# **Regional Disaster Risk Assessment**
# Technical Guidelines

**Prevention, Preparedness and Response to natural and man-made disasters in Eastern Partnership countries - phase 3 (PPRD East 3)**

May 2024

PPRD EAST3 Together for a safer future
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# Abbreviations

| | |
|---|---|
| **CBRNE** | Chemical, Biological, Radiological, Nuclear and high yield Explosives |
| **DHS** | Demographic and Health Surveys Program |
| **DLD** | Disaster Loss Data |
| **DRA** | Disaster Risk Assessment |
| **DRM** | Disaster Risk Management |
| **DRMKC** | Disaster Risk Management Knowledge Centre |
| **DRR** | Disaster Risk Reduction |
| **ECHA** | European Chemicals Agency |
| **EHA Connect** | Connecting Environment and Humanitarian Action |
| **EHAN** | Environment and Humanitarian Action Network Platform |
| **EIGE** | European Institute for Gender Equality |
| **EU MS** | European Union Member States |
| **EUSF** | European Union Solidarity Fund |
| **GAR** | UN Global Assessment Report on Disaster Risk Reduction |
| **GDP** | Gross Domestic Product |
| **GFDRR** | Global Facility for Disaster Reduction and Recovery |
| **GNI** | Gross National Income |
| **GNP** | Gross National Product |
| **GNSS** | Global Navigation Satellite System |
| **HDX** | Humanitarian Data Exchange |
| **HRBA** | Human Rights Based Approach |

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|---|---|
| **IFRC** | International Federation of Red Cross and Red Crescent Societies |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **IRDR** | Integrated Research on Disaster Risk |
| **ISIC** | International Standard Industrial Classification of All Economic Activities |
| **ISO** | International Organization for Standardization |
| **JRC** | Joint Research Centre, European Commission's science and knowledge service |
| **MSB** | Swedish Civil Contingencies Agency |
| **NATECH** | Natural Hazards Triggering Technological Accidents |
| **NDRA** | National Disaster Risk Assessment |
| **PPRD EAST 3** | Prevention, Preparedness and Response to natural and man-made disasters in Eastern Partnership countries Phase 3 |
| **SADDD** | Sex, age and disability disaggregated data |
| **UCPM** | European Union Civil Protection Mechanism |
| **UN Women** | United Nations Entity for Gender Equality and the Empowerment of Women |
| **UNDP** | United Nations Development Programme |
| **UNDRR** | United Nations Office for Disaster Risk Reduction (formerly UNISDR) |
| **UNEP** | United Nations Environment Programme |
| **UNFPA** | United Nations Population Fund |
| **UNISDR** | United Nations International Strategy for Disaster Reduction (from 2019 UNDRR) |
| **USD** | United States Dollar |
| **WDPA** | World Database on Protected Areas |
| **WP** | Work Package |
| **WP H** | PPRD East3 Work Package H on Risk Management Capabilities |

# Purpose and Objectives

The Technical Regional Disaster Risk Assessment Guidelines is developed in the framework of the PPRD East3 Programme Work Package H on Risk Management Capabilities. PPRD East 3 aims to promote regional cooperation within the European Union Civil Protection Mechanism (UCPM)[1], in order to improve the Union's response to natural and man-made disasters. The UCPM calls participating states (6) to develop risk assessments periodically, every three years.

As stated in Sendai Framework for Disaster Risk Reduction 2015–2030: "Disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment" (UNISDR, 2015). The scope of disaster risk assessment encompasses a comprehensive evaluation of various factors related to the potential risks and vulnerabilities associated with natural and man-made disasters. The national disaster risk assessment intends to reach a common understanding of the risks faced in a country, underlying risk drivers and required capacities. Disaster risk assessment is an ongoing process that helps in regularly updating and refining disaster risk management plans. The ultimate goal is to inform disaster risk reduction strategies and policies to enhance the country's resilience and ability to respond to and recover from disasters.

The DRA Regional Guidelines explain the process to develop the National Disaster Risk Assessment, with the objective of:

- proposing consistent approach for disaster risk assessment at national and local levels;
- standardizing disaster risk assessment process among PPRD East3 Partner countries at regional level;
- unifying of the disaster risk assessment based on the similar structure of assessment, templates, impact criteria, loss indicators, and presentation of results;
- strengthening the consistency among PPRD East3 Partner countries for easier comparison of the risk assessment outputs of various geographical areas and hazards.

This Guidelines provides a technical and structured approach for disaster risk assessment, on the basis of European and international guidelines and

[1] Governed by Decision No 1313/2013/EU of the European Parliament and of the Council, amended by Decision (EU) No2019/420 (European Parliament, 2019)

recommendations[2], and best practices of EU Member States. The guide provides a set of tools that can be adapted taking into account the specificities of the countries for further development of disaster risk assessment methodology at the national level. Specifically, the semiquantitative approach for the risk assessment is proposed, which allows to evaluate the risk also with limited quantitative data and to communicate efficiently the results for discussing DRR measures using the risk matrix.

The sections within this technical guideline are designed to be read autonomously and are arranged in accordance with the stages of the National Disaster Risk Assessment (NDRA) process.

**Chapter 1.** The concept of risk and its elements is explained, providing a reference on the terminology. Furthermore, the process of the DRA is examined, introducing the phases detailed in the following chapters and the recommended methodology, which involves the use of a risk matrix.

**Chapter 2.** The first step of the NDRA process is the establishment of the national context, through the definition of a governance model and criteria for the classification of the risk and for its evaluation and treatment decisions.

**Chapter 3.** The second step of the NDRA process is the risk identification. Indication for the selection of the scenarios, related to the main hazards, are provided.

**Chapter 4.** The third step of the NDRA process is the risk analysis, which is developed through the estimation of impact and likelihood of the scenario for each main hazard identified. The overall analysis is lead by a risk scenario assessment template. The risk analysis also includes assessing the confidence level or the level of uncertainty of the risk level estimation.

**Chapter 5.** The last step of the NDRA process is the risk evaluation, conducted through the use of risk matrix for the comparison of the different risks analysed.

[2] EU Guidelines on Risk Assessment and Mapping, 2010 (European Commission, 2010); National Disaster Risk Assessment (UNISDR, 2017); Risk management - Risk assessment technique (ISO 31010, 2019); Recommendations for National Risk Assessment for Disaster Risk Management in EU (JRC, 2019); Recommendations for National Risk Assessment for Disaster Risk Management in EU (JRC, 2021).

# Chapter 1. Disaster Risk Assessment Introduction

## 1.1 DRA Terminology

The terminology is critical when conducting a disaster risk assessment. Especially, if the process of conducting a disaster risk assessment and the results of the risk assessments should be comparable between different countries. As noted in EU Guidelines (2010), the specific terminology for assessment of hazards and impacts differs significantly between the various disciplines. For this purpose, this Guidelines proposes to rely on the UNDRR terminology on disaster risk reduction and International Organization for Standardization ISO 31000, ISO 31010. In addition, UNDRR and ISO terminology is also referred in JRC Recommendations for National Risk Assessment for Disaster Risk Management in EU (JRC, 2019), (JRC, 2021) and in the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015).

**Acceptable risk, or tolerable risk** - Is therefore an important sub term; 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 (UNISDR, 2016).

**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 (UNISDR, 2016).

**Consequences** - Are the negative effects of a disaster expressed in terms of human impacts, economic and environmental impacts, and political/social impacts (ISO 31010, 2019), (European Commission, 2010).

**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 (UNISDR, 2016).

**Critical infrastructure** - The physical structures, facilities, networks, and other assets which provide services that are essential to the social and economic functioning of a community or society (UNISDR, 2016).

**Disaster** - A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic and environmental losses, and impacts (UNISDR, 2016).

**Disaster damage** - Occurs during and immediately after the disaster. This is usually measured in physical units (e.g., square meters of housing, kilometres of roads, etc.), and describes the total or partial destruction of physical assets, the disruption of basic services and damages to sources of livelihood in the affected area (UNISDR, 2016).

**Disaster 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 (UNISDR, 2016).

**Disaster loss** - Refers to directly quantifiable losses such as the number of people killed and the damage to buildings, infrastructure, and natural resources (PreventionWeb, n.d.).

**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, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity (UNISDR, 2016).

**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 (UNISDR, 2016).

**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 (UNISDR, 2016).

**Economic impacts** - The sum of the costs of cure or healthcare, cost of immediate or longer-term emergency measures, costs of restoration of buildings, public transport systems and infrastructure, property, cultural heritage, etc., costs of disruption of economic activity, value of insurance pay-outs, indirect costs on the economy, indirect social costs, and other direct and indirect costs, as relevant (European Commission, 2010).

**Economic loss** - The total economic impact that consists of direct economic loss and indirect economic loss. Direct and indirect economic loss are two complementary parts of the total economic loss (UNISDR, 2016).

**Emergency** - Sometimes used interchangeably with the term disaster, as, for example, in the context of biological and technological hazards or health emergencies, which, however, can also relate to hazardous events that do not result in the serious disruption of the functioning of a community or society (UNISDR, 2016).

**Environmental impacts** – The costs of environmental restoration and other environmental costs (or environmental damage). It should wherever possible be quantified in economic terms but may also be included in non-quantified terms under political/social impacts (European Commission, 2010).

**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 (UNISDR, 2016).

**Extensive disaster risk** – The risk of low-severity, high-frequency hazardous events and disasters, mainly but not exclusively associated with highly localized hazards. Extensive disaster risk is usually high where communities are exposed to, and vulnerable to, recurring localized floods, landslides, storms or drought. Extensive disaster risk is often exacerbated by poverty, urbanization and environmental degradation (UNISDR, 2016).

**Frequent and infrequent disasters** - Depend on the probability of occurrence and the return period of a given hazard and its impacts. The impact of frequent disasters could be cumulative or become chronic for a community or a society (UNISDR, 2016).

**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 (UNISDR, 2016).

**Hazardous Event** – A manifestation of a hazard in a particular place during a particular period of time. Severe hazardous events could lead to a disaster as a result of the combination of hazard occurrence and risk factors (UNISDR, 2016).

**Human impacts** - can be estimated in terms of number of affected people, the quantitative measurement of number of deaths, number of severely injured or ill people, and number of permanently displaced people (European Commission, 2010).

**Indirect disaster losses** - Include declines in output or revenue, and impact on wellbeing of people, and generally arise from disruptions to the flow of goods and services as a result of a disaster (PreventionWeb, n.d.).

**Intensive disaster risk** – The risk of high-severity, mid- to low-frequency disasters, mainly associated with major hazards. Intensive disaster risk is mainly a characteristic of large cities or densely populated areas that are not only exposed to intense hazards such as strong earthquakes, active volcanoes, heavy floods, tsunamis or major storms but also have high levels of vulnerability to these hazards (UNISDR, 2016).

**Large-scale disaster** - A type of disaster affecting a society which requires national or international assistance (UNISDR, 2016).

**Likelihood** – The probability that a given event will occur. Likelihood can be expressed using qualitative terms (for ex. Extreme, High, Medium, Low or Negligible), as a percent probability, or as a frequency (Stanford University, s.d.).

**Multi-hazard** - (1) The selection of multiple major hazards that the country faces, and (2) The specific contexts where hazardous events may occur simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects (UNISDR, 2016).

**Political/social impacts** - Are usually rated on a semi-quantitative scale and may include categories such as public outrage and anxiety, encroachment of the territory, infringement of the international position, violation of the democratic system, and social psychological impact, impact on public order and safety, political implications, psychological implications, and damage to cultural assets, and other factors considered important which cannot be measured in single units, such as certain environmental damage (European Commission, 2010).

**Probability** - probability refers to the frequency of occurrence or the return period of losses associated with hazardous events (PreventionWeb, n.d.).

**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 (UNISDR, 2016).

**Resilience** - The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to 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 (UNISDR, 2016).

**Return period** - Describes how likely a hazard event is to occur at, or above, a specific intensity within a time frame defined by a probability. A longer return period (for example, 100 vs. 20 years) suggests a lower probability that an extreme hazard will occur in any single year (GFDRR, 2022).

**Risk treatment** - Involves developing a range of options for mitigating the risk, assessing those options, and then preparing and implementing action plans. The highest rated risks should be addressed as a matter of urgency. Depending on the type and nature of the risk, the following options of risk treatment are available: avoid, reduce, share/ transfer, accept (Chartered Accountants Australia & New Zealand, n.d.).

**Slow-onset disaster** - Defined as one that emerges gradually over time. Slow-onset disasters could be associated with, e.g., drought, desertification, sea-level rise, epidemic disease (UNISDR, 2016).

**Small-scale disaster** - A type of disaster only affecting local communities which require assistance beyond the affected community (UNISDR, 2016).

**Sudden-onset disaster** - Triggered by a hazardous events that emerge quickly or unexpectedly. Sudden-onset disasters could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, transport accident (UNISDR, 2016).

**Susceptibility** - The "state of being susceptible" or "easily affected." In natural hazards terms, susceptibility is related to spatial aspects of the hazard. It refers to the tendency of an area to undergo the effects of a certain hazardous process (e.g., floods, earthquakes, tsunamis, subsidence, etc.) without taking into account either the moment of occurrence or potential victims and economic losses (Encyclopedia of Natural Hazards, 2013).

**Uncertainty** - Uncertainty and limitations of the outcomes of risk analyses helps decision-makers to agree in additional actions regarding the exercise (such as investing more time and money to collect new data or revise the model, if results are not good enough for decision makers) while boosting future research in the areas that should be further developed (JRC, 2021).

**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 (UNISDR, 2016).

The other terminology can be found on online glossary (UNISDR, 2016) adopted by the United Nations General Assembly in 2017.

## 1.2 Risk and its elements

Among the different definitions of the risk, these guidelines propose to represent the risk as a function of hazard, vulnerability, exposure, and coping capacity (UNISDR, 2016):

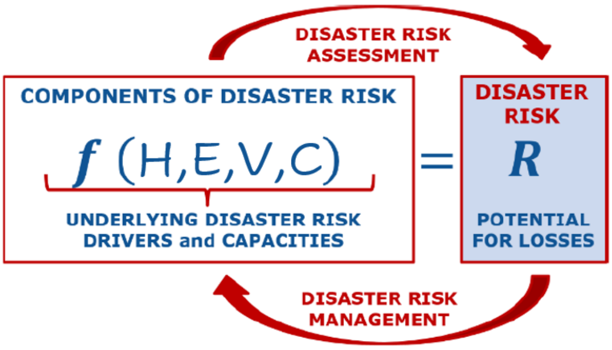


Figure 1. Disaster risk drivers and capacities (H: Hazard, E: Exposure, V: Vulnerability, R: Risk) revised figure (JRC, 2021)

1. Hazard: the intensity of the adverse event causing potential losses.

2. Exposure: elements (property, people, systems or, environment) present in hazard zone that are threatened by the event and thereby subject to potential losses.

3. Vulnerability: how the exposure at risk is susceptible to negative effects due to an adverse event.

4. Capacity: the ability of the system to respond after the event to mitigate the losses.

The level of risk can be reduced by reducing the first 3 elements or by increasing the fourth one.

The vulnerability of people to disasters is inversely proportional to the human capacity to withstand the impact of disasters, that is, the higher the capacity of a society, the less vulnerable it is. Thus, capacity is generally considered to be a component of vulnerability.

A disaster risk besides the likelihood and severity of the hazard event, directly depends on exposed to that hazard, how vulnerable that exposure is, and capability of the system to resist. For example, a severe earthquake in a relatively uninhabited region can be of far less consequence than a relatively minor one near a large conurbation. Similarly, a severe earthquake in an area known to be prone to earthquakes and so with strict design and construction standards can cause fewer fatalities and less damage than an unexpected, much smaller one in an unprepared area with poor building standards (DRMKC, 2017).

### 1.2.1 Hazard

As defined in UN General Assembly Resolution A/71/644 (UNISDR, 2016) hazard is phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.

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.

Hazards may be natural, anthropogenic, or socio-natural in origin. (UNISDR, 2016) Natural hazards are predominantly associated with natural processes and phenomena (such as geological, hydro-meteorological, biological).

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. 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, cascadingly or cumulatively over time, and taking into account the potential interrelated effects.

### 1.2.2 Exposure

The exposure is 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 (UNISDR, 2016). 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.
Exposure represents the people and assets at risk of potential loss or that may suffer damage to hazard impact. It covers several dimensions like the physical (e.g. building stock and infrastructure), the social (e.g. humans and communities) and the economic dimensions (DRMKC, 2017). The exposure has a dynamic nature changing over time as a result of often unplanned urbanisation, demographic changes, modifications in building practice and other socioeconomic, institutional and environmental factors (GFDRR, 2015).
Depending on the scale and the purpose of the risk assessment the attributes and granularity of exposure data may be different.
At European and global levels there are open exposure datasets that can provide spatial component (i.e. geographic location)

| Products | Global datasets | Web link |
|---|---|---|
| **Land-use and land-cover** | MODIS | https://modis.gsfc.nasa.gov/ |
| | GLC-SHARE | https://www.fao.org/land-water/land/land-governance/land-resources-planning- |

| Products | Global datasets | Web link |
|---|---|---|
| | | toolbox/category/details/en/c/1036355/ |
| | Copernicus Global Land Service | https://land.copernicus.eu/global/products/lc |
| | ESA CCI LC | https://www.esa-landcover-cci.org/?q=node/164 |
| | ESA GlobCover | http://due.esrin.esa.int/page_globcover.php |
| | Copernicus Corine Land Cover | https://land.copernicus.eu/pan-european/corine-land-cover |
| | Copernicus Urban Atlas agglomerations with more than 100 000 inhabitants | https://land.copernicus.eu/local/urban-atlas |
| **Mapping human settlements and population** | GHS Global Human Settlement layer | https://ghsl.jrc.ec.europa.eu/ |
| | WorldPop global human population | https://www.worldpop.org/datacatalog/ |
| | HRSL high resolution settlement layer | https://www.arcgis.com/apps/View/index.html?appid=ce441db6aa54494cbc6c6cee11b95917 |
| | LandScan | https://landscan.ornl.gov/ |
| | NASA SEDAC Gridded Population of the World | https://sedac.ciesin.columbia.edu/data/collection/gpw-v4 |
| **Assets at risk and building stock** | GEM Global Exposure Model | https://www.globalquakemodel.org/product/global-exposure-model |

### 1.2.3 Vulnerability

The vulnerability of exposed elements is one of the key components in risk determination. As per the definition of UNDRR, the vulnerability is the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (UNISDR, 2016). Vulnerability relates to the susceptibility of assets such as objects, systems (or part thereof) and populations exposed to disturbances, stressors or shocks as well as to the lack of capacity to cope with and to adapt to these adverse conditions (DRMKC, 2017). The DRM related policies and practices need to take in attention the different dimensions of vulnerability. Among the categories of vulnerability are physical, economic, social, institutional, environmental, agricultural and health (UNISDR, 2016). The degree of vulnerability within a society or a population group may determine a lower or higher probability of being affected depending on social class, ethnic origin, age and gender (DRMKC, 2017).

From a functional perspective, the vulnerability of an asset is related to the specific hazard, and it could be evaluated based on scientific lectures of references. For example, the physical vulnerability to flood could be evaluated basing on the methodology proposed by (Huizinga, J., De Moel, H. and Szewczyk, W., 2017).

Holistically, the vulnerability could be assess through set of hazard independent indicators, that capture the economic, political and social dimensions. For example, INFORM[3] evaluates the vulnerability, considering two categories aggregated through the geometric average: socio-economic and vulnerability and vulnerable groups. If the first category refers more to the demography of a country in general, the vulnerable group category captures social groups with limited access to social and health care systems.

### 1.2.4 Coping capacity

Capacity is 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 (UNISDR, 2016). The capacity to cope requires continuing awareness, resources, organized activities, and the effort of the country's government as well as the existing infrastructure both in normal times as well as during crisis. Coping capacities contribute to the reduction of disaster risks.

For the evaluation of the coping capacity, similarly to the vulnerability, INFORM Risk model examines the measures undertaken by the government to increase the resilience of the society and the effectiveness of their implementation. The coping capacity dimension measures the ability of a country to cope with disasters in terms of formal, organized activities and the effort of the country's government as well as the existing infrastructure which contribute to the reduction of disaster risk. It is aggregated by a geometric mean of two categories: institutional and infrastructure. The difference between the categories is in the stages of the disaster management cycle that they are focusing on. If the institutional category covers the existence of DRR programmes which address mostly mitigation and preparedness/early warning phase, then the infrastructure category measures the capacity for emergency response and recovery.

## 1.3 Disaster risk assessment process

In accordance with ISO 31010 (ISO 31010, 2019) and UNDRR National Disaster Risk Assessment Guidelines (UNISDR, 2017) the risk assessment process is structured and covers risk identification, hazard assessment, determining the impact, through the evaluation of the exposure and vulnerability.

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[3] DRMKC INFORM Risk https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk

ISO 31010 (ISO 31010, 2019) and the National Disaster Risk Assessment Guidelines (UNISDR, 2016) define the risk assessment as a process consisting of three main elements:

- **Risk identification**: definition and description of risks.
- **Risk analysis**: understanding of character, sources and causes of the risks that have been identified and estimation of level of risk. It is also used to study impacts and consequences and to examine the existing capacities.
- **Risk evaluation**: comparison of risk analysis results with risk criteria in order to determine whether or not a specified level of risk is acceptable or tolerable.

The Figure 2 represents the technical scheme of the risk assessment process.

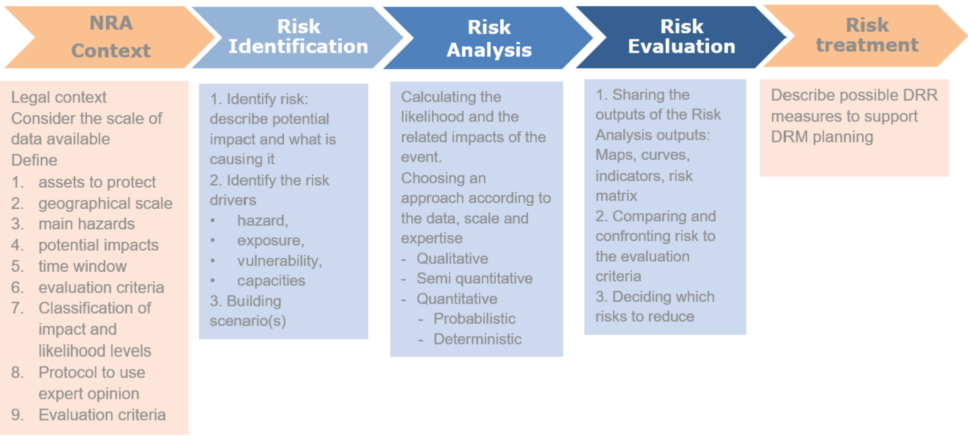



Figure 2. Stages of Risk Assessment process according to ISO 31010 (ISO 31010, 2019)

Finally, the NDRA process conducts to determine the DRR strategy. The main goal of disaster risk reduction (DRR) is to increase the safety of the population, and the disaster risk assessment is the most critical stage in the implementation of disaster risk reduction measures.

## 1.4 Risk Assessment Methodology

Risk assessment is the process of combining the risk components of hazard, exposure, and vulnerability to determine the level of risk.

The approaches vary in various degrees of detail depending on the purpose of the analysis and data available, as well as on how they address uncertainties arising in different stages of the risk assessment process (European Commission, 2010), (DRMKC, 2017).

Risk analysis approach differ among qualitative, semi-quantitative (risk matrix and indicator based) and quantitative (deterministic and probabilistic) methods.

The most suitable methodology should be chosen based on:

- purpose of the analysis (prioritization, planning, analysing the effect of changes, etc.)
- agreed level of detail;
- time spam of the assessment;
- agreed level of uncertainty;
- availability and reliability of information;
- existing models to produce these results;
- resources at hand (in terms of time, money, expertise, etc.) for the exercise.

**Qualitative risk assessment** is a description of risks based on expert evaluation. The qualitative approaches represent subjective risk perception and serve as a starting point for a discussion on assumptions and risk recognition in participation of wide variety of experts and stakeholders in the process (DRMKC, 2017). Qualitative analysis risks are typically used to determine if the further investigation is needed. Sometimes it is the only option when almost all components of risk are not quantifiable or have a very large degree of uncertainty. In order to facilitate replicability of qualitative approach, the processes need to be transparent and structured, so different experts can repeat the analysis.

**Semi-quantitative risk assessment** seeks to categorize risks by comparative scores (e.g., tolerable, intermediate, intolerable). They permit to classify risks based on expert knowledge with limited quantitative data, as a means to capture subjective opinion which makes it a good basis for discussing risk reduction measures.
Risk matrix is a mean to communicate the results of a semi-quantitative analysis. The risk matrix is made of classes of frequency of the hazardous events on one axis, and the consequences (or expected losses) on the other axis.

**Quantitative risk assessment** can evaluate potential impacts in two ways: deterministically or probabilistically.

- Deterministic risk assessment estimates impact from a single hypothetical risk scenario or combination of scenarios, but do not necessarily consider neither the probability of the events in quantitative terms, nor guarantee that all possible events are captured within a deterministic scenario set (JRC, 2021). The deterministic approach typically models scenarios, where the input values are known, and the outcome is observed.
- Probabilistic risk assessment simulates future disasters which, based on scientific evidence, are likely to occur. As a result, these risk assessments can be used when historical data are limited. Probabilistic models therefore complement historical records by reproducing the physics of large number of simulated events (PreventionWeb, n.d.). Accurate

quantitative approaches require scientific contribution and engagement between the science and practitioners (DRMKC, 2017).

None of the approaches are perfect. Risk assessment and associated modelling contain inherent uncertainty. It is important that the limitations of modelling are recognized, and inherent uncertainty is taken in account (DRMKC, 2017).

In this guideline, the semi-quantitative approach is suggested, through the use the risk matrix, which is a combination of two dimensions of risk, severity (impact) and likelihood (probability), which allows a simple visual comparison of different risks (DRMKC, 2017). The risk matrix is made of classes of likelihood of the hazardous events on one axis and the consequences (impacts) on the other axis: once the likelihood and potential overall impact are determined, the risk level can be assessed using the risk matrix.

In EU DRA Guideline (European Commission, 2010) an example of the risk matrix is provided (Figure 3). The risk level is coded by four colour scale: 1) low (green), 2) medium (yellow), 3) high (orange), and 4) very high (red).

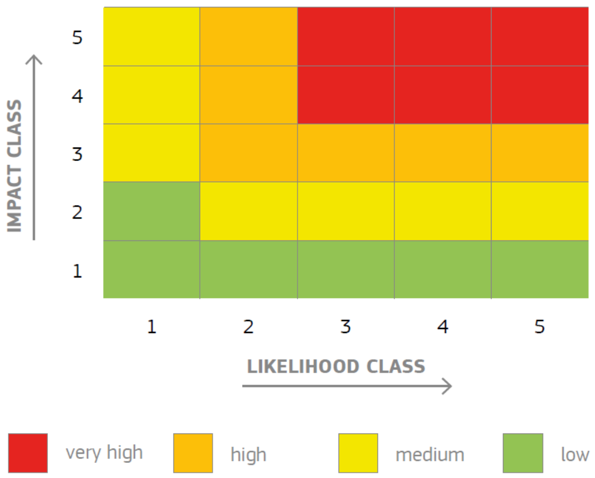



Figure 3. Example of risk matrix, EC Risk Assessment and Mapping Guidelines for Disaster Management, (European Commission, 2010)

## 1.5 Cross-cutting Issues in Disaster Risk Assessment

The Paris agreement and SDG both promote the protection of human rights, alongside with the need to pay particular attention climate change and environment protection. The Sendai Framework have a particular attention is paid on gender dimension of disaster risk, age categories, people with disabilities and low income. Since the impacts of disasters can affect different categories of persons in different way, pose a threat to the environment, and vary with climate change, the cross-cutting issues should be also considered during disaster risk assessment.

In the framework of the PPRD East 3 programme by the Swedish Civil Contingencies Agency (MSB) in 2021 the Practical Guidelines has been developed for integrating gender, human rights, and environmental issues in Disaster Risk Management. The purpose of the Guidelines is to support integration of the cross-cutting issues (CCIs) of gender, human rights, and environment in different Work packages of the programme, including the multi-risk assessment. More details can be found in the Practical Guidelines (Chapter 6, page 57) on the official website of the PPRD East 3[4] (Mathias Österdahl, Jenny Molin, 2021).

Below are provided quick points from the Practical Guidelines to include cross-cutting issues in Disaster Risk Assessment.

**Gender and human rights**

- ✓ Seek engagement of a broad representation of stakeholders and groups in the population in risk assessment processes and coordination mechanisms. This would include government, civil society organisation, research institutions, and private actors specialised in gender and human rights issues and women, girls, boys, men, youth, the elderly, people with disabilities and other minority groups in local communities.
- ✓ Ensure that collection of disaster risk, vulnerability, and loss data is disaggregated by sex, age, disability, income level, and other context-specific social factors. This to enable analysis of how different groups in the population experience, understand, and cope with disaster risks, vulnerability, and loss in different ways.
- ✓ Ensure that communication of risk information reaches all population groups. When carrying out community-based activities, ensure that feedback mechanisms are established through which women, girls, boys, and men of all ages, abilities and backgrounds can provide input on risk assessment activities and report complaints and misconduct, including sexual exploitation, abuse, and harassment.

**Environment**

- ✓ Include existing environmental conditions and threats in risk and vulnerability analyses. Existing environmental data, information, and assessments can provide important input in the risk assessment process. The inclusion and engagement of relevant environmental stakeholders also allows for a more holistic risk assessment.
- ✓ Ensure adaptability to and awareness of environmental drivers, such as climate change, in disaster risk assessments. Promote the importance of ecosystems and environmental values in the area of interest and analyse their role in people's lives and livelihoods.

[4] https://www.pprdeast3.eu/siteassets/practical-guidelines-for-integrating-gender-human-rights-and-environmental-issues-in-disaster-risk-management.pdf#page=7&zoom=100,0,0

- ✓ Build capacities and resources that include environmental perspectives in assessment, mapping, analysis, scenarios, and planning. Different capacities may be needed, e.g., assessment of the immediate and long-term impacts of disasters on environmental systems, climate change adaptation, environmental situation analysis, or the environmental footprint from humanitarian action. Training staff in the use of various environmental impact assessment tools strengthens disaster management capacity.

**Climate change and other environmental drivers of disasters**

- When analysing environmental conditions, risks, vulnerabilities and possible emergency response needs, it is important to reflect on how drivers like urbanisation and climate change affect ecosystems and ecosystem services in relation to human health, societal development, and livelihood.
- This requires an understanding of the risks associated with environmental systems as well as risks to the environment. One example is how degraded ecosystems can, in the long run, lead to clean water shortages, in turn affecting human health and livelihoods, especially during a disaster.
- Regarding climate change and its effect on risks, stakeholders like the national weather and hydrological agencies, environment ministry and/or academic institutions can provide knowledge and data about projected changes in weather patterns and other environmental parameters.
- Climate change adaptation may be needed for some projected risks, but also ensure the promotion and mainstreaming of environmental issues in disaster risk reduction work. Promoting nature-based solutions in DRR, where ecosystem services can provide solutions that are adaptive and mitigate risks, is a win-win!

# Chapter 2. NRA context

## 2.1 Scope and Purpose of the National Disaster Risk Assessment

The purpose of National Disaster Risk Assessment (NDRA) is to reach a common understanding of the risks occurring in a country. The outcome of risk assessment informs Disaster Risk Management (DRM) measures and facilitates stakeholders to know the relative importance of the risks and identify risks to prioritize action for (JRC, 2021). The NDRA reveals the most priority risks considering most exposed, most vulnerable, and most important assets, doing the assessment through different sector and different hazards.

The NDRA is the first step towards developing strategies, programmatic priorities and providing information for rapid disaster risk reduction. The results of risk analysis and assessment provide the main guideline for the development of national governance and planning of DRM, policy development and resource allocation for disaster risk reduction. The results of the risk analysis and assessment can help in development of synergies between different sectors such as health, education, infrastructure, social services, and emergency services.

For that purpose, NDRA should be multi-hazard and multi-sectorial process where assets or sectors are predefined due to importance they have for the security and well-being of society.

In accordance with the JRC Recommendations (JRC, 2021), the objectives of a NDRA are defined for obtaining the information that could be used in Disaster Risk Management (DRM) planning:

- assess levels and related probabilities of identified risks;
- understand the relations between risk and risk drivers and capacities to act upon;
- prioritize risks arising from different hazards, different regions, different assets.

## 2.2 Governance Model

In order to conduct the comprehensive process of National Disaster Risk Assessment, considering its multi-disciplinary nature, the information and knowledge from many parties such as ministries, agencies, academia and communities is required. The key role is also played by the current legislation in the field of civil protection, according to which state bodies and local governments should have all the necessary powers to conduct risk assessments at the national and local levels.

Disaster risk governance model in National Disaster Risk Assessment Guidelines (UNISDR, 2017) is defined as 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. Good governance recommended to be transparent, inclusive, collective, and flexible to reduce existing risks and avoid creating new ones.

The functioning of the governance mechanism depends largely on the political endorsement of the national disaster risk assessment. Ideally, this political endorsement should be further formalized by regulation defining the roles and responsibilities of the various institutions and the decision-making process regarding the results of the evaluation (UNISDR, 2017).

The main goals of the governance model of NDRA are to create a working environment based on the unified methods, develop harmonized results, and take care of the communication to stakeholders, authorities and public.

The governance structure requires (JRC, 2021):

- A robust and flexible governance model of NDRA in which one authority has the mandate to coordinate all parties.
- Political legitimacy or mandate: policies and a legal framework are necessary.
- Involved actors: governmental bodies including line ministries; civil defense; the private sector; civil society; the scientific community and the public.
- Adequate resources for NDRA development.

The Disaster Risk Assessment (DRA) process, including the interinstitutional responsibilities, should be defined in the legislation that lays the ground for the NDRA methodology. The NDRA methodology should be explicitly referred to in the main legislation.

## 2.3 Creation of National DRA Working Group and Stakeholders Identification

The governance model of NDRA should consist of one main DRA working group at national level authorized to coordinate all other working groups responsible for different types of natural and technogenic hazards (JRC, 2021)

The working group responsible for a specific hazard type during the risk assessment process should have a support from all stakeholders and involved sectors related to this hazard. The composition of the working group should include data providers, end-users, and all technical support. In Table 1 an example of composition of the working group and roles of involved parties is presented.

Table 1. Example of the Working group for each specific identified hazard, involving coordinating and participating institutions

| Institution | Role |
| --- | --- |
| **Civil protection authority or Sectoral** | Coordinator, information provider, end-user |

| Institution | Role |
|---|---|
| **Ministry or Scientific institution** | |
| **Sectoral ministry** | Technical consultant, information provider |
| **Scientific institution** | Technical consultant, information provider |
| **Governmental agency** | Technical consultant, information provider |
| **Other related organisations** | Information provider |

In National Disaster Risk Assessment Guidelines (UNISDR, 2017) the list of stakeholders which could be invited in NDRA governance structure is provided. The following is a non-exhaustive list of national entities (or equivalents) that could be considered for involvement in the process of the risks assessment:

- 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 to customize the communications and interactions accordingly (UNISDR, 2017). 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 DRA.

Some administrative or process-related agreements must be prepared and respected throughout the whole working process, which in some cases may already be enshrined in legal bases or operational procedures, among which are:

- Agency responsibilities for holding and maintaining background data and results after the completion of the intermediate processes and for the next rounds of the assessment, including privacy and security settings.
- The package of deliverables to be prepared by each party (e.g. geospatial products and maps, policy briefs, scientific research reports).
- 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).
- Budget and duration of the elaboration of NDRA.

## 2.4 Criteria for the risk classification

When performing a semiquantitative risk assessment using a risk matrix, the criteria for classifying risks should be established at the national level to ensure comparability across various hazards. This involves defining the two components of risk: impact and likelihood levels.

The selection of criteria for impact and likelihood classes is primarily a political decision, reflecting the country's risk tolerance. For instance, one country might classify a human impact of 10 fatalities as "minor," while another country might consider any fatalities as unacceptable. Impact classes are defined for each type of impact and are derived from specific impact criteria. For likelihood levels, it is recommended to carefully choose a scale that can effectively address both intensive and extensive disaster risks. Furthermore, the number of classes depends on the anticipated uncertainties, mainly arising from different risk assessment methodologies: the greater the uncertainties, the fewer the number of classes introduced.

Once the impact and likelihood classes are established, the risk level should be determined by mapping the combinations of these classes in a matrix.

### 2.4.1 Impact criteria

The losses and impacts resulting from disasters are typically influenced by the exposure and vulnerability of affected people and locations, as well as the severity of the hazardous event. 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 definition of loss, damage and impact are provided by JRC (JRC, 2013):

- **Impacts** of a disaster are the broadest term, including positive and negative effects of the disasters though the impacts of disasters are predominantly undesirable. Furthermore, it includes market-based impacts (destruction of property and a reduction in income) and non-market effects (environmental consequences and psychological effects suffered by individuals).
- **Losses** of a disaster represent market-based negative economic impact. These consist of direct losses that result from the physical destruction of buildings, crops, and natural resources and indirect costs that represent the consequences of that destruction, such as business interruption.
- **Damages** caused by natural events refer to physical destruction, measured by physical indicators, such as number of killed, number of buildings in each damage class. When valued in monetary unit, damages become direct losses.

The losses can be **direct** and **indirect, quantifiable** and **non-quantifiable**, and represent market-based negative economic impact of a disaster (JRC, 2015).

- **Direct losses** are those that occur immediately as a direct consequence of an event or disaster. These losses include tangible and immediate impacts such as the physical damage to buildings, infrastructure, and personal property. For example, a hurricane might cause significant structural damage to homes, necessitating costly repairs or complete rebuilds. Additionally, direct losses encompass immediate human impacts, including injuries and fatalities, as well as immediate environmental damage, like the destruction of a natural habitat. These losses are the first to be assessed in the aftermath of an incident as they directly result from the event itself.
- **Indirect losses** are the secondary effects that follow the initial impact of an event, often manifesting over a longer period. These losses are not caused directly by the event but are consequences of the direct losses. For instance, a business might suffer indirect losses due to the interruption of operations caused by damage to its facilities, leading to a loss of revenue. Similarly, a community might experience a decline in property values due to the perceived risk of future disasters. Indirect losses also include long-term impacts on the local economy, such as reduced tourism in a region recovering from a natural disaster. These losses, while less immediate, can have a profound and lasting effect on individuals and communities.

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 (UNISDR, 2017).

- **Quantifiable losses** are those that can be measured and expressed in monetary terms. These include both direct and indirect losses that can be easily calculated, such as the cost of repairing damaged infrastructure, medical expenses for treating injuries, and lost income due to business interruptions. For example, after a flood, the cost of repairing a damaged home and replacing lost inventory in a store are quantifiable losses. These losses are typically the focus of insurance claims and financial aid because their economic value can be accurately assessed and compensated.
- **Non-quantifiable losses** are those that cannot be easily measured or expressed in monetary terms. These include intangible impacts such as emotional distress, loss of life, and cultural or environmental damage. For instance, the trauma experienced by survivors of a natural disaster, the long-term psychological effects on a community, and the loss of cultural heritage sites are all non-quantifiable losses. These types of losses are significant and deeply affect individuals and communities, yet they resist simple financial valuation. Addressing non-quantifiable losses often requires supportive and psychological interventions rather than monetary compensation.

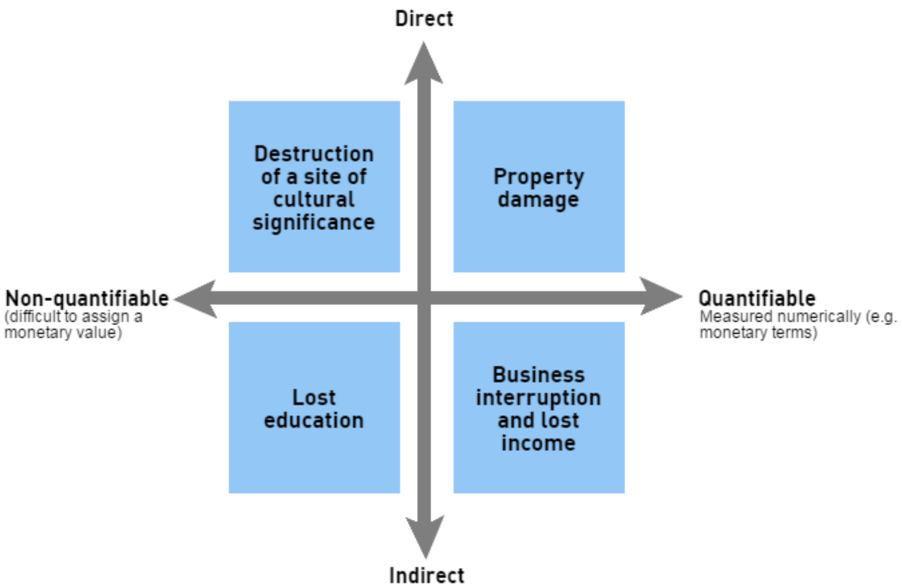



Figure 4. Visual representation of direct/indirect and quantifiable/non-quantifiable losses. Image source (PreventionWeb, n.d.)

The following impact categories for NDRA considered by (European Commission, 2010), (JRC, 2021) and (UNISDR, 2017) are joined into main four groups to be protected at national level Humal impact, Economic impact, Political and social impact, and Environmental impact:

- **Human impact:** Number of people affected (health and safety) – including deaths, severely injured or illness, displaced people due to loss of home or livelihoods. Human impact should be measured in number of affected people (European Commission, 2010).
- **Economic impact:** The sum of the costs of cure or healthcare, cost of immediate or longer-term emergency measures, costs of restoration of buildings, public transport systems and infrastructure, property, cultural heritage, etc., costs of environmental restoration and other environmental costs (or environmental damage), costs of disruption of economic activity, value of insurance pay-outs, indirect costs on the economy, indirect social costs, and other direct and indirect costs, as relevant, measured in local currency or in relation to percentage of GDP (European Commission, 2010).
- **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". Political and social impact can be measured where possible in a local currency or in relation to percentage of GDP[5], percentage of GNI[6] or using a semi-quantitative scale comprising a number of classes, e.g. (1) limited/ insignificant, (2) minor/ substantial, (3) moderate/serious, (4) significant/ very serious, (5) catastrophic/ disastrous. To make the classification of such latter impacts measurable the classes must be based on objective sets of criteria (European Commission, 2010).
- **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. Environmental impacts should wherever possible be quantified in economic terms but may also be included in non-quantified terms, for example, Ha of area, percentage of a damaged territory, or duration of a disaster (European Commission, 2010).

Each category of impacts may be additionally disaggregated by **impact indicators**. Below suggestion of indicators are provided in accordance with the Sendai Framework indicators (UNISDR, 2017) and best practice of EU Member States

[5] Gross domestic product
[6] Gross national income

NDRAs. More on the loss assessment methodology for each indicator can be found in the Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction (UNISDR, 2017). Other or additional indicators may be discussed by the Working group on the base of the specificity of the Country.

**I. Human impact (health and safety)**

- Number of deaths and missing [Sendai indicators A2 and A3] - number of people who died or are presumed dead during the disaster, or directly after, as a direct result of the hazardous event.
- Number of affected people [Sendai indicator B1] – includes the indicators B2 – B5.
- Number of severely injured/ill people [Sendai indicator B2] - people suffering from a new or exacerbated physical or psychological harm, trauma or an illness as result of a disaster.
- Number of people whose dwellings may be damaged or destroyed [Sendai indicators B3 and B4] – affected housing for living with dignity.
- Number of people whose livelihoods may be disrupted or destroyed [Sendai indicator B5] – affected capacities, productive assets and activities required for securing a means of living, on a sustainable basis, with dignity.
- Number of evacuated people - persons who have to evacuate a hazardous location in response to the immediate threat or impact of a disaster, either through their own initiative and resources (self-evacuated) or through the direction and assistance of authorities and/or emergency responders. The number is relevant for the disruption of the society but also the need for facilities to evacuees.

**II. Economic impact**

- Direct economic loss [Sendai indicators C1] – includes the indicators C2 – C6.
- Loss in agricultural sector [Sendai indicator C2] – includes crops, livestock, fisheries, aquaculture, and forest sectors, as well as associated facilities and infrastructure.
- Loss to all other damaged or destroyed productive assets [Sendai indicator C3] – considers the other activities relevant to country's economies.
- Loss in the housing sector [Sendai indicator C4] – includes replacement cost of damaged and destroyed dwellings.
- Loss resulting from damaged or destroyed critical infrastructure [Sendai indicator C5] – considers replacement cost of damaged and destroyed assets of critical infrastructure (healthcare and public health sector, education sector, energy sector, transportation system sector, ICT sector, sewerage sector, waste management sector, government facilities, emergency services, protective infrastructure, green infrastructure).

- Loss to cultural heritage damaged or destroyed [Sendai indicator C6] – cost of rehabilitating, recovering, or restoring damaged assets to a standard like pre-disaster condition of buildings, monuments and fixed infrastructure of cultural heritage assets; real estate market value for destroyed non-movable assets; cost of rehabilitation or restoring, or market value of destroyed or totally lost for movable cultural heritage. Cultural heritage includes buildings, monuments and fixed assets, movable art objects, historical artefacts damaged or destroyed attributed to disasters.
- Cost of coping – includes the resources used by people, organizations and systems to manage adverse event (e.g. relief operations; interventions and potential international assistance, amount of insurance payments).

**III. Political and social impact**

- Damage to critical infrastructure [Sendai indicator D1] – includes the indicators D2 – D4.
- Number of destroyed or damaged health facilities [Sendai indicator D2].
- Number of destroyed or damaged educational facilities [Sendai indicator D3].
- Number of other destroyed or damaged critical infrastructure units and facilities [Sendai indicator D4] – includes energy sector, transportation system sector, ICT sector, sewerage sector, waste management sector, government facilities, emergency services, protective infrastructure, green infrastructure.
- Number of disruptions to basic services [Sendai indicator D5] – includes the indicators D6 – D8.
- Number of disruptions to educational services [Sendai indicator D6].
- Number of disruptions to health services [Sendai indicator D7].
- Number of disruptions to other basic services [Sendai indicator D8] - includes water services, sewerage, transportation system, government services, power and energy, emergency services, communications/ICT services, solid waste services. By the Sendai Framework disrupted means one or a combination of the following: Provision of the service was partially or totally interrupted one or more times as consequence of the disaster; Level of quality of the service was degraded; Coverage of the service was reduced. In the Technical Guidance (UNISDR, 2017) the emphasis is made in the fact that a "disruption" includes interruptions, either single or multiple, short or long, of the services, damage to the facilities or networks that provide the service, or a measurable/noticeable reduction in the quality of the service, or reduction in the population covered by the service, or a combination of all the above. Under this schema, if during a disaster, and/or as a consequence of that disaster any

of the above situations happen to a given service it would count as one disruption of a service. In other words, a service can be disrupted once per disaster, and several services can be disrupted during a disaster. Cascading disruptions of services (for example when the interruption of electricity causes disruption of health services) can also be taken into account as they can be attributed to disasters.

- Loss to cultural properties - qualitative according to significance grouped in classes.
- Diminished public order and domestic insecurity – considering the number of days or through qualitative estimation.
- Impairment of territorial integrity - considering the number of days or through qualitative estimation.

**IV. Environmental impact**

- Destroyed or damaged nature and environment, basing on the NDRA practice of different countries may be measured in damaged area, duration of impact, percent of damage, etc.

After selecting the indicators for each category of impact, the **impact thresholds** on the indicators' value for the attribution of the severity class should be determined. Basing on the best practice of various EU Member States, a set of thresholds are presented as a starting proposal, to be discussed and fine-tuned at the level of each PPRD East3 Partner country, depending on its context and priorities. The same threshold values for the categories of impact should be applied for the characterization of all the scenarios in the NDRA. The threshold value for all impact indicators and its unit of measurement should be discussed and determined by the working group before the NDRA development, considering country's current practice in disaster loss assessment and country priorities.

The impact indicators and thresholds of National Disaster Risks Assessments of Slovenia, Croatia, Estonia, Sweden and Republic of Turkey are provided in Annex 1.

**I. Human impact (health and safety)**

The threshold values here proposed for the indicators of consequences of an event on human life and health come from other national risk assessment guidelines. In the Table 2 the range of values related to affected people basing on NDRA methodologies of:

- Slovenia, National Coordination Body for Disaster Risk Assessment within Administration of the Republic of Slovenia for Civil Protection and Disaster Relief by Ministry of Defence, (ACPDR, 2016).

- Estonia, Ministry of the Interior (Ministry of the Interior of Estonia, 2020).
- Turkey, Disaster and Emergency Management Agency AFAD (EU and AFAD, 2018)
- Croatia, Croatian Platform for DRR (Main WG Croatian Platform for Disaster Risk Reduction, 2019) are reported.

Table 2. Thresholds values for human life and health – example 1

| Category | Number of deaths | Number of severely injured/ill people | Number of evacuated people | Number of people whose livelihoods may be disrupted or destroyed |
|---|---|---|---|---|
| **Insignificant** | Less than 5 | Less than 15 | Less than 50 | Less than 500 |
| **Small** | 5 – 15 | 15 – 45 | 50 – 200 | 500 – 5000 |
| **Moderate** | 15– 50 | 45 – 150 | 200 – 500 | 5000 – 10.000 |
| **Significant** | 50 – 200 | 150 – 600 | 500 – 2000 | 10.000 – 50.000 |
| **Catastrophic** | More than 200 | More than 600 | More than 2000 | More than 50.000 |

The Table 3 shows the thresholds value implemented in NDRA guidelines of Australia (Australian Institute for Disaster Resilience, 2020), the Netherlands (ANV, 2019), and Sweden (MSB, 2016).

Table 3. Thresholds values for human life and health – example 2

| **Physical safety** | | | | |
|---|---|---|---|---|
| limited | significant | severe | very severe | catastrophic |
| **1.1 Fatalities** | | | | |
| ≤5 deaths | >5 deaths<br>≤10 deaths | >10 deaths<br>≤20 deaths | >20 deaths<br>≤50 deaths | >50 deaths |
| **1.2 Severely injured** | | | | |
| ≤10 persons | >10 persons<br>≤20 persons | >20 persons<br>≤50 persons | >50 persons<br>≤100 persons | >100 |
| **1.3 Lack of fulfilment basic needs** | | | | |
| <1000 people weeks | >1000 people weeks<br>≤10,000 people weeks | >10,000 people weeks<br>≤100,000 people weeks | >100,000 people weeks<br>≤1,000,000 people weeks | >1,000,000 people weeks |
| **1.4 Evacuees** | | | | |
| ≤50 persons | >50 persons<br>≤100 persons | >100 persons<br>≤1,000 persons | >1,000 persons<br>≤10,000 persons | >10,000 |

## II. Economic impact:

The consequences for economy have indirect effects on the well-being of the population on the mid and long term. Economic loss is classified by quantitative threshold. The units of measure of the economic loss usually are percentage of GDP, percentage of GNI, minimum wage, conventional units, U.S. dollars, national currency etc.

The Table 4 shows the threshold values of the classification defined in NDRA of Estonia, Slovenia, and Croatia. As reference, the Table 5 compares the GNI of those countries with the ones of the PPRD East3 Partner Countries.

Table 4. Thresholds of Economic impact in millions of Euro of NDRA Estonia, Slovenia, and Croatia

| Category | ESTONIA [million EUR] | SLOVENIA [million EUR] | CROATIA [million EUR] |
|---|---|---|---|
| **Insignificant** | < 1 | up to 100 | up to 30 |
| **Small** | 1 - 10 | 100 - 200 | 30 - 90 |
| **Moderate** | 11 - 50 | 200 - 400 | 90 - 200 |
| **Significant** | 51 - 100 | 400 - 900 | 200 - 900 |
| **Catastrophic** | > 100 | more than 900 | more than 900 |

Table 5. GNI in millions USD in 2020 of the countries of the comparison, data source https://data.worldbank.org/indicator/NY.GNP.MKTP.CD

| COUNTRY | GNI 2020, in million USD |
|---|---|
| **Estonia** | 30 370 |
| **Slovenia** | 53 |
| **Croatia** | 58 550 |
| **Armenia** | 12 450 |
| **Azerbaijan** | 42 420 |
| **Georgia** | 15 100 |
| **Moldova** | 12 250 |
| **Ukraine** | 160 040 |

Some EU Member States to evaluate economic impacts set the threshold values in accordance with the rules of European Union Solidarity Fund (EUSF)[7]. The EUSF defines the financial assistance to EU countries facing major natural disasters. As a general rule, the EUSF can provide financial aid if total direct damage caused by a disaster exceeds €3 billion (at 2011 prices) or 0.6% of an EU country's Gross National Income (GNI), whichever is lower.

Table 6. Thresholds of Economic impact – example 2

| Category | Total economic impact, GNI % |
|---|---|
| **Insignificant** | up to 0.3 % |
| **Small** | 0.3 %–0.6 % |
| **Moderate** | 0.6 %–1.2 % |
| **Significant** | 1.2 %–2.4 % |
| **Catastrophic** | more than 2.4 % |

In the Turkish Risk Assessment (see Table 7), the economic consequence is expressed in a percentage of the Gross National Product (GNP). In 2016 the

[7] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002R2012&from=EN

GNP of Turkey was 2,581 billion US dollars. Catastrophic for the Turkish economy is considered a loss of more than 100 billion US dollars or more than 4% of the GNP. In this case the Turkish economy will have back drop and recovery will take several decades. Poverty will rise dramatically, and critical financing is not possible.

Table 7. Thresholds of Economic impact – example 3

| **Economic and environmental loss** | | | | |
|---|---|---|---|---|
| limited | significant | severe | very severe | catastrophic |
| **2.1 Economic loss** | | | | |
| ≤0.004% GNP | >0.004% GNP<br>≤0.04 % GNP | >0.04% GNP<br>≤0.4% GNP | >0.4% GNP<br>≤4% GNP | > 4 % GNP |

## III. Political and social impact

The selected indicators and the relative threshold values should consider the way society as a whole is affected. The evaluation could be quantitative or qualitative.

In case of quantitative evaluation, the units of measurement of political and social impact may be duration in days of the disruption, number of damaged assets or percentage of the destroyed/damaged infrastructures out of the total. An example of thresholds for disaggregation for damage to critical infrastructure and disruptions is presented in the Table 8, based on the practice of NDRA of Slovenia.

The Table 9 shows a qualitative classification on the indicators of the political/social impact. The disruption of every day's life is when the participation in the normal social existence is hindered. This happens when:

- no education can be followed;
- people are not able to go to work;
- there is reduced accessibility due to blockades on highways and cancellation of public transport services;
- people are not able to make necessary purchases;
- there is reduced virtual/social accessibility due to loss of the internet (e-mail correspondence), telecommunication (TV, telephone, etc.);
- people are not able to use the social provisions of sport, culture or healthcare.

Regarding the loss of cultural heritage, the assessment of the impact could be based on the importance of the sites and objects and whether the damage is reversible or not.
The reputational loss could be based on a qualitative evaluation by expert, regarding how the other governments, citizens and companies perceive the Country.

Table 8. Thresholds of damage to critical infrastructure – example 1

| Category | Number of destroyed or damaged health and educational facilities | Number of other destroyed or damaged critical infrastructure units and facilities | Number of disruptions to basic services |
|---|---|---|---|
| **Insignificant** | 0 - 1 | 0 - 1 | up to 2 days |
| **Small** | 2 – 3 | 2 – 3 | up to 7 days |
| **Moderate** | 4 – 5 | 4 – 5 | Up to 15 days |
| **Significant** | 6 – 7 | 6 – 7 | Up to 30 days |
| **Catastrophic** | More than 8 | More than 8 | More than 30 days |

Table 9. Thresholds of damage to critical infrastructure – example 2

| **Society's functionality** | | | | |
|---|---|---|---|---|
| limited | significant | severe | very severe | catastrophic |
| **3.1 Disruption of every day's life (for a significant part of the society)[2]** | | | | |
| No access to education, work, social networks, health care for more than one day | No access to education, work, social networks, health care for more than a week | No access to education, work, social networks, health care for more than two weeks | No access to education, work, social networks, health care for more than a month | No access to education, work, social networks, health care for more than three months |
| **3.2 Loss of cultural heritage[3]** | | | | |
| Damage to sites and objects of local importance | Minor damage of iconic and world heritage sites and objects.<br>Severe damage of sites or objects of local or sectoral importance | Severe damage to iconic and world heritage sites and objects.<br>Loss beyond recovery of sites or objects of local or sectoral importance | Loss beyond recovery of sites or objects perceived as iconic for Turkish identity | Loss beyond recovery of sites or objects listed as World heritage |
| **3.3 Loss of reputation** | | | | |
| Limited | Significant | Severe | Very severe | Catastrophic |

## V. Environmental impact

The consequences for environment have indirect effects on the well-being of the population on the mid and long term.

The loss for the environment could be express qualitatively (Table 10), based on the possibility of the ecosystem to recover to the pre-emergency condition. The ecosystems subjected to the assessment are those on which a significant part of the population / economy is depending.

In case of quantitative evaluation (Table 11), the units of measurement of damage to assets may be Ha, %, duration in days, number of damaged objects etc.

Table 10. Thresholds of environmental loss – example 1

| Economic and environmental loss | | | | |
|---|---|---|---|---|
| limited | significant | severe | very severe | catastrophic |
| **2.2 Environmental loss** | | | | |
| the ecosystem or species is able to recover fully, with minimal or no intervention | the ecosystem or species requires a diversion of resources to manage their recovery from damage | the ecosystem or species requires a major program of interventions and recovery to restore it to health | the pre-emergency condition has been lost. Although some degree of restoration may be possible | the pre-emergency condition cannot be restored |

Table 11. Thresholds of environmental loss – example 2

| Category | Destroyed or damaged nature and environment, area in Ha | Destroyed or damaged nature and environment, duration in months |
|---|---|---|
| **Insignificant** | Less than 100 | <1 month |
| **Small** | 100 - 1000 | 1 – 6 months |
| **Moderate** | 1000 – 10.000 | 6 – 12 months |
| **Significant** | 10.000 – 100.000 | 12 – 36 months |
| **Catastrophic** | More than 100.000 | More than 36 months |

### 2.4.2 Likelihood criteria

Risk likelihood, or probability, is the possibility of a risk event occurring. The likelihood can be expressed in both a qualitative and quantitative format.
When measuring probability in a qualitative manner, terms such as low, medium, high etc. are used. It is also possible to describe the probability quantitatively.
The process of assessment of likelihood or probability that hazards might occur includes history, modelling, experience, archives memory, science, experimentation, and testing.
In practice, events with a very, very low probability (e.g., meteor strike) are ignored, focusing on ones more likely to occur and can be either prevented, managed, or mitigated (DRMKC, 2017).
As stated by EU DRA Guidelines (European Commission, 2010) quantitative probabilities should be estimated for each scenario, at the stage of risk analysis, using statistical procedure (e.g., using Bayesian methods) which utilizes prior distribution data to assess the probability of a result.
Probability can be measured using return period of events in years and/or frequency in percentages expression. The annual probability of exceeding a loss characterized by a 100-year return period is 1%, which is the inverse of the return period (1/100*100%) (PreventionWeb, n.d.).
The Annex 2 provides examples of probability categories for the NDRAs of Estonia, Croatia, Slovenia, Republic of Turkey, and Sweden.

Basing on the EU Member States NDRAs, a proposal for the classification of the probability and frequency of the risk is provided in Table 12.

Table 12. Risk scenario's probability and frequency classification proposal

| Category | Probability, % yearly | Frequency |
|---|---|---|
| **Very low** | < 1 % | 1 event in 100 years and less |
| **Low** | 1 - 5 % | 1 event in 20 to 100 years |
| **Medium** | 5 - 50 % | 1 event in 2 to 20 years |
| **High** | 51- 98 % | 1 event in 1 to 2 years |
| **Very high** | > 98 % | 1 event per year or more often |

## 2.4.3 Risk criteria

A risk matrix is a tool used to evaluate and categorize risks based on their likelihood and impact. The matrix typically uses a four-color scale to represent different levels of risk, each with specific implications for risk acceptance and management measures.

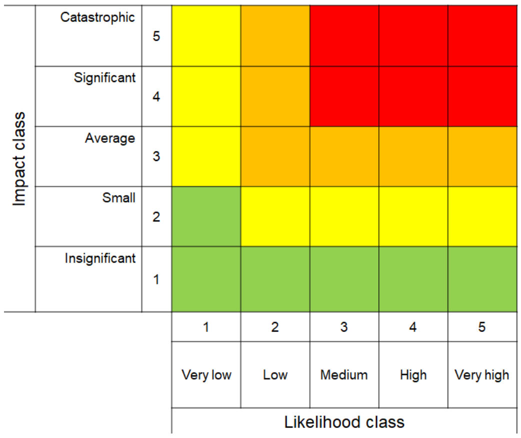



Figure 5. Example of risk matrix with disaggregation into risk levels

The significance of each level is explained in the table and provides the meaning in terms of risk acceptance and necessity of measures for risk management.

| | | |
|---|---|---|
| **Very high (red)** | 4 | Risk cannot be accepted, except in exceptional situations |
| **High (orange)** | 3 | Risk can be accepted if the reduction is impractical or the costs far outweigh the profits |
| **Medium (yellow)** | 2 | Risk can be accepted if costs exceed profits |
| **Low (green)** | 1 | No additional measures are required other than the usual ones |

In defining the risk criteria, it is essential to determine the combinations of likelihood and impact classes that correspond to each risk level in the matrix. The matrix typically uses a grid format, where the rows represent different likelihood classes and the columns represent different impact classes. Each cell in the matrix reflects a specific risk level based on the intersection of these classes, color-coded as green, yellow, orange, or red.

By carefully defining these combinations, organizations can systematically assess and categorize risks, ensuring that appropriate measures are taken to manage them according to their severity and likelihood.

## 2.5 Risk information and data protection

The risk identification and risk analysis requires the collection of different information. Baseline information includes:

- **General documentation on the characteristics of the territory** for which the disaster risk assessment will be carried out, including a description of geographical data (relief, water resources, land cover, vegetation, etc.), climatic characteristics, demographic data (considering gender composition, age composition, people with disability and low income).
- **Information on past disaster losses**, with a brief description of places and dates of the latest occurrences, frequency of occurrence, description of impacts. 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 (UNISDR, 2017).
- **Disaster risk information** already available in the country (on hazard and disaster risk). This might be extracted from lessons learnt, past risk assessment efforts, regional or international efforts related to risk profiling (UNISDR, 2017).
- **Geospatial data**, such as land cover/land use, hazard maps, exposure maps, etc. available on possible disaster risks.

National Disaster Risk Assessment Guidelines (UNISDR, 2017) recommends that the leading agency (coordinator) collects all the available risk information and use it for discussions on scoping, in collaboration with the various data holders (also on the science/policy interface).

When conducting disaster risk assessments, data protection is a critical consideration to ensure the privacy and security of sensitive information. This involves implementing robust measures to safeguard personal data, geospatial information, and other critical datasets from unauthorized access, misuse, and breaches. Data should be anonymized where possible to protect individual identities, and access should be restricted to authorized personnel only. Secure data storage solutions and encrypted communication channels are essential to prevent data leakage during the collection, analysis, and sharing processes. Compliance with relevant data protection regulations, such as GDPR or other local privacy laws, is mandatory to ensure ethical and legal handling of data. By prioritizing data protection, organizations can build trust with stakeholders, ensure the integrity of their risk assessments, and protect the privacy rights of affected individuals and communities.

# Chapter 3. Risk Identification

## 3.1 Hazards Identification at National Level

Identifying hazards 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 (UNISDR, 2017):

- Existing hazard data (e.g., historical loss data, archives);
- 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.

Before the detailed risk analysis and the data collection starts, a process on choose of priority disaster risks should be conducted. As the first step a National DRA Working group discusses and identifies all priority hazards that could significantly affect a country or cause serious damage, which will undergo a more detailed analysis as part of the NDRA. As official data sources can be existing disaster archives, disaster loss databases, national emergency classifiers, catalogues, guides, and other relative documents.

The UNDRR/ISC Sendai Hazard Definition and Classification Review Technical Report (UNDRR, 2020) provides a common set of hazard definitions and a hazard list, which could be used to actively engage policymakers and scientists in evidence-based national risk assessment processes, in case a classification is not already adopted at country level.

The hazard list compiled in this report is open-ended: the experts from different sectors could modify the classification and the list according to the use and the specificity of each country. For example, an acid rain could be a meteorological/ hydrological precipitation-related hazard, while in some context it can also be caused by volcanic emissions. The list should be regularly reviewed and updated, to help the countries investigate the potential sources of risk in their context. Furthermore, the direct and indirect linkages and effects of natural, biological, technological, and other human-induced hazards should be investigated to identify better cascading and multi-risk scenarios.

The proposed by UNDRR hazard list is based on the IRDR Peril Classification and Hazard Glossary (IRDR, 2014) and represent 302 specific hazards in a grouped cluster structure:

- **Meteorological and Hydrological** - resulting from the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources. Examples are tropical cyclones, floods, drought, heatwaves, and coastal storm surges. Hydrometeorological conditions may also be a factor in other hazards such as landslides, wildland fires, locust plagues, epidemics and in the transport and dispersal of toxic substances and volcanic eruption material.
- **Extra-terrestrial** - originating outside the Earth, such as asteroid and meteorite impacts or solar flares; they pass near earth, enter the Earth's atmosphere, and/or strike the Earth, or changes in inter planetary conditions that effect the Earth's magnetosphere, ionosphere, and thermosphere.
- **Geo-hazard** - originating from internal earth processes. This term is used interchangeably with the term geological hazard. Examples are earthquakes, volcanic activity and emissions, and related geophysical processes such as mass movements, landslides, rockslides, surface collapses and debris or mud flows. Hydrometeorological factors are important contributors to some of these processes.
- **Environmental** - arise through degradation of the natural systems and ecosystem services (including air, water, land, biodiversity) upon which humanity depends. However, many of the processes and phenomena that fall into this category may be termed drivers of hazard and risk rather than hazards in themselves, such as soil degradation, deforestation, loss of biodiversity, salinization, and sea-level rise.
- **Biological** - cover a range of hazards of organic origin or conveyed by biological vectors, and including pathogenic microorganisms, and toxins and bioactive substances that occur naturally or are deliberately or unintentionally released, which can affect people and animals at the population level, as well as plants, crops, livestock, and endangered fauna and flora. Examples are bacteria, viruses, or parasites, as well as venomous wildlife and insects, poisonous plants and mosquitoes carrying disease-causing agents.
- **Technological** - originate from technological or industrial conditions, dangerous procedures, infrastructure failures or specific human activities. Examples include industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event.

- **Societal** - brought about entirely or predominantly by human activities and choices; derived from socio-political, economic activity, cultural activity and human mobility and the use of technology, but also of societal behaviour – either intentional or unintentional.

Table 13. UNDRR classification, 2020 (UNDRR, 2020)

| Hazard type | Hazard cluster | Example of Specific hazard |
|---|---|---|
| **METEOROLOGICAL and HYDROLOGICAL [60]** | Convective-related | Thunderstorm |
| | Flood | Flash flood |
| | Lithometeors | Dust storm or Sandstorm |
| | Marine | eStorm tides; tsunami |
| | Pressure-related | Depression or cyclone (low pressure area) |
| | Precipitation-related | Drought; Ice storm |
| **EXTRATERRESTRIAL [9]** | Extraterrestrial | UV radiation, Meteor impact |
| **GEOHAZARD [35]** | Seismogenic (earthquakes) | Earthquake; Tsunami (earthquake trigger); Landslide or debris flow (earthquake trigger) |
| | Volcanogenic (volcanoes and geothermal) | Lava flow; Landslide (volcanic trigger) |
| | Shallow geohazard | Sinkhole; Liquefaction (groundwater trigger) |
| **ENVIRONMENTAL [24]** | Environmental degradation | Air pollution (outdoor / chronic) - poor air quality; Desertification; Salinity; Sea-level rise |
| | Environmental degradation (Forestry) | Deforestation; Wildfires |
| **CHEMICAL [25]** | Gases | Carbon monoxide |
| | Heavy metals | Arsenic |
| | Food safety | Levels of contaminants in food and feed |
| | Persistent organic pollutants (POPs) | Pesticides - highly hazardous; Microplastics |
| | Hydrocarbons | Oil pollution |
| | CBRNE | Chemical agents |
| | Other chemical hazards and toxins | Asbestos |
| | Aquaculture | Marine toxins |
| **BIOLOGICAL [88]** | Aquaculture | Algal bloom |
| | Insect Infestation | Locust |
| | Invasive species | Invasive weeds |
| | Human-Animal interaction | Human-Animal conflict/interaction |
| | CBRNE | Biological agents |
| | Mental health | Suicide cluster |
| | Food safety | Foodborne microbial hazards (including human enteric virus and foodborne parasite) |
| | Infectious diseases (plant) | Bacterial plant disease |
| | Infectious diseases (human and animal) | Anthrax; Waterborne diseases; COVID-19 (SARS-CoV-2) (human) |
| | Infectious diseases (aquaculture) | Shrimp disease (viral) |
| **TECHNOLOGICAL [53]** | Radiation | Radioactive waste |
| | CBRNE | Nuclear agents; Explosive agents |
| | Construction/ Structural failure | Building collapse; Dam failure |
| | Cyber hazard | Data breach; Privacy and data security for citizens |

| | | |
|---|---|---|
| | Industrial failure / Non-compliance | Contamination; Mining hazards |
| | Waste | Solid waste |
| | Flood | Drain and sewer flooding |
| | Transportation | Rail accident |
| **SOCIETAL (8)** | Conflict | International armed conflict;<br>Civil unrest |
| | Post-conflict | Explosive remnants of war (ERW) |
| | Behavioural | Violence |
| | Economic | Financial shock |

The hazards selection could be based on:

- events that have led, at least once, to a disaster or emergency in the country
- major loss events in other countries that could happen in the country
- events that could lead potentially to a disaster or emergency situation

The list of selected for NDRA hazards should be discussed within the national Working group. At the first stage, the most complete hazards list should be developed, which, in the process of prioritization, should be analysed and discussed in the Working group. After the discussions, it is recommended to draw up a short list of hazards, which will be analysed in detail in the second stage of the disaster risk assessment. The main output will be a list, detailed characteristics and parameters of the main hazards that will be further used to assess the risk of disasters and their impact.

Table 14. An example of the list of hazards at national level

| N | Hazard | Definition |
|---|---|---|
| 1 | **Earthquake** | An earthquake is a sudden and rapid shaking of the ground caused by the shifting of rocks beneath the earth's surface, or by volcanic or magmatic activity in the earth. Earthquakes strike suddenly, without warning, and can occur at any time. They can lead to death, injuries, property damage, loss of shelter and livelihoods and disruption of critical infrastructure (IFRC, n.d.). |
| 2 | **Drought** | Sustained and extensive occurrence of below-average water availability, caused by climate variability (INSPIRE, 2015). |
| 3 | **Wildfires** | Wildfires (also known as bushfires, brush fires or forest fires) are large, uncontrolled, and potentially destructive fires that can affect both rural and urban areas. They can spread quickly, change direction and even 'jump' across large distances when embers and sparks are carried by the wind. They are caused by a range of natural causes (such as lightning) or by human carelessness (such as a discarded cigarette) (IFRC, n.d.). |
| 4 | **Floods** | Floods are when water overflows from the normal boundaries of a stream, river or other body of water or accumulates in an area that is usually dry. There are two main types of floods: inundation Floods are slow, developing over hours or days, while flash floods occur suddenly, often without warning, usually due to heavy rain. Though annual flooding is a natural phenomenon in many parts of the world, human habitation and land-use practices have led to an increase in frequency and magnitude of floods (IFRC, n.d.). |

| N | Hazard | Definition |
|---|---|---|
| 5 | **Landslide** | Processes of downhill slope movements of soil, rock, and organic materials related to different types of ground failure. Some common terms used for describing different types of landslides include but are not restricted to slides, rock fall, debris flow (INSPIRE, 2015). |

## 3.2 Disaster Risk Scenario

Risk identification involves the elaboration of scenarios of potential risk situations, which condense the realm of possibilities to a limited number of identified situations. The scenarios are a plausible set of events combined with their consequences.

National risk identifications would need to consider at least all significant hazards of national relevance and intensity that would on average occur once or more often in 100 years (i.e., all hazards with an annual probability of 1% or more) and for which the consequences represent significant potential impacts, i.e.:

- number of affected people greater than 50;
- economic and environmental costs above € 100 million;
- political/social impact considered significant or very serious.

The scenarios provide simplified and generic description of future possible disaster events in terms of their magnitude (impacts) and probabilities (likelihood), making the hazards become tangible.
The scenario development process requires input from scientists, practitioners, policymakers and community experience on past events and knowledge of social, cultural, economic, and political context (JRC, 2021).
Risk assessment using risk scenarios is more subjective deterministic models, related to semi-quantitative risk analysis basing on risk matrices. The aim is to analyse the potential impacts and their likelihood. As a result of evaluation within risk level scales, the definition of risks which can be managed, risks that do not need to be managed (do not pose a threat) and those that cannot be managed are defined.
The scenarios can comprise the triggering events with description of possible consequences from cascading events to the impacts on societal systems, while considering the coping capacities in place (JRC, 2019), (JRC, 2021).
In the context of the risk assessment, a risk scenario is a way of simplified representation of a risk. The purpose of the risk scenario is to prepare a description of possible consequences, vulnerabilities, and probabilities of possible adverse events within a certain territory.
The use of historical data on hazards and consequences, scientific evidence trough data, models and studies are strongly encouraged to develop the scenarios. It is important to take in account events with a high probability of occurrence and a significant cumulative impact.

The disaster risk scenario is a description of:

- harmful events (one or more connected events) for each risk, which could have consequences at nationl level on the life and health of people, economy, social stability and environment;
- events that can lead to arising of and cause the described adverse events, and consists of developments before the disaster and the "trigger" of the disaster;
- circumstances in which the adverse events arise and the level of the vulnerability and resistance of the population, structures and other items in the territory or of the society, using the impact criteria on life and health of people, and the national environment, property, economy, social stability and policy;
- consequences of an event with a detailed description of each consequence.

The scenarios should at least describe two types of events:

- most probable risk scenario, with the most probable adverse event;
- worst case scenario, which considers the most severe possible consequences that can reasonably be projected to occur;

The scenario may be:

- an event which may arise in short time period with a certain probability (floods, earthquakes, forest fires...);
- a risk preceded by certain changes, i.e. when certain events may become real in a longer period of time (for example, if the scenario is based on climate changes).

The preconditions for selection of any of those two types of the scenarios are:

- the probability of the event;
- the scope/severity of the consequences.

The title of the scenario must be used to identify the scenario among others: the name must clarify the hazard, the type of scenario, if historical or invented etc.

In Tables 15 – 18 examples of the risk scenarios and related hazards developed in NDRA of Croatia, Estonia, Sweden, and Turkey are provided.

Table 15. Risk scenario from DRA Report of Republic Slovenia 2014 – 2016, (ACPDR, 2016)

| RISK ASSESSMENTS FOR SPECIFIC DISASTERS | Representative risk scenario |
|---|---|
| Earthquake | Earthquake of intensity VII–VIII on the EMS scale in the central part of the country (Ljubljana) |
| Floods | Floods based on floods in 1990 and 2012 |
| Health threats of biological, chemical, environmental or unknown origin | Pandemic influenza |
| Particularly dangerous animal diseases | Outbreak of foot-and-mouth disease in the north-eastern part of the country |
| Nuclear or radiological disaster | Disaster at Krško Nuclear Power Plant<br>Disaster involving radioactive sources |
| Train accident | Collision between a passenger and a freight train at Jesenice railway station, August 2011 |
| Aircraft accident | Plane crash in a populated area (Ljubljana) |
| Large wildfires | Fire Šumka–Železna vrata–Trstelj (SW Sloveniaa), July 2006 |
| Terrorism | Terrorist attack* |
| Drought | Droughts in 2003 and 2013 |
| Sleet | Sleet in February 2014 |
| Accidents involving dangerous substances | Disaster involving liquefied petroleum gas (LPG) |

Table 16. Hazards type and risk scenarios, Disaster risk assessment for the Republic of Croatia, 2019, (Main WG Croatian Platform for Disaster Risk Reduction, 2019)

| Hazard type | Risk scenario title |
|---|---|
| Plant disease | Spread of golden grapevine yellowness in the Vukovar-Srijem county |
| Animal disease | Spread of foot-and-mouth disease agents in the territory of the Republic of Croatia |
| Extreme temperature | Occurrence of heat waves in the area of the city of Zagreb |
| Epidemic | Influenza pandemic in the entire territory of the Republic of Croatia |
| Industrial accident | Industrial accidents in the area of the plant Faction facilities Ivanić City of oil refinery |
| Flood | Floods in the Danube River basin district |
| Earthquake | Earthquake shaking in the city of Zagreb caused by an earthquake at the level of the return period harmonized with the regulations for earthquake resistance design |
| Forest fires | Outdoor vegetation fires |
| Snow and ice | Traffic and energy collapse in mountainous Croatia caused by snow and ice |
| Drought | Drought in the Osijek-Baranja County |
| Soil salinity | Salinity of the soil in the valley of the Lower Neretva |
| Earthquake | Earthquake and flood in the area of the Zagreb city |
| Radioactive accident | Extraordinary event at the Krško Nuclear Power Plant |
| Radioactive accident | Hazardous radioactive source out of regulatory control |
| Landslide | Occurrence of mass landslides |
| Sea pollution | Sudden pollution of the Adriatic Sea with oil / oil mixture on a larger scale from vessels |

Table 17. Risks and probable worst-case scenarios, Disaster Risk Management Summary of Estonia, 2020, (Ministry of the Interior of Estonia, 2020)

| Event type | Probable worst-case scenario title |
|---|---|
| Rescue event | Flood together with storm |
| | Domino effect accident in enterprise liable to be affected by major accident |
| Police event | Mass Immigration |
| | Sudden attack in a public space |
| | Sudden attack in a passenger ship sailing in the Estonian rescue area |
| | Mass disorder |
| Cyber incident | Interruption of eID service (security errors in the cryptographic algorithm) |
| | Interruption of eID service (eID interruption as an interruption of vital service) |
| | Violation of the integrity of the data essential for the functioning of the state |
| | Cyber-attack together with electricity blackout |
| | Interruption of data transmission service |
| | Major denial-of-service attack (disruption of critical services) |
| Radiological or nuclear accident | Nuclear accident in Loviisa or Leningrad Nuclear Power Plant |
| | Radiation accident in Estonia |
| Health care event | Epidemic |
| | Mass intoxication |
| Infectious animal disease | Outbreak of dangerous infectious animal disease |
| Event caused by the malicious or terrorist use of chemical, biological, radiological or nuclear material | Attack in a crowded place using biological materials |
| | Attack on a passenger ship using radiological/nuclear materials |
| | Attack a passenger plane using chemicals |

Table 18. Risks and scenarios titles, A summary of risk areas and scenario analyses Sweden 2012–2015, (MSB, 2016)

| Hazard type | Risk scenario title |
|---|---|
| **Natural hazards** | |
| Earthquake and volcanic eruption | Volcanic eruption (volcanic dry fog) |
| Landslides | Mudslide |
| Heat-wave | Heat-wave |
| Contagious diseases | Pandemic flu |
| Solar storm | Solar storm |
| **Major accidents** | |
| Extensive fires | Fire on cruise ship |
| Emissions of hazardous substances (CBRNE) | Nuclear accident |
| Dam failure | Dam failure |
| Electronic communications | Disruption in GNSS |
| Food supply | Disruption to food supply |
| Supply of drinking water | Disruption to the supply of drinking water |

| Hazard type | Risk scenario title |
|---|---|
| **Antagonistic incidents** | |
| Terrorism | Bomb attack |
| School shooting | School shooting |
| Violent disturbances | Violent disturbances |

## 3.3 Scenario selection process

The scenario selection process is a systematic and thorough approach that integrates historical data, expert knowledge, and scientific modeling to identify and prioritize potential disaster scenarios (figure 5). This structured method ensures that the final risk assessment is robust and comprehensive, providing a solid foundation for disaster risk management.

The scenario selection process begins with an exhaustive identification of all potential disaster scenarios. This involves drawing from various sources to create a comprehensive list. Historical data provides a foundation by highlighting past disasters and their impacts, offering valuable lessons and patterns. Models of hazards, developed through scientific and statistical methods, help predict future events based on known variables and behaviors. Expert knowledge, gathered from literature and the experiences of professionals who have studied disasters worldwide, contributes additional insights. Additionally, listing critical infrastructures and using backward reasoning helps identify potential scenarios that could disrupt these essential systems.

Once this extensive list is compiled, the next step is to refine it by filtering out less relevant scenarios. Scenarios that appear to have a low impact or are unlikely to occur are removed from consideration. This helps focus the assessment on more significant threats. Similar scenarios are then combined or eliminated to avoid redundancy, ensuring a streamlined and efficient analysis.

Following the initial filtering, a preliminary risk assessment is conducted to further narrow down the list. This stage relies heavily on the expertise of institutions involved in risk assessment. Experts review the remaining scenarios, drawing on their experience, existing documents, and scientific papers to evaluate the potential risks. Through this expert-driven assessment, the most relevant and significant risks are identified for further analysis.

The final step is the full development of detailed scenarios for each prioritized risk. After the preliminary assessment, the chosen hazards are examined in depth, with comprehensive scenarios developed for each one. This involves considering all relevant factors and potential impacts, ensuring a thorough understanding of each risk. By focusing on the most critical hazards identified in the preliminary assessment, this process ensures that the final risk scenarios are detailed, well-documented, and capable of guiding effective disaster preparedness and response strategies.

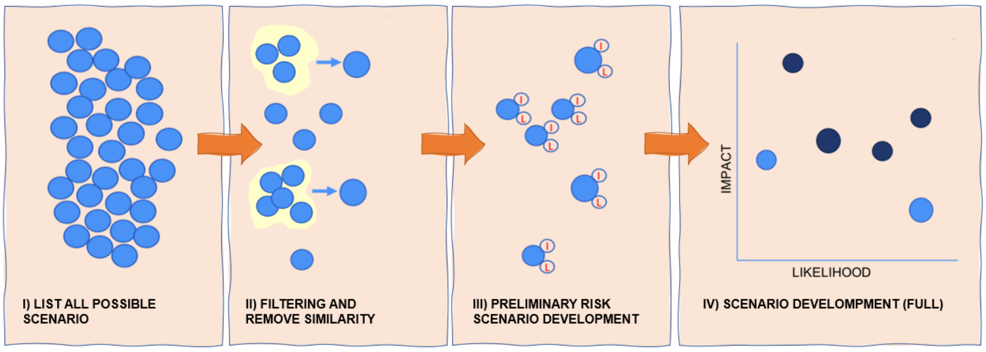



Figure 6. Scenario selection process

Basing on the JRC NDRA Recommendations (JRC, 2019) and different EU Member States current practices on NDRA, this Regional DRA Guidelines proposes the use of specific templates for the development of preliminary and full risk scenario assessment, as defined below.

# Chapter 4. Risk Analysis

## 4.1 The components of the analysis

The risk analysis process of a National Disaster Risk Assessment (NDRA) is a systematic approach designed to evaluate the risk level per each scenario. This comprehensive process involves several key steps, each contributing to a robust understanding of the risks and enabling effective disaster preparedness and mitigation strategies.
Risk analysis involves the estimation of the possible impact severity and likelihood of occurrence of the scenario.

Impact severity refers to the extent of damage or disruption a hazard could cause. Estimating this involves assessing various factors to determine how severe the consequences of a hazard event might be. The estimation process typically includes:

- Human Impact: Assessing potential casualties, injuries, and health impacts. This includes considering population density, vulnerability, and the capacity of healthcare systems.
- Economic Impact: Evaluating the potential financial losses due to damage to property, infrastructure, and business operations. This involves analyzing the value of assets at risk and the potential costs of recovery and rebuilding.
- Environmental Impact: Estimating the damage to ecosystems, natural resources, and biodiversity. This includes considering long-term environmental degradation and its effects on livelihoods and health.
- Social Impact: Considering the disruption to communities, including displacement, loss of services, and psychological impacts. This involves assessing the resilience of social networks and support systems.

Likelihood refers to the probability of a hazard event occurring within a specific timeframe. Estimating likelihood involves:

- Historical Data Analysis: Reviewing past occurrences of similar hazards to identify patterns and frequencies. This helps establish a baseline probability based on historical trends.
- Scientific and Statistical Models: Using predictive models to forecast the likelihood of future events based on current data and trends. These models may consider factors such as climate change, geological activity, and other relevant variables.
- Expert Judgement: Incorporating insights from experts who have experience with similar hazards. Their assessments can provide valuable context and help refine probability estimates.

**Return period and probability**

The Figure 7 shows a record 1000 years of losses of different sizes (magnitudes) - nine events exceeded a loss of '60' over that period. The time period between the nine losses ranges from sixty years to 200 years, meaning that on average losses of a magnitude of 60 were exceeded every 100 years - the return period of this loss.

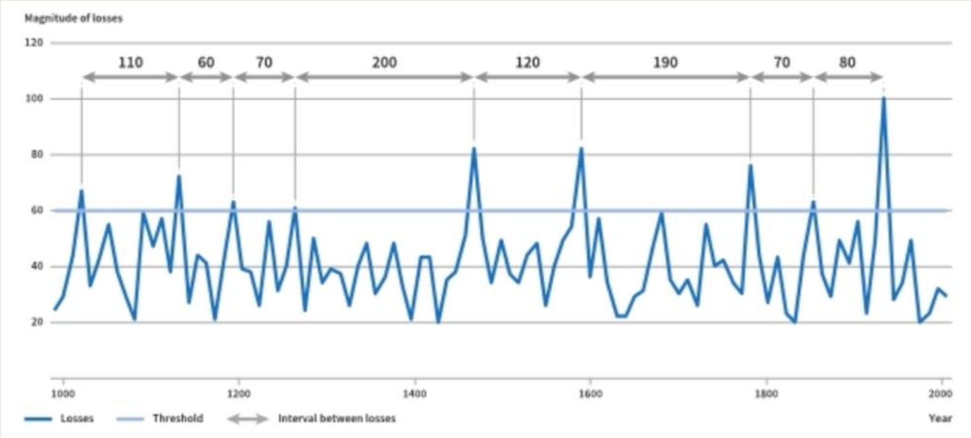



Figure 7. Return period of losses associated with hazardous events (PreventionWeb, n.d.)

Put simply, the 100-year return period loss (the magnitude 60 in Figure 4) occurs, on average, once every 100 years. As the Figure 4 shows, the return period does not mean that the loss occurs every 100 years. Likewise, it does not mean that if the loss occurred today that it would not recur for another 100 years. The return period represents the annual probability of having a loss of this size every year. The annual probability of exceeding a loss characterized by a 100-year return period is 1% - the inverse of the return period (1/100*100%) (PreventionWeb, n.d.).

$$Probability = \frac{1}{Return\ period} \times 100\%$$

The categories and indicators for the evaluation of the impact, and the thresholds of the classes for impact and likelihood shall be established in the phase 1 of the NDRA process related to the establishment of the national context. According to the EU DRA Guideline (European Commission, 2010), the same classes and the relative thresholds for the likelihood and impact evaluation shall be applied to all the different risk scenarios for the consequence.

The final step in the risk analysis process is to combine the estimated classes of impact severity and likelihood to determine the overall risk level, using risk matrix.

Each combination of impact severity and likelihood is assigned a risk level, often color-coded (e.g., green for low risk, yellow for medium risk, orange for high risk, and red for very high risk). This matrix helps visualize and prioritize risks based on their potential impact and the probability of occurrence.

The risk analysis process can be effectively facilitated by utilizing the templates designed for risk scenario assessment within the PPRD East 3 project. These templates serve as structured frameworks for systematically evaluating scenario, based on the potential hazards and their associated risks. The preliminary template is tailored for expedited assessments, providing a streamlined approach to quickly identify and prioritize key risks. It focuses on essential parameters and facilitates rapid decision-making in resource-sensitive situations. Conversely, the full template offers a comprehensive framework for conducting in-depth risk assessments. It allows for a detailed examination of each risk scenario, encompassing a broader range of factors and considerations. This template facilitates thorough analysis and enables stakeholders to gain a comprehensive understanding of the risks involved, supporting informed decision-making and risk management strategies.

## 4.2 Preliminary risk scenario assessment

The preliminary risk scenario-based assessment allows to identify of the priority risks to be included in the National DRA and developed through a full risk scenario-based assessment.

The preliminary risk scenario template (provided in the Annex 3) includes a short description of the event, the consequences, and the probability of the hazard of the risk for a qualitative evaluation of the risk.

General information should be provided about the working group and the date of the elaboration.

The description of the risk scenario includes the title, the type of causing hazard, and brief specification of the risk geographic location, exposure and vulnerability and possible consequences.

The assumed consequences are reported considering four groups of impacts (human, economic, political / social and environment) and the overall impact. The possible impacts should be marked using qualitative categories: 1) small, 2) moderate, and 3) significant.

The probability / frequency of the hazard is evaluated on a three-point scale: 1 - low (e.g. 1 event in 100 year or less frequently); 2 – medium (e.g. 1 event in 2 to 20 years), and 3 – high (e.g. 1 event annually or more frequently).

When the probability/frequency of the hazard and the impact of the event are estimated, it is possible to evaluate the risk level of the scenario, through a risk matrix (see figure 7), which includes 4 categories: 1) low - green; 2) medium - yellow; 3) high - orange; 4) very high – red.

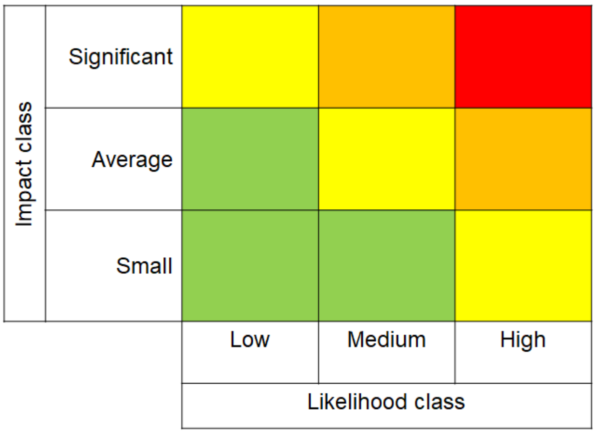



Figure 8. Example of risk matrix for the preliminary risk assessment

## 4.3 Full risk scenario assessment

Once the priority risk scenarios are identified, the Risk Assessment should be prepared on the basis of the detailed (full) risk scenarios. The full risk scenarios should be elaborated by specific working groups assigned for each scenario. The working group should include institutions that are competent in the field of the specific hazard, in close coordination with the scientific institutions, experts and other relevant authorities to analyse the risk.

The template for development of full risk scenario (Annex 4) is more detailed in respect of the preliminary risk scenario since it intends to provide as much information as possible for the risk assessment.

The list of available data and maps supporting the risk assessment (baseline) for the scenario must be provided, such as topographic maps, land cove maps, hazard maps, exposure maps, vulnerability maps, etc.

The description of the scenario includes the indication of the type of hazard and the selection criteria (worst case or most probable scenario). An extended section about the context of the scenario describes the location, settlement, population, morphological characteristic, terrain type, land use and critical infrastructure and sector in the examined area, in order to collect information about the exposures.

The events are described in detail through the meteorological conditions, the time it happens during the day and the year, its potential speed of onset and the probable duration of the acute phase. That information is important for the effects they have on the impacts and on the disaster management actions.

The causes of the event are outlined, giving attention also to cascading effects.

The following section examines the preparedness, response, and recovery capacity.

The impacts are examined, analysing the different groups (human, economic, political & social, and environmental) selected in the NDRA guidelines and their indicators. Per each indicator the category of the severity of the impact and the uncertainty will be identified accordingly with the rational description.

The probability and frequency of the risk scenario should be estimated, describing the methodology implemented and the uncertainty of the evaluation. Thus, the likelihood category of the NDRA guidelines must be indicated.

For each group of impact, combining the evaluation of the likelihood and the severity of the impact, an estimation of the risk is finally carried out, through a methodology for combining the different indicators.

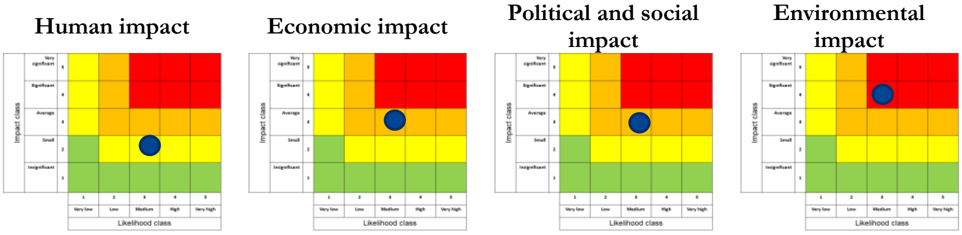



Figure 9. Example of risk matrix with disaggregated presentation of impacts

The overall impact for the final risk evaluation of the scenario can be determined through the weights associated to human, economic, political/social, and environmental impacts.

## 4.4 Uncertainty of risk assessment

The impact and likelihood class estimation, which lead to the risk evaluation, must be accompanied with a level of uncertainty, that depends on the input data and methods used in the different phases of the assessment.

The uncertainties should be quantified, and it can be represented in various ways. See the examples in Tables 19 and 20.

Stating the uncertainty of the outcomes of risk analysis provides important information to the decision-makers in order to evaluate the need for developing the assessment through more detailed data and improved models (investing more time and money).

Table 19. Representation of the uncertainty – example 1 (extracted from National Risk Analysis, Norwegian Directorate for Civil Protection, (DSB, 2014))

**Likelihood assessment**

| | VERY LOW | LOW | MODERATE | HIGH | VERY HIGH | EXPLANATION |
|---|---|---|---|---|---|---|
| Likelihood that the event will occur in the course of a year: 1% | | | | ◎ (moderate uncertainty) | | Once every 100 years based on historical data |

**Consequence assessment**

| SOCIETAL ASSET | CONSEQUENCE TYPE | VERY SMALL | SMALL | MEDIUM | LARGE | VERY LARGE | |
|---|---|---|---|---|---|---|---|
| Life and health | Death | | | ◎ (high uncertainty) | | | Approximately 100 deaths as a direct or indirect consequence |
| | Injuries and illness | | | | ◎ (high uncertainty) | | Between 500–1000 injuries or ill people as a direct or indirect consequence |
| Nature and the environment | Long-term damage | | | ◎ (low uncertainty) | | | 1,000 km² of forest is destroyed 3-10 years of clean-up work |
| Economy | Financial and material losses | | | | ◎ (low uncertainty) | | NOK 10-15 billion |
| Societal stability | Social unrest | | ◎ (low uncertainty) | | | | Known phenomenon, but difficult to avoid |
| | Effects on daily life | | | ◎ (moderate uncertainty) | | | Several hundred thousand are affected by the lack of power and clean water for a few days. Reduced navigability for all means of transport |
| Capacity to govern and control | Weakened national capacity to govern | | | | | | Not relevant |
| | Weakened territorial control | | | | | | Not relevant |
| OVERALL ASSESSMENT OF CONSEQUENCES | | | | ◎ (moderate uncertainty) | | | Medium-sized consequences overall |

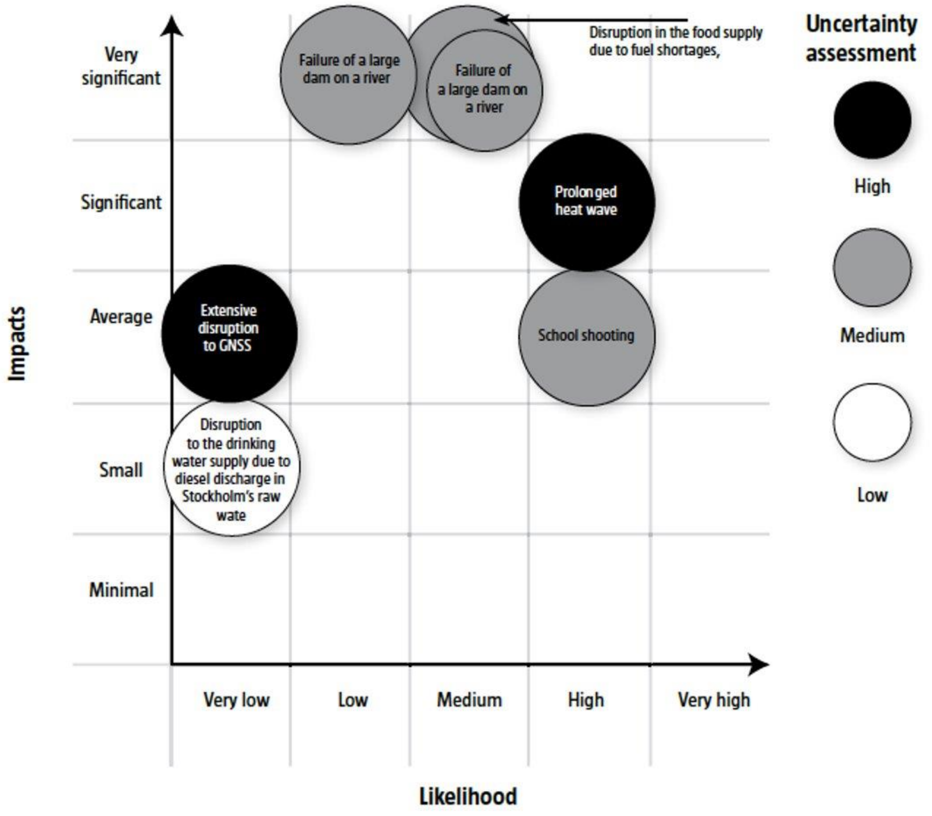
Low uncertainty ◎ Moderate uncertainty ◎ High uncertainty ◎

**"Storm in Inner Oslo Fjord" – overall risk**

| CONSEQUENCES | | | | | |
|---|---|---|---|---|---|
| VERY LARGE | | | | | |
| LARGE | | | | | |
| MEDIUM | | | | ◎ (moderate uncertainty) | |
| SMALL | | | | | |
| VERY SMALL | | | | | |
| LIKELIHOOD | VERY LOW | LOW | MODERATE | HIGH | VERY HIGH |

Low uncertainty ◎ Moderate uncertainty ◎ High uncertainty ◎

Table 20. Representation of the uncertainty – example 2 (extracted from National Risk Assessment, Swedish Civil Contingencies Agency MSB, (MSB, 2016))




| Figure in the risk matrix | Designation, uncertainty | Explanation, justification for the assessment |
|---|---|---|
| | High | There are very few statistics and little data on which to base an assessment and the margin for error is significant. |
| | Medium | Some statistics and data are available. Experts consider the assessment to be the most reasonable, but there is a margin for error. |
| | Low | The assessment is supported by solid experience, statistics and other data. The assessment is possibly inaccurate, but it is not likely. |

# Chapter 5. Risk evaluation

## 5.1 Risk Matrix

A risk matrix is a means a semi-quantitative risk assessment, a combination of two dimensions of risk, severity (impact) and likelihood (probability), which allows a simple visual comparison of different risks (DRMKC, 2017).
For every risk scenario identified in the risk identification stage, risk analysis determines the potential impacts and the probability of occurrence. The disaster risk matrix shows the correlation of the probability/frequency and the impacts, defining the risk level. The risk matrix is made of classes of likelihood of the hazardous events on one axis and the consequences (impacts) on the other axis. When the likelihood is determined, as well as the possible overall impact, it is possible to determine the risk level. The risk level is presented in the risk matrix. Risk matrix helps to define which risks need further or more detailed analysis or which given risk is considered broadly acceptable or not acceptable.
In EU DRA Guideline (European Commission, 2010) an example of the risk matrix is provided (Figure 10). The risk level is coded by four colour scale: 1) low (green), 2) medium (yellow), 3) high (orange), and 4) very high (red).

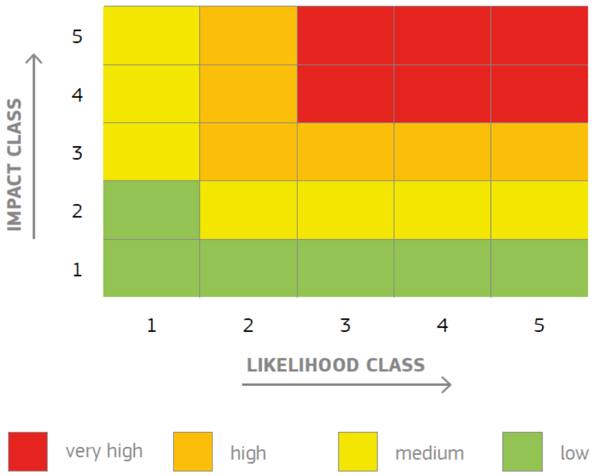



Figure 10. Example of risk matrix, EC Risk Assessment and Mapping Guidelines for Disaster Management, (European Commission, 2010)

The significance of each level is explained in the table and provides the meaning in terms of risk acceptance and necessity of measures for risk management.

| | | |
|---|---|---|
| **Very high (red)** | 4 | Risk cannot be accepted, except in exceptional situations |
| **High (orange)** | 3 | Risk can be accepted if the reduction is impractical or the costs far outweigh the profits |
| **Medium (yellow)** | 2 | Risk can be accepted if costs exceed profits |
| **Low (green)** | 1 | No additional measures are required other than the usual ones |

In the NDRA an overall risk matrix will represent the results of all the risk scenario-based assessments, showing the result of the two-risk scenario (most probable and worst case) per each hazard:

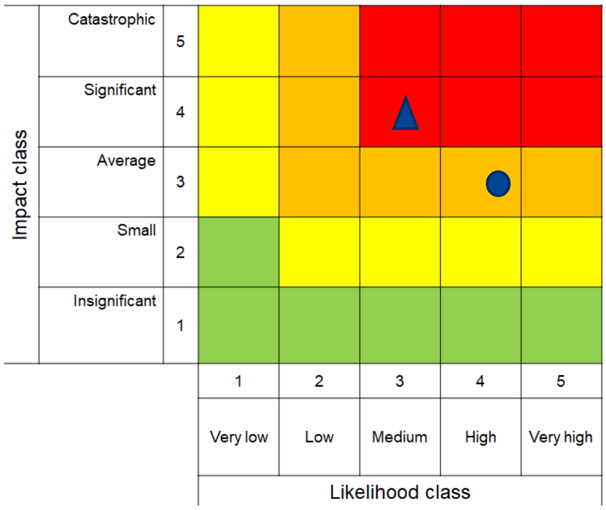



Figure 11. Risk matrix with the representation of the most probable case (circle) and the worst case (triangle)

This structured approach facilitates informed decision-making and effective risk management, ensuring that risks are mitigated to acceptable levels wherever possible.

## 5.2 Risk Treatments (next step)

The result of the evaluation will allow to declare whether the risks are "non-acceptable" or "non-tolerable" (see Table 11). In this case the risk needs to be managed, addressing related risk factors with actions in different phases of disaster risk management: prevention, mitigation, preparedness, recovery and reconstruction or adaption options.

Table 21. Risk level and treatment need

| | | |
|---|---|---|
| **Very high (red)** | **4** | Requirement is risk treatment |
| **High (orange)** | **3** | Requirement is risk treatment |
| **Medium (yellow)** | **2** | Can mean the need to take some actions |
| **Low (green)** | **1** | No additional actions are required |

The selection of risk management options depends on the likelihood and the severity of the events. Frequent events could be treated through risk reduction actions, which is usually the most effective response. Medium risks could be treated through risk reduction and risk-financing instruments that transfer residual risk. When the events became rare and consequently the losses extreme, the insurers are reticent to cover risks and, in that case, public and donor post-disaster assistances are necessary. For very rare events, even the capacity of international aid agencies can be exceeded. Thus, it might be good to consider prevention and adaption risk management options related to governments incentives to reduce risk. (JRC, 2019)

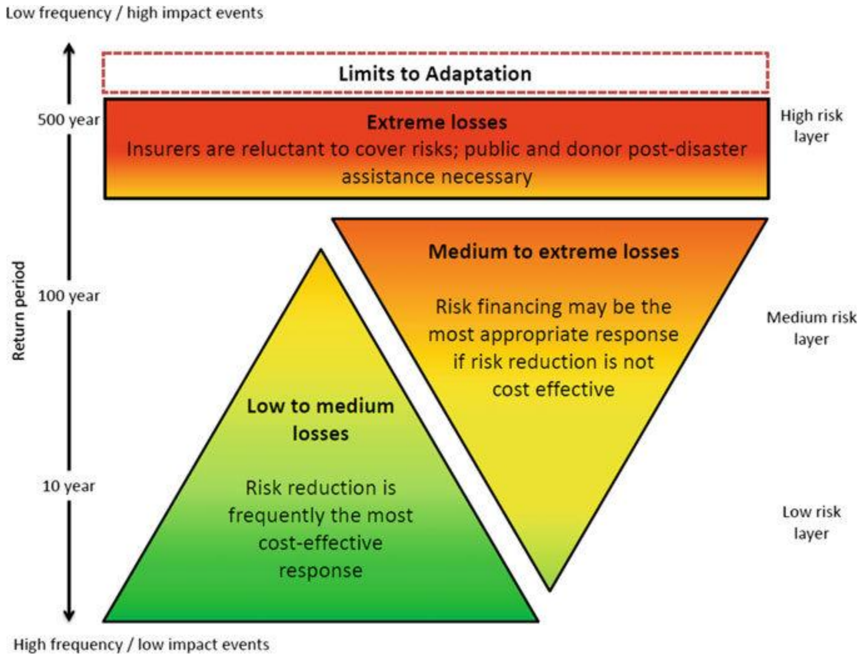



Figure 12. Conceptualising risk layering (Thomas Schinko, et al., 2018)

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# Annex 1. Examples of NDRAs criteria and thresholds for impact disaster evaluation

I. **Disaster Risk Management Summary of Estonia, 2020** (Ministry of the Interior of Estonia, 2020)

| **Severity** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **Value** | **Insignific ant-cant** | **Minor** | **Severe** | **Very severe** | **Catastrop hic** |
| **I. Life and health (number)** | | | | | |
| Deceased | ≤5 | 5 – 15 | 16 – 50 | 51 – 200 | >200 |
| Injured or taken ill | ≤15 | 16 – 45 | 46- 150 | 151 – 600 | >600 |
| Evacuated | ≤50 | 51 – 200 | 201 – 500 | 501 – 2000 | >2000 |
| **II. Property** | | | | | |
| Direct financial cost (million euros) | <1 | 1 – 10 | 11 – 50 | 51 – 100 | >100 |
| Indirect financial cost | insignifica nt | low | high | very high | catastroph ic |
| **III. Natural environment** | | | | | |
| Impact range ($km^2$) | <1 | 1 – 10 | 10 – 100 | 101 – 1000 | >1000 |
| Impact duration | <1 month | 1 – 6 months | 6 – 12 months | 1 – 3 years | >3 years |
| **IV. Vital services** | | | | | |
| Number of services directly affected | 0 - 1 | 2 – 3 | 4 – 5 | 6 – 7 | ≥8 |
| Duration of disruption | <1 day | 1 – 6 days | 1 – 2 weeks | 2 weeks to 1 month | longer than 1 month |

II. **Disaster risk assessment for the Republic of Croatia, 2019** (Main WG Croatian Platform for Disaster Risk Reduction, 2019)

| **Cate gory** | **Consequenc es** | **Social value - Health and life of people** | **Economy, million Croatian kunas HRK[8]** | **Damages / losses to buildings of public social importance, million Croatian kunas HRK** |
|---|---|---|---|---|
| **1** | **Insignificant** | <50 | < 250 | < 250 |
| **2** | **Small** | 50 - 200 | 250 - 700 | 250 - 700 |
| **3** | **Moderate** | 201- 500 | 700 - 1.500 | 700 - 1.500 |
| **4** | **Significant** | 501 - 1500 | 1.500 - 7.000 | 1.500 - 7.000 |
| **5** | **Catastrophic** | >1500 | > 7.000 | > 7.000 |

[8] HRK 1 Croatian Kuna monetary unit is equal to 0,13 euro (on 25.05.2022)

**III. Disaster Risk Assessment Report of Republic Slovenia 2014 – 2016** (ACPDR, 2016)

| Cate gory | Criteria for evaluating the impacts of the risk on people | | | Criteria for evaluating the economic and environmental impacts and impacts on cultural heritage |
|---|---|---|---|---|
| | **Number of deaths** | **Number of injured or sick** | **Number of evacuated people** | % GDP[9] |
| **1** | Up to 5 | Up to 10 | Up to 20 | up to 0.3 % GDP<br>up to 100 million EUR |
| **2** | 5-10 | 10-50 | 20-50 | 0.3 %–0.6 % GDP<br>100–220 million EUR |
| **3** | 10-50 | 50-200 | 50-200 | 0.6 %–1.2 % GDP<br>220–440 million EUR |
| **4** | 50-200 | 200-1000 | 200-500 | 1.2 %–2.4 % GDP<br>440–880 million EUR |
| **5** | More than 200 | More than 1000 | More than 500 | more than 2.4 % GDP<br>more than 880 million EUR |

| Criteria for evaluating the political and social impacts* | | | | |
|---|---|---|---|---|
| **Number of people/ Duration** | **up to 500** | **500–5000** | **5000–50,000** | **More than 50,000** |
| **up to 2 days** | 1 | 1 | 1 | 2 |
| **up to 7 days** | 1 | 2 | 2 | 3 |
| **up to 15 days** | 2 | 3 | 3 | 4 |
| **up to 30 days** | 3 | 4 | 4 | 5 |
| **more than 30 days** | 4 | 5 | 5 | 5 |

*Criteria for evaluating the political and social impacts:

- The number of people, to which the provision of services is physically or functionally hindered or disturbed by the national authorities.
- Lack of or limited access to safe drinking water, food, and energy (electricity, heating, fuel).
- Very limited or no access to the internet and telecommunication systems, arrival to work in educational institutions, public services (access to the media, health services, banking services etc.), public transport, supply, or purchase of basic necessities.

[9] Gross Domestic Product

*Criteria for the evaluation of psychosocial impacts:

- Number of people in whom the disaster causes an unusual or unwanted behaviour (behavioural reactions), such as avoiding attending school, kindergarten, conscious absence from work, conscious avoidance of public transport, a tendency to relocate, irrational financial operations (mass cash withdrawals etc.), accumulation and appropriating of a stock of basic necessities etc.

| **Types of social impacts** | **Level of impact** |
|---|---|
| The impacts of a disaster cannot influence the evaluated content. | Not assessed (NA) |
| Small/insignificant impact. | 1 |
| Poorer population segments find themselves in severe social distress; there is an increase in the number of requests for an emergency financial social assistance. | 2 |
| The consequences of disasters are also felt by the middle-class population, which is reflected in the increased number of applications for emergency financial social assistance. | 3 |
| The consequences of disasters are felt by most of the population, which is reflected in a large increase in the number of applications for social assistance. | 4 |
| The consequences are felt by all residents; this is reflected primarily in new applications for social assistance and reapplications for the allocation of assistance. | 5 |

| **Types of psychological impacts** | **Level of impact** |
|---|---|
| The impacts of a disaster cannot influence the evaluated content. | Not assessed (NA) |
| Small/insignificant impact. | 1 |
| Individual cases of fear are emerging amongst the residents because they do not know the causes and characteristics of the disaster and its consequences. | 2 |
| There is an increase of the phenomenon of fear amongst the residents, especially of a new disaster and its consequences. | 3 |
| There is a climate of fear of survival amongst residents, and the confidence in the competent authorities relating to the response and relief of disaster consequences decreases, while the desire to relocate increases. | 4 |
| Due to the negative events or consequences of a disaster, most people lose confidence in the fact that life in the impacted area could return to a normal state, and the mass migration begins. | 5 |

| **Types of impacts on internal political stability and law and order** | **Level of impact** |
|---|---|
| The impacts of a disaster cannot influence the evaluated content. | Not assessed (NA) |
| Small/insignificant impact. | 1 |
| There are individual cases of public expression of disagreement with the actions taken by the competent institutions, or individual interference of functioning of political institutions (government, parliament etc.), and individual occurrences of hostile campaigns. | 2 |
| There are isolated cases of violations of law and order due to the disaster and the expression of feelings of fear for safety and property; individuals or groups are trying to undermine the internal political situation, and there is a decrease of confidence in the political institutions. | 3 |
| The number of violations of law and order and organised crime also increase, as well as the fear among people; political parties and other stakeholders are trying to | 4 |

| | |
|---|---|
| undermine internal political stability and obtain political benefits by "imposing" their programmes for improving the conditions, and there is a decrease of confidence in the functioning of national institutions. | |
| The violations of law and order, including violent demonstrations, are massive, there are a lot more of criminal offences, and internal security of the country is threatened. Internal political stability of the country is undermined, the constitutionally guaranteed fundamental rights and values are threatened and devaluated. | 5 |

### IV. Swedish National Disaster Risk Assessment, (MSB, 2016)

| Category | Quantitative scale, Human impact | Quantitative scale, Economic/Environmental Impact [SEK][10] | Qualitative scale Political / Social impact |
|---|---|---|---|
| **Very significant** | ≥ 50 dead and/or >100 severely injured | >SEK 1 billion | Very serious |
| **Significant** | 10-49 dead and/or 50-100 severely injured | SEK 500 million-SEK 1 billion | Serious |
| **Average** | 2-9 dead and/or 10-49 severely injured | SEK 100-499 | Serious |
| **Minor** | 1 dead and/or 1-9 severely injured | SEK 20-99 | Minor |
| **Minimal** | No deaths or serious injuries, a number of minor injuries | <SEK 20 million | Minimal |

### V. National Disaster Risk Assessment Republic of Turkey, 2019

| Category | Limited | Significant | Severe | Very severe | Catastrophic |
|---|---|---|---|---|---|
| **Physical safety** | | | | | |
| **1.1 Fatalities** | ≤5 deaths | >5 deaths ≤10 deaths | >10 deaths ≤20 deaths | >20 deaths ≤50 deaths | >50 deaths |
| **1.2 Severely injured** | ≤10 persons | >10 persons ≤20 persons | >20 persons ≤50 persons | >50 persons ≤100 persons | >100 |
| **1.3 Lack of fulfilment basic needs** | <1000 people weeks | >1000 people weeks ≤10,000 people weeks | >10,000 people weeks ≤100,000 people weeks | >100,000 people weeks ≤1,000,000 people weeks | >1,000,000 people weeks |
| **1.4 Evacuees** | ≤50 persons | >50 persons ≤100 persons | >100 persons ≤1,000 persons | >1,000 persons ≤10,000 persons | >10,000 |
| **Economic and environmental** | | | | | |
| **2.1 Economic loss** | ≤0.004% GNP | >0.004% GNP ≤0.04 % GNP | >0.04% GNP ≤0.4% GNP | >0.4% GNP ≤4% GNP | > 4 % GNP |
| **2.2 Environmental loss** | the ecosystem or species is able to recover | the ecosystem or species requires a diversion of | the ecosystem or species requires a | the pre-emergency condition has been lost. | the pre-emergency condition |

[10] SEK 1 Swedish krona equal to 0,095 Euro (on 05/25/2022)

| | | | | | |
|---|---|---|---|---|---|
| | fully, with minimal or no intervention | resources to manage their recovery from damage | major program of interventions and recovery to restore it to health | Although some degree of restoration may be possible | cannot be restored |
| **Society's functionality** | | | | | |
| **3.1 Disruption for every day's life (for a significant part of the society)** | No access to education, work, social networks, health care for more than one day | No access to education, work, social networks, health care for more than a week | No access to education, work, social networks, health care for more than two weeks | No access to education, work, social networks, health care for more than a month | No access to education, work, social networks, health care for more than three months |
| **3.2 Loss of cultural heritage** | Damage to sites and objects of local importance | Minor damage of iconic and world heritage sites and objects. Severe damage of sites or objects of importance | Severe damage to iconic and world heritage sites and objects. Loss beyond recovery of sites or objects of local or sectoral importance | Loss beyond recovery of sites or objects perceived as iconic for Turkish identity | Loss beyond recovery for sites or objects listed as World heritage |
| **3.3 Loss of reputation** | Limited | Significant | Severe | Very severe | Catastrophic |

# Annex 2. Examples of NDRAs Criteria and Thresholds for Likelihood Estimation

**I. Disaster Risk Management Summary of Estonia,** (Ministry of the Interior of Estonia, 2020)

| Category | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| **Probability, years** | Less than once every 100 years | Once every 50 – 100 years | Once every 20 – 50 years | Once every 5 – 20 years | More than 1 every 5 years |

**II. Disaster risk assessment for the Republic of Croatia,** (Main WG Croatian Platform for Disaster Risk Reduction, 2019)

| Category | Exceptionally small | Small | Moderate | Big | Exceptionally big |
|---|---|---|---|---|---|
| **Frequency, years** | <1% | 1 - 5 % | 5 - 50 % | 51 - 98 % | >98% |
| **Probability, %** | 1 event in 100 years and less frequently | 1 event in 20 to 100 years | 1 event in 2 to 20 years | 1 event in 1 to 2 years | 1 event annually or more frequently |

**III. Report on Disaster Risk Assessment in the Republic of Slovenia 2014-2016,** (ACPDR, 2016)

| 1<br>Almost no risk | 2<br>Possible, but unlikely risk | 3<br>Possible risk | 4<br>General risk | 5<br>Specific and immediate (permanent) risk |
|---|---|---|---|---|
| Once in more than 250 years (annual likelihood of up to 0.4 %) | Once in 100–250 years (annual likelihood of 0.4 %–1 %) | Once in 25–100 years (annual likelihood of 1 %–4 %) | Once in 5–25 years (annual likelihood of 4 %–20 %) | Once or multiple times in 5 years (annual likelihood above 20 %) |

**IV. National Disaster Risk Assessment Report, Disaster and Emergency Management Presidency, AFAD, Republic of Turkey 2019**

| Very low | Low | Medium | High | Very high |
|---|---|---|---|---|
| **Annual exceedance probability (AEP)** | | | | |
| ≤ 0.05% per 5 years | ≤0.5% per 5 years<br>>0.05% per 5 years | ≤5% per 5 years<br>>0.5% per 5 years | ≤50% per 5 years<br>>5% per 5 years | >50% per 5 years |
| **Frequency** | | | | |
| 1 per 10,000 years or more | 1 per 1000 to 10,000 years | 1 per 100 to 1000 Years | 1 per 10 to 100 years | 1 per less than 10 years |

**V. National Risk Assessment of Sweden,** (MSB, 2016)

| Qualitative scale (risk matrix) | Quantitative scale for likelihood assessment | | |
|---|---|---|---|
| | **Lower span** | **Magnitude** | **Upper span** |
| **Very low** | ≥0 | 0,0001 on an annualised basis (once in 10 000 year) | <0,0002 on an annualised basis (<once in pa 5 000 year) |
| **Low** | ≥0,0002 on an annualised basis (≥once in 5000 year) | 0,0001 on an annualised basis (once in 1 000 year) | <0,002 on an annualised basis (<once in 500 year) |
| **Medium** | ≥0,002 on an annualised basis (≥once in 500 years) | 0,0001 on an annualised basis (once in 1 000 year) | <0,02 on an annualised basis (<once in 50 year) |
| **High** | ≥0,02 on an annualised basis (≥once in 50 years) | 0,1 on an annualised basis (once in 10 year) | <0,2 on an annualised basis (<once per 5 year) |
| **Very high** | ≥0,2 on an annualised basis (≥ once per 5 years) | 1 on an annualised basis (once per year) | 1 (once per year) |

# Annex 3. Template for preliminary risk scenario assessment

# National Disaster Risk Assessment
# Preliminary Risk Scenario Template

*In the context of the risk assessment, a scenario is a way of presenting risks. The scenarios are prepared by the institutions that are responsible for activities related to each specific risk and are therefore professionally most competent in the field. The purpose of the scenario is to prepare a representation of possible consequences, vulnerabilities and probabilities of possible events.*

## SECTION 1. GENERAL INFORMATION

### 1.1 COUNTRY

Fare clic o toccare qui per immettere il testo.

### 1.2 WORKING GROUP

*List the name of the Institutions that participate to the definition of the Scenario*

Fare clic o toccare qui per immettere il testo.

### 1.3 WG REFERENT

*Indicate name, institution and email of the referent of the Working Group*

Fare clic o toccare qui per immettere il testo.

### 1.4 DATE

*Indicate the date of scenario elaboration*

Fare clic o toccare qui per immettere una data.

## SECTION 2. RISK SCENARIO DESCRIPTION

### 2.1 TITLE OF THE RISK SCENARIO

*This is the name used to identify the scenario among others. Choose a name that clarifies the hazard, the type of scenario, if historical or invented etc. [See the Regional Guidelines, Chapter 3.3]*

Fare clic o toccare qui per immettere il testo.

### 2.2 TYPE OF HAZARD

*Use the classification of hazards adopted in the Country (e.g. flash flood, earthquake, landslide, etc.) [See the Regional Guidelines, Chapter 3.1]*

Fare clic o toccare qui per immettere il testo.

### 2.3 SELECTION CRITERIA

*Why has this scenario been picked? Select the answer [See the Regional Guidelines, Chapter 3.2]*

☐ Most probable risk scenario

☐ Worst Case Risk Scenario

### 2.4 BRIEF DESCRIPTION

*Provide a quick introduction about the scenario, explaining the hazard and its consequences, as well as the explanation about how the scenario was identified (e.g. Events that have led, at least once, to a disaster or emergency in the Country, Major loss events in other countries that could happen in the Country)*

Fare clic o toccare qui per immettere il testo.

### 2.5 COMMENTS

*If any, write here additional comments*

Fare clic o toccare qui per immettere il testo.

## SECTION 3. CONSEQUENCES

### 3.1 IMPACT ACCORDING TO THE INDICATORS

*i) indicate the NDRA categories selected for the classification of the impact severity, according to the NDRA guidelines (e.g. limited, significant, severe, very severe, catastrophic)*
*ii) List the impact indicators selected for each group of impact (e.g. number of fatalities). Add a row per each indicator.*

*iv) Describe the rationale for marking the category of the impact (e.g. 55 deaths)*
*v) Mark the category of the severity of the impact per each indicators*
*vi) Select the level of uncertainty (low, moderate or high) for the estimation of the category severity impact for each indicator*
*[See the Regional Guidelines, Chapter 4.1.2, 4.1.3, 4.3*

| **Impact indicator** | **Category of the severity of the impact** | | | | |
|---|---|---|---|---|---|
| | Human | Economic | Political and social | Environmental | Overall impact |
| Small | ☐ | ☐ | ☐ | ☐ | ☐ |
| Moderate | ☐ | ☐ | ☐ | ☐ | ☐ |
| Significant | ☐ | ☐ | ☐ | ☐ | ☐ |

### 3.2 COMMENTS

*If any, write here additional comments*

Fare clic o toccare qui per immettere il testo.

## SECTION 4. LIKELIHOOD

### 4.1 CATEGORIES OF THE PROBABILITY/FREQUENCY

*Mark the category of the scenario. [See the Regional Guidelines, Chapter 4.2]*

☐ Low Probability
☐ Medium Probability
☐ High Probability

### 4.2 COMMENTS

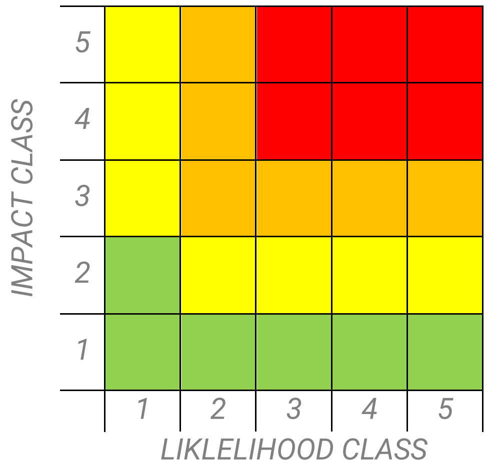
*If any, write here additional comments*

Fare clic o toccare qui per immettere il testo.

## SECTION 5. RISK EVALUATION

### 5.1 OVERALL RISK MATRIX

*Mark the cell corresponding to the human impact class and the likelihood of the scenario*


IMPACT CLASS
5
4
3
2
1
1
2
3
4
5
LIKLELIHOOD CLASS

# Annex 4. Template for full risk scenario assessment

# National Disaster Risk Assessment
# Full Risk Scenario Identification Template

*In the context of the risk assessment, a scenario is a way of presenting risks. The scenarios are prepared by the institutions that are responsible for activities related to each specific risk and are therefore professionally most competent in the field. The purpose of the scenario is to prepare a representation of possible consequences, vulnerabilities and probabilities of possible events.*

## SECTION 1. GENERAL INFORMATION

### 1.1 COUNTRY

Fare clic o toccare qui per immettere il testo.

### 1.2 WORKING GROUP

*List the name of the Institutions that participate to the definition of the Scenario, according to their roles:*
*- Civil protection authority or Sectoral ministry or Scientific institution as COORDINATOR;*
*- Sectoral ministry, Scientific institution, Governmental agency as TECHNICAL CONSULTANT / INFORMATION PROVIDER;*
*- Other related organizations as INFORMATION PROVIDER.*
*[See the Regional Guidelines, Chapter 2.3]*

Fare clic o toccare qui per immettere il testo.

### 1.3 WORKING GROUP REFERENT

*Indicate name, institution, and email of the referent of the Working Group*

Fare clic o toccare qui per immettere il testo.

### 1.4 DATE

*Indicate the date of scenario elaboration*

Fare clic o toccare qui per immettere una data.

### 1.5 DATA SOUCE INFORMATION

*Provide the list of available data and maps supporting the risk assessment for the scenario: topographic maps, land cove maps, hazard maps, exposure maps, vulnerability maps, etc.. [See the Regional Guidelines, Chapter 2.5]*

Fare clic o toccare qui per immettere una data.

## SECTION 2. RISK SCENARIO DESCRIPTION

### 2.1 TITLE OF THE RISK SCENARIO

*This is the name used to identify the scenario among others. Choose a name that clarifies the hazard, the type of scenario, if historical or invented etc. [See the Regional Guidelines, Chapter 3.2]*

Fare clic o toccare qui per immettere il testo.

### 2.2 TYPE OF HAZARD

*Use the classification of hazards adopted in the Country (e.g. flash flood, earthquake, landslide, etc.) [See the Regional Guidelines, Chapter 3.1]*

Fare clic o toccare qui per immettere il testo.

### 2.3 SELECTION CRITERIA

*Why has this scenario been picked? Select the answer [See the Regional Guidelines, Chapter 3.2]*

☐ Most probable risk scenario

☐ Worst Case Risk Scenario

### 2.4 BRIEF DESCRIPTION

*Provide a quick introduction about the scenario, explaining the hazard and its consequences, as well as the explanation about how the scenario was identified (e.g. Events that have led, at least once, to a disaster or emergency in the Country, Major loss events in other countries that could happen in the Country). Select whether or not the scenario is based on a real event.*

Fare clic o toccare qui per immettere il testo.

REAL SCENARIO ☐ yes ☐ not

### 2.5 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 3. CONTEXT OF RISK SCENARIO

### 3.1 LOCATION

*Indicate toponyms, coordinates, geographical relevant characteristics and transboundary impact (if any). Add image(s) to show the area of the scenario (e.g. on Google Earth).*

Fare clic o toccare qui per immettere il testo.

TRANSBOUNDARY RISK ☐ yes ☐ not

### 3.2 SETTLEMENT

*Description of the context in terms of settlement. E.g. Is it a rural or an urban environment? how many major cities are involved? Which are the accesses to the area?*

Fare clic o toccare qui per immettere il testo.

### 3.3 POPULATION

*Indicate the population of the area / population density, giving attention e.g. to possible flow of tourists. If available, provide demographic information.*

Fare clic o toccare qui per immettere il testo.

### 3.4 MORPHOLOGICAL CHARACTERISTIC, TERREIN TYPE AND LAND USE

*Describe the morphological context (e.g. flat, coastal, mountain area), the terrain type (e.g. sandy soil) and the land use (e.g. forest, urban area). This might be important for the event development or to understand how the conditions for the search and rescue operations and recovery operations are.*

Fare clic o toccare qui per immettere il testo.

### 3.5 CRITICAL INFRASTRUCTURE / SECTOR

*Select the infrastructures or the sectors present in the area of the scenario*

☐ Energy industry (production, including storage reservoirs and dams, transfer, storage, transport of energy products and energy, distribution systems)
☐ Communication and information technology
☐ Transport (road, railway, air, maritime and traffic on inland waterways)
☐ Health care system (health care, production, sale and supervision of medicines)
☐ Water management (regulation and protective water structures and municipal water supply structures
☐ Food (production of and supply with food and the food safety system, commodity reserves)
☐ Finances (banking, stock exchanges, investments, insurance and payment systems)
☐ Production, storage and transport of dangerous goods (chemical, biological, radiological and nuclear materials)
☐ Public services (maintenance of law and order, protection and rescue, urgent medical assistance)
☐ Cultural heritage and values
☐ Other: Fare clic o toccare qui per immettere il testo.

### 3.6 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 4. EVENT DETAILS

### 4.1 METEOROLOGICAL CONDITIONS

*Meteorological conditions might be relevant for the Scenario itself (e.g. if the trigger is whether related) or just because they influence emergency operations. The better those conditions are described the more useful is the scenario. In the case of a weather related trigger quantitative information should also be provided. E.g. wind speed, temperature, humidity*

Fare clic o toccare qui per immettere il testo.

### 4.2 SEASONAL PATTERN

*Select the season of the year when the event occurs in the selected scenario. E.g. spring, summer, rainy season, dry season*

☐ spring
☐ summer

☐ rainy season
☐ dry season

## 4.3 TYPE OF THE DAY

☐ Working day
☐ Weekend
☐ Holiday

## 4.4 TIME OFTHE DAY

☐ early morning (sunrise - 9 a.m.)
☐ late morning (9 - 12 a.m.)
☐ noon (12 a.m. - lunch time)
☐ afternoon (2 p.m. - 4 p.m.)
☐ late afternoon (4 p.m. - sunset)
☐ evening (sunset - 11 p.m.)
☐ night (11 p.m. - sunrise)

## 4.5 POTENTIAL SPEED OF ONSET

☐ Sudden-onset disaster
☐ Slow-onset disaster

## 4.6 PROBABLE DURATION OF THE EVENT (ACUTE PHASE)

☐ a few hours
☐ several hours
☐ one day
☐ few days
☐ one week
☐ several weeks
☐ one month
☐ several months
☐ one year
☐ several years

### 4.7 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 5. CAUSE DESCRIPTION

### 5.1 CAUSES AND TRIGGER EVENTS

*What caused the adverse events? Describe the primary hazard with aggravating condition of factor for the worst case scenario. Then describe the trigger secondary hazards (e.g. soil slips associated to a flood event) or any domino/cascading effect (e.g. tsunami-earthquake-nuclear). The better the description the better the forensic of the scenario would be. Understanding the trigger means understanding the possible prevention measures.*

Fare clic o toccare qui per immettere il testo.

### 5.2 CLIMATE CHANGE

*Describe if the climate change affects the level of the risk. E.g. increment of the frequency of the cyclones, increment of temperature, climatic migration*

Fare clic o toccare qui per immettere il testo.

### 5.3 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 6. PREPAREDNESS, RESPONSE AND RECOVERY

### 6.1 COPING RESOURCES

*Please describe local resources and national resources if they are mobilized.*

Fare clic o toccare qui per immettere il testo.

### 6.2 EARLY WARNING SYSTEM

*Set of tool and capacities in place to generate and disseminate timely and meaningful warning information on disasters*

Fare clic o toccare qui per immettere il testo.

## 6.3 WARNING TIME

*Expressed in terms of hours/days. Time occurred between the reception of the alert from the population about potential disaster and the event*

Fare clic o toccare qui per immettere il testo.

## 6.4 IMPLEMENTED PREVENTIVE AND PREPARATORY MEASURES

*In case some measure are in place for the prevention (e.g. river levees, fire break, civil protection training, anti-seismic construction).*

Fare clic o toccare qui per immettere il testo.

## 6.5 IMPLEMENTED PREPAREDNESS MEASURES

*Presence of contingency plans and a structured early warning system.*

Fare clic o toccare qui per immettere il testo.

## 6.6 IMPLEMENTED RESPONSE MEASURES

*Actions taken directly before (during warning time) or during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected (e.g. activation of anticipatory actions, such as preventive evacuation).*

Fare clic o toccare qui per immettere il testo.

## 6.7 TIME NECESSARY FOR RECOVERY

*Time necessary to return to normal life. It depends on the magnitude of the disaster, the preparedness of the country, vulnerability, access to resources, adaptability, and other considerations.*

Fare clic o toccare qui per immettere il testo.

## 6.8 TRANSBOUNDARY DIMENSION

*- if answer with yes on transboundary risk in 3.1*
*Describe the coordination action in place in case of transboundary risk (international initiatives, treaties, protocol or similar forms of cross-border cooperation).*

Fare clic o toccare qui per immettere il testo.

## 6.9 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 7. CONSEQUENCES

### 7.1 SELECT THE GROUPS OF THE IMPACTS TO ANALYZE

*Select the groups identified accordingly to the NDRA guidelines. [See the Regional Guidelines, Chapter 2.4.1]*

☐ HUMAN
☐ ECONOMIC
☐ POLITICAL & SOCIAL
☐ ENVIRONMENTAL

### 7.2 DIRECT CONSEQUENCES

*Report the physical or structural impact caused by the disaster. E.g. fatalities, destruction of infrastructure caused by the force of high winds, flooding or ground shaking. [See the Regional Guidelines, Chapter 2.4.1]*

Fare clic o toccare qui per immettere il testo.

### 7.3 TIMELINE

*Report the increasing impacts per each relevant isochronous, considering the event, the preparedness and response actions.*

### 7.4 INDIRECT CONSEQUENCES

*Report the subsequent or secondary results of the initial destruction. E.g. business interruption losses. [See the Regional Guidelines, Chapter 2.4.1]*

### 7.5 METHODOLOGY FOR DETERMINING THE IMPACTS

*Describe the methodology adopted for the estimation of the impacts, considering each indicator and indicating the existing models to produce the results, the involved expertise, the time spam of the assessment, the level of uncertainty, the availability and reliability of information.*
*E.g. To evaluate the economical impact on the housing sector, the layer of the building (from the Province Database) is intersected with the hazard map (from the Regional Hydrogeological Plan). Then the number of the resulting affected buildings is multiplied by the average unit construction cost.*

Fare clic o toccare qui per immettere il testo.

### 7.6 IMPACT ACCORDING TO THE INDICATORS

*i) Indicate the NDRA categories selected for the classification of the impact severity, according to the NDRA guidelines (e.g. limited, significant, severe, very severe, catastrophic)*
*ii) List the impact indicators selected for each group of impact (e.g. number of fatalities). Add a row per each indicator.*
*iv) Describe the rationale for marking the category of the impact (e.g. 55 deaths)*
*v) Mark the category of the severity of the impact per each indicators*
*vi) Select the level of uncertainty (low, moderate or high) for the estimation of the category severity impact for each indicator*

| Impact indicator | Category of the severity of the impact | | | | | Reliability | Rationale |
|---|---|---|---|---|---|---|---|
| | Fare clic o toccare qui per immettere il testo. | Fare clic o toccare qui per immettere il testo. | Fare clic o toccare qui per immettere il testo. | Fare clic o toccare qui per immettere il testo. | Fare clic o toccare qui per immettere il testo. | | |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |
| Fare clic o toccare qui per immettere il testo. | ☐ | ☐ | ☐ | ☐ | ☐ | Scegliere un elemento. | Fare clic o toccare qui per immettere il testo. |

### 7.7 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 8. LIKELIHOOD

### 8.1 CATEGORIES OF THE PROBABILITY/FREQUENCY

*Indicate the NDRA categories selected for the classification of the likelihood. Then mark the category of the scenario. [See the Regional Guidelines, Chapter 2.4.3]*

☐ Fare clic o toccare qui per immettere il testo.
☐ Fare clic o toccare qui per immettere il testo.
☐ Fare clic o toccare qui per immettere il testo.
☐ Fare clic o toccare qui per immettere il testo.
☐ Fare clic o toccare qui per immettere il testo.

### 8.2 METHODOLOGY FOR DETERMINING THE PROBABILITY OF THE EVENT

*Select the methodology used for the estimation of the probability of the event [See the Regional Guidelines, Chapter 4.1]*

☐ Historical analysis (statistics)
☐ Modelled frequency
☐ Expert judgement
☐ Other: Fare clic o toccare qui per immettere il testo.

### 8.3 UNCERTAINTY FOR DETERMINING THE LIKELIHOOD

*Select the methodology used for the estimation of the probability of the event [See the Regional Guidelines, Chapter 4.3]*

☐ Low uncertainty
☐ Moderate uncertainty
☐ High uncertainty

### 8.4 COMMENTS

*If any, write here additional comment*

Fare clic o toccare qui per immettere il testo.

## SECTION 9. RISK EVALUATION

### 9.1 IMPACT GROUPS - RISK MATRIX

*i) Select the impact group for each specific risk matrix below, accordingly to the impact groups analyzed*

*ii) Per each impact group, state the criteria for the evaluation of the overall group impact based on the relative indicators (E.g. weighted average, maximum class among the classes assigned to the indicators)*

*iii) Per each impact group, mark the cell corresponding to the group impact class and the likelihood of the scenario*

**Impact**: Scegliere un elemento.

**Criteria for overall group impact class evaluation:**
Fare clic o toccare qui per immettere il testo.

IMPACT CLASS

| | | | | | |
|---|---|---|---|---|---|
| 5 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1 | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 1 | 2 | 3 | 4 | 5 |

LIKLELIHOOD CLASS

**Impact**: Scegliere un elemento.

**Criteria for overall group impact class evaluation:**
Fare clic o toccare qui per immettere il testo.

IMPACT CLASS

| | | | | | |
|---|---|---|---|---|---|
| 5 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1 | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 1 | 2 | 3 | 4 | 5 |

LIKLELIHOOD CLASS

**Impact**: Scegliere un elemento.

**Criteria for overall group impact class evaluation:**
Fare clic o toccare qui per immettere il testo.

IMPACT CLASS

| | | | | | |
|---|---|---|---|---|---|
| 5 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1 | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 1 | 2 | 3 | 4 | 5 |

LIKLELIHOOD CLASS

**Impact**: Scegliere un elemento.

**Criteria for overall group impact class evaluation:**
Fare clic o toccare qui per immettere il testo.

IMPACT CLASS

| | | | | | |
|---|---|---|---|---|---|
| 5 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1 | ☐ | ☐ | ☐ | ☐ | ☐ |
| | 1 | 2 | 3 | 4 | 5 |

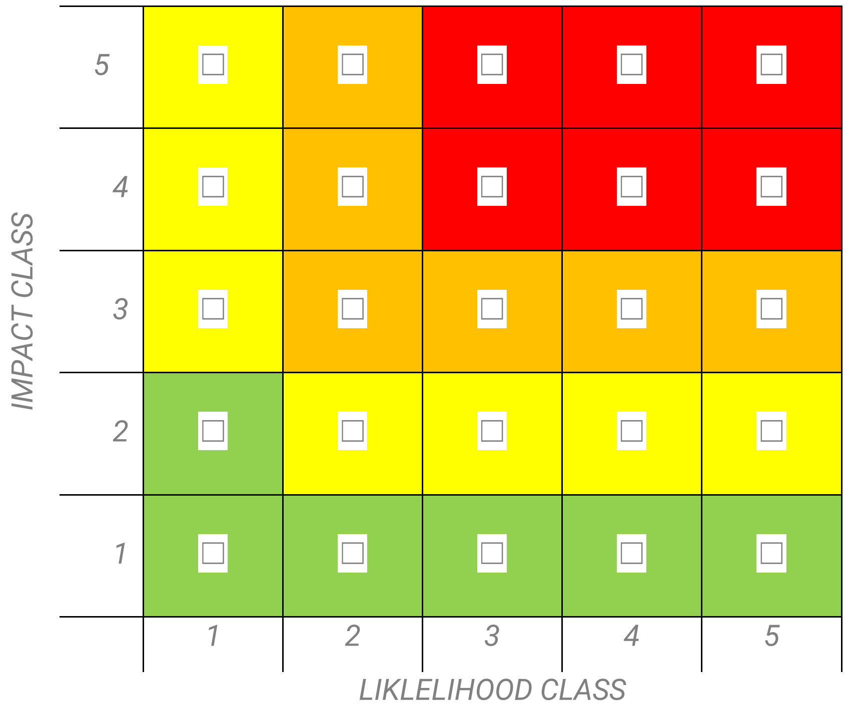
LIKLELIHOOD CLASS

## 9.2 OVERALL RISK MATRIX

*i) State the criteria for the evaluation of the overall impact based on the impact categories of each group (E.g. weighted average, maximum class among the classes assigned to the impact groups)*

*ii) Mark the cell corresponding to the human impact class and the likelihood of the scenario*

**Criteria for overall group impact class evaluation:**
Fare clic o toccare qui per immettere il testo.


IMPACT CLASS
5
4
3
2
1
1
2
3
4
5
LIKLELIHOOD CLASS

## 9.3 RELIABILITY

*Evaluate the overall reliability of the risk assessment*

| | | | |
|---|---|---|---|
| | Experts have knowledge of the design and application of methodology, vulnerabilities and resilience of people and property, and the calculation of possible damage that can be caused by this threat, which is why no significant errors in the results of risk assessment are expected | There is enough statistics and reliable data on damage, vulnerabilities and resilience of people and property, and the existing data are official and reliable, which is why no significant shortcomings in the results of risk assessment are expected | There is a specific methodology that is adapted to risk assessment, which is why high accuracy of assessment results is expected |
| | **EXPERTS** | **DATA** | **METHODOLOGY** |
| **Very high reliability** | ☐ | ☐ | ☐ |
| **High reliability** | ☐ | ☐ | ☐ |
| **Low reliability** | ☐ | ☐ | ☐ |
| **Very low reliability** | ☐ | ☐ | ☐ |
| | There are no experts in risk assessment, nor do they have sufficient knowledge of the design and application of methodology, vulnerabilities and resilience of people and property, and the calculation of possible damage that this threat may cause, therefore significant errors in risk assessment results are expected | There is not enough statistics and data on damage, vulnerabilities and resilience of people and property, and the data that exist are not official or reliable, which is why significant shortcomings in the results of the risk assessment are expected, and the quality of data can be significantly improved in the next assessment | There is not a specific methodology that is adapted to risk assessment, therefore significant errors in risk assessment results are expected |