitutional mechanisms for the orderly transfer of power, sub-national governments tend not to have direct access to local or federal emergency funds. In Tajikistan, for example, local governments cannot access emergency funding; in Laos, DRM funding is highly centralised.

Devolution and political decentralisation, however, are not preconditions for robust DRM institutions. Our sample includes countries with strong central governments that control the majority of decision-making, and also some that display a high-quality sub-national DRM institutional framework. In China, all levels of governments have their own dedicated budget for disaster-related activities, and are able to access them directly for the purposes of disaster mitigation, preparedness and response. Russia, where decision-making is highly centrally concentrated, passed a decree in 2014 that established a clear framework for the monitoring of disaster-management activities. In South Korea, the Ministry of Public Safety and Security is one of the largest central-government agencies, with an annual budget of 3.4trn Korean won (US$3bn).

Political leadership is crucial to DRM strategy

Political leadership is key to the enactment of legislation that reflects a commitment to the prioritisation of DRM. Without a commitment from political leaders, it is difficult to secure the required resources, take relevant legislative action and effectively implement disaster-risk policy. The vast majority of leaders in our sample have expressed active support for DRM. Often, a country's institutional set-up reflects the importance that its government attributes to DRM. In many countries, DRM is intertwined with considerations of national security, making it the prerogative of the home office or the office of civil defence. In nearly all countries, the national entity principally responsible for DRM reports directly to a line ministry or the presidency. In Italy, for instance, the Department of Civil Protection is a technical department, and the government has to report annually to parliament on its civil-protection activities. The Peruvian government in 2013 created a Ministry of Disaster Management in order to increase accountability and clarify reporting lines (it reports to the Presidential Council of Ministers).

Only four countries (Australia, Honduras, South Korea and US), however, have created a statutory body mandated to guarantee the independence of the national entity for DRM. Such institutional independence is a crucial aspect of effective disaster-risk governance; it helps establish accountability for disaster-risk operations, to implement transparent reporting and monitoring systems of financial flows, and to combat corruption (which can be rampant in post-disaster settings). In the US, the Office of the Inspector-General's (OIG) Office of Emergency Management Oversight monitors the activities

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of national-level institutions tasked with DRM, like the Federal Emergency Management Agency (FEMA), and performs aggressive and on-going audits to ensure that disaster-relief funds are spent appropriately.

A key feature of the institutional structure is the extent to which it encourages participation by the private sector and other stakeholders. One half of the countries in our set have a formalised national platform or committee, which helps with private-sector involvement, coordination and information exchange. In South Korea, the Ministry of Public Safety and Security acts as a control tower, handling communication with the public and coordinating with other government agencies, local governments, foreign counterparts, and private-sector organisations. Tajikistan set up a National Platform for Disaster Risk Reduction in 2012, which coordinates with various stakeholders, including the director of the Institute of Geology, Earthquake Engineering and Seismology of the Academy of Science, as well as organisations that act as observers, such as the World Bank and the United Nations Development Programme (UNDP). National platforms such as these reduce the risk that governments and bureaucracies will adopt a top-down, technocratic and interventionist approach to DRM and encourage cross-sectoral synergies.

Governments that make tangible investments in DRM are less vulnerable

Our research shows that the countries with the most robust institutional frameworks are those that have made tangible investments in staff, have created dedicated disaster-risk budgets, and have put in place procedures to monitor and evaluate the performance of their own disaster-risk institutions. The DRIOR model shows that all of these characteristics are closely correlated with countries' overall preparedness. South Korea's Ministry of Public Safety and Security employs over 10,000 permanent staff. Bangladesh's Department for Disaster Risk Management employs 1,200 permanent staff. In many countries (for instance, Haiti, Laos, and Papua New Guinea), the number of staff is small, and positions can be temporary and funded in part by international development agencies and not through the national budget.

In the majority of countries, the agency responsible for responding to disasters has direct access to funds in case of an emergency. Too often, however, disaster-risk agencies lack financial autonomy. This compromises their capacity to mount an effective emergency response, and limits their ability to engage in risk prevention and reduction activities.

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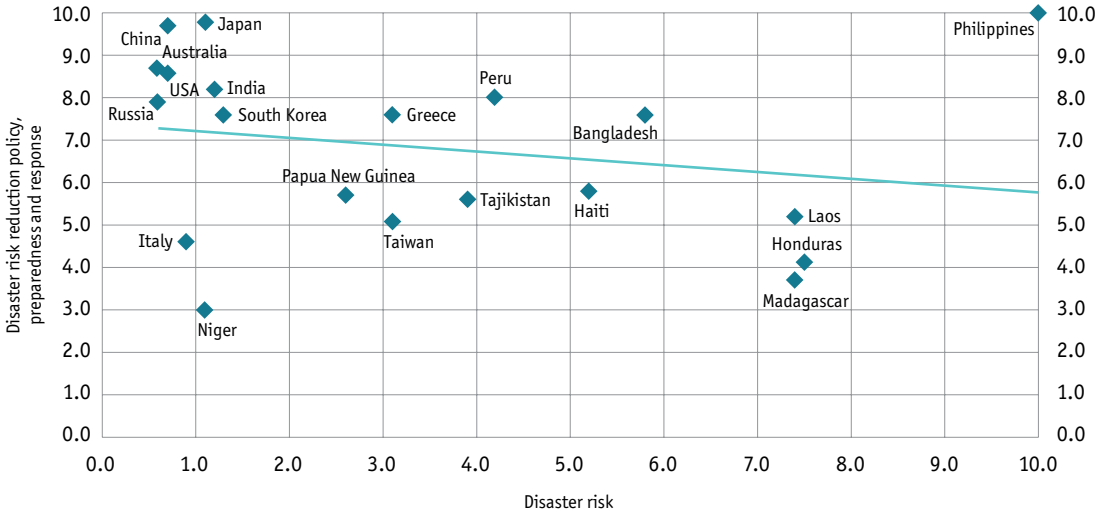
Domain two: Disaster Risk-Reduction Policy, Preparedness and Response

This domain explores a country's disaster risk-reduction strategies and policies at the national and sub-national levels, its budgetary processes in the area of disaster risk, and the extent to which disaster risk has been incorporated into national development plans and other policies. It also assesses governments' disaster preparedness and response capabilities, especially contingency planning for disasters, hazard monitoring, early-warning systems, and other steps that help an effective disaster response.

The quality of countries' disaster risk-reduction policies, preparedness and response are measured across five broad indicators (and 13 sub-indicators):

- National DRR policy framework.
- Sub-national DRR policy framework.
- DRR and response-budget allocation.
- Disaster risk-informed development.
- Preparedness and response.

Figure 8: Disaster risk-reduction policy, preparedness and response



Source: The Economist Intelligence Unit.

Strategic planning is key

The degree to which governments have integrated considerations of disaster risk into their strategic planning and policymaking varies greatly. Honduras, Italy, Madagascar, Niger and Taiwan, for instance, do not have a national strategy, or are in the process of finalizing one. Most countries' disaster-risk strategies aim to reduce risk, prevent disasters and strengthen economic, social and environmental resilience. However, only seven of these countries require sub-national governments

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to establish local DRR strategies. In the Philippines, for instance, the Disaster Risk Reduction and Management Act of 2010 clearly defines local governments' responsibilities in establishing DRR strategies. The list of stipulated tasks includes designing and co-ordinating DRR and DRM activities, capacity building and the operation of multi-hazard early-warning systems. In many other countries, there are no legal provisions that empower local governments and strengthen the role of local communities in DRM. One of these is Russia, where sub-national authorities do not have policymaking powers, but do have primary responsibility for implementation. St Petersburg has established its own DRR strategy, but this flood-prone and politically influential city is the exception.

All countries in our study have some sort of climate-adaptation plan, but, in many countries, integrating DRR and climate-change adaptation is a work in progress. DRR is now widely seen an integral part of social and economic development, and essential if development is to be sustainable for the future—a notion recognised by the Sendai Framework for Disaster Risk Reduction, adopted at the UN World Conference on Disaster Risk Reduction, held in Sendai, Japan, in 2015. Accordingly, disaster risk is no longer a separate consideration for governments and policymakers, but is included and accounted for in many countries' economic-development plans. Climate change threatens development and may lead to more frequent extreme weather events, which can have disastrous effects both on infrastructure and inhabitants. There is a significant overlap in managing these risks, and a failure to integrate climate-change adaptation and DRM into overall risk assessments can result in duplication of measures, policy incoherence, an inefficient use of resources, and damaging competition between different arms of government. Further progress needs to be made towards developing integrated policy frameworks for managing disaster risk and climate-change adaptation.

The prevention of the creation of risk has gained traction and many governments are tackling the issue through land use-planning laws, regulations, or other norms to discourage or ban investment in disaster-prone areas. Japan, for instance, has empowered local governments to categorise areas as disaster-prone, and allows them to ban or restrict construction. In China, laws restrict or prohibit production or construction activities that may cause water or soil loss in ecologically vulnerable areas. In India, experts see reform of the country's land use-planning laws as a key way of reducing vulnerability to a range of disasters, including flooding, mudslides and earthquakes.

Ignoring short-term political and commercial considerations, and building up longer-term resilience by making choices that often bring both benefits and costs, can be challenging. Nevertheless, there are plenty of examples of governments that make it happen. Japan's Act for Concerning Special Finance Support for Promotion Group Relocation for Disaster Mitigation provides financial support to people relocating from disaster-prone areas. The US government provides financial incentives for relocation of assets and individuals from flood-prone areas. China's disaster-prone Shanxi province in 2011 established a relocation plan that aims to move 2.4m people from hazard-prone to safer areas over 10 years. Initiatives like these tend to work best when there is a clearly identifiable, site-specific risk; populations have already been displaced; and people are given some say in the process of relocation/compensation. It is important to note that these measures are typically not "either… or" decisions, but can significantly reduce disaster risk by, for instance, relocating a share of the population at risk.

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Budget allocations for disaster risk are rising in many countries, but dedicated budgets are not yet the norm

Taking the long view, fiscal prudence alone demands the allocation of a budget for disaster risk-related events. The financial cost of disasters, especially in settings where losses are not insured against, can severely dent public funds. In practice, however, governments often face competing priorities, severe fiscal constraints, and incomplete information concerning both the probability of disasters and their potential cost. As a result, dedicated budget lines for DRM are far from the norm. High-income countries, such as Japan and the US, allocate billions of dollars to DRM every year. More often than not, however, governments spend money primarily on post-event response and recovery, especially in low- and middle-income countries. By contrast, Australia, China, Japan, the Philippines, Russia, South Korea and the US earmark funds for DRR and preparedness capabilities. Our research shows that funds for DRR, increasing preparedness and response capabilities and infrastructure, are available in most high-income countries, as well as in Bangladesh, China, Peru and the Philippines.

There is a trend towards boosting allocations for DRR and creating separate budgets. In Peru, disaster risk management funds have risen tenfold in absolute terms since 2011, and now account for about 1% of the public-sector budget. In the Philippines, the annual budget of the National Disaster Risk Reduction and Management Council (NDRRMC) tripled, to P38.9bn (US$840m), between 2015 and 2016. South Korea's Ministry of Public Safety and Security (MPSS), the national agency responsible for DRR, preparedness and response, has funding access to the annual budget for emergency and non-emergency purposes. Its 2016 budget stands at 3.2trn won (US$2.7bn), of which 701bn won have been earmarked for disaster-management programmes administered by the country's Disaster Management Office. Severe underfunding remains a problem in many low- and middle-income countries, and the sources of funds are often not secure. Tajikistan, for instance, has a central Fund for the Liquidation of the Consequences of Emergency Situations. It is aimed at compensating victims and funding rescue operations and reconstruction, but it is raised by tax on certain industries and not from the general budget.

A shift from disaster response to preparedness is underway

There is increasing recognition of the critical role of pre-disaster mitigation and preparedness. Most governments use new technologies, awareness campaigns, and other non-structural measures to protect their populations and physical assets. Engineering solutions and post-event response, with a focus on relief and recovery, still have a big role to play, but forward-looking solutions that make preparedness and behavioural changes priorities have been slowly gaining traction. Many governments are stepping up their game and have been trying to minimise the impact of disasters on their populations and assets, directly reducing the need for relief and rehabilitation. All countries (except Madagascar) have a dedicated and central national agency tasked with monitoring natural hazards, and most have national contingency plans enshrined in their laws or strategic plans. Contingency planning is often heavily concentrated at central-government levels: in eight countries, local governments are not required to formulate and implement their own contingency plans for natural hazards.

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New technologies have fostered countries' capacities to prepare and respond to disasters. In Taiwan, various computer and mobile-phone apps convey to users early-warning updates from the Central Weather Bureau. Schools are equipped with an instant-warning system for earthquakes. Laos, Papua New Guinea and Tajikistan, in contrast, presently do not have early-warning systems to disseminate mass messages via SMS. Another pathway to better disaster-risk preparedness is awareness education. While most countries have written their commitment to strengthen public education and awareness of DRM into their national strategies, the degree of implementation varies. In the Philippines, DRR has been integrated into school curricula at primary and secondary level, and DRR training is mandatory for public-sector employees. Another leader in this area is Japan, whose Central Disaster Management Council publishes a *Disaster Preparedness Drill Plan* annually, detailing the drills to be carried out nationally and by local authorities.

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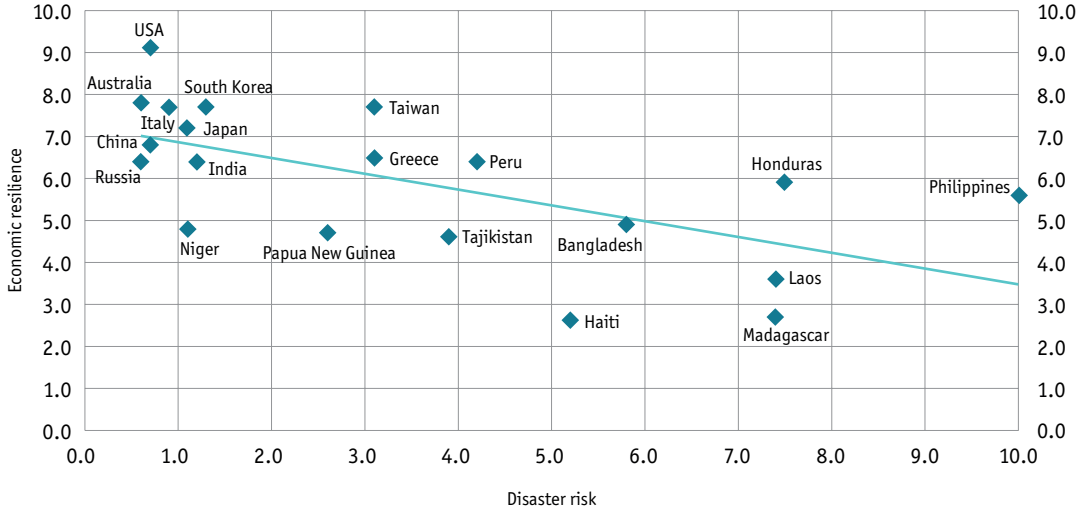
Domain three: Economic Resilience

This domain explores economic resilience—a crucial aspect of a country's capacity to absorb the short- and longer-term economic impacts of disasters. The economic-resilience domain assesses a country's economic structure and macroeconomic stability, its degree of trade openness, its access to insurance markets, and the state of economic development.

Economic Resilience is measured across four indicators (and a total of 11 sub-indicators):

- Economic and financial stability.
- Output and export diversification.
- Insurance market and emergency funds.
- Income and poverty level.

Figure 9: Economic resilience vs. disaster risk



Source: The Economist Intelligence Unit.

Industrialised countries with open and diverse economies are the most economically resilient

Economic resilience captures a country's capacity to deal with the negative shock of disasters and determines, in large part, its capacity to bounce back. Our operational risk-model results show that the US, Australia, Italy, South Korea and Taiwan are the most economically resilient countries. This is unsurprising; open economies with well-developed insurance markets, whose output is diversified and concentrated outside agriculture, are more resilient than those with a narrow economic base, which are vulnerable to large currency swings and have only a nascent financial sector.

The top performers in this domain are large trading nations with stable economic fundamentals, a well-developed banking sector, and a low sovereign debt risk (that is, countries that face a low

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risk of defaulting on their debt). These characteristics enable them to pay for disaster risk-related expenditure from domestic resources or, if necessary, by accessing international capital markets.

Conversely, economic resilience is relatively low in low-income countries. Other factors that undermine their economic resilience are underdeveloped financial and insurance sectors and limited trade openness. The least economically resilient countries also tend to be relatively poorly connected with the outside world by infrastructure, trade and investment. Our model results show that islands, or countries that are part of an island (Madagascar, Haiti, Papua New Guinea), or that are landlocked (Niger, Laos, Tajikistan), are among the least economically resilient.

The degree of access to insurance markets and economic resilience are highly correlated

The sophistication of a country's insurance market, along with the existence of emergency funds and its economic resilience, are highly correlated (at 0.89) in our model. The top four performers on this indicator are South Korea, the US, Taiwan and Australia. All of them have access to liquid insurance or reinsurance markets that allow them to hedge disaster risk. Affordability remains a problem, including in the world's most advanced economies. The US president, Barack Obama, signed into law the Homeowner Flood Insurance Affordability Act of 2014, making flood insurance more affordable by lowering recent rate increases on some policies, and capping some future rate increases.

Integrating climate and disaster risk into the insurance and reinsurance markets in ways that make disaster-risk insurance more widely available and affordable is a work in progress. The private-insurance segment has dramatically improved its capacity to manage disaster risk, for example, but a lack of capital and the difficulty of pricing in tail-risk tend to severely restrict the availability of insurance and/or make it prohibitively expensive, or simply make it unavailable. Scientific progress has made it possible for insurers to assign more accurately the probability of a disaster occurring, and policy change may help allocate more capital to disaster risk in the future. There is a role here for governments in addressing this type of market failure, by taking on risk themselves or passing regulation that helps make disaster risk explicit. For now, however, public-sector solutions are rare and often cannot be practically applied. A lack of information makes them difficult to design, their cost is uncertain, and there are questions about how efficient public-sector provision can be. In Korea, the Ministry of Public Safety and Security (MPSS) sponsors a catastrophe insurance programme that covers storm and flood risk. Under the scheme, the central government subsidises 55-86% of insurance premiums. The Philippines is in the process of setting up the Philippines Catastrophe Insurance Pool (PCIP). Its government and the World Bank are planning to set up a sub-national insurance pool that will provide local-government units with immediate liquidity following disasters, and design a property catastrophe risk-insurance pool for homeowners and businesses. In Australia, the federal government and most states have self-insurance arrangements, often managed through a statutory captive insurer, and some of these governments purchase commercial insurance for large-scale events.

Existing solutions led by the public sector tend to focus on the most prevalent risk. Japan, for example, has a private earthquake insurance programme that indemnifies against damage caused by earthquakes or volcanic eruptions, or from a tsunami following either of these events; however, the government reinsures private insurance companies, making these policies viable. In South Korea, the

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government sponsors and subsidises a Storm and Flood Insurance Program. China has earthquake-catastrophe insurance for residential buildings in selected provinces and the government is considering implementing nationwide earthquake catastrophe insurance for residential buildings by 2018.

The private sector provides the bulk of catastrophe insurance. In Greece, catastrophe insurance is almost entirely provided by the private sector. The same applies in India, although, following major flooding in Southern India in 2015, there have been calls for state-backed national catastrophe insurance.

In some developing countries, micro-insurance to protect farmers against the impact of agricultural disasters is available (for instance in Haiti and Bangladesh), but the geographical coverage, uptake and commercial viability of these insurance products tends to be limited. Papua New Guinea is one of 15 countries participating in the donor-led Pacific Catastrophe Risk Assessment and Financing Initiatives. The country is, however, not among the 10 currently participating in the scheme's Pacific Catastrophe Risk Insurance Pilot programme.

Countries that rely heavily on their agricultural sector are also the most economically vulnerable

Economic resilience is especially low in countries whose economies and populations rely heavily on their domestic agricultural sector. Extreme weather events—ranging from droughts and floods to cyclones and earthquakes—disproportionately affect agricultural sectors and the rural populations that depend on them for their livelihood.

Our analysis shows that countries where agriculture accounts for more than 20% of nominal GDP (Haiti, Laos, Madagascar, Niger, Papua New Guinea and Tajikistan) are also the least economically resilient. Disasters affect the agricultural sector via various channels: they can wipe out a significant share of food production and directly increase food insecurity; they can trigger a jump in imports (and a sudden need for foreign exchange to pay for them) as governments ship in food and goods to deal with the fall-out of a disaster; and they lower incomes through income losses and/or higher food inflation.

The magnitude of these effects is difficult to ascertain, as there are significant data gaps. Our model results, however, are consistent with recent findings of the Food and Agricultural Organisation (FAO). Based on a sample of 78 disasters in 48 developing countries in Africa, Asia and Latin America between 2003 and 2013, the FAO estimates that the agricultural sector (including crops, livestock, fisheries and forestry) absorbs about 22% of the economic impact caused by medium and large-scale hazards and disasters.

The FAO stresses that only 3.4% of humanitarian aid goes to agriculture, even though the sector absorbs more than one-fifth of total damage and losses by natural hazards. All of this underlines the critical need to mainstream DRR and build resilience within the agricultural sector, on which the most vulnerable people—who are often also the most food insecure—depend for their livelihoods.

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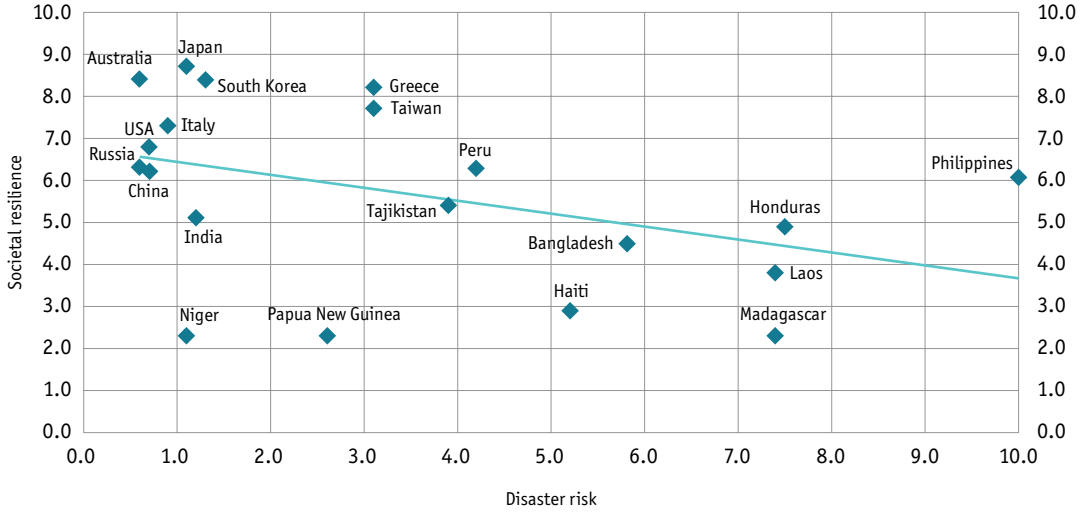
Domain four: Societal Resilience

This domain explores societal resilience—a measure of how societies respond to, and are able to cope with, the impact of disasters. The domain assesses this capacity by looking at 17, mostly quantitative, indicators. They cover areas that are crucial for a society to absorb effectively the negative impact of disasters: the country's ability to maintain public order; its capacity to provide public services (especially in the area of health) and meet basic needs; and proxy indicators for social cohesion and women's empowerment.

Societal resilience is measured across five indicators:

- Safety and security.
- Population health and quality of health systems.
- Food and water security.
- Social cohesion.
- Women's empowerment.

Figure 10: Societal resilience vs. disaster risk



Source: The Economist Intelligence Unit.

Cohesive societies are better equipped to cope with disasters

Our research and model results show that more cohesive societies are better able to cope with the impact of disasters: there is a negative correlation between countries' overall risk level and their societal resilience (-0.69). The best performers in this domain are Japan, Australia, South Korea, Greece and Taiwan—societies with a relatively equal income distribution (with a Gini co-efficient of 0.3-0.4). All of them have sizable welfare systems, capable of providing public goods and services in

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emergency situations: namely, health services, food security and public order. Three out of the top-five performers in this domain are East Asian societies.

Some of the indicators in this domain are remarkably accurate proxies for societal resilience. Countries with a small presence of internal security officers and police (0-150 officers per 100,000 population) tend to be less resilient. In the same way, countries with a high annual rate of homicide (nine or more per 100,000 people) rank at the bottom on this indicator, and a high rate of gun ownership appears to preclude a country's doing well in this category. Countries' performance in this domain is also determined by the existence and the quality of social safety nets. All countries exhibiting significant societal resilience offer universal healthcare, for example.

Finally, it is noteworthy that smaller and medium-size countries, which often tend to display more income equality, do well in this domain. The only top performer with a population of more than 100m is Japan, while population giants, China and India, struggle in this domain.

Disaster risk is highest where vulnerable societies and high exposure to natural hazards coincide

Societal resilience and the resilience of the physical environment are highly correlated. The correlation, at 0.91, is the closest between any of the domains. In other words, countries with populations most at risk from the consequences of disaster are also those with the most vulnerable societies. Our model shows that nine countries, which rank in the bottom half on societal resilience, also face the greatest exposure from the physical environment. This finding is consistent with that of the World Risk Index (WRI), calculated by the United Nations University for Environment and Human Security. The WRI concludes that disaster risk is highest where high exposure to natural hazards coincides with vulnerable societies.

There is an extremely close link between societal resilience and the quality of public health systems

We measure societal resilience through five indicators, but one of them is a particularly good guide to a country's societal resilience: the quality of public health systems and their ability to function in times of crisis, and the government's ability to deliver basic services, such as water, food and shelter. The indicator "population health and quality of the health system" is more closely correlated to societal resilience than any other indicator across domains (the correlation is 0.96). This close link is unsurprising, given the powerful role that a well-functioning public-health system can play in mitigating the impact of disasters on affected communities. The sub-indicators—which cover life expectancy, public health expenditure, health infrastructure and health-contingency planning—capture this. The top performers, without exception, have put in place legislation that requires hospitals to develop business-continuity programmes in the event of a disaster, and have capacity-building and training programmes to assist them with the development of such programmes. Other indicators, especially those relating to food and water security, are also crucial determinants of a country's societal resilience (with a correlation of 0.86). For instance, the share of the population with access to an improved water source and improved sanitation facilities strictly dictates countries' performance in this domain.

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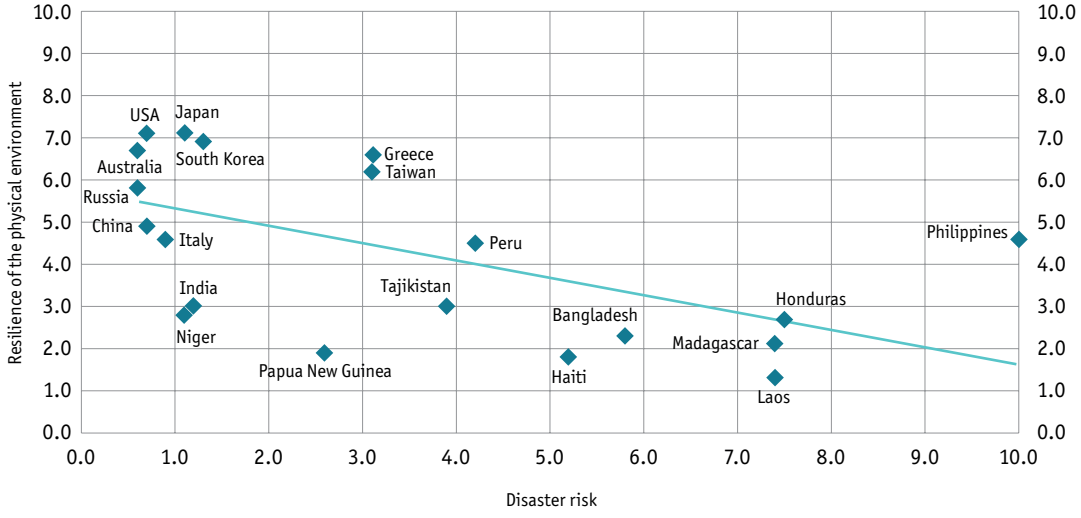
Domain five: Resilience of the physical environment

This domain explores the resilience of a country's physical environment. The frequency of disasters—including droughts, floods and other extreme weather events—varies across countries, as does their impact on the physical environment. We look at 16 qualitative and quantitative indicators that capture aspects of the resilience of a country's physical environment. These indicators range from measures to protect physical assets, and rules and regulations to make them safer, to the general quality of infrastructure and environmental governance.

Resilience of the physical environment is measured across five indicators:

- Environmental performance.
- Exposure of physical assets.
- Implementation of and adherence to building codes.
- Quality of existing infrastructure.
- Critical-infrastructure resilience.

Figure 11: Resilience of the physical environment vs. disaster risk



Source: The Economist Intelligence Unit.

The resilience of the physical environment accounts for much of a country's overall preparedness

The resilience of the physical environment is most closely correlated with countries' overall preparedness (0.94), equal only to societal resilience (0.94). The remaining three domains all have relatively weaker (albeit strong in absolute terms) correlations: economic resilience (0.90), institutional framework (0.81), and DRR policy, preparedness and response (0.74). These findings underline the importance of infrastructure investment, governments' capacity to protect ecosystems

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and human health, preventive and corrective measures and contingency planning in mitigating disaster risk. In eight countries, some types of infrastructure are lacking or inadequate. The research also shows that there are extensive human settlements in areas of disaster in 17 out of 20 countries.

Countries' progress in implementing preventive and corrective measures varies greatly

When it comes to improving the resilience of the physical environment, preventive measures, such as the implementation and adherence to building codes, play a crucial role. The best performers in this domain are Japan, the US, South Korea, Australia and Greece. All of these countries have put in place and promulgated the necessary legislation. In Taiwan, one of the top performers in this category, building codes were first introduced in the 1970s (although some older buildings do not comply with the latest regulations). In the US, there is no uniformly adopted nationwide federal framework in place for building codes; however, there are codes and standards established by recognized organizations that are adopted and sometimes modified sub-nationally. At the other end of the spectrum are countries with building codes that do not account for disaster risk: namely, Bangladesh, Haiti, Laos, Niger and Papua New Guinea. In Bangladesh, for instance, the government admits that 90% of structures do not comply with the building codes. In Tajikistan building codes are not comprehensive or enforced, whereas in Papua New Guinea there is only a dated code of practice for earthquake loading. In Russia, building regulations stipulate limits to the number of floors that can be built in earthquake-prone areas. However, in the Black Sea resort of Sochi, for instance, where the legal limit on the number of floors a building may contain is16, there are many buildings with twice that number.

Income, transparency and the quality of the legal system play a big role in successful risk mitigation

Taking steps to make the physical environment less vulnerable can be costly, and requires legislative action and a bureaucracy willing to enforce rules. It is unsurprising that countries' capacity to manage the risk of the physical environment is a function of their income levels, the robustness of their legal systems and countries' ability to enforce rules. Many countries have taken legislative action to make their buildings safer and to prevent construction in areas that are disaster-prone. Implementation and enforcement of these laws and regulations varies greatly across countries. Enforcement of building codes and environmental rules aimed at reducing disaster risk have cost implications for economic actors, which include the government. In countries with weak legal systems and with a high prevalence of corruption, these costs are easily be avoided by paying off officials. It is not surprising that the best performers in this sub-category are countries with a strong legal system or those where governments have the ability to enforce rules by other means.

South Korea, the US, China and Greece stand out as examples of countries that have implemented binding measures to facilitate the retrofitting of buildings to make them more disaster-resilient. In the US, the city of Los Angeles in 2015 passed a new law under which property owners have seven years to repair wooden buildings and 25 years to fix concrete buildings. Property owners are responsible for funding the improvements, ranging from US$60,000 to US$130,000 for wood-based apartments and millions of dollars for large concrete towers. In Russia, the government has launched a federal

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programme that aims to make buildings in earthquake-prone zones more disaster-resistant. However it focuses on government-funded retrofitting (rather than compelling owners to pay) and has only been partly implemented. The vast majority of countries lack even incentives to encourage people to take voluntary measures (such as tax breaks, variable stamp duty or low interest-rate loans) to facilitate the retrofitting of buildings to make them more disaster-resistant. Bangladesh, which is in the throes of upgrading the building safety of its garment industry, following the collapse of Rana Plaza in 2013, is an example of the tremendous cost of bringing about compliance in low-income countries; the effort to make factories safe is estimated to have cost billions of US dollars and was borne in the main by foreign buyers.

Adaptation can significantly reduce the number of disaster-related deaths

Bangladesh is an example of one of the most successful instances of DRR. Its Cyclone Preparedness Programme has significantly reduced the number of cyclone-related deaths (the deadliest cyclones in the past 50 years are those that have struck Bangladesh). In 1991, a cyclone killed 140,000 people. Since then, the average number of casualties has come down dramatically to a few hundred deaths in recent years. The country has learnt to adapt to recurrent cyclones and the world's biggest cyclone-shelter programme has been central to this achievement. The government and foreign donors have built thousands of concrete shelters on stilts in coastal areas, with a capacity for 9m people.

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Annex I: Analytical framework scoring model

Domain #1: INSTITUTIONAL FRAMEWORK

1.1 Disaster risk-management institutional structure

a. Dedicated national-level institutions responsible for disaster-risk management

Are there dedicated national-level entities (for example, agencies, committees, offices within a ministry) explicitly tasked with the national direction and coordination of disaster-risk management (DRM), defined as (1) Disaster risk reduction (DRR) and (2) preparedness and response measures? (Yes: there is at least one national-level entity explicitly responsible for dealing with (1) and (2) / No: there are no entities responsible for dealing with (1) or (2) / Partially: there is at least one national-level entity explicitly responsible for dealing with (1) or (2))

b. Regional and local DRM

Are there dedicated sub-national level entities explicitly tasked with the sub-national direction and coordination of DRM, defined as (1) DRR and (2) preparedness and response measures? (Yes: there is at least one sub-national level entity explicitly responsible for dealing with (1) and (2) / No: there are no entities responsible for dealing with (1) or (2) at the sub-national level / Partially: there is at least one sub-national level entity explicitly responsible for dealing with (1) or (2))

c. National platform/committee for coordination of stakeholders

Is there a formalised national platform/committee that helps with private-sector involvement, coordination and information exchange?
(Yes / No / Partially: there is a platform/committee, but it is not clear what it is used for in practice)

1.2 Operational effectiveness

a. Staffing

Does the leading national governmental institution responsible for DRM have a permanent staff?
(Yes/No)

b. Access to resources

Does the agency responsible for responding in the event of a disaster have *direct* access to financial (that is, funds) resources in case of an emergency? (Yes, they have direct access / No / Partially: they have access, but there is a lengthy approval process in place)

c. Support from political leadership

Have leading government members (prime minister, president, or ministerial-level) expressed active support for DRM since January 1st 2013? (Yes/No)

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d. Reporting into line ministry

Does the entity responsible for DRM report directly into a line ministry or the presidency? (Yes, and there is a monitoring body mandated to guarantee its independence / Yes, although there is no monitoring body mandated to guarantee its independence / No)

1.3 Transparency and accountability

a. National monitoring and reporting

Does the leading national governmental institution responsible for DRM regularly publish reports on national-level DRM activities?
(Yes: reports are published at least annually and are publicly available / No: there is no reporting or there is no dedicated institution / Partially: reports are published less frequently or are not publicly available)

b. Sub-national monitoring and reporting

Does the leading national governmental institution responsible for DRM regularly publish reports on sub-national level DRM activities?
(Yes: reports are published at least annually and are publicly available / No: there is no reporting or there is no dedicated institution / Partially: reports are published less frequently or are not publicly available)

c. Monitoring and evaluation plan/framework

Is there a clear and established plan/framework for the monitoring of ongoing disaster management activities (for example, national resilience programmes) defining (1) evaluation mechanisms, (2) metrics and (3) frequency of evaluation? (Yes, all three / No / Partially: (1), (2), or (3)

1.4 Political stability

(all indicators come from CRS: CRS scores from 0 to 4, with 4 being the highest risk)

a. Institutional effectiveness

Is the political system able effectively to formulate and execute policies?

b. Governability

Is governability hampered by social unrest or similar limiting factors?

c. Orderly transfers

Are constitutional mechanisms for the orderly transfer of power from one government to another clear, established and accepted?

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Domain #2: DISASTER RISK-REDUCTION POLICY, PREPAREDNESS AND RESPONSE

2.1 National DRR framework

a. Does the country have national DRR strategies? (Yes/No)

b. If (A1) yes, are national DRR strategies aimed at (1) preventing the creation of risk, (2) the reduction of existing risk, and (3) the strengthening of economic, social, health and environmental resilience? (Yes, all three / Yes, two of the above / Yes, one of the above / No)

c. If (A1) yes, do national DRR strategies have (1) clear targets, (2) indicators (that is, tracking progress) and (3) timeframes for completion? (Yes, all three / Yes, two of the above / Yes, one of the above / No)

2.2 Sub-national DRR framework

a. Is the role and responsibility of local government in DRR planning and implementation legally defined? (Yes/No)

b. If (B1) yes, does the national government require sub-national governments to establish local DRR strategies aimed at (1) preventing the creation of risk, (2) the reduction of existing risk, and (3) the strengthening of economic, social, health and environmental resilience? (Yes, all three / Yes, two of the above / Yes, one of the above / No)

c. If (B1) yes, do sub-national DRR strategies have (1) clear targets, (2) indicators (that is, tracking progress) and (3) timeframes for completion? (Yes, all three / Yes, two of the above / Yes, one of the above / No)

2.3 DRR and response-budget allocation

a. DRR budget

A1. Does the country have a dedicated budget line for DRR? (Yes /No/ Partially: there is a DRM budget, but there is not a specific focus in this area

A2. Does the country have a dedicated budget line for *increasing preparedness and response capabilities* (for example. contingency planning, stockpiling of equipment and supplies, associated training and field exercises) (Yes /No/ Partially: there is a DRM budget, but there is no specific focus on this area)

A3. Does the country have a dedicated budget line for *infrastructure reconstruction* in the aftermath of a disaster (Yes/ No / Partially: there is a DRM budget, but there is no specific focus in this area)

A4. Can funds be accessed by local governments? (Yes, for all aspects of A1, A2 and A3 / Yes, for some of A1, A2, A3 / No)

2.4 Disaster risk-informed development

a. Disaster risk-sensitive national development plans

Is disaster risk included and accounted for in national economic development plans? (Yes / No / Partially: There is no formal national economic development plan, but disaster risk is accounted for in other policy areas)

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b. Climate change-adaptation policy
Are policy frameworks for managing disaster risk and climate change-adaptation integrated (that is, addressed in the same document) (Yes / No / There is no formal climate-adaptation plan)

c. Disaster risk-sensitive investment
C1. Do land use-planning laws, regulations and norms discourage or ban *investment* or construction in disaster-prone areas (for example, flood plains) that do not benefit from protective infrastructure (for example, are protected by dykes or other infrastructure)? (Yes, there are national provisions / Yes, but only at a sub-national level and not always / No)
C2. Does the country have a scheme (based on law or programmatic planning) to provide financial incentives (subsidy or tax exemption) for relocation of assets and individuals from hazard-prone to safer areas (Yes / No)

d. Environmental-degradation policies
Do policies on environmental degradation (for example, around deforestation, destruction of coral reefs, etc.) and safeguarding natural ecosystems include provisions specific to DRM? (Yes / No)

2.5 Preparedness and response

a. Hazard monitoring
Is there a national agency tasked with monitoring natural hazards (including collaboration with international agencies / observatories) (for example, weather forecasting agency)? (Yes / No)

a. Contingency planning (national)
Does the country, based on law or strategic document, have national contingency plans (that is, a planned response to the potential occurrence of a hazard)? (Yes/No)

b. Contingency planning (sub-national)
Does the country require local governments to formulate and implement contingency plans for natural hazards? (Yes / No)

c. Early-warning systems
Does the country have early-warning systems (for example, for natural hazards) able to disseminate mass messages (for example, SMS alerts)? (Yes / No)

d. Mobile phone penetration
What is the depth of mobile-phone penetration?

e. Preparedness education
Does the country have a national strategy that aims to strengthen public education and awareness of DRR and preparedness? (Yes / No)

f. Response measures body
Is there a body tasked specifically with managing and providing response measures in case of a disaster? (Yes / No)

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Domain #3: ECONOMIC RESILIENCE

3.1 Economic and financial stability

a. Economic-structure risk
Is there a prevalent structural macroeconomic risk (that is, high volatility of GDP growth, high public debt / GDP, high gross external debt / GDP)? (EIU)

b. Currency risk
Is there the risk of a maxi-devaluation against the reference currency (a devaluation of 25% or more in nominal terms over the next 12-month period)? (EIU)

c. Banking sector risk
Is there the risk of a systemic crisis, whereby bank(s) holding 10% or more of total bank assets become insolvent and unable to discharge their obligations to depositors and / or creditors? (EIU)

d. Sovereign risk
Is there the risk of a build-up in arrears of principal and / or interest on foreign- and / or local-currency debt that is the direct obligation of the sovereign or guaranteed by the sovereign? (EIU)

3.2 Output and export diversification

a. Reliance on agriculture
Is output highly concentrated in the agricultural sector?
(Yes: 20% or more of nominal GDP at factor cost was produced in agriculture / No: less than 20% of nominal GDP at factor cost was produced in agriculture)

b. Export-goods diversification
Are goods exports highly concentrated in one sector?
(Yes: 50% or more of goods export value was produced in one sector / No: less than 50% of goods export value was produced in one sector)

c. Export-services diversification
Are services exports highly concentrated within tourism?
(Yes: 50% or more of services export value comes from travel services / No: less than 50% of services export value comes from travel services)

3.3 Insurance market and emergency funds

a. Insurance-market penetration
What is the share of gross direct insurance premiums as a share of nominal GDP?

b. Supervision and regulation
Is there (1) a government body responsible for the supervision and regulation of the insurance industry, and is there (2) a regulatory framework in place?
(Yes, both (1) and (2) / No: either (1) or (2) or none)

c. Catastrophe insurance
D1. Is catastrophe insurance available in the country? (Yes / No)

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D2. Are there documented instances from reputable sources (for example, national audits, international assessments) suggesting that catastrophe (or related) insurance products are unaffordable to low-income households? (Yes / No)

3.4 Income and poverty level

a. GDP per head

What is the country's GDP per head? (GDP PPP in US$)

b. Poverty

What is the percentage of the population with an income of less than US$1.25/day?

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Domain #4: SOCIETAL RESILIENCE

4.1 Safety and security

a. Safety and security

A1. What is the number of internal security officers and police per 100,000 people?

A2. What is the annual number of homicides per 100,000 people?

A3. How easy is it to access small arms and light weapons?

4.2 Population health and quality-of-health systems

a. Life expectancy

A1. What is the population's life expectancy at birth? (World Bank)

b. Quality of the health system

B1. What is the health expenditure per capita (current; US$)? (World Bank)

B2. What is the number of physicians (per 1,000 people)? (World Bank)

B3. What is the number of hospital beds (per 1,000 people)? (World Bank)

c. Disaster-specific health-contingency planning

C1. Is there regulation requiring hospitals to develop business-continuity programmes in the event of a disaster? (Yes / No)

C2. Are there capacity-building and training programmes to assist hospitals with the development of business-continuity programmes (for example, training for hospital administrators)? (Yes/No)

4.3 Food and water security

a. Food security

A1. Does the country have a food-security policy (for example, maintaining food stockpiles, having contingency arrangements to purchase food or controlling food exports in the case of a food crisis)? (Yes / No)

b. Water and sanitation

B1. How extensive is access to improved sanitation facilities (% of population with access)? (World Bank)

B2. How extensive is access to an improved water source (% of population with access)? (World Bank)

4.4 Social cohesion

a. Income inequality

A1. What is the Gini coefficient?

b. Social safety nets

Does the country offer universal healthcare? (Yes / No / Somewhat)

c. Participation in political processes

Is the population engaged in political processes? (EIU Democracy Index)

4.5 Women's empowerment

a. Education

A1. Mean years of schooling, female (UNESCO)

A2. Literacy rate, female (UNESCO)

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Domain #5: RESILIENCE OF THE PHYSICAL ENVIRONMENT

5.1 Environmental performance

a. Ecosystem vitality

How does the country score in the "ecosystem vitality" indicator of the Yale Environmental Performance Index? (0-100)

5.2 Exposure of physical assets

a. Existence of assets at risk

How extensive are human settlements in areas at risk of disaster? (Very extensive/Some presence/Little or no presence)

b. Protective infrastructure

Is there a documented lack of necessary protective infrastructure (for example, dykes, levees, anchorage, drainage, snow nets, etc.) in the country? (Yes, infrastructure overall is lacking or inadequate / No / Partially: some types of infrastructure are lacking or inadequate)

5.3 Implementation of and adherence to building codes

a. Preventive measures: building codes

A1. Does the country have building codes that account for disaster risk? (Yes/No)
A2. If yes, were building codes that account for disaster risk implemented prior to January 1st 1996? (Yes / No)

b. Preventive measures: adherence to building codes

B1. Are there documented instances of informal settlements (for example, slums or illegal construction) or informal land-ownership arrangements? (Yes / No)
B2. Is corruption among public officials pervasive (for example, a large number of officials appointed rather than elected, reports or rumours of bribery)?

c. Corrective measures: voluntary retrofitting

Has the country implemented incentives to encourage *voluntary* measures (for example, tax breaks, variable stamp duty, low interest loans) to facilitate the retrofitting (for example, *seismic retrofitting*) of buildings to make them more disaster-resistant?
(Yes, at a national level / Yes, at a sub-national level / No)

d. Corrective measures: binding retrofitting

Has the country implemented *binding* measures (for example, Los Angeles's earthquake-safety regulation) to facilitate the retrofitting (for example, *seismic retrofitting*) of buildings to make them more disaster-resistant?
(Yes, at a national level / Yes, at a sub-national level / No)

5.4 Quality of existing infrastructure

b. Road density

How high is the road density of the country (km of paved roads per million population (EIU/ International Road Union)

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c. Rail-network density
How high is the rail-network density of the country (km per million population)? (EIU)

d. Port infrastructure
What is the quality of the port infrastructure? (From 5, very good, to 1, very poor) (EIU)

e. Air-transport infrastructure
What is the quality of the air-transport infrastructure? (From 5, very good, to 1, very poor) (EIU)

f. Power outages
Can firms in the country be expected to experience regular (at least once per month on average) power outages? (Yes / No) (World Bank)

5.5 Critical-infrastructure resilience

a. Critical-infrastructure plan
Does the country have a critical-infrastructure plan?
(Yes / No)

b. Identification of vulnerability and risk of disruption
Does the government (or its responsible ministries or agencies) carry out predictive disaster-scenario modelling or scenario analysis (for example, failure mode and effects analysis and identification of gaps in design standards)? (Yes, on a regular basis / Yes, on a sporadic basis / No)

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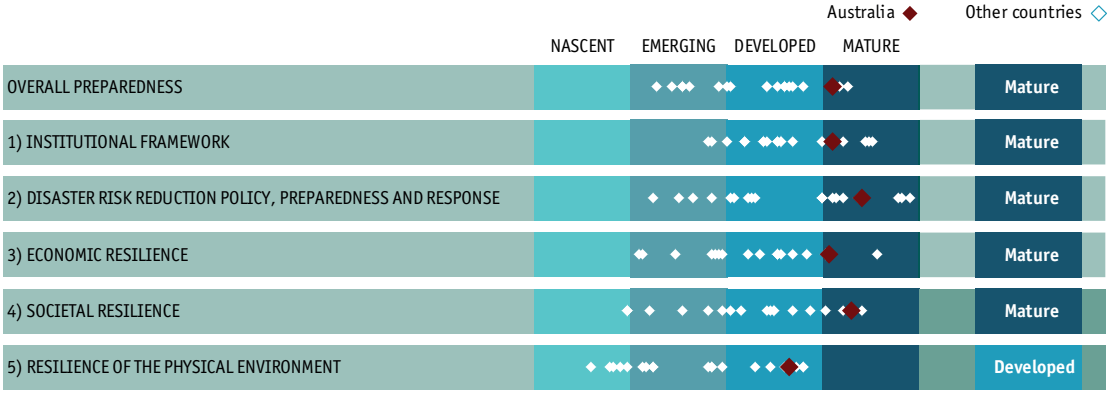
Annex II: Country summaries



Australia

Institutional framework

The federal Attorney-General's Department (which is part of the Ministry for Justice) is the national body responsible for disaster risk management and operations, and the Emergency Management Australia (EMA) division is responsible for preparing for emergencies and disasters by developing and maintaining national plans, and for the co-ordination of crisis response and recovery. The EMA operates the Australian Government's Crisis Coordination Centre—a 24-hour, all-hazards facility that monitors hazards and co-ordinates physical and financial assistance, disaster relief, information and support for the federal government, state governments and non-government agencies. The National Security Resilience Policy division provides policy advice on emergency management, protective security and critical infrastructure protection[1]. The Attorney-General's Department has permanent staff working on disaster risk management, and it publishes performance reviews on its disaster risk management activities in its annual report.

Under Australia's constitutional arrangements, state governments are responsible for emergency management within their jurisdictions and are required to have structures (and funding) in place to deal with disasters. There are also funding mechanisms at the federal government level for meeting state government requests for assistance in the case of large-scale emergencies or disasters. The federal government and state governments share post-disaster recovery and rehabilitation costs under the Natural Disaster Relief and Recovery Arrangements. However, state governments must have reasonably adequate capital (or access to capital) to fund infrastructure losses before being granted access to federal funds[2]. There are several platforms for improving co-ordination between government

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and the private sector on disaster risk management, including the Australian Business Roundtable on Disaster Resilience and Safer Communities[3].

Disaster risk reduction and disaster risk management policy

State governments are responsible for ensuring that legislative and regulatory provisions (such as land-use planning) are in place to manage disaster risk, and most public investment and other planning approvals that might involve some element of disaster risk occur at the state level[4]. In 2011, the Council of Australian Governments (COAG; the peak inter-governmental forum) signed up to the National Strategy for Disaster Resilience[5]. The strategy's priority outcomes encompass disaster risk reduction, improvements to preparedness and response, and the strengthening of economic, social, health and environmental resilience. The COAG's Law, Crime and Community Safety Council (LCCSC)—which consists of federal and state ministers responsible for policing and emergency management—is tasked with overseeing implementation of this strategy. The strategy does not operate in isolation; rather, it is complemented by other initiatives, including the National Climate Change Adaptation Action Plan[6 7]. Risks to the environment, including those related to potential disasters, may also require assessment and approval under the federal Environment Protection and Biodiversity Conservation Act 1999 and/or state legislation[8].

The Bureau of Meteorology monitors weather-related hazards, including floods, heat, drought and tropical cyclones, and it issues warnings using a range of mediums. Geoscience Australia monitors earthquake hazards, and tsunami warnings are issued via the Australian Tsunami Warning System. Emergency Alert—Australia's national, telephone-based emergency warning system—can send SMS warnings to mobile phones and fixed-line telephones[9].

Australia's exposure to severe weather events that affect human settlements is increasing, as population growth leads to greater development in areas that are subject to events such as floods and bushfires[10]. Australia's building codes account for disaster risk and are regularly reviewed, but overall protective infrastructure is inadequate[11].

Key challenges and areas for policy improvement

The Productivity Commission's report on climate change adaptation highlights the absence of measures that facilitate retrofitting existing housing in order to improve disaster resilience[12]. Another key issue is the lack of timeframe for implementing the priority outcomes identified in the National Strategy for Disaster Resilience. A progress report also identified "measurement, evaluation and strategic priority setting" as a key area that would benefit from a more targeted effort[13]. Other concerns include the affordability and availability of insurance for low-income households, and the fact that existing federal funding arrangements are heavily skewed towards disaster recovery, potentially reducing the incentive for state governments to invest in disaster mitigation[14].

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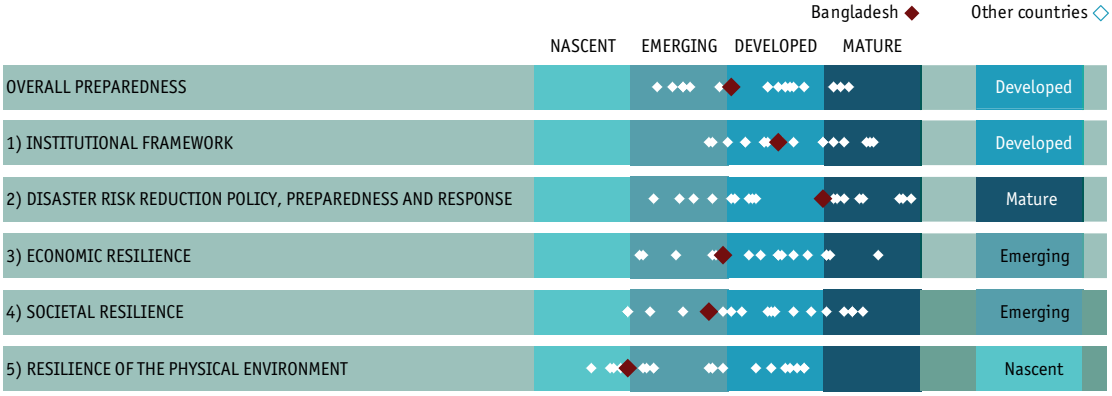
Bangladesh



Institutional framework

The Ministry of Disaster Management and Relief (MoDMR) is the national-level entity responsible for disaster risk management. It reports to the National Disaster Management Council, which is headed by the prime minister. The MoDMR's Department of Disaster Management (DDM) carries out field-level activities through a network of over 2,000 village disaster management committees, 40 district disaster management committees, line ministries and donors[15], and it has approximately 1,200 staff nationwide[16]. The government has dedicated funds for disaster risk reduction, climate change adaptation, recovery and rehabilitation, and United Nations (UN) agencies and non-governmental organisations allocated more than US$100m for disaster risk reduction (DRR) and climate change adaptation (CCA) in 2013–14[17] [18]. There is no monitoring body that guarantees the MoDMR's independence. Disaster management committees at the district level and upazila level (the lowest tier of government) are suitably empowered by law, but bringing about greater community participation and decentralised decision-making remains a challenge. There is no formalised national platform to help the private sector and other stakeholders get involved in disaster risk management[19].

Disaster risk reduction and disaster risk management policy

The National Plan for Disaster Management summarises the government's strategies and visions for disaster management[20]. The policy framework addresses prevention, preparedness, response and recovery, and disaster risk reduction regulations are included in ministries' and government departments' planning and budgeting processes[21]. The government has accounted for disaster risk in its economic development plans, including the Bangladesh Climate Change Strategy and Action Plan (2009–2018). The 7th Five-Year Plan (2016–20) also includes a chapter on sustainable development, the environment and climate change[22]. There are no specific provisions in environmental laws pertaining to disaster risk management, but Bangladesh does have contingency planning for different hazards. A number of agencies are tasked with hazards and issuing early warnings, including the Bangladesh Meteorological Department and the Flood Forecasting and Warning Centre.

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Bangladesh is one of the most disaster-prone nations in the world[23], and every year, approximately 10m Bangladeshis are affected by natural hazards. Poor protective infrastructure is one of the main reasons for the country's vulnerability to disasters.

Key challenges and areas for policy improvement

Bangladesh has come a long way in developing its disaster risk management capacity. A key challenge now is to replace the country's traditional focus on relief with a greater emphasis on preparedness and disaster risk reduction. This requires more decentralisation, efforts to strengthen the role of local communities in disaster risk management (especially women), and steps to improve monitoring and accountability.

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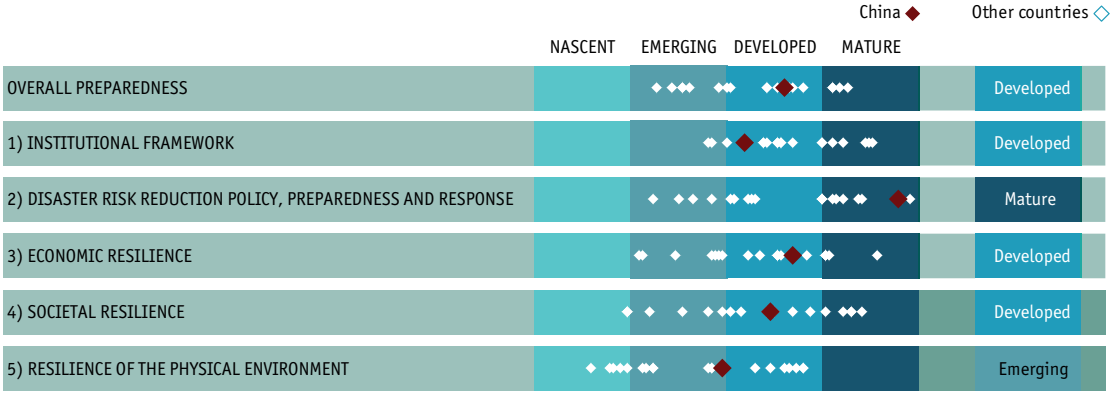
China



Institutional framework

As China's leading national entity for disaster risk management, the China National Commission for Disaster Reduction (NCDR) formulates national plans for disaster reduction, provides guidelines to sub-national entities and co-operates with international organisations for information exchange[24]. The NCDR has also established the Department of Disaster Relief (under the Ministry of Civil Affairs) to conduct disaster risk management activities under its guidance[25]. The expert boards of the NCDR, the National Disaster Reduction Centre of China (NDRCC) and the National Technical Committee on Disaster Reduction and Relief of Standardisation Administration of China (NTCDRRSAC) are dedicated to providing consultation on policies, strategies, regulations and technologies for the NCDR[26]. Members of the NCDR are selected from relevant ministries, commissions and administrations under the State Council, as well as military divisions, scientific research institutions and non-governmental organisations. Most staff members in the Department of Disaster Relief are permanent, as are members of the expert boards of the NCDR, NDRCC and NTCDRRSAC[27].

Different laws for disaster risk management have defined responsibilities for sub-national governments, and provincial and municipal governments have set up local entities accordingly to conduct disaster-related activities[28]. All levels of government have their own dedicated budgets for disaster-related activities, and both funds and rescue materials can be accessed immediately by the corresponding entities for disaster reduction, preparedness and response[29]. Sub-national entities report to their superior entities, but there is no independent monitoring agency (other than the media) to examine the accountabilities of the entities at all levels[30]. Both the government and organisations conduct disaster risk management activities without private-sector involvement.

Disaster risk reduction and disaster risk management policy

Disaster risk reduction (DRR) and preparedness are covered in the National 12th Five-Year Plan on Comprehensive Disaster Prevention and Reduction, which is an integral part of a series of strategic plans for national economic and social development[31]. The plan focuses on improving monitoring and technology, constructing protective infrastructures and increasing rescue materials[32]. Any development and investment project that may cause water and soil loss has to propose preventative

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countermeasures and complete an environmental evaluation before attaining any funds[33]. Both China's National Plan for Climate Change (2014–2020) and the Environmental Protection Law of the People's Republic of China mention disaster prevention, reduction, preparedness for and response to climatic and environmental incidents[34].

The National Meteorological Centre covers extreme weather warnings, while the China Earthquake Administration provides real-time updates for global earthquakes. All alerts are available on their websites, and instant notifications are sent to mobile users through news platforms[35]. Disaster drills, community activities and national education are required to strengthen public awareness on preparedness and response[36]. A number of national and regional contingency plans have been developed, based on the Emergency Response Law of the People's Republic of China, which provides contingency response guidance for natural disasters, calamitous accidents and public health incidents[37]. Different levels of government are in charge of response measures, based on the severity of the disaster.

Aseismatic fortification requirements apply to construction projects from 1998 onwards, buildings on the seismic belt, schools and hospitals[38]. For families living in dilapidated buildings, direct subsidies are provided to conduct retrofitting, and relocation projects are planned for communities that reside in hazard-prone areas, both at the expense of the government[39].

Key challenges and areas for policy improvement

Many people still lack knowledge about disaster preparedness and response, and a systematic education system could improve public awareness[40]. China's catastrophe insurance plan could also be developed to compensate high-risk regions effectively in the near future[41]. Another challenge is the development of a coherent framework on climate change that is integrated with the main DRR framework for risk assessment and adaptation planning[42], as well as a platform to enhance national actions and reduce disasters by allowing private-sector and civil society participation[43]. Training programmes in disaster psychological first aid could be provided for social workers so that they can assist populations affected by disasters[44].

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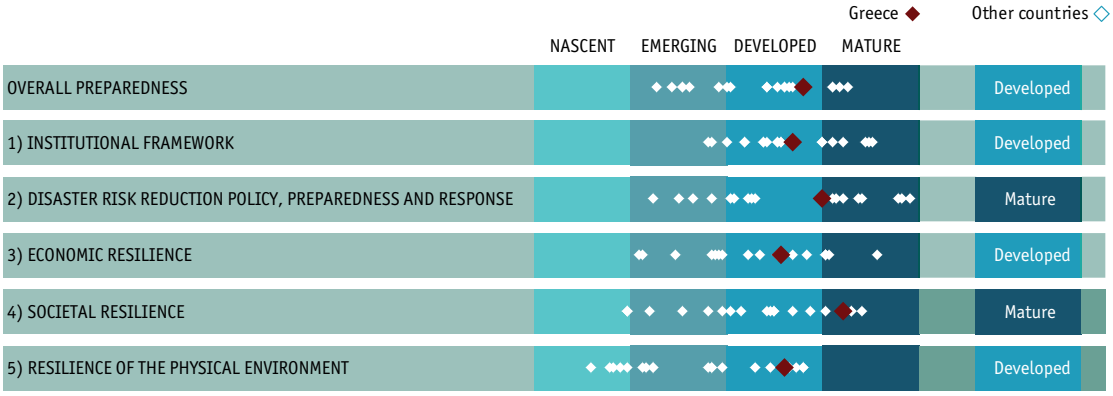
Greece



Institutional framework

The principal agency tasked with disaster risk management is the General Secretariat for Civil Protection[45], which is an integral part of the Ministry of the Interior[46]. The secretariat has its own earmarked budget (within the Ministry of the Interior's Budget), which stood at Euro2.7m in 2016[47]. Significant parts of the budgets of other government agencies (including the fire department, police, coastguard and national meteorological service) are also dedicated to disaster risk management, although the extent of this budgetary support is difficult to ascertain. The secretariat has a permanent staff, and its organisational chart is public[48]. It publishes annual reports on its website, including national and regional data on its activities, and the last nine annual reports (2006–2014) are available in pdf format[49]. These reports include operational data, but they do not include financial data.

Greece's administrative divisions consist of 325 municipalities, organised into 13 regions. These are further consolidated into seven decentralised administrations, which are local branches of central government, rather than institutions of local government (i.e., they are centrally appointed rather than locally elected). All three tiers are tasked with disaster risk management[50] and have budgets allocated to them for this task via the General Secretariat for Civil Protection. Stakeholder co-ordination also falls within the remit of the General Secretariat for Civil Protection [51 52 53].

Disaster risk reduction and disaster risk management policy

Greece has a national disaster risk reduction policy that spans five-year periods[54]. This policy is drawn up by the General Secretariat for Civil Protection, which is also in charge of responding to disasters[55 56]. The policy focuses on analysing existing risk, improving sustainability, protecting the environment and preventing climate change, as well as any relevant health, education[57] and training policies[58]. Social, health and environmental resilience are explicitly mentioned. Greece's investment and business licensing process also takes disaster risk reduction into account. The environmental licensing terms for various types of business are described in law[59], covering many aspects of disaster risk reduction, as well as some aspects of disaster response capability.

Disaster risk management and climate change adaptation are treated as separate policy areas.

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Disaster risk management falls within the remit of the Ministry of the Interior[60], and climate change adaptation falls within the remit of the Ministry of the Environment[61 62]. Legislation to prevent environmental degradation does not include provisions specific to risk management[63 64]. Greece has a set of published disaster contingency plans, referenced by the code word *Xenokratis*[65]. Monitoring natural hazards lies within the remit of the Hellenic National Meteorological Service[66] and early warning systems are in place[67], although these are deemed basic[68] and not integrated[69].

Greek authorities have mapped high-risk areas for forest fires[70], floods[71] and seismic activity[72], and these include areas with significant human presence. Building codes accounted for some aspects of disaster risk as early as 1959[73], and fire safety requirements were upgraded in a major overhaul in 1988[74].

Key challenges and areas for policy improvement

Greece could benefit from greater public accountability, which could be achieved through greater transparency in the use of funds allocated to disaster risk reduction and disaster response. At present, only sweeping budgets are published (with no breakdown by activity), and annual reports, although rich with operating detail, provide no indication of how funds are used. Greece is also exhibiting a silo approach in terms of regulation, and key issues such as investment incentives, climate change and environmental degradation have not been integrated into disaster risk reduction policy.

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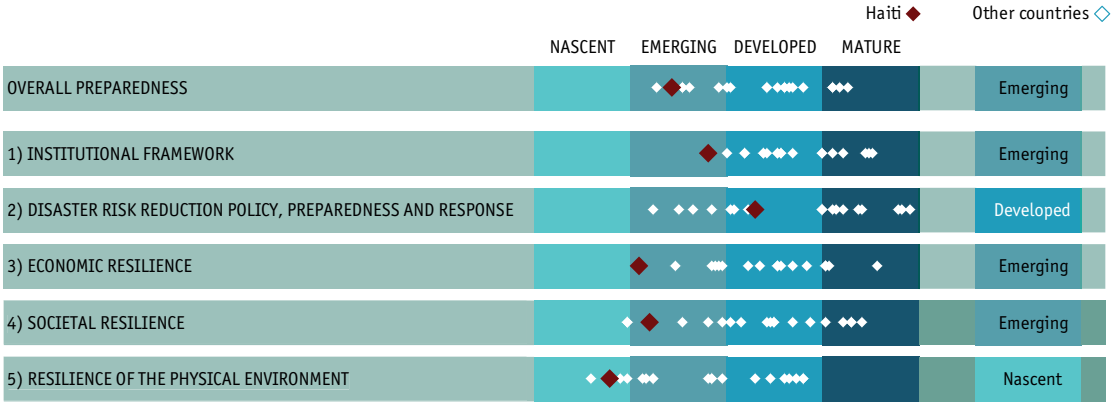
Haiti



Institutional framework

Haiti's disaster risk reduction (DRR) system (*the Système national de gestion des risques et des désastres*; SNGRD) is co-ordinated by the Civil Protection Directorate (DPC)—a dependency of the Ministry of the Interior[75] tasked with both the co-ordination of disaster response and risk and disaster management[76]. The SNGRD is organised at the sub-national level, and Haiti's ten departments have active committees, as well as 100+ active civil society committees[77]. Through a Permanent Secretariat, the DPC co-ordinates the disaster-related efforts of the central government, non-governmental organisations (NGOs) and civil society[78], while the Alliance for Risk Management and Continuity of Operations (AGERCA) serves as a platform for civil society and private-sector support[79]. The DPC has a permanent staff, although a lack of trained staff at national and sub-national levels is one of the DRR system's main shortcomings[80]. The DPC's independence is also undermined by the lack of a distinct budget line. (The office receives funding from the budget allocation assigned to the Ministry of the Interior in the annual national budget lines, rather than directly via appropriations[81].) International partners and donors provide a large portion of the system's funding[82]. The agency's efficacy is further limited by its status as a technical branch of the Ministry of the Interior, as well as the fact that it exists under an organic law of the Ministry and lacks legal status itself[83].

Disaster risk reduction and disaster risk management policy

Haiti's national DRR plan (*Plan National de Gestion des Risques et des Désastres*; PNGRD) establishes goals and objectives for disaster risk management[84]. It focuses on addressing the factors that generate risk in order to reduce the probability of disasters, and reinforcing the capacity to respond to disaster-related needs[85] [86]. There is no direct budget line for increasing preparedness and response capabilities, and as a result, the DPC only has the financial capacity for disaster response, which receives further funding from an Emergency Fund (*Fund d'Urgence*)[87]. An Emergency Operations Centre (*Centre d'Opérations d'Urgence*; COU) also exists for operational and communications purposes in the event of an emergency[88].

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The strengthening of economic, social and environmental resilience is mentioned in the PNGRD (DRR is a cross-cutting issue), and ministries are required to formulate DRR plans[89]. However, climate resilience and DRR are not linked[90]. Some specific DRR regulations exist—such as legislation for land-use planning[91] and a recently adopted building code[92]—but land-use planning laws are outdated[93], and enforcement and oversight is weak[94 95]. Human settlements in risk-prone areas are extensive[96], and informal settlements are the norm[97 98]. Hazard monitoring of weather events exists[99], and a national early warning system (EWS) is in place for both hurricanes and flooding[100]. Advances have been made in contingency planning for the annual hurricane season[101], and in preparedness education, which is in place despite a lack of regulation[102 103].

Key challenges and areas for policy improvement

DRR is limited by Haiti's weak institutional framework. The PNGRD is not supported by any specific piece of legislation[104], and it does not have any implementation mechanisms or underlying regulations, which reduces the strategy to a set of guidelines rather than a policy[105]. The DPC also lacks a legal foundation, and as a technical branch of the Ministry of the Interior, its inability to receive funding and human resources limits its capacity to engage in the prevention and management of natural disasters, in addition to disaster response[106]. The system is also challenged by the country's unstable political situation, which has limited policymaking and governability[107], including a DRR plan that has been pending approval for some time[108].

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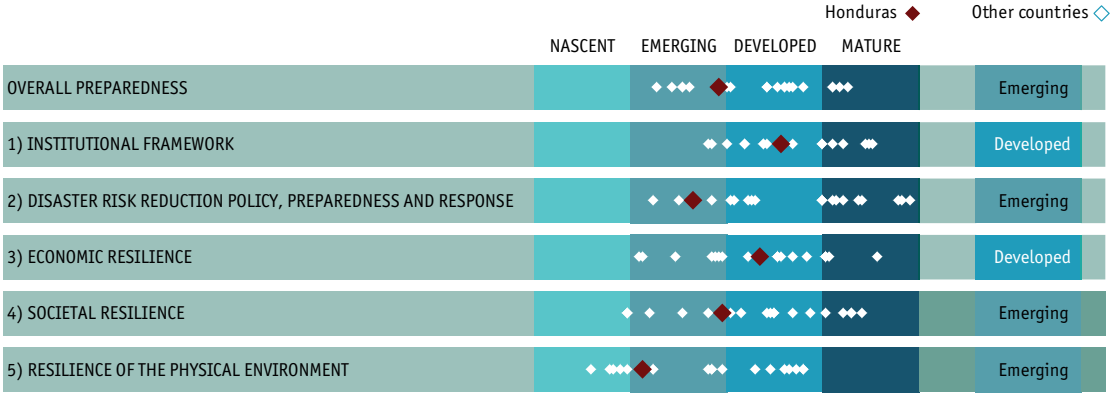
Honduras



Institutional framework

According to Germanwatch's Global Climate Risk Index, Honduras was the world's most vulnerable country in terms of climate risk from 1995 to 2014[109]. It has taken steps to implement disaster risk management, but funding and co-ordination are still lacking. The framework for disaster risk management (DRM) in Honduras has been in place since 1990, when the legislature approved the Law of National Contingencies (Legislative Decree No. 9-90E). This law created the Standing Commission of Contingencies (*Comisión Permanente de Contingencias*; COPECO) and defined its main responsibilities with respect to disaster preparedness and risk reduction. In 2009, the government created the National System for Risk Management (SINAGER) and expanded COPECO's role to include implementing a proactive risk-management policy that integrates DRM considerations into all aspects of the government's planning process[110]. By law, all government entities should pursue DRM, but there are no metrics for measuring progress, and co-ordination across departments is not evident. At the sub-national level, all entities are responsible for the direction and co-ordination of disaster risk management. The 2009 law that established SINAGER also mandates that all municipalities are responsible for implementing disaster risk management, and most have some sort of DRM entity[111].

COPECO can access funds in the case of an emergency. The 2009 Law for the National System of Risk Management (*Ley de SINAGER*) established a national fund for emergencies—the *Fondo Nacional para la Preparacion y Respuesto a Emergencias* (FONAPRE)—and there is a budget line item for funding disaster risk management and allocating resources to emergencies[112].

Disaster risk reduction and disaster risk management policy

Honduras has not yet finalised a national strategy for disaster risk reduction. As part of its plan to implement the Hyogo Framework, Honduras worked on creating a National Plan for Disaster Risk Management in 2012 and 2013[113]. A draft plan was circulated with the intention of approving it[114], but it has not yet entered into law and local experts are unaware of its current status. Although there is no national plan, DRM initiatives continue to grow in municipalities and across sectors, acknowledging the country's vulnerability to disasters[115].

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Despite the absence of a national plan, the role and responsibilities of local governments in disaster risk management and reduction are legally defined. Article 4, Section 1, of the Law for the National System of Risk Management assigns responsibility to local governments for implementing risk management. Municipalities must "include in their plans and actions of any kind a 'Risk Assessment' in order to prevent and minimise the generation of further damage and third parties, in order to make the community safer and incur no liability negligence." Article 28 goes on to require the inclusion of disaster risk management in all regional and local development plans[116].

Honduras also has a dedicated budget line for disaster risk management, as the Law for SINAGER mandates funding at the national level. In 2013 (the latest data available), 31% of the budget amount was allocated to risk reduction, and 66% was allocated to recovery and reconstruction[117]. However, local experts agree that the budget for DRM is insufficient, given the vulnerabilities of Honduras[118]. Various international organisations including the World Bank, the United Nations Development Programme (UNDP), the World Food Programme and the European Commission donate to disaster risk management programmes in the country.

Key challenges and areas for policy improvement

Rapid, unplanned urbanisation and progressive environmental degradation have further aggravated Honduras' disaster vulnerability. The Honduran government has been taking important steps towards adopting a more pro-active DRM approach, but it still needs to increase awareness, knowledge and capacity with regards to incorporating risk reduction and prevention aspects into overall development, territorial and environmental planning. Looking forward, one key challenge will be building and sustaining institutional support and momentum for disaster risk management, given that Hondurans face a number of issues—such as poverty and violence—that have taken priority to date.

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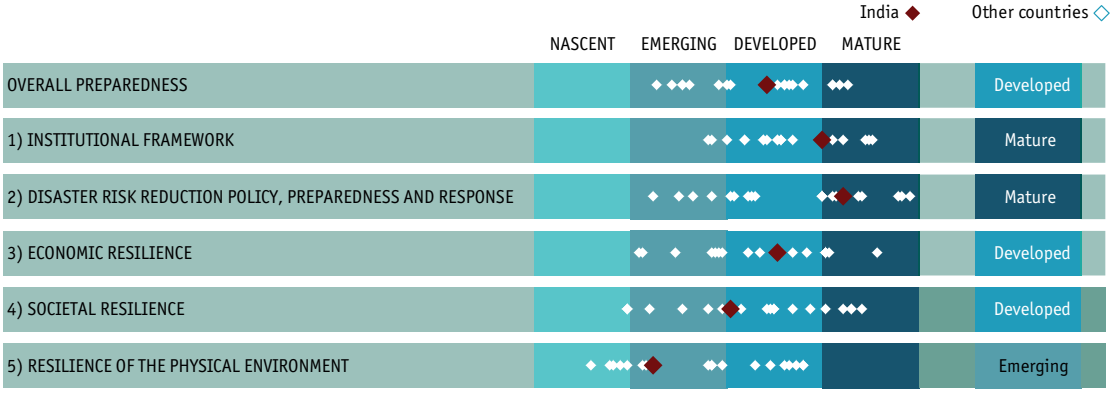
India



Institutional framework

The National Disaster Management Authority (NDMA) is responsible for disaster management, and its expert members and the prime minister (who acts as the NDMA's ex-officio chairman) have statutory authority. The NDMA has a permanent staff, and it facilitates and co-ordinates the enforcement and implementation of policy and plans for disaster management[119]. Its main legal instrument is the Disaster Management Act of 2005—a powerful law with strict penalty provisions. There is no independent authority that guarantees its independence[120]. In the 2014–15 fiscal year, its budget was Rs3.87bn (US$60m). The National Executive Committee (NEC) assists the NDMA as a co-ordinating and monitoring body for disaster management, and the National Institute of Disaster Management (NIDM) acts as a separate capacity-building arm.

Under India's federal structure, disaster risk management is a state matter, and some (but not all) states have a fully functioning disaster management authority and legal frameworks in place. The State Disaster Response Fund has an allocation of Rs612bn for 2015–20[121]. India also has a National Platform for Disaster Risk Reduction, which brings together stakeholders from the public and private sector and international organisations[122].

Disaster risk reduction and disaster risk management policy

India's policy framework for disaster management mandates the mainstreaming of disaster risk reduction into development planning and programmes. The National Disaster Management Policy 2009 has separate chapters on disaster prevention, mitigation and preparedness; response; relief and rehabilitation; reconstruction and recovery; and capacity development[123]. The National Disaster Risk Reduction and Management Plan (NDRRMP) 2011–28 includes targets and timeframes, although not for all disaster risks. Policymakers recognise disaster risk concerns, and environmental laws increasingly reflect these concerns. The National Action Plan for Climate Change, for example, was formulated with an emphasis on managing disaster risk. India's National Contingency Action Plan defines the roles and responsibilities of authorities in contingency planning at the federal, state and district level[124]. Agencies that monitor natural hazards include the Geological Survey of India, the India

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Meteorological Department and the Indian Space Research Organisation (ISRO), and the National Early Warning Centre is equipped to disseminate mass messages.

India is a disaster-prone country, where droughts and floods affect approximately 80m people every year[125]. There is a lack of protective structural infrastructure, although the national building code accounts for disaster risk[126].

Key challenges and areas for policy improvement

India's capacity to deal with disasters has greatly improved since the Gujarat earthquake (2001) and the Indian Ocean Tsunami (2004). The main challenges include upgrading capacity at the district and state level for implementing and enforcing existing laws, strengthening state-level disaster risk institutions and increasing disaster management in the cities.

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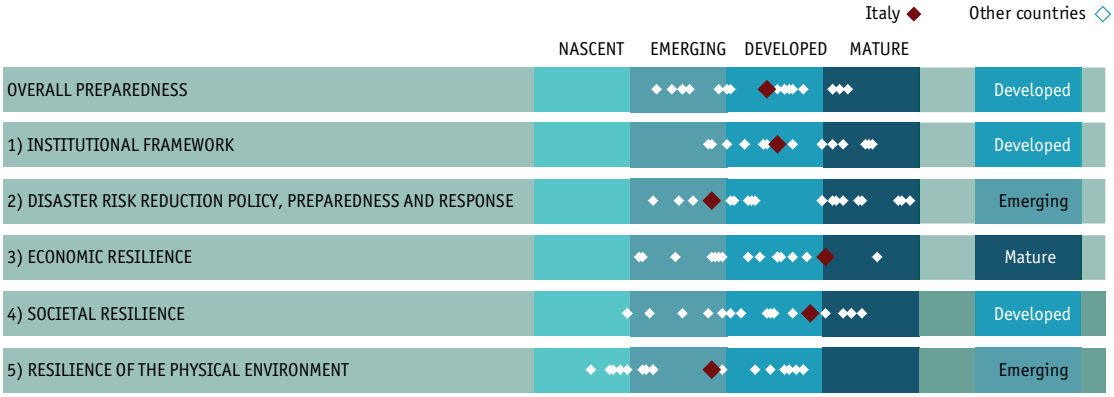
Italy



Institutional framework

The National Civil Protection Department is a technical department within the Presidency of the Council of Ministers, and it is responsible for disaster risk management at the national level[127]. Since 1992, the department has guided the prevention, forecast and monitoring of risks, and established common intervention procedures[128] by co-ordinating the National Civil Protection Service[129]. The department has a permanent staff, divided across offices and services[130]. It has access to the Civil Protection Fund—which is dedicated to its institutional functioning, as well as to prevention activities[131]—and to the National Emergency Fund for responding to disaster situations[132].

The National Civil Protection Service is a complex system that operates according to the principle of subsidiarity and is composed of state administrations, the regions and autonomous provinces, non-autonomous provinces, municipalities and mountain communities[133]. The first response to a disaster is conducted by the municipal structure, under the lead of the mayor. If an event is severe and cannot be dealt with locally, the response is conducted by the province, the prefecture, the regions and (in the case of national emergencies) the state[134]. Public boards, institutes and scientific research groups with civil protection purposes, other institutions and organisations, citizens, associated groups of volunteers, and professional associations and boards can also contribute to the implementation of civil protection activities and tasks[135]. The Italian National Platform for Disaster Risk Reduction, established in 2008, could be an effective tool for involving the private sector[136].

Disaster risk reduction and disaster risk management policy

Disaster risk reduction (DRR) actions suffer from a lack of co-ordination at the national level[137], and the integration of DRR objectives in other policies and guidelines is limited and sectoral. (The National Strategy for Climate Change Adaptation represents the most successful attempt at integrating DRR into environmental policies[138].) The allocation of funds to DRR activities is also not systematic. For example, some resources are currently allocated to both soil stabilisation in areas at hydrogeological risk[139] and to structural interventions and anti-seismic reconstruction in schools[140].

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The Functional Centres Network serves to monitor natural hazards and alert the population if a particular risk threshold is exceeded[141]. It is composed of the Central Functional Centre—based in the Civil Protection Department, with specific tasks relating to meteo-hydro and hydraulic risk[142], volcanic risk[143] and forest fire risk[144]—as well as decentralised centres located in each region and autonomous province. Early warning systems are available at the local level[145], and *Sistema* operates as a national co-ordination centre, monitoring planned or ongoing emergencies all over the country, alerting the population and activating the relevant components of the National Civil Protection Services[146]. To increase public education and awareness in DRR and preparedness, the Civil Protection Department has launched the campaign "*Io non rischio*"[147].

Italy is highly exposed to natural and anthropic risks[148]. Informal settlements are widespread[149], and protective infrastructures are mostly old and not well maintained. Italian legislation in the building sector addresses disaster risk, paying particular attention to seismic resilience[150], but voluntary measures to support retrofitting are not systematic (they are decided on an annual basis). Seismic retrofitting is currently incentivised[151].

Key challenges and areas for policy improvement

Interviews pointed to the fact that DRR is poorly integrated into environmental policies and economic planning, although Italy could turn the National Strategy for Climate Change Adaptation into implementing policies thanks to the strategy's comprehensive scope. It was also noted that Italy needs to update relevant legislation (for example, on land-use planning, environmental degradation); regulate the practice of informal settlement; and develop a catastrophe insurance scheme. According to interviewees, monitoring mechanisms and administrative sanctions should also be established for local authorities that fail to develop appropriate emergency plans and do not carry out prevention activities. Investments for DRR should be systematised, paying particular attention to the maintenance of protective infrastructures and subsidies for voluntary retrofitting measures.

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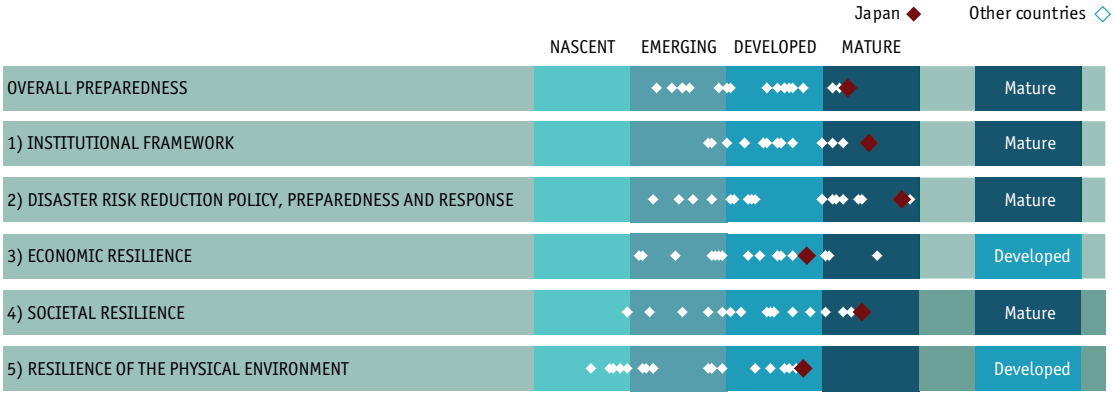
Japan



Institutional framework

The Japanese government has a dedicated department for disaster risk management within the Cabinet Office, headed by the Minister of State for Disaster Management. It is responsible for promoting co-operation across government bodies on disaster risk management and preparedness, and it has a significant permanent staff[152]. Within the Cabinet Office, the Central Disaster Management Council is the policy-making entity, responsible for developing the basic disaster management plan and establishing basic disaster management policies. It consists of the prime minister (the chair), all members of the cabinet, heads of major public corporations and experts[153].

Each government agency has a dedicated budget for disaster management and preparedness. The government is required by law to prepare for disasters by maintaining reserve funds and subsidies, and to take necessary financial measures in the event of an emergency[154]. Regional governments, prefectures and municipals have local disaster management organisations, and they develop local disaster management plans to supplement the national Basic Disaster Management Plan. In terms of practical disaster preparedness and response measures, a fire service organisation is located within each municipal government[155].

The government originally led disaster risk management in Japan. However, in the aftermath of the Great East Japan earthquake, the importance of co-ordination across the private sector, and between the government and the private sector, was recognised, leading to the establishment of the Disaster Risk Reduction Industry Conference of Japan. The conference co-operates closely with the government and has regular meetings with the Cabinet Office[156].

Disaster risk reduction and disaster risk management policy

The Basic Disaster Management Plan is the foundation for disaster management activities. It consists of various plans for each type of disaster, including specific countermeasures to be taken by each entity during various disaster management phases (prevention and preparedness, emergency response, recovery and reconstruction). The plan is revised when necessary[157]. In 2014, the Japanese government

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also established the Fundamental Plan for National Resilience—a master plan to prevent the creation of risk, reduce existing risk and strengthen national resilience. This plan is the national plan for disaster management and national resilience, and sector-specific plans—such as the National Land Use Plan, the Basic Environment Plan and the climate change adaptation plan—are required to align with it[158].

The Japan Meteorological Agency (JMA) is tasked with monitoring natural hazards[159], and an online system has been built that links the JMA with disaster management organisations at the national and local level, as well as media organisations. Disaster management organisations have also been developing a radio communications network exclusively for disasters, and Tsunami and severe weather warnings are provided to citizens via television and radio broadcasting[160]. Many local governments have also established a mailing service for providing safety and emergency information. In the event of an emergency, the Crisis Management Centre in the prime minister's office responds first, appraising the situation, rescuing disaster victims and preventing further damage[161]. Since the Great East Japan earthquake, the national government has also promoted earthquake-resistant retrofitting of houses and buildings[162].

Japan is subject to frequent natural disasters. Approximately 35% of Japan's territory is exposed to disaster risks (such as floods, sediment, earthquakes and tsunamis), and approximately 74% of the population live in at-risk areas[163].

Key challenges and areas for policy improvement

A comprehensive and strategic disaster management system was established in the 1960s, and it has been continuously reviewed and revised to incorporate lessons learned from large-scale disasters[164]. However, recovery and reconstruction efforts in the aftermath of the Great East Japan earthquake varied considerably by region, and public awareness of disaster risk management is currently decreasing.

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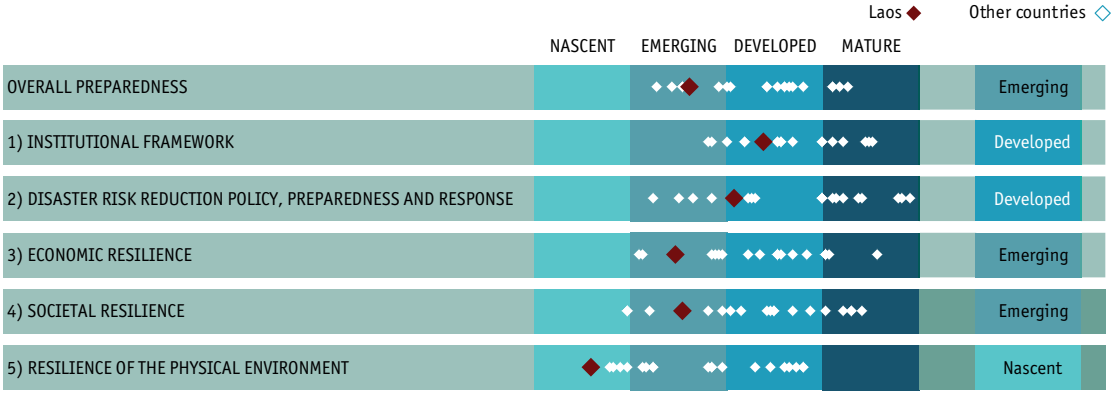
Laos



Institutional framework

Laos has been subject to several natural disasters in recent years. In 2013, for example, a series of five major storms resulted in severe flooding in 12 of the country's 17 provinces, affecting 350,000 people, with damages estimated at LAK2.2 trillion (US$219m). In the same year, Prime Ministerial Decree 220/PM 2013 created a new National Disaster Prevention and Control Committee (NDPCC) in the Ministry of Natural Resources and Environment[165]. Laos also established a Department of Disaster Management and Climate Change (DDMCC)[166], although there does not appear to be a monitoring body to guarantee its independence. The NDPCC has a permanent staff, although it is still being expanded. According to a 2014 report, "while leadership structures are in place, the Department is still in the process of establishing its office and recruiting staff"[167].

Historically, the government has reserved a certain amount of funds for emergencies each year. For instance, there is a national contingency fund (worth US$12.5m), which is administered by the Department of Budget within the Ministry of Finance. However, it is difficult to access emergency response funds. The provincial government must first prepare a recovery plan and budget[168], and decisions are usually made on a case-by-case basis. In 2013, the government adopted a Prime Ministerial Decree on the State Reserve and prepared a draft Decree on Disaster Prevention Fund. The latter decree is still in draft form.

Disaster risk reduction and disaster risk management policy

Laos developed a Strategic Plan on Disaster Risk Management in 2003, with goals stretching until 2020[169]. More recently, sector-specific plans have started to emerge, including the Plan of Action for Disaster Risk Reduction and Management in Agriculture (2014–2016)[170]. The draft Five Year National Socio-Economic Development Plan (2016–2020) indicates that "preparedness for natural disasters and risk mitigation" is a key outcome of the national plan[171]. Key targets include an effort to "establish a system to prevent and manage the disasters which can ensure the safety of people across the country", and to "build early warning centres for meteorology and hydrology that can alert the people's readiness and reduce damage to a certain level." Strengthening economic, social, health and

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environmental resilience is also mentioned throughout the document. Key performance indicators include efforts to "enhance self-initiatives for disaster risk management including flooding, drought, earthquakes [and] landslides", as well as a "complete strategy for responding to the impacts of climate change and to mitigate greenhouse gases"[172].

The Inter-Agency Standing Committee (IASC) co-ordinates the relief activities of the government and international organisations, and it has had an Inter-Agency Contingency Plan (IACP) in place since 2012, which identifies roles and responsibilities during an emergency response[173]. However, problems with implementation have been noted, partly because it has been done on an ad-hoc basis[174].

Key challenges and areas for policy improvement

There is no evidence that private-sector catastrophe insurance is available in Laos[175], and catastrophe insurance has been highlighted as a key need[176]. There is also no regulation requiring hospitals to develop business continuity programmes in the event of a disaster, and there does not appear to be any protective infrastructure or building codes. In recent years, Laos has introduced initiatives to support universal health coverage, such as providing free maternal and child health services, often in conjunction with development partners. The aim is to achieve universal access to health care by 2020[177], an important measure to promote societal resilience.

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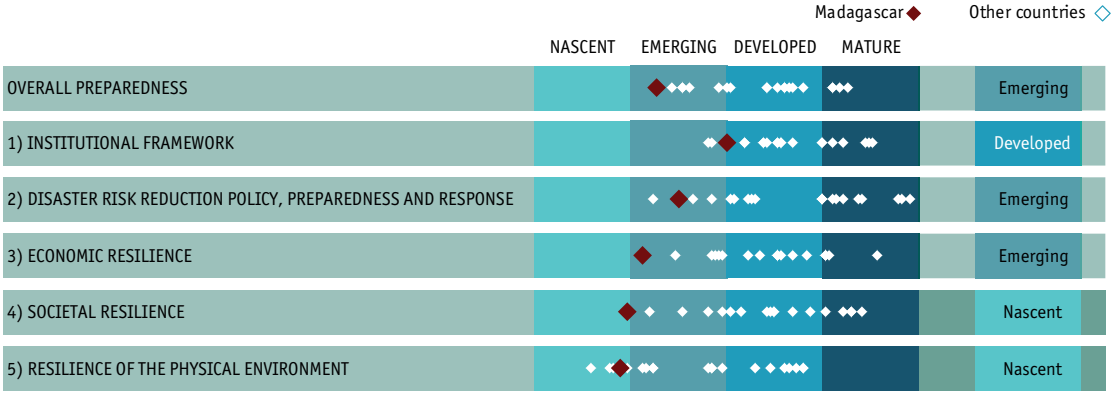
Madagascar



Institutional framework

The inter-ministerial National Council of Disaster Risk Management (CNGRC), headed by the prime minister, is the main strategic entity responsible for all disaster-related activities in Madagascar. Its operational arm, the National Bureau of Disaster Risk Management (BNGRC), is attached to the Ministry of the Interior. The Emergency Reduction and Management Agency (CPGU) is located within the prime minister's office and serves as its permanent technical body[178 179 180 181 182 183]. Both the CNGRC (with its BNGRC) and the CPGU have permanent staff[184 185]. The CNGRC receives funds from the national budget, public subsidies, donations in kind, collected or assigned national or foreign funds, and funds assigned by foundations. The Minister of the Interior is the chief authorising officer of an emergency response fund, taken from the resources of the CNGRC. The executive secretary of the BNGRC is also authorised to hold and manage an imprest fund[186 187 188 189].

There is currently no framework in place to monitor ongoing disaster management activities[190]. An informal national disaster risk reduction (DRR) platform (*Comité de Réflexion des Intervenants en Catastrophes*; CRIC)—composed of national public agencies (CPGU, BNGRC), non-governmental organisations (NGOs) and United Nations (UN) partners—is operational, but it has no official status and acts primarily as a platform for discussion and the exchange of information[191 192 193]. At the sub-national level, a regional committee (CRGRC) is responsible for regional plans related to risk and disaster management and the organisation of prevention and relief activities[194 195]. In practice, the creation and running of sub-national bodies has been non-existent or defective[196 197].

Disaster risk reduction and disaster risk management policy

Madagascar has a framework and organisational structures for disaster preparedness and response. However, a national strategy including DRR and a national law are still awaiting full political validation[198 199 200 201]. Pillar 5 of the national development plan 2015–19 requires the strengthening of disaster resilience and addresses both climate change adaptation and DRM[202]. Policies on environmental degradation do not include provisions specific to DRM[203 204]. General DRM strategies are elaborated by the CNGRC, and the relevant ministries must establish a support and contingency plan

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for each risk type they are meant to cover[205] [206]. In 2015, a new national multi-risk contingency plan was accepted at the operational level[207]. The BNGRC is tasked with managing and providing response measures in the event of a disaster[208] [209], but no centralised monitoring system for hazards currently exists[210].

A national strategy aimed at strengthening public awareness and education is also in place[211] [212] [213], along with an information system (reachable via phone) and a mass SMS message system to alert populations at risk. Human settlements in at-risk areas are extensive[214] [215] [216], and parts of the population live under the constant threat of massive flooding due to degraded or inadequate protective infrastructure. The construction, maintenance and rehabilitation of infrastructure remains a challenge, due to lack of material and financial resources[217] [218] [219] [220]. Madagascar does have building codes and decrees that account for disaster risk[221] [222] [223] [224] [225] [226] [227] [228] [229], but it has not implemented voluntary or binding measures to facilitate retrofitting buildings to make them more disaster-resistant[230].

Key challenges and areas for policy improvement

Madagascar's national legislation focuses primarily on immediate preparedness, response and recovery, but efforts have been made to create legislation and strategies including DRR. These are still awaiting political validation. Integration of disaster risk management (DRM) and climate change adaptation (CCA) considerations is still required, including incorporating a multi-hazard approach into planning and strategy development. Although the mandates of key institutions are defined, the roles of the BNGRC and the CPGU become more blurry at the operational level, and collaboration between governmental bodies and international partners could be strengthened. The absence of an effective government presence at the sub-national level also remains a challenge (particularly with regards to awareness and public education efforts), as does the lack of national funds.

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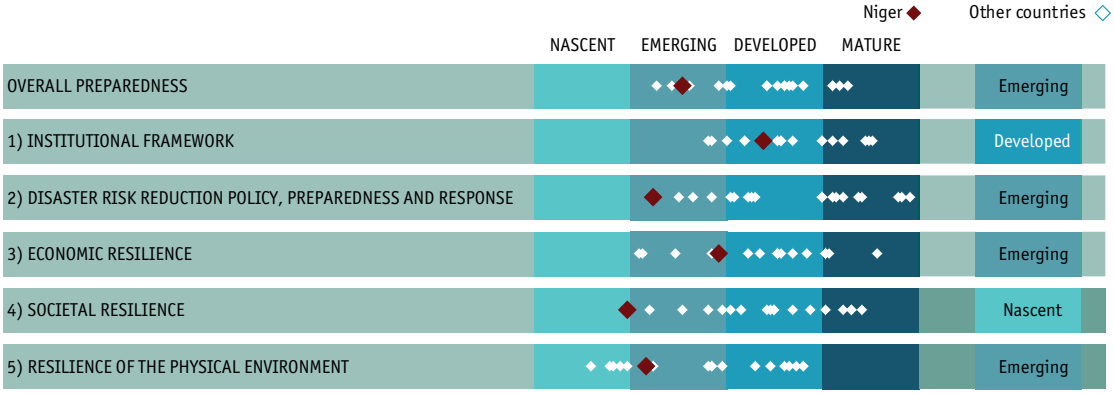
Niger



Institutional framework

The *Dispositif National de Prévention et de Gestion des Catastrophes et Crises Alimentaires* (DNPGCCA) is the national entity tasked with disaster risk management (DRM). It is part of the prime minister's office, has a permanent staff and is composed of the following units: *Coordination du Système d'Alerte Précoce et de Prévention des Catastrophes* (CC/SAP/PC); *Cellule Crise Alimentaire et Gestion des Catastrophes* (CCA/GC); *Cellule Filets Sociaux* (CFS); and *Cellule de Coordination Humanitaire* (CCH)[231] [232] [233]. The national budget supports the administrative operation of the DNPGCCA, but nationally available funds remain a serious challenge, and most financing needs are covered by multilayer institutions and donor governments. There is no centralised national fund for disaster management[234] [235] [236]. The permanent secretariat of the DNPGCCA reports directly to the director of the prime minister's cabinet, and it has a department tasked with ensuring compliance with the procedures of the government and donors[237] [238] [239]. Reports are regularly published by the DNPGCCA and its various units and are publicly available[240] [241]. The DNPGCCA also includes a joint advisory committee (*Commission Mixte de Concertation*), which brings together the government of Niger, official donors and public institutions[242].

At the sub-national level, a regional committee (*Comité Régional*; CR/PGCCA), a permanent regional secretary (*Secrétaire Permanent Régional*; SPR) and a sub-regional committee (*Comité Sous-Régional*; CSR/PCCCA) are tasked with DRM[243]. At the local and communal level, the *Observatoires du Suivi de la Vulnérabilité* (OSV) and the *Systèmes Communautaires d'Alerte Précoce/Réponse Urgente* (SCAP/RU) provide disaggregated data and information and report to the CC/SAP/PC[244] [245] [246]. In 2012, Niger implemented a national DRR platform, and the appointed national focal point is the CC/SAP/PC[247] [248] [249] [250].

Disaster risk reduction and disaster risk management policy

Although Niger's framework and organisational structures for DRM are defined, a national disaster risk reduction (DRR) strategy has only existed in draft form since 2012. It has not yet been politically validated, but it has been accepted on a technical level[251] [252]. DRR elements are mentioned in the

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decrees establishing the DNPGCCA and in some national programmes, such as the PDES 2012–2015 (extended to 2016) with its 3N Initiative (Nigeriens Nourish Nigeriens), which also aims to improve people's resilience[253] [254] [255] [256] [257] [258]. The national action plan for climate change adaptation (CCA) dates from 2006 and does not include policy frameworks for DRM[259] [260]. Policies on environmental degradation and safeguarding natural ecosystems do not include provisions specific to DRM[261] [262] [263].

The DNPGCCA and the Ministry of the Interior (*Direction Générale de la Protection Civile*; DGPC) are the national-level entities tasked with providing response measures, and the CC/SAP/PC monitors natural hazards[264] [265]. Multi-risk contingency plans exist and are usually updated on a yearly basis[266]. There is a flood early warning system (which sends SMS messages out to possibly affected local community leaders), but there is no comprehensive national strategy that aims to strengthen public education and awareness in DRR and preparedness[267] [268].

The country is prone to recurring or cyclical hazards, and human settlements in at-risk areas are present but not extensive[269] [270] [271]. Informal settlements are not well documented, but there are a number of internally displaced persons (as a result of disasters and security threats), as well as refugees from neighbouring countries[272] [273] [274]. Protective infrastructure is mostly non-existent, and existing dykes are out-dated and damaged[275] [276]. The building code does not account for disaster risk, and there are no voluntary or binding measures to make existing buildings more disaster-resistant.

Key challenges and areas for policy improvement

Niger could benefit from stronger institutional and legal frameworks, as well as improved capacities at the national and sub-national level. Comprehensive national legislation that includes DRR is also lacking, as the current focus lies primarily on immediate response to disasters. DRM and DRR are yet to be integrated into all development and poverty reduction policies, programmes and strategies. Integrating climate change adaptation (CCA) into planning and strategy development remains a challenge. In general, stronger collaboration between the different government bodies (and between the different units of the DNPGCCA), along with clearer distinctions of their competencies, would benefit the overall DRM framework. This could help to facilitate co-operation with international partners.

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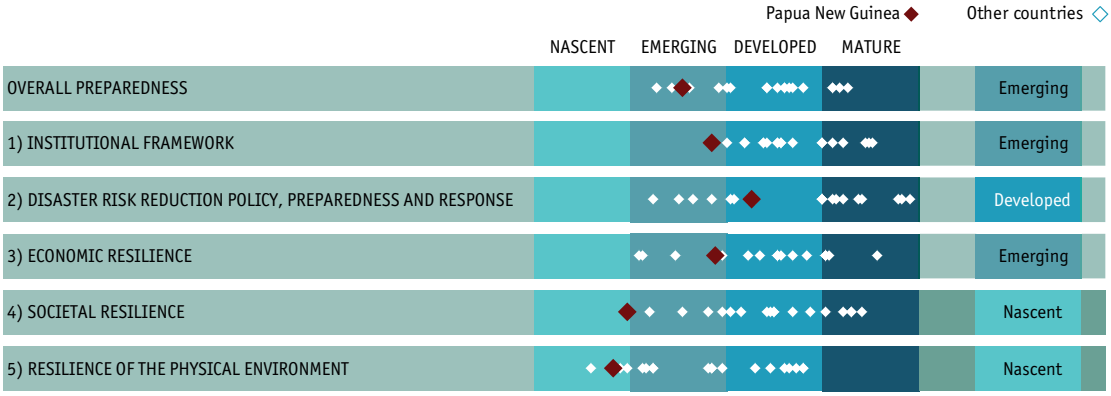
Papua New Guinea



Institutional framework

The National Disaster Centre (NDC)—the lead disaster risk management body in Papua New Guinea (PNG)—is tasked with overseeing disaster risk reduction and preparedness and response measures. The NDC comes under the Department of Provincial and Local Government Affairs (a government ministry) and employs a small permanent staff. It has access to limited funds for assessment and a low-level response following an emergency. Access to greater resources requires a lengthy approval process, and the government usually has to divert resources from other programmes to assist in disaster relief and recovery[277]. There is no monitoring body to ensure the NDC's independence. The NDC's Corporate Plan 2010–2015 outlines a policy framework for monitoring and evaluating disaster management activities, but there is no evidence that it has been implemented[278].

The Disaster Management Act 1984 (as amended in 1987) provides for the establishment of provincial disaster committees, which are responsible for disaster risk management in their jurisdictions, including emergency planning and response, as well as risk reduction and awareness[279]. However, provincial disaster response planning is poor, and only a few provinces have developed disaster response and contingency plans. Provincial disaster offices are generally ill equipped and are not operational around the clock[280]. There is a well-established Disaster Management Team, which includes the United Nations (UN) resident co-ordinator, government officials, UN agencies, other non-governmental organisations (NGOs), international organisations and donors, and it provides disaster response and co-ordination until government resources are activated through the NDC. There is no formal national platform for improving co-ordination with the private sector[281], but private-sector representatives may attend disaster management team meetings when appropriate.

Disaster risk reduction and disaster risk management policy

The 1984 Disaster Management Act is outdated. Disaster management legislation was reviewed in 2014, but the updated legislation has yet to be endorsed by parliament[282]. The current disaster risk reduction strategy is the Disaster Risk Reduction and Disaster Management National Framework for Action 2005–2015. The framework's principles include developing a better understanding of hazards,

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fostering a culture of prevention and resilience-building, and reducing underlying risk factors through sustainable development[283].

Disaster risk management is highlighted in national economic development policies, such as the PNG Vision 2015 document[284] and the PNG Development Strategic Plan 2010–2030[285]. It is also referenced in the National Climate Compatible Development Management Policy[286]. However, risk reduction has yet to be fully mainstreamed into sectoral plans and strategies[287]. Existing land-use planning laws and regulations that could be used to ban or discourage development in disaster-prone areas are rarely enforced[288], and the Environment Act 2000 does not explicitly mention disaster risk management[289] [290].

The PNG National Weather Service monitors weather-related hazards. The Port Moresby Geophysical Observatory monitors seismic activity and is linked to the Pacific Tsunami Warning Centre, and the Rabaul Volcanic Observatory monitors volcanic activity. The country has early warning systems, but their ability to disseminate mass messages is limited as most people live in rural areas and lack telecommunication facilities[291].

PNG is vulnerable to many hazards, including volcanic eruptions, tsunamis, earthquakes, cyclones, floods and landslides, and there are extensive human settlements in areas at risk of disaster[292]. There is little investment in protective infrastructure, and PNG does not have building codes that account for disaster risk (beyond an out-of-date code of practice for earthquake loading)[293].

Key challenges and areas for policy improvement

The lack of funds for disaster relief, risk reduction and hazard monitoring is a longstanding concern, as is PNG's poorly drafted legislation. For example, the 1984 Disaster Management Act states that provincial governments are responsible for disaster relief and risk-reduction operations, but the delegation of authority and financial resources for disaster risk management is not made explicit in the regulations[294]. This has contributed to severe under-funding at the provincial level. Slow implementation of PNG's plans and policies is another major constraint for disaster risk reduction in the country[295]. Policy measures need to be backed up with mechanisms for monitoring progress and timelines for completion. Other issues include a lack of access to insurance products, poor building standards and a lack of continuity planning for medical facilities.

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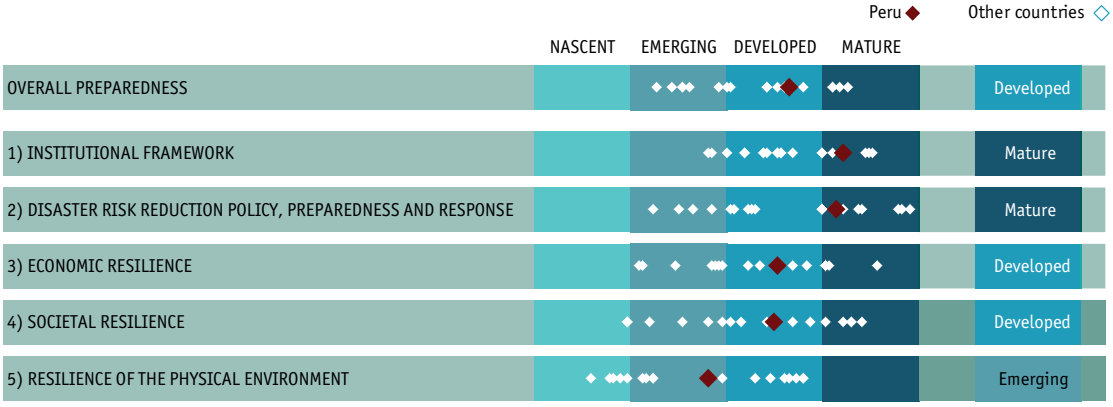
Peru



Institutional framework

Peru is vulnerable to geological and climate-related hazards. Located along the Pacific Rim of Fire, the country has highly seismic hazard zones along the coast and 15 active volcanoes, and it is susceptible to El Niño oscillations[296]. In recent years, the government has taken steps to strengthen its framework for disaster risk management. In 2011, the government passed Law 29664, which created the National System of Disaster Risk Management (*Sistema Nacional de Gestion del Riesgo de Desastres*; SINAGERD), which aims to reduce risk and improve preparedness and response measures[297]. The Disaster Risk Management Secretariat, under the Presidency of the Council of Ministers (*Presidencia del Consejo de Ministros*; PCM) was also created by this law to co-ordinate and oversee SINAGERD's implementation. The law also created the National Centre for the Estimation, Prevention and Reduction of Disaster Risk (*Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres*; CENEPRED), which is responsible for disaster risk information, risk-reduction policies and reconstruction processes. The National Civil Defence Institute (*Instituto Nacional de Defensa Civil*; INDECI) is an existing agency under the former institutional framework and is responsible for emergency response capacity. All three bodies have permanent staff, although the United Nations Office for Disaster Risk Reduction's (UNISDR) 2014 assessment found that human resources are not yet sufficient to fulfil all the tasks required under SINAGERD[298].

Funding for disaster risk management (DRM) is a priority for the government, and in 2014, its budget allocation (including resources for emergency response measures) exceeded 1% of the public sector budget. In fact, since 2011, the budget amount allocated to disaster risk management, including prevention and response measures, has increased from 63m Peruvian soles to 821m Peruvian soles[299].

At the sub-national level, regional and local governments are responsible for disaster risk reduction and preparedness and response measures[300]. The private sector is also engaged, as there are formalised platforms for involvement through CENEPRED and INDECI[301]. In practice, local experts explained that there are several working groups that facilitate private-sector involvement, co-ordination and information exchange[302].

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Disaster risk reduction and disaster risk management policy

The Presidential Council of Ministers (PCM) approved the National Plan for Disaster Risk Management 2014–2021 (PLANAGERD) in May 2014, under DS No. 034-2014[303]. The PLANAGERD established a comprehensive set of specific objectives and priority actions for the main DRM processes: risk identification, risk reduction, emergency response, post-disaster recovery and institutional development[304]. It also defined a broad implementation plan, and a more detailed strategy with quantitative targets is expected to be publicly released in 2016[305].

The government is also taking steps to integrate DRM into its broader policy framework across various areas, including national economic development and climate change. Indeed, Peru's latest national development plan (the Strategic Plan for National Development Through 2021) includes disaster risk management as one of six key themes, and it aims to achieve specific DRM goals by 2016 and 2021[306]. The plan also addresses climate change adaptation and disaster risk management in an integrated manner. High-level goals include ensuring adequate environmental quality, reducing vulnerability to climate change and promoting a low carbon economy[307].

Emergency preparedness and response capacity is comprehensive. The National Institute of Civil Defence (INDECI) runs a national early alert system, which is designed to provide early warnings for various types of natural disaster. The system publishes alerts online for both computer and mobile web browsers[308]. The National Weather Service monitors weather-related hazards, and the Geophysical Institute of Peru monitors seismic activity[309].

Key challenges and areas for policy improvement

Recognising its vulnerability to natural disasters, the Government of Peru is raising awareness of DRM. It is also implementing DRM by integrating it into various policy discussions, and by providing funding for initiatives around the country. However, implementation has been cumbersome, with many reporting that the three main agencies overlap, and that their responsibilities are not always clear. At the sub-national level, the mandate to implement DRM is clear and the funding is available, but human capacity remains a challenge and interviews pointed out that local officials would need more training in order to understand how to implement policy to manage risks better.

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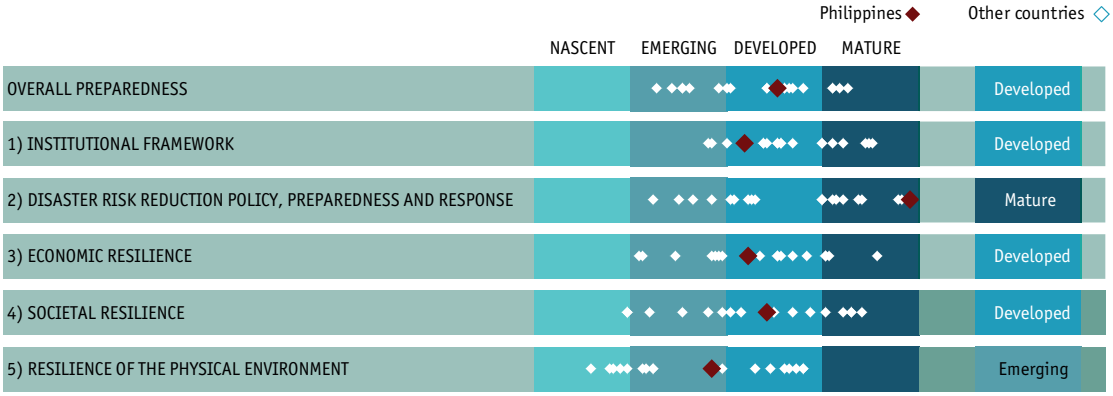
The Philippines



Institutional framework

The National Disaster Risk Reduction and Management Council (NDRRMC) is the leading civilian government institution for disaster risk management[310]. It reports to the president through the powerful Office of Civil Defence (OCD), which sits under the umbrella of the Ministry of Defence. Overall responsibility for implementing and monitoring the National Disaster Risk Reduction and Management Plan (NDRRMP) 2011–28 lies with the OCD. The NDRMCC consists of non-permanent members, and its annual budget was tripled to P38.9bn (US$840m) in 2016[311]. The OCD conducts periodic assessments and monitors the performance of member agencies of the NDRRMC and the Regional Disaster Risk Reduction and Management Council (RDRRMCs). There are two sub-national entities responsible for disaster risk management: one at the local level, and one at the *Barangay* level (the lowest administrative level)[312]. There is no independent body that guarantees the NDRRMC's independence, and there is no formal national platform.

Disaster risk reduction and disaster risk management policy

The NDRRMP 2011–28 prioritises disaster prevention and mitigation, disaster preparedness, disaster response, and disaster rehabilitation and recovery[313]. The main law governing disaster risk reduction and management (Republic Act 10121 Disaster Risk and Management Act 2010) is currently under review. The National Economic and Development Authority (NEDA) has included disaster risk reduction in the Philippine Development Plan (2011–2016) and regional development plans, and it monitors their implementation[314] [315]. The Climate Change Commission (CCC) incorporates climate change policy—in synergy with disaster risk reduction—into national, sectoral and local development programmes. Environmental policies include specific provisions for disaster risk management. The Nationwide Operational Assessment of Hazards (NOAH) under the Department of Science and Technology is the main agency overseeing the monitoring of natural hazards. The government approved a National Disaster Response Plan in 2014[316], and the National Building Code 2011 accounts for disaster risk. The Philippines is one of the most disaster-prone countries in the world[317].

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Key challenges and areas for policy improvement

The Philippines' institutional framework is characterised by overlaps between the OCD, the NRRRMC and the CCC. The legislative framework intends to facilitate a shift from reactive disaster management to proactive disaster risk reduction, but many of the Local Disaster Risk Reduction and Management Councils (LDRRMCs) are still primarily concerned with disaster preparedness and emergency response. The government advocates a community-based disaster risk reduction and management plan (DRRM), but community participation has yet to become a reality on the ground. Other challenges include the need to link poverty reduction and disaster risk reduction; adopt a multi-sectoral and multi-disciplinary approach in risk assessment and disaster risk reduction planning; and formulate and implement comprehensive disaster and climate resilient development and land use plans.

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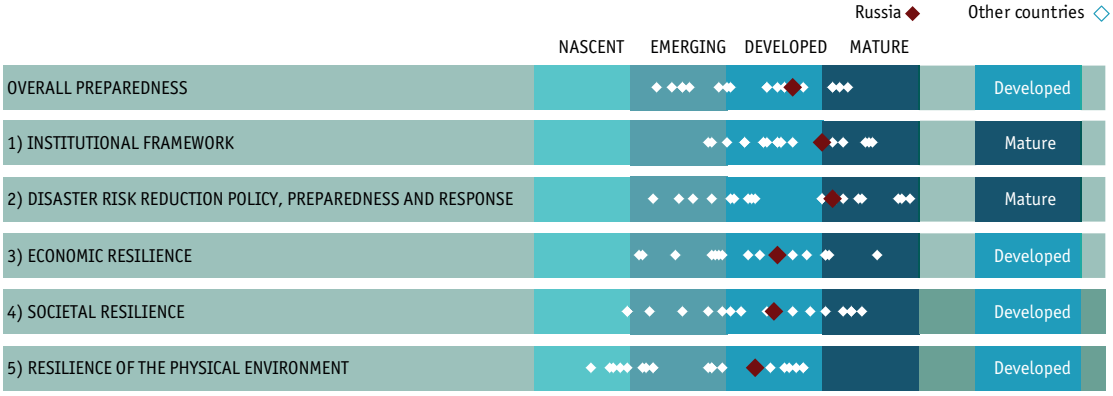
Russia



Institutional framework

The dedicated national-level institution responsible for disaster risk management is the Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters (abbreviated in Russian as MChS, but also known by its English acronym EMERCOM). This is a federal executive body, responsible for drafting and implementing government policy and legal regulation; control and oversight in the field of civil defence; the protection of citizens and territories from natural and man-made emergencies; and the provision of fire and water safety. The President of the Russian Federation oversees its activity[318]. EMERCOM oversees the use of the Reserve Fund of the Russian Federation for Warning and Liquidation of Emergency Situations and the Consequences of Disasters, which is intended to partially cover the cost of certain disaster-related expenditures, as proscribed by Government Decision No. 110 (15 February 2014), including rescue operations, repair work and the payment of compensation[319]. EMERCOM has chief directorates for all of the Russian Federation's administrative units, which are grouped into eight regional centres, as well as separate chief directorates for Moscow, Crimea and Sevastopol[320]. However, these regional chief directorates do not have any independent policy-forming powers, and their main role is implementing policy at the local level and ensuring that necessary measures and resources are in place[321]. The country's National Platform for Disaster Risk Reduction includes a Public Council, which consists of people who are well known in the country and who represent the interests of various strata of society[322].

Disaster risk reduction and disaster risk management policy

Russia has started implementing the Sendai Framework for Disaster Risk Reduction, which is seen as a key priority[323]. Russia's disaster risk management is co-ordinated by the country's National Platform for Disaster Risk Reduction, which also ensures links with sustainable development. All of the country's financial and economic investment plans are co-ordinated closely with EMERCOM to ensure that they are risk-sensitive[324]. Russia has also adopted some climate change adaptation measures aimed at reducing natural disaster damage and other negative climate events, based primarily on the provisions of the Climate Doctrine (2009)[325]. The Ministry of Natural Resources is in the final phase

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of developing the Strategy Convention on Biodiversity Conservation, which includes tasks relating to biodiversity and forestry adaptation to climate change[326]. Principles of State Policy in the Area of Environmental Development of the Russian Federation for the Period up to the Year 2030 (approved in 2012) sets out general guidelines, but it contains little detail and no concrete steps on how to achieve its objectives[327]. EMERCOM, which bears overall responsibility for emergency situations of all kinds, includes the All-Russian Centre of Monitoring and Forecasting of Emergencies (*Antistikhiya*), which is tasked with environmental monitoring, forecasting, and collecting and analysing data on emergencies[328].

The densely populated North Caucasus is one of the most seismically active regions, and the city of Sochi is prone to earthquakes with magnitudes up to 10.0[329]. Building regulations state that towers in 9.0-magnitude areas cannot be more than 16 stories high. Sochi, however, has several towers of 28–30 stories. Such buildings are not subject to normal building regulations[330].

Key challenges and areas for policy improvement

The highly centralised nature of strategy and policy formation means that there is limited scope for local authorities to formulate policy and strategies specific to local circumstances. Although Russia does have a federal law that sets out how to respond in the event of a disaster[331], there is little evidence of efforts to reduce the likelihood of disasters happening in the first place. Principles of State Policy in the Area of Environmental Development of the Russian Federation for the Period up to the Year 2030 sets out general principles, but lacks detail on how they should be implemented[332].

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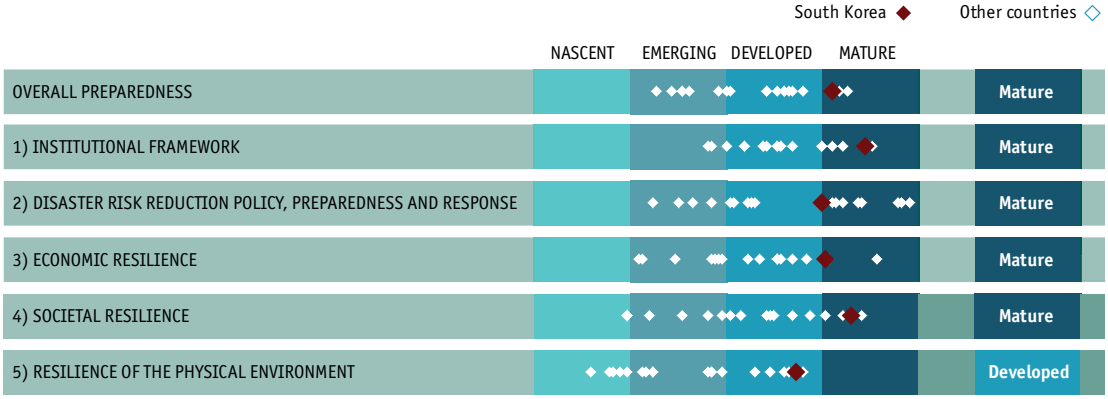
South Korea



Institutional framework

South Korea has a well-established chain of command for disaster risk management, from the central government through to local government, with private sector participation co-ordinated by the central government. As head of the executive branch, the president is ultimately responsible for disaster risk management. As the top cabinet minister, the prime minister exercises direct control over policy-making and implementation. The Ministry of Public Safety and Security (MPSS) is the dedicated agency responsible for disaster risk management, and it is one of five independent agencies reporting directly to the prime minister (separate from the 17 cabinet ministries)[333]. The MPSS' Disaster Management Office is directly involved in disaster prevention, disaster response and disaster recovery. The MPSS is one of the largest central government agencies, staffed with more than 1,000 people at its headquarters, more than 9,000 working in organisations under its control, and a 3.4 trillion won budget at its discretion (as of 2015)[334].

The Central Safety Control Committee, which is chaired by the prime minister, is the highest disaster policy-making authority, and the Central Disaster and Safety Countermeasure Headquarters (headed by the MPSS) acts as its executive arm[335]. Local disaster and safety countermeasure headquarters set up under local governments operate under the central government's control to formulate and implement disaster preparedness and response measures for areas under their respective jurisdictions. The MPSS acts as the control tower, handling communication with the public and co-ordination with other government agencies, local governments, foreign counterparts and private-sector organisations[336].

Under the Framework Act on the Management of Disasters and Safety, safety control plans must be developed and implemented at the national and sub-national level. Central government agencies, local governments and designated infrastructure facilities are required to maintain risk management policies and contingency manuals under the centralised control of the MPSS[337].

Disaster risk reduction and disaster risk management policy

The MPSS' Master Plan for National Safety Control provides a national disaster risk management (DRM) policy framework for policy programmes and investment outlays for five-year plan cycles[338]. The MPSS

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operates the National Disaster Management System, providing disaster monitoring and co-ordinating prevention and response measures. The National Disaster Information Centre is the system's central component, providing real-time disaster updates and alerts[339]. Sub-national disaster management systems are available in 17 metropolitan cities and provinces and 229 cities, counties and wards. Integrating disaster risk reduction (DRR) into broader policy-making for coherent government-wide enforcement remains a work in progress.

Natural disaster management guidelines are enforced at the central, local government and institutional level under a presidential decree on national crisis management. Contingency plans and response measures are mandated for local governments and approximately 40 institutional stakeholders, including the National Police Agency and the Korea Meteorological Administration[340]. The MPSS organises education and training programmes, including the "Safety Korea" annual exercise, which involves participation from central government agencies, local governments, and institutions and organisations. There is a well-developed system for getting alerts out to the public, including via mobile phone text messages. The Ministry of Science, ICT and Future Planning is responsible for developing and implementing a disaster broadcasting strategy, mobilising terrestrial, satellite and cable broadcasting companies[341].

Local governments are responsible for identifying assets at risk and instituting preventive and corrective measures. Building codes and safety standards are enforced at the central and local government level, with protective infrastructure generally falling under the jurisdiction of local governments. However, critical national infrastructure facilities designated under the Framework Act on the Management of Disasters and Safety are the responsibility of facility operators, who are required to work with central and local governments in the event of a disaster[342].

Key challenges and areas for policy improvement

The level of DRR integration into national climate change adaptation and environmental policies is low, although this is improving. For instance, the National Climate Change Adaptation Plan for 2016–20 includes the development of flood maps for risk-sensitive coastal areas and the establishment of a nationwide system for joint utilisation of DRM resources[343]. The National Comprehensive Environmental Plan for 2016–35 (another keystone environmental plan) also requires the development of climate risk area maps and sophisticated joint environmental disaster response mechanisms, which can access scattered resources under the jurisdiction of various stakeholders[344]. Organic co-operation between the MPSS and other stakeholders (both at the central and local government level) has yet to mature as the MPSS is relatively new. (It was created following the November 2014 merger of the National Emergency Management Agency, the Korean Coast Guard and the safety control and disaster management functions of the Ministry of the Interior[345].)

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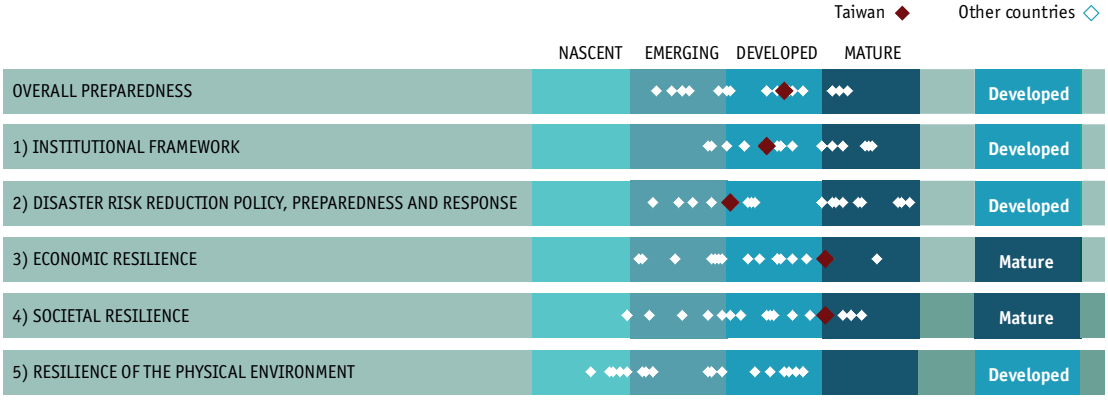
Taiwan



Institutional framework

The National Disaster Prevention and Response Committee (NDPPC) is responsible for executing disaster-related policies approved by the Central Disaster Prevention and Response Council (CDPRC); formulating fundamental plans for disaster prevention and rescue activities; and examining the plans proposed by related ministries. The Office of Disaster Prevention is in charge of preparing reports and documents for both the NDPPC and the CDPRC[346]. The National Science and Technology Centre for Disaster Reduction (NCDR) and the Disaster Prevention and Response Expert Consulting Committee are dedicated to research, technological development and consultation for the NDPPC[347].

In Taiwan, the responsibilities for different disasters have been distributed to different ministries. The Ministry of the Interior, for example, is responsible for typhoons, earthquakes, conflagration and explosions[348]. Different government entities are also responsible for different disasters at the municipal level. At the township level, the village office is in charge of all aspects of disaster management[349]. The corresponding ministries report their disaster management progress to the CDPRC during four council meetings each year, and the regional disaster prevention and response committees report to their superior entity[350]. There is no formal monitoring body (other than the media), and there is no involvement from international organisations or the private sector[351]. Members of the NDPPC and the CDPRC are selected from the Executive Yuan to serve a term, but the Office of Disaster Prevention and the NCDR have permanent staff[352]. A disaster reserve is available at all levels of government and can be accessed in emergencies. There is a short approval process for accessing extra funding in the event of a big disaster[353].

Disaster risk reduction and disaster risk management policy

The Basic Plan of Disaster Prevention and Protection (2013–2017; CPDPP) provides guidelines for implementing the Disaster Prevention and Protection Act[354]. It is more of a blueprint than a strategic plan, however, as it lists overarching directions without clear targets or timeframes, from disaster risk reduction and preparedness to response[355]. Environmental sustainability and disaster prevention

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is the fifth national vision in the National Development Plan (2013–2016), but most environmental degradation policies are short term and are not integrated with disaster risk management[356]. Climate change is a major challenge for Taiwan and is listed as one of the missions in the National Development Plan. Taiwan has linked the Basic Plan of Disaster Prevention and Protection and the National Development Council's Adaptation Strategy to Climate Change[357].

Technology companies are developing mobile apps that send extreme weather and earthquake alerts published by the Central Weather Bureau[358]. The current early warning system only covers schools, but it will be used in factories and residential buildings in the future[359]. There is no contingency plan, but contingency procedures include setting up emergency response teams to handle disaster prevention and protection affairs, co-ordinate with each tier's disaster response centre and other relevant agencies, and execute all the response measures[360]. Education on disaster prevention is promoted to improve public awareness[361].

The building code for earthquake prevention was first introduced in the 1970s, and older buildings do not meet these standards[362]. Some indigenous people refuse to move from hazardous areas, even though relocation projects are available[363]. The drainage systems in urban areas are deemed not sufficient for heavy rain, although the "sponge eco-city" concept is being introduced to cope with hydro-climatic hazards[364].

Key challenges and areas for policy improvement

A lack of clear targets, based on the directions outlined in the Basic Plan, along with reasonable timeframes for accomplishing them, is a key challenge. Reconstruction projects rely heavily on donations from the private sector and social groups, and these groups could be an important counterpart in policy-making sessions for disaster risk management[365].

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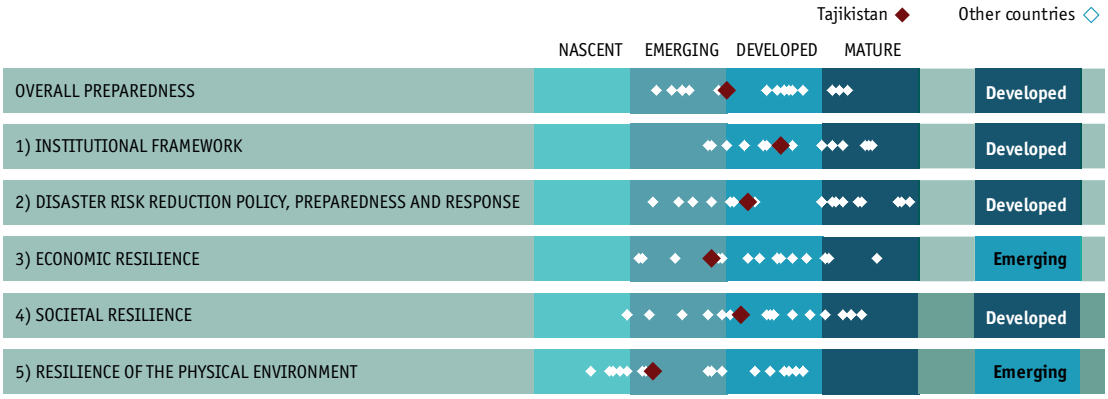
Tajikistan



Institutional framework

The dedicated national-level institution responsible for disaster risk management is the Committee for Emergency Situations and Civil Defence. It is a central executive body, and it is responsible for drafting and implementing government policy and legal regulation; control and oversight in the field of civil defence; and the protection of citizens and territories from natural and man-made emergencies. It also directs policy in relation to preparedness and the protection of citizens, economic objects and territories from the consequences of emergency situations, as well as the overall co-ordination of response measures. The Government of the Republic of Tajikistan oversees the committee's activity[366]. The committee has access to a Fund for the Liquidation of the Consequences of Emergency Situations (created via a tax on certain types of industry), which can be used for certain purposes set out by law, including compensating victims, staging rescue operations and reconstructing damaged areas[367]. Local authorities do not have any independent policy-forming powers and are mainly responsible for implementing policy at the local level—for example, ensuring that local forces and measures are in place for dealing with emergency situations, conducting evacuation procedures, and keeping financial and material reserves in place for dealing with emergency situations[368]. The country's National Platform for Disaster Risk Reduction was set up in 2012 to co-ordinate with the director of the Institute of Geology, Earthquake Engineering and Seismology at the Academy of Science of Tajikistan, as well as organisations that act as observers, such as the World Bank and United Nations Development Programme (UNDP)[369].

Disaster risk reduction and disaster risk management policy

Tajikistan recently completed a National Disaster Risk Management Strategy for 2010–2015, which was formulated with support from the UNDP and based on disaster risk reduction priorities recommended in the Hyogo Framework for Action[370]. It has five key components: institutional mandates and legal issues; disaster risk assessment; disaster risk management and the achievement of sustainable development; disaster preparedness and response; and knowledge management (education, training and public awareness)[371]. The results of this strategy are currently under review, but the

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aim is to formulate a new strategy that aligns with the Sendai Framework. The National Disaster Risk Management Strategy refers back to the 2003 National Action Plan on Climate Resilience[372], noting that while the two are not quite comparable, the conclusions in the Plan on Climate Resilience make vitally important points that should be included in disaster risk management activities[373]. More recently, Tajikistan took part in a pilot Strategic Programme for Climate Resilience[374].

The Information Management and Analytical Centre (IMAC) is a scientific and technical department of the Committee of Emergency Situations and Civil Defence, and it was established to analyse, store and exchange available and incoming data on emergency situations caused by natural and man-made disasters[375]. The Monitoring and Early Warning System (MEWS) is a multi-faceted monitoring and warning system that covers natural and socio-economic hazards affecting Tajikistan. It supports the timely provision of humanitarian assistance by the government and the humanitarian community[376].

Ninety-three percent of Tajikistan is located in a high seismic activity zone[377]. Building codes that account for seismic risk do exist, but they are not always adhered to.

Key challenges and areas for policy improvement

The Disaster Risk Management Programme, co-ordinated by the UNDP, aims to build regional mechanisms for disaster risk management[378], but this has not yet been achieved due to a shortage of funds[379]. The UNDP is currently reviewing the outcomes of the Disaster Risk Management Programme, with a view to formulating a new strategy in line with the Sendai Framework. Despite much of the country lying in a seismic zone, Tajikistan does not have a comprehensive and enforceable system of construction codes. Progress towards creating such a system has been delayed, and the rush to build has meant that regulations are often ignored.

According to the U.S. Government Accountability Office (GAO), there are coordination challenges in managing preparedness grants that continue to "create inefficiencies" between FEMA headquarters and regional staff. The GAO has determined that FEMA does not have clear and quantifiable performance measures for prioritizing grant funding, and that the "Federal interagency does not have a comprehensive, strategic approach for identifying, prioritizing, and implementing investments for disaster resilience"[377]. Additionally, the 2016 National Preparedness Report identified Housing and Infrastructure Systems as areas for improvement since 2012 [378].

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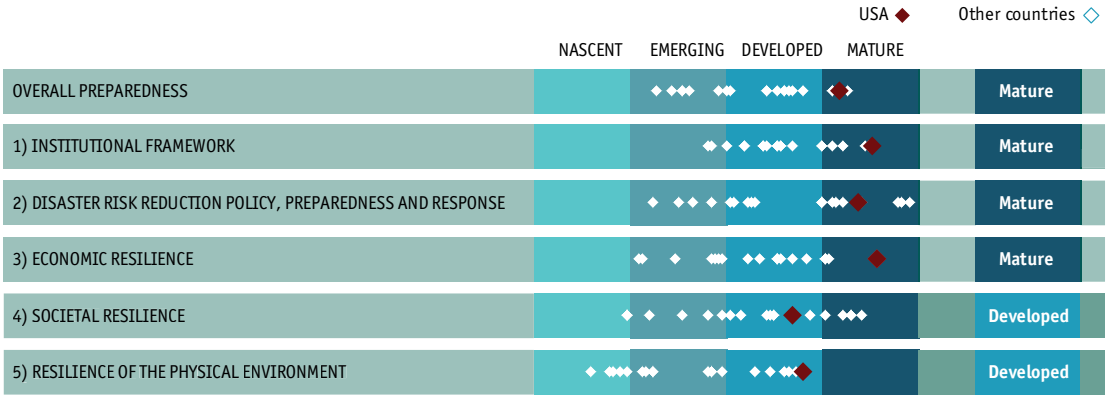
United States



Institutional framework

The Federal Emergency Management Agency (FEMA) is explicitly tasked with the national direction and co-ordination of disaster risk management in the United States (US). FEMA's core mission is to build, sustain and improve capability in order to "prepare for, protect against, respond to, recover from and mitigate all hazards." In 2003, FEMA became part of the US Department of Homeland Security (DHS), which established an organised approach to securing the country against natural and man-made disasters. FEMA is responsible for disaster response measures, and there are ten sub-national FEMA regions in the United States[380]. Both FEMA and DHS have permanent staff and leadership[381].

When a major disaster is declared by the president (authorised by the Robert T. Stafford Disaster Relief and Emergency Assistance Act), FEMA has access to financial resources. Funding comes from the president's Disaster Relief Fund (DRF), which is managed by FEMA, and the disaster aid programmes of other participating federal agencies[382]. The president's DRF (often referred to as FEMA's DRF) is the primary funding source for disaster response and recovery[383]. The Office of Inspector General (OIG) monitors FEMA activities by conducting and supervising independent audits, investigations and inspections of the programmes and operations of DHS[384]. The OIG's Office of Emergency Management Oversight performs aggressive and ongoing audit efforts, which are designed to ensure that disaster relief funds are spent appropriately[385]. The Subcommittee on Disaster Reduction assists and promotes private-sector involvement, co-ordination and information exchange[386].

Disaster risk reduction and disaster risk management policy

The 2014–2018 FEMA Strategic Plan provides strategies to protect the agency's capacity and national capabilities for disaster preparedness. A key strategic priority is enabling disaster risk reduction nationally[387], and the Economic Development Administration ensures that grant investments are allocated to increasing economic resiliency with regards to natural disasters and climate change[388]. Policy frameworks initiated by FEMA, the DHS and the executive office promote the integration of disaster risk management and climate change adaptation[389]. The National Oceanic and Atmospheric Administration (NOAA) established the Regional Coastal Resilience Grant Programme to support the

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resilience of coastal regions, and the Coral Reef Conservation Programme to protect, conserve and restore coral reef resources by maintaining healthy ecosystem function[390].

The Interior Geospatial Emergency Management System is tasked with monitoring natural hazards[391], and the Integrated Public Alert and Warning System and the National Weather Service are early warning systems that disseminate mass messages[392]. The Continuity of Operations Initiative ensures that essential functions continue to operate within individual executive departments and agencies during natural emergencies[393]. The Presidential Policy Directive 8 and FEMA's Strategic Plan 2014–2018 aim to strengthen public education and awareness in disaster risk reduction and preparedness[394].

According to an article published in the journal *Earthquake Spectra*, "a large portion of the population of the United States live in areas vulnerable to earthquake hazard"[395], and it is estimated that nearly 134m people will live in coastal communities by 2020[396]. There is no federal framework in place for building codes to be uniformly adopted nationwide in an effort to improve disaster reliance, but codes and standards established by recognised organisations are adopted and sometimes modified sub-nationally[397].

Key challenges and areas for policy improvement

The federal government does require national and sub-national governments to establish disaster risk reduction strategies aimed at strengthening health resilience, but there are no regulations requiring hospitals to develop business continuity programmes in the event of a disaster, nor are there capacity building and training programmes to assist hospitals with this task.

According to the U.S. Government Accountability Office (GAO), there are coordination challenges in managing preparedness grants that continue to "create inefficiencies" between FEMA headquarters and regional staff. The GAO has determined that FEMA does not have clear and quantifiable performance measures for prioritizing grant funding, and that the "Federal interagency does not have a comprehensive, strategic approach for identifying, prioritizing, and implementing investments for disaster resilience"[398]. Additionally, the 2016 National Preparedness Report identified Housing and Infrastructure Systems as areas for improvement since 2012[399].

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LONDON
20 Cabot Square
London
E14 4QW
United Kingdom
Tel: (44.20) 7576 8000
Fax: (44.20) 7576 8500
E-mail: london@eiu.com

NEW YORK
750 Third Avenue
5th Floor
New York, NY 10017
United States
Tel: (1.212) 554 0600
Fax: (1.212) 586 1181/2
E-mail: newyork@eiu.com

HONG KONG
1301 Cityplaza Four
12 Taikoo Wan Road
Taikoo Shing
Hong Kong
Tel: (852) 2585 3888
Fax: (852) 2802 7638
E-mail: hongkong@eiu.com

SINGAPORE
No. 8 Cross Street
#23-01 & 04
048424
Singapore
Tel: +65 6534 5177
Fax: +65 6534 5077

DUBAI
Economist Intelligence Unit
PO Box No 450056
Office No. 1301A Thuraya Tower 2
Dubai Media City
Dubai
United Arab Emirates
Tel: + 971 (0) 4 433 4202
Fax: + 971 (0) 4 438 0224