DRSF Outline

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Chapter 1 Introduction

1b. Scope and Coverage of DRSF

1. The purpose of the DRSF is to help national statistical systems, particularly the national disaster management agencies and national statistics offices, provide statistical information for informed disaster risk reduction policies and achieve the goals and targets in the Sendai Framework on Disaster Risk Reduction and the 2030 Agenda for Sustainable Development. Disasters pose direct threats to sustainable development and while many, like earthquakes and floods, are, to some extent, unavoidable, many lives can be saved and huge damages can be avoided through informed disaster risk reduction, response, and recovery.

2. The DRSF provides recommendations on methodologies for how to apply intentionally agreed concepts and terminologies for disaster risk reduction in relation to production of official statistics. This includes: recommendations on measurement methodology and on making use of existing data sources within national statistical systems (NSSs) and on providing access to a basic range of disaster-related statistics for multiple purposes, including calculation of indicators.

3. 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."[1]

4. Presently, different countries may have different practices with regards to applying this definition for compiling data and preparing statistical tables. But, in principle, all disaster events aligned with the UN General Assembly definition (regardless of scale) can be included in the official databases that will be sourced for calculating policy-relevant indicators.

5. Paragraph 15 of the Sendai Framework states "The present Framework will apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or

[1] Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction, adopted by the UN General Assembly, December, 2015

man-made hazards, as well as related environmental, technological and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors.”

6. A hazard, combined with the underlying risk factors (exposure, vulnerability and coping capacity) is the underlying trigger for a disaster, and has been defined for the Sendai Framework as "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." Disaster occurrences are usually classified and identified according to the underlying hazard.

7. DRSF applies the above general definitions but elaborates on specific methods for applying the agreed international concepts and definition into the practice of statistics collection and reporting. This includes, for example, guidance on measurement units, classifications and other conventions for compilers of statistics to produce coherent statistics on disaster, risk, occurrences, and impacts, over time and across countries.

8. Variations in measurement scope or in applying definitions have been observed broadly across all components of the framework. However, case studies are presented in this document as examples and to share experiences, with an aim towards providing illustrations of the concepts and sample outputs that will be possible from implementation of DRSF. Examples are also useful for demonstrating some of the challenges in the details of the statistics and the rationale for recommendations provided in the text.

9. Occurrences of disasters are always unique and complex events. Sometimes disasters are sudden and unexpected, and impacts can range from relatively minor damages to massive devastation. Some disasters are acute and highly localized, others may have sweeping effects across vast areas, including effects on multiple countries. Disasters also can develop gradually, as slowly evolving risks. After the call for emergency, impacts from disasters also can accumulate gradually, as the population and its economy transition towards a new post-disaster normal. Even relatively sudden occurrences, like earthquakes, may be followed by a period of aftershocks and a very gradual period of transition and response by the population that can last for months or years.

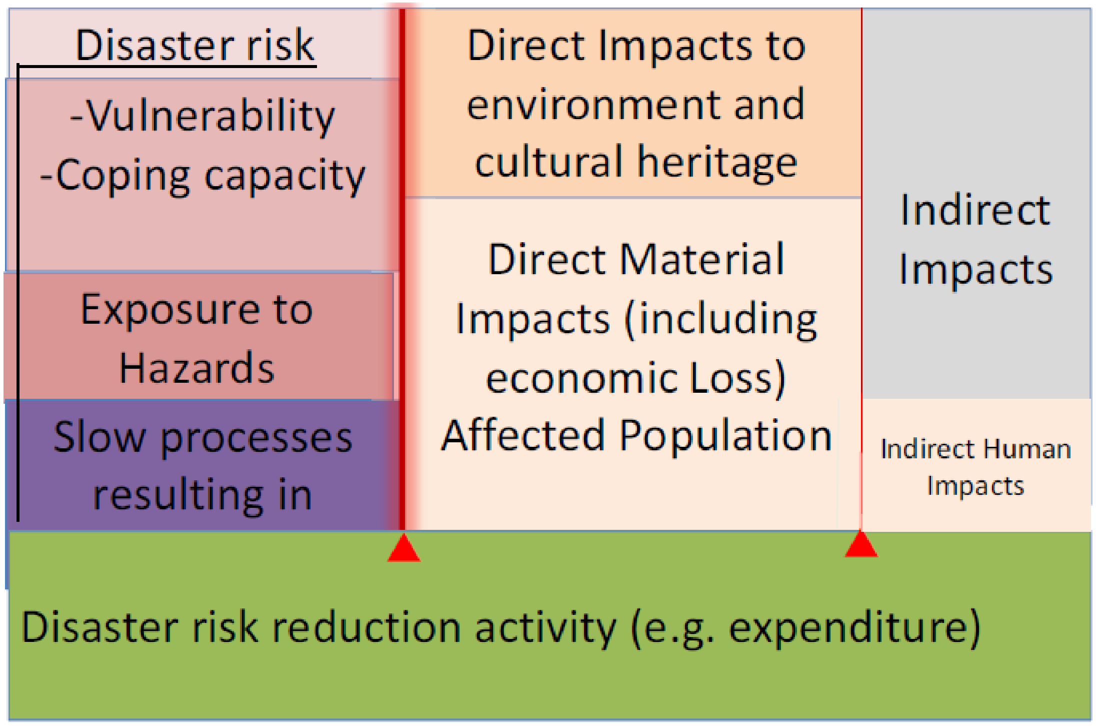
10. A role for the DRSF is to help clarify the challenges and, where possible, provide simplifying solutions by identifying applying measurement rules that are coherent with the broader statistical system and applying them to internationally agreed concepts and terminologies for disaster risk reduction.

11. The **basic range of disaster -related statistics** is developed as the core of the DRSF and the basic cornerstones in the statistics that are important across all national contexts because it is the basis upon which national agencies can build coherence within their systems in terms of definitions, classifications and measurement conventions. In many cases, the full collections of statistical information managed by governments extend well beyond the basic range of disaster-related statistics (for example expanding into the realm of assessment studies and modelled estimation of indirect impacts), but the basic range of disaster-related statistics is a minimum basis needed for building up to the various forms of extensions and applications.

12. A core concept for the basic range of statistics in the DRSF is to maximize efficiency in the use of existing data sources within the NSS, by considering the potential for multiple purposes of data collections, including, in some cases, opportunities to use the same data to produce information for analyses at different points in the disaster risk management cycle (Figure 2).

13. The basic range of disaster-related statistics spans all of the DRSF components that are shown in in Figure 1, with the exception of indirect economic impacts. Indirect economic impacts are important information and serve a wide variety of purposes, but, for practical reasons, they are beyond the scope of the basic range as defined in DRSF.

Fig.1: Components of the DRSF



14. The basic range of disaster-related statistics includes statistics for measuring risk, the occurrences, direct impact, and expenditures related to risk reduction, response and recovery. Guidance for measurement across all of these components has been developed in this document for the purpose of developing coherent compilations of statistics at the national level.

15. Figure 1 can be read like a timeline from left to right. First, there are statistics on disaster risk, *a priori* to the hazard occurrence.

16. Rsk information should be compiled for all types of hazards, including sudden-impact and difficult-to-predict disasters like earthquakes and tsunamis and the slowly-evolving risks (for example drought or rising sea levels), which eventually cross the threshold into a disaster. The slow-evolving risk creates some special requirements for data compilation. The risk column in Figure 1 refers to all types of basic statistics on disaster risk as described in DRSF, summarized in section 2b.

17. Direct impacts are typically happening during the emergency period (middle area) at the time of a disaster occurrence. Indirect impacts more typically accumulate after the emergency period. Disaster risk reduction activities happen continuously, before, after and during disaster emergencies, thus this component is shown as a continuous activity at the bottom of Figure 1.

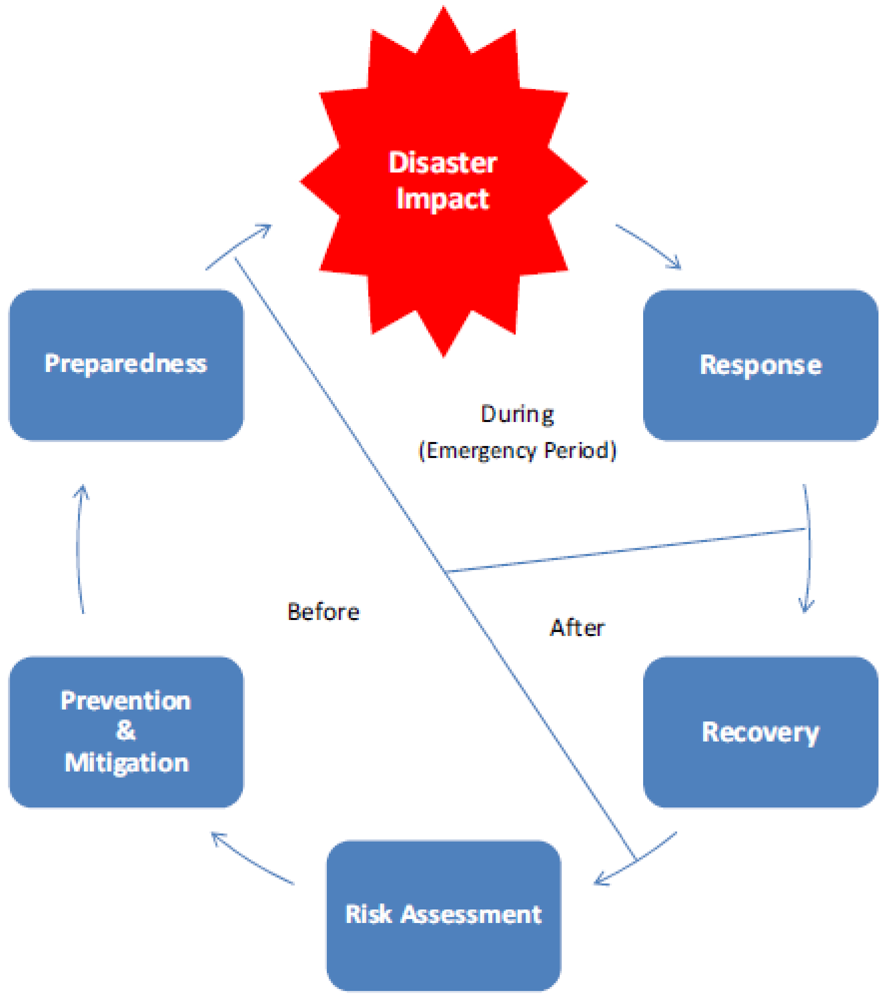
18. As already mentioned above, often disasters are better described as processes of transformation to the affected communities, the landscapes and social and economic contexts, happening after the initial emergency. This process includes a (sometimes lengthy) period of indirect impacts to the population and to the economy that can last for many years and that are often far more difficult to anticipate as risks prior to a disaster as compared to the direct impacts to people and to infrastructure.

19. Most broadly, there are two forms of direct impact statistics: (i) impacts to humans and (ii) material impacts. For direct material impacts its useful to distinguish two types measurement possibilities: (i) physical damages that can be described both in physical terms (e.g. hectares, km, numbers of buildings, etc.) and in monetary terms and (ii) impacts to the environment and to cultural heritage, which are more difficult to enumerate in economic terms using comparable valuation techniques.

20. The risk management cycle is a useful concept from the disaster risk reduction literature for understanding the demands for statistics in relationship to various demands on the decision-makers. As well be explained throughout this document, there aree differences, but also similarities and close relationships, between data requirement across the different phases of risk management.

21. For example, data collected during the emergency response period often leads directly into the information needs for longer-term decision-making during peace time because the authorities improve capacities to identify risks and to minimize risks in advance of a disaster by learning from past experiences.

Figure 2: Cycle of Disaster Risk Management



Reference: this diagram adapted from Thailand Department of Disaster Prevention and Mitigation (DDPM)

22. In order to understand disaster risk, and its management, it is important to produce statistics related to each of the major risk factors. Data for producing statistics on hazard exposure vulnerability and coping capacities are largely extensions of conventional statistics on demographics, infrastructure and economies. Often the basic contextual data that are needed for analyses of disaster risk are the same as inputs used for other types of statistics compilation related to sustainable development (e.g. data on poverty and demographic statistics). The DRSF aims to provide guidance on providing access to basic statistical inputs towards an improved understanding of disaster risk for integrated disaster risk reduction policy-making.

1c. The need, Objectives of International Methodological Guidance

23. ESCAP Resolution E/ESCAP/RES/70/2 on "Disaster-related Statistics in Asia and the Pacific", establishing a regional expert group, requested the development of a framework for a basic range of disaster-related statistics along with guidance for implementation.

24. The Resolution 70/2 recognized a challenge for evidence-based disaster risk management policy, including the need for better use of disaggregated data. Support and encouragement for the work of this Expert Group has been reinforced twice, consecutively, by the Commission in resolutions E/ESCAP/RES/72/11 "Advancing disaster-related statistics in Asia and the Pacific for implementation of internationally agreed development goals" and E/ESCAP/RES/73/7 "Enhancing regional cooperation for the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in Asia and the Pacific"

25. The demand for improvements to the quality and accessibility of basic statistics on disasters has also been acknowledged extensively elsewhere, in many reports on disaster risk and intergovernmental statements, including surveys of current data availability and national capacities. For example, the Report of the OECD Survey "Joint Expert Meeting on Disaster Loss Data: Improving the Evidence Base on the Costs of Disasters: Key Findings from an OECD Survey" outlined some critical problems and limited availability of internationally comparable statistics for many types of analyses on disasters, including for measuring economic loss and for monitoring activities in disaster response and risk reduction.

26. The Hyogo Framework for Action 2005-2015, predecessor to the Sendai Framework, emphasized the importance 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, 2005, p.9).

27. High-level descriptions of the demands for comparable statistics for international analyses of disaster risk has been updated and heightened with the adoption of the Sendai Framework and SDG indicators. Moreover, the new requirements for international reporting of indicators, for the Sendai Framework and for the SDGs, means that governments need to develop centralized databases that integrate relevant statistics across data sources, across different parts of government. These integrations should help to ensure that the outputs are sufficiently comparable for reporting of indicators utilized for international monitoring, among other purposes. Even many of the most developed statistical systems have not yet implemented centralized systems for compilation of data into harmonized tables that could be sourced for producing reports on the agreed international indicators across hazards and over time. Thus, there is a strong demand for development of guidance

and sharing of tools and good practices internationally. Recommendations in the DRSF have been developed utilizing thorough reviews and comparisons of current best practices and other recommendations from the expert group members, which represent a wide diversity of national contexts and the combined perspectives of disaster management agencies and national statistics offices.

28. Indicators in the international databases managed by the United Nations and other organizations are produced based on the official statistics of the national statistical systems, particularly the national statistics offices but also based on a combination of data sources drawing from the activities of multiple government ministries. These systems depend heavily on coordination and consistency, which is accomplished via the adoption and application (at national and local levels) of commonly agreed measurement frameworks, like DRSF. Thus, DRSF is a direct contribution to supporting core activities of the national statistical systems for reporting of the global indicators.

29. This scope for demands on official disaster-related statistics, as defined by the national policy demands and the internationally agreed indicators, rests within a broader context, which includes operational databases that are used for emergency response, post-disaster assessment studies and pre-disaster modelling of risk. Implementation of DRSF will allow governments to not only produce coherent information, but also to make use of the same instruments and collections of data for multiple purposes across the entire disaster risk management policy cycle.

30. 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 a strong mutual understanding among the two domains of expertise of the broad concepts and methods for applying these concepts to practice for producing coherent statistics. DRSF can be used to help build strong partnership between disaster management agencies, national statistical offices, and other official sources of relevant data.

31. DRSF broadly describes the concepts that underpin the scope of demand for statistics for evidence-based policy, clarifies the potential roles of existing sources of official statistics, and provides recommendations on methods for utilizing these sources for compilation of a prioritized set of tables, i.e. the basic range of disaster-related statistics.

32. The DRSF is an extension of conventional statistics. For example, much of the information used for describing core drivers of disaster risk (particularly exposure and vulnerability) are derived from established social and economic statistics systems managed by national statistics offices.

33. On the other hand, occurrences of disasters have a number of special characteristics relevant to compilation of data that make disaster statistics unusual compared to other domains of statistics. For example, for each disaster occurrence and associated variable, several characteristics need to be reported, such as: the type of underlying hazard, the timing and spatial extent of affected area, and the relative scale of the event. Disasters also can be severely disruptive to the practice of official statistics and to the regular activities of disaster management agencies.

34. DRSF doesn't aim to create new concepts regarding disaster observation and risk management but instead to build upon the accepted concepts and definitions in these domains in order to develop guidance for statisticians for tabulating information that are used for multiple purposes, including the response to disasters, designing risk reduction policies, and reporting of international indicators.

35. The adopted Sendai Framework and SDG Indicators provide the common baseline reference on the scope and prioritization of international demands for statistics. However, all countries are starting from very different contexts in terms of the nature (e.g. extent and intensity) of their baseline risk factors. The baseline contexts also vary greatly in terms of current capacities and practices for official statistics. This t diversity contributes to the need for clear guidance for the harmonization of measurement approaches so that basic statistics can be utilized for analyses on the critical drivers of difference in the international indicators (e.g. affected populations) and their trends.

36. Statistics provide a broad vision, for comparisons and for a deeper understanding of risk across hazards. Harmonized statistics can support international support and solidarity not only for responding to major disasters but also for addressing risks. Ultimately, the main objective for DRSF and its implementation in national statistical systems is to help inform a path towards reducing disaster risk and to achieve the goals and targets of the Sendai Framework and of sustainable development. There are many other broad interests in the use of disaster-related statistics, such as, deepening our understanding of climate change or understanding the effects of shocks to a society or to the economy. However, the main focus underpinning the design and scope for this handbook is how to utilize official statistics to inform disaster risk reduction.

1D. Stock-taking & relationships with other frameworks

Global Policy and Indicator Frameworks

37. In 2015, global leaders adopted new landmark agreements, establishing new international goals and targets, in the forms of the Sendai Framework for Disaster Risk Reduction 2015-2030 and the Sustainable Development Goals (SDGs).

38. 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 several of the 17 goals, and covered by 5 indicators (see Annex). By decision of the inter-agency expert group (IAEG) on SDG indicators, the definitions for these indicators are aligned to what has been adopted for the Sendai Framework.

39. 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 at the request of the UN General Assembly. Furthermore, after adoption of the Sendai Framework, an intergovernmental processs was established to reach agreement on terminologies and indicators for monitoring the targets of the Sendai Framework. This intergovernmental process completed in December, 2016 with a report[2] endorsed by the UN General Assembly. In order to help ensure cohesion and that national compilations of official statistics match the demands for global indicators, the terminologies in the DRSF are aligned with the Sendai Framework Report.

40. The Sendai Framework is the successor to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. 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

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

disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

41. The Sendai framework contains a statement of outcome, for the next 15 years, 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 proposed targets 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
    7. Increase the availability of and access to multi-hazard early warning systems and disaster risk information

42. A collection of 27 independent (excluding composite indicators) were adopted for international monitoring of all seven Sendai Framework targets.[3] Monitoring the 7 targets in the Sendai Framework requires, as a minimum, good quality basic statistics on disaster risk, disaster occurrences, direct impacts and commitments to interventions for reducing risks. These basic requirements, in terms of a system of compilation of statistics draws from multiple data sources across multiple governmental agencies and should cover, in principle a complete range of different types of disasters relevant to the country.

International Guidance and Compilations of Disaster-related Statistics

43. Disaster-related statistics is a cross-cutting domain. The indicators identified for the Sendai Framework and SDGs incorporate statistical information on population and the social and economic situations in countries that are factors for disaster risk. Thus the implementation of DRSF is an interaction with a wide range of existing guidelines and international standards adopted by the UN Statistical Commission, including recommendations for population censuses, and classifications and other standards for economic statistics, including the System National Accounts (SNA) and the System for Environmental-Economic accounts (SEEA). The current precedent in the Statistics Commission for disaster-related statistics comes from the Framework for the Development of

[3] See complete list in Annex

Environment Statistics (FDES), which defined a component for “extreme events and disasters”, based largely on the existing practices in intentional databases, particularly the International Disaster Database (EM-DAT)[4] managed by the Centre for Research on the Epidemiology of Disasters (CRED).

44. Other international compilations of statistics or reporting tools that were utilized by the expert group as important references to develop guidance in this handbook included: UNISDR Global Assessment Report (GAR) Risk Data Platform, DesInventar (Disaster Information Management System), and the UN Environment Global Resource Information Database (GRID) network, and Munich Re Natural catastrophe statistics online (NatCatSERVICE).

45. DRSF complements the international reporting tools and databases by supporting development of official statistics at the national or regional levels and promoting improved comparability of statistics through application of harmonized approaches to measurement.

Disaster Risk Assessments and Disaster Response Operational Databases

46. Statistics provide a broad vision, for comparisons and for a deeper understanding of risk across hazards and across disaster occurrences. Disaster management agencies (or civil defense or other responsible organizations) also develop operational databases that are used to develop assessments that inform risk reduction policy and help manage r response in the event of an emergency.

47. Often risk assement studies are conducted with GIS tools (disaster risk mapping). Disaster risk mapping is a common practice of disaster risk management (or related) agencies at the national level and many international organizations are also producing global maps of disaster risk areas. Most of this practice is built upon the same or a similar basic conceptual framework for disaster risk as described in this handbook in section 2.b.

48. However, there are also significant differences in the details of the methodologies applied to the current practices for risk assessments at the national and international levels. Also, practices vary greatly in terms of (e.g.) data sources, use of weighting factors for the different risk factors, level of geographic disaggregation, etc. Often relevant data on risk factors are combined into a probabilistic equation to produce an index as a relative measure for risk by geographic areas. Some of the indices

[4] http://www.emdat.be/

or other measures are developed for specific hazards, others combine measures for risk across multiple hazards into one.

49. There are many internationally recognized analytical studies published in scientific journals and other resources available from the internet as good examples for disaster risk assessment and mapping. As a use of statistics (rather than a source of statistics), its important for statisticians to be aware of common risk assessment practices and their needs in terms of data inputs.

50. Among the important references at the global scale are: the series of UNISDR Global Assessment Reports (GAR), UNEP-GRID, the UNDP Global Report on Disaster Risk (2014), the series of World Risk Reports published by UN University, the Global Risk Index of GemanWatch Institute, Pacific Catastrophe Risk and Financing Initiative (PCRAFI), Pacific Disaster Risk Centre (www.pdc.org). These and other references are important for further explanations for the concepts and related information demands.

51. The role of DRSF in this context is to help to clarify the feasible roles that official statistics can have in terms of inputs and for analysis of disaster risk mapping by national agencies. For this reason, the focus for DRSF is on measurement of the core risk factors (exposure, vulnerability, capacity) individually, rather than on the analytical models that combine figures for risk to produce indicators or risk indices.

52. Descriptions for the analytical models and approaches to applying into estimate broad metrics of risk are already well covered in the disaster risk measurement literature (mentioned above) and therefore are not repeated in this document. Less well covered in the literature are methodologies for collection or estimation of the core inputs into these models (filling gaps in statistics on exposure, vulnerability and capacity).

53. Main requirements for the emergency response operational databases include the need to meet the urgency of decision-making in an emergency situation and to meet other special requirements for incorporating real time information for rapid action. Decision-making using operational data systems occur on an extremely different time scale as compared to the production of statistics and indicators.

54. The requirements for geographic level of detail (resolution) also can be quite different in the case of statistical databases as compared to the operational needs in the midst of an emergency. Official statistics also have other types of quality criteria that are comparatively more vital as compared to the

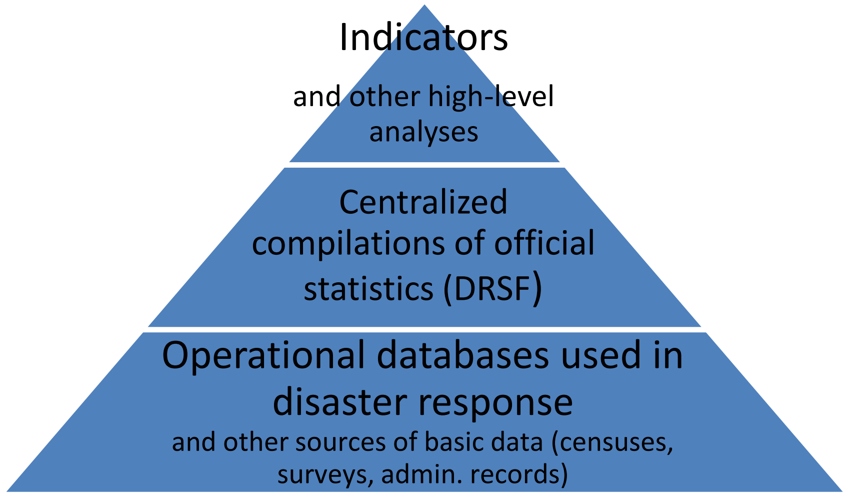
operational data. This includes, particularly, the need for international comparability, and transparency of methods and availability of metadata. There are great possibilities for interactions between official statistics and the operational databases. These interactions are only possible where a common measurement framework has been adopted across the involved agencies, with a common understanding of use of terminologies and scope of measurement for the variables.

55. Descriptions of the components of DRSF are designed to identify and provide guidance on opportunities to utilize the existing data sources or tools utilized across government, applied at appropriate level of detail, accuracy, and timeliness, as required to support the different types of disaster risk reduction decision-making.

56. Statistical databases are summaries of broader collections of raw data gathered from a number of sources, including the operational databases, but also surveys, censuses, monitoring systems, and administrative records. Indicators are designed to provide limited and targeted information to policy-makers and to the general public to help inform disaster risk reduction policy frameworks and to identify if and where progress is being made.

57. DRSF rests in the middle of a theoretical information pyramid. The production of statistical tables inevitably involve some degree of aggregation and summary of data, but the statistics framework also needs to be relatively complete and flexible in terms of level of detail for calculating the full range of high-level indicators and other types of analytical applications of data, including some uses of data that cannot be anticipated in advance and that will be a part of multi-purpose uses the same data.

Figure 3: Information pyramid for disaster risk reduction



Post-disaster needs assessments

58. Post-Disaster Needs Assessments (PDNAs) are conducted by the governments of affected countries, most often in the case of very large disasters, and usual in collaboration with international agencies, particularly the World Bank, as a tool to support countries affected by major disasters to develop plans for their recovery.

59. Guidelines for conducting post disaster assessments and for using these assessments for developing comprehensive disaster recovery plans have been developed and published by the World Bank's Global Facility for Disaster Risk Reduction (GFDRR), in collaboration with the European Commission and the UN Development Programme. A notable example is the PDNA Guide, an extensive series of descriptions of concepts for assessments and recovery planning published by GFDRR in 2014. This Guide "is intended for audiences and users associated with recovery planning within and outside government systems. These include policy makers, leaders and managers of recovery institutions, financial managers, monitoring and evaluation experts, implementing bodies, among others."[5]

60. PNDAs are conducted after very large scale disaster events such as hurricane Yolanda in the Philippines, Thailand's 2011 floods, and Cyclone Evan that caused major economic destruction in Fiji

[5] Guide to Developing Disaster Recovery Frameworks (World reconstruction Conference Version), World Bank, September 2014

and Samoa. The World Bank's GFDRRR website currently hosts post-disaster assessment reports for 49 disasters in 40 countries, including 15 cyclones and multiple droughts, floods, earthquakes, tropical storms, and 1 volcanic eruption (Cape Verde 2014-15).

61. The basic framework for PDNA studies derived from a series of publications developed by the UN Regional Commission for Latin America and the Caribbean (ECLAC), called Damage and Loss Assessment (DALA) Handbook. UN ECLAC first became involved with publishing methods for disaster impacts assessments in the 1970s and the first version of the DALA Handbook was published in 1991, with a revision published in 2003. The DALA Handbook " 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." [6]

62. The structure of DALA is described as a "bottom-up" sectoral approach to collection of data on impacts from disasters, which means that data collected for use in the assessments are organized according to different parts of the economies (including social and environmental "sectors"). In contrast, DRSF is built, where feasible, upon the existing data sources available in the national statistical systems. In the economic realm, this includes, e.g., national accounts, enterprise surveys and censuses, household surveys and censuses, and various forms of administrative records, such as tax records. Implementation of DRSF can lead to increased availability of statistical inputs for use in the assessments and therefore an improved alignment between PDNAs and the official statistical system.

63. Despite the important differences between the practice of conducting an assessment and production of official statistics, there are many useful lessons from PDNAs relevant for the development and application of DRSF. One of the important general lessons from PDNAs is that every disaster is unique in terms of the underlying hazard and, of course, in terms of the social and economic context of the event. This means that basic characteristics of the impacts, including the time that it takes for recovery and renewal, are different for every disaster.

64. PDNAs can have very productive and important complementary interactions with databases of official statistics related to disasters. Outputs of PDNAs will be the most useful to official statistics in

[6] Handbook for Estimating the Socio-economic and Environmental Effects of Disasters (UNECLAC,2003)

cases where there is clear and complete documentation of metadata (e.g. description of data sources used and scope of measurement) for any of the collections of data and estimations used in the reports.

65. If a disaster has resulted in important disruptions to social and economic activities for certain parts of the economy, than dissemination of statistics from official sources (e.g. censuses and surveys) should be designed to contribute to analyses of the event (including PDNAs) while, at the same time, maintaining a broader coherence with the usual standards for coverage, representativeness, and coherence with the broader time series.

Chapter 2 Main Concept and Related Framework

2a) Identifying and counting disaster occurrences and magnitude

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."*

-The United Nations International Strategy for Disaster Reduction (UNISDR), adopted by the UN General Assembly (December, 2016)

2. DRSF applies the above definition but elaborates some criteria to produce harmonized statistics on occurrences and direct impacts of disasters. For each disaster occurrence, there are at least four characteristics, that should be recorded in a centralized disaster statistics databases. These charactersistic of disaster are connecte with all other variables (by using a unique event code or other matching variable) connected to that occurrence. The four characteristics are:
   - 65.1. Timing (date, year, time and duration of emergency period)
   - 65.2. Location (region(s)/province(s)/country(ies) and affected area raster or shapefile)
   - 65.3. Hazard type (e.g. geological, meteorological, etc.)
   - 65.4. Scale (Large, moderate, small)

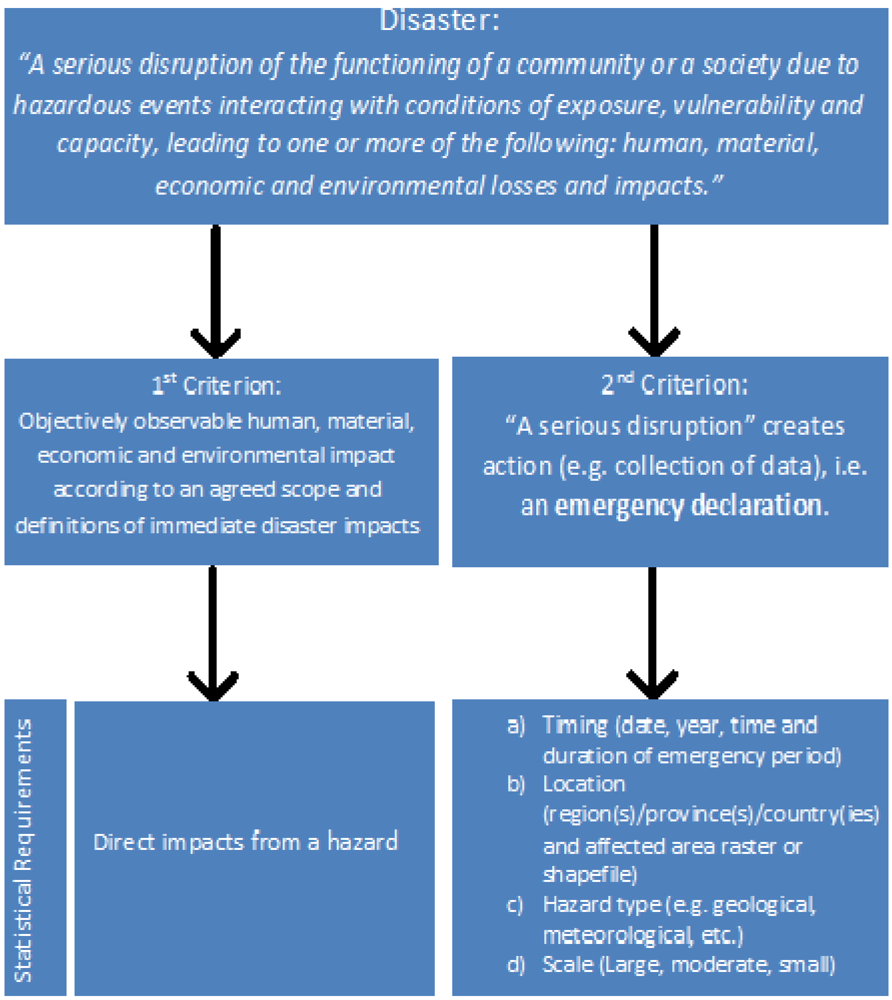
3. From the above definition of a disaster two basic criteria (Diagram 1)can be derived for measurement purposes, (i) observation of significant impacts ("*human, material, economic and environmental losses and impacts"*) and (ii) an emergency declaration ("*A serious disruption of the functioning of a community or a society")*

3. An emergency declaration (at local, regional or national level) is the signal of an abnormal disruption called by officially responsible agencies and therefore is the catalyst from which data on a disaster will be recorded. Emergency declarations can take various forms depending on the type of hazard and laws and administrative policies of the responsible government.

4. Sometimes, es.g. for slowing evolving risks leading to 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 and other responses to boost coping capacity and minimize impacts. This may be the case, for example, for some biological hazards, e.g. relatively small scale outbreaks of disease.

5. Other emergencies may be more explicitly in the form of a formal and public declaration, as, in some countries, this is required in order to mobilize necessary resources for response. Usually large-scale and disasters created by sudden hazards, e.g. an earthquake or tropical storm, result in emergency declarations of this format.

Diagram 1: Criteria and Statistical Requirements for Disaster Occurrences

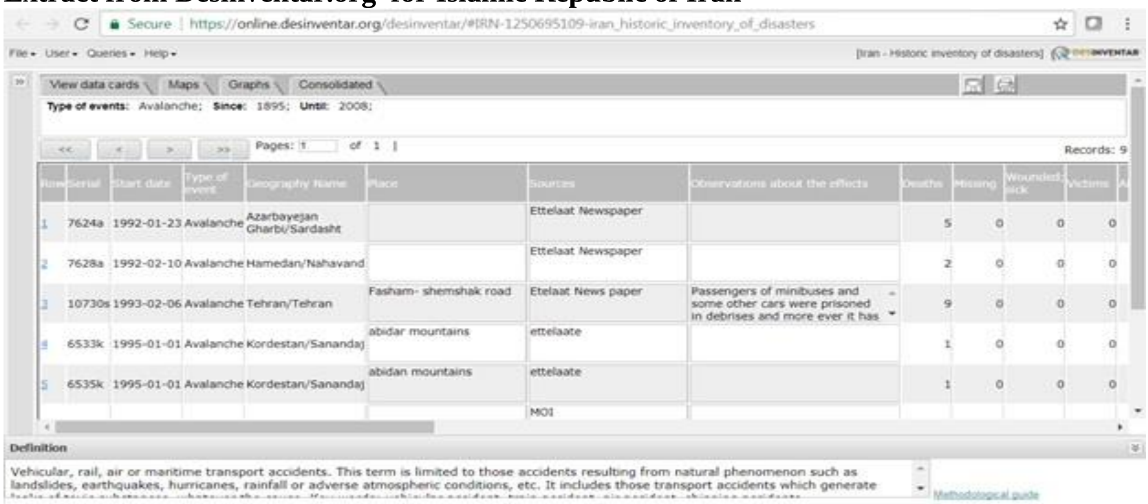


6. The statistical requirements at the bottom of Figure 1 represent basic statistics that should be recorded for each disaster occurrence. At minimum, some information should be recorded on direct impacts

and the basic characteristics of the event, even if incomplete, in order to identify a disaster occurrence within the database.

7. In principle, figures are recorded in relation to an emergency period (including duration but also start and end dates), thus with direct access to the database, virtually any other type of time series trend analyses is also a possibility. Different analyses can be prepared instantaneously, depending on how time-related databases are standardized. Disaster occurrences information is typically stored by disaster management agencies as a set of records, as in this example taken as an extract from the historical inventory of disasters in the Islamic Republic of Iran in Desinventar.org.

Extract from Desinventar.org for Islamic Republic of Iran



Row	Serial	Start date	Type of event	Geography Name	Place	Sources	Observations about the effects	Deaths	Missing	Wounded, sick	Victims
1	7624a	1992-01-23	Avalanche	Azarbayejan Gharbi/Sardasht		Ettelaat Newspaper		5	0	0	0
2	7628a	1992-02-10	Avalanche	Hamedan/Nahavand		Ettelaat Newspaper		2	0	0	0
3	10730s	1993-02-06	Avalanche	Tehran/Tehran	Fasham- shemshak road	Etelaat News paper	Passengers of minibuses and some other cars were prisoned in debrises and more ever it has	9	0	0	0
4	6533k	1995-01-01	Avalanche	Kordestan/Sanandaj	abidar mountains	ettelaate		1	0	0	0
5	6535k	1995-01-01	Avalanche	Kordestan/Sanandaj	abidan mountains	ettelaate		1	0	0	0
						MOI					

8. In the fictitious example below, basic information on disaster occurrence is structured as a list of records, similar in format with Desinventar, for "Neverland". Note that unique occurrence ID's are critical for interpreting the information in these records since different occurrences could occur during the same period, or in the same region or have the same hazard type (or all of the above). In this example, one major drought (event ID 251116) affected multiple regions, a different drought (252126) affected a different region but close to the same time, and a flood occurred in the 'central metro' region later in the same year. Utilizing the event ID and region codes from this simple table of disaster occurrences records, it should be possible to link to all other types relevant statistics related to these events (i.e. impacts statistics) in order to produce summary statistics by regions, by hazard types and by time periods.

9. There are international initiatives for unique naming and coding of hazards, which can be utilized, where applicable, by the national agencies, such as (e.g.) the GLobal IDEntifier number (GLIDE) initiative promoted by promoted by the Centre for Research on the Epidemiology of Disasters (CRED) of the University of Louvain in Brussels (Belgium), OCHA/ReliefWeb, OCHA/FSCC, ISDR, UNDP, WMO, IFRC, OFDA-USAID, FAO, La Red and the World Bank.[7]

Sample Table 1: Register of disaster occurrences for Neverland

[7] http://www.glidenumber.net/glide/public/about.jsp

Event ID	Region code	Region	Area affected shapefile (if available)	Hazard type	Year	Emergency start	Emergency end
25116	011	North cove		Drought	2016	12-Jul	21-Jul
25116	012	Central metro		Drought	2016	12-Jul	21-Jul
25216	011	South bay		Drought	2016	07-Jul	08-Aug
35116	012	Central metro		Flood	2016	12-Dec	30-Dec

10. Disaster impact statistics can be derived and summarized for a given time period and geographic location, at different scales according to the needs for the analyses, by linking the impacts to specific occurrences. For example, for compiling the indicators used for monitoring the Sendai Framework and Sustainable Development Goals, e.g. number of deaths, affected population and direct economic loss from disaster occurrences.

11. Although the main analytical interest is in impacts from occurrences and to measuring risks prior to occurrences, for some types of analyses, it will also be useful to maintain could records on the number of disaster occurrences by geographic region and by hazard types.

12. To underscore the importance of maintaining good records, with a clear and consistent application of criteria for recording disaster and their impacts, two examples are shown below, for Philippines and for Indonesia, in which information on numbers of occurrences were gathered from two different sources.

13. While the decisions made and adopted by the UN General Assembly on terminologies and indicators for the Sendai Framework contribute greatly to pointing compilers of statistics on disasters towards greater harmonization of the concepts, there are still a lot of potential sources of differences in practice, even for the relatively simple first step of d recording disaster occurrences, which could create significance discrepancies for producing statistics on disaster impacts for the SDG and Sendai Framework indicators.

Sample Table 2: Comparison of Disaster Occurrences from Official national source and from EM-DAT for Philippines, 2013-2015

Disaster Occurences		Philippines (EM-DAT)	Philippines (national unadjusted total)
Geophysical	Earthquake	1	1
	Tsunami		
	Eruption/Volcanic Activity	1	
Hydrological	Flood	13	
	Landslide		
	Floods and landslides		
	River Erosion		
	Wave Action		
Meteorological	Strong Wind		
	Convective storm		
	Fog		
	Tropical cyclone		21
	Storm	27	
	Extreme temperature		
Climatological	Drought	1	
	Forest fires/Wild fires		38

Sources: Reporting from Philippines Statistics Authority and Office of Civil Defence, Philipion to Expert Group Pilot Study (2016) and CRED/EMDAT (downloaded 2017)

Disclaimer: statistics shown ine Sample tables in Chapter 2 are for demonstration purposes only; as these statistics predate development of recommendations in this handbook. Information are not necessarily coherent or fully comparable between countries or over time. Sample Tablse are shown in Chapter 2 to illustrate current practices and demonstrate measurement issues through realistic examples.

Sample Table 3: Comparison of Disaster Occurrences from Official national source and from EM-DAT for Indonesia, 2005-2016

Disaster Occurences		Indonesia (EM-DAT)	Indonesia (national unadjusted total)
Geophysical	Earthquake	5	84
	Tsunami		2
	Eruption/Volcanic Activity	11	40
Hydrological	Flood	75	2810
	Landslide	20	1308
	Floods and landslides		162
Meteorological	Strong Wind		1932
	Convective storm		
	Tropical cyclone		
	Storm	2	
Climatological	Drought		191
	Forest fires/Wild fires	2	120
Biological	Epidemic	3	
Other	Conflict		54
	Fire		1216

Sources: Summations based on downloaded stastistics from Indonesia official government disaster loss database (DIBI) (2016) and CRED/EMDAT (2017). The "Unadjusted national totals refers to the period sums (i.e. unadjusted for possible double counting).

14. The first important potential source of discrepancy in scope of measurement for disaster occurrences (and thus in aggregate counts of disaster impacts) is the scope of hazards, which vary from case to case. As recommended in Chapter 3, for this table the available information is organized according to the family level categorization of hazards as defined in the Peril and Hazard Classification developed by IRDR[8].

[8] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.

15. Not all hazards currently incorporated in national databases match with the IRDR family-level categorization and there are also differences in use of terminologies, definitions and scope between countries. For example, while wildfires or forest fires (terminologies vary) are categorized by IRDR as climatological hazards, it is possible that “fires” as reported in this case from the national database of Indonesia, may include accidental fire in urban environments, which have been referenced in UNGA (2016) as “technological accidents”. However, the difference in the details will not create major discrepancies to aggregated statistics as long, at the aggregated level (e.g. “family” of hazards level according to the IRDR reference) can be calculated consistently across countries. So, the details for classifying hazards at the national level need not be standardized to produce official statistics. (In any case, each hazard is inevitably a unique event, affecting a unique location). However, an area of further research for DRSF could be to provide further guidance to aid national agencies in developing their own nationally-adapted hazard classification systems.

16. National agencies should also publish a complete list of nationally adopted hazard categories, with official definitions as part of regular dissemination of metadata associated with disaster impacts statistics. While, the scope of hazards included in databases will vary across different countries, the metadata will allow analysts to avoid making misleading comparisons. Also, to the extent possible, hazard typologies should be linked with the family-level categories of hazards from IRDR (following the example from Table 1).

17. In principle, the statistical tables described in this handbook are applicable to a complete range of types of hazards as relevant to each national statistical compilation, including hazards that are not considered “natural”, such as violent conflict or technological accidents like fires, oil or chemical spills. In some parts of the world, violent conflicts are by far the most serious hazards and may be triggered or exacerbated by natural hazards, such as droughts.

18. Another possible source of discrepancy occurrences is the criteria or threshold applied in identifying disaster and incorporating them into the database. In, CRED/EMdAT, a series of specificd criteria (e.g. disasters that resulted in at least 5 deaths) are applied, effectively limiting the scope of stastistics to relatively large scale disaster ocurrences. In DRSF, as already described above, there not such threshold criteria is needed at the data collection and compilation phase, as long a hazard and specific emergency with some direct impact could be observed and recorded.

19. UNGA (2016) advises that the scope of disasters for monitoring Sendai Framework indicators applies to 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 risk.

20. A third possible source of discrepancies in the recording of statistics on disaster occurrences and their impacts at the national level is the reliability of counts at and elimination of double-counting. Hazards commonly create impacts in multiple geographic regions. These larger scale disaster occurrences should be counted only once as single disaster occurrence affecting multiple regions, and this is easily accomplished

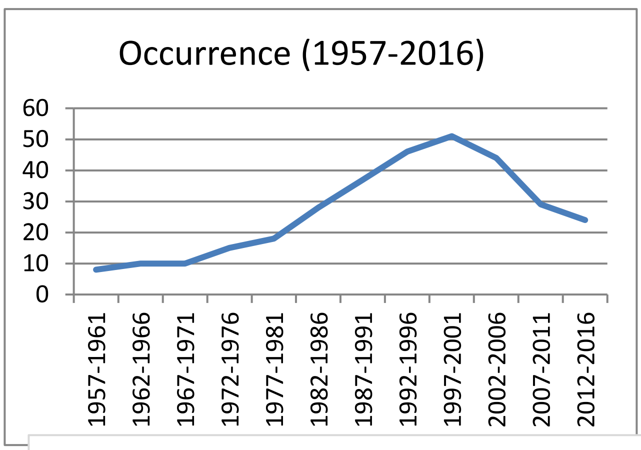
through application of a system of unique event, hazard occurrences and region codes (see "Neverland" example above).

21. Potential for discrepencies in scope of measurement aside, use of disaster occurrences and their impacts are also highly sensitive to the time period of the analysis. The current international standard for a baseline time series analysis of disaster impacts statistics from the Sendai Framework and SDGs is the 16-year period from 2015-2030.

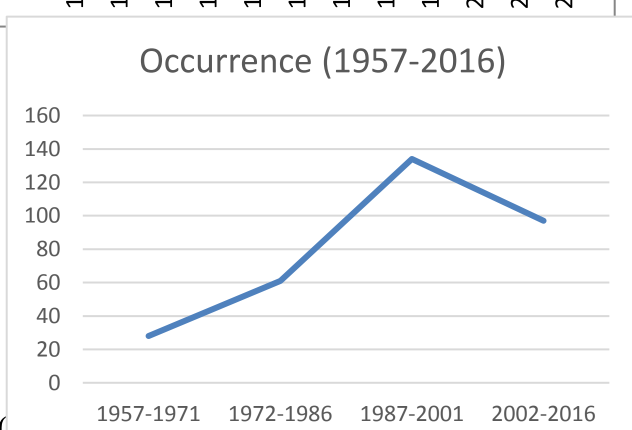
22. Since disasters occur randomly, trends are easier to see over a relatively longer time period an aggregated over time, e.g. at least 3-5 year periods. However, compilations of annual statistics allow for flexibility in the selection of time periods for comparisons, which is important for disaster statistics given the large variabilities and randomness of disaster occurrences and their impacts. In some extreme cases, period adjustment by just one year, can dramatically change the output statistics.

23. The example graphics below shows the same data and same time period, but in three different presentations of trends, according to a simple line graph, using annual, five-year or 15-year sums for numbers of disaster occurrences reported for Bangladesh.

(a) 5-year

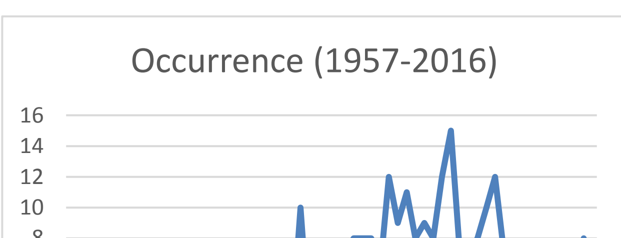


year	occurrence
1972-1976	15
1977-1981	18
1982-1986	28
1987-1991	37
1992-1996	46
1997-2001	51
2002-2006	44
2007-2011	29
[illegible]	[illegible]



year	occurrence
1957-1971	28
1972-1986	61
1987-2001	134
2002-2016	97

(



year	occurrence	year	occurrence
1957	0	1987	6
1958	2	1988	7
1959	0	1989	8
1960	3	1990	8
1961	3	1991	8
1962	0	1992	6
1963	3	1993	12

24. One of the important characteristics for describing aggregated counts of disaster occurrences (and their impacts or risk of impacts) over time is the scale of the individual events. In addition to collecting records on disaster occurrence san their on impacts, disaster management agencies in many countries also categorized disaster occurrences according to scale, most commonly with a 3-category scale (minor, moderate, and large scale occurrences). There are various possible ways of classifying scale. A recommended approach is to refer to the geographic scale of the call for emergency and for financial or other support, i.e.: national scale, regional, or local disasters (Usually, the large scale (national or level 3) disasters are disasters that also attract international attention and solidarity for response and assistance to the affected population with recovery.

25. **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. Large disasters are often also covered by post disaster assessment studies, creating opportunities for more comprehensive and more detailed compilations of statistics on direct and indirect impacts. 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 (and multiple countries). An example was Cyclone Evan (2012), which caused major damages in Fiji and Samoa, spurring separate internationally-funded post disaster assessment studies in both countries

26. **Medium and small scale disasters** refer to emergencies at smaller (less 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. Frequency is related to

scale for some types of hazards, e.g. seasonal floods, and hydrologist have usued time periods (e.g. 5-year and 10-year floods) to indicate the generally predictable trend which is connected to the scale of events. For example, the concept of 5-year floods, 10-year floods, etc., is a reference to usually large-scale seasonal flooding, which is more likely to cause moderate to large scale impacts, as compared to an annual floods, which, under the right conditions, might not be disaster at a all.

27. Statistics for relatively more frequent and smaller disasters are less likely to covered by post disaster assessment studies or other specially targeted data collections. Thus, integration of smaller and more frequent disasters into the database will rely more heavily on more regular and continuous sources of official statistics. Another way some of these challenges of availability of data for a more comprehensive recording of small and medium-scale disaster impacts will be creative use of alternative sources of data, especially geospatial data (See Part II).

28. Although small disaster receive less attention in the media or as a catalyst for investment for disaster risk reduction, disaster management agencies should be comprehensive in recording of occurrences reported by the local authorities into their databases, with unique identifiers and othter associated variables for characterising the occurrence and for linking to impacts statistics tables.

29. “A **slow-onset disaster** is defined as one that emerges gradually over time. Slow-onset disasters could be associated with, e.g., drought, desertification, sea level rise, epidemic disease.” (UNGA, 2016). Slow-onset disasters emerge after a period of slowly evolving catastrosphic risk, which, given the right monitoring conditions, can be identified early in order to develop preventative and mitigation measures for minizing impacts.

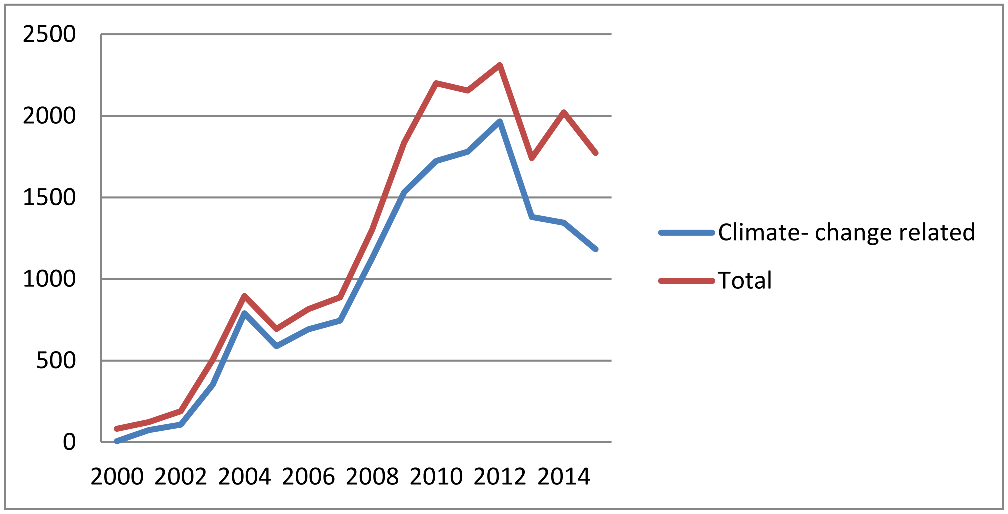
30. “**A sudden-onset disaster** is one triggered by a hazardous event that emerges quickly or unexpectedly. Sudden-onset disasters could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, and transport accident.” (UNGA, 2016).

31. **A cascading multiple-hazard disaster occurrence is** a disaster occurrence in which one type of hazard (such as a strong storm or a tropical cyclone) triggers one or more additional hazards (e.g. flooding or landslides), that create combined impacts to the population, infrastructure and the environment (see further description in Chapter 3). In some cases (e.g. Indonesia), cascading multi-hazard disasters are recorded as specialized hazard types, noting the orginal trigger hazard (e.g. storm), as well as the connected hazards (e.g. floods, landslide). In other cases, cascading multiple-hazard disasters are categorized according to the original trigger event. As already mentioned, the details will differ from case-to-case. But, for comparability purposes, there is a need for a harmonized group of high-level hazard categories (families) and harmonized rules for aggregation.

32. **Climate-related hazards** is a category of hazards that are consequences of activity in the climate, and thus have the potential to be affected by climate. 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, thus reducing overall predictability of such hazards based on historical records (UNU, ibis). Of course, climate change effects will not be evenly distributed across the globe. Statistics are needed for assessing how climate change may

be impacting disaster risk for different countries. Climate-related hazards could include hazards in the climatological, hydrological and meteorological categories of IRDR, see an example compilation for Indonesia below.

Figure 1: Trends of disaster occurrences and climate-change related disasters



Calculations based on statistics downloaded from Disaster Informasi Bencana Indonesia (DIBI): http://dibi.bnpb.go.id

2b) Disaster risk

1) Introduction

1. Improved utilization of official statistics for understanding disaster risk is one of the basic motivations for development of DRSF and its implementation in national statistical systems.

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 of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity." – UN General Assembly, 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.

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

3. Improved understanding of Risk is priority number of the Sendai Framework.

4. "Disaster risk is geographically highly concentrated and very unevenly distributed" (Pelling, in UNU 2013). It's important to recognize extreme geographic variability in degree, and, predictability of hazards and their potential impacts across regions within countries.

5. When designing systems to compile statistical information about the impacts of disasters, differences in the underlying risk are the contextual information, which is critical for understanding how impacts from disasters can be reduced for the future, at least to a level below the threshold of an acceptable limit.

6. While not all impacts and risk factors of disasters will be measured comprehensively, the Sendai Framework and the decisions on indicators by the United Nations General Assembly makes a clear appeal to member States for organized dissemination of a broad range of statistical information, towards a deeper understanding of risk. This includes, in particular, "patterns of population and social economic development", which can be gathered from numerous existing sources of official statistics, by utilizing the existing geographic referencing available for each type of statistic.

7. Disaster risk is dynamic and encompasses nearly all of the core components that are the common work of national statistics offices and other providers of official statistics at the national level, e.g: demographic changes, poverty and inequality, structure of the economy, expenditure, economic production, land management, and so on.

8. A collection of many of the most important and measurable factors of disaster risk can be gathered from paragraph 6 of the Sendai Framework, which states:

   "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. Moreover, it is necessary to continue strengthening good governance in disaster risk reduction strategies at the national, regional and global levels and improving preparedness and national coordination for disaster response, rehabilitation and reconstruction, and to use post-disaster recovery and reconstruction to 'Build Back Better', supported by strengthened modalities of international cooperation."

2) Scope of Measurement

9. In the literature and current practice of many disaster management agencies (e.g. the national disaster management agency of Indonesia, BNPB), disaster risk is essentially equated to three core elements: exposure to hazards, vulnerability and capacity.

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

10. This basic definition for measurement of risk appears in many sources in the disaster risk reduction literature, and has also been known as the PAR model (Birkman, 2013). The basic concept is that disasters occur at the intersection of two forces: the natural hazard (e.g. an earthquake) and the human processes generating exposure, vulnerability and coping capacity. It shows that risk of impacts from a disaster is not driven only, or even primarily, by the scale of the hazard itself (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/GAR, 2015)

11. Usually, in practice, the three elements of exposure to hazards, vulnerability and coping capacity three elements are not fully independent factors of risk. This basic formula is useful as the conceptual basis for setting the scope and organizing statistics on risk in DRSF. It should not to be taken literally as a mathematical formula for econometrics.

12. In Birkman/UNU (2013), Mark Pelling describes two basic types of applications of risk measurement internationally: risk indices and hotspots. UNDP and UNEP-GRID have been among the leading international agencies developing global disaster risk indices (or DRIs). DRIs can be developed for individual hazard types (e.g. for floods or cyclones) or multi-hazard risk, noting that often the multi-hazard risk assessments are not comprehensive for all hazard types due to variation in their relative frequencies and data availability.

13. One of the initial DRIs from UNDP and UNEP-GRID was simply a calculation of number of fatalities divided by the number of people exposed to a particular hazard.. Using this calculation for risk measurement has advantages of simplicity, but assumes that historical statistics on disaster impacts will be a strong indicator for predicting risks from future hazards. Subsequently, DRI methodologies were developed following the same basic assumptions, but including other types of impacts such as economic losses. The approach has an advantage of making maximum use of previous disaster impacts data. However, some of the key factors of disaster risk are dynamic and thus not always predictable based on impacts of the past. Statistical methodologies and measurement units are also not always clearly defined or documented for disaster occurrences of the past. Moreover, the links of this approach to the theory on fundamental factors of risk (hazard, vulnerability, and coping capacity) are lacking. Thus for DRIs and other types of risk assessments of the future, there is a valuable opportunity to make greater use of a collection of consistently framed and defined statistics on the exposure, vulnerability, and coping capacity elements.

14. The early DRI analyses were conducted mainly at a national scale (e.g. in comparison to GDP and population density at the national scale) instead of as analyses of the areas exposed to or directly affected by the hazards. The hotspots approach emerged following a similar model that has been used in the domain of biodiversity, and focuses on applying analyses at a more geographically detailed scale, utilizing key data that can indicate relatively high level of likelihood for hazards combined with exposure and vulnerabilities of the population. Many interesting examples are emerging, for example in the disaster management agency of Indonesia

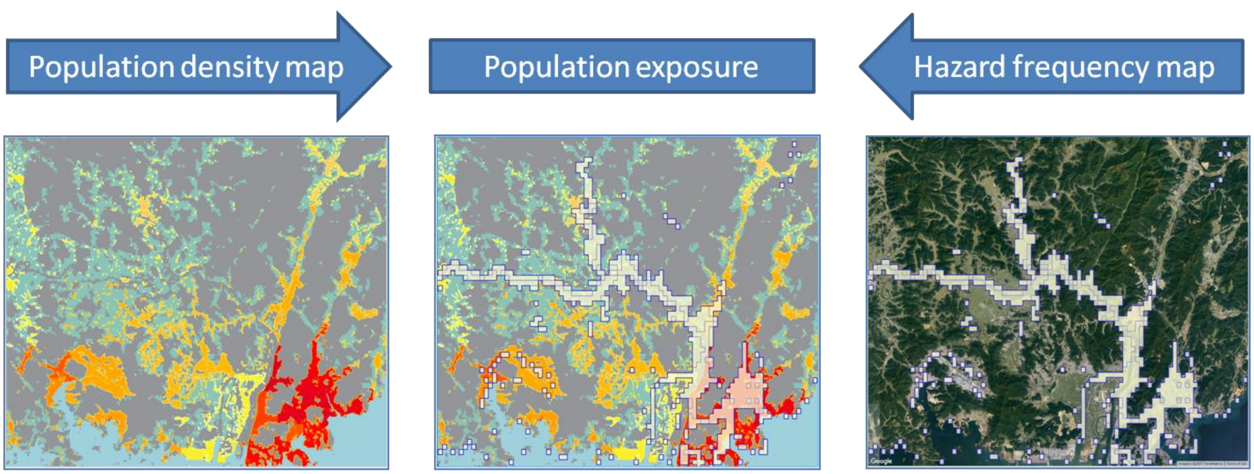
(BNPB), which is tracking statistical information on economic activities (derived, e.g., from local tax revenue records) and on children (from administrative records on enrolment in schools) in relation to the hazard areas of the country.

15. Modern versions of DRIs and other models that can be found in the literature now incorporate, in different ways, the core components of disaster risk mentioned above (i.e. exposure to hazards, vulnerability, and coping capacity). One of the tremendous advantages of these risk assessments, which are conducted with geographic information systems (GIS) is the potential to develop statistics and apply these methods for a full range of different geographic scale for analysis, i.e. at the global, national or regional scales or for hotspots.

16. The focus in DRSF is to clarify the role of official statistics as accessible inputs for these and other types of risk assessments.

3) Estimating exposure to hazards

17. There are two main elements to measuring hazard exposure; there is a probabilistic mapping of the hazard on the one side and a complement mapping of the population, critical infrastructure (and other objects of interest such as high nature value ecosystems) for the exposure side.



(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.)

18. The mapped area meeting in the middle is the hazard exposure measurement. Producing statistics that can be used for estimating the exposure element is one of primary responsibilities of national statistics offices and census organizations (e.g. through the regular population and housing census).

Hazard Element

19. For the hazard element, many variables can be relevant, most of which are not normally a domain for national statistics offices, but are often available from the official sources of disaster management, meteorological and geographic information for a country (or region).
20. A leading example for methodology regarding hazard mapping, and subsequently, production of statistics on exposure, comes from the national disaster management agency of Indonesia (BNPB).
21. A collection of the spatial, intensity, and temporal characteristics for events in an event set is known as hazard catalog. Hazard catalogs and statistics on impacts from historical events together with risk models can be used in a deterministic or probabilistic manner. Deterministic risk models are used to assess the impact of specific events on exposure. Typical scenarios for a deterministic analysis include renditions of past historical events, worst-case scenarios, or possible events at different return periods. A probabilistic risk model contains a compilation of all possible "impact scenarios" for a specific hazard and geographical area. Convergence of results is a concern when using a risk model probabilistically. For example, a simulation of 100 years of hazard events is too short to determine the return period. A random sample of 100 years of events could easily omit events, or include multiple events.
22. The BNPB Indonesia example (below) provides a good practice example of the types of data inputs needed for hazard mapping, among which include:
    a. knowledge of the distribution of soil-type to model the spatial variation of ground acceleration from an earthquake,
    b. values for surface roughness to define the distribution of wind speed from a tropical cyclone;
    c. a digital elevation model (DEM) to determine flood height, and so on.
23. There are also software tools and other resources available for probabilistic hazard modelling software, e.g.:
    a. The Austalian Goverfnment's Earthquake Risk Model (http://www.ga.gov.au/scientific-topics/hazards/earthquake/capabilties/modelling/eqrm)
    b. BNPB Indonesia's InARisk (http://inarisk.bnpb.go.id/)
    c. CAPRA (http://www.ecapra.org/)
    d. U.S. Environmental Protection Agency's CAMEO (https://www.epa.gov/cameo)

24. IPCC SREX (2012) was the first IPCC report to systematically bring the concept of vulnerability along with establish concepts from disaster risk reduction into the realm of climate change science. (Figure 1.13 - p.61). In the 5th IPCC Climate Change Assessment Report (2014), key risks from rising global temperatures are identified based on expert judgment using the following specific criteria: large magnitude, high probability, or irreversibility of impacts; timing of impacts; persistent vulnerability or exposure contributing to risks; or limited potential to reduce risks through adaptation or mitigation.

25. According to IPCC, three changes are likely to be observed for climate-related hazards for some geographic regions due to climate change: 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. Other risk factors (exposure, vulnerability,

capacity) are, for different reasons, also highly dynamic. Thus collection and application of statistics for risk assessment is a continuous cycle of collection of new data, production of statistics, evaluation and use of data in assessment, and integration of lessons learned into the next round of data collection.

Disaster Risk Mapping in Indonesia[9]

26. The Indonesia Methodology for Risk Measurement (BNPB, 2015) incorporates the following variables for producing hazard maps, used for estimating exposure by the population and by assets:
    - Key inputs across all hazard types are: soil type and topography data,
    - Additionally, other inputs by hazard are:
        - slope and river flow variables for flood,
        - annual precipitation and geological data – types of rock and distance from active faults - for landslide,
        - annual precipitation index, and also frequency analysis to measure number of frequency dry class (minimum 5 occurrences with lowest dry value) for drought.
        - for 3 types of hazards (Epidemic, Technological Failure and Social Conflict) population density is also used as a metric for probabilistic prediction

27. Outputs (statistics) from InARisk are summarized according to a susceptibility scale, i.e: (low, medium, or high exposure or vulnerability). Susceptibility scales are calculated based on pre-determined weighting factors, which vary depending on the type of hazard. For the case of flooding, for example, weights for susceptibility is determined according to topography (height above sea level) and distance from the river. When developing risk assessments, it's also necessary to make a distinction for special characteristics of hazards or different types of occurrences. For floods, examples are flash flood scenarios and floods that may result in other related cascading hazards – i.e. landslides.

28. Vulnerability for infrastructure is defined according to 3 categories: housing, public facilities (school, hospital, religious building (airport, station, cultural heritage conduct separate evaluation) and critical facilities (transport network, water infrastructure, energy infrastructure, telecommunication infrastructure)

29. Once overlaid with information on the population, statistics on exposure and vulnerability can be produced through geographic integration of data sources. Input data for vulnerability assessments, for example, are number of persons with disability and number of poor.

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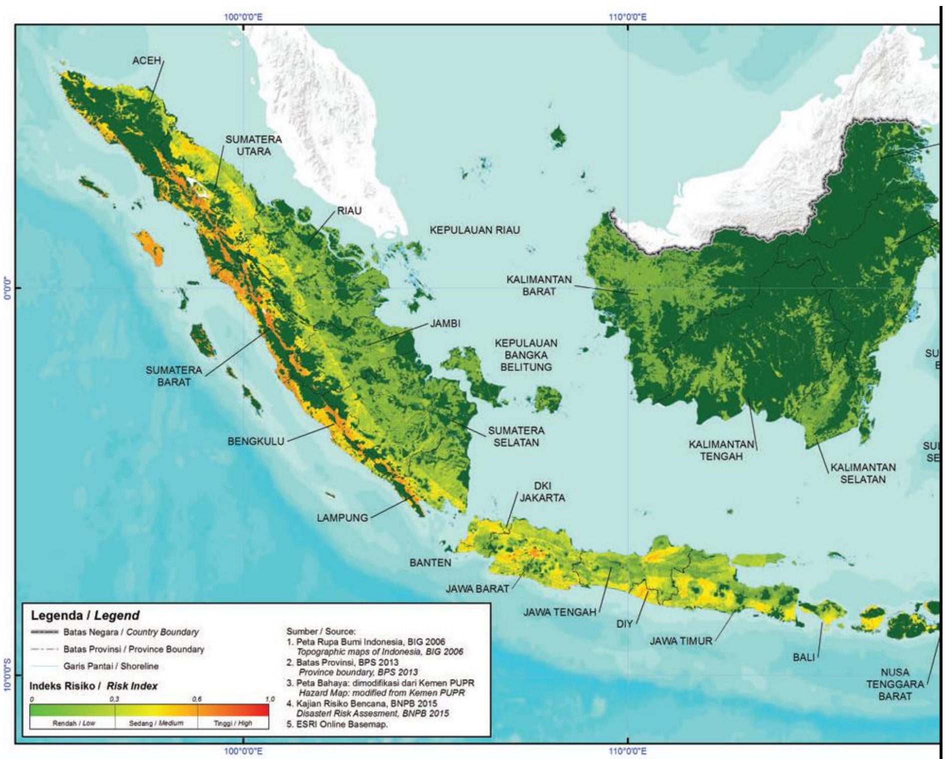
[9] *Information from RBI publication (BNPB, 2015), translated summary by Dyah Emma Hizbaron*

30. Input data for hazard and for vulnerability are geographically disaggregated in order to create risk profile by municipalities or other administrative regions. Analysis is also conducted by grid (GIS raster files). Gridded and administrative region-based risk assessment information is produced by BNPB for: earthquake, volcanic eruption, flood, landslide and drought. The input data used for these risk assessments can serve multiple purposes: including to help identify requirements for emergency response in the event of a hazard (operational database) and also for producing summary statistics on risk - i.e. the figures for exposure and for vulnerability by administrative regions.

31. The approach for the case of economic risk is to identify a multiplier (in monetary terms) for key land use sectors: industrial plantation forest, plantation, dry agriculture, paddy field, mining, and others (including non-productive land). Then the hazard exposure information can be combined with geographic information for each of the sectors (i.e. areas exposed) to estimate the exposure and then identify classes (low, medium, high exposure), according to the size of the calculated monetary value.

Sample of risk index map for Sumatra and Java Islands, Indonesia



Source: Risiko Bencan Indonesia (RBI), BNPB, Government of Indonesia

Exposure element

32. For the exposure side, the objective is to measure people, infrastructure, housing, production capacities and other assets located in hazard-prone areas.

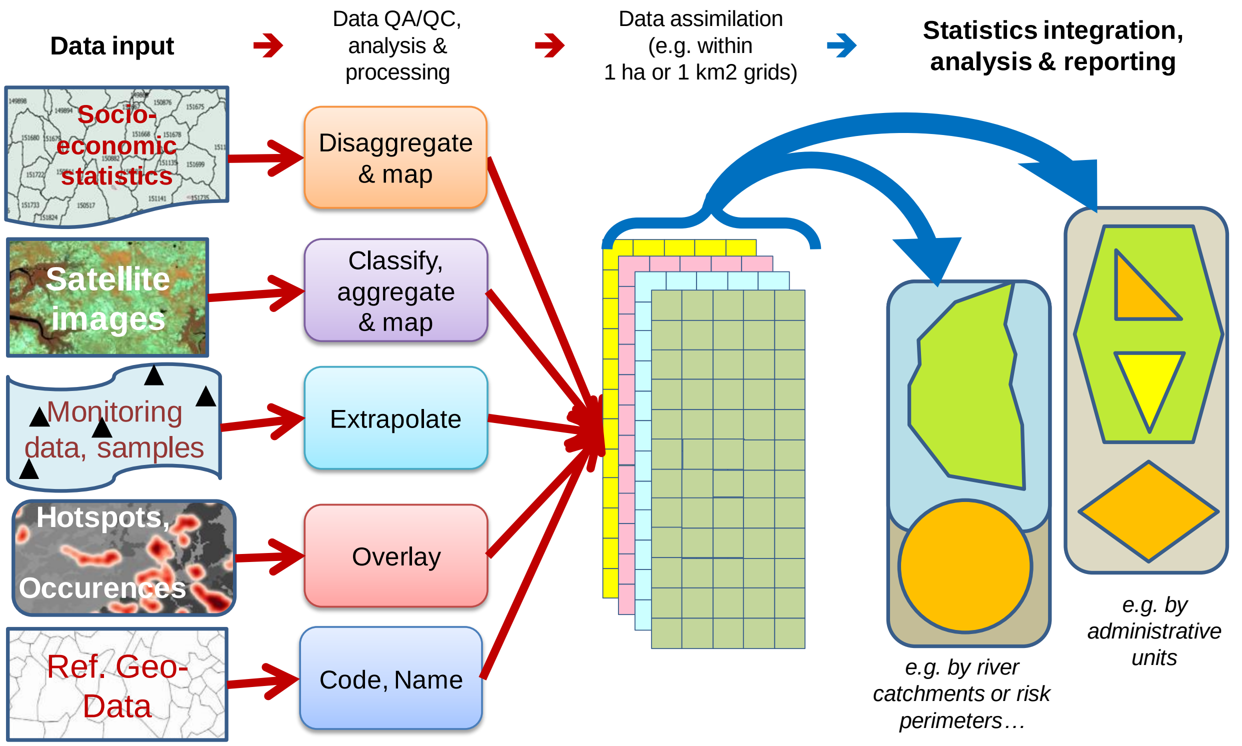
33. Exposure statistics can have dual purposes in disaster statistics because in addition to one of the three basic metrics for disaster risk, exposure statistics also can be useful as baseline statistics for assessing impacts after a disaster. (See other sections in Chapter 2).

34. An approach can be developed as a direct application of the available population census data using GIS. In order to demonstrate the possibilities for applying census statistics for estimating population exposure to hazard, a method was developed and pilot tested among countries in Asia and the Pacific. The method can be applied at different scales, based on the available public access population census counts by administrative region (which can be accessed from national statistics offices at different scales, depending on the country). The methodology[10] was developed and tested among Expert Group countries during 2016 and 2017 and a complete step-by-step manual describing the steps to replicate the same methodology for any country and using the available population data from census authorities.

35. The basic objective for this methodology is a simplified and reproducible approach to producing statistics on population exposure, i.e. estimations of population density in areas exposed to natural hazards or disasters from publically-accessible data sources.

36. The difference in geographic distribution of hazard areas as compared to the normal dissemination of population data (i.e. administrative areas at sub-regional or district levels) creates the requirement to re-allocate a distribution (down-scale) population data so that it can be overlaid with a reasonable degree of accuracy to the actual geographic areas of a hazard or disaster, as produced by experts.

[10] See full methodology descriptions at the Expert Group website (http://communities.unescap.org/asia-pacific-expert-group-disaster-related-statistics)



Grid-based data assimilation – source: Jean-Louis Weber, CBD Technical Series 77, 2014

37. Generally, the lowered the level of geographic detail of the population aggregates (e.g. administrative regions 01, 02, 03), the more useful the gridded estimates of population density should be for producing more accurate statistics on hazard exposure.

38. So, for example, in cases such as Tonga, in the Pacific, where census data are accessible by GPS coordinates, no modelled estimation is required as the census records effectively reveal point locations for households and the number of people living there. These statistics can be used for highly accurate and high-resolution analyses of location of population with respect to other geographic elements (e.g. in terms of proximity to coastal areas)[11], including in relation to hazard area. In most other cases, currently, census data are available somewhere between GPS coordinates and the level of the highest administrative region (e.g. provinces or administrative level 01).

39. Pilot studies revealed that, with high quality data of 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 even with application of a relatively simple model for estimating location of population, to obtain reasonable results, comparable with other existing international estimations (such as, e.g., by Worldpop.org (http://maps.worldpop.org.uk/#/) or by Global Human Settement Layer by JRC http://ghslsys.jrc.ec.europa.eu/) based on census results

[11] See the Pacific Community's POPGIS tool (prism.spc.int)

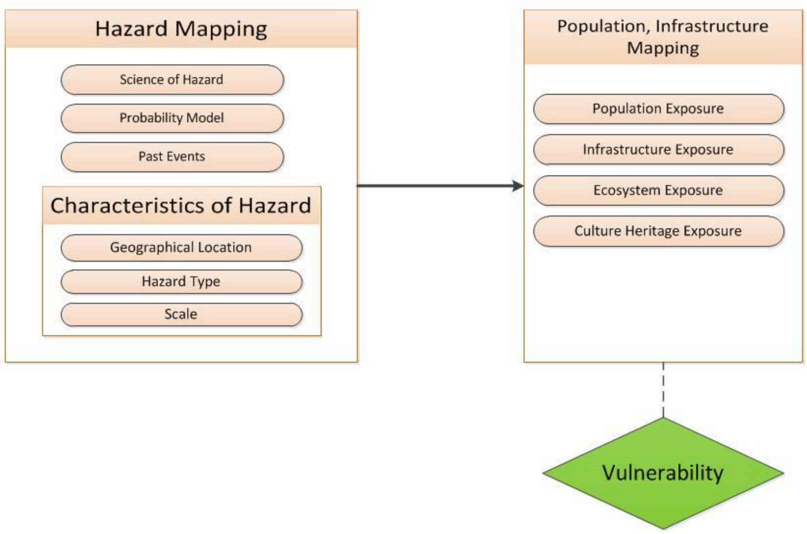
produced by national statistics offices. Due to it's simplicity, transparency and to free access to high resolution GUF data, the model tested during the pilot studies allows reproducing estimations at different scales according to the detail of population data available and to policy requirements.

40. Often it is useful to define homogenous regions --- e.g. urban and rural, residential and non-residential, agricultural land, etc. Thus, one of the basic inputs for developing exposure statistics are land cover and land use maps.

41. Important data sources to consider when developing compilations of data for measuring exposure to hazards are cadastres or other related land use information, household and business registers, household and business surveys, population and housing censuses, and satellite imagery and aerial photos. The quality and level of detail for available information on location of households, businesses, and other land uses, varies greatly across countries and sometimes within countries (e.g. between rural areas and urban centers).

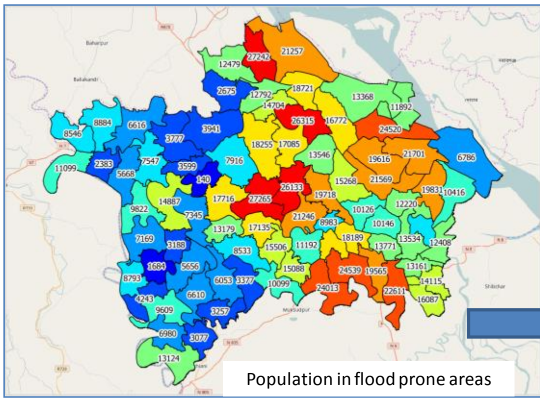
42. Also, the level of detail (i.e. geographic resolution) will vary greatly depending on the purpose of the analyses (e.g. emergency response as compared to preparing aggregated summary statistics and indicators). Therefore, guidance and tools need to be applicable at multiple scales for flexibility across different situations of available data and different uses of the statistics.

Hazard Exposure Model



43. Hazard exposure statistics come in the form of maps that are also very simply converted into standardized statistical tables, as was done for the pilot studies, and shown in this example for flood risk for a district in Bangladesh.

Sample Population Expsoure, Faridpur Zila, Bangladesh



Settlements (GUF) and Population in Flood Prone Areas, Nagarkandi Upzila Faridpur Zila (District), Bangladesh

	Settlements from GUF2012 (hectares)	Settlements (GUF) in flood prone areas (hectares)	% GUF in flood prone areas	Population 2011 (BBS Census)	Population in flood prone areas (GUF and dispersed)	% population in flood prone areas (GUF and dispersed)
Nagarkandi	**2430**	**1741**	**71.7**	**349905**	**269390**	**77.0**
Atghar	77	53	69.2	23102	17716	76.7
Ballabhdi	116	46	40.0	18739	10099	53.9
Bhawal	103	82	79.3	20356	17135	84.2
Char Jasordi	208	124	59.7	30898	24013	77.7
Dangi	263	208	79.2	22799	19718	86.5
Gatti	165	127	76.7	32456	27265	84.0
Jadunandi	97	4	3.7	17058	3377	19.8
Kaichail	157	152	96.6	16951	16661	98.3
Laskardia	253	216	85.2	23694	21246	89.7
Majhardia	90	75	84.1	17563	15506	88.3
Nagarkanda	224	186	82.8	11872	11192	94.3
Phulsuti	57	49	85.4	9168	8983	98.0
Pura Para	77	72	93.8	15839	15088	95.3
Ramkantapur	50	33	65.5	17156	13179	76.8
Ramnagar	139	90	64.3	20745	13546	65.3
Sonapur	82	21	25.2	21016	8533	40.6
Talma	272	205	75.4	30493	26133	85.7

Settlements (GUF) and Population in Flood Prone Areas, Faridpur Zila (District), Bangladesh

	GUF2012 (hectares)	GUF in flood prone areas (hectares)	% GUF in flood prone areas	Population 2011 (BBS Census)	Population in flood prone areas (GUF and dispersed)	% population in flood prone areas
Alfadanga	**602**	**149**	**24.7**	**108302**	**45827**	**42.3**
Bhanga	**2752**	**1908**	**69.3**	**249343**	**184518**	**74.0**
Boalmari	**1022**	**160**	**15.7**	**256658**	**65811**	**25.6**
Char Bhadrasan	**528**	**414**	**78.5**	**63477**	**57445**	**90.5**
Faridpur	**3091**	**1111**	**35.9**	**469410**	**183383**	**39.1**
Madhukhali	**790**	**142**	**18.0**	**204492**	**58120**	**28.4**
Nagarkandi	**2430**	**1741**	**71.7**	**349905**	**269390**	**77.0**
Sadarpur	**1770**	**1120**	**63.3**	**186254**	**139814**	**75.1**
Grand Total	**12986**	**6745**	**51.9**	**1887841**	**1013415**	**53.7**

Source: Expert Group Pilot Studies (ESCAP, 2016)

Table B1a (extract): Hazard Exposure by Hazard Type and Geographic Region

		Region				
		Geo. Region 1	Geo. Region 2	Geo. Region 3	⋮	NATIONAL TOTAL
4	GDP	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**
	Local currency (NAME…)					
	US$ PPP					
5	Population in Hazard Area	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**
5.1	Geophysical					
5.1.1	*High exposure*					
5.1.2	*Moderate exposure*					
5.1.3	*Low exposure*					
5.2	Hydrological					
5.2.1	*High exposure*					
5.2.2	*Moderate exposure*					
5.2.3	*Low exposure*					
5.3	Meteorological					
5.3.1	*High exposure*					
5.3.2	*Moderate exposure*					
5.3.3	*Low exposure*					
5.4	Climatalogical					
5.4.1	*High exposure*					
5.4.2	*Moderate exposure*					
5.4.3	*Low exposure*					
5.6	Other [specify]					
5.6.1	*High exposure*					
5.6.2	*Moderate exposure*					
5.6.3	*Low exposure*					
6	Hazard exposure perimeters/ Built-up areas					
7	Hazard exposure perimeters/ Agriculture areas					
8	Hazard exposure perimeters/ Forest areas					

4) Vulnerability

Sustainable Development Target 1.5

“By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters”

44. According to the Hyogo Framework (United Nations, 2005): "The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and one of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action on the basis of that knowledge"

45. The Sendai Framework recommendations adopted by the UN General Assembly in 2015 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.”**

46. This definition is a very slight modification to the definition from UNISDR (2004) and captures the general concept consistently with most other key references. In some reports, terminologies such as susceptibility, exposure, sensitivity, fragility, and coping capacity have been used

interchangeably with vulnerability. Also the variables for describing different type of risk factors are not always independent. However, from a measurement perspective, vulnerability is a useful concept for organizing statistics on the baseline conditions, beyond the simple overlapping of location with hazards, which increase risks for societies.

47. "Climate change threatens to overwhelm local efforts, requiring more from national and global supporting structures." (World Bank, 2010) Also, many of the factors of vulnerability go well beyond choices by communities or by individuals. Significant correlations with disaster impacts have been shown for factors like age at the time of disaster, income and wealth and employment opportunities and other general characteristics of social-economic status. As disaggregated statistics on the social characteristics of affected populations (or populations in hazards areas) are developed within national statistics systems, researchers will have a much improved evidence base for studying the importance of the variables of social-economic vulnerability as part of the disaster risk profiles for countries or regions.

48. There are growing challenges to predicting risk from climate change and other factors of the modern globalized world. However, from a technical perspective, there are also many enhanced opportunities, like free availability of software and methodologies for making increasing use of new data sources, such as remote sensing, mobile phone datasets, and so on,. The World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) stressed 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." A role for a common statistical framework on disaster impacts and disaster risk can be to help respond to these needs for greater transparency and replicability for the statistical inputs used in risk and impact assessments by generating a common set of rules and guidance for applying the agreed concepts and terminologies into the practice of official statistics.

49. One of the best, and likely most powerful in terms of explanatory power, examples of vulnerability factors is multi-dimensional poverty. For all types of hazards and environments, poor households and communities are the most vulnerable to direct impacts from hazards and to effects from the broad social-economic consequences. Thus, for disaster risk, it is very useful to collect geographically disaggregated information on poverty. The example used in the sample table below is **median household disposable income** according to municipalities or other administrative region of the country. However, many other relevant variables could be tabulated in the same way as inputs into vulnerability assessments, as available. This includes, in particular, the SDG Indicators.

Table B1a (extract): Population Vulnerabilities by Geographic Regions

		Region				
		Geo. Region 1	Geo. Region 2	Geo. Region 3	...	**NATIONAL TOTAL**
1	Population	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**
	Children under 5 years					
	Persons over 65 years					
	Persons with disabilities					
	Households					
2	Median Households disposable income					
2.1	Local currency (NAME...)					
2.2	US$ PPP					
4	GDP	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**
	Local currency (NAME...)					
	US$ PPP					
5	Population in Hazard Area	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**

50. Previous studies can suggest a potential short list for geographically disaggregated variables for compilation for an improve understanding disaster risk in relation to potentially highly vulnerable segments of the population, such as:
    - education enrolment, by age group and education achievement by male and female heads of households
    - information on income and assets of households
    - other human development statistics, by age group, including evidence related to nutrition and childhood health,
    - type of employment, particularly for households engaged in agriculture of fishing
    - urban versus rural distribution of affected or exposed areas
    - dwelling structures, particularly in terms of durability to particular types of hazards

51. If these and other relevant variables are gathered and updated on a regular basis for areas within countries exposed to natural hazards, disaster management agencies would have *a priori* information on extent and specific locations (among other characteristics) of vulnerability for developing disaster risk reduction strategies at local and national levels but also to help inform efficient disaster emergency response and relief efforts.

52. Nearly all facets of vulnerability for disasters cut across three traditional sustainable development pillars. For example, although pollution in water bodies is generally considered as an environmental problem, in the context of disaster risk, pollution is also a social and economic liability as it can lead to significant worse impacts to human lives and health and to the economic costs of recovery.

53. Another example is vulnerability of assets, sometimes called "physical vulnerability", the response of existing structures to potential hazards. Physical vulnerability is not only an engineering problem. In most cases, physical vulnerability also stems from other social-

economic or environmental problems. Relatively poor households often have little choice but to accept relatively less resilient shelters in their dwellings or work places. Poorer communities, such as slums or lower income areas of urban sprawl, often are also more likely to be situated in areas with increased inherent environmental vulnerabilities that affecting the degree of exposure to hazards.

Physcial vulnerability case study: Liquefaction after Canterbury Earthquakes, New Zealand (2009-2013)

54. As of December 2013, residents of Canterbury New Zealand had experienced over 60 earthquakes of magnitude 5 or higher and thousands of smaller aftershocks, over a period beginning from a surprise 7.12 magnitude earthquake on 4 September 2010. During this period, the quake resulted in an estimated 185 deaths, a large decline in the stock of safe dwellings, and (as of May 2016) insures settled 83,000 claims for residential and commercial properties.[12]

55. Among the most devastating impacts to residential areas after the series of Canterbury earthquakes between 2010 and 2013 in New Zealand, were to neighborhoods of Christchurch located in a low-lying delta area near the ocean above relatively loose and sandy soil. These structures were particularly vulnerable not just to the force of the seismic energy, but also from a process of liquefaction that occurred as a result of the movements and realignments to the topsoil.

56. As reported by Munichre.com: large areas Christchurch already low-lying land sank even further, leaving it more susceptible to flood damage in adverse weather conditions. As a further consequence, gravity-dependent infrastructure like sewage systems was no longer feasible.

57. The third effect was that the already thin layer of stable material overlying the liquefiable material was made even thinner. The consequence of this last factor was that thousands of homes were now located in areas where any further seismic activity would likely bring the first two factors into play and affect the land to the extent that it would no longer support buildings.

58. Due to these impacts and their implications for vulnerability, whole neighborhoods of Christchurch were uprooted and displaced into new residential areas expanded to accommodate these populations in other areas of Canterbury or in other parts of the country. The liquefaction, among the many other direct impacts from the earthquakes, have changed the landscape of Christchurch and left the local officials with many decisions to make about how to re-develop the region sustainably and with reduced vulnerability from potential future hazards.

59. The National Statistics Office of New Zealand also conducted an extensive study on the impacts of the earthquake on housing (see Goodyear, 2014) and investigated changes to the stocks of dwellings, numbers of occupied dwellings, household deprivation and crowding, and numbers of people living in 'other private dwellings' (e.g. mobile dwelling or motor camps).

[12] http://www.icnz.org.nz/natural-disaster/canterbury/rebuild-statistics/

60. As with the case of exposure, its useful to define the objects of measurement for vulnerability in terms of geographic areas (areas with known hazard exposure). In these areas, many different social and economic characteristics can be derived and summarized, where available, based on existing sources of official statistics, such as: population and housing census, household surveys, business surveys and business registers, and from statistical information derived from various forms of administrative sources, like civil registration, school enrolment, health information systems, and so on.

61. The core variables for describing vulnerability are snapshots in time. Gradually, statistics systems evolve towards development of a time series, based on consistency in application of the basic concepts and through transparency of information about the data used as inputs, their quality, and the methods used for estimations or calculation of indicators.

Population Group case study: herding households in Mongolia

62. For many vulnerable groups, particularly the poor or under employed, vulnerabilities to disasters can become a vicious cycle with impacts from disasters. In other words, vulnerability creates the context that contributes to causing a natural hazard to become a disaster but also the impacts of disaster, e.g. losses of dwellings, create new vulnerabilities or newly vulnerable groups.

63. However, it is difficult to identify and study this kind of vicious cycle using typical sources of official statistics because sometimes impacts from previous disasters have unexpected or difficult to trace effects, such as (e.g.) migration and particularly urbanization. Some revealing aspects of this vicious cycle have been studied for the case of extreme cold weather events (called a ***dzud***) in Mongolia by the German Institute for Economic (DIW-Berlin) in collaboration with the National Statistics Office of Mongolia (see Groppo and Kraehnert, 2015) by collecting panel time series data from herding and non-herding households from rural areas, and following the changes circumstances for these households over time via longitudinal panel data collection. Included in the study were some households that have migrated or made other changes from the traditional nomadic herding lifestyle after experiencing impacts from a disaster.

64. Groppo and Kraehnert (2015) found clear relationships between vulnerability to disaster impacts with sources of income (i.e. herding versus non-herding), level of income and amount of assets and a with education levels for the heads of the household, particularly the female heads of households.

65. One of the most striking results of the series of results published from the panel survey by was the length time of impacts to the households after a disaster occurrence. In an analysis designed to look at the long-term effects, using the case of the 1999-2002 triple ***dzud*** (a particularly harsh occurrence of this hazard), the researchers found a significant negative effect from exposure t on the probability to complete basic education, 10 to 11 even years after the event. This suggests that, especially for vulnerable groups, it may be necessary to continue to record the indirect impacts to populations up to a decade after a disaster occurrence, or longer.

66. Another example of the vicious cycle of vulnerability and the importance of studying vulnerability in relation to disaster impacts comes from the post disaster assessment study conducted in Samoa after Cyclone Evan (2012). The Report from this post-disaster assessment study stated that “vulnerable groups have been impacted, and new vulnerabilities have been created. The elderly, children, and people with disabilities were recognized as the most vulnerable, but were well taken care of by families and communities. A less visible group of individuals and families that are outside of community structures emerged as particularly vulnerable in disaster contexts. In addition, a new group of vulnerable people has been created due to severely damaged or destroyed homes” (Government of Samoa, 2013).

Vulnerability and Geography

67. Density of population is the basic metric required for calculating population exposure to hazards, but it also can, itself, be a factor for vulnerability. Many rural communities will face marginally higher vulnerability 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 the informal community support systems in rural communities often tend to be particularly strong and adaptable.

68. The defining characteristic of the urban centres, particularly the megacities, many of which are located in coastal zones or otherwise hazardous locations in Asia and Pacific, is extreme population density. While there are social benefits to having large groups of people concentrated within relatively small geographic areas, such conglomerations also can be inherently vulnerable to impacts from hazards. Mumbai is a coastal megacity in Asia with a population of over 22 million in 2017. According to a case study in (IPCC), “coastal megacities are already at risk due to climate related disasters” and “urban poor populations often experience increased rates of infectious disease after flood events.”

69. Hanson et al. (2011) found that about 40 million people in coastal cities are exposed to flooding and sea level rise. Utilizing UN figures on urbanization rates, the authors also predicted that four coastal megacities (Dhaka, Karachi, Mumbai and Lagos) will grow to exceed 50 million. Urban slums are often located in parts of the cities with the highest risks due to environmental and social factors, for example in floodplains or on steep slopes”.[13]

70. The 2010 World Development Report 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 UNDP-UNEP Poverty and Environment Initiative (PEI). The reverse type of situations, unfortunately can also be true, for example where environments are heavily polluted or

[13] For more information, see Working paper on urbanization and disaster risk at http://communities.unescap.org/asia-pacific-expert-group-disaster-related-statistics/content/drsf

degraded, often it is the relatively poor populations that are most likely to be the most directly and proportionately worst affected by the effects of these “technical” or “manmade” hazards, such as a polluted river or exposed landfill.

71. Access to freshwater and sanitation is a good example of a factor of disaster vulnerability, in which “pro poor environmental policies” can create win-win-win outcomes for the poor, for the environment, and for disaster risk reduction. Access to freshwater and sanitation is the topic of Sustainable Development Goal 6 and one of the major and conspicuous symptoms of poverty. Disasters can affect water and sanitation systems in many different ways. Direct impacts include rapid salinization or contamination caused by extreme weather hazards. Vulnerability to these types of impacts can be assessed if statistics are available on location and other basic characteristics of the water and sanitation infrastructure.

72. Water and sanitation assets are included in the indicators for measuring impacts to critical infrastructure in the Sendai Framework monitoring system. National or local authorities will have the best knowledge for summarizing information on water and sanitation (among other types of infrastructure) according to the specific norms and standards in that country.

Sample Table: Households in Bangladesh affected by diseases due to insufficient access to drinking water and sanitation during or after a disaster, by region and types of disease

Division/ District	Total Household	Affected Household	Type of Disease (%)							
			Affected Household	Diarrhea	Dysentery	Skin Disease	Flu-Cough	Fever	Jaundice	Others
Bangladesh	32,174,000	613,474	0.019067384	36.66	21.06	9.97	15.17	9.27	2.73	5.14
Barisal	1,863,000	108,501	0.058239936	36.79	15.58	13.56	15.4	9.47	2.36	6.85
Chittagong	5,626,000	77,651	0.013802169	37.34	27.7	7.73	14.59	8.59	2.82	1.22
Dhaka	10,849,000	139,357	0.012845147	35.17	19.78	8.54	17.61	10.96	2.63	5.32
Khulna	3,740,000	120,060	0.032101604	37.12	23.8	11.78	9.79	7.46	2.11	7.94
Rajshahi	4,487,000	56,920	0.012685536	37.82	16.96	10.36	21.08	6.25	3.39	4.14
Rangpur	3,818,000	55,124	0.014437926	32.24	27.02	5.67	18.43	10.98	3.21	2.45
Sylhet	1,791,000	55,859	0.031188721	41.31	18.1	9.63	11.71	10.91	3.81	4.53

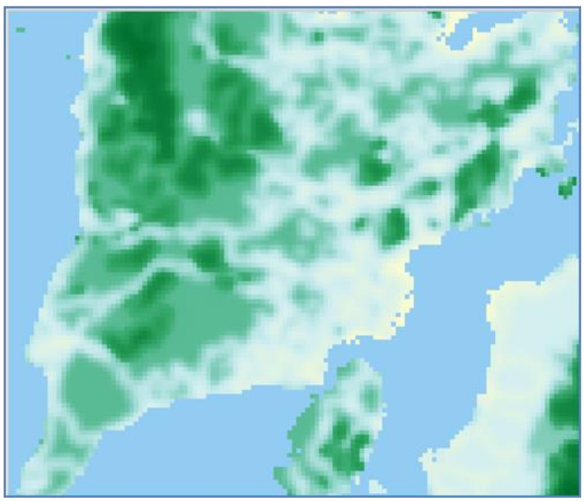
Source: Bangladesh Disaster-related Statistics 2015, Bangladesh Bureau of Statistics, period coverage: 2009-2014

73. When assessing economic-related vulnerabilities, it is important to consider economic structural factors that are specific to individual economies, but may be very significant sources of risk. For example, the tourism industry is likely to face special kinds of direct and indirect impacts from disasters because either important natural or historical monuments were affected or because the occurrence of the disaster directly caused limitations for travel to or within a country.

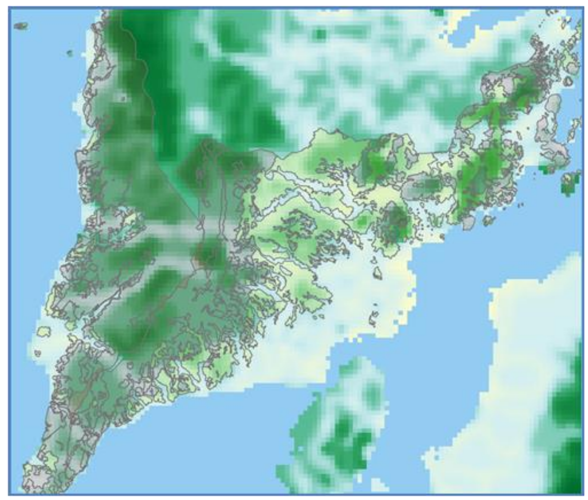
74. Agriculture and other kinds of productive activities that are space intensive and/or heavily dependent on meteorological and other environmental conditions will, in most cases, also be relatively more vulnerable to natural hazards as compared to, for example, services-based economies.

75. Producing empirical evidence for these relationships between hazard exposure and environmental change could be useful for an improved understanding of risk and for developing better land use, sustainable development and environmental conservation planning. The theoretical understanding of relationships between ecosystems and resilience to extreme events has advanced a lot and now is recognized as a core theoretical component in the literature.[14]

76. However, at present, availability of harmonized statistics is mostly limited to a relatively small collection of case studies. Harmonized statistics are needed for analyses of the changes in the relationships between ecosystems and vulnerabilities at different scales in order to influence public policy decisions. An example could be relationships (e.g. in space on a map) between population exposure to floods and landslides in relationship to changes in the volume or condition of forest cover in a certain area.



(left) NLEP, the index of Net Landscape Ecological Potential measured as (Landscape Greenness + Nature Conservation Value) / Fragmentation by Roads



(right) The overlay to NLEP of the map areas at Risks of Rain Induced Landslides (grayish = high, yellowish = moderate) allows measuring land ecosystems exposure to hazard. Example from The Philippines.

5) Coping capacity

Sustainable Development Goals Target 13.1
Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

[14] Building upon previous work conducted for the the economics of ecosystems and biodiversity (TEEB) publications, the UN Experimental Ecosystem Accounting Framework (UN, 2014) reduced impacts from various natural hazards as core examples of benefit in its classification of ecosystem services (CICES).

77. Many strategies for coping with disasters are informal and not managed by governments or through regulations, and therefore their significance, or relevance to understanding risk, is difficult to measure with statistics. For example, one of the coping mechanisms in the case of drought or other types of climate or hydrological-related hazards is simply migration, either permanently or temporarily, in search of a livelihood outside the worst affected areas. Population displacement and other movements of the population that correspond in timing with a disaster can sometimes be captured via statistics from population censuses or population administrative records. More difficult is to attribute movements specifically to hazards or a past disaster.

78. The term "resilience" arises with a variety of meanings or descriptions for disaster risk. Commonly, resilience is mentioned almost interchangeably with the concept of coping capacity. This is the ability for households or businesses or infrastructure to withstand external shocks without sustaining major permanent negative impacts, and instead guiding towards opportunities for improvements in the future (e.g.. "building back better").

79. For example in Birkman (2013): "In contrast to vulnerability, resilience emphasizes that stressors and crises in social-ecological systems also provide windows of opportunity for change and innovation. Hence crises and destabilization processes are seen as important triggers for renewal and learning."

80. Disaster preparedness is a good example of an adapted factor of coping capacity. After major earthquakes struck in the Canterbury province of New Zealand, population and housing census results revealed significant increases in disaster preparedness of households (e.g. emergency food and water storage). Such information reveals a decrease in overall risk, via increased coping capacities, which are direct benefits from learning and from educational programmes.

81. Besides as an input for understanding risk, an additional use for producing statistics on coping capacity, is the information can show direct results from investments in increased preparedness. Disaster management agencies utilize the best available risk information to design and implement activities to reduce the impacts of disasters. These activities take place not just in response to a disaster but also before a disaster through progammes on preparedness, like early warning systems.

82. Disaster risk reduction-related activities (Section 2e) are activities that boost the coping capacities of society. In order to assess the direct results of these investments, governments should collect statistics on coping capacities, e.g. coverage of early warning systems, basic knowledge and preparedness of households.

83. 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 also can have a significant role in determining where people live and work, and in what kind of buildings, their level of hazard protection, preparedness, and access to information and

knowledge. (Wisner et al., 2003). Thus, vulnerability and coping capacity are closely related for some population groups.

2c) Material Impacts and Economic Loss

Material Impacts

1) Material impacts encompass the direct impacts to assets, including critical infrastructure triggered by a hazard. The direct material impacts constitute the scope of measurement for the Sendai Framework direct economic loss indicator.

2) Statistics on direct material impacts are produced by disaster management based on assessments conducted immediately after an emergency (UNGA, 2016). These statistics can be completed by statistical information on the location and basic characteristics of infrastructure in a disaster areas prior to the hazard, i.e. estimates of exposed infrastructure. As with the case of statistics on affected population (see 2d), background statistics serve a dual purpose of baseline information for analyses of impacts data and as inputs to estimate impacts and risk.

3) The most important challenge for compiling coherent basic statistics on material impacts from a disaster is defining measurement units (see discussion in Chapter 5), including development of a robust and consistent method for monetary valuation of impacts to assets (see working paper on measuring direct economic loss).

4) Initially, direct material impacts from historical disasters are measured in physical units, the simplest and one of the most common examples being counts of units (or buildings) damaged or destroyed, see example in Table 1, compiled using reports from pilot testing in the Philippines.

5) Within a category of assets (hospitals, roads, bridges, houses or dwellings), not all units are equivalent. They differ by quantity and quality. Monetary valuation is supposed to integrate qualitative aspects. Nevertheles, in physical terms, raw data should be converted into less coarse statistics, utilizing weights or categories that better reflect the impacts. Examples include: number, length and width of roads and bridges affected (or distance of detour) , traffic capacity of roads or railways affected, capacity of hospitals, hosting capacity of tourist resorts (beds), surface of office buildings, number of students in school buildings, and so on.

Sample Table1: Damages to Critical Infrastructure in the Philippines, 2013-15

	Region	DAMAGES TO CRITICAL INFRASTRUCTURE					
		Hospitals/ Health facilities	Education facilities	Other critical public administration buildings	Roads	Bridges	Other critical infrastructures
PHILIPPINES	Region I (Ilocos)	3			33	5	
	Region II (Cagayan Valley)	30	0	0	19	8	
	Region III (Central Luzon)	64			140	12	
	Region IV-A (Calabarzon)	12	0	0	5		
	Region IV-B (Mimaropa)	123	0	0			
	Region V (Bicol)	66	0	0	10	1	
	Region VI (Western Visayas)	36	0	1			
	Region VII (Central Visayas)	286	82	37	55	26	18
	Region VIII (Negros Island Region)	347	0	0	24	4	0
	Region IX (Zamboanga Peninsula)	0	0				
	Region X (Northern Mindanao)	0	0	0	3	3	
	Region XI (Davao Region)	0	0		18	3	
	Region XII (Soccsksargen)	0					
	Region XIII (Caraga)	0	0		39	6	
	National Capital Region (NCR)	8					
	Cordillera Administrative Region (CAR)	1			20		
	Autonomous Region of Muslim Mindanao (ARMM)						
	Nattional total						

No. of units (e.g. no. buildings), source: report from Philippins for DRSF Pilot Studies (2016),

Target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

Indicator D1: Damage to critical infrastructure attributed to disasters.

6) **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. " (UNGA, 2016)

7) Damages to dwellings create an explicit link between human and material impacts tables. In the example below, impacts are measured again in terms of numbers of units, this time for the case of Indonesia. Number of dwellings, in this case, may be equivalent to number of households affected. In principle, the basic source of this information should be identical with that used to calculate the number of persons affected by a damaged or destroyed dwellings (Sendai Framework Indicators B-3 and B-4).

8) There are similar linkages between tables for most other material impact variables as well. For example, damages to critical infrastructure may have direct links to disruptions of basic services experienced by the population (indicators for Sendai Framework Target D: "Substantially reduce disaster damage to critical infrastructure and disruption of basic services"). Also, damages to non-

dwelling buildings may have consequences for employment, and other variables used to describe impacts to the livelihood of the population. Thus, data sources in direct material impacts can serve multiple purposes, including for populating human impacts tables, thus helping to fulfil to demands for multiple indicators in the Sendai Framework and SDG indicators.

Sample Table 2: Damages to Dwellings in Indonesia

	Damaged Dwellings (#of units)					
	geophysical	hydrological	meteorological	Climatological	Other	total
Aceh	9307	2026	201	0		11534
Bali	3	148	46			197
Bangka-Belitung		0	103			103
Banten	55	403	173			631
Bengkulu	321	178	112			611
Gorontalo		3	3			6
Irian Jaya Barat						0
Jakarta Raya	3	0	250			253
Jambi	47	148	162	0		357
Jawa Barat	1345	6969	1547			9861
Jawa Tengah	830	1285	4768	0		6883
Jawa Timur	612	576	3218	0		4406
Kalimantan Barat		90	158			248
Kalimantan Selatan		334	129	0		463
Kalimantan Tengah			1	0		1
Kalimantan Timur	47	1	39	0		87
Kalimantan Utara			1	0		1
Kepulauan Riau	4	49	111	0		164
Lampung	0	0	1023			1023
Maluku	620	83				703
Maluku Utara	146	23				169
Nusa Tenggara Barat	735	1454	129			2318
Nusa Tenggara Timur	11	151	32			194
Papua	1	0				1
Riau	9	30	343	0		382
Sulawesi Barat		76	31			107
Sulawesi Selatan	66	23	697			786
Sulawesi Tengah		27	3	0		30
Sulawesi Tenggara		8	114			122
Sulawesi Utara	37	145	6			188

Sumatera Barat	2688	504	281	0		3473
Sumatera Selatan	78	20	244			342
Sumatera Utara	27	30	2249	0		2306
Yogyakarta	22	18	61			101
Papua Barat	9	305				314
National Total	17023	15107	16235	0	0	48365

Damaged Dwellings, # of units (1900-present), accessed from Data Informasi Bencana Indonesia (DIBI) http://dibi.bnpb.go.id, 2017

9) Although the crux of the Sendai Framework Target D impacts are damages to critical infrastructure, some of the indicators are described in terms of disruptions of services.

10) Statistics on disruptions to services from material impacts, like all the direct and indirect impacts tables, can be presented according to hazard types (as in Table 2a below) and/or according to geographic regions within the country.

Table D2a Disruptions to Basic Services from a Disaster by Hazard Type

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						
2.1	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	**Water services**						
4.1	No. of people						
4.2	Length of time						
5	**Other Basic Services**						
5.1	No. of people						
5.2	Length of time						
6	**Total Disruptions**	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5	Sendai D-5
6.1	No. of people						
6.2	Length of time						

11) As long as measurement units are different from service to service, an addition a general total (i.e. Sendai Framework global indicator D5) is not possible. A proxy common unit of measurement in physical terms could be the number of persons and/or length of time (number of days) deprived from the services.

12) In addition to damages to critical infrastructure and other buildings, another very important component of direct material impacts is damages to the land, especially to agricultural land, destruction of trees and other environmental resources, and damages to the conditions of important ecosystems.

13) In economic terms, impacts to agriculture are often among the most significant material impacts from disasters. Material impacts are manifested in damages to the land itself, including the soil (accelerated erosion, landslide impacts, salination...), land developments (irrigation systems,

greenhouses...) as well as direct losses to the growing (non-harvested) crops. Each of these components Each of these components of agriculture can be measured separately, in physical terms, and would need to be for monetary valuation due to differences in treatments for different types of assets and for works-in-progress, according to principles in the System of National Accounts (SNA).

14) Moreover, natural environments are critical inputs to resilience of proximate communities to disaster, impacts to ecosystems can include significant changes to resilience, increasing disaster risks after a disaster (e.g. risks of flash floods after deforestation by landslide or volcano eruption), as well as negatively impacting various other quantifiable benefits of ecosystems.

Direct Economic Loss

15) For the remainder of this section we will discuss relationship between material impacts and economic impacts in a broad sense, in which official statistics can be utilized for deriving analyses and indicators on economic impacts from a disaster in a way which is consistent with conventional economic statistics and the National Accounts (SNA).

16) In the outcome report of the *" the open-ended intergovernmental expert working group on* indicators and terminology relating to disaster risk reduction" (UNGA, 2016), the scope of "**direct economic loss**" is restricted to specific type of measurement, which is usually organized and reported officially shortly after disaster occurrences by disaster management agencies.

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

Indicator c3: Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.

17) According to the UNGA (2016) adopted document (p.17): **"Direct economic loss** is the monetary value of total or partial ***destruction of physical assets existing in the affected area***. Direct economic loss is nearly equivalent to physical damage." Moreover, "direct economic losses usually happen during the event or within the first few hours after the event and are often assessed soon after the event to estimate recovery".

18) The Open-ended Intergovenmental working group indicated clearly that physical damages, gauged during or just after the disaster, are the triggering facts to consider for assessing economic loss. It excludes, therefore, indirect effects resulting from population displacement and change of local conditions that are the later consequences of damages. However, assets value relates to the period during which they give rise to benefits and from a time perspective, assessing direct physical destructions and assessing resulting direct economic losses is not equivalent even though the triggering fact is identical. In other words, measuring economic cost of direct material impacts is a relatively more complex measurement challenge, with a broader consideration in terms of the relevant timing of the disaster, as compared to the trigger factors (i.e direct material impacts).

19) According to the SNA, "An asset is 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 transferring value from one accounting period to another. " (SNA2008, para 3.30).

20) Economic loss to assets will include loss of future benefits assessed as a consequence physical assets destruction or damage; they will not include losses of business opportunities and other drawbacks resulting from the disaster, which are indirect impacts.

21) In UNGA (2016), the recommendation for Sendai Framework global indicators is that observed assets prices are used, if possible, at a time close to the disaster period called spot valuation. Reparation of restoration costs may be the implicit value in many cases. Cases such as recovery of value to public infrastructure or to dwellings are good examples. Where (eventually) a comparable reconstruction is likely, with observable costs (to government, to household, and/or to insurance). However, this ideal solution will not be viable in many other cases.

22) Difficulties in implementing a rule of reparation or restoration costs, or other market-price-based measurement of damage will arise in many cases, and for many reasons. For example, recovery will not replicate the pre-disaster context. Newer, at least, of less or more value, assets, probably with stricter protection against hazard standards (called "building back better") replace the old, damaged infrastructure. In many case actual restoration costs of private assets will be assessed on the basis of government practice of compensation: while public infrastructures must be restored anew with a complete cost assessment. In contrast some assets may not be recovered at all.

23) Alternative solutions rely on estimations. Generally, assets market prices are difficult to measure as they depend on a limited market (transactions for buildings, for example, are relatively rare). Hence, the SNA proposes that when direct observation is not possible, an alternative solution can be derived from financial accounting practices. It consists in measuring the "fair value" of companies according to the net present value of expected benefits (SNA Chapter 20, Capital Services). For example, the fair value for an owner-occupied dwelling, could be the fair value of future-expected income from renting out the dwelling.

24) None of the potential solutions for monetary valuation of direct impacts is easy to implement in every case and more pragmatic solutions need be sought out, studied and further developed in the diversity of contexts in which disasters occur (see the New Zealand example, below).

25) The System of National Accounts (SNA 2008) does not purpose to measure explicitly disasters direct impacts economic losses, but it addresses the general equilibrium of economic flows and the changes in assets and liabilities. However, as material impacts from disasters influence economies, economic losses are expressed in reference to GDP (as asked in the global indicators from th Sendai Framework and the SDGs), valuation in monetary terms should seek the best consistency with the SNA. In case of justified divergence, gaps from SNA standard should be described explicitly. Beyond methodological standards, the possibility of finding disaster relevant information in the SNA core accounts has to be assessed.

26) The SNA encompasses additional accounts called satellite accounts or functional analysis. Their purpose is to present in a systematic and comprehensive way all economic information on a particular social domain such as education, health, research and development, environmental protection or on multidimensional activities such as tourism. The main aggregate for a domain is national expenditure. Its magnitude can be compared with other domains and with the total (cross-domain) GDP. DRSF includes Disaster Reduction and Management Expenditure (see Section 2e); satellite accounts (or other presentations) of DRR expenditure can be applied to support estimation of economic losses.

27) In the SNA**, production** is an activity, carried out under the responsibility, control and management of an institutional unit, that uses inputs of labour, capital, and goods and services to produce outputs of goods and services (SNA, 2008). The balancing item from production accounts is Value Added (VA) which sum at the country level is GDP. VA and GDP are firstly computed Gross, which means with no deduction of the regular consumption of fixed capital resulting from assets use and obsolescence. When deduction is done, VA and GDP are called "Net" (NVA, NDP).

28) In the SNA, production depends on inputs of economic non-financial assets (Fixed capital and Inventories), which can be damaged or destroyed in the form of direct material impacts from a disaster. Such sudden assets reduction is not recorded in SNA annual current flows accounts as a deduction to GDP, although its indirect consequences on Value Added may be observed, e.g. from time series analysis. Note that these negative effects will be merged in GDP with the additional VA of restoration activities (as positive contributions to GDP, rather than as losses). In the SNA, disaster related losses are recorded only in the Balance-sheet of non-financial and financial assets in the "The other changes in the volume of assets account" as a "disappearance" of asset under the item "Catastrophic losses".

29) **SNA 12.46: "***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."* In principle, economic losses from disasters is recorded by the SNA, at least for catastrophic losses of "large scale". In DRSF, it should be supplemented with smaller scale disasters as their accumulation all other the year may yield important economic cost.

30) There is one additional basic and critical issue with assets prices to consider for the case of enterprises. In the SNA, assets are defined in reference to owners which are enterprises, government services (for public infrastructures) and households (for dwellings). Prices can be measured as observed market prices and in their absence or inadequacy, by the Net Present Value of expected benefits. In the SNA, these future benefits are those of the owner of the asset, which is fully consistent with the SNA model but means that losses to the economic capital are recorded only from the perspective of their owners. In so far as enterprises provide benefits to their owners (profit) as well as to their employees (compensation) and to the government (taxes), the ownership approach to valuation of economic costs may be insufficient for fully describing the direct costs of material impacts. Costs to other stakeholders, which may be considered impacts to human and social capital are also significant. For example, the economic value of a factory is broader than just the costs for repair to the owner of the building (or insurance) since the value of the asset (according to the SNA), is the value of future benefits.

31) For economic losses from disasters, more comprehensive measurement of net present value of benefits could refer to the Net Value Added instead of capital owner's earnings (Net Value Added is equal to Gross Value Added minus consumption of fixed capital which is a productive consumption and must be deducted from benefits whatever their scope).

32) Another particular case has to be discussed considering production in process. In the SNA, production in process is recorded in inventories or in the case of equipments which require more than one year of production, as formation of fixed capital in proportion to the work done. In the case of managed natural resource, natural growth (of trees, livestock...) follows a similar rule and is recorded as production and gross formation of capital. There is noticeable difference with industrial products as annual crops are not recorded in inventories before they are harvested.

33) For measuring direct economic loss from the material impacts of disasters, destruction of growing annual crops must be recorded, as supported in descriptions for the Sendai Framework global indicator. Again, there are multiple options in terms of pricing these material impacts to the growing crops, considering the timing with respect to the production process and with respect to the indicative (or proxy) market price used for estimating values.

34) Also, in relation to recovery from disaster, practices in the national accounts and the GDP can create a peculiar and counter-intuitive measurement situation for the case of growth of natural assets. As mentioned previously, restoration activities are recorded as production, therefore additional Value Added. This is because they generate income flows which contribute to the economy during the accounting period. In the case of natural growth of natural assets, recording in production of reconstitution of young livestock or young trees, in the case of managed forests, results in a biased picture if the owners of natural assets have been ruined, economically, by a disaster. Particulaly for vulnerable groups, such as poor framers with limited access to credit, communities where livelihoods have been ruined, may actually be reflected as GDP growth, at the point of reconstitution of assets, even if those assets don't yet generate any revenue. This problem is very acute in the case of extreme cold weather disaster ("dzuts") that have occurred in Mongolia and created long-term economic impacts to the affected households. This example highlights that economic losses cannot be understood out of their context, the general economy as well as the economics of disaster prevention, reduction and management.

35) In addition to damages costs, there are numerous economic activities of direct relevance to understanding costs of disasters (see Section 2e). For example, the costs of reconstruction and recovery are a form of risk reduction but also direct indications of economic costs associated with specific disaster occurrences. Often the financing for these costs comes in the form of transfers, e.g. from central government to local governments or from insurers to insurance claimants. Values of these transfers should be available for the compilation of national accounts, and are relatively robust information for valuing direct economic impacts of a disaster.

Vulnerability to disasters and poverty

Sustainable Development Target 11.5 : "By 2030, significantly decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations"

36) From Sustainable Development Target 11.5, there is demand not only for measuring direct economic losses, aligned with the guidance adopted for the Sendai Framework, but also to provide focussed analyses for the poor and people in vulnerable situations. This can be accomplished via the linkages to affected population statistics, in particular households affected by damages to their dwellings or other assets (see further descriptions and examples in Part 2). Another important link for understanding relationships between material impacts from disasters and economic effect on population groups is to review statistics on financial support during and after a disaster. The

example below from Bangladesh shows numbers of household receiving financial support, according to different sources of support and by geographic regions.

37) The summary statistics in sample Table 3 were derived from a household survey (Impacts of Climate Change oh Human Life Survey (2015), which could also be used to derive statistic on household receiving financial support according to relevant population groups -e.g the poor and other people in vulnerable situations.

Sample Table 3: Number of households received financial support from organizations during and after disaster by geographic region, 2009-2014

Divison	Total Household	Organisation				
		Government Office	NGO/ International Organisation	Local Elite Person/ Local social welfare and cooperatives	Business Organisation	Others
	Number					
All	605319	446353	88361	43470	15923	11211
Barisal	189090	148257	24875	9401	4098	2459
Chittagong	63500	49058	3929	7067	2730	716
Dhaka	84601	60672	13797	6425	2307	1400
Khulna	104432	77726	15949	7663	2270	824
Rajshahi	51743	35158	9620	4237	1497	1231
Rangpur	79812	56134	16096	5074	1826	682
Sylhet	32140	19349	4095	3602	1195	3899
	Percentage					
All	100.00%	73.74%	14.60%	7.18%	2.63%	1.85%
Barisal	31.24%	24.49%	4.11%	1.55%	0.68%	0.41%
Chittagong	10.49%	8.10%	0.65%	1.17%	0.45%	0.12%
Dhaka	13.98%	10.02%	2.28%	1.06%	0.38%	0.23%
Khulna	17.25%	12.84%	2.63%	1.27%	0.38%	0.14%
Rajshahi	8.55%	5.81%	1.59%	0.70%	0.25%	0.20%
Rangpur	13.19%	9.27%	2.66%	0.84%	0.30%	0.11%
Sylhet	5.31%	3.20%	0.68%	0.60%	0.20%	0.64%

Source: Bangladesh Disaster-related Statistics 2015, Bangladesh Bureau of Statistics

In practice

38) As seen above, important information can be extracted from the national statistical system, including the National Accounts, but not all that is required for reporting to the Sendai Framework and the SDGs or for analyses of trends or their factors. Additional information is needed for some flows, as well as more regional details as impacts are localized. Also, the macro-economic model has to be interpreted and adapted in view of providing relevant assessments of economic losses. Economic losses are not a mere subset of national accounts. There is still need to continue collate the various elements required on the basis of best practices and record them step by step in the statistical framework. An example of some relevant work \done in Bangladesh is provided above.

39) The example below, from New Zealand, is given to show applications of existing official economic statistics collections for a broader (and/or, potentially more precise and robust) understanding of economic loss by developing accounts of expenditure, insurance transfers, and transfers from central to local governments for disaster recovery . This example comes from work conducted by Statistics New Zealand to help understand economic impacts for Christchurch after the major earthquakes in Canterbury province of New Zealand that happened in 2010 and 2011.

40) In practice, for many disasters, assessments for insurance claims, can take years to be completed comprehensively. By that time, there will able directly observable data on transactions and transfers (e.g from insurance companies or from government subsidized programmes) that can be used to update and probably improve the accuracy of direct economic loss estimations. Therefore, in the months or years after a disaster, there is a need for a coordinated process involving disaster management agencies and analyses of official sources of data on transactions related to the recovery and reconstruction to update and revise the assessments for direct economic loss.

41) Revisionsto the initial estimates for important economics indicators (e.g GDP) is already common practice in national accounts, especially when those indicators have relevance for a long-term time series analyzed. As new information becomes available, revisions to initial estimates for annual GDP (which is often estimated monthly or quarterly) are revised based on the new sources of information with the final estimates, being the most comprehensive and best aligned with international standards and reported to international bodies. A similar approach could be envisioned for the economic loss from disaster measurement, building upon the established practices of disaster management agencies and integrating with existing sources of official economic statistics, for the purpose of increased coherence for analyses international and overt time.

Studying economic impacts from Earthquakes in Canterbury Province, New Zealand

42) Statistics New Zealand produced a study on the impact of the 2010 and 2011 earthquakes from national accounts, focusing on 5 transactions:

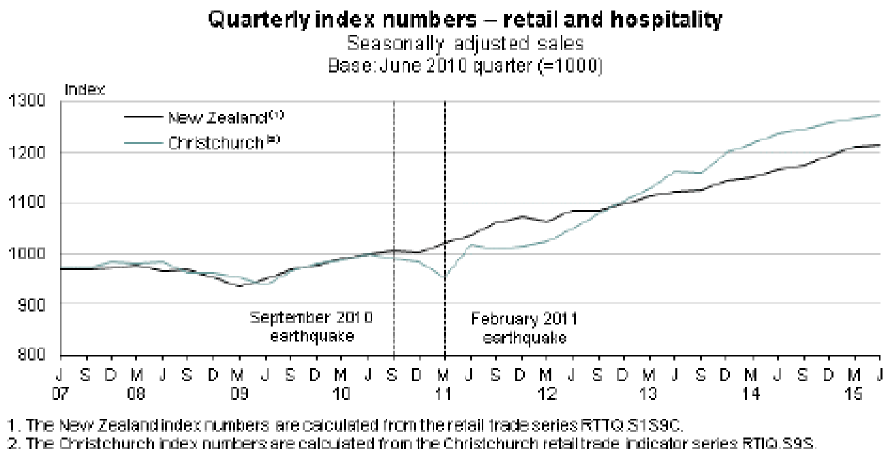
- the non-life insurance flows and policy holder outlays
- Dwelling services
- Earthquake support packages
- Donations
- Purchase of red zone properties by government.

43) The red zones were areas around Christchurch are areas where, after the earthquakes, land was determined to be unstable for continued residency and (re)building properties. Most the other activity identified for review in this study are recorded as current transfers and provide an estimate for compensated losses by employers and employees. These statistics are compiled into accounts based on surveys and a number of data sources, managed specifically for analyses of the earthquakes or regularly utilized regularly by Statistics New Zealand for broader purposes.

44) The effect on dwelling services proved difficult to measure because not many destroyed (i.e. could no longer be occupied) but many dwellings were damaged, but could be repaired and remain inhabitable.

45) In a comparison of trends, significant changes could be observed (see figure below) for retail and hospitality in Christchurch compared to the rest of New Zealand. This information is produced by Statistics New Zealand based on business surveys. This kind of trends analyses reveals the effects after the earthquakes caused by many of the retail shops, hotels, and other buildings normally attracting business actively to the city were seriously damaged or destroyed. The government of New Zealand also conducted a telephone-based census of retails businesses in the Christchurch area to collect information on damages to their assets, as part of a programme to provide financial compensation to small businesses and help with economic recovery in the region.

46)



Christchurch Retail Trade Indicator, June 2015 quarterly report[15]

47) The Canterbury Development Corporation produces quarterly economic reports, utilizing information collected by Statistics New Zealand and these reports contain extensive analyses of trends for the key ways that material impacts from a disaster will be manifested in the economy such as, for example, the long-term trends in retail trade, trends in real estate prices, construction, commodity imports and exports, and changes to the labour market.

1. All buildings in New Zealand are covered for earthquakes by the Insurance Council of New Zealand (ICNZ), which also produces quarterly reports on insurance payments due to the Canterbury Earthquakes. For example, a report in the first quarter of 2017 revealed that insurers settled $1.6 billion for residential claims (dwellings) in 2016, related to the 2010-2011 earhquakes, plus another $1.1 billion in claims for commercial buidlings.[16]

2. Statistics New Zealand also computes regional GDP estimates for New Zealand, based around, for most activities, apportioning GDP to units at the geographic unit (GEO) level using employment data. These regional GDP estimates provide the context (baseline information) of economic activities for regions before and after a major disaster to help understand the impacts and put estimates of value of direct material impacts into context of the size of the broader economy.

2d) Affected Population

1. Affected population is the subject of Sendai Framework Targets (a) and (b)

[15]http://www.stats.govt.nz/browse_for_stats/industry_sectors/RetailTrade/ChristchurchRetailTradeIndicator_HOTPJun15qtr.aspx

[16] http://www.icnz.org.nz/natural-disaster/canterbury/rebuild-statistics/)

(a) **Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005– 2015;**

(b) **Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015;**

2. For each of the disaster impact indicators in the Sendai Framework and SDGs, there is a baseline measurement of population (or economic activity in the case of economic loss) used to provide context to the aggregated statistics for comparisons between countries.

3. The **baseline population** is the population in an area affected by a disaster. The Sendai Framework defines the affected population more specifically linked to impacts. Thus, not all people in this area are necessarily part of the affected population, as defined for the Sendai Framework. The baseline populations serve a different purpose – i.e the denominators for assessing affected population in proportion to the size of the broader population in the relevant vicinity.

"Affected: people who are affected, either directly or indirectly, by a hazardous event. Directly affected are those who have suffered injury, illness or other health effects; who were evacuated, displaced, relocated or have suffered direct damage to their livelihoods, economic, physical, social, cultural and environmental assets. 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. –UNGA, 2016

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".

4. Depending on the geographic scale of analysis, e.g. comparisons between countries, or regions (or even on impacts across communities) baseline statistics are needed to give context to the analyses. The baseline population for understanding impacts of a disaster to people varies according to scale of the analysis.

Table B1a: Population Background Statistics and Hazard Exposure by geographic regions

		Region				
		Geo. Region 1	Geo. Region 2	Geo. Region 3	…	**NATIONAL TOTAL**
1	Population	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**
	Children under 5 years					
	Persons over 65 years					
	Persons with disabilities					
	Households					
2	Median Households disposable income					
2.1	Local currency (NAME...)					
2.2	US$ PPP					
4	GDP	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**	**SDG 1.5.2**
	Local currency (NAME...)					
	US$ PPP					
5	Population in Hazard Area	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**	**SDG 1.5.1**
5.1	Geophysical					
5.1.1	*High exposure*					
5.1.2	*Moderate exposure*					
5.1.3	*Low exposure*					
5.2	Hydrological					
5.2.1	*High exposure*					
5.2.2	*Moderate exposure*					
5.2.3	*Low exposure*					
5.3	Meteorological					
5.3.1	*High exposure*					
5.3.2	*Moderate exposure*					
5.3.3	*Low exposure*					
5.4	Climatalogical					
5.4.1	*High exposure*					
5.4.2	*Moderate exposure*					
5.4.3	*Low exposure*					
5.6	Other [specify]					
5.6.1	*High exposure*					
5.6.2	*Moderate exposure*					
5.6.3	*Low exposure*					
6	Hazard exposure perimeters/ Built-up areas					
7	Hazard exposure perimeters/ Agriculture areas					
8	Hazard exposure perimeters/ Forest areas					

5. Baseline statistics are presented in summary background statistics tables (table B1a) to provide the contextual information (denominators) for calculating the affected population indicators for the SDGs and the Sendai Framework

Sustainable Development Target 11.5
"By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations"

6. Core elements for the affected population have been summarized and defined in UNGA (2016) for the Sendai Framework

B1	Affected population (composite B2-B5)
B2	Number of injured or ill people attributed to disasters, per 100,000 population.
B3	Number of people whose damaged dwellings were attributed to disasters.

B4	Number of people whose destroyed dwellings were attributed to disasters.
B5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

7. In the rest of this chapter, we review each of the core elements of “affected” population, including elementsdefined for the Sendai Framework indicators, from the perspective of collection of official statistics.

Table C.1: Summary table of affected population by hazards types

		Hazards							
		Geo-physical	Hydrological	Meteorological	Climatological	Biological	Other	*Adjustment for multiple counting of events by types*	**NATIONAL TOTAL**
1 - Human impacts, affected population									
	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
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
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
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
1.2.1	*Major injuries*								
1.2.2	*Minor injuries*								
1.2.3	*Ilnesses*								
1.3	**Displaced**								
1.3.2	*Evacuations*								
1.3.2.1	*Managed and government-supported evacuations [also 1.6.1.1]*	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5
1.3.2.2	*Non-supported evacuations*	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5
1.3.3	*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-3
1.3.4	*Other Displaced*	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5
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
1.4.2	*Note: Number of people whose houses were destroyed - see 1.3.3*	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4	Sendai B-4		
1.5	**Loss of Jobs/occupations**								
1.4.3.1	Direct losses of jobs/occupations in agriculture	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5
1.4.3.2	Direct losses of jobs/occupations in industry and services								
1.5.3	Losses of days of activity								
1.5.1	*Direct losses of days of activity in agriculture*								
1.5.2	*Direct losses of days of activity in industry and services*								
1.6	**Number of people receiving aid**								
1.6.1	*Number of people who receieved aid. Including food and non-food aid during a disaster*	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5	Sendai B-5		Sendai B-5
1.6.1.1	*Supported with evacuation (1.3.2.1)*								
1.6.2	*Number of people who receieved aid after a disaster*								
1.7	**Otherwise affected**								
1.8	***Multiple counts, individuals (minus)***								
1.9	**Adjusted Total Affected Population**								

Deaths or Missing

8. Dead or missing are a combined category because missing people are either found or, unfortunately, eventually declared dead. The transition from missing to dead follows a procedure and period of time, which varies according to national laws. The differences between in laws and practices time period for missing persons do not affect the measurement because, eventually, in all cases the total amount of fatalities include missing and later declared dead in the final statistics. It is the case for nearly all direct impacts statistics, that there are likely to be initial estimates, and then, after a period of time and, perhaps, applications of additional data sources, revised estimates for the summary tables and time series.

9. Many previous reports (e.g. Birkman/UNU[17]) have noted that mortality statistics tend to be the relatively most reliable and comparable between countries compared to other indicators of affected population. However, as with other affected population variables, scope of measurement for deaths or missing population currenlt varies internationally, depending in particular on rules for attribution to a disaster. Rules for attribution of deaths to a disaster cannot be standardized across all cases, but the general framework of conventions for attribution is:

   a. deaths occurring during an emergency period (or deaths caused by an injury or illness sustained during an emergency) and believed to be caused by a disaster as defined in Section 2a, and
   b. indirect fatalities associated with a hazard, e.g. deaths from illnesses caused by consequences (poor access to water and sanitation, exposure to unsanitary or unsafe conditions as a result of a hazard).

10. The usual source of official records for deaths or missing after a disaster occurrence is the national disaster management agency (or equivalent organisation). These figures are reported by and to the different levels of local and national government and usually shared in official reports to the press and the general public.

11. These official reports on deaths and missing immediately after a disaster are not necessarily the same information that is processed into the broader official system of administrative data sources that are used as the long-term and comprehensive sources for official statistics on mortality and health of the population.

12. In most countries, mortality statistics are derived from administrative records (e.g. civil registration systems), which record all deaths and, where possible, causes of deaths. These data sources 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.

13. 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 cause of death classification, called ICD 10 (2016)[18], is managed by WHO . ICD10 does not include specific coding for deaths from disaster, but includes a general categories for "External Causes for Morbidity and Mortality" (code XX). Many countries face challenges for producing statistics

[17] Joern Birkmann (Editor), "Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies", Second Edition, United Nations University, 2013, Tokyo, Japan

[18] http://apps.who.int/classifications/icd10/browse/2016/en

from civil registrars 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 authorised to attribute deaths to a specific external event like a disaster.

14. In many cases of deaths occurring outside of medical facilities, the attribution may be robvious or could be estimated based on available records (e.g. timing and location of death), but there also sometimes cases where attribution of a death to a hazard is a matter of individual case-by-case judgement.

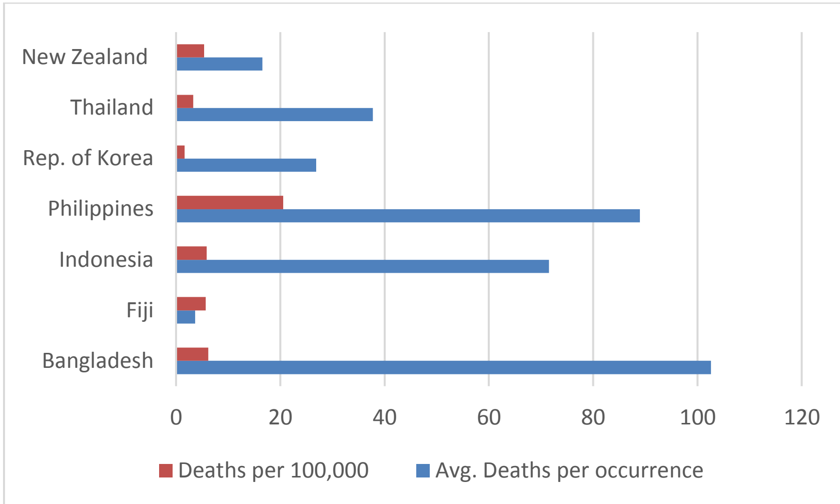
15. If the official determinations made by experts from the disaster management agencies are fed directly into these civil registrar and health information systems, then the attribution determinations could be systematically matched. In this way, the official reports from the disaster management agencies could be made coherent with the broader government system of administrative records and official statistics on health and mortality of the population.

SDG Target 11.5: “By 2030, significantly reduce the number of deaths and the number of people affected… including water-related disasters, with a focus on protecting the poor and people in vulnerable situations”

Sendai Framework global indicator A1: Number of deaths and missing persons attributed to disasters, per 100,000 population.

16. The Sendai Framework global indicator A-1 and SDG indicator for target 11..5 refer to number of deaths and missing persons attributed to disasters, per 100,000 population. As discussed above, the baseline population (per 100,000) may refer to different universes of population, depending on the analysis. In the sample analysis below, this indicator was calculated for selected countries based on the available records from CRED/EMDAT and using national population totals from the latest year in the series (2015). The same information can also be reported by hazard types and by geographic regions. Additionally, the same statistics can be used for a variety of other related indicators or representations of the information. For example, the 2nd indicator in the charts below is number of deaths, on average, per disaster occurrence over the period. The average deaths per occurrence value provides additional perspective of the relative intensity of impacts, on average, for historical disasters (2006-2015). Again, this same information estimating intensity of impacts across disaster could also be reported by hazard types and by geographic regions within countries.

Figure 1: Sample presentation of deaths from disasters, by country, 2006-2015



Source: calculations based on statistics downloaded from CRED/EMDAT (2017)

17. The time period covered in the above figures corresponds with the baseline time period adopted for monitoring this indicator for the Sendai Framework. There are major differences across countries in the baseline disaster risk situation.

Sample Table: demographic disaggregation of affected population statistics, extract from Philippines

PHILIPPINES

	Year	Age groups				TOTAL	Gender groups			TOTAL
		0-4	5-60	60+	Unidentified		Male	Female	Unidentified	
Death	**2013**	46	423	246	5,899	**6,614**	887	864	4,863	**6,614**
	2014	22	202	45	25	**294**	200	87	7	**294**
	2015	12	95	18	10	**135**	94	41		**135**
Missing	**Year**	**Age groups**				**TOTAL**	**Gender groups**			**TOTAL**
		0-4	**5-60**	**60+**	**Unidentified**		Male	Female	**Unidentified**	
	2013	4	42	1	1,038	**1,085**	91	28	966	**1,085**
	2014	2	19	0	11	**32**	25	7	0	**32**
	2015	0	13	0	13	**26**	20	2	4	**26**

Table 1: Deaths/ Missing in Philippines (2013-2015)
Source: Pilot Study

16. When disaster management agencies are initially recording estimates for number of deaths or other types of human impacts, basic information (such as age and gender) on the affected people may not yet be known because compiling demographic or social information about the affected

population is not a priority during the emergency period. Social and demographic information needs to be compiled or estimated later, by linking with other data sources, particularly administrative records on the affected populations as well as with background statistics on populations in affected areas. This is an example of a step in which the basic official data collected by disaster management agencies can be combined with statistics sources managed by national statistical offices, towards the development of summary statistics tables. This process may include systematic feeding of information from disaster management agencies into the civil registration and health information systems, as suggested above.

17. Experience from the Expert Group's pilot studies showed that disaggregated demographic and social information for describing affected populations from historical disasters may be unavailable or incomplete. The sample table extracted from the Philippines pilot study reporting shows an example of how available disaggregated statistics can be utilized, even when the information is incomplete, by including a category for "unidentified". For future disaster occurrences, it should be possible to develop systems to compile a basic range of social and demographically disaggregated statistics that could be produced at regional and national levels within countries.

18. The figure below shows recommended headings for a table containing a short-list of relevant categories for disaggregated statistics for the basic range of affected populaion statistics.

Figure 2: Social Categories for affected population statistics

C2a1 - Age groups			TOTAL
0-4	5-60	60+	

C2a2 - Gender groups		TOTAL
Male	Female	

C2a3 - Urban/Rural population		TOTAL
Urban	Rural	

C2a4 - Specific vulnerability groups		NO TOTAL
Disabled	Poor	

19. Statistics according to these social categories should be compiled both for affected populations and for populations exposed to hazards (baseline before the disaster). Note that the tables present summary statistics for a given geographic area and should not reveal any confidential information, i.e. details that could be used to identify specific individuals.

Injured or Ill

Sample Table: Illness/ Injuries in Bangladesh with demographic disaggregation, 2006-2015

Bangladesh

	C2a1 - Age groups			TOTAL	C2a2 - Gender groups		TOTAL
	0-4	5-60	60+		Male	Female	

Illness	330378	1472750	87605	**1890733**	990769	899966	**1890735**
Injuries	2324	25273	5309	**32906**	19126	13782	**32908**

Source: Bangladesh Disaster-related Statistics 2015, Bangladesh Bureau of Statistics

20. In Bangladesh, illness is a more frequently occurring impact from disasters compared to injuries. The relevance for injuries or for different specific types of illnesses varies by hazard type.

21. Annual figures for affected population variables will usually be highly variable, depending on randomness of exposure to hazards. Therefore, for many types of analyses, presentation of the statistics on affected population variables will be more interesting for dissemination across a longer time period, e.g. at least 3-5 year periods (see Section 2a). However, affected population numbers can be useful in all phases of disaster management and sometimes users may require the most detailed information (temporally and geographically) that is available. Where available, the basic data could be recorded within the emergency period and using GPS location (e.g. for mapping of impacts to humans during an emergency). This same data coule be a primary data source for compiling more aggregated statistics on affected populations for producing indicators and other more aggregated statistical analyses. In other cases, as in the example utilized above from Bangladesh, the information may be gathered later on via household survey.

Displaced Populations

22. UNGA (2016) states that "people can be affected directly or indirectly. Affected people may experience short-term or long-term consequences to their lives, livelihoods or health and to their economic, physical, social, cultural and environmental assets." One of the immediate and conspicuous ways in which live and livelihoods are affected after a disaster is though temporary or permanent displacement. The tables below show evacuation statistics of Philippines and Indonesia. In the case of the Philippines, the term "displaced" has been used for numbers of people evacuated as result of a disaster.

23. In the newly adopted terminology for the Sendai Framework, **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."
    Annotations: Evacuation plans refer to the arrangements established in advance to enable the moving of people and assets temporarily to safer places before, during or after the occurrence of a hazardous event. Evacuation plans may include plans for return of evacuees and options to shelter in place.

24. Thus, evacuations refer to temporary arrangements, usually according to evacuation plans. For all types of movement of the population, including permanent relocation of people due to a disaster, the suggested term is **displacement**.

25. For cases where evacuations are carefully managed, basic social and demographic characteristics of the evacuated population are collected as part of administration of the evacuation plan by the responsible government authorizes (usually social welfare ministries). For this reason, managed/supported evacuations is proposed as an individual variable (1.3.2.1) in the affected population summary table C1. Supported evacuations is also a form of public assistance.

26. However, not all evacuees will be supported logistically or financially by a government agency. Self-supported (or voluntary) evacuations are common in areas with high exposures to certain types of hazards, like tropic cyclones, for which there is usually an advanced warning. Voluntary evacuations include households temporarily sharing dwelling with relatives or in some other accommodations outside of the hazard area.

27. By nature, displacement and the voluntary evacuations are difficult to measure and usually will rely on estimations by experts, based on available baseline statistics from administrative records, population and housing census, and, where possible, targeted surveys on displaced populations. The complete collection of core variables for displacement is shown in the Table C1, 1.3.

Extract from Table C1

1.3	Displaced
1.3.2	*Evacuations*
1.3.2.1	*Managed and government-supported evacuations [also 1.6.1.1]*
1.3.2.2	*Non-supported evacuations*
1.3.3	*Permanent relocations due to destroyed dwelling*
1.3.4	*Other Displaced*

Sample Table 3: Evacuations in the Philippines by Hazard Type and Geographic Region, 2013-15

		DISPLACED		
		geophysical	meteorological	total
PHILIPPINES	Region I (Ilocos)		567,177	567,177
	Region II (Cagayan Valley)		724,559	724,559
	Region III (Central Luzon)		2,227,691	2,227,691
	Region IV-A (Calabarzon)		561,932	561,932
	Region IV-B (Mimaropa)		44,183	44,183
	Region V (Bicol)		2,131,495	2,131,495
	Region VI (Western Visayas)	99	2,471,882	2,471,981
	Region VII (Central Visayas)	465047	870,617	1,335,664
	Region VIII (Negros Island Region)		1,949,110	1,949,110
	Region IX (Zamboanga Peninsula)		3,600	3,600
	Region X (Northern Mindanao)		73,003	73,003
	Region XI (Davao Region)		207,057	207,057
	Region XII (Soccsksargen)		129,368	129,368
	Region XIII (Caraga)		536,806	536,806
	National Capital Region (NCR)		264,323	264,323
	Cordillera Administrative Region (CAR)		239,936	239,936
	Autonomous Region of Muslim Mindanao (ARMM)		27,116	27,116
	National total (unadjusted)	**465146**	**13029855**	**13495001**

Source: Reports to Expert Group Pilot Study (2016)

Sample Table: Number of people evacuated by region and hazard type in Indonesia (2015)

	Province	EVACUATED						
		Drought	Earthquake	Flood	Flood and Landslide	Landslide	Tidal Wave/ Abrasion	Tornado
INDONESIA	Aceh	0	0	36522	68	456	336	29491
	Bali					0		0
	Bangka Belitung			0	0	0		0
	Banten		0	0		0		0
	Bengkulu			0	0	0	0	0
	Central Java	0	0	2833	25	1166		700
	Central Kalimantan			0		0		0
	Central Sulawesi		0	200	375	4		
	East Java	0	0	1040	0	760	0	5
	East Kalimantan		0	10	0	5	0	12165
	East Nusa Tenggara	0		85		1190		5439
	Gorontalo			406		0		522
	Jakarta			1762		5997		7419
	Jambi			150		0		0
	Lampung			0		0		0
	Maluku	4	0	8	423	12		1069
	North Kalimantan			2238		0		11
	North Maluku			11796	0			0
	North Sulawesi			4031		3672		583
	North Sumatra		0	75	77	500		11113
	Papua			0		0		0
	Riau		0	55	0	0		86
	Riau Islands			0		0		792
	South Kalimantan			0	0	0		0
	South Sulawesi		30	103		211	0	40
	South Sumatra		0	0	0	0		0
	Southeast Sulawesi		0	65				0
	West Java		0	1577	65	11825	0	4154
	West Kalimantan			51	0	1740		8
	West Nusa Tenggara		0	600	0	2500		0
	West Papua				0			
	West Sulawesi			0		0		0
	West Sumatra		0	1854	0	8382		75
	Yogyakarta			0		22		3
	National Total	**4**	**30**	**65461**	**1033**	**38442**	**336**	**73675**

Source: Informasi Bencana Indonesia (DIBI): http://dibi.bnpb.go.id

People Affected byDamaged or Destroyed Dwellings

People Affected by Damaged or Destroyed Dwellings

Sendai Framework global indicator B4: Number of people whose damaged dwellings were attributed to disasters.
Sendai Framework global indicator B5: Number of people whose destroyed dwellings were attributed to disasters.

28. One of the primary causes for permanent (or long-term) displacement is due to a destroyed dwelling (1.3.3). Therefore the same basic input data on destroyed dwellings is utilized for producing summary statistics on affected population, particularly for Sendai Framework global indicator B4. Moreover, damages or destroyed dwellings provide a bridge between the affected population and material impacts tables, since these statistics refer to the same enumerations (dwelling units) and same basic input data.

29. Numbers of dwellings damaged or destroyed is an important variable for assessing the material impacts of a disaster and the affected population. Therefore, it is useful to review and, potentially, disseminate these statistics together for purpose of validation and to add context to the meaning of the figures.

Impacts to livelihood

Sendai Framework global indicator B5: Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

34. The concept of livelihoods (or their disruption) was not defined in the UNGA –adopted document by the Open-ended Intergovernmental Working Group for the Sendai Framework global indicators. However, during consultations as part of the process of adopting terminologies and indicators for the Sendai Framework, UNISDR reported the following proposed definition as a result from informal consultations: "means, capabilities, tangible and intangible assets, including human, social, natural, physical, financial resources, that people draw upon to make a living." A challenge with adopting this definition in statistical tables is it seems to incorporate all possible affected population variables into one, which would make indicator B-5 almost undisguisable from the aggregated total affected population (B1).

35. In general use of English language, livelihood is understood as means of obtaining basic necessities, i.e. source of income or employment. For statistical purposes, employment is defined by the International Labour Organisation, and comprehensive standards and guidelines for labour statistics are managed by the International Conference of Labour Statisticians (ICLS)[19]. The ILO also maintains an international database for a broad range of employment-related indicators, including harmonized statistics on unemployment and various categories of under-employment.

[19] http://www.ilo.org/global/statistics-and-databases/meetings-and-events/international-conference-of-labour-statisticians/lang--en/index.htm

36. Currently, there are no international compilations of statistics on impacts to employment, or productivity, earnings, or other relevant variables of livelihood from hazards or from other external shocks. Thus, these are new statistics that should be developed for DRSF, in collaboration with ILO, ILCS (among others).

37. At the national level, for cases where statistics were available from the expert group pilot studies, there were two basic measurement approaches observed:

(a) Losses in terms of numbers of jobs (individuals)
(b) Losses in terms of numbers of days (losses in productive activity and/or earnings)

38. Utilizing a Household Survey on Impacts of Climate Change on Human Life, Bangladesh Bureau of Statistics reported statistics on impacts to livelihoods as distributions, across the affected population, according to ranges in the number of losses of days. (table below).

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

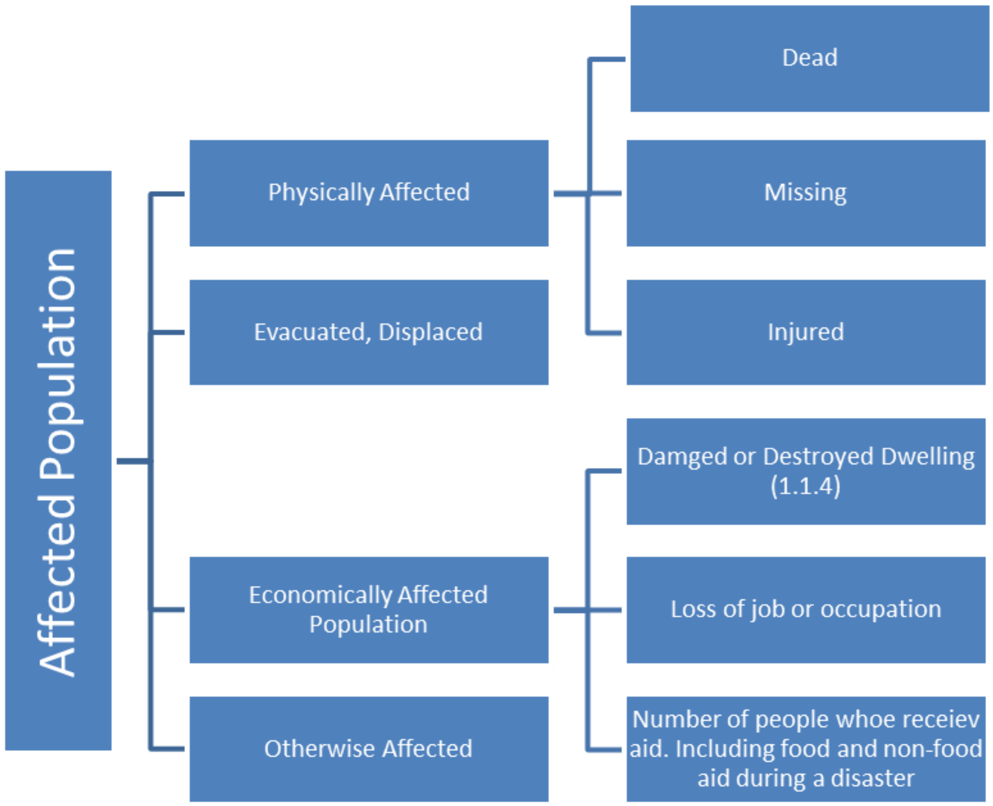
Hazard Type	Number of households mising work	Number of non-working days missed (%)					Average no. of working days
		Total	1-7	8-15	16-30	31+	
Drought	325242	8.16	3.61	2.69	1.47	0.39	12.09
Flood	1071377	26.93	4.98	10.62	9.39	1.94	17.63
Water logging	442145	11.12	4.88	3.23	2.05	0.96	14.85
Cyclone	762788	19.17	12.05	4.51	1.95	0.66	9.33
Tornado	129754	3.27	2.65	0.45	0.14	0.03	5.72
Storm/ Tidal Surge	316257	7.95	4.92	1.5	1.06	0.47	10.08
Thunderstorm	253272	6.37	3.73	2.14	0.46	0.04	7.6
River/ Costal Erosion	143973	3.62	1.23	1.13	0.92	0.34	16.86
Landslides	2019	0.05	0.04	0.01	0	0	5.67
Salinity	60064	1.51	1.18	0.24	0.08	0.01	6.8
Hailsotrm	2998410	7.51	6.29	0.76	0.34	0.12	5.3
Others (Fog, Cold wave etc.)	173708	4.37	2.91	1.16	0.26	0.04	7.15
Total	**3979008**	**100**	**48.46**	**28.44**	**18.12**	**4.98**	**12.13**

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)

39. Losses to livelihood are closely related to the concept of disruptions to basic services (see Section 2c and summary tables in Part 2) for which the recommended unit of measurement (see Chapter 5) is number of people affected and length of time for disruptions.

40. There are numerous of ways that affected population statistics can be organized into summary tables (such as table C1). This is a choice of presentation for dissemination of statistics, rather than a conceptual decision. Databases can always be queried in multiple ways, for serving different analytical purposes. However, organizing and categorizing affected population variables also must be done with careful consideration to avoid problems with double-counting individauls in the aggregated total affected population (e.g. Sendai Framework global indicator B1). The figure is a sample of one of the possible organizations for the relevant variables.

Figure 3: Sample structure of basic range of affected population statistics variables



Adjustment for double counting

41. Affected population variables are not necessarily independent and the same types of impacts could affect the same individuals. For example, an earthquake could cause the same person to be injured, evacuated, and also economically affected. If a simple summation is made of all instances of human impacts, such individuals would be counted multiple times -in the sample tables, this is labelled as unadjusted national totals. Effectively they are counts not of number of people, but number of human impacts, of all types. Adjusted totals are the total numbers of individuals for affected population after adjusting for multiple counting.

42. A similar situation can be observed for a few other areas of social statistics, such as (e.g.) statisics on domestic violence or abuse, in which there are multiple categories of abuse (e.g. physical, verbal/psychological, sexual, other). Sometimes, the same indviduals may be affected by multiple categories of abuse. Therefore, there are two potential aggregated statistics among the relevant populations: total number of people and total number of individual categories or cases of abuse. For some analyses, both aggregations could be of interest to users of the statistics

43. The invented and hypothetical sample table presented below for Neverland is presented to demonstrate the possible cases of multiple counting of affected population and relevant adjustments for producing aggregates in terms of number of people (instead of number of impacts) as is required for the SDG Sendai Framework global indicators.

Sample table: Affected population with adjustments for multiple counting in Neverland

		Region I	Region II	Region III	Region IV	Region V	Region VI	NATIONAL TOTAL
1.1	**Adj. Total affected population**	**6,811**	**3,188**	**2,139**	**1,635**	**0**	**0**	**13,773**
1.1.1	Deaths or missing	568	336	56	5	0	0	**965**
1.1.1.1	*Deaths*	489	296	40	4	0	0	**829**
1.1.1.2	*Missing*	79	40	16	1	0	0	**136**
1.1.2	Injured or ill	1,963	507	234	25	0	0	**2,729**
1.1.2.1	*Major injuries, illness*	156	89	76	5	0	0	**326**
1.1.2.2	*Minor injuries, illness*	1,807	418	158	20	0	0	**2,403**
1.1.3	Displaced	5,627	2,481	2,072	1,626	0	0	**11,806**
1.1.3.1	*Relocated*	129	156	27	58	0	0	**370**
1.1.3.2	*Evacuated*	5,498	2,325	2,045	1,568	0	0	**11,436**
1.1.5	Otherwise affected	534	325					**859**
1.1.5.1	*Number of people whose houses were damaged due to hazardous events*	348	69					**417**
1.1.5.2	*Number of people whose houses were destroyed due to hazardous events*	186	256					**442**
1.1.6	*Multiple counts, individuals (minus)*							
a	*both injured and displaced*	428	69	5	5			**507**
b	*both injured and otherwise affected*	256	32	0	0			**288**
c	*both displaced and otherwise affected*	985	268	200	10			**1,463**
d	*injured, displaced and otherwise affected*	106	46	9	3			**164**

Hypothetical dataset, constructed for demonstration purposes only

44. In the above hypothetical example, there are actually four different situations of multiple counting (a,b,c,a and d). shows how to address the issue of multiple counting using DRSF table.

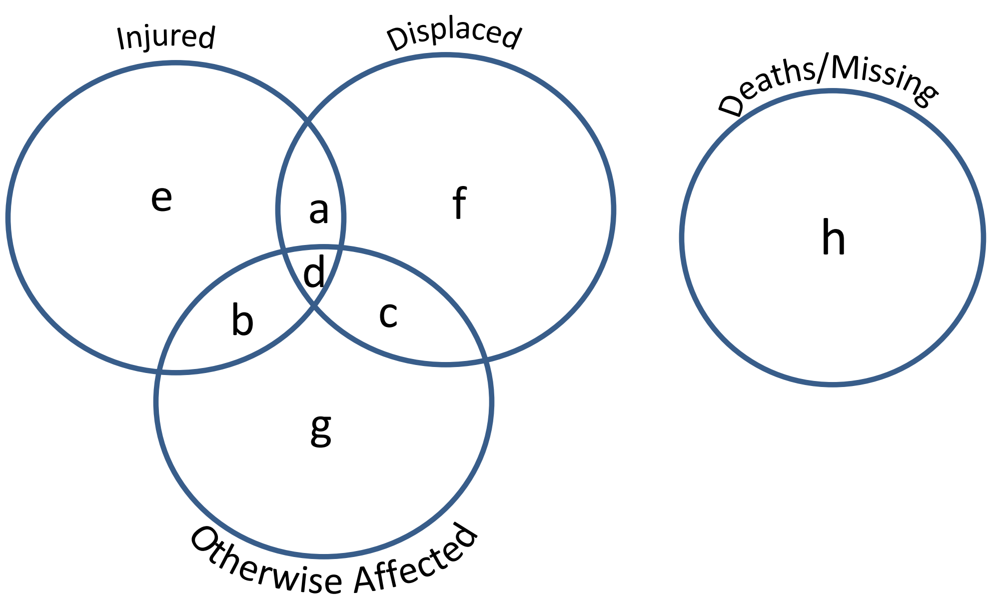
45. In Region I, among the affected people identifie, 428 of them are both injured and displaced (a); 256 of them are both injured and otherwise affected (b); 985 of them are both displaced and otherwise affected(c); and 106 of them are injured, displaced and otherwise affected(d). So, the total number of affected population is:

$$\begin{aligned} Adjusted\ affected\ popluton &= 568 + 1963 + 5627 + 534 - (428 + 256 + 985 + 2 * 106) \\ &= 6811 \end{aligned}$$

46. In this adjusted figure, each subset for deaths/missing, injured/ill, displaced and otherwise affected are mutually exclusive, hence the issue of multiple counting does not exist. By comparison, the unadjusted total (counts of individual impacts) was 8,692. Both figures, may be of interest for analysis of affected population. They are measurements in different units, the adjusted total is number of people and the unadjusted total is number of cases of impacts.

47. The Venn diagram below is a visualization of the different types of multiple counts (a,b,c,d) in evidence from the Neverland example. In practice, measurement of counts for each individual case of multiple counts may not be feasible because it requires matching identification of individuals for different impacts (potentially recorded from different data sources). Therefore, in places of measurement of individual counts for a, b, c, d could be a more general estimation, based on experiences of the expected number of cases (N) of impacts to the same individual. Then, the adjustment in table C1 (or in 1.1.6 in th above sample table) is simply equal to N-1.

Figure: Venn Diagrams showing cases of multiple counts from the sample affected population table



2e) Disaster Risk Reduction Activities

1. 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 rise to, or already, materialize into a disaster event."
2. Government and other entities allocate budgets to DRR, and information on these activities is essential for policy makers to determine effective means of DRR in the different contexts and identify new investment opportunities that could significantly prevent unacceptable risks and militate against impacts.
3. Statistical information on DRR activities, transfers and expenditures are also critical inputs for estimating the economic costs from disasters, since a large part of post-disaster recovery is support for basic needs of affected communities and the reconstruction effort.

Sustainable Development Goal Target 11.b
"By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels"

4. Often the publically-financed disaster risk reduction activities, particularly disaster recovery, are transfers from budget from central government to local authorities, and/or international transfers (e.g. ODA). These transfers can be tracked through national accounts and balance of payments statistics, just as with other types of transfers and activities (i.e. production, investment, employment) in the economy as long as the activities with a DRR purpose can be specifically identified and isolated from the broader national figures.

5. There are two complementary approaches that can be applied for producing statistics on DRR activities, and particularly the quantifications, in monetary terms, of DRR transfers and expenditures. The first approach is to produce a focused analysis of transfers from relevant institutions and to focus analyses of transfers and expenditures on a particular geographic region and time period where there is a large-scale disaster recovery underway. Examples of this approach are briefly presented for major earthquakes of Canterbury New Zealand (see previous section). A 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.

6. The tool that statisticians use to produce the economic statistics in the latter approach is to develop specific functional classifications in order to define the domain of interest. In this case, DRR-characteristic activities are defined in order to objectively identify shares of expenditures or transfers with a DRR purpose. Statistics produced utilizing this classification will be useful for tracking and conducting research on DRR activity, its effectiveness, and for developing new projects or investments, or raising of standards. In order to make a case for increases or improvements in DRR, a sufficiently accurate quantification of the existing activities is needed.

7. Typical outputs from accounts of expenditures or transfers, 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 etc.) – *note see draft classification in Chapter 3 for the complete proposed list of categories DRR activity categories*
    e. Values of transfers from central government to local authorities
    f. Values of transfers from international donors – i.e. DRR-related overseas development assistance (ODA)

8. While hazards and disasters are events happening randomly in terms of timing and in relation to the society, 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). DRR statistics could therefore become an integrated and relatively conventional domain of statistics, as an extension to the existing national accounts. It is an area where close cooperation is needed between disaster agencies and the statistical offices or other government agencies that are used to national accounting methodologies.

Sendai Framework Global target F: Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.

9. Currently the best available approximation of international transfers related to disaster risk reduction activity comes from the Statistics Directorate of OECD. The OECD.Stat Creditor Reporting System (stats.oecd.org) reports statistics on aid by purpose ("sector"), including international flows of humanitarian aid.

10. According to the OECD Statistics director website, "the objective of the CRS Aid Activity database is to provide a set of readily available basic data that enables analysis on where aid goes, what purposes it serves and what policies it aims to implement, on a comparable basis."

11. This database is a global compilation of statistics on **Official Development Assistance: 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).

12. The classification for organizing the international aid flows is purpose-based. A sector or main purpose category (e.g. health or energy), defines the main economic or social infrastructure categories which an individual activity is intended to foster. The sector classification also includes a number of categories which are not allocable by sector. These are: general budget support; debt relief; humanitarian aid, emergency assistance; food aid; support to non-governmental organisations and administrative costs.

13. **Humanitarian assistance** is defined by three sectors-Reconstruction Relief & Rehabilitation, Emergency Response, and Disaster Prevention & Preparedness (OECD.stat code 74010) form the definition of Humanitarian Assistance.

    Humanitarian Aid=Emergency Response+Reconstruction Relief & Rehabilitation+ Disaster Prevention&Preparedness

14. Statistics on humanitarian assistance from OECD also covers man-made crises/complex emergencies (conflict, protracted crises, refugee situation etc.) and OECD estimates that, globally, around 80% of humanitarian assistance goes to conflict-related settings. Also, definitional notes for the relevant classes of ODA transfers, give a strong emphasis to conflict situations and other complex and/or man-made disaster situations.

15. Whether these broader set of statistics for humanitarian aid will be applicable as general proxy measuring international transfers for DRR may depend on the context of different recipient countries. However, clearly this is a scope for development of a new a classification, or sub-classifications, and set of related recommendations for producing statistics specifically on DRR transfers and expenditures, not only for ODA transfers, but also for the transfers and expenditures within the domestic economies.

16. Noting these limitations for applying existing statistics on humanitarian aid OECD for the DRR domain, the following example analyses was prepared for the Philippines below, is presented as a sample of possible outputs and analyses from a systematic compilation of transfers for DRR.

Table 1: Disaster-related inflows of ODA for the Philippines

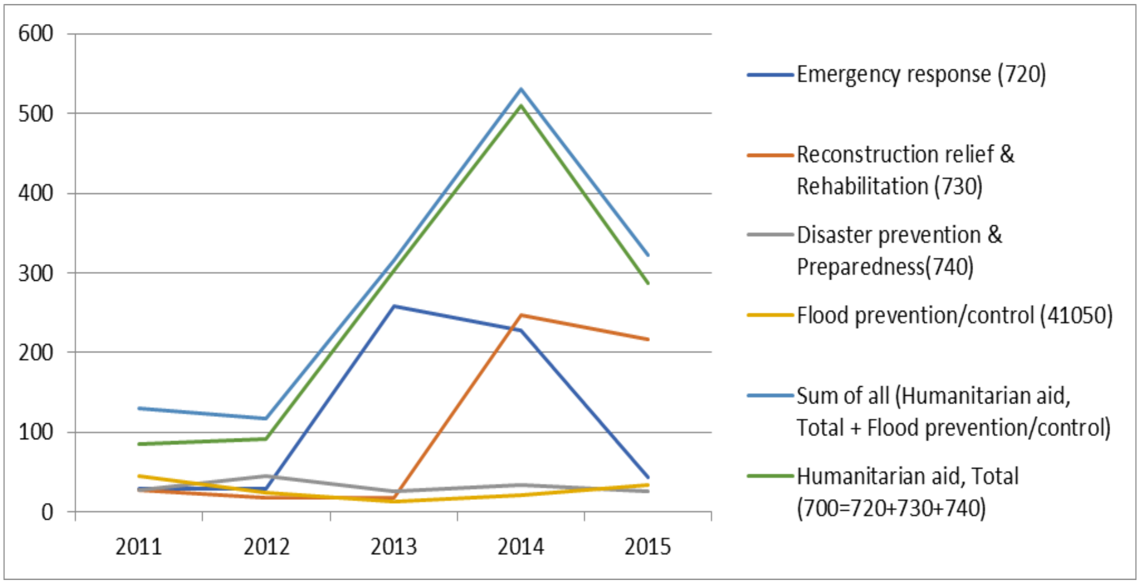
Creditor Reporting System (CRS)								
	Emergency response (720)	Reconstruction relief & Rehabilitation (730)	Disaster prevention & Preparedness(740)	Humanitarian aid, Total (700=720+730+740)	Flood prevention/control (41050)	740+41050	Sum of all (Humanitarian aid, Total + Flood prevention/control)	Total All Sectors (1000)
2011	28.613	28.028	28.211	84.853	45.821	74.032	130.674	756.127
2012	29.159	18.446	44.748	92.353	24.496	69.244	116.849	800.778
2013	258.874	18.620	25.580	303.074	12.664	38.244	315.738	916.332
2014	228.019	247.373	34.126	509.517	21.028	55.154	530.545	1,393.106
2015	44.382	216.856	26.249	287.487	34.774	61.023	322.261	1,199.972

International transfers from all sources into the Philippines, all figures are millions of US$, constant prices, Source: OECD.Stat

17. The first table contains a collection of related components of humanitarian aid (emergency response, reconstruction, relief and rehabilitation, and disaster prevention and preparedness), i.e. total humanitarian aid combined with the flows for flood prevention/control as a general estimation for relevant international transfers for DRR for the case of the Philippines.

18. The overall trend (Figure 1) for humanitarian aid intro the Philippines rose around 3-fold between 2012 and 2015 and peaked in 2014, mostly accountable as emergency response assistance and reconstruction relief, and rehabilitation. In 2013, the Philippines experienced the super Typhoon Haiyan (Yolanda), one of the strongest and most destructive typhoons ever recorded (sustained winds of 285 km/hr), which resulted in more than 6,000 deaths and enormous destruction to homes and infrastructure from the Typhoon winds and the expansive flooding and landslides cause. This super Typhoon is likely to be accountable for a large share of this trend.

Figure 1: Trends for components of Disaster-related inflows of ODA for the Philippines



International transfers from all sources into the Philippines, all figures are millions of US$, constant prices, Source: OECD.Stat

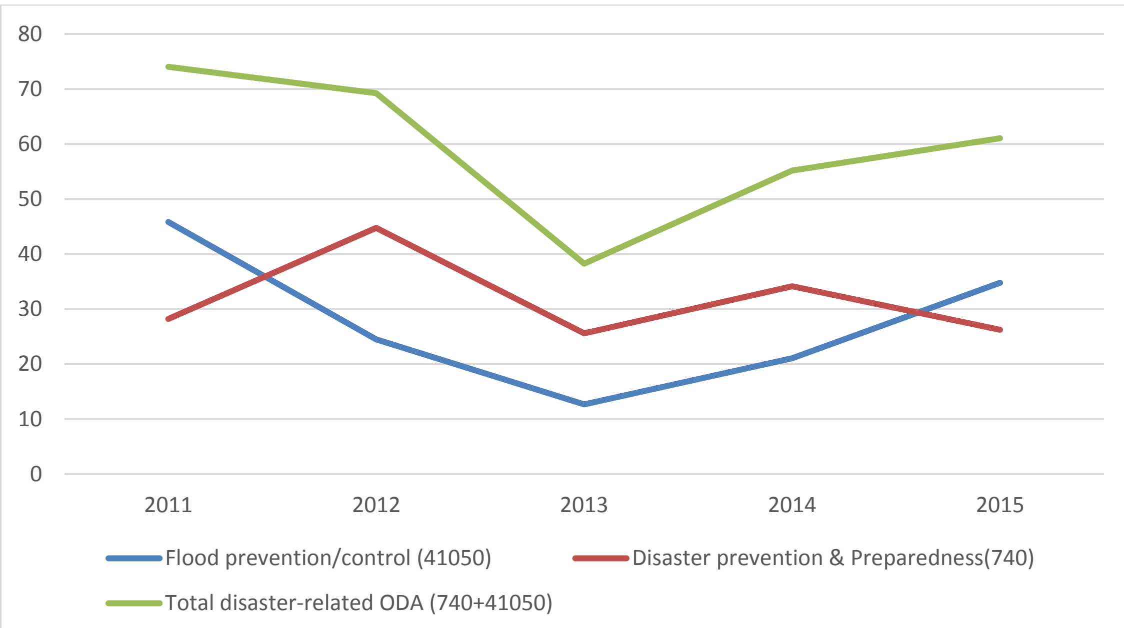
19. As for other relevant ODA flows (shown in Table 2 and Figure 2 below) the changes are relatively little and the values for the preventative and preparedness measures are much lower as compared to the more reactive types of aid – i.e. emergency response and recovery after Haiyan.

TABLE 2: Trends for Selected Categories for Disaster-related ODA transfers into the Philippines

	Flood prevention/control (41050)	Disaster prevention & Preparedness(740)	Total disaster-related ODA (740+41050)
2011	45.821	28.211	74.032
2012	24.496	44.748	69.244
2013	12.664	25.580	38.244
2014	21.028	34.126	55.154
2015	34.774	26.249	61.023

All figures are millions of US$, constant prices, Source: OECD.Stat

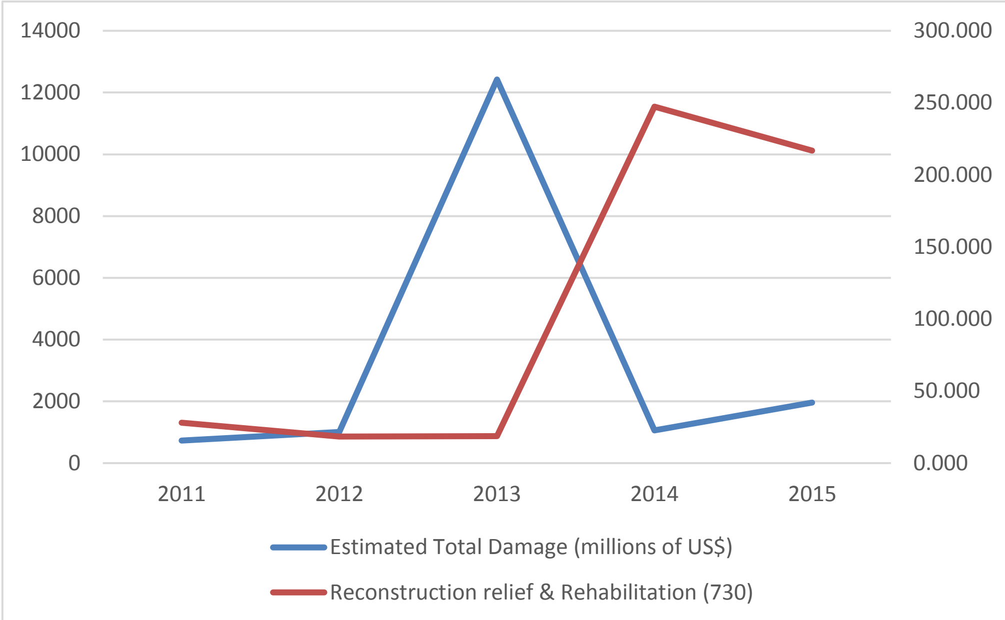
Figure 2: Trends for Selected Categories for Disaster-related ODA transfers into the Philippines



All figures are millions of US$, constant prices, Source: OECD.Stat

20. In figure 3, the trend for reconstruction relief and rehabilitation ODA is shown again with comparison to the estimated total damages from disasters, as reported for Philippines in the CRED/EMDAT database. Note that, due to the differences in scale, the red line for the ODA flows refer to the right-hand axis and the total damages value refer to the left-hand axis. The total value for ODA into the Philippines for reconstruction, relief and rehabilitation in 2014 equals about 11% of the estimated value for total economic damages in 2013.

Figure 3: Comparison of Damages and ODA Inflows for Reconstruction Relief, and Rehabilitation, Philippines 2011-2015



Source: OECD.Stat and CRED-EMDAT

21. Noting limitations of utilizing these figures for analyses related to disasters (in particular, since around 80% of total for humanitarian aid is estimated to be for conflict-settings), the purpose of this sample analysis is purely to demonstrate, as an example, potential analytical uses for these types of statistics, particularly if, in the future, more direct measurement of transfers and expenditure for disaster risk reduction can be made available.

22. If more investments were made in preventative measures prior to 2013, could the number of fatalities and the overall impacts, including the costs to international donors for emergency response and for reconstruction relief and rehabilitation been reduced? This is an example of a question that statistics on DRR activities can be used to help answer.

Chapter 3 Statistical Classification in DRSF

3a) Hazard Categories

23. The Integrated Research on Disaster Risk (IRDR) programme developed and published (in March, 2014) the Peril Classification and Hazard Glossary.[20]
24. Hazards are, combined with other underlying social-economic risk factors (i.e. exposure, vulnerability and coping capacity) the triggers that result in disasters and have been defined by the UN General Assembly as "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." (UNGA, 2016)[21]
25. Starting in 2015, the Asia and Pacific Expert Group on Disaster-related Statistics organized a series of pilot studies to collect and review the current practices and availability of statistics on disasters from official national agencies. For the pilot studies, the Expert Group recommended applying the IRDR Peril and hazard glossary, focussing on the relatively aggregate hazard "family" level in the IRDR classification utilized for the purpose of pilot cross-country compilations.

Figure 1: Peril classification at the Family level.

Source: IRDR 2014

26. At the more detailed level of definitions for hazards (e.g. floods, cyclone, etc.,), which is called the "main event level" in the 2014 version of the IRDR classification and glossary, there are many differences among countries participated in the pilot studies regarding use of terminology and definitions for hazards. This is a consequence of the natural situation in which hazards are unique in every respect, and thus do not function well as objects of statistical measurement. Thus, the focus on risk and impacts from the perspective of society.
27. For example, hazards vary geographically: i.e. tropic hazards or cold-weather storms of the northern and southern hemispheres. Thus, most countries with national compilations of basic statistics on disasters have developed their own systems of classifications at the detailed levels. In terms of level of aggregation, at national and international level, the family-level categorisation of hazards published by IRDR is broadly applicable.
28. The Expert Group also discussed a distinction between single-hazard and cascading multiple hazard events and whether there is a need to classify impacts from cascading multi-hazard events

[20] http://www.irdrinternational.org/wp-content/uploads/2014/04/IRDR_DATA-Project-Report-No.-1.pdf

[21] UNGA, 2016, "Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction" A/71/644, Seventy-first session Agenda item 19 (c), Sustainable development: disaster risk reduction

separately in order to capture the full extent of impacts and to avoid double-counting of disasters or their impacts. Cascading-multiple hazards are hazards that are linked together in causality, i.e. one event (e.g. a cyclone) triggered others (e.g. flood and landslide). National agencies report cascading multiple-hazards as single occurrences, usually classified according to the initial trigger event (e.g. the cyclone) or as (e.g. in Indonesia) special classes of multi-hazard events (e.g. earthquake-tsunami). This is a classification issue at the more-detailed "main event level", and therefore not effecting aggregation at the "family level" categorization of hazards.

29. Through the pilot studies, two hazard types were identified, which were not available in the IRDR classification: waterlogging and salinity[22], which are important in the statistics for Bangladesh. The IRDR classification was comprehensive for all other cases that were reviewed.

30. Most important for harmonization and for improving international comparability for references to hazards in disaster statistics analytical categories or groupings of hazard types for producing summary statistics that meet the needs for disaster risk reduction policy-makers. One of the important examples of aggregated category that should be derivable from an agreed classification of hazards is climate-related disasters. These will include hazards in the meteorological and hydrological hazard families. Whether or not specific hazards can be linked with climate change is a secondary question for analyses, but at least hazards related to the climate can be defined objectively. The IPCC23 has defined the relevant terms for identifying climate-related hazards as follows:

31. **Climate**
"Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. In various chapters in this report different averaging periods, such as a period of 20 years, are also used."

32. **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 change may be due to natural internal processes or

22 Waterlogging: deterioration of drainage condition in a number of southern coastal rivers leading to temporary to permanent inundation of floodplains along those rivers, causing enormous difficulties towards maintaining livelihoods and disrupting land-based productive system including agricultural crops; Salinity: Water and soil salinity are hazards affecting different uses of water including drinking, household, irrigation, fisheries, and ecosystem functioning.

[23] "Managing the Risks of Extreme Events and Diasster to Advance Climate Change Adaptatation" Special Report of the INtegovenmetnal Panel on Climatt Chance (IPCC, 2012)

external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

33. **Hazard**
“The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.”

34. Another aggregated category of hazards mentioned in the Sendai Framework (among other places in the literature) are “man-made disasters”. Following the adoption of new terminologies for the Sendai Framework, the term “natural disasters” is no longer used by UNISDR. However, there are still references to “man-made disasters” or “technological disasters”, which are not covered by the current version of the IRDR Peril and Hazard Classification.

35. In UNGA (2016) “Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction “, **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.”

36. Also from UNGA (2016), **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.”

37. Other relevant types hazards not covered in the scope of the 2014 IRDR publication are violent conflicts, including civil war, and their impacts, e.g. refugee crises. The OECD estimates that approximately 80% of international transfers of humanitarian aid goes to conflict-related settings.”[24] The Sendai Framework (paragraph 15) defines the scope for disaster risk reduction o include "man-made" and "technological" hazards. However, the definition for a hazard as adopted in UNGA (2016) includes the following annotation: "This term does not include the occurrence or risk of armed conflicts and other situations of social instability or tension which are subject to international humanitarian law and national legislation."

Proposed way forward:

38. According to the provisional outcomes of the pilot studies organized by the Asia-Pacific Expert Group, the IRDR family-level categorization seems to be broadly applicable and consistent with current practices for disaster statistics across countries, with a few adjustments (e.g. inclusion of an ‘Other’ category, to include hazard types otherwise not covered). If undertaken, revisions by IRDR to the Peril and hazard glossary should take into account, as much as feasible, analyse of current practices among official agencies at the national level.

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

39. Domain-specific experts, e.g. experts from IPCC and from UNFCCC in the case of climate-related hazards, should be engaged to define special functional categorizations of hazards from the analytical perspectives.

3b) Direct Material Impacts Classification

Note on references: nearly all definitions utilized in this draft section come from one of two sources referenced as [UNGA, 2016], which refers to the"Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction" or [SNA, 2008], which refers to the 2008 edition of the System of National Accounts (https://unstats.un.org/unsd/nationalaccount/sna2008.asp).

40. A new international driver in demand for measurement of direct material impacts from disasters comes from two of the Sendai Framework for Disaster Risk Reduction targets and indicators:

Target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.
Indicator c3: Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.

And

Target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
Indicator D1: Damage to critical infrastructure attributed to disasters.

41. **Direct economic loss** is the monetary value of total or partial destruction of physical assets existing in the affected area. Direct economic loss is nearly equivalent to physical damage. [UNGA p.17, 2016]

42. **Disaster damage** occurs during and immediately after the disaster. This is usually measured in physical units (e.g., square meters of housing, kilometres of roads, etc.), and describes the total or partial destruction of physical assets, the disruption of basic services and damages to sources of livelihood in the affected area. [UNGA p.13, 2016]

43. From the above terminological guidance, approved by the UN General Assembly, it can be interpreted that measurement is required, at first in physical terms, and then valuation in monetary terms, the physical damages to assets immediately following a disaster.

44. An **asset** is 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. [SNA para. 3.5]

45. In some cases, this definition from the SNA definition for an asset should be applicable for the situation of disaster damage, although, important to note that the statistical inputs into this indicator will not be recorded in national accounts directly.[25] The SNA is a useful and comprehensive framework for organizing a broad range of statistics on economic activity, but it was not designed for the specific purpose of defining or recording information on economic impacts from external disasters. Definitions and categories of assets from the SNA are utilized below as an indicative proposal and starting-point for developing concrete recommendations for harmonized statistics on direct economic loss from disasters, in particular a classification for the obects of measurement, i.e. the exposed assets, including critical infrastructure.

46. A specialized functional sub-category for **critical infrastructure** is required because there is an interest to measure direct impacts specifically to critical infrastructure (Sendai Framework Global indicator D1). Thus, a functional sub-classification) was created for this purpose. [26]

Sendai Framework global Indicator D1: Damage to critical infrastructure attributed to disasters.

47. **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. [UNGA p.13, 2016]

48. Note: "The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant." [UNGA pgs. 6 & 7 2016]. The proposed classification shown here is meant to be an indicative example extraction from the broader definition of assets, which may be applicable (either fully or partially) for some Member States.

49. For some classes or concepts in the draft classification developed for this note, existing standards definitions could not be identified from the SNA or from the outcomes adopted by the UN General Assembly for terminologies and indicators for the Sendai Framework for Disaster Risk Reduction (UNGA, 2016). These cases are highlighted.

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[25] except as an "other changes in volume" in asset accounts, an accounting entry which few countries produce regularly.

[26] Note the critical infrastructure classification is a subset, i.e. extracted duplication, of the broader asset classification.

DRAFT Classification (includes sub-classification for critical infrastructure)

2.1 Direct impacts on fixed assets (SNA asset definition)

2.1.1 Dwellings:

> Dwellings are 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]

2.1.1.1 Dwellings destroyed: No definition for destroyed

2.1.1.2 Dwellings damaged: Please refer to the definition of damage above

2.1.2 Buildings and structures:

> Buildings: Buildings other than dwellings include whole buildings or parts of buildings not designated as dwellings. Fixtures, facilities and equipment that are integral parts of the structures are included. Public monuments identified primarily as non-residential buildings are also included. [SNA 10.74]

> Examples include products included in CPC 2.0 class 5312, non-residential buildings, such as warehouses and industrial buildings, commercial buildings, buildings for public entertainment, hotels, restaurants, schools, hospitals, prisons etc. Prisons, schools and hospitals are regarded as buildings other than dwellings despite the fact that they may shelter institutional households. [SNA 10.75]

> Structures: Other structures include structures other than buildings, including the cost of the streets, sewer, etc. The costs of site clearance and preparation are also included. Public monuments for which identification as dwellings or non-residential buildings is not possible are included as are shafts, tunnels and other structures associated with mining mineral and energy resources, and the construction of sea walls, dykes, flood barriers etc. intended to improve the quality and quantity of land adjacent to them. The infrastructure necessary for aquaculture such as fish farms and shellfish beds is also included. [SNA 10.76]

> Examples include products included in CPC 2.0 group 532, civil engineering works, such as highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways; waterways, harbours, dams and other waterworks; long-distance pipelines,

communication and power lines; local pipelines and cables, ancillary works; constructions for mining and manufacture; and constructions for sport and recreation. [SNA 10.77]

2.1.2.1 Critical buildings and structures:

Please refer to the definitions of buildings and structures above.

2.1.2.2 Other buildings and structures:

Please refer to the definitions of buildings and structures above.

2.1.3 Machinery and equipment:

Machinery and equipment cover transport equipment, machinery for information, communication and telecommunications (ICT) equipment, and other machinery and equipment. As explained above, machinery and equipment under a financial lease are treated as acquired by the user (lessee) rather than as acquired by the lessor. Tools that are relatively inexpensive and purchased at a relatively steady rate, such as hand tools, may be excluded. Also excluded are machinery and equipment integral to buildings that are included in dwellings and non-residential buildings. Machinery and equipment other than weapons systems acquired for military purposes are included; weapons systems form another category. [SNA 10.82]

2.1.3.1 Critical machinery and equipment:

Please refer to the definitions of machinery and equipment above.

2.1.3.2 Other machinery and equipment:

Other machinery and equipment consists of machinery and equipment not elsewhere classified. Examples include products other than parts and items identified in other categories of fixed capital formation included in the International Central Product Classification (CPC), Ver.2.0 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. Other examples are products other than parts included in CPC 2.0 groups 337, fuel elements (cartridges) for nuclear reactors; 381, furniture; 383, musical instruments; 384, sports goods; and 423, steam generators except central heating boilers. [SNA 10.86]

2.1.4 Agriculture land, livestock, fish stocks, and managed forests:

Tree, crop and plant resources yielding repeat products cover plants whose natural growth and regeneration are under the direct control, responsibility and management of institutional units. They include trees (including vines and shrubs) cultivated for fruits and nuts, for sap and resin and for bark and leaf products. [SNA 10.95]

2.2 Direct impacts on valuables (SNA asset definition)

Valuables: 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]

2.2.1 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]

2.2.2 Other valuables:

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

2.3 Natural resources (SNA asset definition = non managed)

Natural resources cover mineral and energy resources, soil, water and biological resources. [SNA 29.106(b)]; Natural resources consist of naturally occurring resources such as land, water resources, uncultivated forests and deposits of minerals that have an economic value.[SNA 10.15]

2.3.1 Land, incl.soil:

> 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. The value of land excludes any buildings or other structures situated on it or running through it; cultivated crops, trees and animals; mineral and energy resources; non-cultivated biological resources and water resources below the ground. The associated surface water includes any inland waters (reservoirs, lakes, rivers, etc.) over which ownership rights can be exercised and that can, therefore, be the subject of transactions between institutional units. However, water bodies from which water is regularly extracted, against payment, for use in production (including for irrigation) are included not in water associated with land but in water resources. [SNA 10.175]

2.3.2 Primary forests: No definition

2.3.3 Fish stocks: Please refer to [SNA 10.76]

2.3.4 Freshwater: No definition

2.3.5 Other natural resources

Mineral and energy resources consist of mineral and energy reserves located on or below the earth's surface that are economically exploitable, given current technology and relative prices. Mineral and energy resources consist of known reserves of coal, oil, gas or other fuels and metallic ores, and non-metallic minerals, etc., that are located below or on the earth's surface, including reserves under the sea. [SNA 10.179]

The category other natural resources currently includes radio spectra. [SNA 10.185]

2.4 Critical goods & services

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. The production and exchange of goods are quite separate activities. Some goods may never be exchanged while others may be bought and sold numerous times. The production of a good can always be separated from its subsequent sale or resale.[SNA 6.15]

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. These types of service may be described as change-effecting services and margin services respectively. Change-effecting services are outputs produced to order and typically consist of changes in the conditions of the consuming units realized by the activities of producers at the demand of the consumers. Change-effecting services are not separate entities over which ownership rights can be established. They cannot be traded separately from their production. By the time their production is completed, they must have been provided to the consumers. [SNA 6.17]

2.4.1 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, use in production or other use at a later date. Inventories consist of stocks of outputs that are still held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways and stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing. Inventories of services consist of workin-progress or finished products, for example architectural drawings, which are in the process of completion or are completed and waiting for the building to which they relate to be started. Inventories held by government include, but are not limited to, inventories of strategic materials, and grain and other commodities of special importance to the nation.

2.4.1.1 Inventories/ intermediate and final **products**

Finished goods consist of goods produced as outputs that their producer does not intend to process further before supplying them to other institutional units. A good is finished when its producer has completed his intended production process, even though it may subsequently be used as an intermediate input into other processes of production. Thus, inventories of coal produced by a mining enterprise are classified as finished products, although inventories of coal held by a power station are classified under materials and supplies. Inventories of batteries produced by a manufacturer of batteries are finished goods, although inventories of the same batteries held by manufacturers of vehicles and aircraft are classified under materials and supplies. [SNA 10.142]

2.4.1.2 Inventories/ other products

2.4.2 Expected output of growing (immature, uncultivated) and non-produced crops

2.4.3 Critical services (SNA commodities): No definition

2.4.4 Medical cost of people injured or ill during the disaster occurrence period

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). [SNA 29.135]

2.5 Critical infrastructures [2.1.2], [2.1.3.1], [2.1.4]

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 p.13, 2016]

Hospitals, higher education institutions, day-care centres, schools, social service providers and environmental groups are identified as *Non-profit service providers in the SNA.* [SNA 23.19(a)] The classification known as the International Classification of Non-Profit Organizations (ICNPO) is available [SNA 23.30, Table 23.1]. It's a classification of instituions (not of buildings or infrastructure], but could be of use for defining these items:

2.5.1 Hospitals, health facilities: Defined as building and in CPC under 5312 "non-residential buildings"
2.5.2 Education facilities: Defined as building and in CPC under 5312 "non-residential buildings"

2.5.3 Other critical public administration buildings: No definition

2.5.4 Public monuments: Public monuments are identifiable because of particular historical, national, regional, local, religious or symbolic significance [SNA 10.78]

2.5.5 Roads: Defined as structures and in CPC under 532 "Civil engineering works"

2.5.6 Bridges: Defined as structures and in CPC under 532 "Civil engineering works"

2.5.7 Airports: “non-residential buildings”, Passenger Transport Services (CPC 64); Freight Transport Services (CPC 65)

2.5.8 Piers: “non-residential buildings”, Passenger Transport Services (CPC 64); Freight Transport Services (CPC 65)

2.5.9 Railway Stations: “non-residential buildings”, Passenger Transport Services (CPC 64); Freight Transport Services (CPC 65)

2.5.7 Transport equipment: Transport equipment 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]

2.5.8 Electricity generation facilities: Defined as structures and in CPC under 532 “Civil engineering works”

2.5.9 Electricity grids: Defined as structures and in CPC under 532 “Civil engineering works”

2.5.10 ICT equipment: Information, computer and telecommunications (ICT) equipment consists of devices using electronic controls and also 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]

2.5.11 Dams: Defined as structures and in CPC under 532 “Civil engineering works”

2.5.12 Water supply infrastructure: Defined as structures and in CPC under 532 “Civil engineering works”

2.5.13 Water sewage & treatment systems: Defined as structures and in CPC under 532 “Civil engineering works”

2.5.14 Agriculture and, livestock, fish stocks, and managed forests:

The measurement of the output of agriculture, forestry and fishing is complicated by the fact that the process of production may extend over many months, or even years. Many agricultural crops are annual with most costs incurred at the beginning of the season when the crop is sown and again at the end when it is harvested. However, immature crops have a value depending on their closeness to harvest. The value of the crop has to be spread over the year and treated as work-in-progress. Often the final value of the crop will differ from the estimate made of it and imputed to the growing crop before harvest. In such cases revisions to the early estimates will have to be made to reflect the actual outcome. When the crop is harvested, the cumulated value of work-in-progress is converted to inventories of finished goods that is then run down as it is used by the producer, sold or is lost to vermin. [SNA 6.137]

Tree, crop and plant resources yielding repeat products cover plants whose natural growth and regeneration are under the direct control, responsibility and management of institutional units. They include trees (including vines and shrubs) cultivated for fruits and nuts, for sap and resin and for bark and leaf products. [SNA 10.95]

2.5.15 ther non-public critical infrastructures

3c) Disaster Risk Reduction Characteristic Activities.

50. 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.”

51. Countries allocate budgets to DRR, and information on these activities is essential for policy makers to determine effective means of DRR in the different contexts and identify new investment opportunities that could significantly prevent unacceptable risks and mitigate against impacts.

52. Another important purpose for measuring and monitoring DRR activities and expenditures is they can be critical inputs for estimating the economic costs from disasters, since a large part of post-disaster recovery is support for basic needs of affected communities and the reconstruction effort, good as overall indicators of economic impacts.

53. Often the publically-financed disaster risk reduction activities, particularly disaster recovery, are transfers from budget from central government to local authorities, and/or international transfers (e.g. ODA). These transfers can be tracked through balance of payments and national accounts statistics, just as with other types of transfers and activities (i.e. production, investment, employment) in the economy as long as the activities with a DRR purpose can be specifically identified and isolated from the broader national figures.

54. The tool that statisticians use to produce these economic statistics is to develop specific functional classifications in order to define the domain of interest. In this case, DRR-characteristic activities (DRRCA) are defined in order to objectively identify shares of expenditures or transfers with a DRR purpose. Statistics produced utilizing this classification will be useful for tracking and conducting research on DRR activity, its effectiveness, and for developing new projects or investments, or raising of standards. In order to make a case for increases or improvements in DRR, a sufficiently accurate quantification of the existing activities is needed.

55. The same approach is also utilized for several other important cross-cutting domains of economies (e.g. health, tourism, education), often designed as “satellite accounts”, which refers

to their nature as specially designed extracts (or "satellites") of the system of national accounts (SNA).

56. The provisional classification of DRRCA is developed below, starting from the Sendai Framework and the recently adopted terminology adoptedby the UN General Assembly. (UNGA, 2016) Following the Sendai Framework definition for disaster risk reduction quoted above, the scope of DRRCA. activities is:

1. Disaster Risk Prevention
2. Disaster Risk Mitigation
3. Disaster Management
4. Disaster Recovery
5. General Government, Research & Development, Education Expenditure

Disaster risk reduction characteristic transfers include:

6. Internal transfers between public government services
7. Risk transfers, insurance premiums and indemnities
8. Disaster related international transfers
9. Other transfers

Annotated classification of Disaster Risk Reduction Characteristic Activities and Transfers

The terms, definitions and annotations of the DRRCA displayed below are extracted, as much as possible and relevant, from UNGA, 2016.

Characteristic Activities

1. Disaster risk prevention

Activities and measures to avoid existing and new disaster risks.

a. Risk prevention in advance of hazardous event

The concept and intention to completely 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. Prevention measures can also be taken during or after a hazardous event or disaster to prevent secondary hazards or their consequences, such as measures to prevent the contamination of water.

b. Risk prevention in or after hazardous event

Measures taken to prevent secondary hazards or their consequences such as measures to prevent contamination of water supplies or measures to eliminate natural dams resulting of earthquake induced landslides and/or rock falls.

2. **Disaster risk mitigation**
   Activities and measures to reduce or lessen existing disaster risk or to limit the adverse impacts of a hazardous event

   a. **Structural measures, constructions**
      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.
   b. **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.
   c. **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.
   d. **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.

3. **Disaster risk 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.
   a. **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.
   b. **Emergency management**
      The plans set out the goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives. They should be guided by the Sendai Framework for Disaster Risk Reduction 2015-2030 and considered and coordinated within relevant development plans, resource allocations and programme activities. National-level plans need to be specific to each level of administrative responsibility and adapted to the different social and geographical circumstances that are present. 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.
      Other disaster responses
      Includes provision of emergency services and public assistance by private and community sectors, as well as community and volunteer participation.
   c. **Emergency supply of commodities**

4. **Disaster Recovery**
   a. **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.
   b. **Rehabilitation**
      The rapid and basic restoration of services and facilities for the functioning of a community or a society affected by a disaster.
   c. **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.

5. **General Government, Research & Development, Education Expenditure**
   a. **General Government Expenditure for Disaster Risk Reduction**
   b. **Research & 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. This series of activities is sometimes known as a risk analysis process.
      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.
   c. **Education to Disaster Risk Reduction**
      Includes natural and engineering science, training of risks professional, risks specialized medicine professionals

Acquisition less disposals of land and other non-produced non-financial assets

Addition to Gross formation of fixed capital for the calculation of investment expenditures

a **Acquisition less disposals of land**

b **Acquisition less disposals of non-produced non-financial assets**

Transfers (paid or/and received)

d. **Internal transfers between public government services (current or in capital)**

Includes in particular budgetary transfers from Central government to local government

e. **Risk transfers, insurance premiums and indemnities**

Insurance is a well-known form of risk transfer, where coverage of a risk is obtained from an insurer in exchange for ongoing premiums paid to the insurer. Risk transfer can occur informally within family and community networks where there are reciprocal expectations of mutual aid by means of gifts or credit, as well as formally where governments, insurers, multilateral banks and other large risk-bearing entities establish mechanisms to help cope with losses in major events. Such mechanisms include insurance and re-insurance contracts, catastrophe bonds, contingent credit facilities and reserve funds, where the costs are covered by premiums, investor contributions, interest rates and past savings, respectively.

f. **Disaster related international transfers (current or in capital)**
g. **Public transfers to private (subsidies, transfers in capital...)**
h. **Private transfers (taxes, voluntary transfers...)**

Chapter 4 – Principles for Implementation

The Fundamental Principles of Official Statistics (see annex) were adopted by the UN General Assessment at its 68th Session in 2014. (A/RES/68/261). The following brief discussion on principles for implementation of DRSF is based on Implementation of DRSF is developed based on the Guidelines for Implementation for the Fundamental Principles of Official Statistics, developed and finalized by the UN Statistics Commission in 2015.[27] Disaster-related statistics is an emerging area of official statistics, with special characteristics that are unusual for other more traditional domains of official statistics. However, it is recommended that disaster-related statistics be viewed as integrated extension of the broader national statistics system, which should be developed in alignment with the Fundamental Principles as adopted by the UN General Assembly.

Statistical Coordination

Statistical coordination is especially important factor for implementing DRSF because most of the relevant combinations involve a close collaboration between statistics offices, disaster management agencies, and (in most cases) many other producers of official data.

The Fundamental Principles Implementation Guideline describes the scope of good practices in Statistical Coordination as follows:

> *"The issue of statistical coordination is based on the conceptualization of coordination as the set of processes and procedures for consolidating and achieving official statistics within an institution or between institutions. Coordination usually involves two fields, conceptual harmonization and institutional management.*
>
> *The conceptual harmonization implies that, for all participants institutions in the management of an official statistics, the variables have the same definition, are known and shared by national or international classifications of the subject, are encoded in the same way, the methodology is shared*

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

in all phases of the life cycle of the statistical operation, and in the best scenario, the databases are shared.

Interagency coordination and management aims at the efficient management process within or between institutions, i.e., mechanisms of communication, monitoring and control, and processes and procedures of articulation."

Legal framework,

The Fundamental Principles Implementation guidelines provided links to examples of good practices of national legal frameworks and related codes of practice for organizing and implementing statistical work programmes.[28] Legal frameworks provide clear responsibilities for production of statistics and can help data producers to identify and consult with users.

For some components in the DRSF, disaster management agencies may be involved in both the production or use of official statistics and their application in the analyses used to formulate policies. Thus, the Fundamental principles of independence and impartiality of the statistics programmes should be emphasized. "A strong position of independence is essential for a statistical agency in order to establish credibility among its users." (see UN Handbook of Statistical Organization 2003, page 5)

It means that "Choices of sources and statistical methods as well as decisions about the dissemination of statistics are only made by statistical considerations. (See Fundamental Principle 2)

Principle 1 – Relevance, Impartiality and Equal Access Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honor citizens' entitlement to public information.

Metadata

The documentation of methods and core descriptions of data is an indispensable component of any dataset or compilation used in official statistics. The Fundamental Principles of Official Statistics Implementation Guide states: "Metadata is an important part of the standard dissemination procedure for official statistics."

"For the qualified users it is necessary not only to read the pure statistical results but also to have a professional understanding of how the statistics have been produced. The qualified user will reach the necessary understanding on how to use the statistical results only after knowledge

[28] https://unstats.un.org/unsd/dnss/gp/Implementation_Guidelines_FINAL_without_edit.pdf

about data sources methods and procedures. This is why it is important that every statistics includes relevant and scientific documentation."

Many of the currently available data sources, internationally and nationally, of disaster-related statistics are insufficiently documented, which limits their practical utility for users. Collection of data is never free, it's an investment of resources. Comprehensive documentation of the outputs from a data source is like a form of insurance, protecting the value of the investment for future use.

Metadata is a cornerstone for creating coherence across occurrences or across datasets. Metadata needs must go beyond definitions of concepts or variables, and included explanations of scope of measurement, in practice.

The International Household Survey Network (IHSN) has published comprehensive guidance on metadata documentation of datasets. Although the founding focus for IHSN is survey datasets, the IHSN recommendations on scope[29] for metadata are broadly applicable for all types of datasets in DRSF. The Fundamental Principles Implementation Guideline also provides the generally applicable guidelines for dissemination of micro data (see pgs. 55-56)

Some advice on metadata documentation specific to the disasters domain have been described in this handbook, particularly in the tables and in descriptions for a basic range of disaster-related statistics in Chapter 5. Any centralized database on disaster-related statistical must include a strategically designed 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 to establish explicit links between related variables within the database.

Units of measurement, scope of measurement, definitions for key technical terms, method for monetary valuation, are all key examples of methodological choices, for which multiple options are always possible, so documentation of these choices, in a comprehensive manual or technical annex of concepts, definitions, units, and the population (or universe) addressed by the statistics.

Confidentiality

"In order to maintain the trust of respondents it is the utmost concern of official statistics, to secure the privacy of data providers (like households or enterprises) by assuring that no data is published that might be related to an identifiable person or business." National Statistics offices are well experienced with protecting confidentiality of respondents, as a longstanding fundamental principle for the practice of official statistics. Statistics offices rely on public goodwill and cooperation and trust of respondents as a basic factor for producing timely and accurate statistics.

[29] http://www.ihsn.org/documentation-scope

Disaster statistics pose somewhat of a special case given that disasters are, by definition, unusual, extreme events. In many cases there is a need for fairly detailed geographic disaggregation of statistical information. However, the focus of DRSF tables is on summary statistics, i.e aggregations and statistical summaries of information, which do not include references to identifying characteristics of individual households or businesses. In cases, where access to microdata (i.e. raw data sets) are required, for research purpose, for data sources for assessing disaster risks or impact, methods are available for anonymizing microdata prior to release to researchers. The IHSN has developed guidance on anonymization procedures for household surveys[30] , including links to tools like software and statistical programming codes that have been tested for anonymization of various survey datasets.

Transparency and Accessibility of Data

Principle 1 of the Fundamental Principles for Official Statistics states:

> *"Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information."*

The resolution A/RES/68/261 of UN General Assembly stated that countries need to" facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics."

It is also mentioned in the Sendai Framework Priority for Action 1 that countries need to "promote and enhance, through international cooperation, including technology transfer, **access to and the sharing and use** of non-sensitive data and information, as appropriate, communications and geospatial and space-based technologies and related services."

Besides the improvement in data accessibility, countries should also enhance the transparency on the sources, methods and procedures used to produce official statistics, i.e metadata (see above).

Chapter 5 DRSF data item

5a. A basic range of disaster related Statistics

[30] http://www.ihsn.org/anonymization

Accompanying this document are spreadsheet containing detailed statistical tables - Basic Range Summary Tables.xlsx which are sample output queries from a centralized disaster-related stastistics database. The sample tables, including the links to global indicators, are available for review from the Expert Group Website here:

1. The basic range of disaster related statistics, or the scope of data items relevant to this framework is described as a set of sample tables, see link above.

2. A collection of 5 types of DRSF tables have been developed to demonstrate the scope of the framework and the scope of a basic range of disaster related statics. The basic range of disaster related statistics is a collection of potential output tables or queries from a centralized national disaster statistical database organized in accordance with DRSF.

3. Not all tables, and certainly not all elements of all tables will be available or relevant in all situations and national contexts. Also, in many cases more detailed information than what is presented in the basic range of disaster-related statistics will be available, or the data will be available in other formats, levels of aggregation or other measurement units than what has been presented here. The tables represent an example baseline proposal to help national agencies to identify and develop their own basic ranges and summary tables of disaster related statistics according to their own needs as well as for international reporting purposes.

4. Within the tables, the direct links to internationally adopted indicators (SDGs and Sendai Framework) have been highlighted. These and other nationally-identified indicators could probably help compilers of these statistics to prioritize elements within the tables, if necessary.
    - **A:** Summary tables of disaster occurrences
    - **B:** Selected Background Statistics and Exposure to hazards
    - **C:** Summary tables of affected population
    - **D:** Summary tables of direct material impacts in physical terms
    - **E:** Summary tables of direct material impacts in monetary terms
    - **F:** Summary table of direct environmental impacts
    - **DRRE:** Disaster risk reduction expenditure account

5. There are three main types of background statistics in the DRSF basic range: (i) counts and basic characteristics of disaster occurrences, (ii) background statistics related to vulnerability and coping capacity , and (iii) statistics on exposure to hazards.

6. Exposure statistics serve multiple purposes in the framework, in particular for calculating indicators of risk, as well for assessing impacts, e.g. calculation of ratio indicators used in Sendai Framework and SDGs (e.g. affected population as proportion of 100,000 population).

7. There are three main categories of direct impacts: (i) human impacts (i.e. affected population), (ii) material impacts (includes critical infrastructure), and (iii) environmental impacts. Material impacts are estimated at first in physical terms (D tables) and then, where possible, are calculated in terms of losses in monetary terms (E tables).

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

Time period

9. The relevant time period varies by tables and according to the analysis. From a well-structured and well-documented database, the impacts tables (C,D,E, & F tables) could be reported for virtually any time period, as needed for the analysis. However, for most purposes, 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.

10. For example, for the Sendai Framework monitoring, governments specified a specific monitoring period of 2020-2030, as compared with 2005-2015 for the affected population indicators. Therefore, national agencies may choose to prioritize these 10-year reporting periods for developing summary statistics for affected population.

11. Other components of the framework, i.e. Background statistics and the DRR activity statistics (DRRE tables), represent activities that are continuous and based on data that compiled for reporting on a regular basis – usually annually.

Measurement Units

12. For compilation of national statistics on material impacts of disasters, a broader range of considerations and multiple options need to be considered and, ultimately, prioritized, in order to produce statistics on direct impacts to critical infrastructure and to the economy. In most cases, some initial proposals for first options regarding appropriate measurement units are noted in the tables, as examples. Further options and related considerations are considered in further detail in the next section.

13. Specifications for units of measurement for all basic range variables should always be specified, as part of the essential metadata in the tables.

Geographic regions

14. Level of geographic aggregation for reporting of statistics likewise varies depending on the purpose and selecting various options is a simple matter of adjusting specifications in the database queries. The sample DRSF tables provide a generic presentation (“Geo Region 1”, “…”), adaptable to the different needs or availability of geographically disaggregated data.
15. Key examples of categories for geographic disaggregation in the tables are: municipalities (e.g. Admin level 03), regions or provinces (Admin level 01 or 02), hazard areas, river catchment areas as specified by the relevant authorizes, coastal zones, or other environment-related geographic regions that could be of relevance for analysis of the statistics.

16. If, as recommended for DRSF, the statistics are organized in a GIS-based (or GIS-compatible) database structure, than geographic disaggregation can, in principle, be reported for all types of geographic areas, including areas different from administrative regions or that encompass multiple administrative regions.

17. There are multiple techniques and approaches in GIS for assigning geo-referenced data to reporting at different levels of geographic representation, the simple such example is a grid-based data assimilation (see further explanation in Chapter 6 on Data Sources).

Summary tables of disaster occurrences

18. Identifying a disaster occurrence is an essential first step to any centralized compilation of disaster-related statistics because of the need to attribute impacts specifically to disasters as the trigger events.

19. Based on these decisions by disaster management agencies, a simple register of disaster occurrences, including with unique reference codes and the basic characteristics (e.g. geographic scope of emergency, timing of emergency, etc. – See Section 2a) is prepared. From these registers, basic counts of disaster occurrences can be produced and reported, similar as shown in Table A1.

20. These counts of disaster occurrences are background statistics, useful for computing indicators related to disaster impacts. Counts of occurrences have limited analytical interest on their own, except for tracking the long-term trends in numbers of occurrences of different scales by regions within countries and internationally (e.g. for tracking potential impacts of climate change).

Selected Background Statistics and Exposure to hazards (B tables)

21. Data sources vary significantly for background statistics, compilations require joint work by NSO and NDMA, and may involve statistics from several official government agencies.

22. Exposure to hazards are generally calculated by the NDMA, background statistics and population can be derived from the existing official sources.

23. Statistics on household preparedness can be derived from household surveys and population and housing censuses. Many useful examples are available, including sample survey questions from many different countries.

24. 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.

25. Links to global indicators:
    - Number of deaths attributed to disasters, per 100,000 population. The denominator population could be calculated at different geographic scale (starting from national level), depending on the analysis, including the population in the affected area.
    - Direct economic loss per GDP: Again, the denominator is a background statistic, often available at different scales

Summary tables of affected population (C Tables)

26. There are many possible ways to organize a list of variables on affected population. The examples provided in the C tables is one possible approach, not necessarily comprehensive or relevant in all cases. In many countries, statistics for further detailed categorizations of variables are available and could be reported in summary tables, according to the demand. The C tables should be viewed not as a standard, but as a starting point, for developing basic reporting templates at the national level.
27. As discussed in detail in Chapter 2, the concept of affected population, as an aggregated indicator, creates multiple possibilities for double-counting of the same individuals. This issue is managed in the tables, by applying estimation or the available knowledge of multiple impacts to the same individuals for an adjustment at the bottom of each ‘C’ table.

28. In the case of disaggregation by relevant population groups, references to national definitions should be applied, and documented clearly in metadata for: urban and rural, poor (i.e. national poverty line), and disabled persons.

Summary tables of direct material impacts

29. D1_MAT tables are for recording direct material impacts in "physical" terms, such as area of damages or number of buildings, by categories. Suggestions for physical measurement units have been developed in the next section.

30. Direct impacts to cultural heritage identified separately due to special characteristics regarding measurement units and monetary valuation. Cultural heritage are unowned (or part of public owned infrastructure) with special values to the population, which are sometimes irreplaceable. They may be considered “unproductive” assets, in a strict sense, but often they are crucial sources of attraction for income-generating activity in the tourism industry.

31. Disruption of basic services from a Disaster is an extension f direct material impacts tables (D1_Mat), especially the impacts to critical infrastructure, because usually disruptions to services are a consequence of damaged or destroyed infrastructure. Measurement units for disruptions of basic services are number of persons and length of time.

Summary tables of direct material impacts in monetary terms

32. The direct material impacts in monetary mimic the material impacts tables in physical terms (D tables). Monetary valuations of material impacts needed for calculating direct economic loss (SDG 1.5.2 and Sendai Framework Target C indicators)

Summary tables of direct environmental impacts

33. The final component of direct impacts statistics are the environmental impacts from disasters. A separate compilation of direct impacts to the environment (F tables) is useful because of the unique analytical needs and special considerations regarding measurement unit and possibilities for monetary valuation of these impacts.

34. There are direct impacts to the atmosphere and climate change via emissions and via losses of carbon sequestration capacity. These measurements are available from agencies that track geophysical activities, globally, for example, from the Smithsonian institute: a visualization of the time series of activities, beginning from 1960: http://volcano.si.aximaps.io/

35. Impacts to ecosystems depend on a classification of land cover type such as the 14-class example show in the F-tables and availability of national land cover map or accounting programme. Land cover statistics is typically the responsibility of national mapping or national environmental agencies. The linkages with DRSF happen in terms of overlay with (i) the location of specific direct impacts and (ii) with exposure to hazards (B tables). There are also functional categories of land cover that could be of special interest for assessing exposure or direct impacts, i.e: designated biological reserves and World Heritage site.

Disaster Risk Reduction Expenditure Account

36. While disasters, and their impacts, are occurring randomly, disaster risk reduction is a continuous activity (although often boosted in the recovery period after a major disaster), related to disaster response and informed by the gradual improvements in knowledge (based on analysis of statistics) on disaster risks and how to minimize them.

37. 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 specially designed extractions from the broader aggregated accounting framework, and the

information, in principle, could be derived from the same data sources that are used in national accounts.

38. As discussed in greater detail in Chapter 2, statistics on DRR activity serve many purposes, including to track the response of government and non-government institutions to disaster risk over time, to improve understanding of the types of effectiveness of different types of programs, and as inputs for estimating economic loss of disasters.

39. The DRR Expernditure (DRRE) accounting tables are developed based on a draft proposed classification of disaster risk reduction characteristic-activities (DRRCA) presented in Chapter 3, which was developed utilizing, as much as possible, the existing definitions developed and adopted for the Sendai Framework, from the SNA, and from other related existing resources, such as the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4).

5b: Measurement Units

Examples of potential first priority units of measurement are provided, where relevant in the sample DRSF Basic Range of Disaster-related Statistics tables. In many cases there are multiple options, and collection or reporting of statistics need not be limited to only one choice for each variable.

Dwellings

Dwellings are a special case where the number of units typically is aligned with number of households. Individual buildings may have multiple units (e.g. apartment buildings) affected by a disaster and the number of units is a good approximation for the number of households affected by damaged or destroyed dwellings. There may also be an interest in number of individual people affected (e.g. for calculating an aggregated affected population indicator) and households come in different sizes. For economic loss valuation, there may be a need to restore data on estimated size or area of damages (i.e. in terms of square meters of damage).

Therefore, for the case of dwellings we have at least the following non-exclusive options. If planned in advance, all of the measurements in physical units could, in theory, be derived for dwellings from the same primary data source.

Dwellings Measurement Unit Menu

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

Critical Infrastructure

Critical infrastructure is heterogeneous by nature. They are assets of varied forms, including 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 of impacts to assets. Initially, impacts to critical infrastructure must be observed according to the categories, with specialized units of measurement, in physical terms, most relevant to each type of asset. For many users, the main interest might be the economic costs of the impacts to infrastructure, but measurement in physical terms also has many important uses, in it own right, and the basic data should always be retained within the databases. Also, its important to retain statistics on material impacts in physical terms because economic valuation methodologies may vary across different studies.

For each category of infrastructure, there are multiple options for measurement units in physical terms. The below table offers a first attempt at prioritizing, but multiple measures is always a possibility.

Critical Infrastructure Physical Measurement Units Menu

Critical infrastructures	*Measurement unit*		
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
Railway	no. of units		
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)	

Disruptions to Basic services from a Disaster

Many times material impact, `particularly damages to critical infrastructure, result in disruptions to basic services after a disaster. Target D in the Sendai Framework aims to "Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030."

Critical infrastructure are the "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." Furthermore, a disaster is defined as a "serious disruption of the functioning of a community or a society.." (UNGA 2016). Therefore, impacts to critical infrastructure and the effect the trigger impact has on basic services are central defining features of disasters and, therefore, impacts statistics.

Material impacts from a hazard are the triggers that usually directly cause disruptions to services. However, from a measurement perspective, these disruptions are understood as impacts to the population and should be measured in terms of number of people affected

Additionally, the time element of the disruptions is critical for understanding the scale seriousness of the emergency, the underlying risks of the affected area, and the challenges for recovery. Thus, all disruptions to basic services are recorded with 2 dimensions: no. of people affected and length of time (See DRSF D2 tables).

Impacts to employment

One of the important impact to the population from disasters identified rom the Sendai Framework are impacts to livelihood. As with the disruptions to basic services, the length of time (e.g number of days) of lost income-earning employment need to be considered alongside with the number of people affected. Numbers of jobs by sector could also be of importance, especially for economies with a high dependence on specific critical sectors, such as agriculture.