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MEASURING HAZARDOUS EVENTS AND DISASTERS: SET OF CORE DISASTER-RISK-RELATED INDICATORS

Prepared by the Task Force

The CES Bureau set up a Task Force on measuring hazardous events and disasters (chaired by Italy) in February 2020 to support the implementation of the "CES Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters" (2020). The group was tasked to recommend a set of core statistics and indicators, develop implementation guidance, contribute to the work at the global level on statistical operationalisation of Sendai Framework, and establish a community of practice for exchange of experience and knowledge.

This document presents the proposed set of core disaster-risk related indicators. The Task Force decided to focus the list on measuring disaster risk, which is at the heart of disaster-risk management and many of its elements can be measured with existing statistics. These indicators are recommended for regular production by NSOs as they (a) strengthen evidence for disaster risk; (b) inform about the state of disaster risk in an internationally comparable way; (c) support monitoring and reporting on international policy agreements; (d) ensure consistency and coherence of information across administrative boundaries; and (e) add value to existing statistics. The proposed indicator set complements the "CES Set of Core Climate Change-Related Indicators and Statistics Using SEEA" (UNECE, 2021).

The document also includes a proposal for so-called "complementary indicators" that accompany or complement the message conveyed by "core" indicators, by providing additional detail (at sub-national or sectoral level) or focus, or covering additional aspects.

The Task Force will continue the work until 2024 and, as the next step, will develop the implementation guidelines and core statistics needed for producing these indicators, taking into account the feedback received from the CES Bureau and an electronic consultation among member countries on the proposed set of core indicators.

The Bureau reviewed the proposed set of disaster-risk related indicators in February 2023 and asked the Secretariat to send it for electronic consultation to all CES members and other stakeholders before the 2023 CES plenary session. Subject to a positive outcome of the consultation, CES will be asked to endorse the document.

Please provide your comments by 6 May 2023 using the online feedback form.

Acknowledgements

This document was prepared by the Task on Measuring Hazardous Events and Disasters under its mandate from the Conference of European Statisticians.

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Contents

Acronyms

CES	Conference of European Statisticians
DRM	Disaster risk management
DRR	Disaster risk reduction
DRSF	Disaster-related Statistics Framework
EEA	European Environment Agency
ECLAC	Economic Commission for Latin America and the Caribbean
EM-DAT	Emergency Events Database of the Centre for research on the Epidemiology of Disasters (CRE)
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ESCWA	United Nations Economic and Social Commission for Western Asia
EU	European Union
FDES	Framework for the Development of Environment Statistics
IAEG-DRSF	Inter-Agency and Expert Group on Disaster-related Statistics
ISC	International Science Council
ISIC	International Standard Industrial Classification of All Economic Activities
IWRM	Integrated Water Resources Management
NSO	National Statistical Office
OECD	Organisation for Economic Co-operation and Development
OIEWG	Open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction
SDG	Sustainable Development Goal
SEEA-CF	System of Environmental Economic Accounting – Central Framework
SF	Sendai Framework for Disaster Risk Reduction (2015-2030)
UNDRR	United Nations Office for Disaster Risk Reduction (formerly UNISDR)
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNSD	United Nations Statistics Division
WHO	World Health Organization
WMO	World Meteorological Organization

1 Background

1. The Bureau of the Conference of European Statisticians (CES) set up the Task Force on measuring hazardous events and disasters in February 2020 to support the implementation of the "CES Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters" (2020), including developing implementation guidance, recommending a set of core statistics and indicators, contributing to the work at the global level on statistical operationalisation of Sendai Framework terminology and indicator methodologies, and establishing a community of practice for exchange of experience and knowledge.

2. The Task Force decided to focus the proposed list of core indicators on measuring disaster risk . Understanding disaster risk is at the heart of disaster-risk management, and many of the elements of disaster risk can be measured with existing statistics. This concerns in particular vulnerability, coping capacity and exposure to hazards. Also, the scope is currently limited to hazards for which monitoring systems are generally available, including meteorological and hydrological hazards, geohazards, environmental hazards, chemical hazards, biological hazards and technological hazards. When more experience with the proposed set of indicators will be available, the scope could be broadened.

3. This document presents the proposed set of core disaster-risk related indicators. The implementation guidelines and core statistics needed for producing these indicators will be developed by the Task Force in 2023, taking into account the feedback received from the CES Bureau and an electronic consultation among member countries.

4. The CES Bureau is invited to review the proposed set of core disaster-risk related indicators and decide if the document can be sent for an electronic consultation to all CES members before the CES plenary session. Subject to a positive outcome of the consultation, the set of indicators will be submitted to the 2023 CES plenary session for endorsement.

5. The Task Force has a mandate until 2024. The next planned step is the development of implementation guidelines, which will discuss "low hanging fruits" and other possible starting points for implementation. The implementation guidelines will specify statistics and other data needed for the production of these indicators and discuss information needs for disaster-risk management and immediate disaster response at sub-national/local level. The implementation guidelines will also discuss relationship of the proposed indicators and statistics with statistical frameworks and classifications such as the International Standard Industrial Classification of All Economic Activities (ISIC), the UN Framework for the Development of Environment Statistics (FDES), the System of Environmental-Economic Accounting (SEEA) or the System of National Accounts (SNA).

6. Proof of the usefulness of the indicator list is its implementation by countries. The list should be reviewed after a certain number of years (e.g. 4 years), taking into account national experiences and methodological developments.

7. A platform is needed where countries can present progress, and exchange knowledge and experience (could be for example the annual Expert Fora for Producers and Users of Disaster-related Statistics).

2 Purposes of the set of core disaster-risk related indicators

8. The proposed list of indicators was developed in response to the request by the CES Bureau to provide guidance to NSOs concerning the regular production of disaster-risk related information. As with all CES Recommendations, the list is prepared to help countries in their work on measuring disaster risk and it does not constitute an obligation to implement all the indicators.

9. The main purposes of the set of core indicators are to:

a) Strengthen **evidence for disaster risk**;

b) Allow the **regular production and dissemination of disaster risk information** by all national statistical systems (NSSs) in CES member countries;

c) Inform about the **state of disaster risk in an internationally comparable way**, i.e. help to understand the disaster risk situation in a given area (ideally all dimensions of risk);

d) **Support monitoring and reporting** against international policy agreements (SDGs, Sendai framework, Paris agreement, etc.);

e) Ensure **consistency and coherence of information across administrative boundaries** at the national and sub-national levels, and promote data exchange and harmonization, through interoperability and standardization, between organizations in the NSSs.

f) **Add value to existing statistics** to have regular statistics on disaster risk and support the production of long-term data series.

10. The list of proposed core indicators provides countries useful guidance for producing and using information on disaster risk which is internationally comparable and which paints the broad picture of disaster risk and its changes over time. Given the diversity of countries in terms of disaster risk and capability to produce the related statistics, it is unrealistic to expect a full implementation of this list of indicators in the short-term.

11. NSOs and National Disaster Risk Agencies are invited to jointly prioritise the list of indicators and develop a national work plan for implementation. Prioritisation should take into account:

i. Prevailing hazards in the country;

ii. Level of disaster risk for known hazards;

iii. Methodological soundness of indicators (tier 1 and tier 2 indicators); and

iv. Capacity to produce the underlying statistics in the short-, mid- and long-term.

12. Ideally, in the long-term, the full list of indicators will be implemented as it provides a broad picture of disaster risk which is coherent from the sub-national to the national level, and also internationally comparable.

13. Furthermore, countries may consider disaggregation of these indicators (e.g. by administrative units, ethnicity, gender, income, etc.) and to accompany them with further contextual indicators to inform national and sub-national DRR management.

14. The conceptual scope of the list of proposed indicators is currently limited to main hazards driven by climate change, meteorological and hydrological hazards, geohazards, environmental hazards, chemical hazards, biological hazards, and technological hazards, as they are commonly managed and measured. Countries can apply a broader scope if necessary. It is recommended to review the list of indicators and to widen the scope once experience with its implementation is available. For more information on the hazards included in the scope see section 5.2.1.

15. The indicator set complements the “CES Set of Core Climate Change-Related Indicators and Statistics Using SEEA” (UNECE, 2021).

3 Definition of disaster risk and disaster-risk related indicators

3.1 Definition of disaster risk

16. The "Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction" (UNISDR, 2017) defines **disaster-risk** as *the potential loss of life, injury, or destroyed or damaged assets, which could occur to a system, society, or a community in a specific time period, determined probabilistically as a function of hazard, exposure, vulnerability and capacity*.

17. In other words, disaster risk results from a combination of:

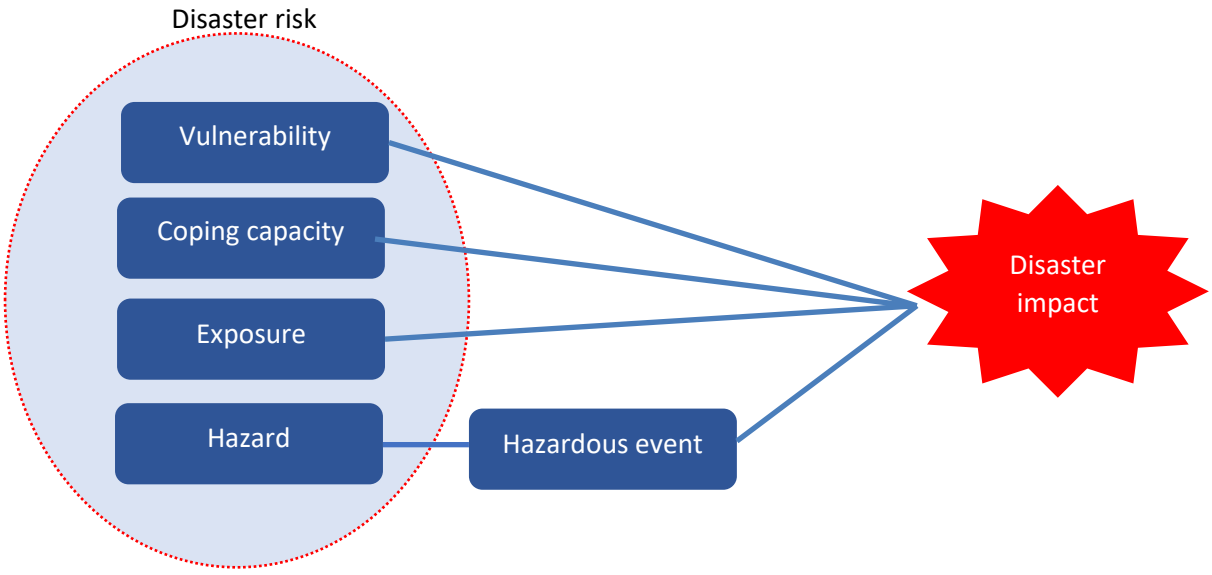
- Vulnerability (or resilience, included here as opposite of vulnerability);
- Coping capacity;
- Exposure; and
- The existence of a hazard.

18. The *Open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction* (OIEWG) defines the terms vulnerability, capacity and exposure as follows:

- **Vulnerability** is the condition 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.
- **Coping 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.
- **Exposure** is the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

19. The following Figure 1: shows the basic model of disaster risk and disaster impact as described above (UNECE, 2020).

Figure 1: Simplified hazardous event-disaster impact model



Source: UNECE, 2020

3.2 Disaster-risk related indicators

20. The main focus of disaster-risk related indicators is on the four components of disaster risk (existence of a hazard, vulnerability, coping capacity and exposure). For these areas a larger number and more detailed indicators are recommended than for other areas, to address the most important aspects of disaster risk, which generally has a wide scope.

21. The set of core disaster-risk related indicators provides aggregated figures (annual national aggregates for all types of hazards) for each of the components of disaster risk. It also includes statistics on disaster-risk reduction activities and impacts.

22. In many circumstances it will be useful to further disaggregate these figures, for example by type of hazard, administrative region or for individual hazardous events or disasters.

4 Main criteria for selection of core indicators

23. The main selection criteria for the proposed list of core indicators are the following:

a) **Relevance** for the region

b) **Sound methodology** available (ideally internationally agreed methodology)

c) **Data generally available** (either within the NSS or other regularly produced by other agencies)

24. However, relevance is the most important criterion as it can trigger development of methodologies or data production, if not available.

25. For practical purposes the identification of core indicators requires prioritization. Therefore, in addition to the above-mentioned main criteria, the following rules were applied in the selection process:

- **Pre-selection of related indicators** from the following global and regional frameworks:
  a) **SDG indicators** (used acronym in tables of this report: SDG);
  b) **Sendai Framework indicators** (used acronym in tables of this report: SF);
  c) **CES set of core climate change-related indicators** (used acronym in tables of this report: CESCC);
  d) **Global set of climate change statistics and indicators** (used acronym in tables of this report: CC).
- Use of **indicators which are not hazard specific**, but which could be disaggregated by type of hazard where relevant.
- Focus on **selected hazards** (see section 5.2.1). Widening of the scope should be considered when experience with the proposed indicator set is available.
- For the time being **excluding certain hazards**, such as extra-terrestrial hazards, societal hazards, transport accidents.
- Consideration of the **main elements at risk** consistently in each of the components of the indicator framework. Main elements at risk include human lives as well as economic and environmental assets (see section 5.2.3). Ideally, for each main element at risk one indicator can be found in each of the components of the indicator framework (for example, there should be at least one indicator for the element at risk “cultural heritage” in each of the framework’s components “disaster risk reduction activity”, “exposure”, “vulnerability”, “coping capacity”, “direct impacts” and “indirect impacts”).
- The core set should be basic and simple, **most countries should be able to easily produce them**. In practice it will not be possible to consider all dimensions of disaster risk from the beginning. Relevant indicators for which no internationally agreed methodology exist (tier 3 indicators) should become part of a research agenda, but nevertheless countries are encouraged to produce national proxy indicators and share their experience.
- Core indicators are generally **annual figures for the entire national territory**. They are not further disaggregated. However, disaggregation is recommended for operational purposes (e.g. by sub-national units, type of hazard, hazardous event, population group (e.g. sex, income, age, ethnicity), economic activity (ISIC), etc.

26. In practice, it was not possible to always apply all these selection criteria. **Expert judgement** of Task Force members was used[1] to keep the right balances between the demands for

i. a comprehensive indicator framework (a large number of indicators) versus a manageable (relatively small) number of core indicators;
ii. selection of relevant indicators versus indicators for which a sound methodology and data exist;
iii. indicators for which methods and data already exist, versus new and better indicators for which methodologies are currently being developed.

27. The resulting list of recommended core indicators reflects the situation as of end 2022. Once countries and international organisations have gained experience with these indicators, it is recommended to review the list, also taking into account methodological developments.

28. A large proportion of the information needed to measure disaster risk is already being produced by NSOs. This requires information about population, infrastructure, health, expenditures etc. The proposed set of core disaster-related indicators is also useful to review whether the existing statistics at an NSO are fit for purpose or certain adjustments are needed to improve data availability and data quality.

[1] For example, in November 2022, all members of the Task Force were consulted to express their opinion whether the proposed indicators should all be core indicators. As a result of this consultation process the list was reduced by 26 indicators (of which most are now recommended as “complementary indicators”).

5 Indicator framework and further considerations

29. This chapter discusses the use of the Disaster-related Statistics Framework DRSF (ESCAP, 2018) as the underlying indicator framework. It also presents additional considerations, such as the types of hazards and the vulnerable elements which are within the measurement scope.

5.1 Use of the Disaster-related Statistics Framework (DRSF)

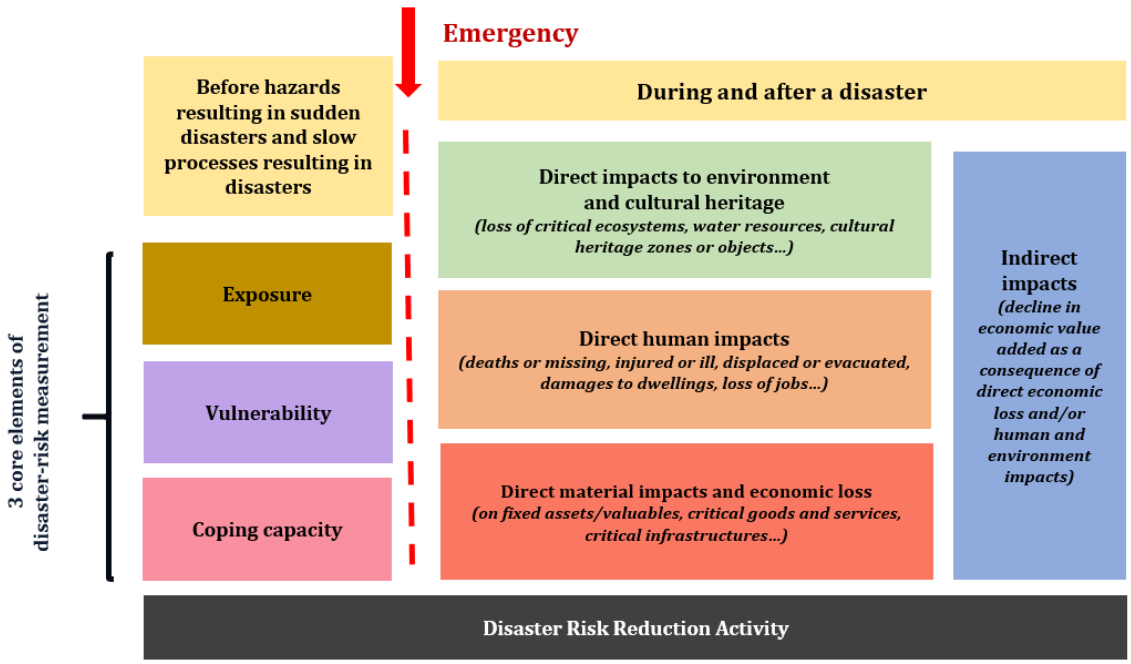
30. The DRSF of ESCAP was developed through an iterative and interactive process by the Expert Group on Disaster-related Statistics in Asia and the Pacific from 2014-2018. The UNECE Task Force on Measuring Hazardous Events and Disasters contributed to the work and prepared the publication *CES Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters* (UNECE, 2020).

31. DRSF is designed for use by national agencies to improve quality and harmonization of statistics in support of monitoring the Sendai Framework for Disaster Risk Reduction 2015-2030 and the Sustainable Development Goals. It provides the foundation for the development of a Global Framework on Disaster-related Statistics[2] by the Inter-Agency and Expert Group on Disaster-related Statistics (IAEG-DRS), which was established under the umbrella of the UN Statistical Commission (50th Session, Decision 50/116) in 2020.

32. DRSF is used as the underlying framework to present the list of core disaster-risk related indicators. Once a global framework is available some of the indicators may need to be re-arranged.

33. Figure 2 presents the main components of DRSF. These components are also closely linked with the indicator framework used for presenting the CES Core Climate Change-related Indicators (organised in 5 areas: climate change drivers, GHG emissions, impacts, mitigation and adaptation).

Figure 2: Disaster-related Statistics Framework (ESCAP, 2018)



[2] See also note on possible input for the development of the global framework in section 8.4.

5.2 Three main dimensions of the indicator framework

34. The indicator framework used for the set of core indicators addresses the following three dimensions:

i. **Types of hazards**: For practical reasons the set of core indicators focusses on hazards for which monitoring systems are developed.

ii. **Components of DRSF**: The components presented in DRSF (see Figure 2 above) and which present the main phases of disaster risk management;

iii. **Elements at risk:** The elements at risk include human lives as well as economic and environmental assets.

35. Applying these three dimensions for the set of proposed core indicators ensures maximum coherence between the indicators. It also allows for the identification of areas which may be important to be measured (in qualitative or quantitative terms), but for which no internationally agreed indicators are currently available.

36. The three dimensions and related measurement challenges are described in more detail in the following sub-sections.

5.2.1 Dimension "Types of hazards"

37. Even if it is desirable to measure risk for all types of hazards, this is difficult from several perspectives, for example:

i. Several hazardous events are difficult to quantify (e.g. droughts);

ii. Not all hazards are equally relevant in all countries;

iii. Thresholds for inclusion of events or losses/damages in databases are not homogeneous.

38. For practical reasons, the Task Force decided to recommend countries in a first step to focus on **main hazards driven by climate change, meteorological and hydrological hazards, geohazards, environmental hazards, chemical hazards, biological hazards** and **technological hazards,** as far as monitoring systems are generally available. When more experience with the proposed set of indicators will be available, the scope could be broadened.

39. The climate change-related hazard types can vary significantly in the region. For example, the intensity, frequency and impacts related to heat waves, cold waves, droughts, floods or forest fires differ in countries.

40. According to the UNDRR/ISC hazard classification (UNDRR/ISC, 2020) climate change is a disaster risk driver, causing compound and cascading hazards. The hazards driven by climate change include meteorological and hydrological, environmental, biological and societal hazards.

41. There is no internationally agreed statistical classification on hazards available. All UN member countries are reporting indicators under the "Sendai Framework for Disaster Risk Reduction 2015-2030", and the recommended classification is the one of the UNDRR/ISC "Hazard definition and classification review" (2020). **For maximum coherence and international comparability, the Task Force recommends using the UNDRR/ISC classification also for the production of disaster-risk related statistics and indicators.**

42. The UNDRR/ISC hazard classification is a non-hierarchical list of hazards recognising that a hierarchical classification does not adequately capture the complex interplay between different hazards. However, to aid readability, it represents the hazards in a grouped structure with hazard types and hazard clusters.

43. A comprehensive measurement of disaster risk in a country would require harmonised measures of all types of hazards as identified in the UNDRR/ISC hazard classification. This very broad scope of hazards includes:

i. **Meteorological and hydrological hazards:** Meteorological and hydrological hazards are those 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. According to EM-DAT, from 1979 to 2019, 50% of all recorded disasters (including technological and 'complex' disasters), 56% of deaths and 75% of economic losses are attributed to weather, climate and water-related hazards. Some of the most devastating hazards include tropical cyclones, drought, riverine floods and heatwaves.

ii. **Extraterrestrial hazards:** Extraterrestrial hazards are those originating outside the Earth, such as asteroid and meteorite impacts or solar flares. For example, solar flares have the potential to cause widespread disruption and damage to communication satellites and to electric power transmission, resulting in large economic losses.

iii. **Geohazards:** Geohazards are hazards with a geological origin. They have been divided into three hazard clusters, two of which – seismogenic and volcanogenic – are the result of Earth's internal geophysical processes, and a third – shallow geohazards – are the result of surface or near-surface processes, generally resulting in erosion or some type of mass movement.

    i. Seismogenic hazards, commonly referred to as earthquakes, give rise to specific hazards such as ground shaking, subsidence or ground rupture, but can also trigger hazards such as tsunami or rockfall.

    ii. Volcanogenic hazards give rise to a wide range of hazards from lava flow and rockfall to ashfall and ground gases.

    iii. Shallow geohazards: Some geohazards may be partially induced or exacerbated by human activity, such as earthquakes or sinkholes from mining activity, or coastal erosion from deforestation.

iv. **Environmental hazards:** Environmental hazards arise through degradation of the natural systems and ecosystem services upon which humanity depends. Ecosystem services including air, water, land, biodiversity and some key earth processes are threatened by environmental degradation, here defined as loss of utility. Degradation can be a gradual process and hard to discern on a day-to-day basis. This includes biodiversity loss, land salination, loss of permafrost, and the marine equivalents – including loss of sea ice.

v. **Chemical hazards:** This covers chemical hazards that have immediate (acute) effects, as well as chronic effects, often resulting from long-term exposures with adverse health outcomes, such as damage to the nervous and immune systems, impaired reproductive function and development, cancer and organ-specific damage.

vi. **Biological hazards:** Biological hazards, which cover a range of hazards of organic origin, can cause significant loss of life, affecting people and animals at the population level, as well as plants, crops, livestock, and endangered fauna and flora, and can lead to severe economic and environmental losses. They include pathogenic microorganisms, and toxins and bioactive substances that occur naturally or are deliberately or unintentionally released. Bacteria, viruses, parasites, venomous animals and mosquitoes carrying disease-causing agents are also examples of biological hazards. Exposure to zoonotic pathogens is often the source of emerging infectious diseases in humans, which puts a focus on risk assessment and risk management measures at the human-animal-environment interface.

vii. **Technological hazards:** A characteristic of technological systems is their complexity, with many dependent subsystems. Thus, failure of one element within this system has impacts that spread throughout the chain. However, impacts can also occur outside the system, with a wide spectrum of impacts ranging from national interests such as state security, to economics, health and basic human needs. Technological hazards arise from the possibility of failure of an existing technology as well as from emerging technologies.

viii. **Societal hazards:** Societal hazards are brought about entirely or predominantly by human activities and choices, and have the potential to endanger exposed populations and environments. They are 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. Societal hazards also have the potential to result in disasters and cause significant numbers of deaths, illness, injury, disability and other health effects, disruption to societal systems and services, and social, economic and environmental impacts. As this is a very broad category that includes technological and chemical hazards, a more restricted type is needed to include some societal processes and phenomena.

44. As priorities in countries differ, and given the broad scope of possible hazards as well as the practical challenges in determining and measuring individual hazardous events, the Task Force recommends countries to focus on the following hazards as a minimum:

a) **Meteorological and hydrological hazards**, for example floods, lithometeors (fog, haze, sandstorm, smoke, etc.), precipitation-related hazards, temperature-related hazards, wind-related hazards, etc.;

b) **Geohazards**, for example seismogenic (earthquakes) and volcanogenic hazards;

c) **Environmental hazards as far as they are seen in relationship with human health and climate change**, for example air pollution, wildfires, soil erosion, sea-level rise, etc.

d) **Biological hazards as far as they concern human health**, for example infectious human health diseases.

5.2.2 Dimension "Components of the DRSF"

45. The set of core disaster-risk-related indicators focusses on the following components of DRSF:

- **Frequency and dimension of hazardous events:** The existence of a hazard is the main component of disaster risk. For analytical purposes and the assessment of disaster risk it is therefore important to measure the main hazardous events and their development over time in terms of magnitude, affected area and impact (thus also measuring success of measures to reduce disaster-risk). The metrics used for measuring hazardous events (usually physical characteristics) differ from those of measuring disasters (usually a measurement of the socio-economic or environmental impact, see "disaster impacts" below).

- **Exposure**: Exposure is a component of disaster risk. The objective is to measure people, housing, buildings (or built-up areas), transportation facilities and other infrastructure, land use, production capacities and other potentially important assets located in the hazard areas, such as important ecosystems, crop areas and economic data for assessing exposure of economic assets and activities. (DRSF para. 24).

- **Vulnerability**: Vulnerability is a component of disaster risk. Vulnerability statistics are an extension of exposure statistics by adding statistics on relevant characteristics, or disaggregation of the population, infrastructure or land uses exposed to a hazard. There are many social-economic factors affecting vulnerability such as age of a person at the time of the disaster, or persons with disabilities which can be significant in situations where physical fitness is necessary for survival. Gender can be a factor, for example due to emergence of

violence and sexual abuse after disasters. Poverty, which correlates with less healthy and less safe environments and poor education is another possible factor. There are also many forms of vulnerability to hazards that are derived from the context of the infrastructure or other characteristics of the built landscape. For example, poor access to freshwater and to adequate sanitation facilities are vulnerable conditions and an area where basic services will be urgently required for restoration and recovery after a disaster. (see DRSF paras. 30-32)

- **Coping capacity**: Coping capacity is a component of disaster risk. It is reflected in many factors related to the resilience of households, businesses, communities, social-ecological systems, and whole countries against external shocks in the form of a hazard. This is the ability of households or businesses or infrastructure to recover from external shocks without sustaining major permanent negative impacts, and instead moving towards opportunities for improvements in the future, e.g., "building back better". Many strategies for coping with disasters are informal and not managed by governments, and therefore difficult to measure. For example, one of the coping mechanisms in the case of drought or other types of climate or hydrological-related hazards is migration, either permanently or temporarily, in search of a livelihood outside the worst affected areas. Population movements that correspond with a disaster can sometimes be captured via statistics from population censuses or administrative records. It is more difficult to attribute movements specifically to hazards or a past disaster. There also are coping mechanisms which can be captured by statistics based on government records, e.g. expenditures from surveys of preparedness of households or businesses in potentially exposed areas. (DRSF paras. 48 – 50).
- **Disaster-risk reduction activities**: Disaster risk reduction-related (DRR) activities are activities that boost coping capacities of society where a disaster occurs or may occur. Outcomes of these investments include improved coverage of early warning systems and the basic knowledge and preparedness of households (coping capacity), and affect the overall risk profile for a given community or region within a country. The costs of investment in DRR are expenditures or transfers for activities with a DRR purpose. A main area of interest about disaster risk reduction activity statistics is national DRR expenditure. The size of this expenditure can be compared with other activities and with total GDP. Risk analyses can benefit from comparisons between investment within the categories of DRR activities, like post-disaster reconstruction expenditures and post-disaster structural measures for future disaster prevention, e.g., build back better. (see DRSF chapter 5)
- **Disaster impacts**: Even if disaster impacts are conceptually not part of the definition of disaster risk it is important to include some indicators related to disaster impacts in the set of core indicators. For assessing disaster risk and the effectiveness of DRR activities, measures on disaster impacts are needed. The magnitude of disasters is usually measured by their impact (e.g. by using the EM-DAT threshold values, which, besides other issues, use the number of deaths or people affected).

5.2.3 Dimension "Elements at risk"

46. The starting point for defining elements at risk is the definition of disaster impact in the "Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction" (UNISDR, 2017): *Disaster impact is the total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being.*

47. From that definition we can derive, that elements which can be impacted by a disaster include humans as well as economic and environmental assets. For the purpose of the indicator framework we call them "elements at risk".

48. To ensure coherence among the chosen indicators throughout all components of the framework the Task Force has broken down these elements in the following categories:

i. **People:** Human beings whose lives, health as well as their physical, mental and social well-being are at risk;

ii. **Housing:** This includes all units intended for habitation. A 'housing unit' is a separate and independent place of abode intended for habitation by a single household, or one not intended for habitation but used as a usual residence by a household. This includes 'occupied conventional dwellings' and 'other housing units'. 'Other housing units' are those that do not come fully within the category of a conventional dwelling either because they are mobile, semi-permanent or improvised, or are not designed for human habitation, but which are nevertheless used as the usual residence of one or more persons who are members of one or more private households. See CES Recommendations for the 2020 Censuses of Population and Housing (UNECE, 2015);

iii. **Basic services:** Services that are needed for all of society to satisfy basic human needs. Examples of basic services include water supply, sanitation, health care, and education. They also include services provided by critical infrastructure such as electricity, telecommunications, transport, and waste management that are needed for all of society to function. For related indicators, disruption, interruption or lower quality of basic services is proposed to be measured for the following public services:

- Education
- Healthcare
- Energy
- Sewerage
- Solid waste management
- Transport
- Water supply
- Information and Communication
- Emergency Response

For more details, see UNISDR (2018).[3]

iv. **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, 2018). Critical infrastructure includes infrastructure providing basic services (see above), protective infrastructure and green infrastructure. For more details, see UNISDR (2018);

v. **Economic activities:** This category refers to the total of economic activities as defined in ISIC rev. 4. Disasters may cause direct economic impacts (e.g. loss of assets) and indirect economic and social impacts (e.g. lower economic output, loss of jobs);

vi. **Food security and agriculture:** This category refers to the food security of a country, which is usually closely related with domestic agricultural production.

vii. **Water security:** This category refers to the availability, accessibility and quality of all freshwater resources, i.e. stocks of surface water, groundwater and soilwater (see SEEA-

[3] https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai

CF) and their sustainable management (Integrated Water Resources Management – IWRM).

viii. **Energy security:** Energy security means having stable access to energy sources on a timely, sustainable and affordable basis[4]. It is singled out as a separate category, given its growing importance in the context of climate change and the current energy crisis.

ix. **Health care:** This is the total of health care capacity, including health care facilities and equipment (see critical infrastructure above), but also the number of doctors, nurses, health education etc. It is singled out as a separate category, given its importance in the context of Covid-19 and other potential climate change impacts.

x. **Cultural heritage:** Cultural heritage includes artefacts, monuments, buildings and sites, museums that have a diversity of values including symbolic, historic, artistic, aesthetic, ethnological or anthropological, scientific and social significance. It includes tangible heritage (movable, immobile and underwater), intangible cultural heritage (ICH) embedded into cultural and natural heritage artefacts, sites or monuments. The definition excludes intangible cultural heritage related to other cultural domains such as festivals, celebrations, etc. It covers industrial heritage and cave paintings. See UNESCO (2009).[5]

xi. **Governance:** Disasters also can have direct and indirect impacts on governance. This includes financial impacts (for example loss of governmental assets, costs of disaster assistance) but also fewer resources for decision making, implementation of law and enforcement.

[4] https://www.osce.org/oceea/446236
[5] https://uis.unesco.org/node/3079731

6 Proposed list of core disaster-risk related indicators after applying the selection procedure

49. Table 1 lists the 53 different core indicators[6] for the following DRSF components:

- Dimensions of hazards
- Disaster risk reduction activity
- Exposure
- Vulnerability
- Coping capacity
- Direct impacts

50. No indicators are currently proposed for the component "indirect impacts" which is an area for further research.

51. Explanation of the columns of Table 1:

ID	Unique identification number of the indicator. The IDs of the indicators are indicative and will be revised later.
Indicator	Name of the core indicator
Elements at risk	P – People H – Housing BS – Basic services CI – Critical infrastructure EA – Economic activity Ec – Ecosystems F – Food security and agriculture W – Water security En – Energy security He – Health care CH – Cultural heritage
Comments	Comments are made if the proposed indicator differs from the one in another international indicator framework and/or it also appears under another DRSF component. Some comments clarify methodological issues or advise on complementary information or possible disaggregation.
Tier	Shows the tier level of the indicator (November 2022). Similar to the global SDG indicator framework all indicators are classified into three tiers based on their level of methodological development and the availability of data at the global level, as follows: • Tier 1: Indicator is conceptually clear, an internationally established methodology and standards are available, and

[6] Note that indicator 36 – "Proportion of land that is degraded over total land area (SDG 15.3.1)" appears in both components vulnerability and direct impacts.

data are regularly produced by at least 50 per cent of countries, for every region where the indicator is relevant.

- Tier 2: Indicator is conceptually clear, an internationally established methodology and standards are available, but data are not regularly produced by countries.
- Tier 3: Internationally established methodology or standards are not yet available, but methodology/standards are being (or will be) developed or tested.

The tier levels are taken from related reference documents (e.g. for SDG indicators and global set of climate change statistics and indicators) or are based on an assessment of members of the Task Force.

Methodology — Presents existing methodological references, including weblinks. Same acronyms as mentioned under "Source" are used.

Source — Information about the original source of the indicator. If the indicator was taken from another international indicator framework, this is indicated here with the identification number of the indicator in that particular framework.

- CESCC: Conference of European Statisticians' Core Climate Change-related indicators
- CC: Global set of climate change statistics and indicators
- SDG: Global SDG indicator framework
- SF: Sendai Framework for Disas5ter Risk Reduction
- TF: Recommended by the Task Force
- WMO: World Meteorological Organization

Table 1: CES Core Disaster-related Indicators

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
Dimensions of hazards																
1	Number of hazardous events per year (per type of hazard)	x	x	x	x	x	x	x	x	x	x	x	Internationally recommended threshold values for other (than hydrometeorological) types of hazards to be developed, countries should use national threshold values in the meantime; tier depends on type of hazard	1-3	WME CHE for hydrometeorological hazards: Guidance for hydrometeorological hazards is currently being finalised: https://community.wmo.int/meetings/wmo-workshop-finalization-cataloguing-hazardous-weather-water-climate-and-space-weather-events-implementation-plan-che	TF
2	Proportion of hazardous events with deaths per year (per type of hazard).	x											Tier depends on type of hazard	1-3	WME CHE for hydrometeorological hazards: Guidance for hydrometeorological hazards is currently being finalised: https://community.wmo.int/meetings/wmo-workshop-finalization-cataloguing-hazardous-weather-water-climate-and-space-weather-events-implementation-plan-che	TF
3	Proportion of coastal areas vulnerable to sea level rise	x	x	x	x	x	x	x	x	x	x	x	Even if this is a very specific indicator, it is one of the very few indicators that may anticipate the location of future impact with accuracy, thus can help to plan accordingly. If the potentially affected area is defined, it is possible to estimate the number of houses, people etc. at risk.	2	Bondesanf, M., Castiglioni, G.B., Elmis, C., Gabbianellis, G., Marocco, R., Pirazzolift, P.A. and Tomasin, A., 1995. Coastal areas at risk from storm surges and sea-level rise in northeastern Italy. Journal of Coastal Research, pp.1354-1379.: https://www.researchgate.net/profile/Fabrizio-Antonioli/publication/312289623_Sea-level_rise_and_potential_drowning_of_the_Italian_coastal_plains_Flooding_risk_scenarios_for_2100/links/5e044b0e299bf10bc37973ab/Sea-level-rise-and-potential-drowning-of-the-Italian-coastal-plains-Flooding-risk-scenarios-for-2100.pdf	CC 106
Disaster Risk Reduction Activity																
4	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national	x	x	x	x	x	x	x	x	x	x	x		2	SDG and SF: https://unstats.un.org/sdgs/metadata/ and https://www.undrr.org/publication/technica	SDG 1.5.4,

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
	disaster risk reduction strategies (SDG 1.5.4, SF E-2))														l-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF E-2, CC 133
5	Proportion of government expenditure on DRR in relation to GDP	x	x	x	x	x	x	x	x	x	x	x	In addition to the total government expenditure a distinction could be made between central government expenditure and local government expenditure	3	See e.g. national example of Indonesia: https://www.unisdr.org/files/32377_32377indonesiadraftdrrinvestmenttra.pdf	TF
9	Proportion of curriculum (hours) in schools dealing with disaster risk in relation to total hours	x												2	Data owned by national government and/or lower levels of government that have jurisdiction on this issue	TF
10	Proportion of government expenditure in early warning or Early Warning Systems (EWS) in relation to GDP	x											There is a caveat that many of EWS may have huge expenditure in the initial investment, and mainly maintenance cost afterwards.	2	Data owned by government	TF
11	Proportion of government expenditure on risk awareness programs in relation to GDP	x											There is a need to define what can be considered as risk awareness programs.	3	Data owned by government	TF
12	Proportion of municipalities with land use plans with consideration of disaster risk in relation to total land use plans.	x	x	x	x	x	x	x	x	x	x	x		2	Data owned by national government and/or lower levels of government that have jurisdiction on this issue	TF
Exposure																
13	Proportion of population living in hazard-prone areas in relation to total population	x	x										Aggregate of global CC indicators 100 and 102; should be presented by types of major hazards	2	Global CC: https://unstats.un.org/unsd/envstats/climatechange.cshtml	CC 100 & 102
14	Proportion of population living in areas affected by projected 1 m sea-level rise	x	x											2	Bondesanf, M., Castiglioni, G.B., Elmis, C., Gabbianellis, G., Marocco, R., Pirazzolift, P.A. and Tomasin, A., 1995. Coastal areas at risk from storm surges and sea-level rise in northeastern Italy. Journal of Coastal Research, pp.1354-1379.: https://www.researchgate.net/profile/Fabrizio-Antonioli/publication/312289623_Sea-level_rise_and_potential_drowning_of_the_Italian_coastal_plains_Flooding_risk_scenarios_for_2100/links/5e044b0e299bf10bc37973ab/Sea-level-rise-and-potential-drowning-	TF

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
															of-the-Italian-coastal-plains-Flooding-risk-scenarios-for-2100.pdf	
15	Proportion of dwellings located in hazard-prone areas in relation to total dwellings		x										Could be presented by types of major hazards; has a wider scope in terms of hazards than CC 92 (Buildings (settlements) vulnerable to climate change)	2	dependent on mapping of hazard prone areas	TF and CC 92
16	Proportion of road infrastructure (km) located in hazard-prone areas in relation to total road infrastructure (km)			x	x								Could be presented by types of major hazards; Possible disaggregation of the indicator by type of road. Countries could produced complementary indicators for other types of transportation infrastructure (railroad, aviation, sea navigation).	2	UNDP: PDNA Transport: https://www.undp.org/sites/g/files/zskgke326/files/publications/PDNA_Transport_FINAL.pdf	TF
19	Proportion of farmland in hazard-prone areas in relation to total farmland							x					Could be presented by types of major hazards	2	dependent on mapping of hazard prone areas	TF
21	Proportion of number of hospital beds in hazard-prone areas in relation to total beds			x	x						x			2	dependent on mapping of hazard prone areas	TF
22	Proportion of population supplied by water supply industry (ISIC 36) in relation to total population in hazard prone areas			x										2	IRWS, and dependent on mapping of hazard prone areas: https://unstats.un.org/unsd/publication/seriesM/seriesm_91e.pdf	TF
Vulnerability																
24	Proportion of population living below the national poverty line, by sex and age (SDG 1.1.1)	x												1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 1.1.1, CC 101
26	Old-age dependency ratio	x												1	Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Old-age_dependency_ratio	Eurostat
28	Proportion of energy from thermal, nuclear and hydroelectric power plants in relation to total energy generation			x						x			WMO warned in its report from this dependence (https://public.wmo.int/en/media/press-release/climate-change-puts-energy-security-risk)	1	WMO: https://public.wmo.int/en/media/press-release/climate-change-puts-energy-security-risk	WMO

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
29	Proportion of population without quality access to electricity			x						x			A relevant indicator, but internationally it still needs to be defined what "quality access" means from a methodological and measurement point of view.	3	For example, Spain's Red Electrica measures "non-availability rate" (percentage of total time)	TF
31	Proportion of world heritage sites without an emergency preparedness plan											x	Countries have the duty to supervise and approve emergency preparedness plans; see also UNESCO database: https://whc.unesco.org/en/list/	2	UNESCO: Emergency preparedness plans: https://whc.unesco.org/archive/2007/whc07-31com-72e.pdf	TF
36	Proportion of land that is degraded over total land area (SDG 15.3.1)						x	x	x	x	x	x	Possible proxy indicator: Change of land area affected by soil erosion (global CC set indicator 61); this is an indicator that can also be used to measure impact	1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 15.3.1, CC 71
Coping capacity																
37	Proportion of agricultural area under productive and sustainable agriculture (SDG 2.4.1)						x	x						1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 2.4.1, CC 148
38	International Health Regulations (IHR) capacity and health emergency preparedness (SDG 3.d.1)	x									x			1	SDG: https://unstats.un.org/sdgs/metadata/	SDG 3.d.1
39	Number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms (SF G-3)	x												2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF G-3
40	Percentage of population exposed to or at risk from disasters protected through pre-emptive evacuation following early warning (SF G-6)	x												2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF G-6
41	Proportion of the target population covered by all vaccines included in their national programme (SDG 3.b.1)	x									x			1	SDG: https://unstats.un.org/sdgs/metadata/	SDG 3.b.1
42	Health worker density (SDG 3.c.1)	x									x			1	SDG: https://unstats.un.org/sdgs/metadata/	SDG 3.c.1

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
43	Proportion of population served by municipal waste collection	x	x	x	x	x	x	x	x	x	x	x	This is a proxy indicator for a well-functioning society. It may or may not related to disasters specifically.	2	Global CC: https://unstats.un.org/unsd/envstats/climatechange.cshtml	CC 96
44	Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type (SDG 15.1.2)						x	x	x	x	x	x		1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 15.1.2, CC 144
46	Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water (SDG 6.2.1)	x		x	x			x	x		x			1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 6.2.1, CC 97
47	Proportion of population with access to electricity (SDG 7.1.1)	x		x	x					x				1	SDG: https://unstats.un.org/sdgs/metadata/	SDG 7.1.1, CC 95
49	Percentage of local governments having a plan to act on early warnings (SF G-4)	x												2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF G-4
50	Proportion of government expenditure in strategic reserves					x							National security plans usually define the strategic reserves; it is generally defined as the reserves of commodities or items that are held back from normal use by governments in pursuance of a particular strategy or to cope with unexpected events. Metadata should define what strategic reserves includes and sectoral disaggregation is recommended. May not be comparable internationally.	2	Data held by governments, however they may not want to release data about this, if considered under the National Security Plan	TF
Direct impacts																
51	Number of disasters (per hazard type) declared by government per year	x	x	x	x	x	x	x	x	x	x	x		1	Count numbers of declarations	TF
52	Direct economic loss attributed to disasters in relation to global gross domestic product (GDP) (SDG 1.5.2, SF C-1))		x	x	x	x	x	x	x	x	x	x		2	SDG and SF: https://unstats.un.org/sdgs/metadata/ and https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SDG 1.5.2, SF C-1

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
53	Proportion of government expenditure in disaster assistance in relation to GDP												Measures the impact on governance; it could be complemented with expenditure from non- government actors like NGOs, international agencies, foreign governments.	3	Data owned by government	TF
54	Number of deaths attributed to disasters, per 100,000 population (SF A-2)	x											Sub-indictor of SDG 11.5.1	1	SDG and SF: https://unstats.un.org/sdgs/metadata/ and https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SDG 11.5.1, SF A-2
55	Number of missing persons attributed to disasters, per 100,000 population (SF A-3)	x											Sub-indictor of SDG indicator 11.5.1	1	SDG and SF: https://unstats.un.org/sdgs/metadata/ and https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SDG 11.5.1, SF A-3
56	Number of injured or ill people attributed to disasters, per 100,000 population (SF B-2)	x												1	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF B-2
58	Number of refugees, migrants and persons displaced by disasters, per 100,000 population	x											Broader scope than indicator 43 of global CC indicator set (referring to climate refugees); Internal Displacement Monitoring Centre (IDMC) has verified, consolidated and multi-sourced estimates of the number of people internally displaced or at risk of becoming displaced by conflict, violence, disasters and development projects across the world; database: https://www.internal-displacement.org/database/displacement-data; A set of displacement indicators for DRR is currently being developed by IOM (https://environmentalmigration.iom.int/sites/g/files/tmzbdl1411/files/documents/IOM-	2	IDMC: https://www.internal-displacement.org/database/methodology Global CC: https://unstats.un.org/unsd/envstats/climatechange.cshtml	CC 43

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
													IDMC-%20Disaster%20Displacement%20Indicators%20-%20Version%20for%20comments.pdf)			
59	Proportion of destroyed dwellings in relation to total number of dwellings		x											1	Countries and insurance companies are counting this as absolute numbers:	TF
60	Number of people whose destroyed dwellings were attributed to disasters (SF B-4)	x	x										It is recommended that this Sendai Framework indicator is presented as relative figure (per 100,000 population)	2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF B-4, CESCC 25
61	Economic value of lost or damaged housing stock in relation to total value of housing stock		x											1	Countries and insurance companies are counting this as absolute number	TF
62	Number of disruptions to basic services attributed to disasters (SF D-5)		x	x									For the SF indicator it is proposed to include the following public services: Educational facilities, healthcare facilities, power/energy system, sewerage system, solid waste management, transport system, water supply, ICT system and emergency response	2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF D-5
63	Number of person days without electricity due to hazardous events		x	x						x			Allows for better international comparability than Sendai Framework Indicator D-5, therefore recommended core indicator	1	Service providers have this data available	TF
64	Number of person days without gas supply due to hazardous events		x	x						x			Allows for better international comparability than Sendai Framework Indicator D-5, therefore recommended core indicator	1	Service providers have this data available	TF
65	Number of person days without water supply due to hazardous events		x	x					x				Allows for better international comparability than Sendai Framework Indicator D-5, therefore recommended core indicator	1	Service providers have this data available	TF
66	Damage to critical infrastructure attributed to disasters (SF D-1)			x	x								Measurement unit: Index of Critical Infrastructure Damage = number of infrastructure units and facilities damaged/population * 100,000	2	SF: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai	SF D-1

ID	Indicator	Elements at risk											Comments	Tier	Methodology	Source
		P	H	BS	CI	EA	Ec	F	W	En	He	CH				
36	Proportion of land that is degraded over total land area (SDG 15.3.1)						x	x	x		x	x	Possible proxy indicator: Change of land area affected by soil erosion (global CC set indicator 61); ideally, land degradation caused by hazardous events is presented separately.	1	SDG and global CC: https://unstats.un.org/sdgs/metadata/ and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SDG 15.3.1, CC 71
69	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters											x		2	SF and global CC: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SF C-6, CC 80
72	Proportion of flooded land	x	x	x	x	x	x	x	x	x	x	x		1	Flooded land information usually available	TF
73	Proportion of forest area affected by forest fires							x		x	x	x		1	Global CC: https://unstats.un.org/unsd/envstats/climatechange.cshtml	CC 67
74	Direct agricultural loss attributed to disasters (SF C-2)							x						2	SF and global CC: https://www.undrr.org/publication/technical-guidance-monitoring-and-reporting-progress-achieving-global-targets-sendai and https://unstats.un.org/unsd/envstats/climatechange.cshtml	SF C-2, CESCC 28, CC 27

7 Complementary indicators

52. Inspired by the indicator types used for OECD environmental indicators, a set of complementary indicators is also recommended. These are indicators that accompany or complement the message conveyed by "core" indicators, by providing additional detail (sub-national detail, sectoral detail) or focus, or by covering additional aspects. For country application of the framework, other country-specific indicators can be added. For application in international work, complementary indicators that describe country-specific features are particularly useful for country projects and peer reviews. Complementary indicators also include new and innovative indicators that are yet to be defined and developed, and that could become core indicators in future.

53. The list of complementary indicators presented here (Table 2 - Table 7) is not exhaustive but may be useful for countries in developing a national set of DRR-related indicators which goes beyond the recommended set of core indicators by addressing specific national information needs. All these indicators have been considered by the Task Force as potential core indicators but were dropped at a later stage as there are either sound methodologies are not available, or the indicators may not be relevant in all countries.

54. Acronyms used in (Table 2 - Table 7): CC = Global set of climate change statistics and indicators; CESCC = Core Climate Change-related Indicators of the Conference of European Statisticians.

Table 2: Complementary indicators – DISASTER RISK REDUCTION ACTIVITY

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
6	Share of government climate change adaptation expenditure in relation to gross domestic product	Elements at risk: all Source: CESCC 35 and CC 129 Methodology: https://unece.org/statistics/documents/CES-set-of-core-climate-change-related-indicators-metadata Tier 3
7	Annual variation (%) of insurance premiums covering loss and damage caused by disasters	Elements at risk: all Source: Similar (but not exactly the same) as CC 137 Methodology: Insurance companies own these data as well as state insurance regulators, and insurance industry associations Tier 2
8	Proportion of government expenditure in relocation programmes of the most exposed communities	Elements at risk: People, housing Source: Task force Methodology: Data owned by government Tier 2

Table 3: Complementary indicators - EXPOSURE

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
17	Proportion of dams with highest level of hazard potential in relation to total number of dams	Elements at risk: Critical infrastructure, water security Source: Task Force

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
		Methodology: A standard classification does not exist, but examples are available from US, Canada, UK, Spain[7] Tier 3
18	Proportion of retail stores located in hazard-prone areas in relation to total retail stores	Element at risk: Economic activity Source: Task force Methodology: Result dependent on mapping of hazard prone areas Tier 2 Comment: retail stores are the lifeline but one could expand the indicator to cover all establishments (e.g., traditional markets) that supply food and other necessities
20	Proportion of world heritage sites in hazard-prone areas in relation to total number of world heritage sites	Element at risk: Cultural heritage Source: Task force Methodology: Result dependent on mapping of hazard prone areas Tier 2
23	Annual mean levels of fine particulate matter in cities (population weighted) (SDG 11.6.2)	Element at risk: People Source and methodology: SDG 11.6.2 Tier 1
78	Proportion of rail infrastructure (km) located in hazard-prone areas in relation to total rail infrastructure (km)	Element at risk: Critical infrastructure Source: Task force Methodology: UNDP: PDNA Transport: https://www.undp.org/sites/g/files/zskgke326/files/publications/PDNA_Transport_FINAL.pdf Tier 2
79	Proportion of aviation infrastructure located in hazard-prone areas in relation to total aviation infrastructure	Element at risk: Critical infrastructure Source: Task force Methodology: UNDP: PDNA Transport: https://www.undp.org/sites/g/files/zskgke326/files/publications/PDNA_Transport_FINAL.pdf Tier 2 Comment: e.g. international airports
80	Proportion of port infrastructure located in hazard-prone areas in relation to total port infrastructure	Element at risk: Critical infrastructure Source: Task force Methodology: UNDP: PDNA Transport: https://www.undp.org/sites/g/files/zskgke326/files/publications/PDNA_Transport_FINAL.pdf Tier 2 Comment: e.g. major ports

[7] National examples: https://www.ferc.gov/sites/default/files/2020-04/fema-333.pdf, https://www.gov.nl.ca/ecc/files/env-assessment-projects-y2015-1783-1783-epr-app-l-u.pdf, https://britishdams.org/2012conf/papers/1%20Legislative%20and%20policy%20frameworks%20for%20dam%20professionals/Papers/1.4%20Vyse%20-%20Potential%20changes%20to%20hazard%20categorisation%20and%20inflow%20design%20floods%20for%20reservoirs%20in%20the%20United%20Kingdom.pdf, https://www.miteco.gob.es/es/agua/temas/seguridad-de-presas-y-embalses/guiatecnicaclasificacion_adaptacionants_nov2021_v16_tcm30-533050.pdf

Table 4: Complementary indicators - VULNERABILITY

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
25	Proportion of population with physical and mental disabilities in relation to total population	Element at risk: People Source and methodology: CC 105 Tier 3
27	Energy import dependency (Net imports / Gross available energy)	Elements at risk: Basic services, energy security Source: Eurostat Methodology: https://ec.europa.eu/eurostat/cache/metadata/EN/t2020_rd320_esmsip2.htm#indicator1644323547043 Similar with global CC indicator 94 (Net energy imports as proportion of total energy supply) Tier 1
30	Power outages	Elements at risk: Basic services, critical infrastructure, energy security Source: European Environment Agency Methodology and other possible indicators on energy systems: https://www.eea.europa.eu/publications/adaptation-in-energy-system Tier 1
32	Proportion of buildings without a disaster risk-related insurance policy in relation to the total number of buildings	Element at risk: Housing Source: Task force Methodology: Insurance companies, as well as state insurance regulators, and insurance industry associations own information about the number of dwellings, or buildings, and total number of dwellings and buildings is also known by cadastre agency or tax agency. Tier 2
33	Change in water-use efficiency over time (SDG 6.4.1)	Element at risk: Water security Source and methodology: SDG 6.4.1 Tier 1
34	Proportion of bodies of water with good ambient water quality (SDG 6.3.2)	Elements at risk: Basic services, ecosystems, food security and agriculture, water security Source and methodology: SDG 6.3.2 and CC 38 Tier 2 Comment: Lack of good ambient water quality leads to vulnerability; Can also be used to measure impact of hazardous events on water bodies
35	Reduction in the extent of natural and semi-natural ecosystems	Elements at risk: Ecosystems, food security and agriculture, water security Source and methodology: CC 66 Tier 2 Comment: Can also be used to measure impact of hazardous events on ecosystems

Table 5: Complementary indicator – COPING CAPACITY

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
45	Proportion of population using safely managed drinking water services (SDG 6.1.1)	Element at risk: People Source and methodology: SDG 6.1.1 and CC 98 Tier 1

Table 6: Complementary indicators – DIRECT IMPACTS

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
57	Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) (SDG 3.9.2)	Element at risk: People Source and methodology: SDG 3.9.2 Tier 1
67	Proportion of number of travels disrupted in relation to total planned travels	Element at risk: Economic activity Source: Task force Methodology: e.g. Zanni, A.M. and Ryley, T.J., 2015. The impact of extreme weather conditions on long distance travel behaviour. Transportation Research Part A: Policy and Practice, 77, pp.305-319. Tier 3
68	Proportion of traded commodities (tons) disrupted in relation to total traded commodities	Element at risk: Economic activity Source: Task force Methodology: not available, to be developed Tier 3
34	Proportion of bodies of water with good ambient water quality (SDG 6.3.2)	Elements at risk: Basic services, ecosystems, food security and agriculture, water security Source and methodology: SDG 6.3.2 and CC 38 Tier 2 Comment: Lack of good ambient water quality leads to vulnerability; Can also be used to measure vulnerability (lack of good water quality is an element of vulnerability)
35	Reduction in the extent of natural and semi-natural ecosystems	Elements at risk: Ecosystems, food security and agriculture, water security Source and methodology: CC 66 Tier 2 Comment: Can also be used to measure vulnerability
70	Proportion of change in permanent snow cover	Elements at risk: Economic activity, ecosystems, food security and agriculture, water security, energy security, cultural heritage Source and methodology: CC 32 Tier 2
71	Reduction of extent of glaciers	Elements at risk: Economic activity, ecosystems, food security and agriculture, water security, energy security, cultural heritage Source and methodology: CC 35 Tier 2

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
75	Economic value of loss in agriculture production (tons of crops) in relation to total planned production	Element at risk: Food security and agriculture Source: Task force Methodology: Agro-insurance Industry has these data. Tier 2
76	Economic value of loss in livestock production (meat and milk) in relation to total planned production	Element at risk: Food security and agriculture Source: Task force Methodology: Agro-insurance Industry has these data. Tier 2 Comment: related to indicator CC 29 (impact of climate change on livestock productivity - tier 3)

Table 7: Complementary indicator – INDIRECT IMPACTS

ID	Indicator	Elements at risk, source, methodological reference, tier and comments
77	Excess mortality	Element at risk: People Source: WHO, Eurostat, University of Oxford Methodology: Eurostat's excess mortality indicator is expressed as a percentage of additional deaths in a month compared to a baseline period https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Excess_mortality; University of Oxford provides an index that makes country data comparable: Excess mortality P-score. Methodology: https://ourworldindata.org/excess-mortality-covid#excess-mortality-p-scores Tier 3 Comment: This indicator allows integrating all deaths of all kind of hazard events

8 Issues for further research

8.1 Scope of the indicator framework and indicator selection

55. Currently the scope of the indicator framework is limited to hazards driven by climate change, health, environmental hazards and geophysical hazards. More experience with the proposed set of core indicators, as well as methodological development is needed, to further broaden the scope of the indicator set. This may also result in a larger number of recommended core indicators.

8.2 Tier 3 core indicators

56. The set of core DRR indicators currently includes the following four tier 3 indicators:

- 5 - Proportion of government expenditure in DRR in relation to GDP
- 11 - Proportion of government expenditure in risk awareness programs in relation to GDP
- 29 - Proportion of population without quality access to electricity
- 53 - Proportion of government expenditure in disaster assistance in relation to GDP

57. These indicators were identified as relevant, but methodological development is needed. These indicators are recommended to be considered in the research agenda of the IAEG-DRS.

8.3 Indicators on indirect impacts

58. The difference between direct and indirect impacts is an important concept for the Sendai Framework targets and indicators. Direct impacts include physical (partial or total) damage. Indirect economic loss is "a decline in economic value added as a consequence of direct economic loss and/or human and environmental impacts." (UNISDR, 2017)

59. Direct impacts tend to be relatively short-term impacts of a disaster and they are the object of emergency response. Indirect impacts affect the individuals, businesses and communities within and in the proximity of the disaster area. Sometimes these effects will continue for years or possibly even for decades after a disaster. Examples of indirect impacts include loss of livelihoods, loss of jobs, long-term unemployment, psycho-social impacts, household debt, displacement, depressed demand for goods and services and other effects to prices, increased dependence on imports, disruptions to supply chains for products or for services like education, and so on.

60. Identifying and measuring direct impacts is simpler than measuring indirect impacts, as in most cases the links between disaster and impact can be identified. Identifying and measuring indirect impacts (such as losses of productivity, losses of jobs etc.) is not trivial as also other external factors have to be considered and often baseline data is required (for example to calculate "excess mortality").

61. As indirect impacts of disasters may have a long-lasting impact on the society and the environment, their measurement is important for better management of disaster-risk.

62. Indicators are needed in particular to measure indirect impacts concerning

a) Human loss and damage;

b) Physical capital loss and damage;

c) Social capital loss and damage;

d) Human capital loss and damage:

e) Business loss and damage;

f) Natural capital loss and damage; and

g) Cultural heritage loss and damage.

8.4 Possible input for the development of the global DRSF

63. Currently the DRSF is hazard event oriented. This implies that NSOs not necessarily perceive that disaster risk is within their jurisdiction. A more detailed framework would allow for an easier identification of the relevant indicators.

64. One could consider to further develop the DRSF to add more details such as:

- Hazard dimensions (precursors, magnitude/intensity, areal extent, speed of onset, duration, etc.)
- The different disaster risk reduction actions (preparedness, early warning, hazard mitigation, reduction of exposure, reduction of vulnerability)
- A distinction of the following categories of losses (direct and indirect):
    - Human loss and damage
    - Social capital loss and damage
    - Human capital loss and damage
    - Physical capital loss and damage
    - Business loss and damage
    - Natural capital loss and damage
    - Cultural heritage loss and damage

65. Figure 3 below shows the components that could be presented in a revised DRSF.

66. If a revised framework is adopted in the future, the proposed indicators can be rearranged into the new categories.

Figure 3: Suggestion for an expanded / more detailed DRSF

9 References

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