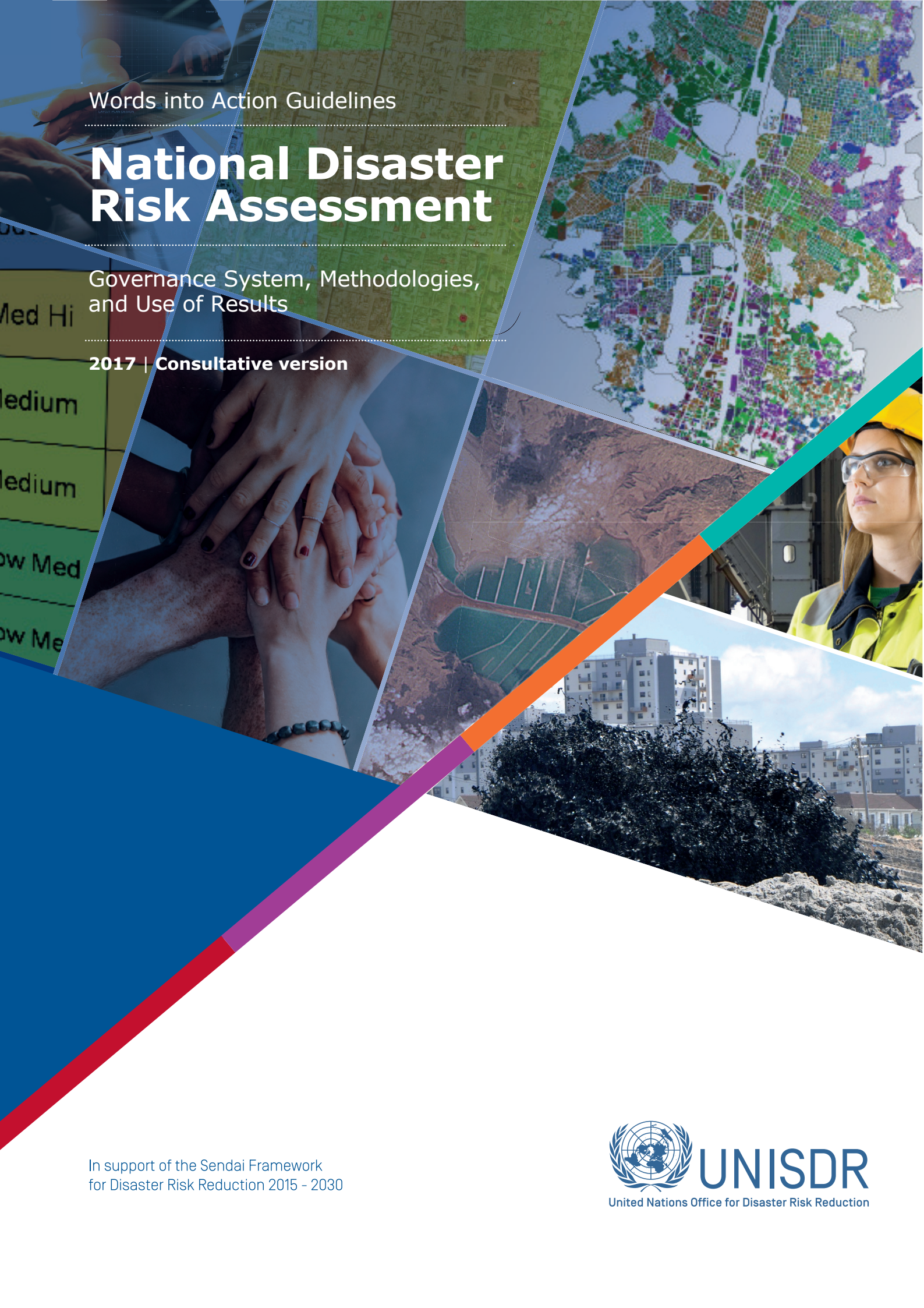


Words into Action Guidelines

# National Disaster Risk Assessment

Governance System, Methodologies,  
and Use of Results

2017 | Consultative version



In support of the Sendai Framework  
for Disaster Risk Reduction 2015 - 2030



**UNISDR**

United Nations Office for Disaster Risk Reduction



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# Chapter 1 Background

## About the *Guidelines*

### Introduction

In 2016 the United Nations Office for Disaster Risk Reduction (UNISDR) commissioned the development of guidelines on national disaster risk assessment (NDRA) as part of a series of thematic guidelines under its “Words into Action” initiative to support national implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030.<sup>1</sup>

The present *Guidelines* are the result of the collaboration between over 100 leading experts from national authorities, international organizations, non-governmental organizations, academia, think tanks and private-sector entities. They focus on Sendai Framework’s first Priority for Action: Understanding Disaster Risk, which is the basis for all measures on disaster risk reduction and is closely linked to the other three Priorities for Action.

The Guidelines are intended to:

(a) Motivate and guide countries in establishing a national system for understanding disaster risk that would act as the central repository of all publicly available risk information. This national system would lead the implementation and updates of national disaster risk assessment for use in disaster risk management, including for risk-informed disaster risk reduction strategies and development plans;

(b) Encourage NDRA leaders and implementing entities to aim for *holistic* assessments that would provide an understanding of the many different dimensions of disaster risk (hazards, exposures, vulnerabilities, capacities). The assessments would include diverse types of direct and indirect impacts of disaster – such as physical, social, economic, environmental and institutional. They would also provide information on the underlying drivers of risk – such as climate change, poverty, inequality, weak governance and unchecked urban expansion.

Both of these outcomes may take many years and many iterations of the assessments, but as long as all the efforts have full national ownership by stakeholders and the scientific community and each update of the assessments is continuously improved, they are achievable in every country.

The *Guidelines* aim to be a policy guide and a practical reference to introduce the audience, especially practitioners of disaster risk reduction, to policy, process and the high-level technical requirements for a holistic national disaster risk assessment. They provide an overview of policy objectives, effective governance,

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<sup>1</sup> UNISDR, 2015. Sendai Framework for Disaster Risk Reduction 2015 - 2030, The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

processes of design, implementation and use of assessment results in comprehensive disaster risk management.

They are based on the premise that any national disaster risk assessment needs to consider intensive and extensive risks, and that disaster risk management needs to be correlated with sustainable development and the effects of climate change.<sup>23</sup>

The *Guidelines* are structured in three parts. The first part focuses on important elements in the NDRA process: preparation and scoping, implementation and use of results. The second part consists of modules on specific issues that should be considered depending on the objective and scope of the assessment. The third part covers more in-depth information on conducting risk assessment for various hazards.

Although the *Guidelines* focus on national disaster risk assessment, many of the concepts presented are relevant and applicable for subnational or sector-specific assessments.

## Methodology

The *Guidelines* are based on a detailed review of the methodologies, approaches and governance mechanisms practised in national disaster risk assessment across the globe, as well as on existing guidelines.

The selection of an approach for conducting the assessments takes account of a wide range of issues including the purpose of NDRA, available capacities and resources, quality of the available data, political will and engagement of the stakeholders and sectoral priorities. The design of the *Guidelines* permits the sharing of the findings from studying the most effective existing assessments. It also addresses the expected variability by offering information on a wide range of topics and hazards to be adapted to different national contexts.

With the objective of understanding the roots of the existing gap between the production of risk information and its actual use in decision-making in disaster risk management, the team working on the *Guidelines* held consultations both with national policy institutions and with technical experts. They did this to ensure that the recommended approach would be based on understanding both the policy and technical aspects of NDRA and use of the assessment in decision-making.

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<sup>2</sup> Natural climate variability and human-generated climate change influence the frequency, intensity, spatial extent and duration of some extreme weather and climate events. The vulnerability of exposed human society and ecosystems interacts with these events to determine impacts and the likelihood of disasters (IPCC, 2012). Besides natural hazards, climate change can also lead to change in exposure, for example in the case of climate refugees as a result of sea-level rise and draught.

<sup>3</sup> IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA.

## Target audience

The *Guidelines* advocate for an “all-of-government” and “all-of-society” approach for NDRA to ensure its legitimacy, comprehensiveness and effectiveness. This is an imperative given the multifaceted character of disaster risk, its causes and its need for interlinked action at all government levels, and across sectors and communities.

The *Guidelines*, therefore, address the following entities:

- Policymakers concerned with setting disaster risk management and sustainable development policy priorities and planning instruments across the entire public administration system at national and subnational levels.
- National, subnational and local practitioners of disaster risk management who will use the outputs from the assessment to guide the design and implementation of disaster risk management measures.
- Disaster risk management practitioners at regional and global development institutions financing or providing technical support to developing countries for conducting national risk assessments.
- Technical experts from a wide range of thematic specializations (e.g. hydrometeorology, geophysics, sustainable development, climate change, public health, engineering, social protection, anthropology) who are involved in providing risk information for use in policy decisions.
- Academia and centres of research and knowledge creation that have a major role to play in providing a solid scientific basis for disaster risk assessment.
- Civil society representatives concerned with various aspects of building societal resilience at national and local levels or in a specific sector.
- The private sector – a key actor for reducing losses, prioritizing risk-proofed investments and the economic resilience of disaster-prone communities, as well as for providing data, methodologies and tools for NDRA.

## How to read the *Guidelines*

The *Guidelines* are designed to allow freedom in reading various sections according to the interests and needs of the users. They consist of three main parts:

**Part one - Main body** (the present document)

This part focuses on the three stages of the assessment process. All elements of the three stages are closely connected through overlaps and feedback loops:

Stage I: Preparing and scoping

Stage II: Conducting risk analysis

Stage III: Using the results for disaster risk management and development decisions.

Part one provides policy guidance. Technical references for designing and implementing assessments are set out in technical modules in parts two and three, as well as in footnotes and references.

## **Part two - Special topics**

This part consists of modules on specific issues to be considered when designing and carrying out a national disaster risk assessment. Their relevance will depend on the country-specific context and national policy objectives. Each module can be read independently.

The topics addressed include the following:

- Climate change
- Health aspects
- Direct and indirect economic impacts
- Social exposure and vulnerability
- Data management
- Citizen participation
- Cost benefit analysis
- Benefits of probabilistic modelling
- Use of geographic information system
- Technologies for risk assessment
- Cross border issues
- Risk communication
- Groups with vulnerabilities
- Cascading risk
- Use of the assessment for risk financing.

## **Part three - Hazard specific risk assessment**

This part consists of modules covering more in-depth information on conducting risk assessment for specific hazards.<sup>4</sup> The Sendai Framework calls for multi-hazard management of disaster risk based on understanding small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or human-generated hazards, as well as related environmental, technological and biological hazards and risks. Part three is a work in progress and in the coming years will gradually cover more hazards and assessment methods.

The technical modules give an overview of concepts, methodologies and tools related to each special topic and hazard. They are aimed at an audience that

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<sup>4</sup> For the interim version of the *Guidelines*, released in May 2017, parts two and three have not gone through editing to harmonize the writing style. This will be done for the final version.

understands risk assessment but is not expert in the topic. Each module offers resources and links to further information and guidance.

**Table 1** - Structure of the Guidelines: the list of technical modules and their status in the Guidelines consultative version

## Introduction to national disaster risk assessment

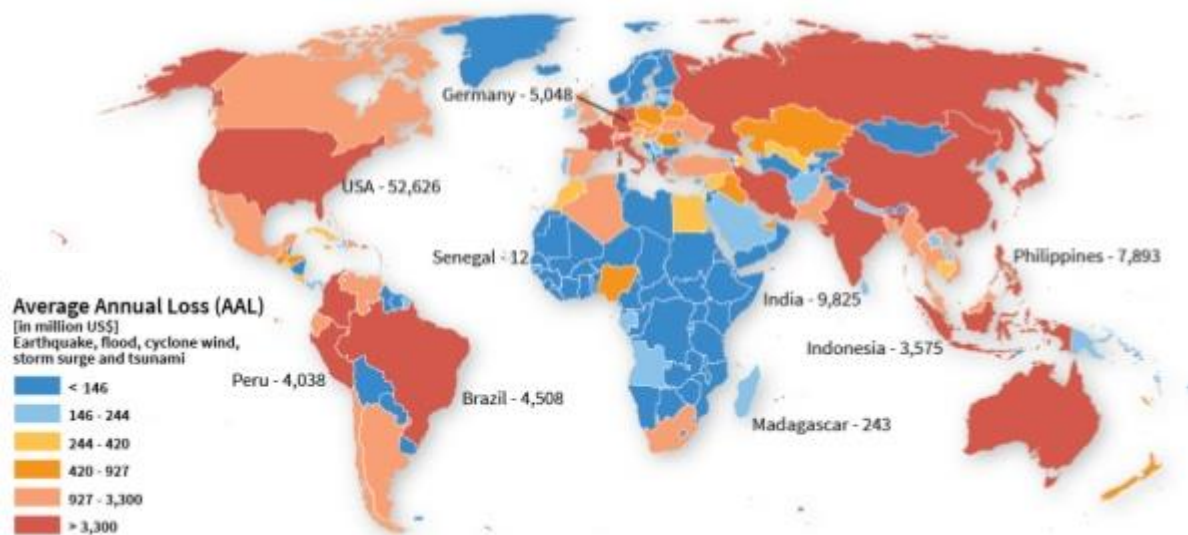
### Rationale for investing in national disaster risk assessment

<b>Part One</b>	<b>Main body</b>	
<b>Part Two</b>	<b>Special topics</b>	
Under Review	1.	Climate change and its implications in NDRA
Complete	2.	Why invest in probabilistic risk assessment?
Complete	3.	Cross-Sectoral and Multi-Risk Approach to Cascading Disasters
Complete	4.	Direct and Indirect Economic Impact
Under Review	5.	Social exposure and vulnerability
Complete	6.	Marginalized and minority groups consideration in NRA
Complete	7.	Health aspect in disaster risk assessment
Under Review	8.	Cross-border and international nature and grand challenges
Complete	9.	Data Management Throughout the National Risk Assessment Process
Complete	10.	Use of GIS in implementing NDRA
Complete	11.	Citizens participation and crowdsourcing
Complete	12.	Supporting decision for DRR investments
Complete	13.	Developing Risk Assessment to Support Sovereign Risk Financing and Risk Transfer
Complete	14.	Risk communication with general public
<b>Part Three</b>	<b>Hazard-Specific Risk Assessment</b>	
	Geophysical	
Complete	1.	Earthquake Hazard and Risk Assessment
Complete	2.	Tsunami Hazard and Risk Assessment
Under development	3.	Volcanic Eruption Hazard and Risk Assessment
	Hydrological	
Under Review	1.	Flood Hazard and Risk Assessment
Complete	2.	Landslide Hazard and Risk Assessment
Complete	3.	Coastal Erosion Hazard and Risk Assessment
Complete	4.	Sea Level Rise Hazard and Risk Assessment
	Meteorological	
Complete	1.	Tropical Cyclone Hazard and Risk Assessment
	Climatological	
Complete	1.	Wild Fire Hazard and Risk Assessment
	Pandemics and epidemics	
Under Review	1.	Biological Hazard and Risk Assessment
	Technological	
Complete	1.	Natech Hazard and Risk Assessment
Under development	2.	Chemical Hazard and Risk Assessment
	Man-made	
Under development	1.	Malicious attacks

Recent disasters dramatically affected millions of people, with hundreds of thousands of lives and US\$ 1.5 trillion lost between 2005 and 2014 alone, a tenfold



increase over the previous decade. Global economic loss from disasters varies on average from US\$ 250 billion to US\$ 300 billion each year.<sup>5</sup> Figure 1 gives an overview of risk levels from only five hazards across the world. This trend is set to continue undermining development gains and causing risks to people, the economy, the environment and culture.



**Figure 1** - Expected disaster losses annualized over the long term (average annual loss). Results are from UNISDR global risk assessment of earthquake, flood, cyclone wind, storm surge and tsunami (in millions of US dollars). *Source: UNISDR Global Assessment Report on Disaster Risk Reduction 15*

Changing climate, rapid urbanization, ongoing violence and conflicts in many parts of the world, changing demographics, technological innovations, increasing inequality and many other known and emerging changes with their inherent uncertainties have created an unprecedented context for disaster impact.

Apart from sudden large-scale disasters (intensive risks), the accumulation of impacts from small frequent events (extensive risks)<sup>6,6</sup> and slowly developing health, safety, security and environmental crises have a quiet but massive effect on society and on sustainable development. Investing in understanding disaster risk is therefore more important than ever if we want to understand its complexity and efficiently manage the resources required for managing disaster risk and designing interventions.

The Sendai Framework reinforces the crucial shift made in Yokohama and Hyogo from *managing disasters* to *managing disaster risk*, while resilience-building has grown into a shared ground for all international agreements made under the 2030

<sup>5</sup> UNISDR, 2015. Global Assessment Report on Disaster Risk Reduction (GAR) 2015, The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

<sup>6</sup> UNISDR, 2011. Global Assessment Report on Disaster Risk Reduction (GAR) 2011, The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

Agenda. Coherence and linkages between the implementation of the Sendai Framework, the 2030 Sustainable Development Goals, the Paris Agreement on climate change, the outcomes of the World Humanitarian Summit and the New Urban Agenda, and allied sectoral agreements such as the International Health Regulations (2005) are critical to ensure risk-informed development and resilience-building.

Resilience has been defined as: “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management”.<sup>7</sup> Resilience-building starts with understanding the risk that a society is facing, including disaster risk.

The outputs of an effective national disaster risk assessment inform disaster risk reduction efforts, including risk-informed sustainable development strategies, climate change adaptation planning, national disaster risk reduction across all sectors, as well as emergency preparedness and response.

The disaster risk management policy and planning applications of the outputs include:

- Informing national sustainable development plans so as to avoid the creation of new risk, reduce and manage existing risks, build resilience across various sectors and protect new and existing development from hazardous events.
- Informing national disaster risk reduction and climate change adaptation, including setting risk reduction goals and targets.
- Identifying strengths and gaps in national capacities, and resilience in relation to the risk levels.
- Identifying needs for more detailed sectoral or geographic risk assessments.
- Guiding disaster risk financial management and investment.
- Setting the basis (methods and data) for real-time prediction of exposure, vulnerability and impact in case of an unfolding disaster for the purpose of response and recovery planning
- Supporting public education and awareness activities.

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<sup>7</sup> UNISDR, 2016. Open-ended Intergovernmental Expert Working Group on Indicators and Terminology relating to Disaster Risk Reduction: Report of the Second Session (Informal and Formal), The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

National disaster risk assessments are costly exercises but the long-term benefits of risk-informed disaster risk reduction significantly outweigh the initial costs of the assessment. For most of the risk management measures that would benefit from a risk assessment, the financial cost of conducting an assessment is marginal in relation to the total cost of the investment.

Implementing national assessments, giving due consideration to the impact of climate change and to the correlation of disaster risk management with sustainable development creates a purposeful platform for communication and collaboration among stakeholders in disaster risk management, climate change adaptation and development, who, in many countries, are operating in silos. The approach to assessing and managing risks of different hazards and in different sectors (e.g. in relation to diseases) often occurs in isolation. Multi-hazard assessments help bring these actors together to study the relative risks of each type of hazard and find common ground for taking effective measures and using resources efficiently through an “all-hazards” approach.

### **Rationale for the approach presented in the *Guidelines***

A review of the achievement of the Hyogo Framework for Action 2005-2015 in risk identification and national disaster risk assessments has identified critical requirements for successful assessments, providing useful information for disaster risk reduction decision-making and practice. The review revealed that for an assessment to be successful, it needs the following:

- Inclusive governance mechanism
- Broad set of technical, financial, and administrative capacities
- Availability of reliable data and a solid methodology that meet the intended use of risk assessment results
- Political will to ensure that the outcomes are accessible, understandable and usable for the intended disaster risk management purposes.<sup>8</sup>

The approach presented in these *Guidelines* ensures that the following requirements for the success of an assessment are covered:

- ***NDRA governance mechanism***: It is critical to ensure that the governance mechanism is well embedded in the disaster risk *management* governance mechanism and is inclusive. It should involve various sectoral ministerial portfolios, the national science and technology communities, the private sector and civil society.

While national disaster risk *assessment* governance is primarily concerned with the assessment process itself, the national disaster risk *management* governance has a broader scope, including the design and implementation

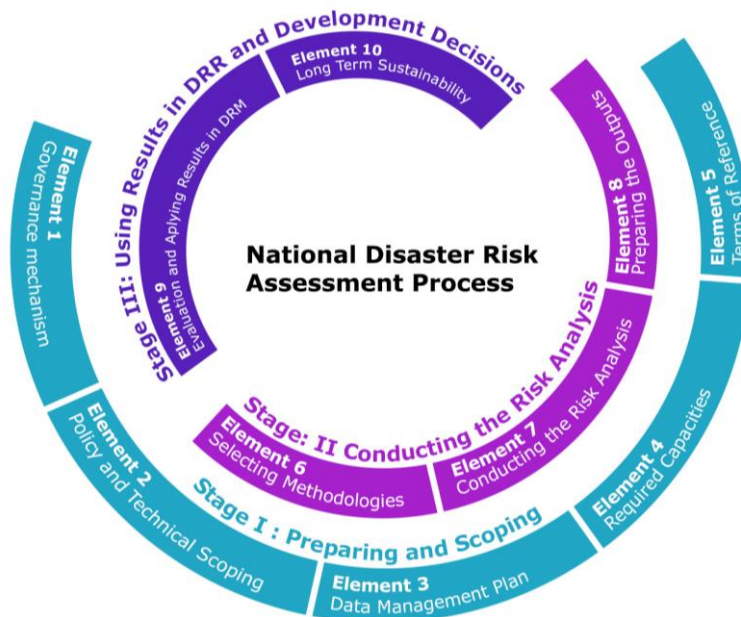
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<sup>8</sup> UNWCDRR, 2015. Risk Identification and Assessment (Priority 2) Multi-Stakeholder Working Session, United Nations World Conference on Disaster Risk Reduction, Sendai, Japan.

of disaster risk reduction strategies and enabling systematic integration of disaster risk considerations into development planning.

- **Purpose, methodology and outputs:** Clarity on the purpose of the risk assessment is needed to develop the scope, select the methodologies and tools, and the format of the outcomes. The methodology selected will define the sensitivity and robustness of the outcomes. While methods can vary significantly, it is essential to define the limitations of the chosen methodology to avoid false perception of precision, and define the confidence levels and uncertainties as well as the role of risk perception and risk acceptance that inevitably affects the decisions.  
Without clarity on the purpose, appropriate methodology and tailoring the outputs for the purpose, risk assessment will remain no more than a scientific and engineering exercise, which will not be used in decision-making.
- **Capacities for conducting NDRA:** This refers to the technical, financial and administrative capacities required for effective implementation. An NDRA is often a complex and resource-intensive undertaking. Its scope is a trade-off between the full scientific depth of the assessment and the time and human resources that can be devoted to carrying it out while meeting the objective of using the assessment in disaster risk management.
- **Data management:** Availability of data is critical for a sufficiently grounded assessment. The assessment is made on the basis of validated sources of information and data on hazards, exposure, vulnerabilities and coping capacities. It might also be necessary to improve the existing data on hazard, exposure, vulnerability and capacities, as well as historical disaster loss data, the ongoing collection and recording of losses and damages, and the data management systems for NDRA.
- **Political commitment:** Political endorsement, leadership and the support of a high-level national authority, and ownership and commitment from all stakeholders are required to provide the necessary input data, understand the results and their limitations, and use the results in disaster risk management decision-making.

The first part of the *Guidelines* presents 10 enabling elements for designing and implementing an assessment, clustered in three stages. The elements are interlinked through many areas of overlap and feedback loops.



**Figure 2** - Ten enabling elements in three stages of the NDRA process, interlinked through overlapping areas of concern and feedback loops

### Understanding disaster risk components

Over time the conceptualization of disaster risk has undergone a transformation. These *Guidelines* use the classic disaster risk concept, which describes risk in terms of likelihood and impact, based on the interaction between hazard, exposure, vulnerabilities and capacities. To identify and evaluate the best measures for reducing risk, an assessment should also explain the underlying drivers of hazard, exposure, vulnerabilities and capacities, as well as the direct and indirect impacts. Below are the definitions of these components from the Open-ended Intergovernmental Expert Working Group (OIEWG) report to the General Assembly on Indicators and Terminology, 2016.

**Disaster risk:** The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.

*The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socioeconomic development, disaster risks can be assessed and mapped, in broad terms at least.*

*It is important to consider the social and economic contexts in which disaster risks occur and that people do not necessarily share the same perceptions of risk and*



*their underlying risk factors.*

Acceptable risk, or tolerable risk, is therefore an important subterm; the extent to which a disaster risk is deemed acceptable or tolerable depends on existing social, economic, political, cultural, technical and environmental conditions. In engineering terms, acceptable risk is also used to assess and define the structural and non-structural measures that are needed in order to reduce possible harm to people, property, services and systems to a chosen tolerated level, according to codes or “accepted practice” which are based on known probabilities of hazards and other factors.

Residual risk is the disaster risk that remains even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach.

National Disaster Risk: intensive and extensive Disaster Risks that either have a potential (cumulative) impact that is significant and relevant for the nation as a whole and/or require national DRM coordination.

*Annotation: the boundaries of National Disaster Risk depend on the purpose and scoping of a NDRA process. This has to be defined in each country, taking into account existing governance and DRM policies. National Disaster Risks at least include all risks that cannot be sufficiently managed at sub-national level.*

Extensive Disaster Risk: the risk associated with low-severity, high-frequency events, mainly but not exclusively associated with highly localized hazards.

Intensive Disaster Risk: the risk associated with high-severity, mid to low-frequency events, mainly associated with major hazards.

**Disaster risk assessment:** A qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend. Disaster risk assessments include: the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.<sup>9</sup>

**Hazard:** A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin. Natural hazards are predominantly associated with natural processes and

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<sup>9</sup> In these *Guidelines*, assessment of coping capacity, underlying drivers of risk, direct and indirect impact are part of understanding disaster risk

phenomena. Anthropogenic hazards, or human-induced hazards, are induced entirely or predominantly by human activities and choices. This term does not include the occurrence or risk of armed conflicts and other situations of social instability or tension which are subject to international humanitarian law and national legislation. Several hazards are socio-natural, in that they are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change.

*Hazards may be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity or magnitude, frequency and probability. Biological hazards are also defined by their infectiousness or toxicity, or other characteristics of the pathogen such as dose-response, incubation period, case fatality rate and estimation of the pathogen for transmission.*

Multi-hazard means (1) the selection of multiple major hazards that the country faces, and (2) the specific contexts where hazardous events may occur simultaneously, in a cascading manner or cumulatively over time, and taking into account the potential interrelated effects.

Hazards include (as mentioned in the Sendai Framework for Disaster Risk Reduction 2015-2030, and listed in alphabetical order) biological, environmental, geological, hydro-meteorological and technological processes and phenomena.

**Exposure:** The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

*Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.*

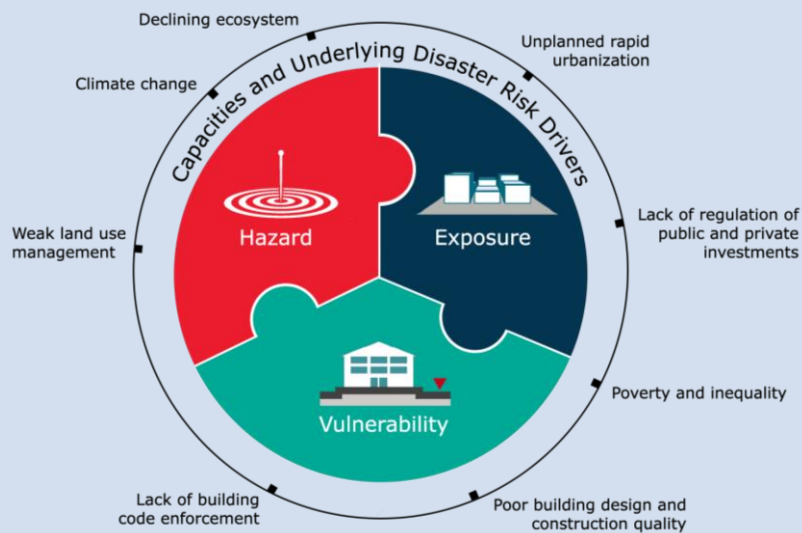
**Vulnerability:** The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards

**Capacity:** The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience. Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management.

Coping capacity is the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks.

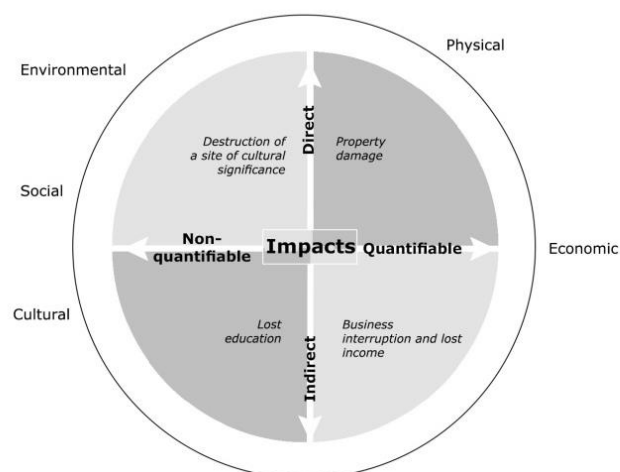
**Underlying disaster risk drivers:** Processes or conditions, often development-related, that influence the level of disaster risk by increasing levels of exposure and vulnerability or reducing capacity.

Underlying disaster risk drivers — also referred to as underlying disaster risk factors — include poverty and inequality, climate change and variability, unplanned and rapid urbanization and the lack of disaster risk considerations in land management and environmental and natural resource management, as well as compounding factors such as demographic change, non-disaster risk-informed policies, the lack of regulations and incentives for private disaster risk reduction investment, complex supply chains, the limited availability of technology, unsustainable uses of natural resources, declining ecosystems, pandemics and epidemics.



**Figure 3** - Underlying drivers may influence more than one component of disaster risk

**Disaster impact:** is the total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being



**Figure 4** - There are direct and indirect impacts of disasters. Not all types of impact can easily be quantified in monetary terms

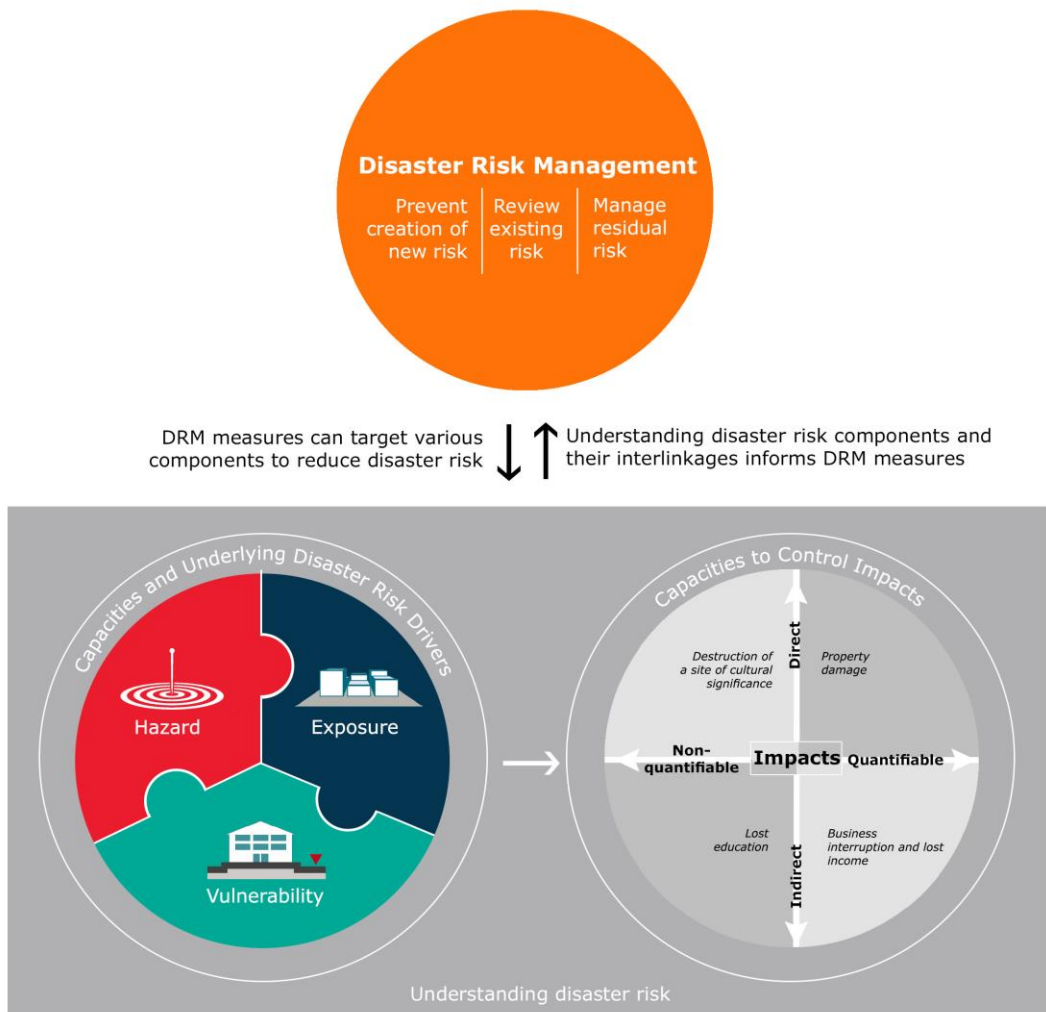
**Economic loss:** Total economic impact that consists of direct economic loss and

indirect economic loss.

**Direct economic loss:** the monetary value of total or partial destruction of physical assets existing in the affected area. Direct economic loss is nearly equivalent to physical damage.

**Indirect economic loss:** a decline in economic value added as a consequence of direct economic loss and/or human and environmental impacts. Indirect economic loss includes microeconomic impacts (e.g., revenue declines owing to business interruption), meso-economic impacts (e.g., revenue declines owing to impacts on natural assets, interruptions to supply chains or temporary unemployment) and macroeconomic impacts (e.g., price increases, increases in government debt, negative impact on stock market prices and decline in GDP). Indirect losses can occur inside or outside of the hazard area and often have a time lag. As a result they may be intangible or difficult to measure.

Hazard, exposure, vulnerabilities and capacities are dynamic and constantly changing as a result of changes, for instance, in land use and land cover, rapidly growing urbanization, construction practice and regulations and technological innovations. Other processes further impact the dynamics of hazard, exposure, vulnerability, capacity and their interactions, including underlying root causes such as climate change, population growth or changing demographic structures, and changing levels of inequality gaps and poverty. Therefore, understanding (through NDRA) and addressing (through disaster risk management) the root causes of all dimensions of risk is an essential consideration.



**Figure 5** - Comprehensive understanding of disaster risk empowers effective and comprehensive disaster risk management

### Process of national disaster risk assessment

The risk assessment process flow outlined in the international standards on risk management (ISO 31000:2009) and on risk assessment (31010:2009) is the most commonly used.<sup>10</sup> It starts with setting the context and then consists of three steps: risk identification, risk analysis and risk evaluation. This process flow is the basis for most European assessments and for the Australian national risk assessment guidelines and some others. Below is a description of each component of the process, cross-referencing the elements in the *Guidelines* that cover that step.

**Establishing context:** This step is concerned with understanding the risk management context in order to define the purpose and scope of the risk assessment. It includes engaging and consulting with stakeholders and defining criteria for decisions.

<sup>10</sup> Updated version of ISO 31000 and 310310 due for release in 2019.



In the *Guidelines*, establishing context starts in element 1 and is then completed with policy and technical scoping in element 2.

**Risk identification:** From a national disaster risk assessment perspective, this step is concerned with a very high-level scoping of hazard, exposure and vulnerabilities to define the direction for the rest of the assessment process. It uses the knowledge and experience of stakeholders, data on past disasters and risk information to draw initial conclusions about the importance of a specific hazard, assets, known vulnerabilities and major impacts of concern for an NDRA. Consideration should be given to both extensive (frequent, low-impact) and intensive (occasional, high-impact) events, as well as potential cascading events and simultaneous events linked to the same cause (e.g. El Niño and La Niña).

In the *Guidelines*, disaster risk identification starts in element 2 and is then completed with more technical depth in element 6.

**Risk analysis:** This step is concerned with obtaining a more detailed understanding of the disaster risk: detailed hazard analysis, exposure analysis, vulnerability analysis and capacity analysis. The analysis provides insight into the interaction of a single hazard or a multi-hazard with the exposure and all dimensions of vulnerabilities (physical, environmental, social, economic and cultural). Each point of interaction of disaster risk components creates a unique coupling: a specific impact and its likelihood.

Another component of risk analysis is understanding and evaluating the effectiveness of the existing capacities (or the controls and measures in place for managing the risk, as this is called in ISO:31010). Understanding the effectiveness of capacities is critical for identifying targeted measures to manage the risk.

Risk analysis also includes assessing the confidence level or the level of uncertainty. This is relevant for both single-hazard and multi-hazard disaster risk analysis, with any time-horizon. Risk analysis is covered in elements 6 and 7.

**Risk evaluation:** This step allows for risk prioritization for the purpose of managing the risk. The multi-hazard disaster risks analysed for likelihood and impact could be presented in different ways to facilitate the visualization and prioritization process. The risk prioritization is further adjusted based on an understanding of capacities, risk perception<sup>11</sup> and risk acceptance of the whole of a country's society, and by the availability and level of resources to manage the risks. This requires input from those owning the risk and who are responsible for disaster risk management.

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<sup>11</sup> Instead of considering risk perception and acceptance as part of the risk evaluation, another option is to perform an additional "societal risk assessment" to analyse societal risk considerations, as suggested by the International Risk Governance Council.

The whole of society is represented through stakeholder coordination and communication mechanisms to define the priority disaster risks. Only then is there a legitimate basis for disaster risk prioritization – defining the risks of high societal importance that require immediate attention, the risks that could be tolerated or neglected, and the risks that need to be closely monitored. Risk evaluation is covered in elements 8 and 9.

**Table 2** - Mapping of ISO steps to the elements in the *Guidelines*

ISO steps	Guideline elements	
<b>Establishing context</b>	Element 1	Establishing NDRA governance mechanism
	Element 2	Defining the policy scope and technical scope of NDRA
<b>Risk identification</b>	Element 2	Defining the policy scope and technical scope of NDRA
	Element 6	Selecting risk analysis methodologies
<b>Risk analysis</b>	Element 6	Selecting risk analysis methodologies
	Element 7	Conducting risk analysis
<b>Risk evaluation</b>	Element 8	Preparing the outputs of risk analysis for communication with stakeholders
	Element 9	Facilitating the process for applying results in DRM decisions and solutions

## Chapter 2    **Implementing a national disaster risk assessment**

This chapter describes in detail each of the three stages of the assessment: preparing and scoping, conducting risk analysis and using the results for disaster risk management and development decisions. Stage I covers the first five elements, stage II covers the next two and stage III the final two.

The elements reflect the logic of each stage, but many are interlinked. All the elements should be read in order to obtain a complete picture and better understand how they can enable a country to implement an effective NDRA process for producing information for use in disaster risk management.

### **Stage I    Preparing and scoping**

This stage considers what needs to be done before embarking on an NDRA process, ensuring that outputs are fit for purpose. It explains the importance of identifying the key stakeholders and shaping viable governance mechanisms for NDRA, including roles and responsibilities, defining the thematic scope of the assessment, agreeing on a data management plan, and assessing the technical capacities necessary for successful implementation of the NDRA and, if necessary, developing those capacities. The final product of this preparatory stage is the terms of reference to initiate the assessment process. The elements below detail each of these components.

#### **Element 1 Establishing a governance mechanism**

This element describes the rationale, objectives, structure and considerations for modalities of operation of an NDRA governance mechanism.

##### *Why a governance mechanism is needed?*

The rationale for establishing a governance mechanism is based on the following:

- (a) An effective NDRA requires consultations, engagement and contributions from a wide range of stakeholders: governmental bodies including line ministries; civil defence; the private sector; civil society; the scientific community and the general public.

Many of these groups are owners of risk and in positions to manage that risk. As each has a different and often conflicting understanding of disaster risk, they communicate disaster risk information differently, have different institutional and legal requirements, and different levels of financial resources to engage with a national disaster risk assessment.

(b) A successful NDRA requires a system of institutions, operational modalities, policies and a legal framework to guide, manage, coordinate and oversee implementation. The principles of good governance – inclusiveness, transparency, accountability, efficiency and responsiveness – guide the implementation process. This is of particular interest, as the outcomes of an NDRA might in some cases show levels of risk that are not politically palatable and would therefore need a transparent and accountable risk evaluation.<sup>12</sup>

To function effectively, the NDRA governance structure requires:

- Clarity and agreement on the division of the roles and responsibilities of each involved actor
- Political legitimacy or mandate
- Adequate resources.

Obtaining long-term political commitment for a national disaster risk assessment is of great importance, because the assessment informs strategic decisions on risk management that require long-term political and financial commitment for their implementation. Besides, the assessment itself is an iterative process that can stretch across a political term of office and requires long-term sustainability.

Such a governance mechanism is defined based on the high-level objective of NDRA. For example, an assessment that is only supposed to provide inputs for national emergency preparedness and planning may have a different lead agency from an assessment that is meant to provide hazard and risk information for a comprehensive disaster risk reduction strategy, sustainable development planning or climate change adaptation.

### *Governance structure*

While the context of NDRA governance is directly guided by the high-level objective of the assessment, and it can differ from country to country, there is also an emerging overall pattern of NDRA governance mechanisms defining roles and responsibilities of various entities:

- **Lead agency:** The lead agency, which coordinates and oversees the whole process and acts as the secretariat for the national disaster risk assessment, could be any of the following:
  - National civil protection agency/national disaster risk reduction agency
  - Environmental protection agency
  - Ministry of Internal Affairs

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<sup>12</sup> For example, high-risk levels that could trigger concerns of scaring off investment, or low-risk levels that could limit chances of donor investment in disaster risk management projects.

- Ministry of Planning and Development
  - Agency with a broad mandate related to disaster risk management
  - Office of the Prime Minister.
- **Multi-stakeholder coordination body:** Implementation of the national disaster risk assessment is carried out by a specially established coordination body that includes a variety of stakeholders (as the risk owners) and other actors who will use the outputs of the assessment for their disaster risk management measures. It is essential to include in this body stakeholders from the public and the private sector, from entities working on development planning and climate change adaptation, from civil society and the media, and general public representatives. If possible, it is best to give governance of the assessment to an existing intergovernmental coordination structure. This reduces the overheads and ensures long-term sustainability. The existing mechanism should be enhanced with the right technical entities and if needed other relevant stakeholders to ensure coverage of the full scope of the national disaster risk assessment.

A variety of mechanisms and tools could be used for consultations, communication and collaboration depending on the objective. These could include in-person multi-stakeholder meetings and workshops, questionnaires, online collaboration platforms, social media and geospatial data platforms.

- **Technical committee:** A multisectoral technical committee provides scientific advice throughout the process, secures sufficient contributions from experts, and ensures an adequate level of scientific quality of the risk assessment. This committee has to ensure cooperation on the interface between science and policy. It should consist of a group of recognized experts with diverse backgrounds who understand both the technical and the policy implications of national risk assessments and how they are used in disaster risk management.

Importantly, the technical committee should be of such a size and structure to allow access to a wide network of experts to quickly mobilize the expertise and advice required on specific technical matters. It may be necessary to set up additional thematic subcommittees on themes related to hazards, exposure, susceptibility, capacity, or cross-cutting themes.

The technical committee might also decide to create subcommittees focusing on specific hazards. In the absence of the necessary expertise – for example, for conducting probabilistic risk modelling – a country should mobilize the capacities of the international scientific community.

Whatever governance model is chosen, it should be suitable for implementing every step of the assessment from beginning to end, including:



- Identifying and engaging stakeholders
- Budgeting
- Undertaking quality control
- Holding multi-stakeholder consultations
- Defining needed capacities
- Defining the methodology
- Identifying data management requirements
- Overseeing delivery of outputs.

### *Legal framework*

The viability of a governance mechanism depends largely on the political endorsement of the national disaster risk assessment. Ideally, such political endorsement could be further formalized by a regulatory act prescribing the roles and responsibilities of the various institutions and the decision process concerning the outputs of the assessment.

### *Process agreements*

For the effective functioning of the governance mechanism, some administrative or process-related agreements must be made and respected throughout the whole process, which in some cases may already be enshrined in legal bases or operational procedures:

- Roles and responsibilities of each partner.
- Budget and duration of the assessment.
- Conditions for including or excluding specific risks.
- Conditions for the risk-related data communication (including the assigning of confidentiality levels, if needed) during the assessment among its partners (internally) and among a larger group of stakeholders (externally).
- Agency responsibilities for holding and maintaining background data and results after the completion of the process and for the next rounds of the assessment, including privacy and security settings.
- The package of deliverables (e.g. geospatial platforms and maps, policy briefs, scientific research reports).
- Accountability of risk owners upon receiving the results.

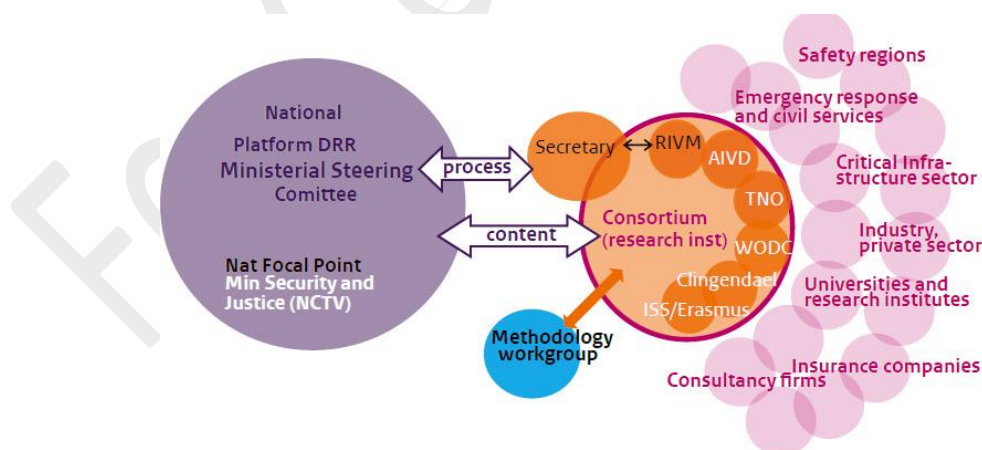
#### **Toolbox 1 - Stakeholders to be invited into the governance structure**

The following is a non-exhaustive list of national entities (or equivalents) that should be considered for involvement in the process:

- Office of the Prime Minister (or similar level)
- National disaster risk management agency/ministry
- Ministry of Interior
- Ministry of Finance
- Ministry of Development and planning
- Ministry of Environment

- Ministry of Education
- Ministry of Health
- Ministry of Infrastructure and Public Utilities
- Ministry of Defence
- Ministry of Agriculture
- Emergency services – civil protection, fire and rescue, medical assistance, law enforcement
- National statistics office
- Public and private entities managing major lifelines such as telecommunication, water and sanitation, energy, transportation
- Representatives of local authorities
- National entity leading climate change adaptation efforts
- National entities leading scientific and data collection work related to various hazards: e.g. national hydro-meteorological agency, national geological agency
- Universities, think tanks and technical institutions from relevant fields (e.g. scientific departments relevant to various hazards, structural and civil engineering, social sciences, economics, geospatial data)
- National census department
- Civil society representatives, including representatives of women, children and other vulnerable groups
- Chamber of commerce (representing the private sector)
- Insurance sector.

The role of each stakeholder should be clear from the beginning so as to customize the communications and interactions accordingly. Depending on the roles, the stakeholders may be informed, consulted or solicited for data or technical advice, or fully involved to support implementation at different stages of the assessment.



**Figure 6** - Organizational structure of Netherlands national risk assessment. *Source: Words into Action Guidelines on National and Local Platforms (Consultative version), 2017.*

## Element 2 Defining the policy scope and technical scope of NDRA

The objective of this element, scoping of NDRA, is to ensure NDRA is designed and implemented to be “fit for purpose”.

Before conducting a national disaster risk assessment, it is important to conduct a feasibility study. The study should define the policy scope, the technical scope and the boundaries set by the technical, financial and political resources available for the assessment. The scope of the assessment will depend on the complexity and scale of a country and its risks.

The “policy scoping” is based on national disaster risk management policy objectives for preventing the creation of new risk, reducing existing risk, managing residual risk and developing resilience. Policy scoping may start with a political discussion at the higher level of government, such as a council of ministers, and then be continued by consultation with the stakeholders represented in the governance mechanism.

The “technical scoping” translates the policy scope into elements of disaster risk assessment (hazard, exposure, vulnerability and capacity), as well as the time-horizon for considering risk levels and the time cycle for updating the assessment.

The main mechanism for defining the scope is consultation with the stakeholders and users. The best modalities for this element are facilitated workshops for the technical committee and scientific stakeholders. Limitations posed by technical and financial resources would be considered in finalizing the scope.

The national disaster risk assessment is an iterative process whereby every element is built on the previous one, based on the results and decisions made, but may also demand updates or expansion of the previous element. Iterative scoping may lead to adjustments to the governance mechanism to ensure that the appropriate stakeholders are consulted and engaged within each element.<sup>13</sup>

### *Using existing risk information*

Both policy and technical scoping benefit from existing loss and risk information:

- **Information on past losses:** Existing information on past disaster losses can provide valuable insights to guide the discussions in defining the scope. It should, however, be handled with care as it cannot predict the future. Records of historical disaster losses are known in most countries as a National Disaster Loss Database. These are especially helpful for understanding cumulative losses from high-frequency and low-intensity events, but do not provide information on low-frequency high-intensity events and extreme events.

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<sup>13</sup> Together, the policy scoping and technical scoping are similar to the step of “pre-assessment” of the IRGC Risk Governance Framework.

- **Disaster risk information:** In every country, some level of information is already available on hazard and disaster risk. This might be extracted from lessons learnt, past risk assessment efforts, or regional or international efforts related to risk profiling. It is recommended that the lead agency should be accountable for the collation of all the available risk information and its use for discussions on scoping, in collaboration with the various data holders (also on the science/policy interface). Examples of existing risk information from international sources can be found in Toolbox 2.

**Toolbox 2** - Examples of existing hazard, risk, and historical loss information from global sources

Index for Risk Management (INFORM) tool (EU) - INFORM combines 50 different indicators related to the conditions that lead to crises and disasters. INFORM includes data on the area's human and natural hazard risks, the vulnerability of the communities faced with hazards, and the coping capacity of local infrastructure and institutions. <http://www.inform-index.org/>

Global Assessment Report (GAR) Atlas Risk Data Platform (UNISDR) - Online tool which shares spatial data information on global risk from natural hazards. It covers tropical cyclones and storm surges, earthquakes, riverine floods, and tsunamis. <http://risk.preventionweb.net/capviewer/main.jsp?tab=0>

Think Hazard (GFDRR) - An online tool created by GFDRR to enable non-experts to consider natural hazard information in project design. Users can assess the level of river flood, earthquake, drought, cyclone, coastal flood, tsunami, volcano, and landslide hazard. <http://thinkhazard.org/>

EMDAT (CRED) - Online database that contains essential core data on the occurrence and effects of over 22,000 mass disasters in the world from 1900 to the present day. The database is compiled from various sources, including UN agencies, non-governmental organisations, insurance companies, research institutes and press agencies. <http://www.emdat.be/>

Global Assessment Report (GAR) disaster loss database (UNISDR) - Online database of detailed disaster loss database for 94 countries. These databases are developed at national level. [http://www.desinventar.net/index\\_www.html](http://www.desinventar.net/index_www.html)

### *Policy scoping*

It is recommended to discuss the following topics in the policy scoping:

- **Societal functions/values, sustainable development and disaster risk reduction priorities:** What does a country want to protect against disaster risk? What are the "values to protect"? The Sendai Framework describes the main objectives as "reducing risk and losses in lives, livelihoods and health in economic, physical, social, cultural and environmental assets of persons, businesses, communities and

countries".<sup>14</sup> Individual countries may have specific priorities for disaster risk reduction – for example, protecting long-term economic growth or the safety and livelihoods of a low-income population. Defining risk reduction priorities gives direction to the selection and design of risk management measures<sup>15</sup>.

### **Toolbox 3 - Sendai Framework global targets and indicators**

The Sendai Framework global targets and the set of indicators<sup>16</sup> that were agreed upon by all countries in 2016 through an open-ended intergovernmental expert working group (OIEWG) can be used to guide the discussion on risk reduction priorities. The targets and indicators cover a wide range of impacts, such as:

- Number of people injured or illness attributed to disaster
- Number of people whose dwellings were damaged or destroyed
- Number of people displaced
- Direct loss of economic, agricultural and other productive assets, housing sector, or cultural heritage
- Disruption to critical infrastructure or basic services, health services, etc.

Target C and its indicators are presented here as an example:

#### **Global target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.**

C-1 (compound)      Direct economic loss attributed to disasters in relation to global gross domestic product.

C-2                      Direct agricultural loss attributed to disasters.  
*Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.*

C-3                      Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.  
*Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.*

C-4                      Direct economic loss in the housing sector attributed to disasters.  
*Data would be disaggregated according to damaged and destroyed dwellings.*

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<sup>14</sup> UNISDR, 2015. Sendai Framework for Disaster Risk Reduction 2015 - 2030, The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

<sup>15</sup> J. Birkmann, et al., 2013. Framing Vulnerability, risk and societal responses: the MOVE framework

<sup>16</sup> United Nations General Assembly, 2016. Report of the Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction, United Nations General Assembly, Geneva, Switzerland.

C-5	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters. <i>The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant.</i>
C-6	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

- **Disaster risk management measures:** The intended use of the outputs of the assessment should be clarified to the extent possible at an early stage as they have important implications for the technical scope. Consultation sessions with stakeholders from different policy fields are an important mechanism to elicit a range of potential management measures that draw on the outputs of the assessment. Regulations, initiatives and programmes relating to disaster risk reduction and disaster risk management should also be considered to see how those (or similar ones in the future) could be risk-informed by the assessment. Some questions are listed below as examples of the range of issues to be considered in relation to the national disaster risk assessment:

  - What kind of policy decisions will it inform, and how?
  - Will it serve the national disaster risk reduction strategy?
  - Will it serve climate change adaptation planning?
  - Will it serve national development planning?
  - Will it serve national business, sectoral or community resilience planning?
  - Is it focused on emergency preparedness and on saving lives, or will it serve holistic risk management planning to inform prevention, preparedness, response and recovery planning and practice?
  - Will it inform high-level disaster risk management investment planning or decisions on investing in risk reduction of key infrastructure? If so, which infrastructure for which hazards should it cover? And should it identify the most vulnerable infrastructure or just the most vulnerable sector as the basis for further assessment?
  - Will it form the basis for disaster risk financing and insurance?
  - Will it provide the basis for updating building codes?

- Will it serve as the basis for financial support to subnational governments to invest in disaster risk reduction?
  - Will it provide insights on vulnerability of most common construction types?
  - Will it provide risk data disaggregated for low-income and vulnerable groups including women and children?
- **National versus nationwide:** Does the “N” in NDRA mean that the assessment has to inform disaster risk management decisions for the whole country, or is it limited to risks that are “of national importance (i.e. that the actual event would require national coordination)? If the latter is the case, the governance structure should delegate the separate assessment of non-national risks to the appropriate government level and sectors.
  - **Current NDRA status:** The scope of the assessment might vary according to the status of existing national, subnational and sectoral risk assessments, as well as the current status and potential of a country’s science/policy interface. If nothing exists, neither sectoral nor subnational risk assessments, the scope of a “first run of NDRA” might be limited to the main hazards that are most obvious from the experience of the stakeholders or from international information like the index for risk management (INFORM) or global/regional risk profiling conducted by international agencies. Alternatively, if sectoral assessments have already been completed, the scope should be as broad as possible and include existing work (where practical, and as long as it fits the NDRA objectives).
  - **National versus local and sectoral disaster risk assessment:** An NDRA targets risks of national significance. This will also include disaster risks that only manifest themselves at provincial or community level, or in specific sectors. There is significant evidence of good practices across the globe of successful community-based disaster risk assessments. Careful balancing of bottom-up with top-down approaches in disaster risk assessment and establishing stronger linkages between the national assessment and local-level, community-level and sectoral disaster risk assessment practices could enrich both processes.<sup>17</sup>

A national risk assessment can provide a wealth of data and information for subnational and sectoral use. Examples include:

- Use in advocacy and awareness at the local/sectoral level

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<sup>17</sup> This depends on the governance system of a country. In some countries the responsibilities for disaster risk management (even for national disaster risks) are strongly decentralized, while in other countries the subnational level has no mandate whatsoever regarding national disaster risks. Furthermore, the level of autonomy of self-governing subnational bodies (e.g. federal States) can set limitations for a top-down approach to NDRA.



- Use for scoping step local/sectoral risk assessments
- Using hazard, exposure, vulnerability and capacity datasets as a starting point for developing higher resolution/local risk assessments
- Access to national and international technical experts
- Standardization of subnational and sectoral disaster risk information to enable local and cross-sectoral interconnections.

At the same time, representatives at the local and sectoral level can contribute with datasets that are available only to them (e.g. data on assets that are critical at local level). Arguably, NDRA could be a macro-level aggregation of subnational and sectoral risk assessments, so long as the interoperability of the methodologies is ensured. However, this will not always be reachable or optimal. In some countries, the governance mechanism and local/sectoral capacities may not be sufficient to guarantee coherence.

Depending on the size of the country, the nature of hazards and the national versus local disaster risk management governance mechanism, national guidelines for conducting risk assessment may be useful. These would help ensure that all risk assessments conducted at local and sectoral level adhere to a certain level of standards and benefit from common methodologies and relevant datasets.

- **National versus supranational disaster risk assessments:** Risks do not stop at administrative borders. For some risks it might be useful to carry out a cross-border<sup>18</sup> or supranational risk assessment in cooperation with other countries and international organizations (which might already have been done in the past). This is relevant for shared hazards (e.g. river basins) and hazards with potential cross-border impacts (e.g. industry and nuclear plants), as well as for potential cross-border cascading effects and interdependent assets (e.g. critical infrastructure).<sup>19</sup>

Supranational disaster risk assessments will have a specific scope and specific objectives of their own; risk-informing, for example, cross-border disaster risk reduction strategies, critical infrastructure protection and international emergency response and humanitarian aid.

- **Time-horizon of NDRA:** It is important to define the time-horizon to be considered in the risk analysis, based on the understanding of the implications this has for the assessment of impact and likelihood. The selection of a time-horizon depends on the type of decisions that rely on the NDRA outputs. For example, disaster preparedness and emergency

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<sup>18</sup> This could be land borders or shared seas.

<sup>19</sup> Taking into account, for example, the UNECE Convention on the Transboundary Effects of Industrial Accidents ([unece.org/env/teia.html](http://unece.org/env/teia.html)) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes ([unece.org/env/water](http://unece.org/env/water)).

management often address a time-horizon of three to five years, which gives sufficient confidence for the disaster risks identified. An NDRA process that informs national development planning may use longer time-horizons, especially in the context of understanding longer-term risk trends from climate change, urbanization, sustainable development or changes in disaster risk reduction policies. A longer time-horizon is especially critical when it comes to evaluating the benefits of investment in new development and in reducing vulnerability of infrastructure.

### *Scoring criteria for impact and likelihood*

The scoping stage should define the criteria for scoring impact and likelihood. The choice of criteria is largely a political decision and should be part of the shareholder discussions. Scoring criteria include the following:

- **Impact criteria:** While the complexity of impact assessment varies significantly across countries, along with the risk assessment methodologies, a consensus on impact criteria should be reached as a part of the scoping process. Impact criteria should be defined across different types of impact critical for the country. In the current practices of national risk assessment, the impact criteria are based on a broader understanding of the main “values to protect”, sometimes referred to as “vital or critical societal interests”.

The following types of impacts may be considered:

- *Human impact:* Number of people affected – including deaths, severely injured or illness, displaced due to loss of home or livelihoods.
- *Economic impact:* Includes damage and loss assessment in financial terms – the costs of the damage, the costs of the reparation and restoration, the costs of emergency measures, the costs of long-term recovery (costs of disruption of economic activities, unemployment, indirect social costs such as those for the restoration of education and health systems).
- *Environmental impact:* Includes the loss of and structural damage to nature conservation areas, ecosystems and protected species, as well as general environmental pollution. The costs of environmental recovery are in most cases seen as part of the economic impact.
- *Political and social impact:* Includes political implications of a disaster, social psychological impact, disruption of daily life, and violation of peace and rule of law. It could also include impact on development gains, (in)equality and social cohesion, as a separate “value to protect”.

The impact-level categories would be decided by the stakeholders and would vary from one country to another. Categories are defined for every type of impact and may be in different formats. For example, economic loss

levels may be defined as an absolute financial loss or as a percentage of gross domestic product.

The selection of labels associated with each category can become a sensitive issue, as this would be linked to the risk tolerance of a government and society. For example, one country might define as “insignificant” a human impact as being no more than 10 fatalities, more than 50 injured, and no need for evacuation; whereas another might define it as no fatalities or injured and no one or just a small number of people evacuated for a short period of time.

The following labels are commonly used for impact categories, although quantitative values should be assigned to each label and communicated to stakeholders:

1. Insignificant
  2. minor/substantial
  3. moderate/serious
  4. significant/very serious
  5. catastrophic/disastrous.
- **Likelihood criteria:** The selection of probability categories and their definition would also depend on the stakeholders and may have some different gradation in different countries. For example, one country may define the probability of >1 in 20,000 years as “very unlikely”, whereas another might apply that label to the probability of one event in 100 years or less.

It is recommended to use quantitative likelihood categories wherever possible and avoid emotive terms or terms that could be misunderstood by others. It is also recommended to select a likelihood scale that can effectively cover the analysis outcomes of intensive and extensive disaster risks.

### *Technical scoping*

The technical scoping of NDRA goes hand in hand with the policy scoping. It considers available information on hazard, exposure, vulnerability and capacity in order to determine the relevant risk elements.

**Identifying and scoping hazard** allows the NDRA to narrow the focus from the full range of hazards faced by a country to those that present the greatest risk to its safety, security and development. Scoping hazard includes deciding whether NDRA should be focused on a limited number of significant risks or on multi-hazards. Understanding which hazards NDRA is to be focused on requires careful consideration of the following:

- Existing hazard data (e.g. historical loss data)

- Regional and global trends (e.g. impact of changing climate)
- Economic activities that can trigger natural hazards (e.g. in extractive industries or un-managed land use)
- Technical resources available for conducting risk analysis (e.g. input hazard data and expertise for modelling complex interdependencies of hazards)
- Financial resources available for conducting risk analysis.

It is particularly important to consider the balance between analysing intensive risks and extensive risks, and especially in relation to their respective potential impacts on sustainable development.

Potential hazards include the whole spectrum of hazards across the following hazard categories:

- *Geophysical* (earthquake, tsunami, volcanic eruption)
- *Meteorological/hydrological* (flood, storm surge, cyclone, hurricane, hail, heat wave)
- *Climatological* (drought, wildfires, frost)
- *Biological* (human epidemics, livestock pests and diseases, crop pests and diseases)
- *Technological and human-generated* hazards (increasing attention is being given to emerging risks from technological developments and the dependency of society on technology).

**Identifying and scoping exposure** provides an initial understanding of what should be the focus of NDRA to match both the policy and the hazard scope. This may include various assets in the social, physical, economic, environmental and agricultural categories. NDRA should be responsive to the protection of those sectors that have priority importance for sustaining a country's communities and ongoing development or those that are most susceptible to hazards. NDRA may be focused on impacts that threaten the whole country or significant areas within the national territory: major cities, major river basins, regions in proximity of volcanoes, coastal zones, nationally protected areas, public structures, cultural heritage, or critical infrastructure (including cyber).

**Identifying and scoping vulnerabilities** provides knowledge of the various types of vulnerabilities and interlinkages that should be considered in the assessment to match the policy scope. Categories of vulnerabilities include physical, economic, social, institutional, environmental, agricultural and health.

**Identifying and scoping capacities** provides an initial common understanding of the indicators that would be used for assessing capacities to manage the risk of disasters or coping capacity as defined by the Open-ended Intergovernmental Expert Working Group. Flaws in capacity, such as weak capacity in enforcing building codes, are among underlying drivers of risk. The scope of capacity should be assessed at an early stage and in consultation with the stakeholders, because of the wide range of views on the definition of capacity, the issues that can be considered, and the role of stakeholders in collecting the data for assessing capacity.

Some guidelines and methods are available, as well as many different sets of sectoral capacity (or resilience capacity) indicators, such as the following:

- European Commission *Risk Management Capability Assessment Guidelines*<sup>20</sup>
- INFORM indicators
- CADRI (Capacity for Disaster Reduction Initiative) methodologies
- Health-sector indicators for implementing the International Health Regulations.<sup>21</sup>

However, there is variability across sectors in the availability of methodologies with a comprehensive list of indicators for disaster-coping capacity.

### **Element 3 Developing an NDRA data management plan**

This element describes the rationale for having a data management plan for NDRA and what are the critical issues to be considered and covered in this plan.

Risk assessment is an extremely data-intensive process and conducting a national risk assessment may involve accessing information from a wide range of stakeholders including mapping agencies, scientific and technical ministries, universities and other research institutions, and the private sector. In addition, valuable new data and analyses are created during risk assessments. It is therefore necessary to develop a strategy to efficiently organize and manage the data as they become available, as well as distributing the results to participants and key stakeholders. A “gap analysis” (i.e. necessary data vs. available data) can be the starting point of such a strategy.

Data management plans govern the process by which data are gathered from participating entities, the technical and quality standards (including data resolution) to which new data will be produced, how data will be maintained during the risk assessment, and the means by which the output data will be shared and secured.

Data availability, accessibility and security are always major challenges in conducting risk identification and can have a significant impact on the credibility of the results. The quality of the results is directly related to the quality of the input data. Given the effort spent in collecting, preparing and maintaining all the necessary types of data, the return on investment can be maximized if the created datasets are shared and used many times.

At the beginning of the scoping and the risk identification process, arranging for commitments from data owners and designing mechanisms to facilitate data-

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<sup>20</sup> European Commission, 2015. Risk Management Capability Assessment Guidelines, Official Journal of the European Union, retrieved from site: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015XC0808%2801%29>

<sup>21</sup> <http://www.who.int/ihr/about/en/>

sharing both technically and administratively can maximize the quality of the risk identification. To this end the scoping stage of the assessment has to result in a data quality protocol, taking into account the required resolution of data to complete the NDRA in accordance with its set objectives and scope.

Open data and software standards and licensing options are now widely available for use by data providers and analysis software developers. These should be adopted where possible to ensure that information is developed, applied and maintained for multiple use and knowledge-sharing while still maintaining intellectual property interests and sufficient security for confidential information.

The following are some of the main recommendations for managing data and developing data management strategies:

- Assign a clear coordination role in data management to the lead agency, including provisions for central data storage and the mandate to define data standards.
- Incorporate stakeholders, both as potential contributors and users of risk assessment data, early in the planning process. Provide stakeholders with an understanding of the importance and value of their data for quality risk assessment. Give them an opportunity to make substantive contributions to the data management plan.
- Agree upon the data quality and resolution (based on the NDRA scope), licensing, metadata standards, acceptable formats and other protocols as early as possible.
- Whenever possible, release data under open licences that encourage wide use for many purposes.
- Develop a common repository for data during the risk assessment to facilitate sharing of the results and outputs when the assessment is completed.
- Document the data-sharing plan in a memorandum of understanding or other formal agreement that clarifies the expectations and responsibilities of participating stakeholders, including a non-disclosure agreement for restricted data.

Data availability for NDRA is best ensured by means of a legal basis that consolidates the key provisions of the data management strategy, such as obligatory data-sharing, transparent data ownership, lead agency coordination, data storage and restricted access to confidential data.

For further explanation of these concepts, see Module 9. Data Management throughout the National Risk Assessment Process Plan, in part two of the *Guidelines*.

### **Textbox 1 - More about open data policy for disaster risk assessment**

To serve decision makers across a society, data need to be fully open, both legally and technically. By definition, a piece of data or content is open “if anyone is free to use, reuse, and redistribute it – subject only, at most, to the requirement to attribute and/or share-alike” (Open Knowledge Foundation Network).

This means that data must be:

1. Technically open: Many government datasets are locked in data formats that can only be read by proprietary software (and sometimes hardware, like obsolete magnetic tape backup drives). The data must be released in ways that allow any device or software to read them.
2. Legally open: The licence under which the data are released must permit redistribution and reuse.
3. Accessible: The data must be available at a public internet address (URL).
4. Interoperable: The data must follow open standards.
5. Reusable: The data can be redistributed and reused in ways that were not necessarily anticipated by the curator of the original data.

*Source: Open Data for Resilience Initiative: Field Guide, GFDRR, 2014*

## **Element 4 Developing NDRA required capacities**

This element describes the type of capacities that are required for implementing NDRA.

The NDRA process requires strong administrative, technical and financial capacities.<sup>22</sup> After the governance mechanisms are established and the scope of NDRA is defined, it is important to check whether the existing capacities are sufficient for the successful implementation of NDRA. If not, it is recommended that capacity improvement be part of the preparation stage.

**Administrative capacities** refer to the legal and institutional frameworks within the country and how inclusive they are for multi-stakeholder national disaster risk assessment. Characteristics that contribute to this include a clear division of roles and responsibilities across all stages of NDRA including communication, existence of required expertise or procedural possibilities of engaging external stakeholders in the NDRA process.

**Financial capacities** refer to the availability of funds for the completion of NDRA given the ambitions defined in its thematic scope.

**Technical capacities** refer to the type and level of technical expertise necessary

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<sup>22</sup> European Commission, 2015. Risk Management Capability Assessment Guidelines, Official Journal of the European Union, retrieved from site: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015XC0808%2801%29>.



for NDRA. The analysis of current technical capacities should include the current status of interaction, collaboration and communication between the scientific community and the policy process (science/policy interface).

The range of technical capacities that might be needed varies significantly according on the types of risk to be addressed, the level of detail/resolution expected, the complexity of multiple elements to be taken into consideration (both hazard-specific and non-hazard-specific) and the engagement of the different actors in the assessment process. Some important technical capacities could be highlighted to ensure their presence during the NDRA process:

- **Technical capacities within the scientific community** refer to the capacities required for the technical committee to ensure technical supervision, management, and facilitation of the NDRA process as well as the capacities of the technical teams conducting various forms of analysis. This encompasses a wide range of technical expertise that is necessary for understanding methodologies for hazard, exposure, vulnerability and capacity analyses and being able to conduct such analyses, whether they are qualitative, quantitative, or semi-quantitative. Some countries might need international technical support to address the capacity gaps in the short term.
- **Technical capacities within the non-scientific community** refer to the basic capacities of non-scientific experts (policy makers and decision makers) to better understand risk information in order to make informed decisions. The following provides some basic capacities for understanding risk information that will be beneficial before engaging in meaningful dialogue and discussion on national disaster risk assessment:
  - Understanding fundamental concepts of hazard and exposure, vulnerability, capacity, uncertainty and confidence level.
  - Understanding basic concepts of probability and return period of a hazard.
  - Understanding uncertainty and limitations of risk analysis methods
  - Importance of linking NDRA with comprehensive disaster risk management strategies and sustainable development

The comprehensive development of all disaster risk assessment capacities is often a long-term process that will be achieved through incremental improvements through each new round of NDRA. However, the critical capacities necessary for implementation the outcome of the assessment need to be addressed before the launch of the NDRA process.

**Table 3** - Categories of technical capacities, amount of effort, and suggested methodologies for capacity development

Capacity	Description	Level of effort (time)	Relevant entities	Suggested modalities for capacity development
Technical capacities within the scientific community	To access available datasets and models, use modeling tools for further analysis and to prepare risk reports for decision makers.	High (few weeks to months)	Technical individuals or teams supporting decision makers or conducting relevant research	Hands-on trainings, courses on-line/in person or mixed to be run by qualified experts. This would allow recognition of individuals who gain a higher level of expertise who the decision makers can rely on their support in providing the risk information and explanations.
	To conduct quantitative hazard and risk analysis	Extensive (few years)	Technical teams that will conduct components of the NDRA that need fully quantitative assessment and modeling.	<ul style="list-style-type: none"> <li>- University programs focused on different hazards and various aspects of risk modeling</li> <li>- Bilateral training-by-doing programs which are set up between two technical institutions in a developed and a developing country</li> </ul>
Technical capacities within the non-scientific community	To understand the results, the limitations, uncertainties, and use the results in planning and decision-making	Moderate (few days to weeks)	Decision makers in Disaster Risk Management	Technical trainings presented in person at workshops or online

## **Element 5 Developing terms of reference for NDRA**

This element describes the importance of developing a comprehensive terms of reference to manage the implementation and delivery of NDRA.

After the scope of the assessment has been determined, the terms of reference should be drawn up. These will guide the process and provide the basis for resource allocation. They should clearly indicate the timeline, milestones and deliverables, roles and responsibilities of various stakeholders, as well as the budget within which the process should be completed and results delivered. They need to be endorsed by the designated national authority/authorities and supported by adequate resource allocation.

A national disaster risk assessment is a project and must be managed as a project: i.e. with a project document, project management team, project board (part of the NDRA governance body), regular reporting and final evaluation. The evaluation is essential for identifying and documenting lessons learned so as to improve the next rounds of the assessment and future use of its results.

Ensuring sustainability of efforts should be a major consideration in the terms of reference. If the assessment is conducted with the assistance of international entities or the private sector, the terms of reference should include a requirement that knowledge for its updating and management is transferred to and built within national public authorities.

## Stage II Conducting risk analysis

Risk analysis is performed by the technical team, based on the terms of reference developed at the end of the scoping and preparation stage. The process provides the tools for decision-making and engaging stakeholders in disaster risk management. It involves agreeing on a set of methodologies for analysing risk from various hazards and for merging the outputs into a common format for evaluating and comparing risks and communicating the results.

### Element 6 Selecting risk analysis methodologies

This element briefly describes various risk analysis methodologies, risk comparison techniques and considerations for selecting the most suitable methodologies.

Many different and complementary methods and tools are available for analysing risk. These range from qualitative – based on the subjective perceptions of experts – to semi-quantitative and quantitative methods, including probabilistic risk analysis, which is the most rigorous method.

The Sendai Framework encourages all-hazard disaster risk management. This requires an understanding of impact from multiple major hazards that a country faces, such as:

- (i) Single hazards
- (ii) Aggregation and comparison of risk from all hazards
- (iii) Sequential, simultaneous, cascading and interrelated effects of some hazards.

For single-hazard risk analysis, aggregation and comparison of risk analysis, a wide range of methodologies, approaches and tools are available, with varying levels of sophistication. For sequential, simultaneous and cascading risk analyses, however, fewer approaches and tools are available.

Selecting an analysis methodology means striking a balance between the following:

1. Quality of the methodology and its appropriateness for the purpose the results should serve.
2. Resources it requires: technical (including data, tools and expertise), financial and time.
3. Significance of the risk and level of investment for managing the risk.

Some methodologies, such as probabilistic modelling, can provide a comprehensive view of hazard, risk and uncertainties that may be needed for certain decisions such as in relation to the design of high-cost structural disaster risk reduction measures. For example, investment decisions for certain structural measures may require a cost-benefit analysis to choose the most efficient design; whereas some non-structural measures, such as educating schoolchildren to evacuate, have lower costs associated with them or would not require

comprehensive results from probabilistic modelling. Sometimes the cost of prevention is low enough that it is better to simply invest in prevention rather than a sophisticated analysis of risk.

### *Single-hazard risk analysis*

A single-hazard risk analysis has the following components:

- **Hazard analysis:** Provides information on where, how big and how frequent the hazard events are, and on how severe their effects are (e.g. ground shaking for earthquakes, wind speed for cyclones, etc.).
- **Exposure analysis:** Provides information on the presence, attributes and values of assets that may be impacted by a hazard. The NDRA scope, including criteria selected for evaluating consequences (e.g. impact on people or the economy), guides the selection of assets to be included in this analysis.
- **Vulnerability analysis:** Provides information on how an identified asset reacts to the effects of the hazard. Identification of vulnerabilities is guided by the NDRA scope, including criteria selected for consequence evaluation, such as people, the economy, the environment and sustainable development gains. For many hazards, vulnerability assessment of structures and estimation of physical impacts is often the first step towards understanding downstream impacts on the population and the environment.
- **Uncertainty analysis:** For all the components of risk analysis, it is important to associate a level of uncertainty or confidence level in the calculations or estimates. This can be done by tracking the uncertainty or confidence level at every step where an estimate or judgement or calculation is made quantitatively or qualitatively.

Once these components are in place, a risk analysis can be carried out for each hazard. The following are the options for risk analysis methodologies, starting with the most sophisticated and resource-intensive one:

**Probabilistic analysis:** Probability is an inherent attribute of risk. All methodologies deal with probability either explicitly or implicitly but the probabilistic approach is a systematic and comprehensive methodology that quantifies these probabilities.

Probabilistic risk considers a large number of possible scenarios, their likelihood and associated impacts. In this method, a significant amount of scientific information on hazard, exposure and vulnerabilities, as well as insights from

historical loss and damage data, is used to simulate (or model) the complex phenomenon of disaster risk.

**Textbox 2 - More about the probabilistic risk method and outputs**

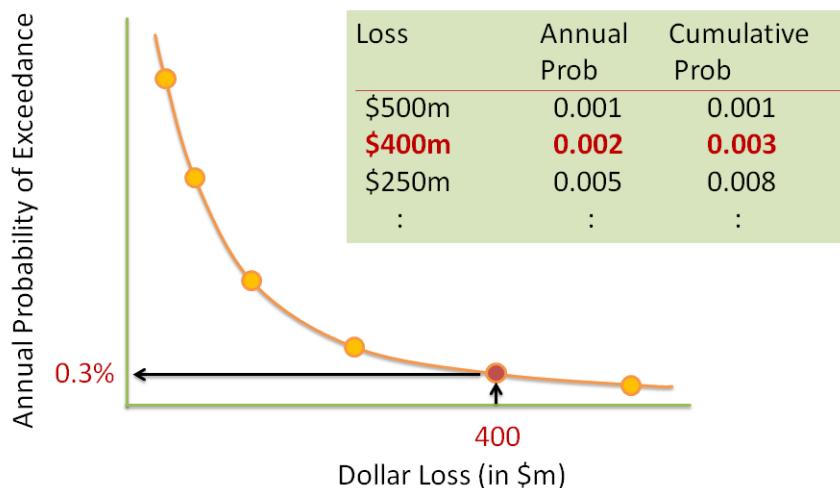
While probabilistic risk analysis is resource intensive, it has numerous advantages, including the following:

1. Ability to measure the risk costs (average annual loss (AAL) or return period losses) and consequently the ability to undertake cost-benefit analysis of alternative risk reduction measures.
2. Ability to aggregate risks from various hazards based on annualized losses (AAL).
3. Ease with which quantitative comparison of relative risk from various hazards can be undertaken.
4. Suitability for effectively capturing and quantifying uncertainties.
5. Tendency to reveal a more complete picture of risk in terms of both likelihood and impacts. (Scenario and historical approaches, on the other hand, tend to drift towards "known" and experienced risks, often leading to an underestimation of actual risk).

Some common terminology used in probabilistic risk analysis is described below:

**Exceedance probability (EP) curve:** The EP curve describes, for each level of dollar loss of interest, what the annual probability is for that level of loss or higher to happen. Figure 7 displays an example EP curve, where the annual probability of exceeding US\$ 400 million is 0.3%.

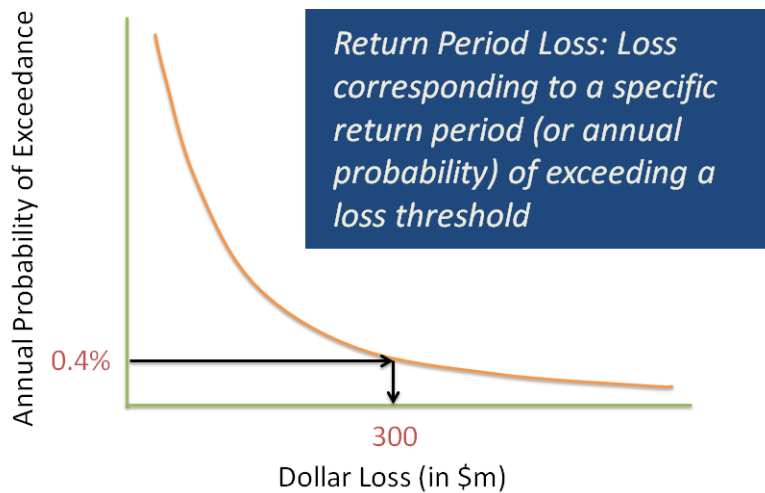
Sometimes the annual probability of exceedance is plotted on the x-axis and the dollar loss on the y-axis, but the concept is the same.



**Figure 7 - Exceedance probability curve**

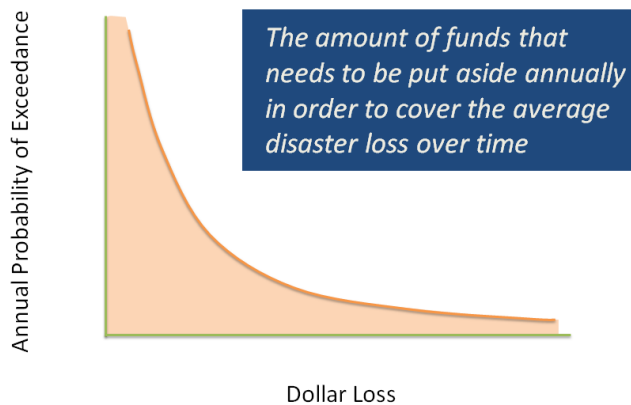
The return period loss (sometimes referred to as the probable maximum loss or PML) is the loss corresponding to a certain likelihood, expressed in terms of annual probability of exceedance, or its reciprocal, the return period. Once the EP curve is constructed using probabilistic methods (or a number of scenarios with various likelihoods), loss can be obtained for any desired probability of exceedance (or return period). Similarly, the annual probability of exceedance can be obtained for any loss

level of interest. For example, in Figure 8 the 250-year (or  $1/250 = 0.004$ , i.e. 0.4% annual probability of exceedance) loss is \$300million.



**Figure 8** - Return period loss or probable maximum loss (PML)

**Average annual loss (AAL):** The long-term expected loss on an annualized basis, averaged over time. While there may actually be little or no loss over a short period of time, the AAL also accounts for much larger losses that occur less frequently. As such, AAL is the amount of funds that needs to be put aside annually in order to cumulatively cover the average disaster loss over time. AAL, in mathematical terms, represents the area under the EP curve.



**Figure 9** - Average annual loss (AAL)

Although the terms described above originated mainly from the insurance industry to describe dollar losses resulting from catastrophe risk, the same probabilistic concepts can be used for measuring other types of losses such as life losses or environmental losses.

**Deterministic or scenario analysis:** A deterministic or scenario analysis is the process of analysing the impacts or losses from a single event (scenario). This method characterizes possible event realizations in terms of size and location of events, but does not fully quantify the frequency of occurrence of these events or



assess their impacts in a probabilistic manner.

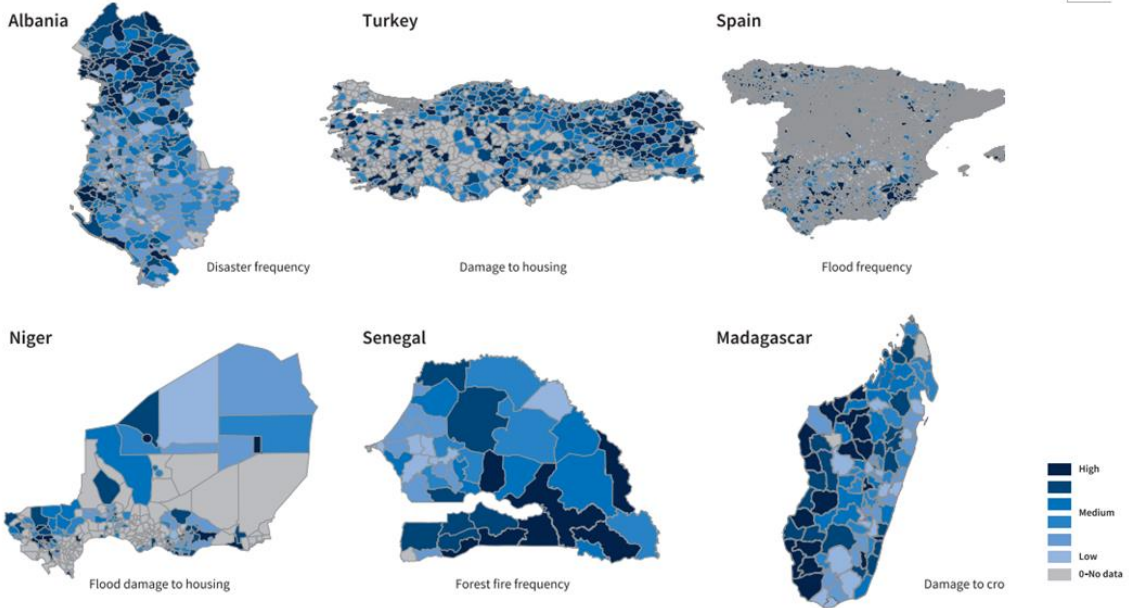
Selection of the scenario and analysing the consequences may be supported by historical loss information or some level of scientific understanding of hazard, exposure and vulnerability in the region of interest. If when scenario or deterministic analysis is used in risk analysis, it is recommended that multiple scenarios with various likelihoods of occurrence (even if the likelihood is not explicitly quantified) be analysed to obtain a more complete picture of risk.

**Historical analysis:** A database of damage and loss from past disasters, collected systematically over a reasonably long time, can provide a valuable understanding of extensive risks. Such databases can be used to conduct a historical analysis, providing information on frequency of occurrence, potential impacts and the overall risk associated with frequent events. A historical analysis cannot be used for infrequent hazards, such as earthquakes, and can be misleading by not revealing information about high-intensity events with low probability (e.g. a flood of one in a 100 year return period or 1% probability of occurrence in one year).

**Expert elicitation:** If no other information or means to carry out risk analyses are available, individuals with good understanding of various components of disaster risk in the country can conduct the analysis using their expert judgement. While it is more common to conduct a qualitative analysis using the expert elicitation method, it is also possible for experts to provide a quantitative perspective on risk. This method has a significant amount of uncertainty for intensive risk and potential bias, particularly if a single expert is consulted. Consultation with multiple experts may reduce the potential bias.

**Textbox 3 - National disaster loss databases will be used for monitoring Sendai Framework progress**

Besides being a data source to use in the historical analysis method, national disaster loss databases will be necessary for monitoring progress in Sendai Framework implementation at national and global level to report on Sendai Targets A to D, which measure loss, damage and impact from disasters. As of today, 105 countries have established national disaster loss databases. Many of these need to be updated and upgraded to comply with the Sendai Framework hazards coverage and monitoring requirements.



**Figure 10 - Historical loss databases are established and used in many countries around the world. Source: Global Assessment Report (GAR) 2015.**

#### **Toolbox 4 - Considerations in establishing a national historical loss database**

The process of establishing or upgrading the national loss database is led by an appropriate national entity, although three scenarios may exist in the data collection process:

Scenario 1: Local civil protection collects and reports to national level

Scenario 2: National/regional assessment centres

Scenario 3: Hazard specific national authorities.

The choice of host institution is fundamental to the success and sustainability of the database. Hosting the database goes beyond the physical fact of having a computer or server where the database will be stored. The host institution is responsible for keeping the database up to date, coordinating efforts among different national and subnational entities who collect the disaster loss data, and producing output reports.

Experience from many countries shows that long-term sustainability of a national loss database is contingent on having the database maintenance and data collection embedded in the operations of the host agency. A national statistical office can be the host entity or can support another entity in hosting the database.

The following are the core activities for implementing this component:

1. Identifying key stakeholders and partners: host institution, data sources and end users.
2. Developing implementation plan with timelines, as well as roles and responsibilities for all actors involved.
3. Establishing recording methodology that should consider national legislation, context and existing practices. This includes deciding on the historical time frame and disaggregation level to collect data
4. Developing an official sustainability plan endorsed by the host agency and other relevant contributing agencies.
5. Setting up the computational environment for the database.
6. Recruiting data collectors and conducting training for the historical research.
7. Conducting training on day-to-day collection of loss data, which is done by permanent staff of designated entities at subnational and national level.
8. Developing and implementing an overall quality control strategy.
9. Starting day-to-day collection of losses.

*Source: UNISDR, 2015*

For further information see: *Guidance for Recording and Sharing Disaster Damage and Loss Data*, European Commission Joint Research Centre, 2015

[http://drr.jrc.ec.europa.eu/Portals/0/Loss/JRC\\_guidelines\\_loss\\_data\\_recording\\_v10.pdf](http://drr.jrc.ec.europa.eu/Portals/0/Loss/JRC_guidelines_loss_data_recording_v10.pdf)

### *Aggregation and comparison of risk from all hazards*

One of the objectives of risk analysis is to provide a basis for adding and comparing risk from different hazards that may affect a country. Usually several single-hazard risk assessments are carried out first and then the outputs are used as input to tools and techniques that allow the various risks to be aggregated, compared and evaluated for decision-making. Such analysis provides a more complete understanding of risk from all hazards.

#### **Aggregation of risks**

Although this process may sound straightforward, various issues may need input from experts. Issues include the interlinkages of impacts and whether the risk outputs from all the hazards are presented in a common standard metric that can be simply added up. For example, if risk analyses for multiple hazards are all conducted probabilistically, loss results (e.g. dollar losses, life losses) can be combined probabilistically. However, to be additive, the risk from each hazard needs to be represented in an annualized form (see average annual loss in Textbox 2), which can then be summed up to give an idea of total risk.

In contrast, return period losses at a certain return period of interest (see Textbox 2) cannot be aggregated as easily. If a scenario approach is used to calculate risk from various hazards, aggregation is even more challenging since it is harder to find a standard loss metric that can be summed up. For example, if all the scenarios are worst case scenarios, there is little value in knowing the sum of all worst case scenario losses since it is improbable that all worst case events will happen at the same time.

#### **Comparison of risks**

Several techniques and methods exist for comparing risks from different hazards. ISO guidelines on risk assessment provide a variety of techniques. Although not all of these techniques are commonly used in disaster risk management, most can be adjusted to use in comparing risk for risk management decisions. The following are three of the most commonly used methods:

- 1. Probabilistic risk analysis:** Various risk outputs – such as return period loss at various return periods of interest or average annual loss (see Textbox 2) – computed for each of the hazards can be compared from probabilistic risk analyses conducted for different hazards. The exceedance probability curve, one of the main outputs of probabilistic analysis, gives users the freedom to look into a variety of likelihoods or diverse values of impact from different hazards to compare, prioritize and make risk management decisions.
- 2. Multi-criteria impact and likelihood scenario analysis:** In this approach, the different hazards within the scope of the national disaster risk assessment are summarized into a set of “stress test scenarios” in the context of all

relevant coping capacities of a country. The method allows the outcomes of single-hazard analyses (e.g. probabilistic, deterministic) to be compared.

The scenarios are selected as broad as possible so as to provide better insights to decision makers on the range of possibilities. Therefore, if the resulting capability gaps are resolved sufficiently, a country is more or less resilient to any existing or future risk. This approach has been most commonly used for emergency preparedness, recovery and reconstruction planning for which the "maximum credible" or "plausible worst case" scenario is of interest.

The method can also be used for other disaster risk reduction decisions, but to that end requires careful consideration of the scenario selection, as the use of worst case scenarios favours intensive risks over extensive risks.

The selection of scenarios is largely based on expert elicitation and requires the involvement of a wide range of stakeholders and experts to provide the scenarios for all kinds of risks and capacities. The scenarios are analysed on two dimensions of risk: impact and likelihood. And the final outcome of the analysis is represented in a risk matrix of likelihood and impact, as a basis for prioritizing risks (see also box 4). However, the resulting risk matrix does not provide an absolute ranking of risks. The acceptable risk appetite, the current coping capacity and new opportunities for risk reduction are among the other factors that might influence how the priorities are defined.

**Textbox 4 - Risk matrix or multi-criteria impact and likelihood analysis**

A risk matrix is the common template presenting the impacts, likelihoods of risks and confidence levels. This matrix projects the outcomes of the impact and likelihood analysis onto two axes. The visual tool helps decision makers see a clear distinction between impact and likelihood levels.

The actual impact and likelihood levels of different national risks represented in the risk matrix are the result of a single-hazard risk analysis.

	Consequence level				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	Extreme	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Very low	Low	Medium	High	High
Very rare	Very low	Very low	Low	Medium	High
Extremely rare	Very low	Very low	Low	Medium	High

Another aspect that needs to be presented is the confidence level or level of uncertainty. The confidence level is an additional level of information supporting decision-making. Various methods to add this element to the risk matrix have been used in different countries and national guidelines.

	Consequence				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	4	4	3	2	1
Likely	5	4	4	2	2
Unlikely	5	5	4	3	2
Rare	5	5	5	3	3
Very rare	5	5	5	4	3
Extremely rare	5	5	5	4	4

	Consequence				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	3	2	1	1	1
Likely	3	3	2	1	1
Unlikely	4	3	2	1	1
Rare	4	4	3	2	1
Very rare	5	4	3	2	2
Extremely rare	5	5	4	3	2

The image above shows two risk matrices with priority levels. The darker colour and number one denote the highest priority and the lighter colour and number 5 the lowest. On top the colouring for risks with the highest level of confidence and below for risks with the lowest level of confidence. The second one shows a broader range of high priority, as it cannot be ruled out that the risks should in fact be higher up in the matrix.

Source: *National Emergency Risk Assessment Guidelines*, Australian Institute for Disaster Resilience

**3. The index-based approach:** In this method, a wealth of information and data on hazard, exposure, vulnerability and capacity can be simplified to be represented with index scores (a number out of a full score) and then combined to present risk level with a single index score. The index-based approach provides actual risk values or likelihoods. Its main benefit, however, is the simplicity of using its output for comparing risk levels from various hazards or between regions of interest (e.g. subnational regions). Also subindices, if designed well and communicated transparently, can provide insight into the sources of risk from hazard, exposure, vulnerability or capacity. For example, the index for risk management (INFORM)<sup>23</sup>, which has been developed at a global level to understand and measure the risk of a humanitarian crisis across various countries, assigns risks an overall score out of 10. It is a composite indicator combining 53 indicators. Figure 11 shows the INFORM multi-layer system. The elements in each layer are presented by an index value, which is calculated based on the contributing elements at the lower layer. Depending on the users' purpose and intent to target the disaster risk management measures, comparison and evaluation can be done using the indices at any layer.

Risk	INFORM																
Dimensions	Hazard & Exposure				Vulnerability				Lack of Coping Capacity								
Categories	Natural		Human		Socio-Economic		Vulnerable Groups		Institutional	Infrastructure							
Components	Earthquake	Tsunami	Flood	Tropical cyclone	Drought	Current Conflict Intensity	Projected Conflict Intensity	Development & Deprivation (50%)	Inequality (25%)	Aid Dependency (25%)	Uprooted People	Other Vulnerable Groups	DRR	Governance	Communication	Physical Infrastructure	Access to Health System

**Figure 11** - INFORM model. Source: *INFORM methodology document (accessed March 2017)*

### *Sequential, simultaneous, cascading and interrelated effects of some hazards*

The triple disaster in Japan on 11 March 2011 is a well-known case of sequential and simultaneous hazards with cascading effects. The disaster started with the Tōhoku earthquake, which killed about 100 people. The ensuing tsunami killed about 18,000, and there was uncertainty about the consequences of the

<sup>23</sup> Inter-Agency Standing Committee and the European Commission, n.d. Index for risk management (INFORM), Joint Research Centre of the European Commission, retrieved from site: [www.inform-index.org](http://www.inform-index.org).



radioactive contamination resulting from the Fukushima Daiichi nuclear meltdown. The interaction between natural and technological hazards was amplified by local vulnerabilities, and the Fukushima nuclear accident was considered "a profoundly man-made disaster – that could and should have been foreseen and prevented".<sup>24</sup> Other critical infrastructure in the affected area was broadly compromised, thus constraining efforts to contain the cascading effects of the primary disruption.<sup>25</sup>

Cascading risks and disasters have serious implications for national risk assessment processes, especially when they disrupt the functioning of society and the economy due to their impacts on critical infrastructure. It is vital not only to understand and assess cascades in critical infrastructure, but also to know how to stop them from escalating.

Unfortunately, modelling such complex phenomena requires a significant amount of data and complex modelling tools and expertise, which can make it unfeasible to conduct quantitative modelling as common practice. Nevertheless, possible cascading effects of major hazards should be explicitly noted and quantified to the extent possible.

A complementary approach suggests that the paths of cascades can be understood in advance of the triggering events by identifying sensitive nodes that generate secondary events and rapidly scale up a crisis. Risk scenarios based on hazard can be integrated with corresponding vulnerability scenarios using escalation points to represent unknown triggers. The involvement of all stakeholders such as emergency managers, governmental and non-governmental organizations and representatives of the private sector could help determine which *consequences* of a disaster could become the principal *drivers* of cascades.

For more information, see part three, Module 3, on cross-sectoral and multi-risk approach to cascading disasters.

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<sup>24</sup> The National Diet of Japan, 2012. The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission: Executive Summary, The National Diet of Japan, Tokyo, Japan.

<sup>25</sup> Pescaroli, G. and Ilan Kelman, I., 2016. How Critical Infrastructure Orients International Relief In Cascading Disasters. *Journal of Contingencies and Crisis Management*, 25(2), pp. 56–67.

## **Element 7 Key considerations in conducting risk analysis**

This element describes key considerations in conducting a risk analysis. More information on various methodologies and tools, and further resources relevant to conducting the risk assessment can be found in the modules on special topics and hazard specific risk assessment in part three.

### **Identifying and compiling existing input data**

Identifying and compiling existing input data for various components of risk analysis are critical for the following purposes:

- (a) Further refining the technical scoping, including selection of analysis methodologies, since the level of detail in risk analysis is often driven by the resolution or quality of the available data;
- (b) Identifying data gaps and areas that require further data collection.

Data and information needed for analysing disaster risk often reside in a country's research institutions, government laboratories, statistics offices, etc. Sometimes private-sector studies are made public, especially when commissioned by government entities. On a broader scale, existing regional or international studies, though they may vary in resolution, can be used to supplement other available data.

Further considerations are described in element 3 on data management strategy of NDRA in this document and more details can be found in Module 9 on data management in part two of the *Guidelines*.

### **Assessing capacities**

Understanding capacities is one of the main components of disaster risk assessment. It adds perspective when prioritizing and evaluating risks for decision-making. It is essential to understand capacities in order to quantify the total impact. Consideration needs to be given to how capacity assessment fits best in the process of NDRA and, more broadly, in disaster risk management. The concept of "lack of capacity" is often considered to be part of risk analysis itself, as it is one of the risk elements, besides hazard, exposure and vulnerability.

### **Toolbox 5 - Categorization of capacity**

The following list sets out the different ways in which countries categorize “capacity” in the context of disaster risk:

- By phase of the risk management cycle: prevention, preparedness, response and recovery.
- By the structural nature of the capacity: structural versus non-structural. Structural means actual, physical structures (e.g. dams, dikes); non-structural means “softer” measures (e.g. policy instruments and community resilience).
- By “target” within a holistic approach: human, human-made environment (built and technical) and natural environment.
- From the perspective of the “built environment”: (in descending order) spatial planning, building construction, technical systems within a building, usage of the building, human behaviour.
- Based on natural/psychological mechanisms: “coping” versus “adapting”. Coping focuses on tactical measures, based on the current risk level and previous events. Adaptation focuses on strategic measures in anticipation of future changes in risk.
- By institutional capability: administrative, technical, and financial.
- By element of risk: capacities to reduce hazard, exposure, and vulnerability.
- By element of impact: capacities to reduce human, economic, environmental and political-social impact.
- By system orientation: institutional, community or individual.

Each of these can have a particular added value for the purpose of NDRA capacity analysis, either for the overall view of all risks or for specific hazards or sectors. It is recommended to discuss and select the most suitable categorizations with the stakeholders, and then set them out in a shared understanding of “NDRA definitions of concepts”.

### **Determination of sources and drivers of risk**

The risk analysis phase provides the opportunity to better understand the underlying causes of risk. The risk assessment may highlight that a risk is dominated largely by the element of hazard due to climate change, exposure due to unchecked urban expansion, vulnerability due to lack of building code enforcement, poverty and inequality or capacity due to weak governance.

And cross-cutting themes can be identified that influence several components of risk at the same time, such as climate change and rapid technological development. If there is a specific risk that can be reduced by a change in policy or practice that eliminates or diminishes the root cause of the risk, this should be noted in the assessment.

## **Climate change considerations**

Some disaster risks have a direct relationship with the increase in frequency and magnitude of extremes in climate variables (temperature and precipitation) and low capacity to adjustment. In particular, the policies and investments in climate change adaptation and disaster risk management should be fully aligned to benefit from measures that address both. Therefore, it is critical to ensure that NDRA incorporates the impacts of climate change on the relevant hazards and risks. See part two, Module 1, on climate change and its implications for NDRA for further information on the topic.

### **Element 8 Preparing the outputs of risk analysis for communication with stakeholders**

This element emphasizes the importance of using various tools and methods to prepare the outputs of analysis for communication and use by stakeholders for the purposes of NDRA.<sup>26</sup>

Presenting the results in a format that is understandable, relevant and useful to the stakeholders is key to the success of a risk assessment. A review of current risk assessment efforts shows that more innovation and collaboration with experts in communications and other disciplines is necessary to improve the translation of technical information into transferable and useful information for decision makers and practitioners. For example, presenting the risk and loss values in an economic or social context, or expressing probabilities within the political timeframe or human lifetime, especially for low-likelihood but high-consequence events, helps convey the risk message clearly.

The final consolidated report of a risk assessment, communicating risk information to the general public or a local community, requires a different strategy from that for communicating the same information to economists or policymakers. It is recommended to pay close attention to the development of a communication strategy that breaks down the full risk assessment results into digestible pieces for different target audiences. Consider the goals for each target audience, varying from decision-making on risk prioritization and disaster risk reduction measures (NDRA stakeholders), disaster risk awareness and education (general public), to incentives for follow-up research (scientific community) and use of information for other risk assessments (subnational governments, sectors).

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<sup>26</sup> Risk communication is a two-way process. This is reflected in element 9. Element 8 focuses only on the preparation of the results for two-way communication.

The following tools and formats can be used to report the results for different purposes:

- Geospatial tools and mapping for hazards and risk information. For further information, see Module 10 on the use of geographic information system and Module 11 on technologies to support disaster risk assessment.
- Risk matrices for comparison and showcasing prioritization of risk levels to decision makers are a common format to use for all risks. See Textbox 4 in Element 6.
- Scenario information depicted in maps and infographics, as well as preparation of exercises, to raise awareness among the general public.
- Brief snapshots of risk values, trends, with and without possible disaster risk reduction policies (if identified in the scoping step) and main findings for communicating with high-level decision makers.
- Exceedance probability curves to communicate the concept of risk layers for disaster risk reduction actions.
- Sector reports to explain the assumptions, methodologies, findings and relevance of the information produced to the identified disaster risk management actors.
- Simple and clear formats, such as infographics, to present hazard and risk information accompanied by simple actions and decision-making considerations for use in communicating with the general public.

## **Stage III Using NDRA results for disaster risk management and development decisions**

### **Element 9 Facilitating the process for evaluation and applying results in disaster risk management decisions**

This element provides an overview of the necessary re-engagement between the technical team and the stakeholders to understand the NDRA results, evaluating the risks so as to prioritize them and apply the assessment to the original policy scope defined at the scoping and preparation stage.

The outputs of risk assessment are inputs to decision-making on plans, actions and investments for managing disaster risk. Understanding of disaster risk through an NDRA provides a scientific and evidence base for decision-making and planning. Once the technical team prepares NDRA outputs, the results and findings are presented to the key stakeholders to ensure the outputs are understandable and are usable for the purpose that was originally defined in the scoping phase. This closes the loop between the phase of conducting risk assessment and the scoping phase.

It is important to use the governance system of stakeholders that was designed at the early phases of the project to bring together all the key stakeholders involved in the scoping phase. This includes the scientific teams who conducted the risk assessment, the experts and the disaster risk management policy teams.

The following are some key issues that must be discussed and decided upon through engagement with stakeholders:

- Evaluating and prioritizing the risks identified in the assessment. This process can be enhanced by setting transparent risk evaluation criteria or prioritization perspectives in advance (in stage I). The end result of the risk evaluation is a decision by the authorities (preferably the council of ministers or the national parliament), after stakeholder consultations and if possible public participation, on the "prioritization of risk".

This means defining the risks of high societal importance that require immediate attention: priority hazards, priority exposed elements, priority vulnerabilities and priority capabilities to then decide on and design various disaster risk reduction measures. It is recommended to record the decision rationale regarding the prioritization of risks, as well as decisions regarding treatment options, and whether or not the "risk owner" has the option of accepting, treating or transferring the risk.

- Acceptable levels of risk.
- Uncertainties in results, as these will affect DRM policy decisions.
- The stakeholders discuss disaster risk management solutions based on risk prioritization, and further understanding of causes and sources of risk and identifying and perhaps addressing the underlying causes of risk and other considerations such as the following:
  - Large potential (indirect) consequences for Sustainable Development Goals.
  - Need for synchronization with other policy fields such as climate change adaptation, critical infrastructure protection and other sectoral needs.
  - Balanced mix between prioritization measures to avoid new risks, reduce existing risks and manage residual risks by means of all stages of the disaster risk management cycle: prevention, preparedness, response and recovery.
  - Need for continuity of existing disaster risk management policies.
  - Potential for quick wins.
  - Use of NDRA results for development planning, perspective planning and land-use planning.

This dialogue may lead to demand for further analysis to gain additional perspectives, such as further understanding of risk drivers<sup>27,28</sup>, or impact of certain disaster risk management policies or cost-benefit analysis of specific investments.

This step is not by any means the end of disaster risk management or disaster management planning, but only an opportunity to evaluate options while interacting with the technical teams who conducted the national assessment.

At the end of this step, the final set of risk assessment outputs – as datasets, maps, reports or any other formats, customized for the stakeholders – is delivered to the NDRA lead agency, and this cycle of NDRA comes to an end.

Relevant to this element are Modules 9: data management, Module 10: use of geographical information systems (GIS), and Module 15: risk communication with the general public.

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<sup>27</sup> UNISDR, 2015. Global Assessment Report on Disaster Risk Reduction (GAR) 2015, The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

<sup>28</sup> United Nations General Assembly, 2016. Report of the Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction, United Nations General Assembly, Geneva, Switzerland.



## **Element 10      Ensuring long-term sustainability of NDRA system**

This element describes the recommended long-term plan for the country NDRA system.

The vision of Sendai Framework priority 1, Understanding disaster risk, and the approach presented in these *Guidelines*, is to have a well-established central system for understanding disaster risk in every country that produces the risk information needed for prevention, mitigation, preparedness, response and recovery, in order to build a resilient future. This central system, with a multi-stakeholder governance system, updates the NDRA every few years, conducts specific risk assessment on demand and maintains the national clearinghouse of risk data and information.

It is important to put in place a long-term sustainability plan for the NDRA system. The plan should include the following:

- Clarity on NDRA updating time cycle.
- Operational mechanisms for “on-demand” customized risk assessments such as sectoral risk assessment, or site-specific hazard assessment for significant investments.
- Defining a financial strategy both for NDRA updates and “on-demand” assessments from public and private entities.
- Open data policies and data sharing from “on-demand” private assessments.
- Mechanisms for international exchange and access to science and technology advances in risk assessment, including tools for communication and application in disaster risk reduction.

Iterative processes for NDRA will further help to modify the course towards sustainable development. This requires having a legally and institutionally supported regular process of NDRA that is inclusive, science-based and sufficiently responsive to specific needs of the people, areas, sectors and assets most at risk.

## Concluding notes

The Sendai Framework calls for strong political leadership, commitment and involvement of all stakeholders, at all levels, to pursue the goal of preventing new and reducing existing disaster risk “through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience”.

Such a complex task requires novel approaches and methods, and perhaps most importantly, new mindsets. Building resilience against disasters is largely a cross-cutting theme and starts from understanding disaster risk. A national disaster risk assessment sets the stage for successful disaster risk management ranging from prevention and reduction to preparedness and response and recovery strategies.

Understanding disaster risk and its interaction with the Sustainable Development Goals, climate change adaptation and disaster risk drivers requires more effort to be directed at extensive risk and its interaction with intensive risk. It also requires a disaggregated exposure, vulnerability, risk and loss mapping, as well as a deeper discussion of potential governance deficits.

While understanding disaster risk reveals inherent dependencies and interdependencies across many sectors, the notion of “socially constructed disaster risks” remains central, suggesting that vulnerabilities and capacities define and shape the disaster risk profile in a society.

Addressing those vulnerabilities allows modification of the structural conditions of unsustainable development models, such as poverty and inequality that exacerbate disaster risk. This inherent linkage of disaster risks and long-term development brings another importance to NDRA as an instrument for managing a short- to long-term risk-informed development model that is sustainable and integrated, allowing for the consideration of multiple cascading effects across different sectors.

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For Consultation

## ANNEXES

### Annex 1: Further resources and relevant guidelines

Title	Author	Date	Link
<i>International or regional guidelines</i>			
Risk management: Principles and guidelines on implementation  ISO/DIS 31000	International Organization for Standardization	2009	<a href="https://www.iso.org/standard/43170.html">https://www.iso.org/standard/43170.html</a>
Risk management - Risk assessment techniques  ISO/IEC 31010	International Electrotechnical Commission (IEC)/ International Organization for Standardization (ISO)	2009	<a href="https://www.iso.org/obp/ui/#iso:std:iec:31010:ed-1:v1:en">https://www.iso.org/obp/ui/#iso:std:iec:31010:ed-1:v1:en</a>
Using national risk assessment to develop risk management capabilities at the country level	International Risk Governance Council	2012	<a href="http://www.irgc.org/wp-content/uploads/2013/02/IRGC_12December2012_workshop_15Feb.pdf">www.irgc.org/wp-content/uploads/2013/02/IRGC_12December2012_workshop_15Feb.pdf</a>
Risk Assessment and Mapping Guidelines for Disaster Management	European Commission	2010	<a href="https://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf">https://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf</a>
National-level Risk Assessments: An Analysis Report	European Union Agency for Network and Information Security	2013	<a href="http://www.enisa.europa.eu/publications/nlra-analysis-report/at_download/fullReport">www.enisa.europa.eu/publications/nlra-analysis-report/at_download/fullReport</a>
INFORM index for risk management	European Commission and IASC (Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness)	2014	<a href="http://www.inform-index.org">http://www.inform-index.org</a>



<i>National guidelines or reports on national risk assessment</i>			
National Emergency Risk Assessment Guidelines	Australian Institute for Disaster Resilience	2015	<a href="http://www.aidr.org.au/media/1490/practice-guide-101-national-emergency-risk-assessment-guidelines.pdf">www.aidr.org.au/media/1490/practice-guide-101-national-emergency-risk-assessment-guidelines.pdf</a>
All Hazards Risk Assessment Methodology Guidelines 2012–2013	Public Safety Canada	2012	<a href="http://www.publicsafety.gc.ca/cnt/rsr/cs/pblctns/ll-hzrds-sssmnt/index-en.aspx">www.publicsafety.gc.ca/cnt/rsr/cs/pblctns/ll-hzrds-sssmnt/index-en.aspx</a>
National Risk Assessment In the Netherlands	Organisation for Economic Co-operation and Development	2012	<a href="https://english.nctv.nl/binaries/national-risk-assessment-2012_tcm32-84266.pdf">https://english.nctv.nl/binaries/national-risk-assessment-2012_tcm32-84266.pdf</a>
Working with Scenarios, Risk Assessment and Capabilities in the National Safety and Security Strategy of the Netherlands	Ministry of Security and Justice, Netherlands	2009	<a href="http://www.preventionweb.net/files/26422_guidancemethodology_nationalsafetyan.pdf">www.preventionweb.net/files/26422_guidancemethodology_nationalsafetyan.pdf</a>
Handbook on Mitigating Spatial Relevant Risks in European Regions and Towns	MiSRaR project, Netherlands	2012	<a href="http://www.misrar.nl/UserFiles/File/MiSRaR_practical_handbook_ENGLISH_definitive_version(1).pdf">www.misrar.nl/UserFiles/File/MiSRaR_practical_handbook_ENGLISH_definitive_version(1).pdf</a>
A summary of relevant elements of the National Risk Assessment compilation based on selected parts of the Report on Threats to National Security	Rządowe Centrum Bezpieczeństwa	2015	<a href="http://rcb.gov.pl/wp-content/uploads/EN-Poland-A-summary-of-relevant-elements-of-the-national-risk-assessmentOK.pdf">http://rcb.gov.pl/wp-content/uploads/EN-Poland-A-summary-of-relevant-elements-of-the-national-risk-assessmentOK.pdf</a>

Documents, reports, papers on various aspects of disaster risk assessment			
Global Assessment Report (GAR)	UNISDR	2009, 2011, 2013, 2015	<a href="http://www.preventionweb.net/english/hyogo/gar/2015/en/home/index.html">http://www.preventionweb.net/english/hyogo/gar/2015/en/home/index.html</a>
Science for Disaster Risk Management 2017: knowing better and losing less	Joint Research Center, European Commission	2017	<a href="http://drmkc.jrc.ec.europa.eu/knowledge/Challenges-Sharing">http://drmkc.jrc.ec.europa.eu/knowledge/Challenges-Sharing</a>
Overview of Natural and Man-made Disaster Risks the European Union may face	European Commission- Commission Staff Working Document	2017	To be provided
Understanding Risk in an Evolving World	GFDRR	2014	<a href="https://www.gfdr.org/sites/gfdr/files/publication/Understanding_Risk-Web_Version-rev_1.8.0.pdf">https://www.gfdr.org/sites/gfdr/files/publication/Understanding_Risk-Web_Version-rev_1.8.0.pdf</a>
Making a Riskier Future	GFDRR	2016	<a href="https://www.gfdr.org/sites/default/files/publication/Riskier%20Future.pdf">https://www.gfdr.org/sites/default/files/publication/Riskier%20Future.pdf</a>
Open Data – Policy and Principles for DRM	GFDRR	2016	<a href="https://www.gfdr.org/sites/default/files/publication/OpenDRI%20Policy%20Note.pdf">https://www.gfdr.org/sites/default/files/publication/OpenDRI%20Policy%20Note.pdf</a>
Risk Modelling tools	GFDRR	2014	<a href="https://www.gfdr.org/understanding-risk-review-open-source-and-open-access-software-packages-available-quantify-risk">https://www.gfdr.org/understanding-risk-review-open-source-and-open-access-software-packages-available-quantify-risk</a>
Recommendation of the Council on the Governance of Critical Risks	OECD	2014	<a href="http://www.oecd.org/gov/risk/Critical-Risks-Recommendation.pdf">http://www.oecd.org/gov/risk/Critical-Risks-Recommendation.pdf</a>
OECD Recommendation on Disaster Risk Financing Strategies	OECD	2017	<a href="https://www.oecd.org/daf/in/insurance/OECD-Recommendation-Disaster-Risk-Financing-Strategies.pdf">https://www.oecd.org/daf/in/insurance/OECD-Recommendation-Disaster-Risk-Financing-Strategies.pdf</a>

Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters	GFDRR	2017	<a href="https://www.gfdr.org/sites/default/files/publication/Unbreakable_FullBook_Web-3.pdf">https://www.gfdr.org/sites/default/files/publication/Unbreakable_FullBook_Web-3.pdf</a>
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For Consultation

## Annex 2: Country Cases

*Country cases for the interim version of guidelines are limited. More cases will be included in the final version.*

### Country: United Kingdom

United Kingdom's approach to national risk assessment.

#### Introduction

The National Risk Assessment (NRA) is a comprehensive all-hazard assessment of the most significant emergencies (malicious and non-malicious) the United Kingdom could face over the next five years. It is updated every two years (the last iteration was completed in 2016) and it includes the publication of an unclassified National Risk Register. The first NRA was first produced over ten years ago and has been regularly updated and improved ever since.

The NRA draws on expertise from a wide range of departments and agencies of Government. Each department is responsible for leading the assessment of specific risks that relate to their policy remit and/or their responsibility for a specific sector of critical national infrastructure. The resulting product is an integrated whole-of-government approach to National Risk Assessment.

The NRA identifies generic risks rather than every possible scenario and uses a 'reasonable worst case scenario' methodology to capture the most challenging, but still reasonably plausible manifestation of a risk.

There are three stages to the assessment: the identification of risks; assessment of their likelihood and potential impacts; and comparison/prioritisation of the risks. All three stages involve consultation with subject matter experts including independent challenge groups of academics and government scientists.

Each of the risks in the NRA is described as a 'reasonable worst case scenario'.

For a risk to be included in the NRA, it must:

- have the potential to cause serious detrimental effects to the security of the UK, human welfare or the environment;
- have an expected impact that reaches a minimum threshold (typically significant damage to the UK); and
- have at least a 1 in 20,000 chance of occurring at least once in the UK in the next five years.

Each risk is assessed on the basis of its likelihood and its potential impacts on:

- human health (including, mental health impacts people displaced/evacuated, injured, or killed by the events);
- the nation's critical infrastructure and essential services (such as electricity, telecommunications, transport, etc.);
- the environment; and
- the economy.

The assessment also includes a more qualitative analysis of the psychological impacts on the country (which includes public outrage and public perception of the risk).

As part of HM Government’s duties under equality and diversity legislation, both the process and the outputs of the NRA have been reviewed to highlight how risks or the required response may affect/take into account the needs of people of a specific gender, age, sexual orientation, religion, ethnic/national origin or disability.

Long-term trends (such as climate change) are examined through their potential effects on the risks covered by the assessment.

### The governance mechanism for a risk assessment

Each risk is assigned to a lead assessor (government department or agency) with support from internal and external experts. The overall production of the NRA, including setting the methodology, is led by the Civil Contingencies Secretariat, which is part of the National Security Secretariat in the Cabinet Office. The NRA is collectively agreed by Ministers.

The NRA builds on risk assessment work conducted throughout the whole of Government and across the scientific and academic community. As such it benefits from the governance arrangements already in place for work carried out by government departments (including parliamentary accountability).

Independent expert groups also help government departments and agencies improve their understanding of the consequences of their risks, such as the effect on the mental wellbeing of the population.

<b>Identify</b>	<b>Assess</b>		<b>Prioritise</b>	<b>Sign-off</b>	
1. Lead assessors review existing risks and suggest new ones	3. Health specialists sense checks casualty & fatality figures	4. Sector chief economists validate economic impact figures	7. Chief scientists network evaluates risk matrix	9. Cross-gov. steering group provides policy lead clearance	10. Senior civil servants provide strategic oversight
2. Expert groups; chief scientists & cross-gov. steering group provide challenge	5. Social disruption scoring is checked in a cross-gov. policy leads workshop	6. Psych. impact assessment is validated by external experts from academia	8. Cross-gov. steering group evaluates risk matrix	11. Senior Gov. Ministers provide ministerial clearance	12. Prime Minister considers the full document and provides final sign-off

**Fig. 1** - Governance diagram

## **What were the existing technical, financial, and institutional capacities to conduct risk assessment?**

Evidence based policymaking means that government departments and specialist agencies conduct risk assessment work on the areas of policy they lead on as part of their ongoing work. Existing technical capacities are also complemented by close partnerships between Government and industry, for example private operators of critical infrastructure have worked with regulators and government agencies to fund research aimed at understanding emerging risks such as space weather and cyber attacks.

Furthermore, Government works with the academic community to establish the areas of research where additional work is required.

The Natural Hazards Partnership is an example of the level of cross Government technical and institutional capacities in this field. This partnership is a consortium of 17 public bodies (mainly government departments and agencies, trading funds and public sector research establishments) which aims to build on partners' existing natural hazard science, expertise and services to deliver fully coordinated impact-based natural hazard advice.

## **What international support was used for the national disaster risk assessment? (if relevant)**

On certain topics, such as flooding or radiation emergencies, European research projects have yielded additional evidence which has supplemented our national analysis.

The UK also regularly shares best practice with international partners bilaterally and through groups such as the Disaster Risk Management Knowledge Centre and the Disaster Prevention Expert Group (both EU initiatives) and the OECD High Level Risk Forum. Informal regional networks such as the North European Forum for Risk Assessment have also been a source of good practices which have enriched our country's approach.

## **What was the data management process?**

A simple file sharing system supported by a secure online portal with strict access controls has been used to store and disseminate the information covered by the assessment.

As the NRA represents the synthesis of multiple assessments conducted by a variety of organisations, data informing the assessment for each risk is not centrally stored.

HM Government releases a significant amount of information, including data sets, to support transparent policy making and foster innovation. An online portal ([data.gov.uk](https://data.gov.uk)) brings it together into one searchable website. Making this data easily available means it will be easier for people to make decisions and suggestions about government policies based on detailed information. There are datasets available from all central government departments and a number of other public sector bodies and local authorities.

## **Technical methodologies**

A variety of analysis methods have been used in producing the NRA, ranging from stochastic modelling to expert elicitation workshops using the Delphi method. Historical data and lessons learned from past occurrences have been combined with probabilistic modelling of scenarios.

## **How was the scope of the risk assessment defined?**

The scope of the risk assessment is based on the UK's national resilience legislation (the Civil Contingencies Act of 2004).

Every iteration of the NRA undergoes a validation process to ensure relevant risks are captured in the assessment. This validation process includes:

- Workshops with industry, academia and local responders;
- Cross-Government group discussions (at operational, senior management and ministerial levels);
- Consultation with the Government Chief Scientific Adviser and the network of chief scientists across Government; and
- Parliamentary oversight, via specialist committees such as the Lords Science and Technology Committee.

## **How was the risk assessment linked with DRR strategy and plans?**

The NRA is used for considering national resilience challenges at a Government level, and to provide guidance to local emergency planners and responders on the kinds of risks which they may need to address in their local area.

The NRA is at the centre of the UK's national disaster risk reduction strategies. It informs national strategies on counter-terrorism, bio-security, flood resilience and cyber-security – amongst others. The NRA is also the backbone of a wider assessment of the national security risk landscape known as the National Security Risk Assessment (NSRA) which informs the National Security Strategy and Strategic Defence and Security Review.

## **What was the duration and budget of the risk assessment?**

The NRA is produced every two years and is funded as part of the standard operating costs of the department and agencies involved in the assessment.

## **Where any guidelines used?**

The Cabinet Office, as the coordinating agency for the NRA, produces its own guidelines and methodology for departments and agencies taking part in the assessment.



## **Country: New Zealand**

**New Zealand's approach to initiating, designing, conducting and delivering national disaster risk assessment.**

### **Introduction**

**Risk assessment of natural hazards has been completed in New Zealand for several decades, as legislated under the National Civil Defence Emergency Management Plan Order, which was last updated in 2015. However, up until recently, risk assessment was conducted in 'silos' (i.e. national security agencies were individually responsible for security assessments and natural hazard assessments were predominantly undertaken at a local level or independently by scientific research agencies). Further, there was not a consistent methodology available across Government agencies that enabled comparison of nationally-significant risks.**

**Understanding of the risks associated with specific hazards and event scenarios is based on assessments undertaken by Civil Defence Emergency Management (CDEM) Groups, national agencies, and the science and research sector. The recommended risk management standard to be used as the basis for risk assessment and management in New Zealand is AS/NZS ISO 31000.2009. Under current CDEM legislation, the following hazards require risk assessment:**

- (a) earthquakes
- (b) volcanic hazards
- (c) landslides
- (d) tsunamis
- (e) coastal hazards (including coastal erosion, storm surges, and large swells)
- (f) floods
- (g) severe winds
- (h) snow
- (i) droughts
- (j) wild fires and urban fires
- (k) animal pests and diseases
- (l) plant pests and diseases
- (m) infectious human disease pandemics (including water-borne illnesses)
- (n) infrastructure failure

- (o) hazardous substance incidents
- (p) major transport accidents
- (q) food safety incidents (for example, accidental or deliberate contamination of food)
- (r) terrorism.

Under the leadership of the Department of Prime Minister and Cabinet, New Zealand is developing a new methodology for assessment of nationally-significant risks. Hazards are assessed based on vulnerabilities and exposure, and taking a scenario-based approach, assesses overall level of risk against a standardised table of consequences across social governance and sovereignty, economic, environmental and built domains. The methodology also considers current and future risk management options.

### **The governance mechanism for a risk assessment**

New Zealand takes an “all hazards, all risks” approach to national security, considering a variety of hazards, as well as traditional security threats. The governance mechanism for New Zealand’s national risk assessment follows this approach by bringing together a wide range of stakeholders from different sectors, as the focus is on understanding and managing generic consequences and vulnerabilities instead of a specific hazard. The risk assessment governance mechanism brings together stakeholders at three levels of Government – Ministers; Chief Executives; Senior Officials and other officials. Relationships with local government, quasi-government agencies and the private sector are also leveraged.

Technical expertise used in the risk assessment itself was drawn predominantly from lead Government agencies, supported by the science and research sector as appropriate. A Project Team comprising officials from the Ministry of Civil Defence & Emergency Management, a business unit of the Department of Prime Minister & Cabinet, led a collaborative development and review process of the risk profiles and associated risk scoring.

The review process involves a step-by-step analysis to ensure lead agencies have followed the risk assessment methodology, that content was appropriately placed within the profile, and that the scenario assessments were supported by evidence and expertise. This was undertaken in phases:

1. An initial workshop with a large number of technical experts from agencies legislated to manage a variety of natural hazards. This provided an opportunity to test the assumptions behind consequence scoring and brainstorm alternative scenarios. The workshops were led by a member of the project team with appropriate technical acumen.

2. A cross-check from another project team member. This allowed for both technical and formatting quality control review to be undertaken to ensure consistency and completeness with the risk assessment methodology.

3. The project team also conducted an in-depth review of the risk assessment including:

- Validating the risk assessment approach taken by each agency.
- Reviewing all risk assessment material, including all 'workings'.
- Providing feedback to agencies on the review of the risk profile.
- Ensuring, to the best of the project teams' ability, that no gaps in existing knowledge were found.
- Ensuring all referencing was identified on the risk profile or on accompanying documentation.

### **What were the existing technical, financial, and institutional capacities to conduct risk assessment?**

The standard used as the basis for risk assessment and management in New Zealand is AS/NZS ISO 31000.2009. This standard forms the basis for the national level risk assessment methodology, noting some customisation to make assessments suitable to New Zealand. Individual Government agencies hold their own capacities to conduct risk assessment, drawing from this standard.

Conducting a national-level risk assessment requires additional commitment from many of these agencies. Through the first iteration of the national risk assessments, it was identified that methodologies and approaches within agencies was not uniform and where it was present, tended to be focused on operational rather than strategic risk. The Hazard Risk Management and Analysis team in the Ministry of Civil Defence & Emergency Management was used extensively in development and application of this methodology, coordinating cross-agency assessments.

### **What international support was used for the national disaster risk assessment? (if relevant)**

International best practice for risk assessment was considered during development of the national level risk assessment methodology, drawing on a range of publically-available reports. Science and research reports were also incorporated into the risk assessment. International experiences of wild fires were considered when generating relevant scenarios.

### **What was the data management process?**

While the majority of the information is based on national experience and publically available, data for assessments carries a security classification and is not 'open'. All risk assessment data is currently held within the Ministry of Civil Defence & Emergency Management and is managed in a variety of data formats,

including excel spreadsheets. As part of continuous improvement of the risk assessment methodology it is anticipated that a shared database platform will be developed, enabling lead agencies to access and update assessment data as required. This will ensure that the methodology captures changes in risk over time.

Information on natural hazards is publically available and supported by a range of central and local government agencies, as well as science agencies and research institutes.

### **Technical methodologies**

The fundamental component of the technical methodology is that all national level risks can be compared using a standard set of principles, using the same likelihood and consequences measures to determine a greater sense of the current and future, and acceptable and unacceptable risks New Zealand face, and provide the opportunity to identify changing and emerging risks.

The methodology for calculating scenario risk is based on a maximum credible event scenario approach, with consequence scoring for scenarios completed using a logarithmic scale. This approach allows different events, with quite different probabilities, to be effectively represented using simple scoring scales; a five point scale has been used thus far. The likelihood scale is also logarithmic, to be appropriate for a wide range of malicious and non-malicious risks.

Assessments are based on current, available information and current risk management practices. All risk assessments include a level of expert judgement in order to make effective decisions under uncertainty. The likelihood for each scenario is assessed quantitatively wherever possible, but based on qualitative expert judgement where there is no data or body of evidence. The process of completing the assessments allows central government agencies to identify gaps in evidence or understanding as well as include their level of confidence in the information used. A confidence ranking has been used to show best judgement has been used in the risk narrative and assessment.

### **How was the scope of the risk assessment defined?**

The scope of the risk assessment has identified by central government agencies using a collaborative across-agency approach.

### **How was the risk assessment linked with DRR strategy and plans?**

The national risk assessment is used to identify gaps in risk management, highlighting risks not currently accounted for or managed under Ministerial mandates, or central government agencies. Individual risk profiles identify current risk management practices across the '4R' framework (reduction, readiness, response and recovery). This includes identifying any governing

legislation and plans. This can highlight any gaps in risk management of these individual risks.

The national risk assessment and the methodology underpinning it have been aligned with other relevant and related work, such as: The Treasury Living Standards Framework; Local Government New Zealand's establishment board for a risk management agency; the Financial Market Authority Assessment; the Sendai Framework for Disaster Risk Reduction; and the Climate Change Conference (COP 21) in Paris.

**New Zealand is currently developing a National Disaster Resilience Strategy, which will be an implementation plan for the Sendai Framework in New Zealand. The national risk assessment will provide a key input into this work by describing the national risk profile, highlighting key exposures and vulnerabilities, and analysing wider 'system trends' that the strategy needs to take account of. Together these two pieces of work are key to promoting a broad conversation about risk and resilience in New Zealand, and how we best position ourselves for the future.**

**What was the duration and budget of the risk assessment?**

**The risk assessment does not have a defined budget and has been an ongoing process as the methodology and evidence utilised have evolved over time. Work commenced in August 2015.**

**Where any guidelines used?**

This question is covered off above.

### **Examples of risk assessment results in use for DRR**

Individual risk assessments are being used by senior government officials to test and further coordinate arrangements for risk reduction, readiness, response and recovery for high priority risks.

## Annex 3: Definitions<sup>29</sup>

### Capacity

The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience.

*Annotation: Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management.*

*Coping capacity is the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks.*

### Disaster Risk

The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.

*Annotation: The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socioeconomic development, disaster risks can be assessed and mapped, in broad terms at least.*

*It is important to consider the social and economic contexts in which disaster risks occur and that people do not necessarily share the same perceptions of risk and their underlying risk factors.*

**Acceptable risk**, or tolerable risk, is therefore an important subterm; the extent to which a disaster risk is deemed acceptable or tolerable depends on existing social, economic, political, cultural, technical and environmental conditions. In engineering terms, acceptable risk is also used to assess and define the structural and non-structural measures that are needed in order to reduce possible harm to people, property, services and systems to a chosen tolerated level, according to codes or “accepted practice” which are based on known probabilities of hazards and other factors.

**Residual risk** is the disaster risk that remains even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach.

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<sup>29</sup> UNISDR, 2016. Open-ended Intergovernmental Expert Working Group on Indicators and Terminology relating to Disaster Risk Reduction: Report of the Second Session (Informal and Formal), The United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.

**National Disaster Risk:** intensive and extensive Disaster Risks that either have a potential (cumulative) impact that is significant and relevant for the nation as a whole and/or require national DRM coordination.

*Annotation: The boundaries of National Disaster Risk depend on the purpose and scoping of a NDRA process. This has to be defined in each country, taking into account existing governance and DRM policies. National Disaster Risks at least include all risks that cannot be sufficiently managed at sub-national level.*

**Disaster Risk Assessment**

A qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend.

*Annotation: Disaster risk assessments include: the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.*

**National Disaster Risk Assessment:** the assessment of national disaster risks.

**Disaster Risk Governance**

The system of institutions, mechanisms, policy and legal frameworks and other arrangements to guide, coordinate and oversee disaster risk reduction and related areas of policy.

*Annotation: Good governance needs to be transparent, inclusive, collective and efficient to reduce existing disaster risks and avoid creating new ones.*

**Disaster Risk Management (DRM)**

Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

*Annotation: Disaster risk management actions can be distinguished between prospective disaster risk management, corrective disaster risk management and compensatory disaster risk management, also called residual risk management*

**Exposure**

The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

*Annotation: Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.*

**Hazard**

A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.



*Annotations: Hazards may be natural, anthropogenic or socionatural in origin. Natural hazards are predominantly associated with natural processes and phenomena. Anthropogenic hazards, or human-induced hazards, are induced entirely or predominantly by human activities and choices. This term does not include the occurrence or risk of armed conflicts and other situations of social instability or tension which are subject to international humanitarian law and national legislation. Several hazards are socionatural, in that they are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change.*

**Impact** The total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being.

**Resilience** The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.

**Vulnerability** The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

*Annotation: For positive factors which increase the ability of people to cope with hazards, see also the definitions of "Capacity" and "Coping capacity".*



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