DISASTER-RELATED STATISTICS FRAMEWORK (DRSF)

Expert Group on Disaster-related Statistics in Asia and the Pacific

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Expert Group on Disaster-related Statistics in Asia and the Pacific

Disaster-related Statistics Framework

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EXECUTIVE SUMMARY

The Disaster-related Statistics Framework (DRSF) was developed through an iterative and interactive process by the Expert Group on Disaster-related Statistics in Asia and the Pacific from 2014-2018.

During the process of developing the DRSF, several important events or initiatives coincided with the Expert Group's mission. Therefore, the Asia-Pacific Expert Group established partnerships and worked with the intention to create alignment and clear and simple inter-operability with related projects or emerging requirements of national statistical systems.

Most notably, the World Conference on Disaster Risk Reduction (WCDRR) in 2015 led to adoption of the Sendai Framework for Disaster Risk Reduction 2015-2030 and subsequently a collection of agreed international indicators and terminologies for monitoring its implementation (UNGA, 2015 and UNISDR, 2017).

The Sendai Framework represents a new global consensus on core concepts and targets and overall statistical requirements for disaster risk reduction. The Sendai Framework describes statistics requirements for global monitoring, via the Sendai Framework Monitor[1] for the seven global targets for disaster risk reduction.

The adoption of the Sendai Framework and inclusion of disaster risk reduction targets in the Sustainable Development Goals (SDGs) has created enhanced demand for investments for development of accessible databases for disaster risk management and for improved international comparability of statistics for monitoring risks and impacts from disasters. A main objective of the DRSF is to generate relevant statistics that are used for calculating international indicators for reporting to the Sendai Framework and SDGs global monitoring systems, managed through the UNISDR Sendai Framework Monitor.

For consistency, the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs) decided to align their indicators with selected Sendai Framework indicators for the disaster-related targets for Sustainable Development Goal monitoring.[2] Targets for reducing disaster impacts appear prominently across three of the 18 SDGS: including 3 indicators (1.5.1, 1.5.2 and 1.5.3) under Goal 1 "End poverty in all its forms for all people everywhere" and also including targets under Goal 11 "Make Cities and Human Settlement, Inclusive, Safe, Resilient and goal 13 "Take Urgent Action to Combat Climate Change and its Impacts".

Whereas core concepts and indicators for disaster risk reduction (DRR) for international monitoring have been defined in the Sendai Framework and SDGs, there is a need to translate the agreed concepts and definitions into specific instructions and technical recommendations for production and dissemination of statistics.

Disaster-related statistics includes, but is not limited to, statistics about disaster occurrences and their impacts. Disaster-related statistics also includes statistical information used for risk assessment and post-disaster impact assessments, which rely on analyses of a variety of

[1] https://sendaimonitor.unisdr.org/

[2] See United Nations Statistics Commission Document E/CN.3/2017/2.

sources of data on the population, society, and economy, like censuses, surveys, and other instruments used in official statistics for multiple purposes.

Each disaster is different, unpredictable, and creates significant changes to the social and economic context for affected regions. Disaster risk is unevenly dispersed within countries, across the world and over time. To identify authentic trends, rather than random fluctuations or effects of extreme values, much of the analyses of disaster related statistics requires a coherent time series and depends on clear and well-structured statistical compilations. This context put an exceptionally high value for harmonizing of measurement for related statistics over time and, as much as feasible, across countries and regions.

Statistics on impacts of disasters are linked to uniquely identifiable disaster occurrences. Collections of these statistics need to be structured and documented in such a way as to maintain the links to relevant characteristics of the underlying disaster occurrence (e.g. timing, location, hazard type), while also remaining accessible to users as inputs for cross-disaster analyses, e.g. monitoring indicators over time or in models for predicting and minimizing disaster risk. Thus, a basic challenge in disaster-related statistics is to make statistics accessible for use in multiple forms and purposes of analyses, while maintaining harmonized and coherent compilations via structured use of metadata.

Disasters have the potential to affect all elements of society and they threaten sustainable development in many places around the world. However, disasters have also inspired international solidarity and have become a major component of international aid. International efforts to reduce disaster risk will be strengthened by improved statistics on the costs and the factors of risk associated with disasters. Better quality statistics leads to improved capacities for research, monitoring, and development of new evidence-based policies.

A core element for the statistical framework is measurement of factors of risk, i.e. probabilities associated with a hazard, exposure to the hazard, according to location of population and infrastructure, vulnerabilities and coping capacity. Disaster risk can be analysed at different scales – e.g. level of individuals or households, communities, regions, countries, and internationally. Therefore, this statistical framework is applicable at multiple scales, and can be applied flexibly, depending on the requirements of users of the statistics.

Understanding disaster risk involves an integration of statistics on the social, environmental and economic conditions of particularly defined geographic areas. The DRSF is not locked to any specific indicator or level of aggregation. On the other hand, there is also a need for consistency for analyses of time series, which depends on standardizing certain methodological elements over time, such as clear definitions for variables, groupings of variables, and rules for scope of measurement and disaggregation.

DRSF contains internally-coherent and internationally consistent guidance for utilizing existing data to produce information relevant to all the phases of disaster risk management, including for risk identification, prevention, and mitigation as well as for disaster preparedness, response and recovery. The process of development involved extensively studying current practices, pilot studies to test draft recommendations based on real compilations of data by official agencies, open consultations online, and a series of expert meetings, workshops and seminars.

Frameworks for official statistics have been developed for many other cross-cutting topics and fields of research, and the DRSF draws inspiration and its structure from the other similar types of guidance adopted by the United Nations Statistics Commission on other complex topics such as International Recommendations for Water Statistics and Tourism Statistics. A common objective from these and other examples of international recommendations for statistics is the need to develop a common baseline of information, or basic range of internationally-comparable statistics, collected from a diverse range of existing sources of data that are typically dispersed across multiple government agencies.

The main users of this framework are expected to be national disaster management agencies (NDMAs) and national statistics offices (NSOs), but there are a diverse range of other national stakeholders involved in collections of relevant data, such as ministries of environment, mapping agencies and land management authorities, ministries of finance, ministries of health, economic and social development policy makers, meteorological organizations, and so on.

The Expert Group process facilitated development of many important international partnerships for statistical development, including the Global Partnership for Disaster-related Statistics, founded by the United Nations Office for Disaster Risk Reduction (UNISDR), the Economic Commission for Europe (UNECE) and the UN Economic and Social Commission for Asia and the Pacific (ESCAP) at the First UN World Data Forum in January 2017.

People depend on their governments, which conduct, by law, many of the functions related to disaster risk management, particularly response and recovery and risk reduction. As a statistical framework, the DRSF only has bearing on production, dissemination and analyses of official statistics and does not influence national laws or policies for disaster risk management. Although legal contexts vary significantly among countries, a basic range of disaster-related statistics can be produced with reasonable international comparability. The objective of this international statistical framework is to harmonize, as much as feasible, across national statistics systems towards comparable measurements of disaster risk, disaster impacts, and risk reduction interventions.

Statistics provide the context and a broad vision for comparisons and for a deeper understanding of risk across individual and multiple hazards. Harmonized statistics are used to inform international support and boost solidarity, not only for responding to major disasters but also for addressing risks on a continuous basis, utilizing support from international cooperation.

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Experts from member States (listed in alphabetical order by country)

Artavazd Davtyan (Ministry of Emergency Situations, Armenia), Rashad Gasimzade (Ministry of Emergency Situations, Azerbaijan), Md. Rafiqul Islam (Bangladesh Bureau of Statistics), Sultan Mahmud (Ministry of Disaster Management and Relief, Bangladesh), Cheku Dorji (National Statistics Bureau, Bhutan), Pema Thinley (Department of Disaster Management, Bhutan), Nana Yan (Institute of Remote Sensing and Digital Earth – RADI, China), Litiana Naidoleca Bainimarama (National Disaster Management Office, Fiji), Poasa Naimila (Fiji Bureau of Statistics), Agus Wibowo (BPS-Statistics Indonesia), Choril Maksum (BPS-Statistics, Indonesia), Hermawan Agustina (BNPB-Disaster Management Agency of Indonesia), Indra Murty Surbakti (BPS-Statistics, Indonesia), Ridwan Yunus (BNPB-Indonesia/UNDP), Wyandin Imawan (BPS-Statistics Indonesia), Sahar Sahebi Araghi (Statistical Centre of Iran), Nobuyoshi Hara (Tohoku University), Satoru Nishikawa (Japan Water Agency), Setsuko Saya (Cabinet Office, Japan), Takeya Kimio (JICA, Japan), Yuichi Ono (Tohoku University/Global Centre for Disaster Statistics), Zaitun binti Mohd Taha (Department of Statistics, Malaysia), Aishath Shahuda, and Ashiyath Shazna (National Bureau of Statistics of Maldives), Fathimath Tasneem (National Disaster Management Centre, Maldives), Francisco Javier Nava Jimenez (National Institute of Statistics and Geography, Mexico), Arrunaa Chadrabal (National Emergency Management Agency, Mongolia), Odbayar Mishigdorj (National Agency for Meteorology and Environmental Monitoring, Information and Research Institute of Meteorology, Hydrology and Environment, Mongolia), Tungalag Chuluunbaatar (National Statistics Office of Mongolia), Cing Lun Huai, San Myint, and Kyaw San Oo (Central Statistical Organization, Myanmar), Andrew Hancock , Chase O'brien, Daren Allen, Gary Dunnet, Ian Newman, Jeff Cope, and Rosemary Goodyear (Statistics New Zealand), Deniece Krizia Ballesteros, Kathreen Ong, Rownie Aura G. Abella, and Relan Jay Asuncion (Office of Civil Defense, National Disaster Risk Reduction and Management Council of Philippines) , Lisa Grace Bersales, and Rowell Casaclang (Philippine Statistics Authority), Eun ha Chang (Center for International Development and Cooperation, Korean Women's Development Institute), Chihun Lee, and Yong-kyun Kim (Ministry of Interior and Safety, Republic of Korea), Hae Ryun Kim (National Statistics Office, Republic of Korea), Ranjith Weerasekara, S.M.H.N Samarkone, W.A.D.R.D. Athukorala, and W.P.S. Sisilarathna (Department of Census and Statistic, Sri Lanka), Budsara Sangaroon (National Statistical Office, Thailand), Chainarong Vasanasomsithi, and Kanokporn Chucherd (Department of Disaster Prevention and Mitigation, Thailand), Peter Korisa, and Zoe Touteniaki Ayong (National Disaster Management Office, Vanuatu).

Experts from international agencies and universities (alphabetical order):

Anggraini Dewi (ADPC)
Alexander Loschky (UNSD)
Antony Omondi Abilla (UN-Habitat)
Benson Sim (UNSD)
Catherine Gamper (OECD)
Chee Hai Teo (UNDP/GGIM)
Daniele Ehrlich (EU-JRC)
David Kasdan (Sungkyunkwan University)
Debarati Guha-Sapir (CRED)
Francesca Perucci (UNSD)
Greg Scott (UNDP/GGIM)
Galmira Markova (FAO)
Haoyi Chen (UNSD)
Herman Smith (UNSD)
Julio Serje (UNISDR)
Li Zhaoxi (UNDP)
Marcus Newbury (UNSD)
Masaru Arakida (ADPC)
Michael Nagy (UNECE)
Michael Smedes (UNSD)
Michelle Yonetani (IDMC)
Meimei Leung (World Vision)
Nancy Chin (UNSD)
Peeranan Towashiraporn (ADPC)
Philip Bright (SPC)
Rachel Scott (OECD)
Rajesh Sharma (UNDP)
Ralf Becker (UNSD)
Reena Shah (UNSD)
Rhea Katsanakis (UNISDR)
Ritsuko Yamazaki-Honda (UNISDR)
Robert Smith (Midsummer Analytics)
Sanjaya Bhatia (UNISDR)
Sanny Jegillos (UNDP)
Seonmi Choi (UN Environment)
Sara Duerto Valero (UN Women)
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Scott Pontifex (SPC)
Steven Ramage (GEO)
Sujit Mohanty (UNISDR)
Yongyi Min (UNSD)
Yi Sun (The Hong Kong Polytechnic University)

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ABBREVIATIONS/ACRONYMS

BNPB	Badan Nasional Penanggulangan Bencana (Disaster Management Agency) of Indonesia
CRED	Centre for Research on the Epidemiology of Disasters
DALA	Damage and Loss Assessment
DRI	Disaster Risk Index
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRSF	Disaster-related Statistics Framework
DRRCA	DRR-Characteristic Activities
EMDAT	CRED Emergency Events Database
FDES	Framework for the Development of Environment Statistics
GIS	Geographic Information System
GFDRR	World Bank Global Facility for Disaster Risk Reduction (GFDRR)
NDMAs	National Disaster Management Agencies
NSOs	National Statistics Offices
NSSs	National Statistical systems
OEIWG	Open-ended Intergovernmental Expert Working Group on Indicators and Terminology relating to Disaster Risk Reduction
ODA	Overseas Development Assistance
PDNA	Post-Disaster Needs Assessment
SDI	Spatial Data Infrastructure
SNA	System of National Accounts
SEEA	System of Environmental-Economic Accounting
TFMEED	Task Force of Measurement of Extreme Events and Disasters
UNECE	United Nations Economic Commission for Europe
UNISDR	United Nations Office for Disaster Risk Reduction

PART I

MAIN CONCEPTS FOR MEASUREMENT

CHAPTER 1: INTRODUCTION

Background

1. In May 2014, ESCAP Resolution E/ESCAP/RES/70/2 on "Disaster-related Statistics in Asia and the Pacific", established the Expert Group on Disaster-related Statistics in Asia and the Pacific and requested it to develop a basic range of disaster-related statistics along with guidance for implementation.

2. The ESCAP Resolution 70/2, establishing this Expert Group, recognized better use of disaggregated data as a challenge for evidence-based disaster risk management policy in the Asia-Pacific region. The document stressed the importance of disaggregated data related to disasters in enabling a comprehensive assessment of the socioeconomic effects of disasters and strengthening evidence-based policymaking at all levels for disaster risk reduction and climate change adaptation.

3. Since 2005, there has been an international consensus on the need to "develop systems of indicators of disaster risk and vulnerability at national and sub-national scales that will enable decision-makers to assess the impact of disasters on social, economic and environmental conditions and disseminate the results to decision-makers, the public and population at risk." (UN Hyogo Framework for Action, 2005, p.9).

4. The demand for internationally comparable methods for producing statistical evidence for disaster risk reduction received renewed and increased attention internationally with the adoption by the UN General Assembly of the Sendai Framework for Disaster Risk Reduction and with prominent inclusion of disaster risk reduction targets within the UN Sustainable Development Goals (SDGs).

5. The 2030 Agenda for Sustainable Development established 17 Goals and 169 targets for the eradication of poverty and the achievement of sustainable development. In March 2016, the 47th Session of the United Nations Statistical Commission (UNSC) agreed to a Global Indicator Framework, specifying 230 indicators for measuring progress towards the Sustainable Development Goals. In the SDGs, there are 11 disaster-related targets, spanning many of the 17 goals, and covered by 5 indicators, including under Goal 1: "End poverty in all its forms everywhere", Goal 11 "Make Cities and Human Settlement, Inclusive, Safe, Resilient and Sustainable" and Goal 13 "Take Urgent Action to Combat Climate Change and its Impacts" The inter-agency expert group (IAEG) on SDG indicators, decided that the definitions for these indicators would align with indicators adopted for international monitoring of the Sendai Framework.

6. The Sendai Framework for Disaster Risk Reduction was adopted at the Third UN World Conference in Sendai, Japan, in March 2015. It is the outcome of stakeholder consultations initiated in March 2012 and inter-governmental negotiations from July 2014 to March 2015, supported by the United Nations Office for Disaster Risk Reduction (UNISDR) at the request of the UN General Assembly. After the adoption of the Sendai Framework, an intergovernmental process was established to reach agreement on terminologies and indicators for monitoring the targets of the Sendai Framework. This intergovernmental process completed and was endorsed by the UN General Assembly in December, 2016. To help ensure cohesion between

national compilations of official statistics with demands for global indicators, the terminologies used in the DRSF are aligned with this Report.[3]

7. The Sendai Framework contains a statement of outcome for 2030, which is to achieve a substantial reduction of disaster risk and losses, to lives, livelihoods and health and to the economic, physical, social, cultural, environmental assets of persons, businesses, communities and countries. The Sendai Framework establishes four priorities for action:

1) Understanding disaster risk;
2) Strengthening disaster risk governance to manage disaster risk;
3) Investing in disaster risk reduction for resilience; and
4) Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction.

8. The targets for monitoring progress in the framework are:

1) Reduce global disaster mortality;
2) Reduce the number of affected people;
3) Reduce direct disaster economic loss;
4) Reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities;
5) Increase the number of countries with national and local disaster risk reduction strategies;
6) Enhance international cooperation; and
7) Increase the availability of and access to multi-hazard early warning systems and disaster risk information

9. A collection of 38 independent (including compound) indicators were adopted for global monitoring of all seven Sendai Framework targets. The Sendai Framework global monitoring indicators and associated terminologies were developed by governments and international experts through the Open-ended Inter-Governmental Expert Working Group on Indicators and Terminology relating to Disaster Risk Reduction (OEIWG). Two of the Sendai Framework Indicators: Deaths from disasters and direct economic loss from disasters are included in the SDGs.

10. At the 21st Conference of the Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC) in Paris (December 2015), a new agreement on accelerating and intensifying the efforts to combat climate change was made. The work to develop modules and procedures for the implementation of the Paris Agreement will utilize the rich experience with the reporting and review/analysis of climate-related information and data under the UNFCCC. The Paris Agreement requires all Parties to put forward their best efforts to address climate change through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. The Paris Declaration also refers to the Sendai Framework and the SDGs.

[3] A/71/644: "Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction"

11. UNISDR, as the custodian agency for international monitoring of the Sendai Framework indicators, has launched an international monitoring process and online tool, called the Sendai Monitor[4] for collecting figures for the agreed international indicators from official national sources, particularly NDMAs and NSOs.

12. UNISDR Technical Guidance for indicators reporting (UNISDR, 2017) was developed following adoption of global agreement on the indicators and associated terminologies (UNGA, 2015).

13. One of the main objectives of this handbook is to generate statistics that are used for calculating relevant international indicators for reporting to the Sendai Framework Monitor and SDGs global monitoring systems. This handbook complements the guidance on indicators by focussing on the underlying statistical infrastructure. In the case of disaster-related statistics, this requires integration from a diverse variety of data sources and many different government agencies. A framework is required to supply the basic data inputs used for calculating international indicators, as well as to meet other related, but often broader and more in-depth, information needs for policy at the national and local levels.

14. According to the Sendai Framework, a **disaster** is "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." (UNGA, 2016).

15. For development of this handbook, the Expert Group on Disaster-related Statistics in Asia and the Pacific consulted with a broad spectrum of disaster risk reduction and statistical experts and with established groups and forums focussing on related topics, including: the UNECE Task Force on Extreme Events and Disasters, UN Expert Group on Statistical Classifications, the Advisory Expert Group on National Accounts, UN Expert Group on Environment Statistics, and the UN Committee of Experts on Global Geospatial Information Management (UN-GGIM).

16. Each of the existing groups or initiatives and publications bring their own perspectives. This handbook is an attempt to create a harmonized description of statistical requirements and solutions with a focus on disaster risk management.

Demands for a statistical framework

17. Within this context of a globally agreed policy framework and global indicators monitoring systems, governments have put increased attention to development of nationally centralized databases for a basic range of disaster-related statistics. As development of centralized disaster-related databases is a new endeavour in nearly all countries, there is a strong demand for technical guidance and sharing of tools and good practices internationally.

18. Basic requirements for the international indicator monitoring systems include comparability of concepts and methods for measurement across disaster occurrences. Thus, these systems depend heavily on coordination and consistency at the national and local levels, which can be accomplished via the adoption and application of a commonly agreed measurement framework.

[4] https://sendaimonitor.unisdr.org/

19. Presently, countries have different practices for compiling data and preparing statistical tables related to disasters, which makes it difficult to make comparisons or conduct time series analyses covering multiple disasters. The DRSF has the potential to address challenges for creating coherence across data sources and to incorporate statistics related to all types of disasters (regardless of scale), towards a nationally centralized and internationally-coherent basic range of disaster-related statistics.

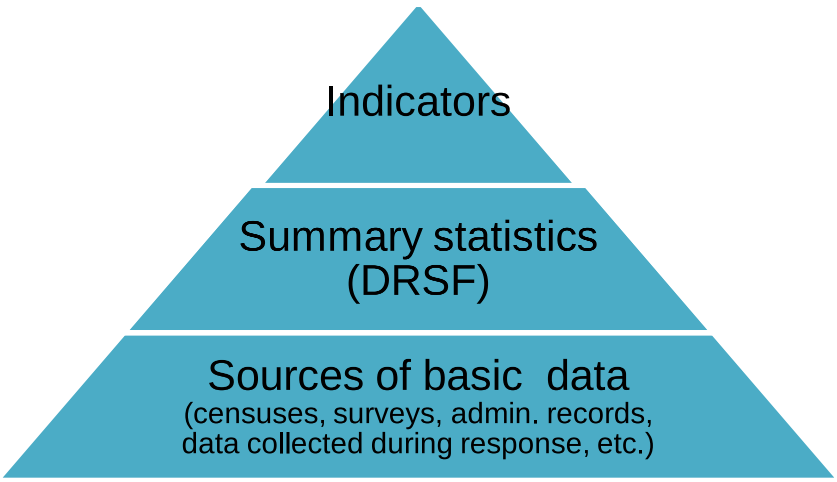
20. Statistical databases are summaries of collections of raw data gathered from many sources, including operational databases, surveys, censuses, monitoring systems, and administrative records.

21. Indicators are calculated from these databases for monitoring progress and to provide targeted information to policy-makers and the public to help inform disaster risk reduction. Where possible, indicators should be used to identify and encourage actions to reduce risk and create sustainable development before disasters occur. For example, indicators of disaster risk can be developed, based on variables measuring exposure vulnerability and coping capacity and can be used to unambiguously reveal progress with reducing overall risk of the population in a country or region. Such indicators are built upon integration of a very broad spectrum of data and multiple data sources, including population, social, economic and environmental data used for estimating probabilities of hazards.

22. A statistical framework thus rests in the middle of the theoretical information pyramid. The production of statistical tables inevitably involves some degree of aggregation and summary of basic microdata, but the statistics framework also needs to be relatively complete and flexible for calculating a broad range of indicators and for facilitating other types of analyses as well.

Figure 1.1

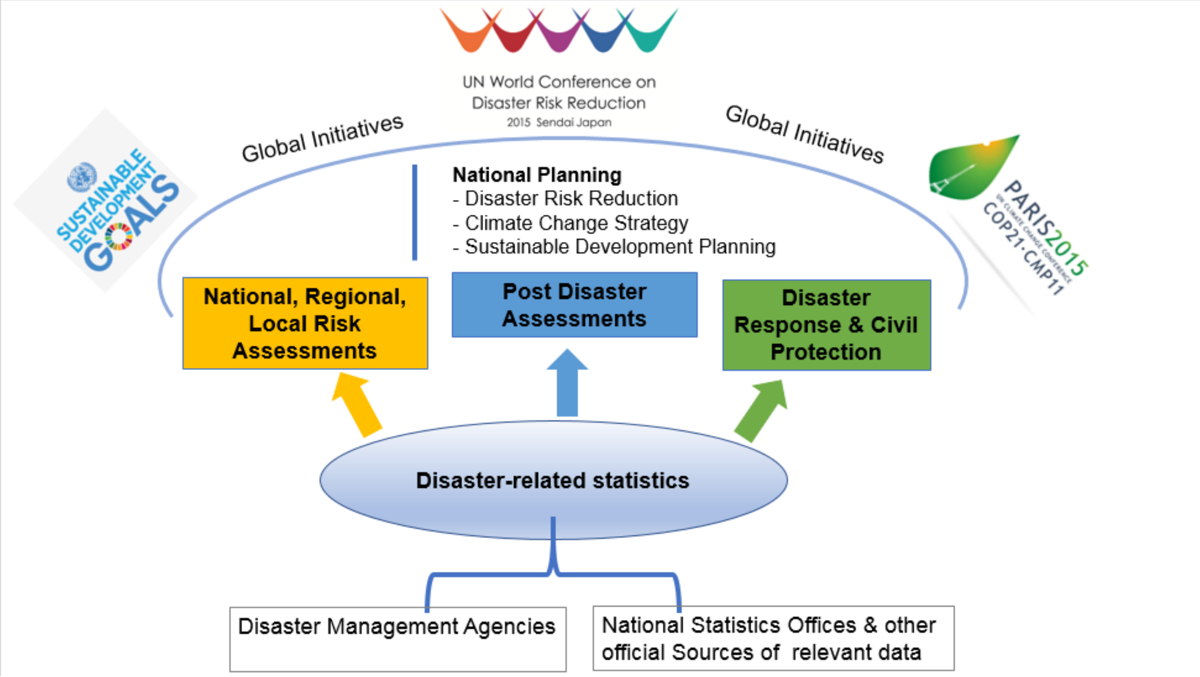
Information pyramid for disaster risk reduction



23. The goal of this framework is to produce statistical compilations that will assist applications designed for disaster risk reduction, especially in national and international indicators reporting, and statistical analyses as required for decision-making at national and local levels.

Figure 1.2

National and international applications for harmonized national disaster-related statistics



24. This statistical framework pertains strictly to measurement only, and does affect the existing policies or official duties of government agencies with respect to intervening in disaster risk management. However, implementation of the statistical framework should help national agencies to define and implement clear requirements, roles and responsibilities across government for collection and sharing of data, and for making statistics accessible for policy-relevant research and monitoring purposes.

25. The framework should also help to identify opportunities to utilize existing data sources within the national statistical system (NSS). In some cases, adaptions to the sources or to the way that data are shared between agencies are needed to fit the purposes for disaster risk reduction statistical analysis. It is usually more efficient and cost effective to adapt and reuse existing data sources rather than to establish new collections in response to each new policy question or indicator. Efficiency in the statistical system also needs to be balanced with the requirements consistency and other basic quality criteria of statistical outputs.

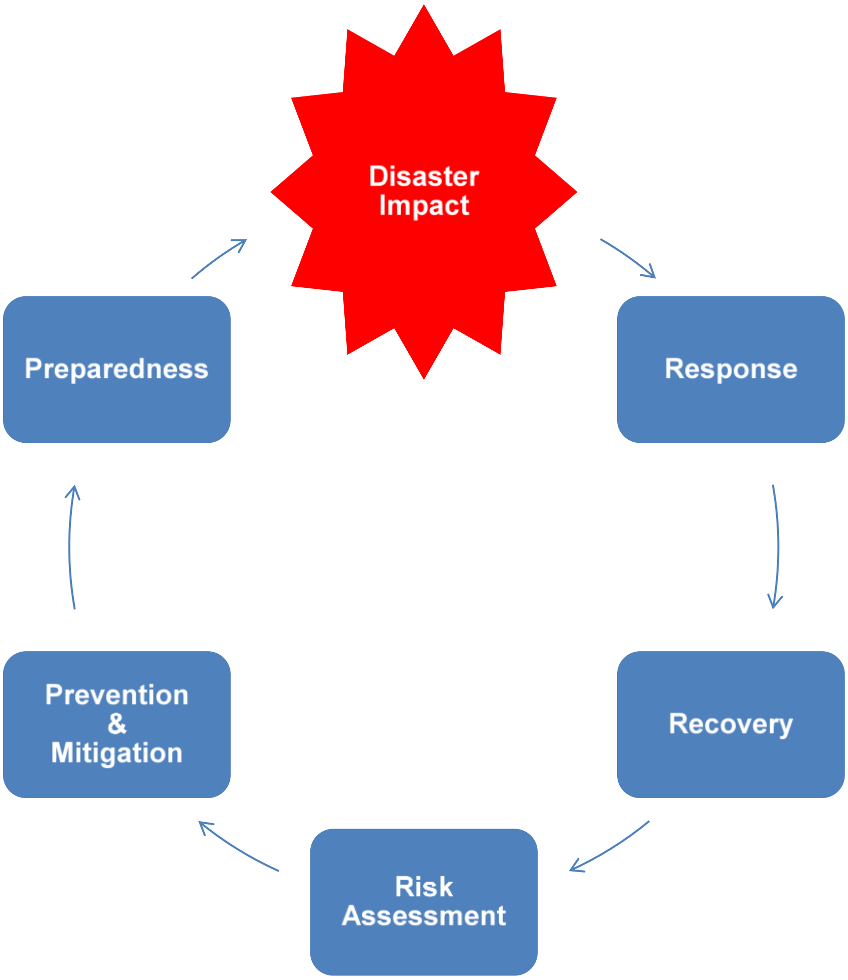
26. The UNECE Task Force on Measurement of Extreme Events and Disasters (TF-MEED)[5] produced a comprehensive report on the roles of national statistics office in close collaboration with the Asia-Pacific Expert Group on Disaster-related Statistics. A principle role for statistics offices and other government agencies is to provide the baseline (related) statistics, which are essential for disaster-risk management.

[5] https://www.unece.org/stats/ces/in-depth-reviews/meed.html

27. The risk management cycle is a useful concept for understanding the demands for statistics, and the various perspectives of decision-makers at the national level, and their relationship to the data collection or analysis. While there are some overlapping statistical requirements to support decision-making across the different phases of the cycle of disaster risk management, there are also important differences.

Figure 1.3

Cycle of disaster risk management



Source: Diagram adapted from Thailand Department of Disaster Prevention and Mitigation (DDPM)

28. During an emergency, responding agencies have special requirements regarding timeliness, accuracy and level of geographic detail to serve operational purposes in a coordinated emergency response. The priority is to save lives and minimize other damaging effects on the population. In contrast to these operational uses of data, statistics are used in broader risk assessments or for monitoring impacts over time, in which case more time is available to give attention to accuracy, comparability between sources, consistency over time, or other qualitative characteristics of the information. Statistics are designed to provide summaries for analyses by regions or by groups of people or businesses and are never used for identifying specific individuals.

29. Table 1.1 provides an overview of issues faced by decision-makers and a sample of the demand for statistics in each phase of the risk management cycle.

Table 1.1
Statistics in disaster-risk reduction decision making

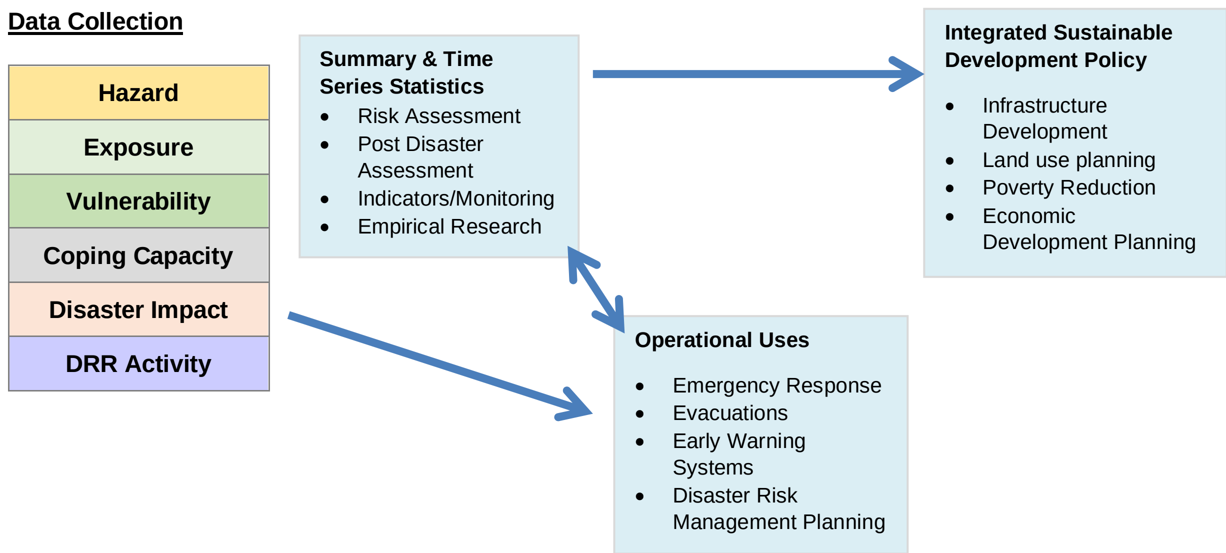
Typical issues in the different phases of disaster risk management	Typical decisions and plans to be made	Sample of use of statistics
'Peace time': Risk Assessment • **Disaster risks can be estimated but are not known** • **Development investments should be informed by risk profiles** • **Use of best available knowledge so that development does not exacerbate existing (and or create new) disaster risks**	• Prioritizing investments in risk reduction • How to invest in development while avoiding new risks • Guide policies for reducing exposure and for vulnerable groups (including, potentially, via relocation outside of hazard areas)	• Dynamic hazard profiles (magnitude, temporal and spatial distribution) • Vulnerability and baseline of exposure: (demographic and, socioeconomic statistics) e.g. baseline of exposure in areas prone to hazards and identifying vulnerable groups • Learning from experience of past disasters, e.g. effectiveness of early warning systems
'Peace time': Risk Mitigation and Preparedness • **Risk Profiles are changing as new information becomes available and development in potentially vulnerable areas takes place** • **Early warning systems and other monitoring systems, where available, are delivering information on risks and possibilities for mitigating impacts**	• Introduction of new measures to reduce disaster risk • Introduction of mechanisms to improve or ensure sufficient early warning and adequate preparedness • How to invest in risk reduction measures as an integrated part of the broader poverty reduction and sustainable development initiatives • Whether and how to discourage development in hazardous areas	• Scale, locations and other characteristics of investment in disaster risk reduction • Signals of slowly developing risks approaching thresholds to a potential disaster • Level of awareness, preparedness, and investment against disasters by households, businesses, and communities • Identifying factors that cause and or exacerbate disaster risks, e.g., environmental degradation, highly vulnerable infrastructure, or extreme poverty.
Emergency: Response • **Imperative is to act quickly and efficiently to save lives and mitigate unnecessary suffering** • **Sufficient scale of injection of resources to bring crisis under control** • **Urgent demand to meet overwhelming needs for places where vital systems and delivery of basic services were affected**	• Determine the geographic scale of the disaster and prioritize needs for emergency relief • How to make the response the most efficient • How to manage needs given impacts to local supplies of goods and services (how to address temporary interference to local services supply) • How to mount emergency response while also putting in place requirements for medium and long-term recovery	• Disaster occurrence, including temporal, and spatial spread of the event • Disaster type and characteristics of impacts, e.g., rapid or slow onset, intensive or extensive impacts. • Immediate indication of impacts on population, damage, losses, and disruption of basic services • Recovery needs, which potentially could be increasing • Disaster response: who, what, where, when, and how much

Typical issues in the different phases of disaster risk management	**Typical decisions and plans to be made**	**Sample of use of statistics**
Medium and long-term recovery • **Yet unaddressed humanitarian needs** • **Risk that fragile communities could regress into a new emergency crisis if recovery needs are not met** • **Less spotlight on initial response may translate to less resources for recovery** • **Often a normal development policy-planning cycle resumes with many requirements but, , with less available resources due to disaster**	• How to prioritize recovery of economic sectors and determination of appropriate scale of re-building effort in affected location • How to determine appropriate level of investment required for complete recovery from impacts for disasters: • Returning to consideration of future risk identification and mitigation (see risk assessment)	• Comprehensive and credible post-disaster accounting for damage, losses, and disruption of functions /services • Requirements for economic recovery, e.g., direct and economic losses. • Coping capacity of communities, localities and sectors • New post-disaster inputs for calculation of risk of future incidents

Reference: Developed by Asia-Pacific Expert Group in collaboration with the UNECE TF-MEED.

30. The scope for demands for a basic range of disaster-related statistics and indicators can be seen within a broader context, which also includes operational databases that are used for emergency response (Figure 1.3).

Figure 1.4
Uses of disaster-related data



31. Ideally, disaster-related statistics will become an integrated part of the broader sustainable development planning of the country at national and local levels. An example is the integration of disaster risk assessments into land use planning and building resilience to disasters as a part of the broader strategy against multi-dimensional poverty. For instance, areas identified as having high probabilities of exposure to a hazard could be imposed with restrictions on constructions or appropriate requirements for resilience of structures against hazards. Such interventions could further be designed or targeted in a way that also creates

additional benefits for poverty reduction in the relevant communities since reducing poverty can be an effective means at building resilience to disasters, and vice versa.

Use of this handbook

32. This handbook provides recommendations on methodologies for how to apply internationally agreed concepts and terminologies to production of official statistics. This includes technical recommendations on estimation for a basic range of disaster-related statistics used for multiple purposes, including calculation of indicators used for national and international monitoring. Not all recommendations are applicable in all cases and in some cases the demands for statistics require much more detail or a broader scope of measurement than what is presented here. Thus, the basic range of disaster-related statistics can be considered as a general target for the national statistics system for producing internationally harmonized statistics, noting that the disaster risk or policy context in each country will likely introduce special or additional requirements or potential measurement solutions that are specific to that country.

33. The remainder of Part 1 (Chapters 2-5) outlines the conceptual framework for a basic range of disaster-related statistics, applying and interpreting the concepts from the Sendai Framework and related references on disaster risk management for the practice of data collection and statistical compilations. Part 2 of this handbook (Chapters 6-9) provides guidance for implementation of the framework, including practical steps for organizing data and tools to support the process of national integration and harmonization across data sources, such as classifications, definitions, advice on measurement units, and summary tables as sample compilations of the complete basic range of disaster-related statistics.

CHAPTER 2: MAIN CONCEPTS FOR MEASUREMENT

1. A disaster is: "A serious disruption of the functioning of a community or a society 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, adopted by the UN General Assembly via the Report of the OEIWG (2016).

2. For each disaster occurrence, there are at least three characteristics of the event that should be recorded in a centralized database for the compilation of basic statistics on impacts from the disaster. The three characteristics are:

   a. Timing (date, year, time and duration of **emergency period**)
   b. Location and geographic **scale** (regions/provinces/country(ies) and affected area in a GIS format, e.g. shapefile)
   c. **Hazard type** (e.g. geological, meteorological)

3. In addition, each disaster occurrence has a unique identifier code for ease of reference and querying within a multi-disaster database. There are international initiatives for unique naming and coding of hazards, which can be utilized, where applicable, by the national agencies, such as the GLobalIDEntifier number (GLIDE) initiative.[6]

Box 1: Example Recording of Basic Characteristics of Disaster Occurrence

A simple example for recording a disaster occurrence, which is used as the basis for identifying impact statistics, can be demonstrated using a hypothetical example. Let us imagine the case of a sudden flood disaster affecting a specific area in Central Thailand. The hazard type (flood) is indicated within the alphanumeric code of this occurrence (FL).

Authorities in the affected area were surprised by the flood, caused by sudden intense rain, and they called for an emergency, which lasted for 4 days, at the beginning of May. Geographic reference or location of the disaster can be referenced according to official policy by a responsible agency in Thailand. In this example, the hypothetical flood disaster resulted in an emergency in one district and in one province of Thailand, called Samut Prakan. In addition, if available, a geospatial data file can be stored within the database for mapping and recording the spatial boundaries of the hazard area, e.g., inundation area, and/or impacts area, e.g., a contiguous area within which direct impacts were observed.

Code	Geo 1	Geo 2	Geo 3	Geo 4	Em. beginning	Em. End (d-m-y)
Fl2018-01-THA	Central Region	Chao Phraya River Basin	Samut Prakan	Central District	01-05-18	04-05-18

[6] The GLIDE is a project initiated and maintained by the Asian Disaster Reduction Center (ADRC) in collaboration with ISDR, CRED, UNDP, IFRC, FAO, World Bank, OFDA/USAID, La Red, and OCHA/ReliefWeb, http://www.glidenumber.net/glide/public/about.jsp

4. These characteristics of disasters are used for making connections between variables to develop time series statistics, such as, the long-term trends of impacts from disasters by hazard type.

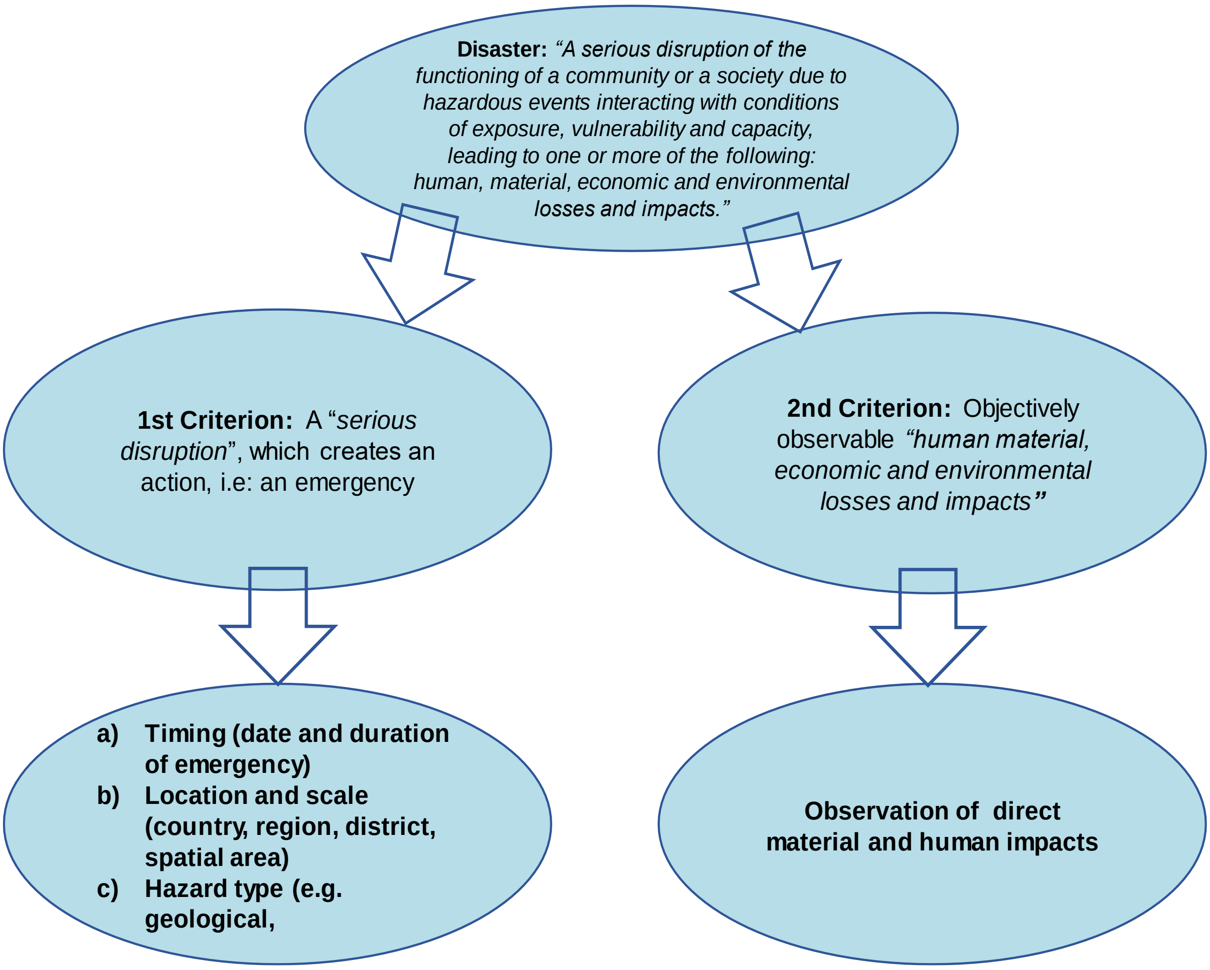
5. Each disaster is different, and the disaster risk context differs greatly across countries and regions. However, by applying common broad measurement principles for identifying and recording disaster occurrences, a degree of harmonization for the scope of measurement for impact statistics can be achieved.

6. From the international definition of a disaster, two basic criteria are needed for measurement of disaster occurrences and impacts in alignment with the international indicators and Sendai Framework Monitor:

a. "*human, material, economic and environmental losses and impacts*" (i.e., observation of significant impact)) and
b. "*A serious disruption of the functioning of a community or a society*" (e.g., an emergency).

Figure 2.1

From disaster occurrence to disaster impact statistics collection



7. For Sendai Framework Monitor, no impact thresholds are placed for observation of disaster occurrences for compilation of the disaster impacts statistics used for monitoring the targets. The Sendai Framework "will apply to the risk of small-scale and large-scale, frequent

and infrequent, sudden and slow-onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks." (United Nations, 2015, paragraph 15).

8. An impacts threshold is an analytical tool used for analysis and comparisons. Thresholds are a form of filtering of the broader compilation of basic statistics, to meet certain analytical requirements or as a method of achieving some specific targeted quality characteristics of the datasets needed for a specific purpose. As mentioned, there is no specific threshold criteria global monitoring of the Sendai Framework indicators by UNISDR. But, threshold criteria may be useful in other cases. For example, within EMDAT, minimum threshold criteria were defined so that the compilations focus primarily on moderate to large-scale emergencies, of which EMDATs data sources are likely to have relatively better-quality statistics in terms of completeness and reliability. Such filtering of impacts thresholds can be useful for various analyses, but do not affect the original basic compilations of data, which should contain the complete and unfiltered data.

9. So, referring, for example, to our hypothetical case in Box 1 of a flood in Thailand (Fl2018-01-THA), if none of the EMDAT criteria[7] is met, then this flood occurrence and its consequences would be counted in the national database but not in EMDAT. Sendai Framework global monitoring also does not put any specific reporting requirements regarding geographic referencing or geographic scale. For other uses of the statistics, the geographic scale of the emergency could be a useful standard reference for characterising the geographic scale of the disaster occurrence.

10. Inconsistencies in scope of measurement for disasters, can come about because different countries face risks from a different group of hazards. Some hazards are common only in tropical or non-tropical climates, some affect only coastal areas or areas with hills or mountains. Thus, current national databases for classifying **hazards types**, vary from country to country. Many countries have an officially adopted list of hazard types and definitions inscribed into the national laws for disaster response. In these cases, the scope of official data collections (and metadata) should align with the scope and terminology from the national laws.

11. National agencies are encouraged to follow the scope of hazards defined for Sendai Framework monitoring. This recommendation is to report nationally aggregated statistics according to the overall coverage of IRDR Peril Classification and Hazard (IRDR, 2014), and for two additional categories of hazards defined for the Sendai Framework: environmental hazards and technological hazards (see Chapter 8 for complete discussion). For all cases, a formal **glossary of the hazard types** should be published as part of the core metadata alongside the statistics.

12. An **emergency** (at local, national or regional level) is a common signal or indicator of a disaster occurrence and its timing. Emergencies, whether declared or undeclared, can take a wide variety of forms depending on the type of hazard and laws and administrative policies of the responsible government. Standardization of emergency declarations policy is not necessary for the compilation of statistics. However, a general acknowledgement of an emergency situation by officially responsible agencies is usually the catalyst that triggers collection of official data on the impacts of an emergency situation. This aligns well with the

[7] EMDAT Criteria is: ten (10) or more people reported killed, or Hundred (100) or more people reported affected, or Declaration of a state of emergency, or Call for international assistance

concept of an acknowledgement of abnormal disruption, according the norms and standards of the country, and a basic criterion in the international definition for a disaster.

13. The UN World Health Organisation (WHO) defines an **emergency** as a managerial decision or response in terms of extraordinary measures. A "state of emergency" demands to "be declared" or imposed by somebody in authority who, at a certain moment, will declare a state of emergency. Thus, the emergency is usually defined in time and space, as … it implies rule of engagement and an exit strategy." (WHO Glossary). Thus, in contrast to a disaster occurrence, an emergency, if applicable, has a specific duration of time.

14. A characteristic that causes the nature of emergencies to vary is the situation of either a **sudden or slow-onset disaster** (see Chapter 8). Sometimes, for slowly evolving risks leading to a disaster, the emergency response may take the form of initiating collection of data for monitoring the situation, followed by implementation of a series of preventative measures (such as evacuations or other responses to boost coping capacity and minimize impacts). For other emergencies, especially sudden or unexpected hazards, there is more likely to be an explicit emergency declaration or request for rapid mobilization of resources for response.

Box 2: Sudden and slow-onset disasters

Recall, previously, in our hypothetical scenario, the central district of Samut Prakan, Thailand, experienced sudden flooding in May 2018 which also surprised the authorities. Meanwhile, imagine there is also an area of northeastern Thailand, which had not received rain for many months, causing significant hardship and significant losses to agricultural production in that region. By June, the hardships and risk caused local and national authorities to initiate an urgent programme to collect data on the current impacts and to analyze future risks.

Although there may not have been a specific emergency call, an unusual disruption was observed in Roi Et, and action has been taken to record observations on the impacts. Thus, the slow onset drought disaster can now be recorded and classified in official records in the hypothetical sample below.

Code	Geo 1	Geo 2	Geo 3	Geo 4	Em. beginning	Em. End (d-m-y)
Fl2018-01-THA	Central Region	Chao Phraya River Basin	Samuth Prakhan	Central District	01-05-18	04-05-18
Dr2019-01-THA	Northeast	Mekong	Roi Et		01-06-18	01-06-18

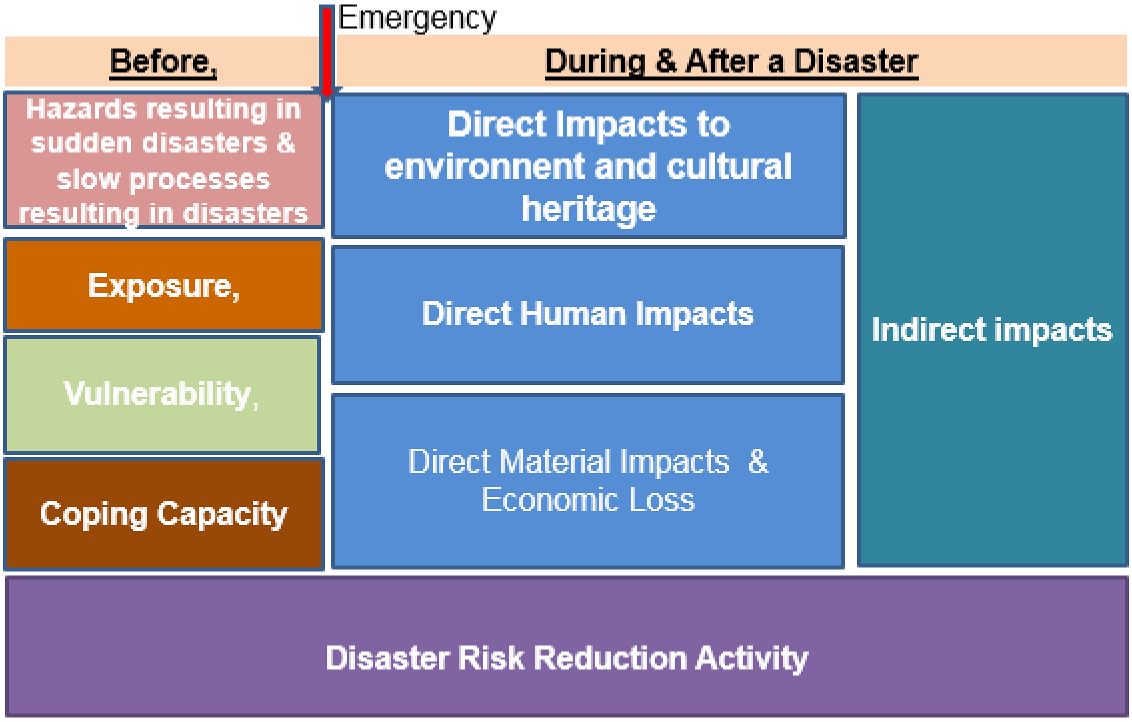
Basic range of disaster related statistics

15. Collection of statistics related to disasters is applicable for disasters of any scale or magnitude and there is a clear demand for a nationally coherent measurement framework for application at different scales. (UN, 2015, Paragraph 15, ibid).

16. Components of the basic range of disaster-related statistics are shown in Figure 2.2.

Figure 2.2

Components of the Disaster-related Statistics Framework (DRSF)



17. The boxes in this Figure 2.2 represent a useful way of broadly organizing the basic range of disaster-related statistics, but there are also data that have multiple uses in analysis and therefore may appear in multiple components. Since there are relationships between these components, there are advantages of having a centralized database that covers all components of disaster-related statistics.

18. Nearly all elements in Figure 2.2 can be measured, or estimated, from direct observation and incorporated into a centralized database of disaster-related statistics. One exception is the measurement of **indirect impacts** from disasters, which are characterized as consequences of a disaster. These need to be estimated via application of assumptions or other type of modelled scenario analysis to estimate a quantified range of values for indirect consequences to the economy or other changes to social conditions after a disaster.

19. The basic demands for disaster impacts statistics include reviewing the trends across occurrences for risk assessment, which may require analysis over a long period (perhaps 50-100 year trends). Thus, it is critically important that the counts and descriptive characteristics of disaster occurrences are produced consistently over time and across different occurrences.

CHAPTER 3: DISASTER RISK

Background

1. Improved utilization of official statistics for understanding disaster risk is the basic motivation for the development of a DRSF and its implementation in national statistical systems. Improved understanding of risk is also the number one priority of the Sendai Framework.

2. **Disaster risk** "is 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, 2017).

3. Disasters are the outcome of present conditions of risk, including exposure to a hazard and the related patterns of population and socioeconomic development. (United Nations, 2015). These risks are geographically concentrated and unevenly distributed (Birkman, 2013). Measurement must account for extreme variability of risk with a broad coverage of the land and population while also producing disaggregated statistics for relatively high-risk hotspots.

4. Paragraph 6 of the Sendai Framework covers the issue of risk drivers: "More dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change and variability, unplanned and rapid urbanization, poor land management and compounding factors such as demographic change, weak institutional arrangements, non-risk-informed policies, lack of regulation and incentives for private disaster risk reduction investment, complex supply chains, limited availability of technology, unsustainable uses of natural resources, declining ecosystems, pandemics and epidemics."

5. Disaster risk is dynamic and its measurement is captured, in part, by common work of NSOs and other providers of official statistics at the national level. Areas of statistics covered include: demographic changes, poverty and inequality, structure of the economy, expenditure, economic production, conditions of ecosystems, and land management.

6. The focus in the DRSF is to clarify the role of official statistics and how they can be made as accessible as possible for risk assessments.

7. Two complementary types of risk assessment have been observed internationally (Bikman, 2013): risk indices and hotspots. Disaster risk indices (DRIs) can be developed for individual hazard types (e.g. for floods or cyclones) or multi-hazard risk, i.e. an index covering multiple hazard types. High risk areas will vary in geographic scale and do not align specifically with administrative boundaries used by governments. The hotspots approach thus follows a similar model that has been used in the domain of biodiversity and focuses on applying analyses at a more geographically detailed level, utilizing data that can indicate relatively high levels of likelihood for hazards overlain with geographic information on exposure and vulnerabilities.

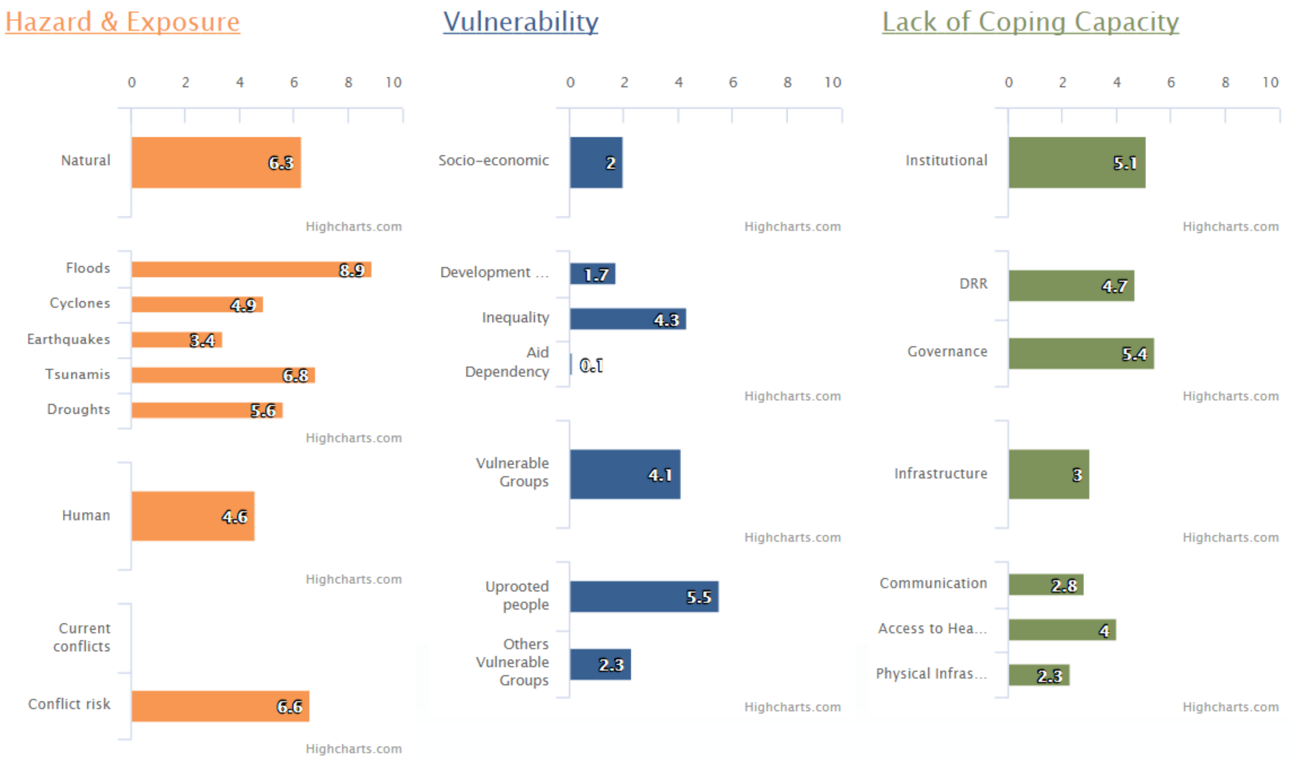
8. Example of risk indices ares the World Risk Index (WRI) of United Nations University World Risk Reports,[8] the Inform Index for Risk Management[9] (sample below), and UNDP's

[8] https://ias.unu.edu/en/

[9] http://www.inform-index.org/

Disaster Risk Index (DRI).[10] An example of a risk hotspot would be an area with relatively high probabilities of hazard coupled with specific vulnerabilities or low resilience in case of disasters.

Sample of National Scale IMPACT Index Score for Disaster Risk



Source: www.inform-index.org

9. Modern analyses of disaster risk incorporate both approaches through geographically disaggregated statistics and analysis using hazard profiles coupled with geographic information systems (GIS). An advantage of the GIS-based production of statistics for risk assessment is the potential to apply the methods to produce summary statistics at different geographic levels -e.g. at the global, regional or national level, and for hotspots.

10. Many interesting examples are emerging, for example the disaster management agency of Indonesia (BNPB), is tracking statistical information on exposure of population, as well as for economic activities (derived from local tax revenue records) and on children (from administrative records on enrolment in schools) in relation to the hazard areas of the country.

Scope of measurement

11. In the literature and current practice of many disaster management agencies, disaster risk is defined for measurement according to three core elements: exposure to hazards, vulnerability and coping capacity.

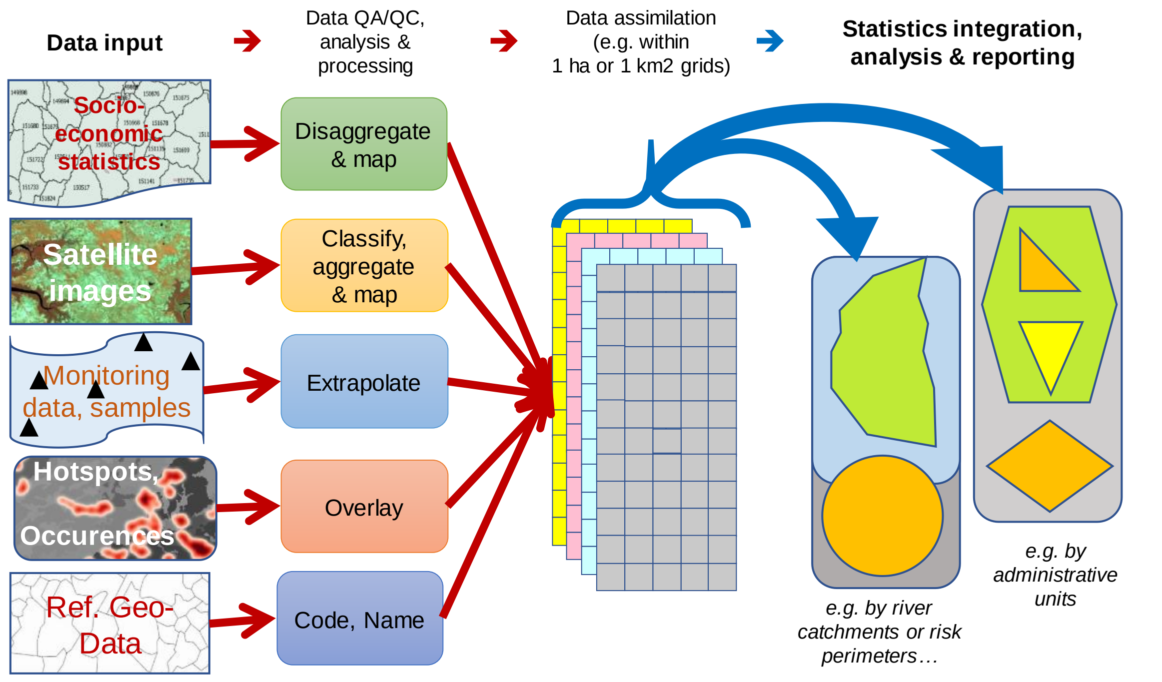
[10]http://www.undp.org/content/undp/en/home/librarypage/crisis-prevention-and-recovery/reducing-disaster-risk--a-challenge-for-development.html

$$Risk = f(Hazard\ Exposure, Vulnerability, Capacity)$$

12. This basic definition for measurement of risk has also been known as the PAR model (Birkman, 2013). Risk of impacts from a disaster is not driven only by the **magnitude**[11] of the hazard (e.g. force of energy of the earthquake or category of storm) but also by social factors that create exposure, vulnerability and coping capacity (UNISDR, 2015).

13. Statistics for disaster risk assessment are developed by the assimilation of datasets in geographic information systems (GIS) and by integration of the relevant data sources for risk mapping. Risk maps are used to produce functional maps but also statistical tables summarizing risks faced for a given study area and to show relative degrees of risks across geographic areas. Integration and assimilation of data in GIS makes it possible to produce time series information in ways that were not previously possible, such as estimation of exposure to hazards.

Figure 3.1
Grid-based data assimilation



Source: Weber, CBD (2014)

Estimating exposure to hazards

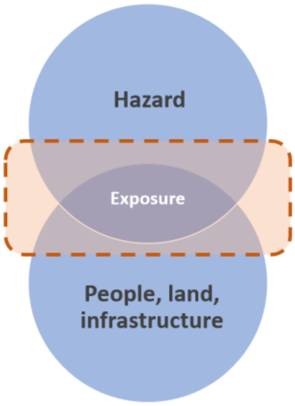
14. There are two main elements to measuring exposure to hazards; These are:

a. a probabilistic map of the hazard and
b. a complementary map of the population, critical infrastructure (and other objects of interest such as high nature value ecosystems) on the exposure side.

[11] Magnitude, as the term is used here, refers to the hazard (rather than disaster) and is distinctly different from the geographic scale of a disaster (discussed earlier) or the scale of impacts. Note, also, that neither information on magnitude of hazards nor on scale of disasters are relevant for international indicators reporting for the Sendai Framework Monitor.

15. The mapped area meeting of overlap is the exposure to hazards measurement. Producing statistics that can be used for estimating the exposure to various hazards is one of primary responsibilities of national statistics offices (particularly from national population and housing censuses).

Figure 3.2
Exposure to hazards



Hazard mapping

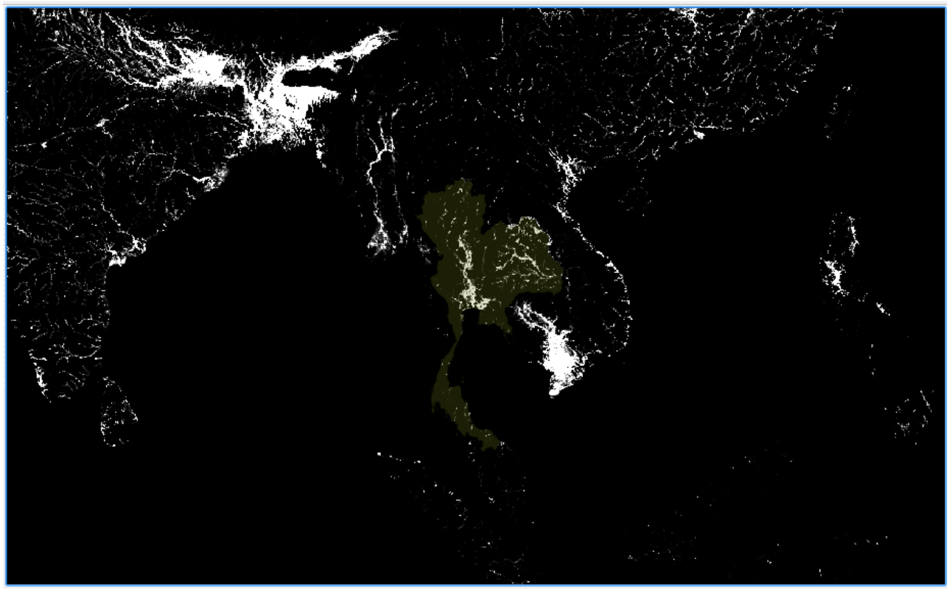
16. For hazard mapping, many variables can be relevant and are usually available from the official sources of disaster management, meteorological and geographic information for a country or region of a country.

17. A collection of the spatial, intensity, and temporal characteristics for a set of potential hazards is known as a **hazard catalogue**. There are various approaches to developing maps of potential hazards, depending on the type of hazard and the approach used to assess probabilities of a hazard occurrence.

18. Deterministic risk models are used to assess the impact of specific events on exposure. Typical scenarios for a deterministic analysis include examining past historical events, worst-case scenarios, or possible events that reoccur at different times. A probabilistic risk model contains a compilation of all possible "impact scenarios" for a specific hazard and geographical area. A goal for probabilistic hazard modelling is a convergence of results and for this a long-time series of input data is usually necessary. A simulation of 100 years of hazard events is usually too short to determine the return period for most hazard types, particularly infrequent hazards such as a tsunami.

19. Hazard mapping is usually the responsibility of disaster management and specialized scientific agencies monitoring underlying phenomena associated with different types of hazards, e.g., geological and hydrological authorities. There is currently a lack of international standardized approaches or guidance materials for hazard mapping. However, it is important that users of disaster-related statistics are aware of the basic methodologies and availability of hazard maps. Therefore, hazard mapping, particularly for use in producing statistics for disaster risk management is recommended for the DRSF list of topics for further study.

Sample for flood hazard frequency and distribution map for Thailand and surrounding areas



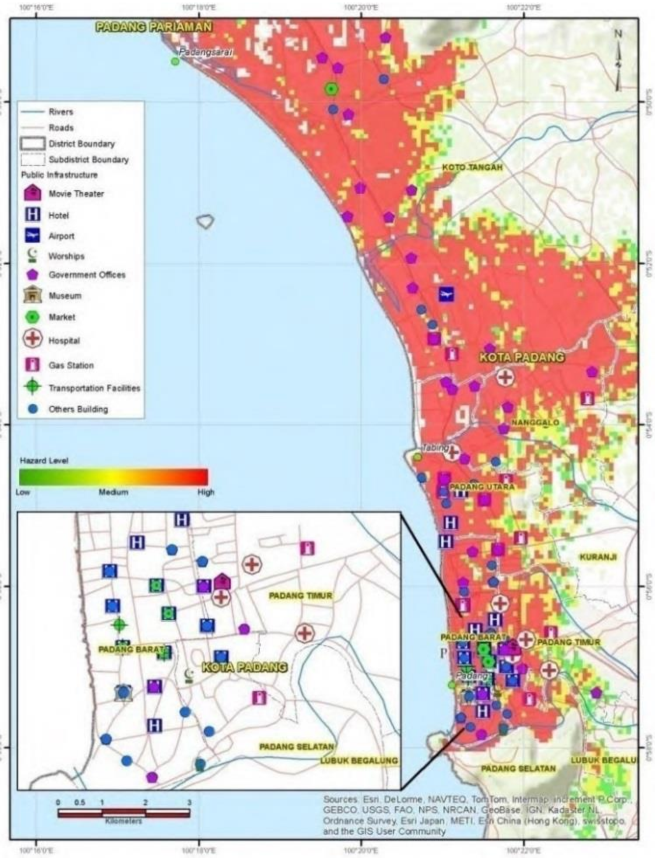
Reference: Center for Hazards and Risk Research - CHRR - Columbia University Center for International Earth Science Information Network - CIESIN - Columbia University. 2005. Global Flood Hazard Frequency and Distribution. Palisades, NY: NASA Socioeconomic Data and Applications Centre (SEDAC).

20. The above sample, part of a global map from Colombia University and NASA-SEDAC is based on a database on historical flood hazard occurrences. Building on this mapped information on past occurrences, hazard maps should be developed, incorporating a variety of predictive variables available as spatial datasets, such as digitized elevation models and average precipitation. National agencies have a crucial responsibility to produce and regularly update hazard catalogues for their countries at suitable levels of resolution for use in informing national and local risk reduction policies.

Box 3: Hazard and risk mapping example: BNPB-Indonesia *InaRISK*

The BNPB Indonesia example provides a good practice example of the types of data inputs likely to be needed for hazard mapping, such as:

a. Knowledge of the distribution of soil-type to model the spatial variation of ground acceleration from an earthquake,
b. Water supply and use balances and other statistical information used for tracking the hydrological cycle and use of water in the economy
c. Values for surface roughness to define the distribution of wind speed from a tropical cyclone;
d. A digital elevation model (DEM) to determine potential flood height or other hazard features.



InaRISK is risk analysis information for Indonesia covering each of the core risk factors: hazard exposure, vulnerability, capacity. The method employs data analyses across space, utilizing a gridded assimilation approach to predict probabilities for impacts from disasters, including: potential of losses life, financial losses, physical damage, and exposed natural resources. The assessments are conducted for 9 different types of hazards, with varying characteristics in terms of frequency and possibility of advanced warning.

Source: BNPB-Indonesia, 2016

21. There are a variety of software tools and other resources available for probabilistic hazard modelling software, by hazard type or for multiple hazards. The following were identified through the Expert Group's study:

- The Australian Government's Earthquake Risk Model, http://www.ga.gov.au/scientific-topics/hazards/earthquake/capabilties/modelling /eqrm
- BNPB Indonesia's InARisk, http://inarisk.bnpb.go.id/
- Probabilistic Risk Assessment Platform (CAPRA), http://www.ecapra.org/
- European Commission Joint Research Centre Flood Hazard Maps, http://data.jrc.ec.europa.eu/collection/floods
- European Plate Observer System (EPOS) Seismic Hazard Portal, http://www.seismicportal.eu/
- Institute of Remote Sensing and Digital Earth (RADI) and Chinese Academy of Sciences (CAS) Drought Mechanism
- Hazard elements in the Index of Risk Management (INFORM)

- UNISDR Global Assessment Report on Disaster Risk Reduction (GAR), http://www.preventionweb.net/english/hyogo/gar/2015/en/home/data.php
- OpenQuake Platform, by the GEM Foundation, https://platform.openquake.org/
- Rapid Analysis and Spatialisation of Risk (RASOR), http://www.rasor-project.eu/
- U.S. Environmental Protection Agency's CAMEO, https://www.epa.gov/cameo

22. The outputs of hazard analyses include:

- Location and extent for geographical analysis of hazards,
- Frequency and duration for temporal analysis of hazards,
- Scale and intensity for dimensional analysis of hazards,
- Probability of occurrence of hazards, and
- Physical, economic, environmental and social vulnerability factors.[12]

23. According to IPCC, three changes are likely to be observed for climate-related hazards for some geographic regions because of rising global temperatures: increases in frequency, severity, and decreased predictability of hazards. Thus, climate change has contributed to the dynamic nature of hazards, as an input into the formula for assessing risk.

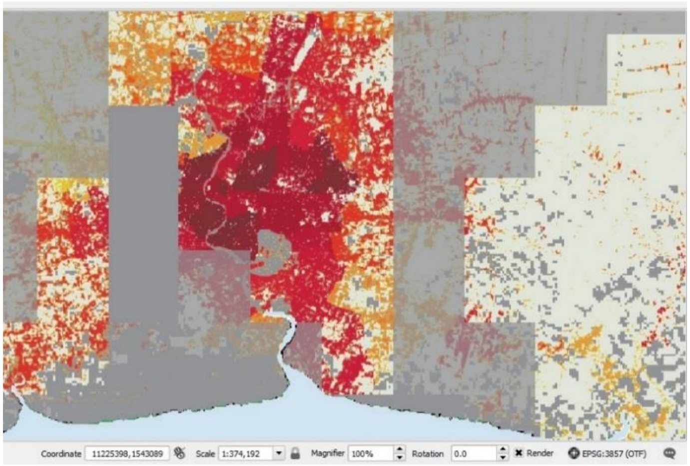
Exposure statistics

24. For the exposure side of hazard exposure estimation, 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 variables located in the hazard areas, such as important ecosystems, crop areas and economic data for assessing exposure of economic assets and activities.

25. Exposure statistics have dual purposes. In addition to one of the three basic metrics for disaster risk, exposure statistics also are used as baseline statistics for assessing impacts after a disaster, (e.g. for estimating the value of economic impacts).

[12] European Commission (2010)

Box 4: Pilot tests for an approach to population exposure statistics



A methodology was developed and tested among Expert Group countries during 2016 and 2017 for estimating population exposure using the available population data from census authorities. A step-by-step manual was produced describing the steps to replicate the output statistics for any country (or region). Pilot tests of the methodology utilizing publicly available census data, processed satellite imagery in the form of a new product from the German Aerospace agency (DLR) called the Global Urban Footprint (GUF), and maps of land cover, and hazard maps found from various international sources on the internet. The data were integrated in GIS and used to produce test estimates for population exposure to hazards in 6 countries: Bangladesh, Fiji, Indonesia, the Philippines, Republic of Korea, and Thailand. This method was developed, and pilot tested among countries in Asia and the Pacific to demonstrate the possibilities for applying census statistics for estimating exposure to hazards for analysis at different scales, based on the available population data by administrative region (which can be accessed from national statistics offices at different scales, depending on the country).

The image reveals a sample output utilizing a hazard map (shaded areas) for floods produced by CIESIN/SEDAC (reference above) combined with the ESCAP pilot gridded population density estimates (yellow-orange-red) based on population census from Thailand National Statistics Office and the GUF. See the Expert Group website (https://stat-confluence.escap.un.org/x/1oL2) for complete description of methodology and the manual.

26. The same basic principles of assimilation of data with hazard maps with population and social data (see, e.g., Box 4) apply to information about the physical infrastructure. Geospatial data on location of critical infrastructure and land cover, including agricultural areas by type of crops and various types of ecologically important areas, e.g., protected areas are fundamental inputs used for assessing exposure to hazards before a disaster and as baseline referencing for assessing impacts after a disaster.

27. Hazard exposure statistics can be presented in the form of maps that can be simply converted into standardized statistical tables, such as in the example shown in DRSF Table B1a (see Annex).

Vulnerability

28. The Sendai Framework recommendations adopted by the UN General Assembly in 2016 defined **vulnerability** as "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."

29. If the statistics used in vulnerability assessments are gathered and updated on a regular basis by geographic regions, and specifically for hazard areas within countries, disaster management agencies would have *a priori* information on extent and specific locations (among

other characteristics) of vulnerability for developing targeted disaster risk reduction or response strategies at local and national levels, in alignment with the overarching objective of SDGs and of not leaving anyone behind.

30. 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.

31. There are also many forms of disaster vulnerability 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 factors of disaster vulnerability and an area where basic services will be urgently required for restoration and recovery after a disaster. These factors may be particularly significant for women and girls.

32. Vulnerability is an extension of initial exposure statistics by adding statistics on relevant characteristics, or disaggregation of the population, infrastructure or land uses exposed to a hazard, such as the elements in tables B1a and B1b (see Annex), i.e., by sex, age, income, and disability.

33. A short list of basic variables likely to be factors for vulnerability measurement in risk assessment, should include:

- Median household disposable income;
- Education enrolment, by age group and level of achievement and by male and female heads of households;
- Information on assets of households, such as type of dwelling;
- Other human development statistics, by age group, including evidence related to nutrition and childhood health;
- Type of employment, e.g., identifying households engaged in agriculture or fishing; and
- Urban versus rural distribution of affected or exposed areas

34. A variety of characteristics of individuals may combine in complex ways to create vulnerabilities to a disaster where it otherwise might not have existed. Thus, it is important to produce statistics the basic social and demographic characteristics of populations, especially in high risk areas. An important example of an element of complex (or intersectional) sources of vulnerability is gender.

Gender and disaster vulnerability

Gender intersects with a range of other socio-economic factors affecting vulnerability. Gender refers to the social norms that shape the behaviours and roles that women and men, girls and boys, are expected to play in any society. The expectations, power and influence of women and men differs between societies, and typically changes over time. Gender is therefore an essential factor to be considered in how people experience and are affected by disasters. It often interacts with other factors, such as socio-economic status, to increase or decrease vulnerability. For example, in some settings, women and children may be more vulnerable than men to the impacts of disasters because of having less access to and control of resources or a lesser role in decision-making before, during and after an event.

35. Gender must be a key determinant in any disaster related vulnerability assessment However, sex-disaggregated data on the effects of natural hazards on mortality and morbidity are currently available only for a small number of cases, mostly from research literature. Adequate monitoring of the impacts on the lives of women and men may require that some data disaggregated by sex and age are recorded for smaller areas of a country. Therefore, sex and geographic disaggregation is an important area for further development of disaster-related statistics by NSOs and NDMAs.

36. Disasters have different effects on women, men, girls and boys. Gender roles and norms also play an important role in the aftermath of disasters, including in terms of access to livelihoods and participation in reconstruction efforts.

37. Additional dimensions associated with gender that impact vulnerability status include safety and security associated with increases of the prevalence of sexual and physical violence and harassment in situations of instability, such as post disaster settings, and barriers to participating in decision making. Climate-change related drought is known to drive increases in child marriage rates among the most vulnerable communities, as parents are more likely to choose to marry their daughters off much earlier in exchange for dowries for survival.[13] Exposure to violence may render women survivors physically and psychologically unable to fully engage in disaster recovery. Prevalence of sexual or physical violence and the presence of gender inequalities in post-disaster recovery processes are perpetuated partly due to women's limited participation in decision making, including for designing and shaping public governance institutions and recovery plans that involve women in assessing risk and setting up inclusive prevention strategies.

38. Children are more vulnerable than adults because they are dependent and less skilled to deal with the physical, emotional and psychological impacts of disaster. Young girls may be particularly at risk during times of disaster as they are often more dependent or protected than boys and may be seen as an asset or a liability depending on the circumstances. Older women and men are also vulnerable due to dependency and have needs that must be considered in disaster risk management. Evidence suggests that women live longer than men, and in ageing societies, the population affected by a disaster is likely to compose of elderly women in larger numbers. Studies of ageing populations have revealed location and type of residence can be a good reference for assessing vulnerability for the elderly, especially in cities.

39. Explanations of the differences between female and male mortality during the 2004 tsunami, for example, have been formulated in terms of gender. Women's and girls' higher vulnerability was associated with lower access to information, the lack of life skills such as swimming ability, constrained mobility outside their home, and the increased vulnerability of women staying home with children at the time of the sea-level rise. Gender differences were not the only factor. The physiological attributes of females and males at different ages have a substantial impact on vulnerability during tsunamis. For example, a quantitative assessment of sex and age differences in mortality based on a longitudinal survey before and after the tsunami in Indonesia showed that some of the explanation lies in differences in physical strength,

13 *https://www.theguardian.com/society/2017/nov/26/climate-change-creating-generation-of-child-brides-in-africa*

stamina and running and swimming ability. Overall, prime-age males were the most likely to survive the tsunami because they were the strongest. Their presence in the household at the time of tsunami also had a protective effect on the survival of wives and children. [14]

40. In some contexts, women's ability to cope after disasters may also be less than that of men because of their limited economic empowerment. Evidence shows that women are less likely than men to own productive assets, including land and machinery and are therefore more dependent on natural resources, which might be compromised because of disasters. They are less likely than men to have a bank account and access to financing, which limits their flexibility in responding to financial constraints. In single-headed households, women are more likely to have custodianship of children and therefore incur in additional expenses and responsibilities.

41. Household survey data indicates that in four of every five households (80 per cent) without water on premises, it is women and girls who oversee water collection, and a large share of them also bear the burden of collecting firewood and fodder[15]. In addition, in heavily agriculture-dependent areas in Africa and Asia and the Pacific, women are much more likely than men to work in the agricultural sector. When water sources, land and forests are affected byf natural disasters, women and girls are more likely to see their livelihoods compromised and are often forced to spend more time carrying out these tasks, which impinges on their available time for paid employment, education and leisure.

Physical vulnerability

42. Vulnerability applies not only to individuals or households, but also infrastructure, which is sometimes called "**physical vulnerability**". In most cases, physical vulnerability also stems from other social-economic or environmental problems. Relatively poor households often have little choice other than to accept relatively less resilient shelters in their dwellings or work places. Moreover, poorer communities, such as **slums**[16] or lower income areas of urban sprawl, are often the most likely to be situated in areas with high exposure to hazards.

43. Physical vulnerability also applies to descriptions of land and water bodies. Although pollution in water bodies is generally considered an environmental problem, in the context of disaster risk, pollution also causes social and economic vulnerability because, in the case of a disaster, it can lead to significantly worse impacts to human lives and health and to the economic costs of recovery.

44. The 2010 World Development Report (World Bank, 2010), focusing on climate change, stated that "natural systems, when well-managed, can reduce human vulnerability". Examining and supporting cases of positive synergies between environmental protections, also called 'pro poor environmental policies' is one of the objectives for the United Nations Poverty and Environment Initiative (PEI). Wherever environments are heavily polluted or degraded, it is often the relatively poor populations that are more likely to be disproportionately affected and, therefore, more vulnerable in the event of a disaster.

[14] Oxfam International, 2005 for India and Indonesia

[15] UN Women's SDG report on gender, page 105 (analysis from MICS and DHS surveys)

[16] A slum household suffers: lack of access to improved water source, lack of access to improved sanitation facilities, lack of sufficient living area, lack of housing durability or lack of security of tenure (UN-Habitat,2016)

45. Population density and geographic location are the basic dimensions of exposure measurement, but they also can be factors for vulnerability. Many rural communities face marginally higher vulnerabilities due to the generally poorer access to transportation, health facilities, and other types of critical infrastructure or support services. The largest share of people living in poverty also tends to be in rural areas in developing countries. On the other hand, other facets of rural communities, such as informal community support systems, can be sources of resilience.

46. High population density is the defining characteristic of the urban centres, particularly in the high-population megacities, many of which are in coastal zones or otherwise hazardous locations. This is particularly the case in Asia and the Pacific, where high population density is common. While there are social benefits to having large groups of people concentrated within small geographic areas, such concentrations can be inherently vulnerable to impacts from hazards, especially in urban slums.

47. There are also macroeconomic vulnerabilities including, diversity of the economic structure, and importance of particular sectors, such as agriculture or fishing.

Coping capacity

48. **Coping capacity** 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 disaster. 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".

49. 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 population administrative records. It is more difficult to attribute movements specifically to hazards or a past disaster.

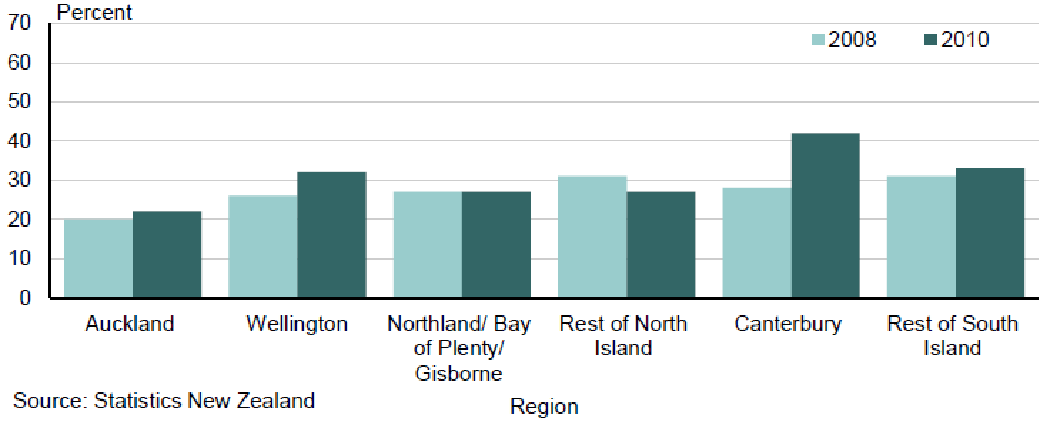
50. There also are coping mechanisms which can be captured by statistics based on government records, e.g. expenditures or from surveys of preparedness of households or businesses in potentially exposed areas.

51. Household preparedness to disasters can be measured from household surveys, for example. After major earthquakes struck the Canterbury province of New Zealand, survey results revealed significant increases in disaster preparedness of households. e.g., rationing emergency food and water storage. The New Zealand General Social Survey[17] asked New Zealanders about a range of factors of basic preparedness for disasters and found significant differences in results for the factors studied across regions and over time.

[17] http://archive.stats.govt.nz/browse_for_stats/people_and_communities/well-being/nzgss-info-releases.aspx

Figure 3.3

Households with household emergency plan, by region, 2008 and 2010



Source: Statistics New Zealand

52. Disaster management agencies need to consider the best available risk information to design and implement activities to reduce the impacts of disasters, including through educational programmes, early warning, systems, and other methods for strengthening resilience through improved preparedness.

53. People are not equally able to access the resources and opportunities (or knowledge and information about hazards). The same social processes involved in the disadvantages of poverty (or other sources of vulnerabilities) can also have a significant role in determining their level of preparedness and access to information and knowledge. (Wisner et al., 2003).

Example Statistics on percentages of households attending training or simulations in hazard areas

Type of Training and/or Simulation Attended	Yes (%)	No (%)
(1)	(2)	(3)
Earthquake	96,1	3,9
Earthquake and Tsunami	80,5	19,5
Flood	14,3	85,7
Volcanic Eruption	2,6	97,4
Drought	2,6	97,4
Tidal Wave	2,6	97,4
Landslide	1,3	98,7
Tornado	1,3	98,7
Land and Forest Fires	1,3	98,7

Source: BNPB-Indonesia, 2013

54. The example above comes from a study of disaster preparedness in Padang City of Indonesia. These types of statistics should also be disaggregated, where feasible, by sex, age, income groups, disability and for urban and rural areas. Table B3 (Annex) is a sample list of relevant statistics by geographic regions for coping capacity assessment.

CHAPTER 4: IMPACTS STATISTICS

Background

1. The Sendai Framework Monitor and associated Technical Guidance (UNISDR, 2017) provides explanatory guidance and the scope of reporting requirement for inputs into aggregated analyses and monitoring of progress for indicators on disaster impacts at the international level.

2. Other references and tools preceded the global Sendai Framework Monitor, and they complement it as related references or additional sources of statistics, such as: DesInventar[18], the European Union-JRC Working Group on Disaster Damage and Loss Data[19], UNISDR Global Assessment Reports (GAR)[20], EMDAT[21], SIGMA from Swiss Reinsurance and NatCat from Munich Re[22], and IRDR Guidelines on Measuring Losses from Disasters (IRDR, 2015).[23].

3. Post disaster needs assessments (PDNAs) are a form of post-disaster analyses, designed to provide information and the overall picture of costs and estimated needs for recovery, especially following large disasters.

4. Impacts statistics are the inputs for conducting post disaster assessments and for computing indicators, brought together in common compilations, commonly known as loss and damage databases.

5. The objectives in the DRSF are to synthesize and elaborate, where relevant, current international guidance and provide recommendations or suggested good practices to improve coverage and consistency in the collections of basic statistics across and for all types of disasters.

Attribution of impacts

6. The classic challenge for producing impacts statistics is the attribution of particular data to a disaster. This is a direct causal relationship, and statistical reference to a disaster. For example, a fatality can be attributed as death from a disaster if it was caused by one of the nationally identified hazard types. Not all cases will be equally clear attributions, therefore a minor statistical error can be expected in disaster impact statistics due to challenges with attribution.

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[18] Under transformation into Desinventar-Sendai, see: https://www.desinventar.net/

[19] European Commission-JRC (2015)

[20] GAR is a series of assessment reports released by UNISDR, see: https://www.unisdr.org/we/inform/gar

[21]A database of disasters and disaster impacts with global coverage and covering the period from 1900 to present, www.emdat.be

[22] Sigma and NatCat Armenia proprietary datasets available through paid subscription

[23] IRDR (2015), *Guidelines on Measuring Losses from Disasters: Human and Economic Impact Indicators (IRDR DATA Publication No.2*), Beijing: Integrated Research on Disaster Risk

7. Traditionally, data on direct impacts focussed on observations in the disaster area immediately after a disaster. However, direct impacts can take a variety of forms, including sudden and immediate impacts but also delayed consequences, (e.g. buildings collapsing or demolished several weeks after an earthquake, persons dying from injuries weeks or months after the event). Modern statistical systems can produce statistics on a much broader range of impacts and do not depend only on what could be observed and recorded during or immediately after an emergency.

Core sources for impacts statistics

8. A general checklist of steps or methodological approaches can be summarized for impacts statistics as observed from current practices in national statistical systems:

a. Initially, disaster management agencies observe and assess direct impacts during and immediately after an emergency as a part of the disaster response. These initial observations can be summarized and converted into statistics, e.g. aggregated by geographic area.

b. Baseline, or background, statistics for the location of the disaster, such as basic characteristics of infrastructure and population known prior to the hazard can be used to complement the initial observations by disaster management agencies and assist in the production of complementary metrics used for impacts statistics. Background statistics provide contextual information to convert some of the initial observations of damages or other disruptions into comparable units of measurement, to develop appropriate aggregations and disaggregation.[24]

c. Review of the outputs of monitoring instruments, like remote sensing imagery from satellites or local tracking of basic services or other economic activities is one of the important types of background statistics, particularly for disasters. Interpretation of remote sensing imagery is a crucial tool for assessing impacts, including estimating the extent of losses and for deepening the understanding of how risk factors contributed to the disaster. Other types of monitoring systems, such as collections of reports to response or to insurance agencies may be a source of data on disruptions to basic services.

d. Not all impacts can be observed directly, thus another crucial step involves compilations of regular sources of time series statistics within the national statistical system, such as the population and housing census, business surveys, and compilations of other records of economic activity, which can be used to evaluate trends (before and after the disaster) and estimate statistics on the impacts. This includes trends for estimating indirect impacts, such as effects on GDP or for analyses of links with population movements.

Damage and loss database structures

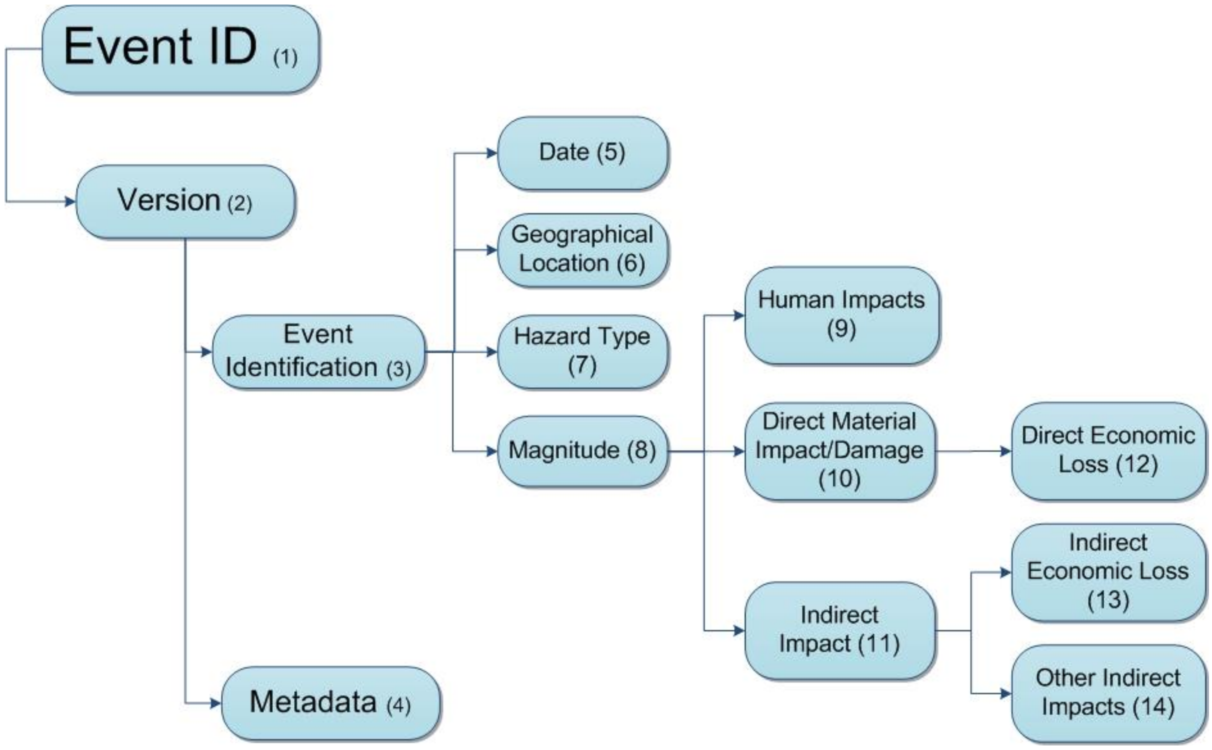
9. National databases need to adopt a clear and specific structure for organizing the components of impacts and related signifiers or metadata. Figure 4.1 is a version of a database model from the European Commission-JRC (2015). This model demonstrates the recommended general approach for structuring the integration of multiple datasets related to disaster impacts across disaster occurrences in a centralized national database.

[24] For example, baseline statistics on the economy in the affected area, like average values of agricultural production, are used to estimate economic loss

10. In this modified presentation of the European model, each box constitutes an individual compilation of data and metadata, which are linked to the unique event ID and therefore may be instantly queried according to the basic characteristics of disasters, i.e., timing, location, geographic scale of emergency, and hazard type.

Figure 4.1

Database model for disaster impacts statistics



Source: adapted version of a diagram in European Commission-JRC (2015)

Time series aggregation

11. The recommendation for compilation of impact statistics used for producing indicators or in time series analysis is to make compilations on an annual basis, at minimum (see also IRDR, 2015), and the Sendai Framework Monitor is collecting impacts statistics as annual aggregations for each year within its scope.

12. Aggregation for time series analyses, or for analyses by hazard types or location, means the statistics are no longer attached to a specific disaster occurrence, but the basic data are retained within the nationally centralized database according to the basic structure in figure 4.1, for potential other future use in research (e.g. comparisons of impacts between two individual occurrences).

13. For assessing trends over time, a long-time series of impact statistics is required due to the inherent randomness over space and time of exposure to hazards. For example, for the Sendai Framework Monitoring, governments specified 10-year periods of 2020-2030, as compared with 2005-2015 for the affected population indicators.

Geographic aggregation

14. Statistics on disaster impacts can be presented according to hazard types and according to geographic regions within the country, as shown in the example DRSF impacts tables (C, D, E, F & G tables – see Annex).

15. Geographic aggregation of location specific information or geo-referenced statistics can be easily customized, according to specific uses, with GIS. For the purpose of the Sendai Framework aggregations, observations related to specific disaster occurrences are reported for the national scale or for other smaller administrative regions within the country, e.g., districts, municipalities, provinces – Admin. 03, 02, 01 or other types of defined regions, like river basins.

16. Impacts statistics are recorded according to a specific disaster occurrence and, sometimes, a disaster area (or 'disaster footprint') is defined for a specific event.[25]

17. A simple three-category system (small moderate, and large disasters) is a common practice of national agencies for indicating and grouping the scale of impacts from a disaster. There is no requirement or instruction. The geographic scale of the administration of an emergency response and recovery effort, e.g., local, national or regional scale is recommended as a simply proxy measure for categorizing scale of disasters. While categorizing the scale of disaster areas is not relevant for the international monitoring of Sendai Framework indicators, this information may be useful for other purposes given the differences in associated risks.

18. **Large disasters** are disasters in which the emergency is at a national (or higher) scale and have special characteristics of interest for analysis because they are relatively rare but have extensive and long-term effects on sustainable development. Large disasters tend to generate more data compared to small disasters and they are often covered by post- disaster assessment studies[26]. The impacts of large disasters often cross administrative boundaries, including international borders, and therefore recordings of statistics for large scale events are usually applicable to multiple reporting regions.

19. **Medium and small-scale disasters** refer to emergencies at smaller than national geographic scales. On aggregate, across disasters, the small and medium disasters tend to cause greater impacts to a country or region because they are more frequent than large disasters. This distinction is related to the concept of **intensive and extensive risk** from disasters developed in UNISDR (2015). "Extensive risk is used to describe the risk associated with low-severity, high-frequency events, mainly associated with highly localized hazards. Intensive risk is used to describe the risk associated to high-severity, mid to low-frequency events, mainly associated with major hazards." Small disasters have impacts limited to relatively small local areas, for example concentrated severe storms. Medium-scale disasters are defined by a threshold of impacts causing emergency reaction from authorities from multiple administrative regional authorities – such as from multiple, villages, districts or provinces.

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[25]. Currently, there is no internationally standardized methodology for tracing a 'disaster footprint'. However, it is recommended to define disaster areas, where feasible, as tracing the contiguous areas where direct impacts could be observed. It is further recommended to identify with standard geographic referencing the lowest level of administrative region (usually Admin 03) for which basic background statistics on the population are available.

[26] such as Cyclone Evan that caused major economic destruction in Fiji (Government of Fiji, 2013) and Samoa (Government of Samoa, 2012)

Human impacts

20. Three tables (C1, C2, and C3) are shown in the Annex of tables for organizing the list of basic range human impacts elements according to geographic regions, hazards types, or demographic and social categories

21. Some data and statistics relate to both the human and material categories of impacts. For example, the same data sources that are used for accounting for damaged or destroyed dwellings (and Sendai Framework Target C for economic loss) should also be applicable for estimating the number of people whose houses were damaged due to hazardous events (a Sendai Framework indicator under Target B for affected population).

22. Besides statistics on the various forms of impacts from disasters on people, there is also a demand for aggregated counts of the "affected population" after a disaster, for example as an indicator for international monitoring of the Sendai Framework (UNGA, 2015). There is also a need to produce disaggregated statistics on people affected by disasters for a full understanding of post-disaster recovery needs and for use in future risk assessments.

Demographic and social disaggregation

23. Disasters affect groups of people differently. There has been a strong call from expert groups working on SDG and Sendai Framework indicators for disaggregation of disaster impacts for assessment of relevant vulnerabilities. The ESCAP Resolution 70/2 of May 2014, establishing the Asia-Pacific Expert Group emphasized the importance of disaggregated statistics for "enabling a comprehensive assessment of the socioeconomic effects of disasters and strengthening evidence-based policymaking at all levels for disaster risk reduction and climate change adaptation".

24. Technical Guidance in the Sendai Framework Monitoring (UNISDR, 2017) calls for disaggregation of people by hazard, geography, sex, age, disability and income.

25. The Sendai Framework Monitor collects age disaggregated statistics according to three groups: 0-15, 16-64 and 65+. In addition to meeting this minimum grouping for international reporting purposes, collection of impacts to infant children (0-5 years old) is also recommended, since children at this age are dependent on a parent, or other guardian, in an emergency.

26. Statistics disaggregated by social and demographic categories will become progressively more available and simpler to estimate for future disaster occurrences through increased experience with compiling summary statistics before and after disasters, and via linking datasets.

Deaths or missing persons

27. Each country defines deaths and missing persons differently according to their own national laws. For example, countries may use different time periods and procedures for missing persons including the reclassification of cause of death. The statistics will reflect the national legislation and policies. It is not expected that these differences will significantly affect the analyses or comparisons of statistics in the long-term because the basic concepts remain the same across countries.

28. The general framework for attribution of death or missing persons includes two broad types of scenarios:

a. Deaths or missing persons occurring during an emergency period (or deaths caused by an injury or illness sustained during an emergency) and believed to be caused by a hazard, and
b. Indirect fatalities associated with a hazard. An example is deaths from illnesses caused by consequences (poor access to water and sanitation, exposure to unsanitary or unsafe conditions) resulting from a hazard.

29. Deaths or missing persons are typically reported by different levels of local and national government and usually at some stage are shared in official reports to the public via the press. Commonly there is a need to revise original reported counts on deaths (and other human impacts) following the emergency and after there has been sufficient time to assess the sources and to verify data collected. The revised estimates must be stored in the centralized compilations of disaster impacts statistics across occurrences and utilized for calculating indicators.

30. A key consideration of compilation of revised figures is to ensure that the final official counts of deaths after a disaster are also incorporated into the broader official system of administrative records (i.e., the civil registration system) and statistics, which is also the source used for the long-term official statistics on mortality and health of the population (See Chapter 9).

Injured and ill

31. Aside from death, the two-other main physical impacts from disasters to humans are injuries and illness. The relative importance of injuries or illnesses will vary depending on the characteristics of the underlying hazard as well as on social factors, especially the vulnerability factors of the population in an affected area and the seriousness of the illness or injury.

32. In Bangladesh, for example, illness is a more frequently occurring impact from disasters compared to injuries, overall. But, the frequencies for injuries or illnesses vary by hazard type and depending on the age and gender of the exposed population. (Bangladesh Bureau of Statistics, 2016)

Displacement

33. For all types of movement of the population that are a direct consequence of a hazard, including evacuations and permanent relocations of people due to a disaster, the suggested term is **displacement**.

34. The Open-Ended Intergovernmental Working Group (OEIWG) decided to exclude displacement statistics from indicators on affected population for the Sendai Framework Monitor. Developing consistent approaches of measurement on displacement is difficult because there are many different types of displacement of people during and after a disaster. Therefore, the concept is only relevant for existing statistics that may be used in analyses and national or local levels, in accordance with the Sendai Framework paragraphs 28 (d) and 3(h).

35. In the adopted terminology for the Sendai Framework (UNGA, 2015), **evacuation** is defined as: "moving people and assets temporarily to safer places before, during or after the occurrence of a hazardous event in order to protect them." Data on evacuations could be used for assessing impacts to population, but evacuations are also a method of disaster risk reduction. Both analytical perspectives can be accommodated in statistics if observations of evacuations are accessible in the database.

36. The nature of displacement (and its measurement) varies according to length of time (e.g. temporary or permanent) and whether displacement was arranged (or ordered or financed) by governing agencies. Sometimes movement of people related to a disaster is a matter of voluntary and self-funded choice. There are also cases, especially for large disasters, in which governing authorities order and provide support for evacuation or relocation of populations in designated affected areas. The latter case is more easily measured, but both could be important for tracking impacts of disasters, and the responses of people, over time.

37. Population movements that correspond with a disaster can sometimes be captured via statistics from population censuses or population administrative records. It is more difficult to attribute movements specifically to hazards or a past disaster without posing a specific query in census or survey questionnaires.

38. A common cause of displacement after a disaster is damaged or destroyed dwellings, which, is data that can be reutilized for multiple perspectives in statistical tables, starting with the accounting of material impacts variables (below). There are also cases where the dwelling structure may have received negligible damages but due to the changes of circumstances regarding the location of the dwelling, the area is deemed unsafe for continued residential occupation. Most broadly, displacement statistics can be summarized according to permanent or temporary displacement.

Impacts to livelihood

39. Impacts (or disruptions) to livelihoods is a concept from the internationally adopted recommendations for the Sendai Framework monitor (UNGA, 2015). UNISDR guidance defines livelihoods as: "the capacities, productive assets (both living and material) and activities required for securing a means of living, on a sustainable basis, with dignity." The concept is broad and the OEIWG deferred o national practices for measurement for Sendai Framework indicators.

40. A core factor for sustainable livelihood for which impacts are measured in some countries is impacts to employment. For measurement units, impacts to employment can be measured similarly with disruptions to basic services (see last section in this chapter), i.e., in terms of number of people affected and length of time affected.

41. Utilizing a specially designed household survey, the Bangladesh Bureau of Statistics reported statistics (see Box 5) on impacts to employment (and other basic factors of livelihood like access to water and sanitation) across the affected population, according to numbers of individuals affected by geographic regions and as a distribution of the number of days missed.

Box 5: Utilizing household survey for collecting data on human impacts

Where feasible, household surveys are a potential good option for collecting data on direct and indirect impacts from historical disasters by posing specific questions to households in areas that recently experienced a disaster. A well-documented example is available from the Bangladesh Bureau of Statistics, which collected and published extensive statistics on effects of disasters on the population through a national sample household survey though the Impact of Climate Change on Human Life (ICCHL) Programme.

Included within the scope of the national survey in Bangladesh was statistics on impacts to livelihood, including temporary losses in education and employment.

Number of households missing work due to disasters by hazards and distribution by number of days missed, 2009-2014

Hazard Type	Number of households mising work	Number of non-working days missed (%)					Average no. working day
		Total	1-7	8-15	16-30	31+	
Drought	325242	**8.16**	3.61	2.69	1.47	0.39	12.
Flood	1071377	**26.93**	4.98	10.62	9.39	1.94	17.
Water logging	442145	**11.12**	4.88	3.23	2.05	0.96	14.
Cyclone	762788	**19.17**	12.05	4.51	1.95	0.66	9.
Tornado	129754	**3.27**	2.65	0.45	0.14	0.03	5.
Storm/ Tidal Surge	316257	**7.95**	4.92	1.5	1.06	0.47	10.
Thunderstorm	253272	**6.37**	3.73	2.14	0.46	0.04	7
River/ Costal Erosion	143973	**3.62**	1.23	1.13	0.92	0.34	16.
Landslides	2019	**0.05**	0.04	0.01	0	0	5.
Salinity	60064	**1.51**	1.18	0.24	0.08	0.01	6
Hailsotrm	2998410	**7.51**	6.29	0.76	0.34	0.12	5
Others (Fog, Cold wave etc.)	173708	**4.37**	2.91	1.16	0.26	0.04	7.
Total	**3979008**	**100**	**48.46**	**28.44**	**18.12**	**4.98**	**12.**

Bangladesh Disaster-related Statistics, "Household distribution of number of non-working days due to last natural disaster by categories, 2009'-14". (ICCHL; BBS; SID; Ministry of Planning , 2016)

http://www.bbs.gov.bd/site/page/76c9d52f-0a19-4563-99aa-9f5737bbd0d7/Environment--Climate-Change-&-Disaster

42. Physical human impacts (deaths or missing, injuries, and illnesses) always happen within the geographic area of the disasters. Impacts to livelihood, however, which are indirect effects, could potentially happen to people outside of a geographic area defined by the physical or material impacts from the hazard.

Material impacts

43. Direct material impacts are equivalent to "damages" as the term is used in many other related references (EU-JRC, FAO, PDNA)[27]. DRSF uses the term "direct impacts" for consistency with UNISDR (2017) and to avoid confusion between damaged and destroyed assets.

44. Direct material impacts constitute the scope for valuing **direct economic loss** according to the definition adopted for the Sendai Framework Monitor. Material impacts to the environment and cultural assets are distinguished due to differences in measurement units and valuation for economic loss measurement.

[27] PDNA, FAO, and JRC use the terminology of damages and losses. Physical Damages to infrastructure are contrasted to losses, which is equivalent to indirect impacts in the Sendai Framework and DRSF.

45. Regarding measurement units, direct observations of material impacts from a disaster are compiled, initially, in physical terms, (e.g. in terms of area (sq. m), or counts of units or buildings by type) that are damaged or destroyed (see measurement units menu in Chapter 7).

46. Material impacts can also be represented in relation to the numbers of people exposed or affected by the impacts. This includes, where possible, disaggregated statistics, e.g., by gender or by income categories) on populations exposed to material impacts of disasters. **Disruptions to basic services** are caused by material impact, with direct consequences on affected people.

47. The observation of impacts, initially in physical terms, is critical inputs for estimating the scale of the impacts of the disaster from an economic perspective, both in volume terms[28], and in terms of money. For developing systems for compiling time series in monetary terms, (i.e. economic losses), it is crucial that the basic data in physical terms is compiled in national databases following a defined structure. (see Annex of tables and Classification of Objects of Impacts in Chapter 8).

48. 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) Direct impacts tend to be relatively more immediate impacts of a disaster and they are the objects of emergency response. Indirect impacts affect individuals, businesses, and the public in proximity of the disaster area and sometimes these effects will continue for years or possibly even for decades after a disaster. Examples of indirect impacts include depressed demand for goods and services, and other effects to prices, increased debt or dependence on imports, disruptions to supply chains for products or for services like education, and so on.

49. The scope of measurement for the direct material impacts is defined according to the stocks of physical objects (see list of objects of direct material impacts in Chapter 8) that were damaged or destroyed as direct result of a specific disaster occurrence. Especially important for disaster impacts statistics is **critical infrastructure** and agricultural crops.

50. **Critical Infrastructure** is "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, 2017). A list of critical infrastructure types is presented as a sub-group of the broader classification of the objects of direct material impacts in Chapter 8.

51. In addition to damages to critical infrastructure and other components of the built-up landscape, another important form of direct material impacts is damage to the land and other natural resources, especially agricultural land, destruction of trees, and damages to the conditions of important ecosystems such as forests and water bodies.

52. The System of Environmental-Economic Accounting (SEEA) 2012 – Central Framework is an internationally agreed standard for producing comparable statistics on the environment and its relationship with the economy, following a similar accounting structure as the SNA. According to SEEA, **environmental assets** are "the naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity."

[28] See definition of measurement in volume terms measurement from System of National Accounts 2008

53. Land and natural resources are also economic assets and are included within the SNA assets boundary, and therefore, in principle, a part of the overall scope of national asset accounting. However, some of the natural benefits from ecosystems that are recognized in SEEA are beyond the scope of SNA and are not currently valued in monetary terms. An example is the natural protections against hazards provided by vegetation. Natural ecosystems provide a natural barrier, and thus a boost to coping capacity in the form of natural protection along coastlines or upstream. These benefits are recognized as ecosystem services in the SEEA Experimental Ecosystem Accounting Framework.

54. Environmental assets are a potentially important component for the basic range of disaster-related statistics. Generally, these assets were not included within the scope of the Sendai Framework Monitor. However, some items, such as trees or agricultural land are counted in Sendai Framework Indicator C2 “Direct agricultural loss attributed to disasters”, depending on the nature of the objects that have been lost.

Impacts to agriculture

55. In economic terms, impacts to agriculture are often among the most significant after disasters. This is partly because, as a land intensive activity, agriculture faces a relatively large exposure to hazards.

56. To capture the full impact of disasters on the agriculture sector, the Food and Agriculture Organisation of the United Nations (FAO) has developed a methodology for damage and loss assessment, which is integrated, through a collaborative process with UNISDR, into the Sendai Framework Monitoring Process within the structure of indicators for direct economic loss. The FAO methodology distinguishes between damage (total or partial destruction of physical assets), and loss (changes in economic flows arising from a disaster).[29]

57. Impacts to each subsector of agriculture can be divided into two main components: production and assets. Production damage is measured in terms of the value of destroyed agricultural inputs (seeds, fertiliser, feed and fodder) and outputs (stored produce). Production loss is measured in terms of the value of agricultural production lost from the disaster. Assets damage is measured in terms of the value of the destroyed facilities, machinery, tools, and key infrastructure related to agricultural production. The monetary value of damaged assets is calculated using the replacement or repair cost. This allows for an estimation of the extent and value of damage and loss for all components in each subsector.

58. Table F (see annex) was developed by FAO following the basic format of the DRSF basic range tables and describes the key components of the damage and loss assessment methodology for agriculture.

59. The assessment of production loss should be done for all primary crops. Primary crops are those that come directly from the land without having undergone any real processing, apart from cleaning. Primary crops are divided into annual and perennial crops. Annual crops are those that are both sown and harvested during the same agricultural year, sometimes more than once; perennial crops are sown or planted once and not replanted after each annual

[29] This FAO terminology (“damages” and losses”) corresponds with several other references, as noted above, and essentially corresponds with the direct impacts and indirect impacts distinction from the Sendai Framework and utilized in DRSF.

harvest. Annual primary crops include cereals, pulses, roots and tubers, sugar crops, some oil-bearing crops, some fibre crops and vegetables, tobacco, and fodder crops. Perennial primary crops include fruits and berries, nuts, some oil-bearing crops and spices and herbs.

60. There are basic differences in approaches to valuation of losses for seasonal crops and perennial crops (or livestock or other types of multi-use assets). These differences are necessary because of differences of nature of the losses. Destruction of seasonal crops can be assessed as a one-time loss, which hopefully can be recovered over time and will not directly affect the next harvest, whereas losses of perennial crops relate to expected future returns that would have extended beyond the season in which the disaster happened.

61. For annual (or seasonal) crops, loss is measured as the anticipated (but unrealized) market value of the finished product for the affected crops. However, production loss for perennial crops is measured in terms of the discounted expected yield.

62. Livestock, forests (both cultivated and non-cultivated forests are recognized as assets for forests), aquaculture and forestry are included in the FAO methodology and in Sendai Framework Monitor for direct economic loss.

63. These resources, and the perennial crops, are assessed for calculation of monetary indicator terms in relation to the discounted expected yield, which requires the following statistics:

a. Pre-disaster value of perennial crops or animals killed by the disaster;
b. Replacement cost of fully/partially damaged assets, at post-disaster price;
c. Difference between expected and actual value from survived animals and perennial crops in a disaster year; and
d. Discounted expected value from dead animals until full recovery and/or replacement of livestock.

64. Impacts to the land itself, or to land improvements, should, in principle, also be included. Damaged or destroyed buildings and machinery used by agricultural enterprises are valued according to replacement costs, as generally recommended for direct economic loss measurement in the Sendai Framework Monitor (see below).

Economic loss

65. It is important to consider the multiple ways economies are affected by disasters because some of these economic impacts are difficult to attribute with a causal relationship with the disaster, and therefore could be missed. Direct material impacts tend to be more explicitly observable, but there is still usually a need for estimations or to utilize multiple data sources for valuation of thes impacts. The agriculture case (above) is a good example of the challenges, stemming from the need to adopt conventions for handling monetary valuations of different types of impacts differently, e.g., perennial and annual crops.

66. Economic loss statistics must be built on a clear and consistently applied concept of measurement, to avoid mixing figures incoherently (e.g. mixing stock with flow measures) or double-counting. Some types of economic losses are implicitly included in national accounts and other economic statistics, but they are not easily disentangled as impacts variables and,

due to accounting rules, some values will appear as positive contributions to key indicators like GDP and investment. [30]

67. One of the economic responses after a disaster emergency period and recovery is a short-term boost in construction activities, which can give a misleading impression of resilience and economic growth because the losses of assets, to which the construction is replacing, do not affect the computation of GDP directly. However, there are also indirect effects to GDP, which are more difficult to measure, and it is important to develop a complete description, as much as is feasible, of the overall effects of disasters on the economy.

68. Reducing "direct disaster economic loss" by 2030 is target C in the Sendai Framework and a target under multiple sustainable development goals – in relation to poverty reduction (Goal 1), sustainable cities and human settlements (Goal 11), and climate change action (Goal 13). **Direct economic loss** is defined for international monitoring of Sendai Framework and SDG targets as "the monetary value of total or partial destruction of physical assets existing in the affected area."

69. **Assets** are defined in the System of National Accounts (SNA) as stores of value "representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of transferring value from one accounting period to another. "(SNA 2008, para 3.30). In other words, assets have an intrinsic value represented by their expected benefits to owners and this value can be lost or reduced directly by a disaster.

70. Proposed for direct economic loss measurement for the Sendai Framework and SDGs monitoring in UNISDR (2017) is the cost for replacement (e.g. reconstruction/restoration) of damaged or destroyed assets, which is a different concept compared to measuring changes to the values of assets (see box 5 on economic loss and the SNA). Replacement or reconstruction costs (although they may be estimated) represent actual flows of financial resources that were necessary to restore the physical assets back to its previous condition before the disaster. Thus, the statistics used in the Sendai Framework and SDGs economic loss indicator are also a metric of investments for post-disaster recovery.

71. Use of replacement costs for measuring direct economic loss is practical for several reasons: (a) the values are relatively easy to interpret for analysis, (b)they are a part of the broader productive activities of the economy and thus can be compared directly with GDP, and, (c) the values are also a component of disaster risk reduction expenditures accounting (next chapter).

72. Although the definition provided for the Sendai Framework Monitor refers to assets, also for consideration for measurement of direct economic loss are "household consumer durables", a class of product, such as private owned cars, which technically are not included as assets in the SNA, but have a value in their own final use by households.

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[30] For example, reconstruction or repairs of assets after a disaster are productive and income-earning activities, thus contributing positively to GDP in periods after a disaster. Research after disasters in the United States has shown that a short-term increase in GDP and employment can be commonly observed at the local level in areas after a disaster. In part, this is an effect of efforts for recovery of direct economic losses, according of the Sendai Framework definition.

73. Several primary sources for estimating the value of replacement costs for damaged or destroyed assets can be utilized in a complementary way.

a. Governing agencies responsible for the relevant types of infrastructure (roads, buildings, agricultural land etc.) may conduct an assessment as part of the immediate disaster response and recovery, which could include estimated replacement costs based on existing (pre-disaster) statistics on average per unit costs by infrastructure type in the affected region.

b. Estimation based on average costs, as proposed in UNISDR (2017), noting that such estimations could be prone to inaccuracies, depending on the variance in costs across space. When using average per unit costs or other proxies for estimating replacement costs, there will always be a degree of uncertainty, which should be quantified and included in the metadata.

c. Direct observations of expenditures for recovery will be available for some s from reports or surveys of businesses or reports of expenses by the government agencies, e.g., Ministry of Transport for the case of roads, or from reports from records of insurance claims covering a disaster. [31]

74. By combining data sources, a reasonably reliable and coherent picture of expenses for recovery of assets should be feasible and compiled into tables like E1A (see Annex), and for producing an estimate for aggregated expenditure for recovery.

75. Although the basic measurement objective for the Sendai Framework direct economic loss indicator is to quantify the recovery of the affected physical assets, of course not all damaged or destroyed assets will be recovered. There may not be precisely a replacement of the assets that existed before the disaster. Some assets will simply be written off whereas others will be replaced by different new assets. The costs of "**build back better**", for example, are different from the costs of recovering losses. These additional costs, represented by structural measures with a purpose of disaster risk mitigation, e.g., seismic resilience of buildings are also useful statistics, and an important component of the overall economic investment in disaster risk reduction (see next Chapter).

76. In the System of National Accounts (SNA), there is a recording for changes to the value of a country's stock of assets caused by **catastrophic losses.**[32]

[31] Note that not all replacement expenditures can be observed (or even take place), not all assets will have been insured, and suitable proxies (e.g. average per unit costs for affected assets) are not always available. Thus, some combination of compilation of these statistics with estimation based on proxies is a common practice across disasters for compiling replacement costs.

[32] "The volume changes recorded as catastrophic losses in the other changes in the volume of assets account are the result of large scale, discrete and recognizable events that may destroy a significantly large number of assets within any of the asset categories. Such events will generally be easy to identify. They include major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought and other natural disasters; acts of war, riots and other political events; and technological accidents such as major toxic spills or release of radioactive particles into the air. Included here are such major losses as deterioration in the quality of land caused by abnormal flooding or wind damage; destruction of cultivated assets by drought or outbreaks of disease; destruction of buildings, equipment or valuables in forest fires or earthquakes." [SNA 12.46]

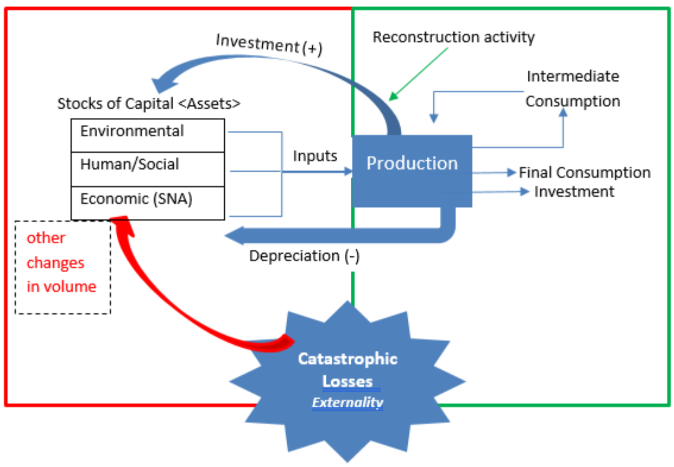
Box 6: Economic loss and the SNA

The costs associated with replacement of direct impacts are already incorporated implicitly within the SNA as productive (i.e. positive) activities. Indirect impacts will implicitly affect GDP in the year of the disaster (and subsequent years after). The total (direct and indirect) effects of a disaster on GDP are ambiguous within the national accounts.

However, as there is a strong demand from policy-makers and researchers, many statistics offices and/or national accounts authorities produce analysis, especially after very large disasters, utilizing national accounts and the sources of national accounts statistics to estimate the indirect effects of a disaster, and thus produce an unambiguous assessment of the effects of a hazard on economic activities by sector and for the whole economy. Several important references can be noted, e.g.: Escobar, C-G (2011), USBEA (2009), and Statistics New Zealand (2012b).

In principle, values for the direct impacts to assets, valued in terms of losses to value of the asset base, are already included, in this case explicitly, in the SNA, through a special recording called catastrophic losses. These losses are represented as a special type of change ("other changes in volume") to the national balance sheet for physical assets. This is a change in the stock of assets, which has no direct or explicit effect on the flows portion of the accounting framework, such as production and income. The figure below is a simplified representation of the relevant stocks and flows according the SNA, including the recording for catastrophic losses on the left side, which represents changes to stocks of assets and with the flow variables on the right side, which includes activities like reconstruction.

Catastrophic Losses in the SNA



The direct impacts from disasters recorded in the SNA Other Changes in Volume to Asset account cover losses in asset values from relatively large-scale occurrences (see definition from SNA), and therefore should be appended with estimates of the costs of damages from smaller scale events as well.

The valuation of catastrophic losses in the SNA matches with the approach developed by FAO for measuring losses to perennial crops and livestock (see Impacts to Agriculture), i.e. by assessing the change in asset values (discounted expected return).

77. For many disasters, especially large disasters, the indirect economic impacts are likely to be much larger in value compared to the values for destruction of assets and there is a strong interest for measures of indirect economic losses from disasters, for example to produce estimates of the effect of disasters on GDP growth. However, an initial focus on reliable measurement of direct economic costs is a sensible priority because the input data are also

basic building blocks upon which assessments and modelling of indirect economic impacts can be developed later.

78. In summary, while there is a strong international demand for internationally comparable indicators for direct economic loss, there is also an interest to produce multiple related figures, where possible, in order to meet different purposes of economic analysis, including assessments of the indirect economic impacts of disasters, and accounting for costs of expenditure for the post- disaster rebuilding and the broader measurement of disaster risk reduction expenditures, including costs for building back better.

Economic loss and poverty

79. The demand for direct economic loss from disasters measurement goes beyond the aggregate losses by country or for regions within a country. Although there is no requirement for disaggregation of economic losses by individuals (or types of individuals) for the Sendai Framework Indicators. There are other national or local-scale analytical purposes for providing disaggregated statistics for focused analyses for risk reduction, e.g., for people in vulnerable situations. This can be accomplished, to a certain extent, via disaggregation by income of human impact statistics, in particular households affected by damages to their dwellings or other assets, and by rigorous mapping of vulnerabilities before and after a disaster.

80. Another important link for understanding this relationship with poverty reduction is statistics on financial support to households during and after a disaster. For example, statistics should be compiled, where feasible, after each disaster on households receiving financial or other support by geographic regions and also compile summary statistics on coverage of insured losses versus uninsured losses.

81. If a poor household's dwelling is destroyed, the replacement costs are very small from the perspective of GDP, but extremely large from the perspective of that household, especially if the impacts were uninsured. The indirect impacts, e.g., displacement, loss of employment or reduced income could be even worse. It is important to compile and retain the basic data and metadata on material impacts and the people affected to allow for the possibility of disaggregated analyses focussing on poverty and leaving no one behind.

Disruptions to basic services

82. Disruptions to the functioning of a community or a society is one of the defining elements of disasters (UNGA, 2015). These disruptions are typically connected with material impacts from disasters and sometimes statistics on disruptions can be produced based on the same basic data inputs used for assessing material impacts after a disaster.

83. The measurement of disruptions to basic services was one of the issues discussed by the OEIWG to develop suitable recommendations for international monitoring of indicators. The OEIWG concluded that the international monitoring of indicators could be accomplished via the counts of relevant numbers of critical infrastructure types, as the disruptions are consequences of material impacts to critical infrastructure.

84. In addition, to help guide compilation of statistics for these indicators, UNISDR developed a list of the basic services that could be disrupted by disasters as follows:

- Health Services (CPC 86: "Human health services");
- Educational Services (ISIC 85);
- Public Administration Services (CPC 91 "Administrative services of the government");
- Transport Services (ISIC 49: "Land transport and transport via pipelines", ISIC 50 "Water transport", ISIC 51: "Air transport");
- Electricity and Energy Services (ISIC 35: "Electricity, gas, steam and air conditioning supply");
- Water Services (ISIC 36: "**Water** collection, treatment and supply"); and
- ICT Services (CPC 4 "Telecommunications, broadcasting and information supply services")

85. The portions of these services provided by government are included as part of the UN Central Product Classification (CPC rev 2.1), within Section 9: "Community, social and personal services" and in the International Standard Industrial Classification of All Economic Activities (ISIC Rev 4) Sections O, P, or Q.

86. For cases where additional data are available on the nature of the disruptions to basic services, national agencies might also consider development of an additional collection of two other key dimensions for analysis of the disruptions to basic services. This can be done, for example, by counting the number of people impacted and the length of time of the disruptions (see Table D2 in the Annex). Although this information is not relevant for international reporting under the Sendai Framework or SDGs, some official statistical agencies are already collecting such information and are encouraged to continue.

CHAPTER 5: DISASTER RISK REDUCTION ACTIVITY

1. 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 e.g. coverage of early warning systems and the basic knowledge and preparedness of households (see Coping Capacity, Chapter 3), 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 disaster risk reduction (DRR) purpose.

2. 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 as discussed in Chapter 4.

3. The Report of the OECD Joint Expert Meeting on Disaster Loss Data "Improving the Evidence Base on the Costs of Disasters: Key Findings from an OECD Survey" (OECD, 2016), made a connection between statistics on impacts and investment in disaster risk reduction as follows:

> *"The rationale for the work on improving the evidence base on the cost of disasters is grounded in the evidence that recent shocks from natural and man-made disasters continue to cause significant social and economic losses across OECD countries. The increase in damages is widely considered to outpace national investments in disaster risk reduction, but this claim is more intuitive than supported by evidence. Indeed, there is hardly any comparable data available on national expenditure for disaster risk management."*

4. Investment in disaster risk reduction has been shown, via case studies, to be highly efficient and financially smart investments if compared to risk of potential losses.[33] The case can be strengthened by development of robust statistical evidence for the costs and benefits of DRR activities over time. Moreover, monitoring current risk situations, including existing investments in risk reduction, can be used for identifying new investment opportunities that have the potential to significantly reduce risk or prevent unacceptable risks.

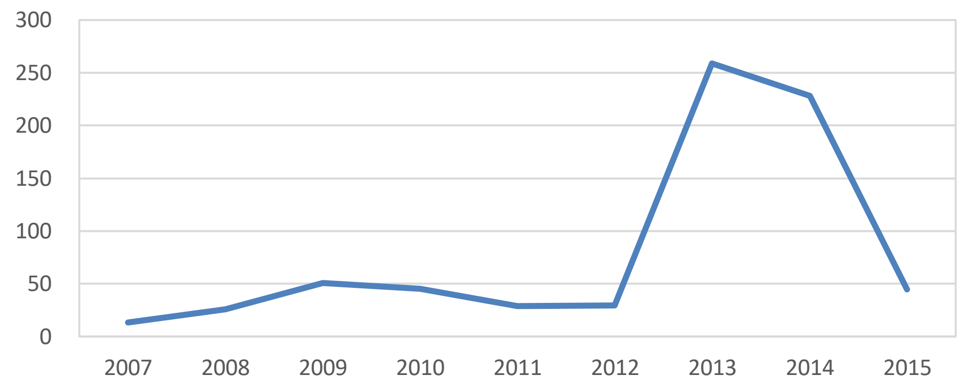
5. Many national governments have previously conducted ad hoc studies of disaster risk expenditures, known as DRM expenditure reviews. The aim for producing DRR economic statistics, is to separate values for expenditure with a DRR purpose, for regular annual accounting of relevant expenditures. This way, governments can track the trends of investments in reducing risks of disasters and to make assessments with respect to the measured risk and with respect to the costs of impacts when a disaster occurs.

6. OECD (2014) provided examples from a selection of OECD and non-OECD member states over time. Relevant expenditures tend to be on the rise for the countries with available time series statistics, but trends vary by types of expenditure. For example, after large disasters there are large spikes in DRR expenditures for response, recovery and reconstruction. These trends and peak values can be compared with the broader and more stable trend of other forms of DRR expenditures for a cross-country and cross-disaster analyses of how costs of DRR are

[33] See, e.g., UNDP, 2004

manifested and how they might be addressed efficiently and with minimum impacts to people. For example, the sample trend analysis below was produced using actual data on expenses related to emergency response or recovery from multiple sources for a country that experienced a very large disaster in 2013.

Sample of trend in expenditures related to disaster response and recovery (millions of US Dollars)



7. Moreover, the relevant expenses by government and other actors after a disaster are also used for estimating **direct economic loss**. (see chapter 4)

8. Expenditure statistics are typically aggregated at national scale, but equally important is to identify statistics on transfers, including transfers from the national budget (or from international sources) to local projects and local government. Producing statistics on transfers is crucial for identifying beneficiaries and potential gaps or opportunities for targeted interventions to reduce risks.

9. The publicly-financed disaster risk reduction activities, particularly disaster recovery, are often transfers from central government budgets to local authorities, and/or international transfers, or Overseas Development Assistance (ODA). If the activities with a DRR purpose can be specifically identified and isolated from the broader national aggregates, than these transfers can be tracked through balance of payments and national accounts statistics like other types of transfers and activities (production, investment, employment) in the economy.

10. The Sendai Framework describes **disaster risk reduction** (DRR) as a scope of work "aimed at preventing new disaster risks as well as reducing existing disaster risks and managing residual risk, all of which contributes to strengthening resilience. DRR encompasses all aspects of work including the management of residual risk, i.e. managing risks that cannot be prevented or reduced, and are known to give rise to, or already, materialize into a disaster event." (UNISDR, 2017).

11. Expenditures on disaster risk reduction may be difficult to identify and isolate from current transactions because they are implicitly recorded as part of a broader classification of transactions. There are two complementary approaches that can be applied for isolating the relevant values and producing statistics for a DRR activities, particularly the quantifications, in monetary terms, of DRR transfers and expenditures.

12. The first approach is to produce a focused analysis of transfers from relevant institutions and to analyse transfers and expenditures for a particular geographic region and

time period where there is a large-scale disaster recovery underway. Existing government finance and statistics are derived from administrative records or outcomes of surveys or censuses businesses and household activities, including trends. Analysis of trends, in the case of recovery from large scale disasters will indicate specific and temporary diversions in the trends, which can be used for estimation of expenditures for DRR activities for the recovery in those areas. Furthermore, a post-disaster recovery period is an opportune moment to establish coordination mechanism between government agencies for sharing data or producing proxy measurement for tracking **disaster risk reduction characteristic activities (DRRCA)**.

13. The second approach is to develop a series of functional accounts and indicators that track all types of transfers and expenditures in the economy with a specific DRR purpose. Statisticians develop specific functional classifications in order to define the domain of interest, e.g., the SEEA classification of environmental activities, and DRR-characteristic activities (DRRCA) are defined to objectively identify shares of expenditures or transfers with a DRR purpose. The same approach is also utilized for several other important cross-cutting domains of the economy, e.g., health, tourism, education, environment), often designed as "satellite accounts". These satellite accounts are specially designed extracts (or "satellites") of the system of national accounts (SNA). Satellite accounts have the same structure and accounting rules as the core SNA, but with a specifically designed scope for a functional purpose, such as monitoring DRR-related activities.

14. The provisional classification of DRRCA has been developed (see chapter 8), starting from the Sendai Framework and the terminologies adopted for the Framework in UNGA (2015). The scope of DRRCA activities is:

a. Disaster Risk Prevention;
b. Disaster Risk Mitigation;
c. Disaster Management;
d. Disaster Recovery; and
e. General Government, Research & Development, Education Expenditure

15. Disaster risk reduction characteristic transfers include:

a. Internal transfers between public government services;
b. Risk transfers, insurance premiums and indemnities;
c. Disaster related international transfers; and
d. Other transfers

16. Typical outputs from accounts of expenditures or transfers of DRR activity, following the basic framework of the SNA, will include:

a. Total national expenditure with a DRR purpose;
b. DRR expenditure by source of financing, e.g., central government, local government, private sector;
c. DRR expenditures and transfer by beneficiaries;
d. DRR expenditure by type of DRR activity, e.g., disaster preparedness, recovery and reconstruction, early warning systems;

e. Values of transfers from central government to local authorities; and

f. Values of transfers from international donors, i.e., DRR-related overseas development assistance (ODA).

International assistance

17. **Overseas development assistance (ODA)** is defined by OECD[34] as flows to countries and territories on and to multilateral development institutions which are a) provided by official agencies, including state and local governments, or by their executing agencies; and ii. each transaction of which: a) is administered with the promotion of the economic development and welfare of developing countries as its main objective; and b) is concessional in character and conveys a grant element of at least 25 per cent (calculated at a discount rate of 10 per cent). ODA's are international compilations of statistics.

18. Humanitarian assistance is the portion of ODA in the OECD database related to three sectors: and Disaster Prevention and Preparedness, Emergency Response, and Reconstruction Relief and Rehabilitation. OECD has created publicly accessible time series compilations of ODA by categories and by donors and recipients. It is worth noting that an estimate of around 80 per cent of the international flows of humanitarian assistance are for conflict-related settings, or other types of complex disaster situations involving refugee crises or violent conflicts.

19. While hazards and disasters are events happening randomly in terms of timing and location, DRR is a continuous activity needed to strengthen society's resistance and resilience and thus DRR statistics should be compiled on a continuous and periodic basis (e.g. as annual accounts). In this way, DRR statistics could become an integrated and relatively conventional domain of statistics, as an extension to the existing national accounts.

20. However, there are also special demands for analysis of DRR activities at certain periods, such as immediately after a large-scale disaster, and emergencies sometimes spur a boost in DRR expenditures and international transfers, which can be tracked via regular compilations of the statistics and then linked with specific disasters for analysis (see sample trend above).

[34] Stats.oecd.org

PART II

TOOLS AND GUIDANCE FOR IMPLEMENTATION

CHAPTER 6: BASIC STEPS FOR IMPLEMENTATION

1. The Fundamental Principles of Official Statistics were adopted by the UN General Assembly at its 68th Session in 2014. (A/RES/68/261).[35] Guidelines for Implementation for the Fundamental Principles of Official Statistics were developed and finalized by the UN Statistics Commission in 2015.[36] The Fundamental Principles describes the core responsibilities and quality criteria for work on official statistics. Understanding these principles helps identify opportunities and challenges for agencies involved with disaster-related statistics. (see also ECE TF-MEED).

2. UNDP (2009) summarizes a basic checklist of steps for establishing an institutional environment for official disaster-related statistics:

Step 1– Create an enabling environment for disaster risk reduction

Step 2 – Find an appropriate 'home' for the database

Step 3 – Integrate use of official statistics for design and monitoring of national strategies disaster risk reduction

Step 4 – Collect, enter and validate data

Step 5 – Conduct analysis, manage data and ensure sustainability

Institutional arrangements for disaster-related statistics

3. NSOs are typically empowered by national law to promote national statistical quality aligned with the commitment to the Fundamental Principles of Official Statistics. One of the ways that NSOs respond to these responsibilities is by establishing and enforcing methodological standards. This supports the development of transparent and consistent time series.

4. NSOs have a responsibility for continuous review of new tools for improving the availability and quality of statistics, including the use of big data and geospatial information. This can be done in collaboration, where applicable, with other producers of statistics. In reviewing new tools and new opportunities, NSOs also need to identify and address as an integrated part of the broader official statistical systems, emerging areas of demand for statistics, such as disaster-related statistics.

5. For institutions at an early stage of creating a nationally centralized database or system for compilation of disaster-related statistics, one of the vital steps is to design a database and system of information flows for accessing coherent and well-documented data for organization into standardized tables.

6. Ultimately, the roles or potential contributions of NDMAs, NSOs and others for production and compilation of relevant official data should be reflected in the governing policies, such as the national statistical law, national statistical policy, and work programmes. This would allow the facilitation and access to necessary resources to build and sustain capacities for developing and managing national databases.

[35] (A/RES/68/261), https://unstats.un.org/unsd/dnss/gp/FP-New-E.pdf

[36] https://unstats.un.org/unsd/dnss/gp/impguide.aspx

7. Many guidelines on institutional arrangements already exist, especially for the development of systems for compiling statistics on disaster impacts (also known as loss and damage databases), particularly from the European Union and UNDP. In addition, the UNECE Task Force for Measuring Extreme Events and Disaster (TF-MEED) developed a complementary report on the role of national statistics offices for disaster-related statistics.

8. UNDP Guidelines and lessons for establishing disaster loss databases (UNDP, 2009) emphasized the importance of engagement of partners from the initial stages of database development, to promote a clear and common understanding of the expected scope for the data collection and its importance for tracking and reducing disaster risk.

9. The goal of partnerships is "to create a database initiative in conjunction with other disaster-related capacity building activities and within government structures to ensure local ownership and management of the data." It is important to ensure that data collection and validation are conducted in alignment with nationally-adopted framework and standards for data sources and methodologies.

10. A centralized database does not require that all related basic data are stored physically in the same place or on the same server. Rather, the objective should be institutional and technological solutions (e.g. via a centralized online portal) for accessing the basic range of disaster-related statistics with a seamless system of database queries. These queries can be used for calculating indicators, conducting risk and post-disaster assessments, and other statistical purposes that arise during the phases of disaster risk management.

11. When data is organised in a geospatial interface (with codes and format compatible with use in geographic information systems), the databases will have inherent flexibility in terms of geographic scale and level of detail of analysis, so that the same basic data inputs can be (re)utilized for complementary analyses at virtually any geographic scale.

Statistical coordination

12. Once a suitable institutional environment has been established for producing a basic range of disaster-related statistics, TF-MEED identified some core functions for the national statistical system, as follows:

- Produce primary data;
- Produce baseline official statistics;
- Provide geospatial information;
- Coordinate information flows;
- Provide data sharing platforms;
- Maintain disaster database; and
- Produce official statistics and indicators on climate change and disasters

13. Statistical coordination is a particularly important factor for the DRSF because most of the compilations of statistics involve close collaboration between disaster management agencies, and several other producers of official data. The current situation for disaster-related statistics in countries is that data collections are scattered and dispersed among a variety of governing agencies, in varying formats and according to different frameworks.

14. The relevant institutions typically involved in producing official data at the national or subnational scale are: disaster management agencies (or equivalent coordinating in organizations), national statistics offices, geographic or mapping agencies, ministries with responsibilities for critical infrastructure and/or emergency response, and potentially also including non-governmental organizations involved with research or with support for disaster risk reduction and response.

15. Statistical coordination usually involves both conceptual harmonization and institutional management. The conceptual harmonization requires that, for all institutions involved, the variables have the same definitions, which are known and shared and are encoded in the same way. Also, documentation of methodologies is shared during the phases of statistical production and after the final data have been processed. (UN Statistics Division, 2015).

16. An important coordination mechanism, particularly during early stages of development (or expansion or redevelopment) phases for a database, is to establish a multi-agency technical working group. The technical working group should involve all key data providers across government and be empowered to adopt decisions on terminologies and key methodological issues. The purpose is to create coherence across basic data collections, data processing, compilation, aggregation, dissemination and analysis for a basic range of disaster-related statistics.

17. The expected core analytical uses for the basic range of statistics should be made explicit and included in the terms of reference for relevant databases as the reference for defining and assessing qualities of the input data. The goal for statistical coordination and related activities of the technical working group should be to make official statistics accessible for use in disaster risk reduction policy and related research.

Roles and responsibilities

18. A crucial first step for implementation of DRSF by national agencies is a detailed mapping of existing sources of data accessible at the national level for calculating variables in the basic range of disaster-related statistics tables. To assist with this national mapping or assessment exercise, specific demands for statistics and common sources for relevant data are outlined for the basic range for disaster-related statistics in chapters 8 and 9. Further discussions on roles of national statistics offices for these statistics can also be found in the outcomes of the ECE TF-MEED.[37]

19. Government agencies perform their monitoring and statistical analyses functions by law. Government institutions have obligations to collect statistical and geospatial data for assessing risks and the impacts that disasters have on people. Statistics may come from the census, relevant surveys and other sources of official data. So, coordinating agencies must develop standard models for applications of these data if greater resilience to disasters is to be achieved.

20. Practices vary from country to country according to legislated mandates of governing institutions. It is common that a national disaster management agency (NDMA), or equivalent

[37]https://www.unece.org/statistics/networks-of-experts/task-force-on-measuring-extreme-events-and-disasters.html

national institution, has the primary responsibility for the collection of initial observations of impacts immediately after a disaster for coordinating emergency response, recovery, and for official reporting to the government and to the media. Some of these initial functions related to data collection are governed by national laws or policies. For example, identification and coding of a disaster occurrence and for collection and management of data on missing persons. All related methodological practices and procedures of disaster management for collecting and managing data should also be shared for coordination with agencies involved in the technical working group.

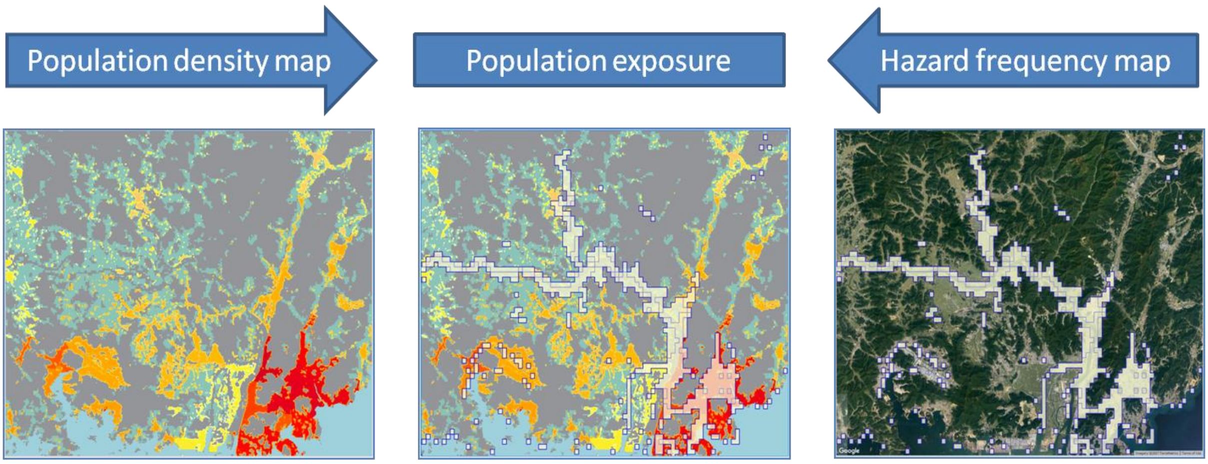
21. Through implementation of DRSF it will be possible to: (i) improve production of statistics from existing databases and (ii) bridge the representations of the realm of disasters and risk reduction on the one hand, with the socio-economic statistics on the other. The bridge between the two domains of statistical information is essential for producing indicators. This bridge requires strong partnership between disaster management agencies, national statistical offices, and other official sources of relevant data. It also requires a mutual understanding of core concepts and the methods for applying the concepts to the practice of producing coherent statistics.

Geographic Information Systems (GIS)

22. There are growing challenges to predicting disaster risk due to climate change and other factors of the modern globalized world. However, from a technical perspective, there are many enhanced opportunities, such as the free availability of software and methodologies for making use of new data sources, like remote sensing, mobile phone datasets, and especially the use of geographic information systems (GIS) for assimilation of data. For example, Figure 6.1 shows an example for calculation of exposure of population to a hazard, by using GIS to create multiple layers of statistic derived from geospatial data. Statistics, e.g. numbers or proportions of exposed people by administrative areas, can be calculated directly from the maps.

Figure 5.1

Population exposed to hazards measurement



Sources: Right Map: UN Environment-GRID'S frequency of flood hazard map. Left map: Population census 2015 from KOSTAT, resampled by UNESCAP to the DLR's Global Urban Footprint

23. GIS is an indispensable tool for producing and analysing disaster-related statistics for their use in disaster risk reduction policy. While emphasizing the tremendous opportunity for

evidence-based policy from these new tools, the World Bank's Global Facility for Disaster Risk Reduction (GFDRR) alerted that "these advances and innovations create a need for better standards and transparency, which would enable replicating risk results by other actors, reporting on modelling assumptions and uncertainty, and so forth."

24. Increasingly, traditional data sources of the national statistical system like household and business registers, household and business surveys, and population and housing censuses are conducted with use of detailed geographic referencing. The geographic referencing may be confidential at the level of individual records, but summary statistics can be disseminated for defined areas, e.g. hazard areas. The broad trend has been a rapid expansion in the possibilities, using affordable tools and the existing data, towards increased flexibility and level of detail for geographic disaggregation of statistics on risk. For example, utilizing tablets for surveys and census interviews and preparing datasets in GIS-accessible formats have become common practices across the globe, whereas such advancements hardly existed within national statistics offices a mere decade ago.

25. Nearly all components of the basic range of disaster-related statistic depend on GIS for compilation, integration, or analysis and therefore establishing a database infrastructure in GIS, or a spatial data infrastructure (SDI) is a critical early step in the development of disaster-related statistics.

26. One of the advantages of working with data in GIS software is flexibility to present statistics at different scales, and combining multiple layers of variables. Agencies responsible for the underlying statistics should develop a common set of policies and standards for geographic reference and for managing GIS files, which can be used to maintain a minimum standard of reliability, accuracy, and relevant protections of confidentiality so that the statistics can be used at different scales for disaster risk reduction.

27. Geo-referencing is the coding of data, statistics and indicators according to geographic location, either point location (coordinates) or area (a standard reference shape or polygon). Adopting and implementing common intra-governmental norms and standards, including standards for place names and georeferenced coding is crucial for using GIS to seamlessly share, integrate and use geospatial information for improved decision making. (UNGGIM, 2015)

28. In addition, advancement of accessibility to geospatial data, like remote sensing, is a major opportunity for managers of disaster-related statistics to study factors of risk, for visual assessments of impacts, and as a resource for integrating and capturing new added values from existing and more traditional sources of data, such as sample surveys.

29. With the increased use of geo-referencing and emergence of analytical tools in GIS, geospatial information and services now "contribute vastly to the overarching effort of preventing or reducing the social, economic, and environmental impacts of disasters." UNGGIM (2017)

30. A standard spatial data infrastructure (SDI) allows for the integration of geospatial datasets, such as satellite imagery, e.g., visual spectral imagery in a disaster area immediately after the occurrence, which are often crucially important data sources for producing or validating statistics before and after a disaster.

31. At a minimum, variables identified for vulnerability to disasters should be compiled to the lowest available sub-national administrative regions. In DRSF background statistical tables, all variables are organized according to pre-defined geographic regions within countries. In reporting tables, geographic disaggregation is predetermined by existing practices and requirements of users. GIS provides the opportunity to modify geographic regions for specific analysis.

32. Often it is useful to define homogenous regions – e.g. urban and rural, residential and non-residential, and agricultural land. The European Joint-Research Council Guidance (De Groeve et al.,2013) describes three common layers of organization and use of disaster impacts data:

- Local civil protection;
- National/Regional assessment centres; and
- Hazard specific national authorities

33. Some specific requirements, e.g., level of geographic detail and timeliness will vary across different applications of the data, but, in principle, the same sources of data can be utilized for multiple purposes and for multiple scale of analyses and decision-making. The adoption of a harmonized framework and common standards, e.g. for geo-referencing and for geographic aggregation, will help ensure that reliable data can be accessed and used more efficiently, and reused for analyses at multiple phases of disaster risk management.

Metadata and quality assurance

34. Collection of data is usually resource intensive. Comprehensive documentation of the outputs from a data source is a vital protection for the value of that data for future use in statistical analyses. Metadata is the cornerstone for creating coherence across datasets. The issues discussed in this handbook, such as units of measurement, scope of measurement, definitions for key technical terms, and methods used for monetary valuation, are all key examples of methodological choices, for which multiple options are always possible. Sometimes the best choice is not the most obvious one and sometimes choices involve a practical compromise between the different qualitative dimensions of data (accuracy, reliability, relevance, simplicity). Documentation of these choices, in a comprehensive manual, glossary, and/ or technical annex attached to statistical releases should be standard practice.

35. The main role of metadata is descriptions explaining fundamental information about data, which are used for interpreting the data in analyses. Metadata also serves an additional purpose in facilitating a query system and developing an efficient structure in databases so that the same basic input data can be reused for multiple purposes.

36. A centralized database on disaster-related statistics must include a system of unique identifiers and coding for individual disaster occurrences and their main characteristics. Identifier codes within the datasets are an efficient method for linking data with metadata and for establishing links between related variables. Three characteristics of each disaster occurrence are recorded (see Chapter 2). A complete nationally-adopted **official glossary of**

hazard types[38] is an example, particular to disaster-related statistics, of important data for users for interpreting the statistics. As noted in Chapter 2, this glossary might simply replicate a list and legally adopted definitions for hazards, if available, as legislated for DRM purposes.

37. Currently, disaster occurrences and impacts information is typically stored as a set of records (see, for example, Desinventar.net). Given a standardized use of reference to time ("Start date") and location ("geographic name"), basic statistics on disaster occurrences and impacts could be queried from these underlying records for multiple disaster occurrences over a specified period, e.g. 2015-2030. However, accounting for the requirements of storing metadata and microdata from multiple separate collections requires a functional database structure. that integrates the impact statistics according to a model of relationships between components of the basic range of disaster-related statistics (see figure 4.1 in Chapter 4 and figure 7.2 in Chapter 7).

38. Each disaster occurrence may have many sources of data that are compiled and utilized to describe the relevant variables attached to that disaster. Usually, each data collection, when integrated, needs to be accompanied by a package of metadata explanations plus notes on revisions or other relevant details.

39. A standard practice for estimations or use of proxies for measurement is to include a confidence interval and related information to explain the expected accuracy of the figures and to correctly interpret the statistics and apply the values to their analysis appropriately. For example, indicators on economic impacts of disasters (both direct and indirect) are typically dependent on estimation or the use of average values (see UNISDR, 2017).

40. Another purpose for metadata is to inform continuous improvements to the scope, coverage, and accuracy of statistics and their use in analyses. "A first step in handling of uncertainty is to be aware of it at different levels of data collection and recording and communication: fitness for use (i.e., how well data model fits to application field), measurement errors while collecting data, processing errors while recording data and interpretation errors while communicating it. A second step is to be transparent when showing/visualizing the uncertainty at different levels. Only then, the overall quality of data can be assessed, and users can use the data in their work." (EU-JRC, 2015).

41. The European Joint Research Centre (EU-JRC, 2015) introduced a concept of the "data curator" for the different elements of data production, including (but not limited to) the:

- Calculation of codified values of database fields accompanied with method used;
- Identification of unclear or missing values that should be investigated;
- Conversion into the unit defined by methodology;
- Utilization of external references for the validation and verification process; and
- Applying an event identifier to provide relations to background information which is not (primarily/necessarily) part of disaster loss database, e.g., hazard event characteristics.

38 The IRDR Hazard Glossary and Peril Classification (IRDR,2014) and Sendai Framework Indicator Technical Guidelines (UNISDR, 2017) should be utilized, as relevant, as references for harmonizing with international definitions

42. For most components of the basic range of disaster-related statistics, particularly the disaster impacts and many of the variables used for risk assessment, the data curator is typically the disaster management agency, or equivalent national institution. However, national statistics offices and other ministries or agencies will often retain the primary responsibility for many of the background statistics that are used in the impacts and risk assessments, such as baseline statistics on the population and economy.

Prioritization

43. One of the purposes of developing a basic range of disaster-related statistics is to help national statistical systems to identify and adopt priorities for statistical development for disaster risk management. For statistical systems at an early stage of the development of nationally harmonized disasters statistics, a limited core, first-tier compilation of statistics should be established as a basis for gradually expanding into a broader collection of data in the future.

44. The Sendai Framework and SDG targets provide broad macro-scale priorities for policy and a common international approach to monitoring progress. Within the basic range tables (see Annex) the input variables used (as numerators or denominators) in the internationally adopted indicators (SDGs and Sendai Framework) have been highlighted.

45. Some data inputs are utilized for multiple analytical purposes and appear as basic building blocks in multiple components of the basic range of disaster-related statistics, thus they are systemically important priorities for establishing a basic range of statistics. For example, the primary characteristics of a disaster occurrence (see Figure 3 in Chapter 2): timing, location, hazard type and magnitude, are minimum requirements to identify disasters and describe their basic characteristics. These are core data elements for developing databases and time series statistics on disaster impacts.

46. Another example of systemically important data are the inputs used for exposure statistics, (population, land and infrastructure) in hazard areas. These statistics are used for risk assessment, emergency response and as baseline statistics for measuring impacts after a disaster.

47. Another factor for prioritization is the current priority policy questions for decision-makers in the country. These priorities will vary but some common priorities can be identified for each of the main types or phases of disaster risk reduction decision-making (see Chapter 6).

48. The prioritization of qualitative aspects of the statistics, e.g., relevance, precision, timeliness) is a function of the expected uses. For example, if the statistics will be utilized in time series analysis (e.g. indicator reporting and monitoring over time, then consistency, metadata transparency and international comparability are priorities for making the data accessible for their intended uses. In contrast, during an emergency, urgent accessibility to data at flexible scales (including detailed geographic reference with the best available accuracy) are the first priorities.

49. Case studies developed Expert Group on Disaster-related Statistics in Asia and the Pacific show examples of how official statistics can be used or presented in a variety of way, in maps and tables, to meeting multiple purposes, potentially expanding upon the basic range of disaster-related statistics.

50. Statistics for relatively large disasters benefit from greater attention from post-disaster assessments and specially targeted data collections after the occurrences. Smaller and more frequent disaster occurrences will also have data on impacts collected and compiled into national databases, but they will rely more heavily on the regular and continuous sources of official statistics, such as including questions in household surveys or extracting information from monitoring systems operating in areas of the country exposed to hazards. Therefore, an additional consideration for prioritization is addressing challenges with coverage of extensive disaster risks, or the small and medium-scale disasters, that may not be as well captured by the existing compilations of impacts data and analysis.

Development of Technical Standards

51. After a suitable institutional environment has been established, with development of priorities, responsible agencies are ready to establish standards for developing the databases for harmonization and consistency in the variables over time. Key steps towards achieving technical standardization or harmonization for the content of national databases are:

a. Identify a basic range of statistics and mapping of existing data sources (see Chapters 8 and 9);

b. Adopt common definitions, an official glossary of hazard types (for statistical purposes), classification systems (where relevant), and standards for measurement units for each variable across the involved institutions producing official data. (Reference tools for this step are provided in Chapters 7 and 8); and

c. Develop database structure and establish sustainable and regular compilations of data using SDI.

CHAPTER 7: BASIC RANGE OF DISASTER-RELATED STATISTICS

1. A collection of summary statistics tables was developed for the DRSF as the basic templates for extracting statistics from the underlying databases in line with the recommendations in this handbook and comprehensively for the basic range of disaster-related statistics. The DRSF Basic Range of Disaster-related Statistics tables are presented in the Annex and also are available in spreadsheet (.xls) format on the expert group's website.[39] The Basic Range of Disaster-related Statistics tables was developed based on pilot studies and extensive discussions by the expert group. Each variable is a potential output from querying the national disaster-related statistics databases. The tables are comprehensive of the basic range according to multiple purposes by national agencies according to their own needs, such as for gap assessments.[40]

2. Most of the statistics in the basic range are compatible with GIS, meaning that the variables are associated with a standardized system of geo-referenced coding.

3. One of the advantages of working with data in geographic information system (GIS) is that statistics can be produced and calculated and reported flexibly at different geographic levels according to administrative and/or functional classifications of geographic areas (e.g. provinces, municipalities, river basins, buffer areas, hazard areas). The sample DRSF basic range tables provide a generic presentation ("Geo Region 1", "…"), adaptable to the different needs or availability of geographically disaggregated data.

4. A general minimum recommendation for the disaster impacts statistics is to attribute human and material impacts according to the district or municipality level of administrative region.

5. The basic range of disaster related statistics is organized according to generic tables or categories of tables, as follows:

- **A:** Summary tables of disaster occurrences;
- **B:** Selected background statistics and exposure to hazards;
- **C:** Summary tables of human impacts;
- **D:** Summary tables of direct material impacts in physical terms;
- **E:** Summary tables of direct material impacts in monetary terms;
- **F:** Summary of material impacts to Agriculture;
- **G:** Summary table of direct environmental impacts; and
- **DRRE:** Disaster risk reduction expenditure accounting

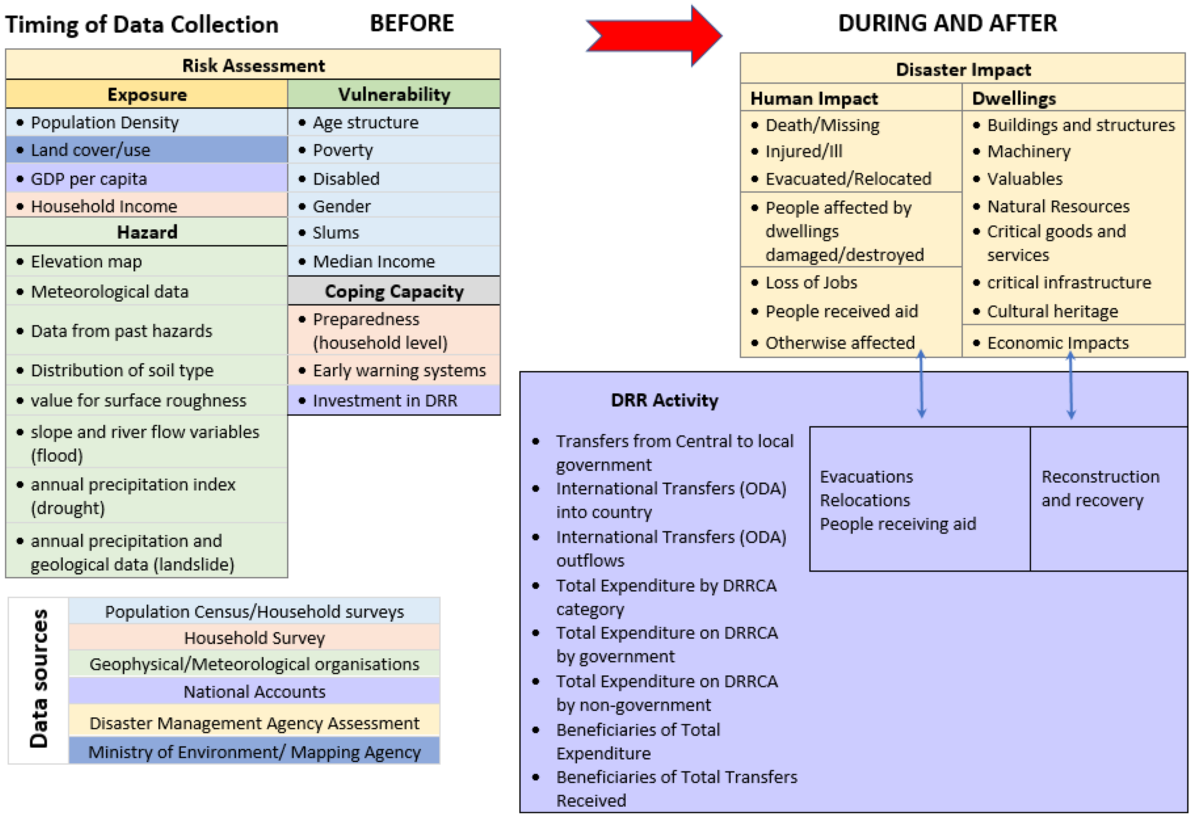
[39] https://stat-confluence.escap.un.org/x/1oL2

[40] Note: these tables are not designed for international collection of or monitoring of statistics using. The tables are presented as a tool for use by agencies responsible for developing relevant official statistics. The only relevant internationally agreed monitoring systems are the Sendai Framework Monitor and the SDG Indicators.

6. The scope for the basic range of disaster-related statistics (Figure 2.2) can be summarized in terms of a basic timeline, in relation to the cycle of disaster management. This relates to before, during and after the disaster occurrence.

Figure 6.1

Basic range of disaster-related statistics before, during and after a disaster



Summary tables of disaster occurrences (A tables)

7. Identifying a disaster occurrence is an essential element for centralized compilations of impacts statistics because of the need to attribute impacts specifically to disasters (Chapter 2). Additionally, long-term series of data on disaster occurrences and their basic characteristics (geography, timing, hazard type) are useful for many different types of trend analyses, such as the dynamics of risk and for measuring the relative intensity of impacts from individual occurrences over time.

8. A register or listing of disaster occurrences with data on their basic characteristics is the basic structure that has been used in DesInventar as in the sample below, drawing from the example seen previously, in Chapter 2.

Sample of registry of disaster occurrences

Code	Geo 1	Geo 2	Geo 3	Geo 4	Em. beginning	Em. End (d-m-y)
Fl2018-01-THA	Central Region	Chao Phraya River Basin	Samut Prakan	Central District	01-05-18	04-05-18

Dr2019-01-THA	Northeast	Mekong	Roi Et		01-06-18	01-06-18
……	……	……	……	……	……	……

9. Table A1 (see annex) is an organized extraction (or database query) from these types of basic records on disaster occurrences as initially recorded and archived by disaster management agencies. Logical groups for organizing statistics on disasters and their impacts are by geographic regions and by types of hazard, over time.

Selected background statistics and exposure to hazards (B tables)

10. A basic range of background statistics used in risk assessments are summarized in tables B1, B2, and B3.

11. Exposure to hazards is generally calculated by disaster management agencies, utilizing statistics from various sources for mapping hazards and mapping exposure of population, land and infrastructure derived from the existing official sources.

12. Measures of vulnerability are potentially vital background statistics, but difficult to define *a priori* and may involve complex relations with multiple factors. To develop an empirical approach to measuring vulnerability prior to a disaster, there is a need to develop a basic minimum selection of categories for disaggregated statistics describing the population and infrastructure, especially for hazard areas, as was developed as an example in Table B1b: Population Exposure by social groups, as:

- Age groups;
- Sex;
- Urban vs. rural populations;
- Persons with disabilities; and
- Economic poor (income below national or international poverty)

13. By agreement in the Sendai Framework, governments report on number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms. These and other underlying statistics for describing coping capacity, or resilience, to disasters could be extracted from official databases to produce a summary resembling table B3: Coping Capacity Background Statistics.

14. There are also background statistics compiled on a regular basis primarily for other purposes that may need to be investigated for estimating magnitudes of impacts in disaster areas. An example (not included in tables in the Annex) is collection of data on crop values, on average by growing areas, which are used for estimation of economic impacts to agriculture.

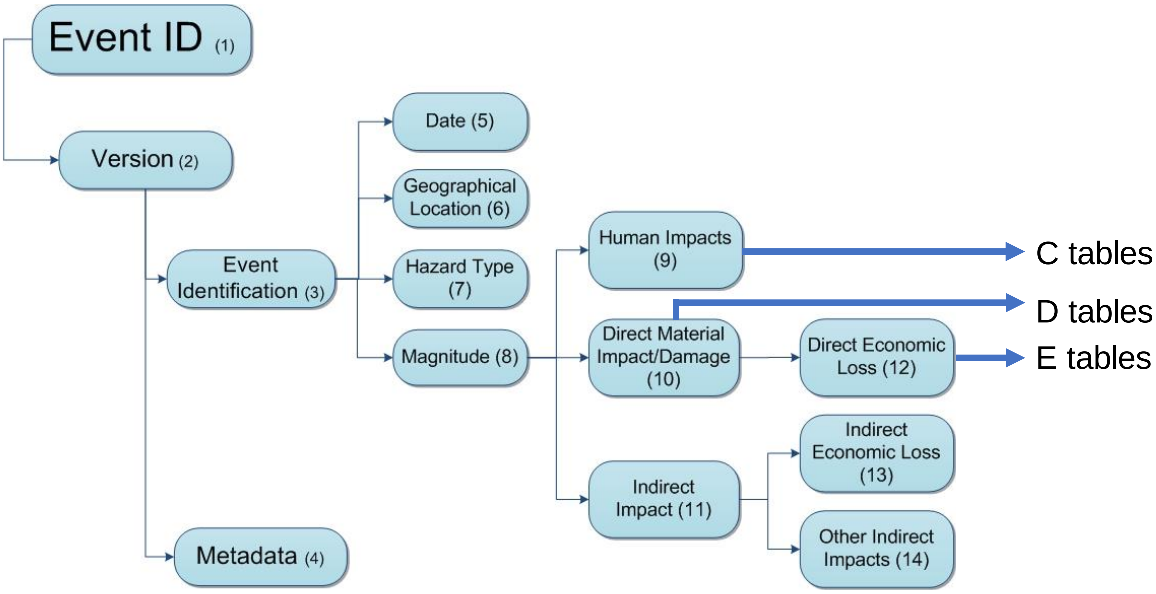
Summary tables of human impacts (C tables)

15. Impacts statistics (C, D, and E tables) are collected and coded in association with each individual disaster occurrence, following the basic model in Figure 4.1 and could be summarized as annual or multi-year statistics according to hazard types, geographic region, and according to demographic and social categories (where applicable).

16. These records can be summarized in statistics for each variable according to hazard types or geographic regions for annual monitoring by utilizing the references to the characteristics of the disaster occurrences.

Figure 6.2

From Data Model to Summary Tables



17. As mentioned in Chapter 4, a simple aggregation across human impacts creates multiple possibilities for double-counting of the same individuals. This issue is potentially managed by estimation of numbers of multiple impacts to the same individuals for an adjustment at the bottom of the table. If it is possible to adjust for double-counting in the totals, there will be two related but conceptually distinct aggregated counts across human impacts categories (see bottom of C tables)[41]: the total number of impacts, including individuals impacted in multiple ways (which is the Sendai Framework "affected population" indicator) or the number of people experiencing one or more impacts.

18. For disaggregation by social groups, references to national definitions should be applied, and documented clearly in metadata for: urban and rural, poor (i.e. national poverty line if it exists), and persons with disabilities. Sex and age disaggregation can have a variety of uses in analysis and should always be included in compilations of human impacts wherever possible. It is recognised that practices may differ across countries (e.g. for defining age group categories). The Sendai Framework Monitor compiles statistics from reporting agencies on impacts by three categories: 0-15, 16-64 and 65+. However, as discussed in Chapter 4, other groupings, e.g. a category for infants (e.g. 0-5 years old) may be important for assessing vulnerability.

[41] For example, if as direct consequence of a disaster, two people are injured, and one person is both injured and had her house destroyed, the total number of persons impacted is 2 and the total number of human impacts (Sendai Framework indicator B1) is 3. Neither figure is wrong, they are simply measurements of slightly different things.

Summary tables of direct material impacts (D tables)

19. Direct material impact (D) tables are for recording direct material impacts in "physical" terms, such as area (sq. m.) of damages or number of buildings, by categories. Recommendations for physical measurement units are presented later in this Chapter.

20. Direct impacts to cultural heritage and to the environment are identified separately due to special characteristics regarding measurement units and monetary valuation. Cultural heritage is unowned (or part of public owned infrastructure) with special value to the population and often they are irreplaceable.

21. Disruptions of basic services from a Disaster (D2 tables) are presented as an optional extension of direct material impacts tables, especially impacts to critical infrastructure. In the Sendai Framework, disruptions to services are consequence of damaged or destroyed infrastructure and the global indicator refers to statistics on numbers of units of critical infrastructure damaged or destroyed. However, some national agencies are also collecting data number of people affected and length of time by the types of disruptions.

Summary tables of direct material impacts in monetary terms (E tables)

22. Material impacts are estimated at first in physical terms (D tables) and then, compilations of the costs for reconstruction or replacement are applied to produce international indicators on Direct Economic Loss according to the Sendai Framework indicators (E tables). Also, the FAO developed a table, consistent with the DRSF format (Table F), which specifies the scope of basic range material impacts statistics relevant to agriculture, forestry, and fisheries.

23. The direct material impacts in monetary terms are broadly the same as direct material impacts (D tables), the difference being that the measurement units is amount of money. Monetary valuations of material impacts needed for calculating direct economic loss (SDG 1.5.2 and Sendai Framework Target C indicators) are based, in most cases, according to the costs of reconstruction or replacement of damaged or destroyed assets.

24. As discussed in Chapter 4, the monetary values compilations for material impacts normally requires a combination of data sources, including insurance claims assessments or assessments for cost of reconstruction, the recorded values of assets prior to a disaster (where available), records of actual transactions for recovery of damages (expenditure on post-disaster reconstruction) and average costs of crops or other exposed assets for estimating costs of damages based on average per unit values.

Summary material impacts to Agriculture (F table)

25. The FAO developed a table, consistent with the DRSF format (Table F), which specifies the scope of basic range material impacts statistics relevant to agriculture, forestry, and fisheries, by hazard types.

26. Impacts to agriculture presents some special considerations regarding measurement units, and particularly for monetary valuation of the impacts (see discussion in Chapter 4).

Summary tables of direct environmental impacts (G tables)

27. Environmental impacts variables (G tables) are built upon a nationally standardized classification of land cover types (such as the 14-class example presented in the G tables in the Annex). There are also functional categories of land cover that could be of special interest for assessing direct impacts such as designated biological reserves and World Heritage sites.

28. Monitoring impacts to water resources, ideally, should be an extension of data collection and monitoring programmes of national and regional water authorities.

29. Emissions of sulphur associated with volcanic eruptions and carbon emissions from wildfires are typically estimated by institutions responsible for official scientific monitoring of atmospheric conditions. Some national space agencies or other international scientific organizations are monitoring these emissions globally.

Disaster Risk Reduction Expenditure and Transfers (DRRE Tables)

30. The DRRE tables are sample accounting tables, to be developed as special functional accounts or "satellite accounts" of the national accounts, following, as much as possible, the standard practices of the System of National Accounts (SNA).

31. While disasters, and their impacts, are occurring randomly, disaster risk reduction is a continuous activity. Certain activities such as post disaster reconstruction are boosted in the recovery period after a major disaster and are related to disaster response and informed by the gradual improvements in knowledge on disaster risks and strategies to minimize them.

32. The disaster risk reduction activity accounting tables have been developed in alignment with the standards and formats of the System of National Accounts (SNA) because the information in these tables are extractions from the broader aggregated accounting framework for the whole economy. In principle, DRRE tables could be derived from the same data sources that are used in national accounts. This is dependent on the possibility of separately identifying the portions of activities with a primary disaster risk reduction purpose.

Measurement units for material impacts statistics

33. Recommendations for measurement units for the objects of material impacts as classified in Chapter 6 and in the D tables are specified below. Measurement units are a basic and vital consideration for the design of basic data collections on impacts and their compilation into nationally centralized databases.

34. There are multiple possibilities for measurement units and for material impacts statistics and national compilations should aim to converge toward consistency across disaster occurrences for improved quality of disaster impacts time series statistics. The options are not mutually exclusive, and for some cases, e.g., dwellings it is necessary to collect the same information in multiple units of measurement, e.g., number of people and number of units.

35. Thus, presented below is a 'menu' of recommendations for measurement units by category of material impacts, focussing on critical infrastructure and noting that for some cases multiple options from the menu might be selected for data collection.

36. Infrastructure is heterogeneous by nature. It includes buildings, equipment, land, and inventories. There is no possibility to produce an aggregated count of total damages to critical infrastructure without a common unit of measurement across all the relevant types of assets (i.e. monetary valuation).

37. Initially impacts to critical infrastructure are observed in physical terms, individually for each type of infrastructure or type of damages. For many types of critical infrastructure, a simple option is to count number of units, e.g., buildings, and where possible these counts are made more meaningful by utilizing categories already used in statistics or in their management by governments. For example, many countries use a tiered system to classify the different types of health facilities (from large hospitals down to small clinics). Thus, databases could keep records of numbers of tier 1, tier 2 and tier 3 facilities damaged or destroyed over time.

38. Defining the measurement units applies both to statistics on impacts and statistics on exposure of critical infrastructure, prior to the disaster. These compilations need to be coordinated closely with the relevant ministries, e.g., Ministry of Education, Ministry of Health, and Ministry of Transport who are typically responsible for official categorizations of facilities (if available) and the general monitoring and management of the infrastructure.

Menu of physical measurement units for material impacts

	Measurement units		
Dwellings	No. of units (households)	No. of people	Area in sq. m.
Critical infrastructures			
Hospitals, health facilities	No. of buildings by official category (tier 1, tier 2,)	capacity (no. of beds)	sq. m.
Education facilities	No. of buildings by official category (tier 1, tier 2,)	capacity (no. of students)	sq. m.
Other critical public administration buildings	no. of units		
Public monuments	no. of units		
Religious buildings	no. of buildings by official category		
Roads	km	capacity (avg. daily traffic affected)	no. of roads by official category
Bridges	km	capacity (avg. daily traffic affected)	no. of bridges by official category
Railways	km	Capacity (avg. daily passenger and/or tonnes of shipping)	
Airports	no. of buildings by official category	capacity (avg. daily traffic affected)	
Ports	no. of units by official category	capacity (avg. daily traffic affected)	
Transport equipment	no. of units		

Electricity generation facilities	no. of units	capacity (no. of people affected)	
Electricity grids	no. of units	capacity (no. of people affected)	
ICT Equipment	capacity (no. of people affected)	no. of units	
Dams	no. of units by official category	no. of units	capacity (no. of people affected)
Water supply infrastructure	no. of units	capacity (no. of people affected)	
Water sewage & treatment systems	no. of units	capacity (no. of people affected)	
Agriculture land, livestock, fish stocks, and managed forests	sq. km	capacity (food production affected)	

Dwellings

39. For the special case of dwellings, the number of units is mostly aligned with number of households impacted. Individual buildings may have multiple units, e.g., apartment buildings affected by a disaster and the number of units should be developed as a good approximation for the number of households affected by damaged or destroyed dwellings, i.e., counts of units, not counts of buildings.

40. If basic data on the number of individuals residing within each affected dwelling are not available for the impacts assessment, this can be estimated based on statistics on average household size within the affected area. However, compilers should take into account that household sizes vary geographically and by other factors, e.g., poverty that are also potentially correlated to disaster impacts.

41. It's also useful to compile data, where feasible, on estimated size or area of damages (in terms of square meters of damage) as an input for estimating expected costs of the damages. The severity of impacts is linked to the distinction a damaged or destroyed asset, an important distinction especially in the case of dwellings because a destroyed dwelling results in temporary or permanent displacement of the household and damages need to be repaired (either with or without temporary displacement).

Dwellings	**No. of units (households)**	**No. of people**	**Area in sq. m**	**Cost of impacts in local currency**
Damaged				
Destroyed				

42. If data are available for identifying shares of cases of insured or uninsured losses, an additional disaggregation could be introduced, such as:

Dwellings	**No. of units (households)**	**No. of people**	**Area in sq. m**	**Cost of impacts in local currency**
Of which costs insured				

Of which costs uninsured				
Of which insurance status unknown				

CHAPTER 8: DEFINITIONS AND CLASSIFICATIONS

1. Standard definitions and classifications for statistics are developed and adopted by national and international agencies to ensure a reasonable comparability in use of terminologies and in aggregated scope of measurement between countries and over time. Statistical classifications group and organise information meaningfully and systematically, usually in discrete, exhaustive and mutually exclusive sets of categories that are defined according to a set of criteria for similarity. (Hancock, 2013)

2. Statistical classifications are exhaustive listings of the contents of defined categories, even if not all elements are commonly measured currently as part of official statistical systems. Exhaustiveness in the classifications is an important factor for the classification's function as a description for the groups of concepts, ideas, events, or objects that constitute the topic. Classifications are tools for explanation and elaboration of coverage of the available data, statistics, or indicators, including cases where not all elements are relevant or could be measured. In other words, classifications do not define what should be measured in every instance, rather they are tools for clarifying scope of measurement in each instance.

3. The United Nations Statistics Commission has developed a set of principles and essential components for statistical classifications (Hoffman and Chamie, 1999). For development of new classifications or categories for statistics, it is important to build on sound and established concepts and practices but also incorporate emerging conceptual or technological innovations to produce a system that will remain robust and applicable for the harmonization of statistics across countries for producing time series statistics in the long-run.

4. During the development of DRSF, the Expert Group, identified three gaps in terms of classifications systems or complete definitions for disaster-related statistics: (i) hazard types (ii) the objects of direct material impacts, and (iii) disaster risk reduction activities (DRRCA).

5. In response to these gaps, the Expert Group developed a set of provisional recommendations, including two proposed provisional classifications. This chapter elaborates recommendations for development of these classifications, as a contribution to further consultation, at the global level, towards increased international harmonization of related statistics.

6. Further study is recommended, including pilot testing implementation by official national agencies, for the following proposed provisional classifications and definitions, followed by further consultations towards standardization at the global level, for all three of the topics covered in this chapter.

Hazards types

7. As mentioned in Chapter 2, lists of relevant hazards are developed at the national scale, in some cases according to official policy legislated by government. Disaster risk is also extremely variable across country and regions within countries and not all hazard types are relevant in each country. Thus, countries have different lists of relevant hazard types at the detailed level. However, at the broad aggregated level, this diverse range of hazards can be

summarized, for statistical purposes, in comparable aggregates that are useful for analysis of trends and for informed risk reduction.[42]

8. Methodological guidance for monitoring the Sendai Framework indicators recommended utilizing the IRDR Peril and Hazard Glossary (IRDR 2014). In IRDR (2014), the most aggregated level in the classification is called the hazard "family":

a. Geophysical;
b. Hydrological;
c. Meteorological and Climatological;
d. Biological; and
e. Other (e.g., technological and environmental hazards)

9. There are two additional categories of hazard types identified for monitoring the Sendai Framework monitoring: "**technological hazards**"[43] and "**environmental hazards**".[44]

10. Other types of hazards excluded from the scope of IRDR (2014) are violent conflicts, including civil war and the associated human crises, e.g. refugee crises. The OECD estimates that approximately 80 per cent of international transfers of humanitarian aid goes to complex disasters and conflict-related settings.[45] However, these circumstances are excluded from the scope of Sendai Framework monitoring, according to the Report of the OEIWG (UN, 2015), which excludes "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".

11. The IRDR glossary has a hierarchic structure, meaning it presents multiple levels of aggregation, called "Family" (see above), "Main Event", and "Peril". There are established lists of hazard types for data collection in many countries, usually approximately corresponding with the "Main Event" or "Peril" levels in IRDR (2013). However, for international comparisons the more aggregated family level is the most comparable and suitable for a wide range of purposes.

12. There are also other aggregations or grouping of hazard types that are of particular interest for trends analyses, such as **climate-related disasters**, which can be derived from a

[42] For example, if country 'A' records statistics for floods, flash floods and country 'B' records statistics only for a generic category called floods, the two countries' statistics could still be broadly coherent and comparable at the level of hydrological disasters.

[43] Technological hazards "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."- UNGA (2015)

[44] Environmental hazards "may include chemical, natural and biological hazards. They can be created by environmental degradation or physical or chemical pollution in the air, water and soil. 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." - UNGA (2015),

[45] See statistics on humanitarian aid at stats.oecd.org

grouping of IRDR hazard types. These are hazards in the meteorological and hydrological hazard families as defined by IRDR (2014).[46]

13. **Climate** is "the synthesis of weather conditions in a given area, characterized by long-term statistics (mean values, variances, probabilities of extreme values, etc.) of the meteorological elements in that area." (WMO, 2017). The Intergovernmental Panel on Climate Change (IPCC) has indicated a strong likelihood that climate change will lead to increases in frequency and severity of related hazards, and reduce overall predictability of such hazards based on historical records (see, e.g., IPCC, 2012 and Birkman, 2013). Trends will be different and unevenly distributed across the globe. Statistics are needed for assessing how climate change may be impacting disaster risk for different countries or different regions over time.

14. A **cascading multiple-hazard disaster occurrence** is a disaster in which one type of hazard, such as a strong storm causes one or more additional hazards, e.g., flooding or landslides, creating combined impacts to the population, infrastructure and the environment. Cascading multiple-hazard are not two events with proximate timing or locations by coincidence. They are events that are causally linked to the same original trigger hazard, and thus are part of a single (multi-hazard) disaster occurrence. Cascading multi-hazard disasters can be reported as their own specialized category of hazard types, noting for categorization purposes the original trigger hazard, e.g. storm, as well as the connected hazards, e.g., floods, landslide.

15. Given enough available data and the right monitoring infrastructure, slowly evolving catastrophic risk or "**slow onset disasters**"[47], can potentially be identified as major risks early on in order to develop preventative and mitigation measures to reduce risks of impacts. A "**sudden-onset disaster"**[48] is characterized by having very little, if any, prior warning to a specific event. Sudden-onset disasters do not always end as quickly and definitively as they begin. Earthquakes, for example, often are followed with aftershocks. Volcanic eruptions can be either sudden or slow-evolving disasters. Thus, one of the unfortunate and common characteristics for both slow-onset and sudden-onset disasters is that they are difficult to determine, in concrete measurement terms, exactly when the hazards begin and when the impacts of disasters cease.

Classification for objects of material impacts

16. A classification for objective material impacts is needed to define, delineate and create comparability in scope of measurement for aggregated statistics on direct material impacts. The European Joint-Research Centre (JRC, 2005) called these objects the "affected elements".

[46] Alignment with meteorological and hydrological families of IRDR can be broadly applied for scope for measurement of climate-related disasters. However, some special distinctions may be needed in the details, for example to distinguish between fires that are accidents caused directly by human activities in urban area as compared to wildfires that are consequences of extreme climate conditions (dry heat). Further study of relationships between hazard types and analyses of climate change is suggested as an area for further study.

[47] "A **slow-onset disaster** emerges gradually over time. Slow-onset disasters could be associated with, e.g., drought, desertification, sea level rise, epidemic disease." (UNGA, 2015)

[48] **"A sudden-onset disaster** is one triggered by a hazardous event that emerges quickly or unexpectedly. Sudden-onset disasters could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, and transport accident." (UNGA, 2015).

17. The "affected elements" are a subset of all the exposed elements of the physical infrastructure from the risk assessment statistics. They define the scope of disaster impacts in terms of geographic areas, indicators, and (initially measured in physical terms) represent the scope for valuations of direct economic loss indicators.

18. Implementation of this objective material impact classification is used to:

a. create comparability in scope of measurement for aggregated statistics on disaster impacts, e.g., direct economic loss measurement;
b. improve coherence in categorization or cross-disaster compilations of material impacts statistics, noting that sometimes impacts assessments are conducted or indicators calculated based on incomplete information; and
c. help establish linkages, where relevant, between post-disaster collection of data on impacts by disaster management agencies with the existing systems of baseline economic statistics and to address the specialized functional requirement for an applied definition for critical infrastructure.

19. Recommendations on measurements units (size/length, area, etc.), for recording statistics in physical terms for each of the affected objects are provided in Chapter 5

20. Although one of the principle recommendations for developing statistical classifications (see Hancock, 2013) is, as much as feasible, to create statistical balance across the categories in a classification structure, there is an intentional imbalance in the presentation below, mainly because of the need for a detailed focus on critical infrastructure.

21. The classification below is designed as a comprehensive response to statistical demands for disaster-related statistics. However, further testing and development is recommended involving classifications experts and utilizing actual data collected on material impacts from a disaster.

22. Most of the groupings and definitions utilized in this section come from one of two sources:

a. The "Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction" (2015), which was further elaborated for the Sendai Framework Monitor in UNISDR (2017).
b. The 2008 edition of the System of National Accounts (UN, 2008), as well as some aligned or related sources of definitions such as the International Central Product Classification (CPC), Ver.2.1, the UN Central Product Classification (CPC ver. 2.1) and the System of Environmental-Economic Accounts –Central Framework (SEEA).

23. Each object can be either **damaged** or **destroyed**. Damages are the partial physical destruction to buildings or other objects. Destroyed assets are assets which are beyond repair. A destroyed asset is a total loss in terms of asset value and replacement would require a complete reconstruction.

24. The scope of this classification was developed in relation to the definition of assets from the SNA, because the Sendai Framework definition for direct economic loss (see Chapter 2) refers explicitly to impacts on assets. An exception is household consumer durables, which are not assets according to the SNA definition, but are potentially important objects of direct material impacts from disasters.

Draft provisional classification for objects of material impacts from disasters

1. Buildings and structures

Buildings and related structures, fixtures or land improvements.

1.1 Dwelling

Residences, including residential buildings or parts of building or other structures used as residences.

SNA defines dwellings as "buildings, or designated parts of buildings, that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are also included, as are public monuments identified primarily as dwellings. [SNA 10.68]; CPC Ver 2.1 class 5311.

1.2 Critical buildings and structures

Critical buildings and structures are defined as a specialized sub-category of buildings and structures for disaster statistics.

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 are critical buildings and structures. [UNGA, 2015]. Most critical infrastructures are assets involved in providing non-profit services, according to the SNA.

1.2.1 Healthcare facilities

Defined in CPC 5312 ("non-residential buildings") heath care facilities are: health centres, clinics, local, regional and tertiary hospitals, outpatient centres, health laboratories and in general facilities used by primary health providers.

1.2.2 Education facilities

Defined in CPC under 5312 "non-residential buildings" education facilities are: play schools, kindergartens, primary, secondary or middle schools, technical-vocational schools, colleges, universities, training centres, adult education, military schools and prison schools.

1.2.3 Public monuments

Public monuments are identifiable because of their historical, national, regional, local, religious or symbolic significance [SNA 10.78]. Public monuments include religious buildings or other facilities that often have additional functions for the community, including as refuge or assembly areas in the case of an emergency.

1.2.4 Other critical public administration buildings

Public buildings providing public services, other than those already mentioned are included in this category.

They include buildings used for refuge, assembly or as evacuation centres not otherwise classified (e.g. excluding public monuments), as well as buildings belonging to emergency response institutions, such as fire, police, army and emergency operation stations.

1.2.5 Roads

Defined in CPC under 532 "Civil engineering works", roads include highways, paved roads and unpaved roads.

1.2.6 Bridges

Defined in CPC under 532 "Civil engineering works", bridges include road bridges and railroad bridges.

1.2.7 Railways

Railways include surface railroads, underground railroads and railway stations.

1.2.8 Airports

Airports includes International airports, National airports; "Passenger Transport Services (CPC 64) and Freight Transport Services (CPC 65).

1.2.9 Piers

Piers include National and International ports, Fisheries ports, and other docks and piers; "Passenger Transport Services "(CPC 64) and "Freight Transport Services" (CPC 65)

1.2.10 Transport equipment

Transport equipment within SNA asset definition (excluding consumer durables) consists of equipment for moving people and objects. Examples include products other than parts included in CPC 2.0 division 49, transport equipment, such as motor vehicles, trailers and semi-trailers, ships, railway and tramway locomotives and rolling stock; aircraft and spacecraft; and motorcycles, bicycles, etc. [SNA 10.84]. It includes pipelines for transporting oil or gas.

1.2.11 Electricity generation facilities

Electricity generation facilities include, power stations and substations, refineries and CPC 532 "Civil engineering works".

1.2.12 Electricity grids

Electricity grids include power grids, transmission lines; CPC 532 "Civil engineering works".

1.2.13 ICT equipment

Information, computer and telecommunications (ICT) equipment consists of devices using electronic controls and the electronic components forming part of these devices. Examples are products within CPC 2.0 categories 452 and 472. In practice, this narrows the coverage of ICT equipment mostly to computer hardware and telecommunications equipment. [SNA 10.85]; ICT equipment includes telephone networks and other communication networks, related facilities for internet connectivity, radio and television stations.

1.2.14 Dams

Dams are artificial barriers presenting the flow of water for one or more purposes, including electricity production and water storage; CPC 532 "Civil engineering works".

1.2.15 Water supply infrastructure

Water supply infrastructure includes drinking water supply systems (water outlets, water treatment plants, aqueducts and canals which carry drinking water, storage tanks), wells, and reservoirs; CPC 532: "Civil engineering works".

1.2.16 Water sewage and treatment systems

Water sewage and treatment systems includes sanitation and sanitary sewage systems and collection and treatment of solid waste; CPC 532: "Civil engineering works".

1.2.17 Other critical infrastructures

Other critical infrastructures include buildings or structures with critical functions, particularly for disaster risk reduction or other protection functions, not elsewhere included, such as underground water infiltration trenches and storage systems, regional storm water reservoirs, flood protection walls and river defences, drainage systems and water storage systems. It also includes canals and other water management systems classified as critical but not included under water supply or treatment systems above. It may also include military installations and weapons systems.

1.3 Other buildings and structures

Other buildings and structures include all other buildings and structures, defined according to CPC and not designated as critical. These include commercial buildings or public government buildings, or facilities not included as critical. Also included are waste management plants and landfills and parks and green areas, or other permanent structures not otherwise classified.

2. Machinery and equipment

Machinery and equipment covers transport equipment, machinery for information, communication and telecommunications (ICT) equipment, and other machinery and equipment.

2.1 Critical machinery and equipment

Critical machinery and equipment are defined as a sub-category of assets for disaster statistics, particularly transportation, communication, and other equipment used for emergency response.

Critical machinery and equipment includes machinery and equipment used within critical buildings or other structures for providing basic services, such as equipment in health facilities, education facilities, and transportation equipment classified as critical.

2.2 Other machinery and equipment

Other machinery and equipment consists of machinery and equipment not classified as critical in 1.3. Examples include products included in the International Central Product Classification

(CPC), CPC Ver.2.1 divisions 43, general purpose machinery; 44, special purpose machinery; 45, office, accounting and computing equipment; 46, electrical machinery and apparatus; 47, radio, television and communication equipment and apparatus; and 48, medical appliances, precision and optical instruments, watches and clocks.

3 Environmental resources

3.1 Agricultural Land

Agricultural land consists of the ground, including the soil covering and any associated surface waters, over which ownership rights are enforced and from which economic benefits can be derived by their owners by holding or using them (SNA, 2018). Agricultural land includes the land and improvements to land used for production of agriculture.

3.2 Managed forests

Managed forests include areas that have a long-term documented management plan. They include planted forests, which are predominantly composed of trees established through planting and/or deliberate seeding.

3.3 Primary/Natural forest

Primary/natural forests are defined as forest areas other than managed or planted forests. They are naturally regenerated forests of native species, where there are no clearly visible indications of human activities and the ecological processes have not been significantly disturbed. Key characteristics of primary forests are that: (a) they show natural forest dynamics, such as natural tree species composition, occurrence of dead wood, natural age structure and natural regeneration processes; (b) the area is large enough to maintain its natural characteristics; and (c) there has been no known significant human intervention or the last significant human intervention occurred long enough in the past to have allowed the natural species composition and processes to have become re-established. [SEEA 5.286]

3.4 Cultivated biological resources

3.4.1 Livestock

Livestock are animal resources yielding repeat products and includes animals whose natural growth and regeneration are under the direct control, responsibility and management of institutional units. They include breeding stocks, dairy cattle, draft animals, sheep or other animals used for wool production and animals used for transportation, racing or entertainment. Animals raised for slaughter, including poultry, are not fixed assets but inventories. (SNA)

3.4.2 Fish stock and fisheries

Fish stock and fisheries includes aquatic resources yielding repeat products, consisting of aquatic resources maintained for controlled reproduction. These include aquatic plants (seaweeds), crustaceans, diadromous fishes, freshwater fishes, marine fishes and mollusks.

3.4.3 Work-in-progress Agricultural Crops – for all primary crops

"Work-in-progress consists of output produced by an enterprise that is not yet sufficiently processed to be in a state in which it is normally supplied to other institutional units. Work-in-progress occurs in all industries, but is especially important in those in which some time is needed to produce a unit of finished output, for example, in agriculture, or in industries producing complex fixed assets such as ships, dwellings, software or films. Although work-in progress is output that has not reached the state in which it is normally supplied to others, its ownership is nevertheless transferable, if necessary. For example, it may be sold under exceptional circumstances such as the liquidation of the enterprise." [SNA 10.134]

See FAO Indicative Crop Classification (ICC)

3.4.4 Annual crops

Annual crops are those that are both sown and harvested during the same agricultural year, sometimes more than once;

3.4.5 Perennial crops

Perennial crops are sown or planted once and are not replanted after each annual harvest. Annual perennial crops include cereals, pulses, roots and tubers, sugar crops, some oil-bearing crops, some fiber crops and vegetables, tobacco, and fodder crops. Perennial primary crops include fruits and berries, nuts, some oil-bearing crops and spices and herbs.

3.5 Non-cultivated biological resources

Non-cultivated biological resources consist of animals, birds, fish and plants that yield both once-only and repeat products over which ownership rights are enforced but for which natural growth or regeneration is not under the direct control, responsibility and management of institutional units. Examples are virgin forests and fisheries within the territory of the country. [SNA 10.182]

3.6 Water resources

Water resources consist of surface and groundwater resources used for extraction to the extent that their scarcity leads to the enforcement of ownership or use rights, market valuation and some measure of economic control. [SNA 10.184]

4. Valuables (SNA asset definition)

Valuables are produced goods of considerable value that are not used primarily for purposes of production or consumption but are held as stores of value over time. Valuables are expected to appreciate or at least not to decline in real value, nor to deteriorate over time under normal conditions. They consist of precious metals and stones, jewellery, works of art, etc. Valuables may be held by all sectors of the economy. [SNA 10.13]

4.1 Art objects, music instruments

Paintings, sculptures, etc., recognized as works of art and antiques are treated as valuables when they are not held by enterprises for sale. In principle, museum exhibits are included under valuables. [SNA 10.153]

4.2 Other valuables

Other valuables not elsewhere classified include such items as collections of stamps, coins, porcelain, books etc. that have a recognized market value and fine jewellery, fashioned out of precious stones, and metals of significant and realizable value. [SNA 10.154]

5. Inventories (SNA asset definition)

Inventories are produced assets that consist of goods and services, which came into existence in the current period or in an earlier period, and that are held for sale, used in production or for other use at a later date. [SNA 10.142]

5.1 Inventories of agricultural crops

Includes all primary crops; see FAO Indicative Crop Classification (ICC)

5.2 Inventories of agricultural inputs

Products used as inventories in production of crops; includes seeds, fertilizer, feed, and fodder.

5.3 Other inventories

Other inventories include all other produced assets aligned with SNA definition for inventories.

6. Household consumer durables

Household consumer durables are durable goods acquired by households, which are held over multiple accounting periods but are not used in a production process (and therefore not classified as assets). An example is privately owned automobiles. The Classification of Individual Consumption According to Purpose (COICOP), which is currently under revision, clarifies the difference between durable versus non-durable or semi-durable goods.

Disaster Risk Reduction Characteristic Activities (DRRCA) Classification

25. The Sendai Framework describes disaster risk reduction (DRR) as a scope of work "aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contributes to strengthening resilience. DRR encompasses all aspects of work including the management of residual risk, i.e. managing risks that cannot be prevented nor reduced, and are known to give raise to, or already, materialize into a disaster event."

26. The **DRR-characteristic activities** (DRRCA) classification is presented as a draft tool for defining and categorizing this specific domain of interest for the purpose of consistently producing statistics on expenditures and transfers/investments for DRR (see Chapter 5).

27. The terms and definitions used in the proposed DRRCA classification are extracted, as much as possible, from the Sendai Framework and terminologies agreed for Sendai Framework Monitoring (see UNGA, 2015 and UNISDR, 2017).

28. The DRRCA classification and its definitions are provided to help compilers with identifying and organizing the data and metadata from government finance statistics and should be applied and adapted with more detailed descriptions at the national level.

29. DRRCA is a classification of activities. As such, it has a relationship, conceptually, to the United Nations Standard Industrial Classification of All Economic Activities (ISIC), Revision 4. Most DRR-characteristics activities are a part of government (and thus would relate to Section 0 in ISIC, Revision 4: “Public Administration and Defence; compulsory social security”), but there can also be characteristic activities initiated by (or funded by) institutions outside of the public sector, such as domestic non-profit institutions or international development organizations.

DRRCA classification

1. Disaster risk prevention

Activities and measures to avoid existing and new disaster risks.

1.1 Risk prevention in advance of hazardous event

Risk prevention in advance of a hazardous event is a concept and intention to avoid potential adverse impacts of hazardous events. While certain disaster risks cannot be eliminated, prevention aims at reducing vulnerability and exposure in such contexts where, as a result, the risk of disaster is removed. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high-risk zones, seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake and immunization against vaccine-preventable diseases.

1.2 Risk prevention in or after a hazardous event

Risk prevention in or after hazardous events relates to prevention measures taken to prevent secondary hazards or their consequences. Included are measures to prevent contamination of water supplies or measures to eliminate natural dams caused by earthquake-induced landslides and/or rock falls.

2. Disaster risk mitigation

Disaster risk mitigation includes activities and measures to reduce or lessen existing disaster risk or to limit the adverse impacts of a hazardous event. Mitigation differs from prevention in that it is reactive to an identified and currently existing risk or impending threat. Thus, the activities mitigate for specific threats, instead of general risk prevention.

2.1 Structural measures, constructions

Structural measures and constructions include any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard resistance and resilience in structures or systems. Common structural measures for disaster risk reduction include constructed dams, flood levies, ocean wave barriers, earthquake-resistant construction, and evacuation shelters. Structural measures will include “building back better” after a disaster.

2.2 Non-structural measures

Non-structural measures are any measures not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts through their integration in sustainable development plans and programmes, through policies and laws, public awareness raising, training and education typically to reduce vulnerability and exposure. Non-structural measures may include risk transfers paid/received (e.g. insurance purchases).

2.3 Land-use planning

Land- use planning can help to mitigate disasters and reduce risks by discouraging settlements and construction of key installations in hazard-prone areas, including consideration of service routes for transport, power, water, sewage and other critical facilities.

2.4 Early warning systems management

Early warning systems management incorporates inter-related sets of hazard warnings, risk assessments, communication and preparedness activities that enable individuals, communities, businesses and others to take timely action to reduce their risks.

3. Disaster risk management

Disaster risk management is the organization and management of resources and responsibilities for creating and implementing preparedness and addressing all aspects of emergencies and others plans to respond to, and to decrease the impact of disasters. The plans set out the goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives.

3.1 Preparedness

Preparedness is the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current disasters.

3.2 Emergency management

Emergency management includes national-level plans that are specific to each level of administrative responsibility and adapted to different social and geographical circumstances. The time frame and responsibilities for implementation and the sources of funding should be specified in the plan. Linkages to sustainable development and climate change adaptation plans should be made where possible.

3.3 Emergency supply of commodities

Emergency supply of commodities includes resources and responsibilities for providing emergency support of commodities during a disaster.

3.4 Other disaster responses

Other disaster responses include provision of emergency services and public assistance by private and community sectors, as well as volunteer participation.

4. Disaster recovery

Disaster recovery involves the restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk.

4.1 Relocation

Relocation is t the movement of people, for different reasons or circumstances because of risk or disaster, permanently from their places of residence to new sites.

4.2 Rehabilitation

Rehabilitation involves the rapid and basic restoration of services and facilities for the return to normal functioning of a community or a society affected by a disaster.

4.3 Reconstruction

Reconstruction involves the medium and longer-term repair and sustainable restoration of critical infrastructures, services, housing, facilities and livelihoods required for full functioning of communities and livelihoods of residents in a region affected by a disaster.

5. General government, research and development, education expenditure

5.1 General government expenditure for disaster risk reduction

General government expenditure for disaster risk reduction is expenditure, which must be estimated indirectly, incurred by general government on both individual consumption goods and services and collective consumption services, with an explicit disaster risk reduction purpose.

5.2 Research and development, risk assessment, and information

Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios.

ISO 31000 defines risk assessment as a process made up of three processes: risk identification, risk analysis, and risk evaluation.

Risk information includes all studies, information and mapping required to understand the risk drivers and underlying risk factors.

5.3 Education for disaster risk reduction

Education for disaster risk reduction includes natural and engineering science, training of risks professionals and risk specialist medicine professionals.

CHAPTER 9: COLLECTION AND ANALYSES OF STATISTICS IN THE DISASTER RISK MANAGEMENT CYCLE

1. Statistics in this framework are derived from a wide variety of sources. Important data sources for compiling the basic range of disaster-related statistics include:

- Population and housing census, household surveys,
- Monitoring data from geophysical, meteorological and geographic organizations,
- The national accounts and its sources such as enterprise surveys,
- Administrative records on the population (e.g. CRVS) and on public services (e.g. education)
- Government finance statistics,
- Disaster management agency assessments and monitoring,
- Ministry of environment assessments and monitoring, administrative records of health and safety institutions
- specialized surveys targeting disaster-affected households and businesses (where possible)

2. Mapping the existing data sources with the prioritized requirements for a basic range of disasters related statistics is crucial for development of disaster-related statistics.

Before a disaster

3. Risk statistics are the baseline information about the population or infrastructure compiled prior to a disaster for risk areas whereas impacts statistics are information for describing a population affected by a specific disaster occurrence and affected area. However, the disaggregation of statistics on the human impacts, in many cases, simply mirror the categories that were identified in the vulnerability assessments – e.g. children, the elderly and the income poor. Eventually, collections and analyses of statistics before and after a disaster should become a systematic and mutually reinforcing set of linked processes used to improve one another and built upon the same basic initial data collections. For example, baseline statistics on economic activity for areas exposed to hazards are reused for estimating costs of damages in impacts assessments.

Components of basic range of disaster-related statistics: before a disaster

Exposure to Hazards
Vulnerability
Coping Capacity
DRR Activity

4. **Risk assessment** is a process to determine the nature, extent, and locations of risk, by analysing exposure and conditions of vulnerability to hazards and present coping capacities against all types of disaster impacts. A comprehensive risk assessment process consists of understanding of current situation, needs and gaps, hazard assessment, exposure assessment,

vulnerability analysis, loss/impact analysis, risk profiling and evaluation and formulation or revision of disaster risk reduction strategies and action plans.[49]

5. Risk assessment incorporates statistical information from past disasters in combination with a broad variety of current social economic statistics for developing risk profiles in relation to geographic data on potential hazards.

Population and social statistics for risk assessments

6. Population censuses and household surveys are critical sources of data on the population, including their location and basic demographic and social characteristics. These data are the basic inputs for measuring exposure and vulnerability to hazards.

7. Examples of descriptive statistics on the population used in risk assessment from the population and housing census and household surveys are:

- Population density by location
- Characteristics of dwellings (e.g. construction materials)
- Median household disposable income
- Education enrolment, by sex, age group and level of achievement
- Information on assets of households, such as type of dwelling
- Other human development statistics, by age group, including evidence related to nutrition and childhood health,

8. The primary sampling units for censuses (or census blocks) are instruments for organizing census collection operations and usually contain somewhere between 50-350 households, depending on the country and region. The level of geographic aggregation for census data that are available to most users is usually at the level of administrative region (e.g. provinces, municipalities or administrative level 01, 02 and 03 – e.g. districts, provinces, regions).

9. Since censuses, in principle, include everyone, then it is possible to analyse census data at a fine level geographic disaggregation as long as individual confidentiality is not compromised.

10. Estimation of exposure of population to hazards statistics on population is built upon at the population data at the most detailed geographic scale (highest geographic resolution) as available in order to overlay this information in GIS with the maps of hazard areas to calculate the numbers in the overlapping areas.

11. Generally, the higher the geographic detail of the population aggregates, the more accurate the estimates of population in hazard areas. Level of geographic disaggregation varies by data sources, but the information can be integrated using GIS and utilized for multi-scale analyses

[49] http://www.undp.org/content/dam/undp/library/crisis%20prevention/disaster/2Disaster%20Risk%20Reduction%20-%20Risk%20Assessment.pdf

12. For example, the Statistics Development Division of the Secretariat for the Pacific Community (SPC) has developed a methodology to estimate coastal populations with higher levels of geographic resolution than the administrative reporting areas, utilizing census data, see the SPC PRISM (see also Andrew et al., *forthcoming*). While the SPC mapping of coastal populations was not developed specifically for disaster risk assessment, it is a good example of the type of data and approach to compilations in GIS that is fundamentally important for risk assessment and feasible using currently accessible datasets, such as census data at the highest geographic level of disaggregation as available in the county.

13. Pilot studies for the population exposed to hazards estimation methodology conducted as part of the DRSF pilot studies were conducted based on public access (admin 02 or Admin 03) datasets and revealed that, with high quality data on built-up areas such as the DLR Global Urban Footprint (GUF) produced from radar satellite images (accessible at https://urban-tep.eo.esa.int/#), it is possible to use these census datasets to estimate exposures of population in relation to hazard areas.

14. Censuses are conducted, in most cases, on a 10-year cycle, with intra-census period updates made in between, based on projections and use of other sources like population administrative records and surveys. An active collaboration for producing and sharing of these statistics is needed between national statistics offices and the other entities in government with the relevant geographic information on location of hazards and agencies responsible for conducting risk assessments.

15. At the macroeconomic scale, summary statistics on structure of employment (e.g. shares of employment by main categories of activity.) and metrics for levels of inequality can be used for assessing vulnerabilities or coping capacity. Structural macroeconomic vulnerabilities can be measured, in some cases, such as aggregated statistics on shares of employment or production activities in agriculture, tourism, or other categories of potential interest for risk assessment. The potential for producing such aggregated economic statistics according to hazard area should also be investigated, such as via use of administrative data.

Mapping and environmental monitoring

16. One of the basic inputs for developing exposure statistics are land cover and land use maps and, where available, the cadastres of municipalities. Land cover and land use maps, among other kinds of geospatial information, provide the necessary baseline information for defining specific geographic objects of interest in risk assessment.

17. Development of hazard maps and profiles should include, as much as possible, data and lessons learntabout hazards from passed disasters. The other key components for developing hazard maps are a collection of standard collections of national mapping and environmental mapping agencies, such as:

- Elevation map, also known as the digital elevation model (DEM)
- Meteorological data (for predicting flood, landslide, drought)
- Distribution of solid types (important for predicting risk associated with earthquakes)
- Values for surface roughness (used in assessing tropical cyclone hazard)
- Slope and river flow values (flood)

- Slope and geological features for hillsides and mountain sides (landslide)
- Impervious surfaces (can increase risks associated with floods or storms)
- Scale, locations and other characteristics of investment in disaster risk reduction (such as technical infrastructure)
- Monitoring signals of slowly developing risks approaching thresholds to a potential disaster (e.g. changes of land use in disaster-prone areas, changing practices in agriculture or fishing).
- Urban versus rural distribution of exposed areas
- Mapping of ecologically important areas or 'hot spots' and protected areas
- Mapped statistics on ecological condition[50] or sites identified for environmental degradation, e.g. polluted water bodies

18. Hazard maps are developed utilising specialized expertise relevant to each hazard, e.g. earthquakes, volcanoes, extreme meteorological events, floods, tsunami, etc. Hazard data typically are produced as official products by national meteorological, geological, hydrological, disaster management, or other scientific organizations working within or in collaboration with governments.

19. Hazard mapping also involves probabilistic modelling, utilizing the available data and in relation to a defined time period (extreme events are more probable the longer the timespan under study) and a confidence interval chosen by the experts. Different degrees of exposure or probabilities of a hazard are used to produce multiple mapped layers according to different expected degrees of risk (high, medium and low exposure).

20. Internationally, compilation of hazard maps, derived from a variety of sources and with international scope can be found at UNEP-GRID[51], the Group on Earth Observations' Geoportal[52] and the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI).[53]

21. On the exposure side, land cover and land use maps, as well as other sources of related information, such as cadastres, maps of critical ecosystems or hotspots, maps of critical infrastructure, and a broad range of other geographic information can be important inputs for analyses in relation to hazards. In addition, statistics describing environmental condition, for example related to the quality of water bodies or characteristics of forests, which are also important inputs for use in measurement of factors of vulnerabilities to disasters.

22. GIS can be used for integration of a comprehensive repository of relevant geographic information. Multiple layers of mapped data can be integrated to produce statistics relatively simply if the maps can be gathered and consolidated into a centralized database for disaster risk reduction purposes.

23. One of the key data sources for risk assessment, including for producing hazard catalogues is remote sensing, and particularly satellite imagery. Land cover mapping and

[50] See Weber (2014)

[51] www.grid.unep.ch/

[52] http://www.geoportal.org/

[53] http://pcrafi.spc.int/

mapping of impervious surfaces, human settlements, and built-up areas, for example, can be produced as a snapshot at different moments in time from interpretation of various forms of satellite imagery, including visible light at daytime, night lights, radar imagery, and so on.

Disaster preparedness

24. In some cases, for example for slowly developing catastrophic risks like drought, high probability of disaster impacts can be anticipated and therefore pre-emptively counter-acted by localized boosting of coping capacities. This includes the development/enhancement of an overall preparedness strategy, policy, and institutional structure. Warning and forecasting of capabilities, and plans for helping at-risk communities by being alert and to hazards and ready for action are key preparedness functions of governments.

25. **Preparedness** is defined as the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current disasters. Preparedness exists at multiple scales, e.g.: household preparedness, preparedness of communities, preparedness of disaster response facilities, and preparedness of countries or regions within countries.

26. Statistics on household preparedness against disaster impacts have been collected in many countries from household censuses or surveys by incorporating the topic into the questionnaires (see examples in chapter 3 and in table B3 in the annex).

27. Where possible, statistics on the amounts and locations of investment in disaster risk reduction (see Chapter 5) are important for assessing coping capacities in risk areas and for monitoring effectiveness of such interventions, over time.

28. Relevant information at the community or higher scale of analysis include:

- Adoption and implementation national disaster plans;
- Type and number of shelters in place;
- Type and number of internationally certified emergency response and recovery specialists; early warning systems for all major hazards;
- Emergency supplies and equipment stockpiles;
- Number of volunteers;
- Expenditure on disaster risk reduction;
- Total official international support (ODA) for DRR.

29. One of the critical elements of preparedness for many hazards types is coverage of the population and business by **early warning systems management**. Early warning systems are designed based on an optimization of risk reduction utilizing the results of risk assessments.

1. Use of early warning systems in the case of impending disaster is informed by statistics on likelihood of the hazard and expected degree of impacts, according to the calculated exposure. Below is a simplified example of a decision matrix for applying available data on exposure.

Sample of impact matrix for informing preparedness initiatives or developing early warning systems

Likelihood	High			
	Medium			
	Low			
		Minor	Moderate	Severe
	Potential Impacts			

Source: World Bank (2016)

During a disaster

30. **Disaster response** are the "actions taken directly before, 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." (UNGA, 2015).

31. A spatial data infrastructure (SDI) is an effective means for integrating relevant data sources from the pre-disaster compilations, along with real time information about the disaster occurrence for rapid assessment and decision-making by the disaster response authorities and for response putting resources in the right places for efficiently meeting needs.

32. This includes geo-referenced data on:

- Timing and geographic location of the hazard
- Population exposure in hazard area
- Vulnerable groups in hazard area
- Critical infrastructure, including disaster emergency response facilities and shelters inside and outside of hazard area
- Vulnerable areas, such as potentially hazardous areas which could increase the impact; storage or use of hazardous substances, landfills, polluted areas, etc.
- Businesses in hazard area
- Agriculture in hazard areas

33. Statistics fit for the purpose for disaster-response, at minimum, are geo-coded; attached with sufficient metadata to facilitate interoperability with operations systems; and are routinely accessible, with emergency protocols.

34. The UN Office for the Coordination of Humanitarian Assistance (OCHA) and several other cooperating agencies that work in humanitarian crisis situations have developed guidance for rapid assessment[54], as part of the emergency response during a disaster. Rapid assessments are tools used for coordinated emergency response, rather than for producing statistics. However, in many cases, the same data used for emergency assessments can be reutilized for estimation of statistics on disaster impacts after the emergency period.

[54] See, e.g., www.acaps.org

Data collected during a disaster occurrence

35. Immediately after a disaster, the responsible agencies must first acknowledge the situation of an emergency or of impacts to make a record for a disaster occurrence and assign a unique identifier for the occurrence (see Chapter 2). Once this is established, a part of the immediate disaster response will normally include a range of potential data collections for estimating and recording statistics on the impacts.

36. A part of the response to disasters is provisioning various types of support to households or enterprises. Depending on the nature of the disaster and capacities for response, this may include:

- Support for evacuation or relocation
- Transfers of other basic needs like food, water, and other supplies
- Medical assistance and other emergency response services
- Transfers of financial resources to help local institutions with recovery efforts.

37. Support to households or businesses by local or national government agencies is commonly accompanied by a system of registration and/or collection of basic information for those receiving support. These administrative records from disaster response and recovery can be digitally stored as non-public databases, from which statistics can be derived, including, if designed properly, disaggregated statistics by characteristics like age and sex, disability, employment, and income.

38. However, disaggregated information describing the characteristics of impacted population may not be known at the time of the disaster and compilation of statistics is not the priority during an emergency. Therefore, disaggregation of impacts may involve a secondary step of estimation and linking between multiple data sources after the disaster (see below). For cases where data on basic characteristics of people that were impacted are incomplete, the unknown cases should still be recorded and classified as unknown (e.g. categories are male, female, and sex unidentified), leaving the possibility for filling these gaps through estimation later.

39. The main responsibilities for compilation of statistics during the disaster are national disaster management agencies, line-ministries (such as the Ministry of Interior, Ministry of Agriculture, and Ministry of Health) and sub-national administrative bodies (such as municipal administrations). Also, research institutions and NGOs (e.g., Red Cross or Red Crescent) play an important role in disaster response and recovery, including collecting data during an emergency.

40. Noting that the verified statistics on disaster impacts may take some time to finalize, eventually the data collected during, and as part of, the emergency response from a disaster can be a crucial resource for producing impacts statistics and for potentially improving methodologies for future risk or post disaster assessment methodologies.

After a disaster

Statistics for post-disaster assessment

41. Disaster recovery is the process of restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "**building back better**", to avoid or reduce future disaster risk. (UNISDR, 2017)

42. After an emergency period, NDMAs coordinate a process to compile data on impacts and produce assessments of the impacts, that are used for multiple purposes, including to inform the recovery but also for monitoring trends of impacts overtime (e.g. Sendai Framework monitoring) and as inputs into future risk assessments.

43. The post disaster recovery may include:

- Relocation of people who, for different reasons or circumstances because of risk or disaster, have moved permanently from their places of residence to new sites.
- Rehabilitation**:** the rapid and basic restoration of services and facilities for the return to normal functioning of a community or a society affected by a disaster.
- Reconstruction: the medium and longer-term repair and sustainable restoration of critical infrastructures, services, housing, facilities and livelihoods required for full functioning of communities and livelihoods of residents in a region affected by a disaster.

44. These elements of recovery may be captured in statistics through a combination of direct observations by recovery organizations or related institutions along with estimations based on analysis of trends in economic and social data (e.g. population movement and construction activities) collected before and after a disaster as a part of the usual compilations of official statistics. In this case many of the key data sources mentioned for risk assessment before the disaster (e.g. census, economic statistics or land cover maps) come back into use, but with the new post-disaster compilations, for making comparison to the pre-disaster situation.

45. Measures for the various forms of direct impacts (found in C, D, E, F, and G tables in the annex) are also compiled in post disaster assessments, including Post-Disaster Needs Assessment (PDNA) studies, using the conceptual framework and methodologies developed initially by the Economic Commission for Latina America and the Caribbean (ECLAC) and now managed by the UN Development Group, the World Bank and the European Union.[55]

46. PDNAs contain two perspectives: the quantifications of physical damages and economic losses and the identification of socio-economic recovery needs based on information obtained from the affected population.[56] PDNAs also typically incorporate estimations for both direct and indirect economic impacts. The DALA methodology "focuses on the conceptual and methodological aspects of measuring or estimating the damage caused by disasters to capital stocks and losses in the production flows of goods and services, as well as any temporary effects on the main macroeconomic variables." (ECLAC, 2003).

[55] http://www.undp.org/content/undp/en/home/librarypage/crisis-prevention-and-recovery/pdna.html

[56] http://www.worldbank.org/en/events/2017/06/12/post-disaster-needs-assessment-for-resilient-recovery

47. Utilizing, where possible, data collected before and during a disaster to evaluate and provide the context for measuring impacts, most of the basic range of impacts statistics will be compiled through a combination of data sources in the weeks and months or years after a disaster.[57]

Post-disaster assessment data sources

48. The common data sources and actions for collecting data for impacts statistics after a disaster are summarized as follows.

49. First, there may have been a primary observation of material or human impact during a disaster. These are the initial reports, during or immediately following an emergency, which are subject to revision. An example is the disaster management agency or estimations of numbers of dwellings damaged and destroyed based on observations during disaster recovery.

50. Second, compilations of statistics from administrative records from disaster response and recovery along with related estimations of human impacts, such as number of individuals affected by the damaged and destroyed dwellings.

51. Third, records from government authorities, insurance companies, or other sources of data on degree of magnitude and monetary values for the material impacts and disruptions to basic services.

52. Fourth, targeted follow-up surveys are designed, where possible, to collect additional information and to fill gaps in information on impacts to the population and to businesses in the affected area.

53. Fifth, analyses of regular sources of time series statistics, available before and after a disaster, are used to test hypotheses and produce estimations on impacts. Relevant sources for these impact assessments could include virtually all types of sources used in official statistics. Key examples include the population and housing census, household surveys, business surveys and censuses, the national accounts, employment surveys, and before-and-after satellite imagery.

54. For the economic valuation of the material impacts to assets from disasters (direct economic loss), many sources need to be considered, especially: values for insurance claims, data collected from establishment surveys or administrative records on reconstruction and recovery, and estimations based on baseline statistics on infrastructure, average construction costs, and detailed data from the sources of agriculture statistics (see Chapter 4).

55. Costs of disaster risk reduction characteristic activities, especially relevant expenses after a disaster like reconstruction expenses related to the recovery, but also interventions for mitigating impacts after disasters are compiled from common data sources, used in national accounts, especially, in this case, administrative records on government expenditures.

[57]Previous studies (e.g. Groppo and Kraehnert) have shown the possibility for identifying potential long-term impacts from disasters up to 10 years after the initial emergency because disasater may have effects on fundamental development capacities such as education and early childhood development There is no current standard time frame for a length of time reference for studying the effects of disasters. The time period may depend, among other factors, on the nature of the hazard and the coping capacity of impacted communities.

56. Although, the national accounts are not a primary source of statistics for assessing direct economic impacts of disasters, in principle all of the direct and indirect impacts of disasters are incorporated in the national accounts, implicitly or explicitly.

57. For most countries in Asia and the Pacific, Africa and Europe, producing national accounts is a responsibility of national statistics offices. However, in some countries, including in most of the countries in Latin American and the Caribbean, national accounts are compiled by Central Banks. Another arrangement (e.g. in the United States and in Thailand) is production of national accounts by a specialized economic advisory council within the government. Regardless of the institutional arrangements of a particular country, exchange of data and metadata and a collaboration between national accounts and the centralized database on disaster impacts statistics is an important step for validation, for creating coherence across the national statistical system, and for identifying inputs for modelling the indirect impacts of a disaster.

Population and health administrative data after a disaster

58. The usual source of official records for deaths and causes of death, where it could be determined, are civil registration authorities and the Ministry of Health, which is responsible for maintaining and monitoring health information systems. In the event of a disaster, particularly for large scale disasters, records for deaths or missing is, in the short-term, commonly tabulated as part of the emergency response and initial assessment of human and material impacts from disasters. These figures are reported by and to the different levels of local and national government and usually at some stage are shared in official reports to the public.

59. For countries with well-functioning systems for registration of deaths, mortality statistics are derived from administrative records (i.e. civil registration systems), which record all deaths and causes of deaths. As most countries do not yet have fully comprehensive systems for recording vital events, often surveys are used to supplement for producing statistics on deaths. These statistics have many important uses for the broader statistical system, including for estimating the rate of growth of populations and for investigating public health issues, such as trends in mortality from different types of health challenges. These civil records are complemented by broader health information systems (HIS), which are managed by health ministries, in collaboration with resident health institutions, like hospitals. Health administrative records contain confidential information, but can be utilized to produce broad summary statistics that describe trends in the population without revealing private information about individuals.

60. A critical step for ensuring consistency in the statistical systems and completeness of data across different applications of mortality statistics, is that the cases of deaths resulting from disasters are also incorporated correctly and completely into the broader civil registration system and aggregated mortality statistics for the country.

61. In principle, deaths are recorded in civil registers and/or in health information systems according to a standard classification for causes of death. The current international classification is called the international Statistical Classification of Diseases and Related Health Problems – 10th revision, or ICD 10 (2016).[58] ICD 10 is managed by the World Health

[58]http://apps.who.int/classifications/icd10/browse/2016/en, https://icdlist.com/icd-10/index

Organisation (WHO). ICD10 does not include specific coding for deaths from disaster, but includes a general category for "External Causes for Morbidity and Mortality" (codes V01-Y98), which includes classes for exposure to many different types of hazards that are either related to or beyond the scope of the Sendai Framework.

62. The first group of external causes of mortality in ICD10 are related to accidents, particularly transport accidents, which may or may not be relevant the scope of disaster risk reduction, depending on if there was a direct relationship with a hazard fitting within the scope of the Sendai Framework. The second group of external causes of mortality in the ICD10 index include exposure to fire, smoke, or heat (X00-X19), or other types of hazards or "forces of nature (X30-X39), and "accidental exposure to other specific factors" (X52-X58).

63. Many countries face challenges for producing statistics from civil registration of good coverage for cause of death. Attributing deaths to disasters has special challenges. Where possible, the preferred practice for official records on cause of deaths is diagnosis by a trained medical professional. These professionals are trained for identifying diseases and other likely internal causes of death. Typically, medical professionals are not trained and may not be authorized to attribute deaths to a specific external event like a disaster.

64. A useful example to learn from and potentially to emulate for disaster-related deaths is current practices for collecting, compiling and reporting statistics on traffic accidents. As explained in an Information Note for by the Secretariat for the Pacific Community (SPC) and the Brisbane Accord Group[59], there are three main interacting sources of data used for compiling statistics on road-related deaths:

- National Health Information Systems (HIS): for data on hospital admissions and emergency room attendance due to traffic crashes and their outcomes, and deaths certified by a medical practitioner.
- National Civil Registration (CR) Systems: for data on deaths both in and outside of hospitals. These systems usually record cause of death (linked to the health information systems and police records) as well, and may include outcomes from coroner's cases in countries where those processes are applicable.
- Police Incident Information Systems: for data on traffic incidents attended, including data on both the outcome (in the case of an injury or death), and conditions that contributed to the crash occurring. Other systems to collect data from first responders - such as data from paramedical services (ambulance or fire service) may also exist within the police information systems, health information systems or independently.

65. Overall, improvements to national systems for vital statistics, especially mortality and cause of death statistics is an important priority for statistical development in many countries and further progress in this domain more generally could also benefit the reliability and completeness of statistics on disasters.

66. One of the other crucial uses for administrative data for disaster-related statistics is for linking records of individuals from various administrative sources (including civil registration, but also other sources related to, e.g. education enrolment, tax enrolment, etc.) with data collected on disaster impacts. Linking with administrative data is a potential method for describing the population affected in terms of relevant disaggregation categories – e.g. by sex,

[59] http://www.pacific-crvs.org/images/doc/CRVS_Notes/Road_Related_Deaths.pdf

age, disability, income, etc. These are estimated calculations for each category, based on linking records between microdata on human impacts with the relevant administrative sources. Protection of confidentiality is an important point for emphasis in the use of the administrative records after a disaster, because these records need to be protected against use for identifying individuals.

Mapping and environmental monitoring

67. The prediction of probabilities of future events can be improved by information from past disasters. Probability of hazards is dynamic (for example due to climate change). Therefore, the probabilistic models need to be updated at regular intervals, integrating new information as it becomes available.

68. The basic physical information, including areas affected by a hazard should be compared, where feasible to the pre-disaster predicted hazard areas. Over time, mapping of information on actual hazards, especially relatively frequent hazards, could be utilized to evaluate and improve the accuracy of hazard mapping for disaster risk measurement and for risk reduction interventions. However, the possibilities for mapping the disaster area (or 'disaster footprint') vary depending on the hazard type and currently there are no standard methodologies yet for post-disaster footprint mapping.

69. In addition to mapping the physical hazard, another post-disaster mapping exercise that is potentially relevant both for improving pre-disaster risk assessments but also as a tool for impacts assessment, is to define contiguous areas in which direct material impacts could be observed.

70. Flood hazards are one the relatively simple cases. Flood areas can be mapped after a disaster utilizing remote sensing to define the inundation area. An example was produced by Columbia University, Center for International Earth Science Information Network (CIESIN) and NASA Socioeconomic Data and Applications Centre (SEDAC), in which mapped data on historical flood hazards from 1985-2003 was used to produce a global map of flood hazard frequency and distribution.[60] With the continuous development of disaster-related statistics globally, GIS-compatible statistics for will become progressively accessible to governments for use in reducing risks before and after disaster.

[60] http://sedac.ciesin.columbia.edu/data/set/ndh-flood-hazard-frequency-distribution

ANNEX

BASIC RANGE OF DISASTER-RELATED STATISTICS TABLES

Statistical tables are organised into worksheets according to basic components in the DSRF. The variables represent queries from a disaster-related statistics database. The tables are comprehensive of the Basic Range of Disaster-related Statistics and can be used by national agencies as a tool for assessing gaps and identifying opportunities to produce new statistics for disaster risk reduction.

Geo regions are officially designated geographic regions of relevance to the reporting, such as national (aggregate), regional or province (admin 02), district (admin 03), or other geographic regions important to the compilation or analysis, e.g. river catchments.

The relevant **time period** varies by tables and according to the analysis. For most impact statistics, a time period of at least 3-5 years is the most relevant given randomness and large year-to-year fluctuations in disaster occurrences and their impacts. DRRE tables, on the other hand, should be compiled annually, as with other national accounts.

A Summary tables of disaster occurrences

A1 Summary table of disaster occurrences, by hazards types, scale, and geographic region

A tables count numbers of occurrences according to the hazards, scale and geographical classifications. Disaster occurrences are background statistics, i.e. they are useful for providing context variables for statistics in other tables

B Selected Background Statistics and Exposure to hazards

B1a Population Background Statistics and Hazard Exposure by geographic regions
B1b Population Exposure by social groups
B2 Exposure of Land and Infrastructure by Hazard Type
B3 Coping Capacity Background Statistics

B tables are for assessing availability of background statistics (sometimes also called "baseline statistics") as well as hazard exposure statistics, which are compiled prior to disaster occurrences, and updated over time according to the relevant categories (hazard types and geographic zonings). Exposure statistics serve multiple purposes, in particular for calculating indicators of risk, as well for assessing impacts.

C Summary tables of human impacts

C1 Summary table of human impacts by hazards types
C2 Summary table of human impacts by geographic regions
C3 Summary table of human impacts by demographic and social categories

C tables are for compiling data related to affected populations (impacts on people) according to hazard types, geographic regions (national total, regions/states, municipalities, or river catchments), and demographic and social categories (age, gender, urban and rural, poor, and disabled). Selected optional sub-categories of impacts (e.g. major or minor injuries) are included in the table for compilation and compilers may wish to insert additional sub-categories according to the data availability and demand for statistics.

D Summary tables of direct material impacts in physical terms

D1a Summary table of direct material impacts by hazards types
D1b Summary table of direct material impacts by hazards types and geographic regions
D2a Disruption of basic services from a disaster by hazard type
D2b Disruption of basic services from a disaster, by geographic region

D tables are for recording direct material impacts in "physical" terms, such as area or number of buildings. The supplemental category of "critical infrastructure" are included in the tables as an initial proposal for measuring the critical material impacts of disasters from the disaster risk reduction perspective.

E Summary tables of direct material impacts in monetary terms

E1a Summary table of direct material impacts by hazards types
E1b Summary table of direct material impacts by hazards types and geographic regions
E tables mostly replicate the D_MAT tables and are for recording the impacts in monetary values, when it is relevant and possible, to calculate the direct economic losses, aligned with the Sendai Framework definition

F Agriculture

F1 Summary of material impacts to Agriculture by hazards types

F1 was developed by FAO in alignment with requirements for Sendai Framework monitoring and for presentation in DRSF.

G Summary tables of direct environmental impacts

G1 Summary table of direct environmental impacts by hazards types
G2 Summary table of direct environmental impacts by hazards types and geographic regions

G tables extend the compilations on direct material impacts to include impacts to the environment.

DRRE Disaster risk reduction expenditure account

DRRE_Activ. Production expenditure account (current plus investment) by characteristic activities
DRRE_Trans. Transfers expenditure account and DRR National Expenditure

DRRE are satellite accounting tables developed to assess the feasibility for compiling DRR expenditure accounts based on existing data sources used in the national accounts or based on reporting from NDMA and other partner agencies.

A Summary of disaster occurrences

A1 Summary table of disaster occurrences, by hazards types, scale, and geographic region

Measurement units: counts of occurrences

	Geo Region 1			Geo Region 2			Geo Region 3			...			Adjustment for multiple counting of events by regions/states (-)			Adj. National total		
	Very large events	National scale medium to large events	Local scale events	Very large events	National scale medium to large events	Local scale events	Very large events	National scale medium to large events	Local scale events	Very large events	National scale medium to large events	Local scale events	Very large events	National scale medium to large events	Local scale events	Very large events	National scale medium to large events	Local scale events
Geo-physical																		
Hydrological																		
Meteorological & Climatological																		
Biological																		
Other																		
Total																		

Data source: *NDMA, national register of disaster occurrences, according to official national designation*

International definition for a 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." (UNGA, 2015)*

Suggested variable for classifying scale of disasters: *geographic scope of emergency (e.g. local scale, province-level, or national emergency). Generally, Large disasters are prone to extensive individual reporting while other events are reported on a statistical basis. The difference between calls for emergency at national and other scales will depend on the national context.*

Adjusted National Total columns *refers to the national total for number of disaster events, by scale and hazard type, adjusting for multiple counts across geographic regions.*

B Selected Background Statistics and Exposure to hazards

B1a Population Background Statistics and Hazard Exposure by geographic regions

Measurement units: see column at right

		REGION					Measurement Unit
		Geo. Region 1	Geo. Region 2	Geo. Region 3	Geo Region ...	NATIONAL TOTAL	
1	Population	SDG 1.5.1, Sendai A1,B1	SDG 1.5.1, Sendai A1,B1	SDG 1.5.1, Sendai A1,B1	SDG 1.5.1, Sendai A1,B1	SDG 1.5.1, Sendai A1,B1	No. of people
1.1	*Children under 5 years*						No. of people
1.2	*Persons over 60 years*						No. of people
1.3	*Persons with disabilities*						No. of people
2	Households						No. of households
3	Median Households disposable income						currency
3.1	*Local currency (NAME...)*						currency
3.2	*US$ PPP*						US$ PPP
4	GDP	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	currency
4.1	*Local currency (NAME...)*						currency
4.2	*US$ PPP*						US$ PPP
5	Population in Hazard Area						No. of people
5.1	Geophysical						
5.1.1	*High exposure*						No. of people
5.1.2	*Moderate exposure*						No. of people
5.1.3	*Low exposure*						No. of people
5.2	Hydrological						
5.2.1	*High exposure*						No. of people
5.2.2	*Moderate exposure*						No. of people
5.2.3	*Low exposure*						No. of people
5.3	Meteorological & Climatological						
5.3.1	*High exposure*						No. of people
5.3.2	*Moderate exposure*						No. of people
5.3.3	*Low exposure*						No. of people
5.4	Biological						
5.4.1	*High exposure*						No. of people
5.4.2	*Moderate exposure*						No. of people
5.4.3	*Low exposure*						No. of people
5.5	Other [specify]						
5.5.1	*High exposure*						No. of people
5.5.2	*Moderate exposure*						No. of people
5.5.3	*Low exposure*						No. of people

Data sources: *Joint work of NSO and NDMA, background statsitics derived from NSO and from national acccounts; exposure to hazards calculated by NDMA*

Links to global indicators: *Number of deaths attributed to disasters, per 100,000 population*

Exposure *is measured according to hazard area maps, produced using a variety of physical data inputs (see Chapter 2). Hazard maps are overlayed with social and economic statistics to estimate exposure. The ranking (high, moderate, low) refer to hazard probabilities - for example flood hazards are usually higher closer to the sources and depending on the slope and features of the terrain. The hazard may exist at lower probabilities, farther away.*

B1b Population Exposure by social groups

Measurement units: Number of people

		C3a1 - Age groups				TOTAL	C2a2 - Sex		TOTAL	C2a3 - Urban/Rural population		TOTAL	C2a4 - Specific vulnerability groups		NO TOTAL
		0-5	0-15	16-64	65+		Male	Female		Urban	Rural		Disabled	Poor	
1	Population		**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	**SDG 1.5.1, Sendai A1,B1**	
2	Population in Hazard Areas														
2.1	Geophysical														
2.1.1	*High exposure*														
2.1.2	*Moderate exposure*														
2.1.3	*Low exposure*														
2.2	Hydrological														
2.2.1	*High exposure*														
2.2.2	*Moderate exposure*														
2.2.3	*Low exposure*														
2.3	Biological														
2.3.1	*High exposure*														
2.3.2	*Moderate exposure*														
2.3.3	*Low exposure*														
2.4	Meteorological & Climatological														
2.4.1	*High exposure*														
2.4.2	*Moderate exposure*														
2.4.3	*Low exposure*														
2.5	Other [specify]														
2.5.1	*High exposure*														
2.5.2	*Moderate exposure*														
2.5.3	*Low exposure*														

Data sources: *joint work of NSO and NDMA, background statistics derived from population and housing census; maps of hazards calculated by NDMA*
Links to global indicators: *Number of deaths attributed to disasters, per 100,000 population*
Exposure *is measured according to hazard area maps, produced using a variety of physical data inputs (see Chapter 2). Hazard maps are overlayed with social and economic statistics to estimate exposure.*

B2a Exposure of Land and Infrastructure by Hazard Type

Measurement units: see below table

		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	NATIONAL TOTAL		Measurement Units
1	**Critical infrastructures in Hazard Area**								
1.1	Hospitals, health facilities								buildings, by type
1.2	Education facilities								buildings, by type
1.3	Other critical public administration buildings								sq m.
1.4	Public Monuments								sq m.
1.4.1	*Religious buildings*								
1.5	Roads								km
1.6	Bridges								m
1.7	Airports								buildings, by type
1.8	Piers								facilities, by type
1.9	Railways								km
1.10	Transport equipments								facilities, by type
1.11	Electricity generation facilities								facilities, by type
1.12	Electricity grids								facilities, by type
1.13	ICT Equipments								facilities, by type
1.14	Dams								facilities, by type
1.15	Water supply infrastructure								facilities, by type
1.16	Water sewage & treatment systems								facilities, by type
1.17	Other critical infrastructures								facilities, by type
2	**Land**								
2.1	Land								sq km
2.2	Agricultural land								sq km
2.3	Forest Areas								sq km
2.4	Built-up areas								sq km

Data source: *Joint work of NDMA and official data source of land cover, land use, and infrastructure maps*
Definitions for Critical Infrastructure: *See DRSF Classification of Material Impacts (Chapter 8)*
Land defined according to definition in SEEA Central Framework: *"the space in which economic activities and environmental processes take place and within which environmental assets and economic assets are located." Definitions for Agricultural land, forest areas, and built-up areas, see: DRSF Chapter 8.*
Measurement units: *Chapter 5*

B Disaster Risk Reduction Expenditure Account

B3 Coping Capacity Background Statistics

		Geo Region 1	Geo Region 2	Geo Region 3	...	National	Measurement Units
1	GDP	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	SDG 1.5.2	Currency
2	GDP per capita						Currency
3	Median Households disposable income						Currency
3.1	Local currency (NAME...)						Currency
3.2	US$ PPP						US$ PPP
4	Number of dwellings with slum designation						no. of units
5	Population living in areas with slum designation						no. of people
6 Early Warning Systems							No. of systems
6.1	Population covered	Sendai G-3	Sendai G-3	Sendai G-3	Sendai G-3	Sendai G-3	%
6.2	Share of population in exposure areas covered						%
6.3	Investment Expenditure (also DRRE_A, 3.2)						Currency
7 Household Preparedness							
7.1	Share of households with emergency plan						%
7.2	Share of households with backup storage of food and water						%
7.3	Share of households with improved access to water and sanitation						%
7.4	Other Preparedness (houehold level)						%
8 Environmental Resilience							
8.1	Forest area						sq km
8.2	Share of water bodies in good condition						%
8.3	Other ecosystem condition measures						
9 Risk Reduction Activity							Currency
9.1	Disaster risk reduction characteristic transfers received						Currency
9.2	Disaster Risk Prevention						Currency
9.3	Disaster Risk Mitigation						Currency
9.4	Disaster Management						Currency
9.5	Disaster Recovery						Currency
9.6	General Government, Research & Development, Education Expenditure						Currency
10 DRRCA Transfers from Central to local government							Currency

***Data Sources** : Household Preparedness from Population and Housing Census and/or household surveys*
Forest Area: national land cover statistics
Water and ecosystem assetments from national water enviroment protection authorities
Risk Reduction Activity: Finance Ministry and National Accounts

***Definition of Slums:** UN-HABITAT (2016)*

C Summary of Human Impacts

C1 Summary table of human impacts by hazards types

Measurement units: Number of people, except 1.5.3, which is number of days

		HAZARDS					
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	NATIONAL TOTAL
1 - Summary of Human Impacts							
	Human, affected population						
1.1	**Deaths or missing**	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1
1.1.1	*Deaths*	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2
1.1.2	*Missing*	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3
1.2	**Injured or ill**	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2
1.2.1	*Major injuries*						
1.2.2	*Minor injuries*						
1.2.3	*Illnesses*						
1.3	**Displaced**						
1.3.1	*Permanent relocations due to destroyed dwelling*	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4
1.3.2	*Other Displaced*						
1.4	**Dwellings Damaged**						
1.4.1	*Number of people whose houses were damaged due to hazardous events*	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3
1.5	**Loss of Jobs/occupations**						
1.5.1	Direct losses of jobs/occupations in industry and services	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5
1.5.2	Direct losses of jobs/occupations in agriculture						
1.5.3	Losses of days of activity						
1.5.3.1	*Direct losses of days of activity in agriculture*						
1.5.3.2	*Direct losses of days of activity in industry and services*						
1.6	**Number of people evacuated or receiving aid**						
1.6.1	*Number of people who received aid. Including food and non-food aid during a disaster*						
1.6.2	*Supported with evacuation*						
1.6.3	*Non-supported evacuations*						
1.6.4	*Number of people who received aid after a disaster*						
1.7	**Otherwise affected**						
1.8	**Total Human Impacts (no of impacts)**	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1
1.9	**Multiple counts, individuals (minus)**						
1.10	**Total Human Impacts (no of people)**						

Variables 1.4 an 1.3.3 based on measurement of damage and destruction to dwellings (material impacts tables)
Multiple counts is an adjustment for aggregation in terms of number of people (instead of number of impacts), see Chapter 6 for further explanation.

C2 Summary of human impacts by hazard type and geographic regions

Measurement units: Number of people, except 1.5.3, which is number of days

		Geo Region 1							Geo Region ...							Hazard types/ National Total							
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*Adjustment for multiple counting of occurrences by types*	TOTAL Region 1	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*Adjustment for multiple counting of events by types*	TOTAL Region ...	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*Adjustment for multiple counting of events by types*	*TOTAL adjustment for multiple counting of events by Regions/States (-)*	NATIONAL TOTAL
1 - Summary of Human Impacts																							
1.1	**Deaths or missing**	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1		SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1		SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1			SDG 1.5.1/ Sendai A-1
1.1.1	*Deaths*	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2		Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2		Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2			Sendai A-2
1.1.2	*Missing*	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3		Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3		Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3			Sendai A-3
1.2	**Injured or ill**	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2		Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2		Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2			Sendai B-2
1.2.1	*Major injuries*																						
1.2.2	*Minor injuries*																						
1.2.3	*Illnesses*																						
1.3	**Displaced**																						
1.3.1	*Permanent relocations due to destroyed dwelling*	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4		Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4		Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4			Sendai B-4
1.3.2	*Other Displaced*																						
1.4	**Dwellings Damaged**																						
1.4.1	*Number of people whose houses were damaged due to hazardous events*	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3		Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3		Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3			Sendai B-3
1.5	**Loss of Jobs/occupations**																						
1.5.1	Direct losses of jobs/occupations in industry and services	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5			Sendai B-5
1.5.2	Direct losses of jobs/occupations in agriculture																						
1.5.3	Losses of days of activity																						
1.5.3.1	*Direct losses of days of activity in agriculture*																						
1.5.3.2	*Direct losses of days of activity in industry and services*																						
1.6	**Number of people evacuated or receiving aid**																						
1.6.1	*Number of people who received aid. Including food and non-food aid during a disaster*																						
1.6.2	*Supported with evacuation*																						
1.6.3	*Non-supported evacuations*																						
1.6.4	*Number of people who received aid after a disaster*																						
1.7	**Otherwise affected**																						
1.8	**Affected Population (no of impacts)**	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1		SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1		SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1			SDG 1.5.1/ Sendai B-1
1.9	**Multiple counts, individuals (minus)**																						
1.10	**Total Human Impacts (no of people)**																						

***Variables 1.4 an 1.3.3** based on measurement of damage and destruction to dwellings (material impacts tables)*
Multiple counts is an adjustment for aggregation in terms of number of people (instead of number of impacts), see Chapter 6 for further explanation.

C3 Summary table of affected population by demographic and social categories

Measurement units: Number of people, except 1.5.3, which is number of days

		C3a1 - Age groups				TOTAL	C3a2 - Sex		TOTAL	C3a3 - Urban/Rural population		TOTAL	C3a4 - Specific vulnerability groups		NO TOTAL
		0-5	0-15	15-64	65+		Male	Female		Urban	Rural		Disabled	Poor	
1 -Summary of Human Impacts															
	Human, affected population														
1.1	Deaths or missing		SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	SDG 1.5.1/ Sendai A-1	
1.1.1	*Deaths*		Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	Sendai A-2	
1.1.2	*Missing*		Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	Sendai A-3	
1.2	Injured or ill		Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	Sendai B-2	
1.2.1	*Major injuries*														
1.2.2	*Minor injuries*														
1.2.3	*Illnesses*														
1.3	Displaced														
1.3.1	*Permanent relocations due to destroyed dwelling*	Sendai B-4			Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	
1.3.2	*Other Displaced*														
1.4	Dwellings Damaged														
1.4.1	*Number of people whose houses were damaged due to hazardous events*	Sendai B-3			Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	Sendai B-3	
1.5	Loss of Jobs/occupations														
1.5.1	Direct losses of jobs/occupations in industry and services	Sendai B-5			Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	
1.5.2	Direct losses of jobs/occupations in agriculture														
1.5.3	Losses of days of activity														
1.5.3.1	*Direct losses of days of activity in agriculture*														
1.5.3.2	*Direct losses of days of activity in industry and services*														
1.6	Number of people evacuated or receiving aid														
1.6.1	*Number of people who received aid. Including food and non-food aid during a disaster*														
1.6.2	*Supported with evacuation*														
1.6.3	*Non-supported evacuations*														
1.6.4	*Number of people who received aid after a disaster*														
1.7	Otherwise affected														
1.8	**Affected Population (no of impacts)**	SDG 1.5.1/ Sendai B-1			SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	SDG 1.5.1/ Sendai B-1	
1.9	Multiple counts, individuals (minus)														
1.10	Total Human Impacts (no of people)														

Urban and rural designations according to national definitions
Designation for 'poor' according to national poverty line (or, if unavailable, World Bank global absolute poverty line)
Multiple counts is an adjustment for aggregation in terms of number of people (instead of number of impacts), see Chapter 6 for further explanation.

D Summary tables of direct material impacts

D1a Summary table of direct material impacts by hazards types

Measurement unit: see column at right

		Hazard types						Measurement unit
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL	
Direct economic material impacts								
1-Direct impacts on fixed assets or consumer durables								
1.1	Dwellings (number)							no. of units
1.1.1	*Dwellings destroyed (number)*							no. of units
1.1.2	*Dwellings damaged (number)*							no. of units
1.2	Buildings and structures							sq. km
1.2.1	*Critical buildings & structures*	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	sq. m
1.2.2	*Other buildings and structures*							sq. m
1.3	Machinery and equipment							
1.3.1	*Critical machinery and equipment*	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	no. of units
1.3.2	*Other machinery and equipment*							no. of units
1.4	Consumer Durables							no. of units
2-Direct impacts on valuables (SNA asset definition)								
2.1	Art objects, music instruments							no. of units
2.2	Other valuables							no. of units
3-Natural resources								
3.1	Land, incl. soil							sq. km
3.2	Agriculture land							sq. km
3.3	Primary forests							sq. km
3.4	Livestock							no. of units
3.5	Fish stocks							tonnes
3.6	Freshwater							sq. km
3.7	Other natural resources							sq. km
4-Critical goods & services								
4.1	Inventories (SNA asset definition)							
4.1.1	*Agriculture (incl. immature crops)*							tonnes
4.1.2	*Inventories/ other products*							tonnes
5-Critical infrastructures [1.2.1]								
5.1	Hospitals, health facilities	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	no. of units
5.2	Education facilities	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	no. of units
5.3	Other critical public administration buildings	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	no. of units
5.4	Public monuments							no. of units
5.4.1	*Religious buildings*							no. of buildings
5.5	Roads							km
5.6	Bridges							no. of units
5.7	Railways							km
5.8	Airports							no. of units
5.9	Piers							no. of units
5.10	Transport equipments							no. of units
5.11	Electricity generation facilities							no. of units
5.12	Electricity grids							no. of units
5.13	ICT Equipments							no. of units
5.14	Dams							no. of units
5.15	Water supply infrastructure							no. of units
5.16	Water sewage & treatment systems							no. of units
5.17	Other critical infrastructures (specify)							no. of units
6-Direct impact on cultural heritage								
6.1	**Direct impact on cultural heritage zones**							sq. km
6.1.1	UNESCO cultural heritage sites							sq. km
6.1.2	National cultural heritage designations							sq. km
6.1.3	Urban heritage							sq. km
6.1.4	Other heritage designations							sq. km
6.2	**Direct impact on cultural heritage objects**							
6.2.1	Buildings and monuments							no. of units
6.2.2	Cultural heritage valuables [2]							no. of units
6.2.3	Other cultural heritage (please specify)							no. of units

For definitions see Material Impacts Classification in Chapter 8

Distinguishing between damaged or destroyed is feasible for all variables and may be reported depending on demand. For the case of dwellings, destroyed dwellings results in displacement whereas a damaged dwelling might be repaired without displacement.

D1b Summary table of direct material impacts by hazards types and geographic regions

Measurement unit: see column at right

		Geo Region 1						Geo Region ...						National Total								
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL Geo Region 1	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	...	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*TOTAL adjustment for multiple counting of events by*	NATIONAL TOTAL		Measurement unit
	Direct economic material impacts																					
	1-Direct impacts on fixed assets or consumer durables																					
1.1	Dwellings (number)																					no. of units
1.1.1	*Dwellings destroyed (number)*																					no. of units
1.1.2	*Dwellings damaged (number)*																					no. of units
1.2	Buildings and structures																					sq. km
1.2.1	*Critical buildings & structures*	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4		Sendai D-4		sq. m
1.2.2	*Other buildings and structures*																					sq. m
1.3	Machinery and equipment																					
1.3.1	*Critical machinery and equipment*	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4		Sendai D-4		no. of units
1.3.2	*Other machinery and equipment*																					no. of units
1.4	Consumer Durables																					no. of units
	2-Direct impacts on valuables (SNA asset definition)																					
2.1	Art objects, music instruments																					no. of units
2.2	Other valuables																					no. of units
	3-Natural resources																					
3.1	Land, incl. soil																					sq. km
3.2	Agriculture land																					sq. km
3.3	Primary forests																					sq. km
3.4	Livestock																					no. of units
3.5	Fish stocks																					tonnes
3.6	Freshwater																					sq. km
3.7	Other natural resources																					sq. km
	4-Critical goods & services																					
4.1	Inventories (SNA asset definition)																					
4.1.1	*Agriculture (incl. immature crops)*																					tonnes
4.1.2	*Inventories/ other products*																					tonnes
	5 Critical infrastructures [1.2], [1.3]																					
5.1	Hospitals, health facilities	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2	Sendai D-2		Sendai D-2		no. of units
5.2	Education facilities	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3	Sendai D-3		Sendai D-3		no. of units
5.3	Other critical public administration buildings	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4	Sendai D-4		Sendai D-4		no. of units
5.4	Public monuments																					no. of units
5.4.1	*Religious buildings*																					no. of buildings
5.5	Roads																					km
5.6	Bridges																					no. of units
5.7	Railways																					km
5.8	Airports																					no. of units
5.9	Piers																					no. of units
5.10	Transport equipments																					no. of units
5.11	Electricity generation facilities																					no. of units
5.12	Electricity grids																					no. of units
5.13	ICT Equipments																					no. of units
5.14	Dams																					no. of units
5.15	Water supply infrastructure																					no. of units
5.16	Water sewage & treatment systems																					no. of units
5.17	Other critical infrastructures																					no. of units
	6 Direct impact on cultural heritage																					
6.1	**Direct impact on cultural heritage zones**																					sq. km
6.1.1	UNESCO cultural heritage sites																					sq. km
6.1.2	National cultural heritage designations																					sq. km
6.1.3	Urban heritage																					sq. km
6.1.4	Other heritage designations																					sq. km
6.2	**Direct impact on cultural heritage objects**																					
6.2.1	Buildings and monuments																					no. of units
6.2.2	Cultural heritage valuables [2]																					no. of units
6.2.3	Other components																					no. of units

For definitions see Material Impacts Classification in Chapter 8

Distinguishing between damaged or destroyed is feasible for all variables and may be reported depending on demand. For the case of dwellings, destroyed dwellings results in displacement whereas a damaged dwelling might be repaired without displacement.

D2a Disruption of basic services from a Disaster by hazard type

Measurement unit: number of people and period of time

		Hazard types					
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL
Disruptions to Basic services from a Disaster							
1	**Health services**	Sendai D-7	Sendai D-7	Sendai D-7	Sendai D-7	Sendai D-7	Sendai D-7
1.1	No. of people						
1.2	Length of time						
2	**Educational services**	Sendai D-6	Sendai D-6	Sendai D-6	Sendai D-6	Sendai D-6	Sendai D-6
2.1	No. of people						
2.2	Length of time						
3	**Public administration services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
3.1	No. of people						
3.2	Length of time						
4	**Transport services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
4.1	No. of people						
4.2	Length of time						
5	**Electricity and energy services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
5.1	No. of people						
5.2	Length of time						
6	**Water services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
6.1	No. of people						
6.2	Length of time						
7	**ICT services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
7.1	No. of people						
7.2	Length of time						
8	**Other basic services**	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8	Sendai D-8
8.1	No. of people						
8.2	Length of time						
9	**Total disruptions**	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5

Definitions of Services: see UNISDR Technical Guidelines for Sendai Framework Indicators or DRSF Chapter 4

D2b Disruption of basic services from a Disaster, by geographic region

Measurement units: number of people and period of time

		Region					
		Geo. Region 1	Geo. Region 2	Geo. Region 3	Geo. Region …	Adjustment for multiple counting of events by regions	ADJ NATIONAL TOTAL
Disruptions to Basic services from a Disaster (Sendai D-5)							
1	**Health services**	**Sendai D-7**	**Sendai D-7**	**Sendai D-7**	**Sendai D-7**		**Sendai D-7**
1.1	No. of people						
1.2	Length of time						
2	**Educational services**	**Sendai D-6**	**Sendai D-6**	**Sendai D-6**	**Sendai D-6**		**Sendai D-6**
2.1	No. of people						
2.2	Length of time						
3	**Public administration services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
3.1	No. of people						
3.2	Length of time						
4	**Transport services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
4.1	No. of people						
4.2	Length of time						
5	**Electricity and energy services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
5.1	No. of people						
5.2	Length of time						
6	**Water services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
6.1	No. of people						
6.2	Length of time						
7	**ICT services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
7.1	No. of people						
7.2	Length of time						
8	**Other basic services**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**	**Sendai D-8**		**Sendai D-8**
8.1	No. of people						
8.2	Length of time						
9	**Total disruptions**	**Sendai D-5**	**Sendai D-5**	**Sendai D-5**	**Sendai D-5**		**Sendai D-5**

Definitions of Services: see UNISDR Technical Guidelines for Sendai Framework Indicators or DRSF Chapter 4

E Summary tables of direct material impacts in monetary terms

E1a Direct material impacts by hazards types

Measurement units: national currency (estimated costs for recovery of damages)

		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL
1-Direct impacts on fixed assets or consumer durables							
1.1	Dwellings (number)	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4
1.1.1	*Dwellings destroyed (number)*						
1.1.2	*Dwellings damaged (number)*						
1.2	Buildings and structures						
1.2.1	Critical buildings & structures	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5
1.2.2	Other buildings and structures	Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3
1.3	Machinery and equipment						
1.3.1	Critical machinery and equipment	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5
1.3.2	Other machinery and equipment						
1.4	Consumer Durables						
2-Direct impacts on valuables (SNA asset definition)							
2.1	Art objects, music instruments						
2.2	Other valuables						
3-Natural resources							
3.1	Land, incl. soil						
3.2	Agriculture land (ref F1)	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2
3.3	Restoration Costs for Primary forests						
3.4	Livestock (ref. F1)						
3.5	Fish stocks (ref F1)						
3.6	Restoration Costs for Freshwater						
3.7	Other natural resources						
4 Critical infrastructures [1.2], [1.3]							
4.1	Hospitals, health facilities	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5
4.1.1	*Medical services during the emergency for people injured or ill*						
4.2	Education facilities						
4.3	Other critical public administration buildings						
4.4	Public monuments						
4.4.1	*Religious buildings*						
4.5	Roads						
4.6	Bridges						
4.7	Railways						
4.8	Airports						
4.9	Ports						
4.10	Transport equipments						
4.11	Electricity generation facilities						
4.12	Electricity grids						
4.13	ICT Equipments						
4.14	Dams						
4.15	Water supply infrastructure						
4.16	Water sewage & treatment systems						
4.17	Other critical infrastructures						
5 Restoration costs for Direct impact on cultural heritage		Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6
6 Other direct costs associated with disaster recovery (e.g. emergency medical services)							
7 Total Direct Economic Loss [1.1-1.3 + 2 + 3 + 4]		SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1

Monetary valuation for costs of material impacts normally requires a combination of data sources, particularly: assessments for cost of reconstruction, insurance claims assessments or the recorded values of assets prior to a disaster (where available), records of actual transactions for recovery of damages, i.e. expenditure on post-disaster reconstruction.

For definitions, refer to DRSF, Chapter 8 and current international standards, such as the System of National Accounts (SNA, 2008)

E1b Summary table of direct material impacts by hazards types and geographic regions

Measurement units: national currency (estimated cost of damages)

		Geo Region 1						Geo Region …						Hazard types/ National Total						
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	*Adjustment for multiple counting of events by types*	TOTAL Region/State 1	Geo-physical	Hydrological	Meteorological & Climatological	Biological	*Adjustment for multiple counting of events by types*	TOTAL Region/State …	Geo-physical	Hydrological	Meteorological & Climatological	Biological	*Adjustment for multiple counting of events by types*	*TOTAL adjustment for multiple counting of events by Regions/States (-)*	NATIONAL TOTAL
1-Direct impacts on fixed assets or consumer durables																				
1.1	Dwellings (number)	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4		Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4		Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4	Sendai C-4			Sendai C-4
1.1.1	*Dwellings destroyed (number)*																			
1.1.2	*Dwellings damaged (number)*																			
1.2	Buildings and structures																			
1.2.1	*Critical buildings & structures*	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5			Sendai C-5
1.2.2	*Other buildings and structures*	Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3			Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3		Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3	Sendai C-3			Sendai C-3
1.3	Machinery and equipment																			
1.3.1	*Critical machinery and equipment*	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5			Sendai C-5
1.3.2	*Other machinery and equipment*																			
1.4	Consumer Durables																			
2-Direct impacts on valuables (SNA asset definition)																				
2.1	Art objects, music instruments																			
2.2	Other valuables																			
3-Natural resources																				
3.1	Land, incl. soil																			
3.2	Agriculture land	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2		Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2		Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2			Sendai C-2
3.3	Primary forests																			
3.4	Livestock																			
3.5	Fish stocks																			
3.6	Freshwater																			
3.7	Other natural resources																			
4-Critical infrastructures [1.2] & [1.3]																				
4.1	Hospitals, health facilities	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5			Sendai C-5
4.1.1	*Medical services during the emergency for people injured or ill*																			
4.2	Education facilities																			
4.3	Other critical public administration buildings																			
4.4	Public monuments																			
4.4.1	*Religious buildings*																			
4.5	Roads																			
4.6	Bridges																			
4.7	Railways																			
4.8	Airports																			
4.9	Ports																			
4.10	Transport equipments																			
4.11	Electricity generation facilities																			
4.12	Electricity grids																			
4.13	ICT Equipments																			
4.14	Dams																			
4.15	Water supply infrastructure																			
4.16	Water sewage & treatment systems																			
4.17	Other critical infrastructures	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5		Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5	Sendai C-5			Sendai C-5
5 Restoration costs for Direct impact on cultural heritage		Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6		Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6		Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6	Sendai C-6			Sendai C-6
6 Other direct costs associated with disaster recovery (e.g. emergency medical services)																				
7 Total Direct Economic Loss [1.1-1.3 + 2 + 3 + 4]		SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1		SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1		SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1	SDG 1.5.2, Sendai C-1			SDG 1.5.2, Sendai C-1

***Measurement units** : national currency (estimated cost of damages)*

Monetary valuation for costs of material impacts normally requires a combination of data sources, particularly: insurance claims assessments or assessments for cost of reconstruction, the recorded values of assets prior to a disaster (where available), records of actual transactions for recovery of damages, i.e. expenditure on post-disaster reconstruction, and average costs of crops or other exposed assets for estimating costs of damages based on average per unit values.

F Material impacts to Agriculture

F1 Summary of material impacts to Agriculture by hazards types

		Hazard types						Measurement units
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL	
1-Crops								
1.1	Area affected by crop type	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	sq. km
1.2	Stored produce destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
1.3	Stored inputs destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
1.4	Equipment/machinery destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	units
1.5	Discounted yield value of perennial trees until replanting							currency
1.6	Post-disaster short-run maintenance costs							currency
2-Livestock		SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	
2.1	Number of animals killed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	animals
2.2	Stored products, feed and fodder destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
2.3	Equipment/machinery destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	units
2.4	Discounted value of livestock products from dead animals until full recovery							currency
2.5	Post-disaster short-run maintenance costs							currency
3-Forestry		SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	
3.1	Area damaged or destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	sq. km
3.2	Stored wood volume destroyed	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
4-Aquaculture		SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	
4.1	Production from land-based ponds	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
4.2	Production from water based cages and pends	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
4.3	Stored production lost	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
4.4	Facilities destroyed							units
4.5	Post-disaster short-run maintenance costs	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	currency
5 - Fisheries		SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	SDG 1.5.2, Sendai C-2	currency
5.1	Small scale production loss	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
5.2	Coastal production loss	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
5.3	Industrial (large-scale) production lost	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	tonnes
5.4	Facilities destroyed (fishing gear, engines, vessels, storage, etc.)	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	Sendai C-2	units

This table was prepared for use in DRSF by FAO Statistics Directorate, for more information or technical guidance, please contact FAO Statistics, Rome
Definitions according to national practices for agriculture statistics, and current international standards, such as the System of National Accounts (SNA, 2008) and current standards from FAO:
http://www.fao.org/statistics/standards/en/

G Summary tables of direct environmental impacts

G1 Summary table of direct environmental impacts by hazards types at country level

Measurement units: see column at right

		Hazard types							Measurement unit
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*Adjustment for multiple counting of events by types*	TOTAL	
Direct environmental impact									
1	**Direct impacts on ecosystems by land cover types**								
1.1	01 Urban and associated developed areas								sq. km
1.2	02 Homogeneous herbaceous cropland								sq. km
1.3	03 Agriculture plantations, permanent crops								sq. km
1.4	04 Agriculture associations and mosaics								sq. km
1.5	05 Pastures and natural grassland								sq. km
1.6	06 Forest tree cover								sq. km
1.7	07 Shrubland, bushland, heathland								sq. km
1.8	08 Sparsely vegetated areas								sq. km
1.9	09 Natural vegetation associations and mosaics								sq. km
1.10	10 Barren land								sq. km
1.11	11 Permanent snow and glaciers								sq. km
1.12	12 Open wetlands								sq. km
1.13	13 Inland water bodies								sq. km
1.14	14 Coastal water bodies and inter-tidal areas								sq. km
2	**Loss of critical ecosystems**								
2.1	Man And Biosphere and other biological reserves (UNESCO, UNEP)								sq. km
2.2	Other designated ecosystems/habitats								sq. km
2.3	Ecosystems hosting threatened species (IUCN Red List)								sq. km
2.4	Other critical ecosystems								sq. km
3	**Losses of natural water resource (quantitative/qualitative)**								
3.1	Losses due to pollution of natural surface water								no. of water bodies
3.2	Losses due to pollution of groundwater								no. of water bodies
3.3	Losses due to destruction of natural surface water reserves								no. of water bodies
3.4	Losses due to destruction of groundwater reserves								no. of water bodies
4	**Direct impacts to the atmosphere or climate change**								
4.1	Emissions of GHGs								tonnes
4.2	Loss of carbon sequestration capacity								tonnes
4.3	Other direct impact on global warming								
4.4	Emissions of SO2								tonnes
4.5	Emission of other (non-GHG) air pollutants (specify)								tonnes

Data sources *: Collaboration between national monitoring authorities for land cover, water resources, and atmospheric conditions with initial impacts assessments of NDMAs after a disaster*

G2 Summary table of direct environmental impacts by hazards types and geographic regions

Measurement units: see column at right

		Geo Region 1						Geo Region …						National Total								
		Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL Geo Region 1	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	TOTAL Geo Region…	Geo-physical	Hydrological	Meteorological & Climatological	Biological	Other	*TOTAL adjustment for multiple counting of events by Regions/States (-)*	ADJ NATIONAL TOTAL		Measurement units
Direct environmental impact																						
1	Direct impacts on ecosystems by land cover types																					
1.1	Urban and associated developed areas																					sq. km
1.2	Homogeneous herbaceous cropland																					sq. km
1.3	Agriculture plantations, permanent crops																					sq. km
1.4	Agriculture associations and mosaics																					sq. km
1.5	Pastures and natural grassland																					sq. km
1.6	Forest tree cover																					sq. km
1.7	Shrubland, bushland, heathland																					sq. km
1.8	Sparsely vegetated areas																					sq. km
1.9	Natural vegetation associations and mosaics																					sq. km
1.10	Barren land																					sq. km
1.11	Permanent snow and glaciers																					sq. km
1.12	Open wetlands																					sq. km
1.13	Inland water bodies																					sq. km
1.14	Coastal water bodies and inter-tidal areas																					sq. km
2	Loss of critical ecosystems																					
2.1	Man And Biosphere and other biological reserves (UNESCO, UNEP)																					sq. km
2.2	Other designated ecosystems/habitats																					sq. km
2.3	Ecosystems hosting threatened species (IUCN Red List)																					sq. km
2.4	Other critical ecosystems																					sq. km
3	Losses of natural water resource (quantitative/qualitative)																					
3.1	Losses due to pollution of natural surface water																					no. of water bodies
3.2	Losses due to pollution of groundwater																					no. of water bodies
3.3	Losses due to destruction of natural surface water reserves																					no. of water bodies
3.4	Losses due to destruction of groundwater reserves																					no. of water bodies
4	Direct impacts to the atmosphere or climate change																					
4.1	Emissions of GHGs																					tonnes
4.2	Loss of carbon sequestration capacity																					tonnes
4.3	Other direct impact on global warming																					
4.4	Emissions of SO2																					tonnes
4.5	Emission of other (non-GHG) air pollutants (specify)																					tonnes

***Data sources** : Collaboration between national monitoring authorities for land cover, water resources, and atmospheric conditions with initial impacts assessments of NDMAs after a disaster*

DRRE Disaster Risk Reduction Expenditure Account

DRRE_A Production expenditure account (current plus investment) by characteristic activities

Measurement units: Local currency *(US$ PPP)*

		Providers of disaster risk reduction services (SNA institutional sectors)											Rest of the World (RoW)
				General government (incl. non-profit institutions controlled by governments and social security)				Households					
		Non-financial corporations	Financial corporations	Central government	State government	Local government	**Subtotal General government**	Households owners of unincorporated enterprises	Employees and recipients of property and transfer incomes	**Subtotal Households**	Non-profit institutions serving households (NPISHs)	**TOTAL Resident sectors (units with at least 1 year of activity)**	
Activity expenditure account (current plus investment)													
1	**Disaster Risk Prevention**												
1.1	Risk prevention in advance of hazardous event												
1.2	Risk prevention in or after hazardous event												
2	**Disaster Risk Mitigation**												
2.1	Structural measures												SDG 11.c.1
2.2	Non-structural measures												
2.3	Land-use planning												
2.4	Early warning systems management												
3	**Disaster Management**												
3.1	Preparedness												
3.2	Emergency management												
3.3	Other disaster responses												
3.4	Emergency supply of commodities												
4	**Disaster Recovery**												
4.1	Relocation												
4.2	Rehabilitation												
4.3	Reconstruction												
5	**General Government, Research & Development, Education Expenditure**												
5.1	General government expenditure for Disaster Risk Reduction												
5.2	Research & Development, risk assessment, and information												
5.3	Education to Disaster Risk Reduction												
A	**Subtotal current production expenditure (SUM 1 to 5)**												
1	**Disaster Risk Prevention**												
1.1	Risk prevention in advance of hazardous event												
1.2	Risk prevention in or after hazardous event												
2	**Disaster Risk Mitigation**												
2.1	Structural measures												
2.2	Non-structural measures												
2.3	Land-use planning												
2.4	Early warning systems management												
3	**Disaster Management**												
3.1	Preparedness												
3.2	Emergency management												
3.3	Other disaster responses												
3.4	Emergency supply of commodities												
4	**Disaster Recovery**												
4.1	Relocation												
4.2	Rehabilitation												
4.3	Reconstruction												
5	**General Government, Research & Development, Education Expenditure**												
5.1	General government expenditure for Disaster Risk Reduction												
5.2	Research & Development, risk assessment, and information												
5.3	Education to Disaster Risk Reduction												
B	**Subtotal Gross formation of fixed capital (SUM 1 to 5)**												
6	**Acquisition less disposals of land and other non produced non-financial assets**												
6.1	Acquisition less disposals of land												
6.2	Acquisition less disposals of non produced non-financial assets												
C	**Investment production expenditure**												
Total DRR Production Expenditure (current plus investment)													

DRRE_B Transfers expenditure account & DRR National Expenditure

Measurement units: Local currency *(US$ PPP)*

	Institutional sectors											
			General government (incl. non-profit institutions controlled by governments and social security)				Households					
	Non-financial corporations	Financial corporations	Central government	State government	Local government	**Subtotal General government**	Households owners of unincorporated enterprises	Employees and recipients of property and transfer incomes.	**Subtotal Households**	Non-profit institutions serving households (NPISHs)	**TOTAL Resident sectors (units with >1 year of activity)**	**Rest of the World (RoW)**
Transfers expenditure account												
Total Transfers Paid (6.1)												
6.1 **Disaster risk reduction characteristic transfers paid**												
6.1.1 Internal transfers between public government services (current or in capital)												
6.1.2 Risk transfers, insurance premiums and indemnities												
6.1.3 Disaster related international transfers (current or in capital)												
6.1.4 Public transfers to private (subsidies, transfers in capital...)												
6.1.5 Private transfers (taxes, voluntary...)												
6.1.6 Other transfers												
Total Transfers Received (6.2)												**SDG 17, Sendai F1**
6.2 **Disaster risk reduction characteristic transfers received**												
6.2.1 Internal transfers between public government services (current or in capital)												
6.2.2 Risk transfers, insurance premiums and indemnities												
6.2.3 Disaster related international transfers (current or in capital)												
6.2.4 Public transfers to private (subsidies, transfers in capital...)												
6.2.5 Private transfers (taxes, voluntary...)												
6.2.6 Other transfers												
DRRE Net transfers (6.1 minus 6.2)												
Total DRR Production Expenditure (current plus investment)												
DRR National Expenditure = Total Production Expenditure plus Net Transfers												
Benefits of the DRR National expenditure (by beneficiaries)												
Beneficiaries of the Total Production Expenditure												
Beneficiaries of Total Transfers Received												

GLOSSARY

Term	Definition
Affected Population	Sum of categories of selected direct human impacts: deaths, missing, injured, ill, evacuated, relocated, and otherwise affected. Annotation: People can be affected directly or indirectly. Affected people may experience short-term or long-term or long-term consequences to their lives, livelihoods or health and to their economic physical, social, cultural and environmental assets. In addition, people who are missing or dead may be considered as directly affected. (see UNGA, 2015)
Asset	A store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another.
Attribution to a disaster	A direct causal relationship with a disaster; statistical reference with an identifiable disaster occurrence.
Building back better	Structural measures with a disaster risk mitigation purpose (e.g. seismic resilience in building reconstruction). Note, costs of building back better are distinct and should be separated, where feasible, from reconstruction costs used to estimate direct economic loss.
Cascading multi-hazard disasters	A disaster in which one type of hazard (such as a strong storm) causes one or more additional hazards (e.g. flooding or landslides), creating combined impacts to the population, infrastructure and the environment.
Catastrophic losses	The volume changes to assets recorded as catastrophic losses in the other changes in the volume of assets account, which are the result of large scale, discrete and recognizable events that may destroy a significantly large number of assets within any of the asset categories. They include major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought and other natural disasters; acts of war, riots and other political events; and technological accidents such as major toxic spills or release of radioactive particles into the air. (SNA, 2008)
Climate	The synthesis of weather conditions in a given area, characterized by long-term statistics (mean values, variances, probabilities of extreme values, etc.) of the meteorological elements in that area. (WMO)

Term	Definition
Climate Change	A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.
Climate-related hazard	Climate-related hazards is a category of hazards that are consequences of climatological activity, and thus have the potential to be affected by climate change.
Coping Capacity	Coping capacity is factors for resilience of household, businesses, communities, regions, and whole countries against external shocks in the form of a disaster. This is the ability for households or businesses or infrastructure to respond to external shocks without sustaining major permanent negative impacts, and instead guiding towards opportunities for improvements in the future (e.g. "building back better").
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. (UNGA, 2015)
Cultural heritage objects	Culturally important objects (such as important artefacts) located in cultural heritage zones with special value to a population.
Cultural heritage zones	Areas previously designated for historical and cultural significance (e.g. UNESCO World Heritage sites or other nationally or regionally designated locations).
Damages	Material impacts to that could be recovered, in principle, through future repairs.
Direct impacts	Impacts happening during or shortly following disaster directly triggered by a hazard. Direct impacts include impacts to humans and material impacts.
Direct economic loss	The monetary value of total or partial destruction of physical assets existing in the affected area. (See UNGA, 2015)
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, UNGA, 2015)
Destroyed	Material impacts resulting total loss of an object, beyond recovery except through replacement construction and/or relocation.

Term	Definition
Disaster Management	The organization and management of resources and responsibilities for creating and implementing preparedness and addressing all aspects of emergencies and others plans to respond to, and to decrease the impact of, disasters and to build back better.
Disaster response	Actions taken directly before, 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; includes operational response, which are the coordinated actions of emergency responders, utilizing detailed data on the location of disaster, population, critical infrastructure, and other relevant priority concerns
Disaster risk	"the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity." (UN, 2015) *Annotation: The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socioeconomic development, disaster risks can be assessed and mapped, in broad terms at least.*
Disaster Risk Reduction	A scope of work "aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contributes to strengthening resilience. DRR encompasses all aspects of work including the management of residual risk, i.e. managing risks that cannot be prevented nor reduced, and are known to give rise to, or already, materialize into a disaster event." (UNISDR, 2017)
Disaster Risk Mitigation	Activities and measures to reduce or lessen existing disaster risk or to limit the adverse impacts of a hazardous event. Mitigation differs from prevention in that it is reactive to an identified and currently existing risk or impending threat. Thus, the activities mitigate for specific threats, instead of general risk prevention.
Disaster Risk Prevention	Activities with an intention to intention to avoid potential adverse impacts of hazardous events. While certain disaster risks cannot be eliminated, prevention aims at reducing vulnerability and exposure in such contexts where, as a result, the risk of disaster is removed.
Displacement	Movement of the population as a direct result of a hazard, including evacuations and permanent relocations of people due to a disaster

Term	Definition
Dwellings	Buildings, or designated parts of buildings, and other structures, that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences.
Early warning systems management	An interrelated set of hazard warning, risk assessment, communication and preparedness activities that enable individuals, communities, businesses and others to take timely action to reduce their risks."
Emergency management	The organization and management of resources and responsibilities, which predominantly focused on immediate and short-term needs, for addressing all aspects of emergencies and effectively respond to a hazardous event or a disaster. The set of specialized agencies that have specific responsibilities and objectives in serving and protecting people and property in emergency situations including agencies such as civil protection authorities, police, fire, ambulance, paramedic and emergency medicine services, Red Cross and Red Crescent societies, and specialized emergency units of electricity, transportation, communications and other related services organizations.
Environmental assets	The naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity. (SEEA, 2012)
Environmental hazard	"May include chemical, natural and biological hazards. They can be created by environmental degradation or physical or chemical pollution in the air, water and soil. 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." (UN, 2015)
Evacuations	Moving people and assets temporarily to safer places before, during or after the occurrence of a hazardous event in order to protect them.
Extensive and Intensive Risk from Disasters	"Extensive risk is used to describe the risk associated with low-severity, high-frequency events, mainly associated with highly localized hazards. Intensive risk is used to describe the risk associated to high-severity, mid to low-frequency events, mainly associated with major hazards." (UNISDR-GAR, 2015)
Extreme Weather Event	An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme

Term	Definition
	weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).
Finished goods	Consist of goods produced as outputs that their producer does not intend to process further before supplying them to other institutional units. (SNA, 2018)
Goods	Goods are physical, produced objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets. (SNA, 2018)
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." (UN, 2015)
Hazard exposure areas	Designated areas known to be exposed to specific hazards based upon scientific evidence (hazard catalogue), including past events and various types of meteorological, geological, or hydrological data.
Hazard catalogue	A collection of the spatial, intensity, and temporal characteristics for a set of potential hazards for a defined geographic area
Hazard glossary	Nationally-adopted list of relevant types of hazards for disaster risk management, with definitions. Hazard glossaries are important metadata for use of disaster statistics, and therefore should be a publicly accessible reference with statistical releases
Indirect Impacts	Consequences of a disaster for which causality is not directly observed and therefore must be estimated via application of some assumptions and analysis, Consists of various forms indirect consequences to the people, social condition, the economy or the environment. From UN (2015), Indirectly Affected are: "people who have suffered consequences, other than or in addition to direct effects, over time due to disruption or changes in economy, critical infrastructures, basic services, commerce, work or social, health and psychological consequences."
Injured, ill	The number of persons whose health or physical integrity is affected as a direct result of the disaster. Does not include victims who die.

Term	Definition
Inventories	Produced assets that consist of goods and services, which came into existence in the current period or in an earlier period, and that are held for sale, use in production or other use at a later date.
Land	Land consists of the ground, including the soil covering and any associated surface waters, over which ownership rights are enforced and from which economic benefits can be derived by their owners by holding or using them. (SNA, 2008)
Land-use planning	Systematic assessment of physical, social and economic factors in such a way as to encourage and assist land users in selecting options that increase their productivity, are sustainable and meet the needs of society. Land- use planning can help to mitigate disasters and reduce risks, for example by discouraging settlements and construction of key installations in hazard-prone areas, including consideration of service routes for transport, power, water, sewage and other critical facilities.
Large disasters	Large disasters are disasters in which the emergency is at a national (or higher) sale and have special characteristics of interest for analysis because they are relatively rare but have sweeping and long-term effects on sustainable development
Magnitude	Strength, force of energy or related characteristic of a hazard. These are scientific measurements based on continuous scientific monitoring, utilizing a measurement scale defined by specialists in the relevant physical science (e.g. Richter or Local Magnitude scale (ML) for earth shaking).
Medical costs	Total expenditure on health measures the final use by resident units of health care goods and services plus gross capital formation in health care provider industries (institutions where health care is the predominant activity).
Medium and small-scale disasters	Disasters with emergencies at smaller than national geographic scales, which usually result in fewer and less intensive impacts, but may be more frequent occurrences, and thus, the cumulative effect can be very significant, and represent large shares of the total number of disaster impacts for a country or region over time.
Missing	The number of persons whose whereabouts since the disaster is unknown. It includes people who are presumed dead. After some amount of time, missing become part of the count of deaths.

Term	Definition
Natural resources	Non-produced fixed assets, consisting of naturally occurring resources such as land, water resources, uncultivated forests and deposits of minerals that have an economic value.
Non-structural measures	Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts through their integration in sustainable development plans and programmes, in particular through policies and laws typically to reduce vulnerability and exposure, public awareness raising, training and education.
Official Development Assistance(ODA)	ODA is defined as flows to countries and territories on and to multilateral development institutions which are: a) provided by official agencies, including state and local governments, or by their executing agencies; and ii. each transaction of which: a) is administered with the promotion of the economic development and welfare of developing countries as its main objective; and b) is concessional in character and conveys a grant element of at least 25% (calculated at a discount rate of 10 per cent). (See OECD)
Physical Vulnerability	See definition of vulnerability (below) as applied to land and infrastructure, such as buildings, roads, and other built-up areas
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current disasters.
Reconstruction	The medium and longer-term repair and sustainable restoration of critical infrastructures, services, housing, facilities, and livelihoods required for full functioning of a community or a society affected by a disaster. (UN, 2015)
Relocated	People who, for different reasons or circumstances because of risk or disaster, have moved permanently from their places of residence to new sites (safer areas).
Risk Assessment	A process to determine the nature, extent, and locations of risk, by analysing exposure and conditions of vulnerability to hazards and present coping capacities against all types of disaster impacts. A comprehensive risk assessment process consists of understanding of current situation, needs and gaps, hazard assessment, exposure assessment, vulnerability analysis, loss/impact analysis, risk profiling and evaluation and formulation or revision of disaster risk reduction strategies and action plan.

Term	Definition
Services	Services are the result of a production activity that changes the conditions of the consuming units, or facilitates the exchange of products or financial assets. (SNA, 2008)
Slow onset disaster	A disaster that emerges gradually over time. Slow-onset disasters could be associated with, e.g., drought, desertification, sea level rise, epidemic disease. (UN, 2015)
Structural measures	Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard resistance and resilience in structures or systems. Common structural measures for disaster risk reduction include constructed dams, flood levies, ocean wave barriers, earthquake-resistant construction, and evacuation shelters.
Sudden-onset disaster	A disaster triggered by a hazardous event that emerges quickly or unexpectedly. Sudden-onset disasters could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, and transport accident. (UNGA, 2015)
Technological hazard	"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." (UNGA, 2015)
Urban Slum household	A slum household suffers: lack of access to improved water source, lack of access to improved sanitation facilities, lack of sufficient living area, lack of housing durability or lack of security of tenure. (UN-Habitat, 2016)
Valuables	Produced goods of considerable value that are not used primarily for purposes of production or consumption but are held as stores of value over time.
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. (UN, 2015)

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