The 2019 Global Assessment Report on Disaster Risk Reduction (GAR19)

Concept Note

(May 2018)

Background

In adopting the Sendai Framework for Disaster Risk Reduction 2015 – 2030 (Sendai Framework), the 2030 Agenda for Sustainable Development (2030 Agenda), the New Urban Agenda (NUA) and the Paris Agreement, Member States clearly identified the prevention of new risk, the reduction of existing risk, and the strengthening of resilience, as central to global efforts in realizing sustainable development pathways in the 21st century.

The UN Global Assessment Report on Disaster Risk Reduction (GAR) is the flagship report of the United Nations on worldwide efforts to reduce disaster risk. The GAR is published biennially by the UN Office for Disaster Risk Reduction (UNISDR), and is the product of the contributions of nations, public and private disaster risk-related science and research, amongst others.

The next GAR will provide: a) an update on global progress made in implementing the outcome, goal, targets and priorities of the Sendai Framework and disaster-related Sustainable Development Goals (SDGs), b) current and future risk trends introducing systemic risk perspectives as represented in the forthcoming Global Risk Assessment Framework (GRAF), c) cutting edge, innovative research and practice in disaster risk management and good practice on how to manage and reduce disaster risks, and d) an introduction to the wider scope and systemic nature of hazards to be considered in implementing the Sendai Framework.

Developed through an extensive set of partnerships with international organizations, governments, businesses, academic and research institutions, the GAR is both an ongoing process of evidence generation and policy engagement, and a product – in the form of a biennial report published by the UNISDR. The process contributes directly to greater access to risk information for decision-making, and identifies feasible practices that can be employed at the local, national, regional and international levels.

During the period of implementation of the Hyogo Framework for Action 2005 – 2015 (Hyogo Framework), a total of four Global Assessment Reports were produced between 2009 and 2015. GAR09 focused on *Risk and Poverty in a Changing Climate*, and provided evidence that disaster risk is disproportionately concentrated in lower-income countries with weak governance and how underlying drivers such as badly planned and managed urban development, vulnerable rural livelihoods, environmental degradation, poverty and inequality, further generate and accumulate disaster risk in low-income communities and households.

GAR11, *Revealing Risk, Redefining Development*, identified effective public policies to address the disaster risk–poverty nexus and the political and economic imperatives and constraints for increased public investment in disaster risk reduction. Using innovative hybrid probabilistic risk models, GAR11 produced risk profiles for a number of countries in order to demonstrate how a risk-layered approach to managing disaster risks could maximize benefits while reducing costs.

GAR13, *From Shared Risk to Shared Value: The Business Case for Disaster Risk Reduction*, explored the nexus between private investment and disaster risk and showed how businesses can invest in managing their disaster risks to reduce the costs and interruptions represented by disaster losses and impacts, and how they can enhance performance and reputation by minimizing uncertainty and unpredictability.

GAR15, *Making Development Sustainable: The Future of Disaster Risk Management* presents the case for a broad reinterpretation of disaster risk reduction. As the HFA was drawing to a close, GAR15 questions whether the way in which disaster risk reduction has been approached under the HFA is really fit for purpose in a world now threatened by catastrophic increases in disaster risk. It showed why the focus of disaster risk reduction needs to move from managing disasters to managing risks if it is to contribute to making development sustainable.

The *GAR Atlas: Unveiling Global Risk* presents the risk associated with a number of hazards[1] with a global level of observation and a national level of resolution. By using the same methodology, arithmetic and exposure model to calculate the risk for all these hazards, the GAR Atlas provides globally comparable multi-hazard risk metrics and enables comparisons of risk levels between countries and regions and across hazard types. In this way, the GAR Atlas facilitates a better understanding of the global risk landscape, enabling the estimation of the order of magnitude of probable losses in each country, and taking into account the risk contributions from different hazards.

[1] earthquakes, tsunamis, riverine flooding, cyclonic winds and storm surge

From the Hyogo Framework for Action to the Sendai Framework for Disaster Risk Reduction and the 2030 Agenda for Sustainable Development

The transition from the Hyogo Framework to the Sendai Framework, represented not only a fundamental shift in paradigm – from managing disasters to managing risk – but also promoted the management of risk within the operationalization of the 2030 Agenda for the achievement of the Sustainable Development Goals (the SDGs). In adopting common metrics for measuring the global targets of both the SDGs and the Sendai Framework[2], and making explicit the relationship between the Global Platform for Disaster Risk Reduction (GP) and the UN High-level Political Forum on Sustainable Development (HLPF), the two agreements and the implementation architecture that follows are wedded as never before. As a result, the themes to be addressed in GAR19 will be aligned to the HLPF 2019, namely 'Empowering people and ensuring inclusiveness and equality'.

GAR19 and subsequent GARs will focus not only on risk emanating from natural hazards, but as specified in Paragraph 15 of the Sendai Framework, will cover a broader spectrum of hazards and risk that includes 'small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks'.

GAR19 will therefore introduce the aspect of the additional hazards to be addressed in the implementation of the Sendai Framework and the 2030 Agenda, in the development of the global risk assessment framework, and their dynamic interactions with systemic risks. GAR19 will also provide emphasis on efforts at the national and sub-national scales.

The 2019 edition of the GAR will be structured thus:

1. Presentation of trends and analysis of reporting by countries of progress in implementing risk-informed sustainable development and the Sendai Framework, through the online Sendai Framework Monitor. This chapter will present analysis in the context of the contribution of the Sendai Framework to the achievement of the SDGs, and examine efforts undertaken by countries to fulfil monitoring and reporting requirements, exploring the evolution of disaster losses as compared with baseline data from the HFA decade 2005-2015.
2. Exploration of current and future risk trends, introducing interactions with systemic risks, with emphasis on drought as an exemplar of complex, multi-dimensional, cascading risk phenomena incorporating many of the new elements introduced in Paragraph 15 of the Sendai Framework. In so doing, GAR19 will introduce the Global Risk Assessment Framework (GRAF) and describe the roadmap for the evolution of the GRAF to 2030.

[2] The UN Statistical Commission at its 48th Session in March 2017 endorsed the Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs) | Note by the Secretary-General - E/CN.3/2017/2*, proposing a) the indicators recommended by the Open-ended Intergovernmental Expert Working Group on indicators and terminology relating to disaster risk reduction (OIEWG) and b) the identification of UNISDR as custodian agency of disaster-related targets of the SDGs.

3. Examination of the evolving policy environment since 2015 and the progress made towards reaching Target E of the Sendai Framework (Substantially increase the number of countries with national and local disaster risk reduction strategies) – for which the deadline is 2020. The chapter will examine experiences to date in respect of establishing the enabling environment for risk informed decision-making at regional, national and sub-national scales, and in a variety of contexts – including 'fragile states' – with the view to guide and steer efforts towards achievement of Target E and risk-informed sustainable development in the context of the 2030 Agenda and the Paris Agreement.

4. Introduction to Paragraph 15 of the Sendai Framework, including biological, technological and environmental hazards and risks and the inter-connected relationships and dependencies that exist within and across social, ecological and economic systems and behaviors. GAR19 initiates the wider investigation – to be further developed through subsequent GAR editions and the GRAF – with the view to guide the efforts of societies in realizing the goals and outcomes of the 2030 Agenda, the Paris Agreement, the New Urban Agenda and the Sendai Framework, and allow ongoing evaluation of efficacy and impact.

Global disaster trends

The 2017 North Atlantic hurricane season featured both the highest total accumulated cyclone energy (ACE) and the highest number of major hurricanes since 2005, and was by far the costliest season on record. Munich Re quote total weather-related losses (insured and non-insured) in 2017 of USD 330 billion, of which USD 320 billion were weather-related. In their dataset, this is the highest weather-related loss on record (after inflation adjustment) and the second-highest year for losses from disasters triggered by natural hazards in general.

When Hurricane Irma made landfall, it hit Barbuda with maximum sustained winds of 295 km/h, record rainfall and a storm surge of nearly three meters. Deaths were limited to one but an estimated 90% of properties were damaged. This prompted the Prime Minister to order the complete evacuation of all residents as Hurricane Jose approached. It was three weeks before residents were permitted to return, and three months later, only an estimated 20% of the population had returned. Hurricane Maria proved still more devastating for Dominica. Total damages and losses were estimated at USD 1.3 billion or 224% of GDP, with significant parts of its rainforest damaged and destroyed. This has implications across society, the losses incurred by the tourist sector alone are estimated at 19%, and 38% of housing was damaged[3]. Maria provoked the longest blackout in United States' history in Puerto Rico, affecting 35% of the island's population for at least three months – continued problems following the hurricane may see the privatization of the Puerto Rico Electric Power Authority (PREPA), the largest publicly owned power

[3] Post Disaster Needs Assessment – Government of the Commonwealth of Dominica

authority in the United States[4]. The disaster prompted the Federal Emergency Management Agency to approve USD 1.02 billion of assistance to the *Individual and Households Program* and obligate USD 555 million in *Public Assistance Grants*[5].

Drought in the Horn of Africa brought Somalia to the brink of famine in 2017, but this is only a part of the story. An unusually high 18,000 cases of cholera were recorded in the first three months of 2017 alone, as clean water sources dried up in the region. The impact of drought on food systems, combined with man-made market failure risk, unfit coping mechanisms, societal fragility and chronic insecurity, exacerbated losses and dramatically increased the number of people affected. The result is displacement in significant numbers, deteriorating public health, and accelerating environmental degradation.

Both the United States and Europe have been hit hard by wild fires in 2017, Chile saw its worst wildfires in the country's history, and a new record in fire damages was set in Portugal. With a warming world, longer, more intense wildfire seasons are expected to be more commonplace.

From the man-made hazards perspective, an estimated 7 million people per year die from air pollution-related diseases, including stroke and heart disease, respiratory illness and cancers, according to the WHO. Health related heat waves, amplified by climate change, kill ten times more people in the United States of America than tornados or other extreme weather events[6]. Overall an estimated 12.6 million people died as a result of living or working in an unhealthy environment in 2012 – nearly 1 in 4 of total global deaths, according to new estimates from WHO. Environmental risk factors, such as air, water and soil pollution, chemical exposures, climate change, and ultraviolet radiation, contribute to more than 100 diseases and injuries, while deaths of infectious diseases such as malaria and diarrhea have declined.

These are all clear examples of how crippling the realization of risk can be, when allowed to build (in some cases unchecked) across inter-connected systems, and is a clear reminder of the need for comprehensive assessment across geographies, sectors and scales of the determinants of risk, so as to support the development of inter-connected solutions that prevent and mitigate such social, ecological and economic damage and loss. It is in cases as clear as these, that the world is once again reminded of the imperative to shift the way we work, from isolated, siloed approaches, to inter-disciplinary systems thinking, identifying correlations and managing uncertainties.

Although relatively speaking in their infancy, correlated predictive analytics exist – the UNHCR for example, is pioneering innovative approaches using machine-learning and indicator-based algorithms synthesizing interrelated variables from precipitation to commodity prices to predict population movements and corollary impacts; initiatives like this are challenging the way risk is modelled.

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4 Attributed to the Governor of Puerto Rico.

5 Federal Emergency Management Agency, Department of Homeland Security, Government of the United States of America

6 after Professor Richard Keller, University of Wisconsin-Madison

GAR19 Structure

GAR19 will entail four chapters:

1. **Implementation of the Sendai Framework for Disaster Risk Reduction and disaster risk-informed Sustainable Development:** a review of global, regional, national and local progress and challenges, including in support of the 2030 Agenda, the Paris Agreement and the New Urban Agenda.

2. **Global risk trends:** patterns and trends in global disaster risk and vulnerability – initiating the shift from a single model to a global intercomparison approach, introducing interactions with systemic risks with an emphasis on drought, and the Global Risk Assessment Framework (GRAF).

3. **Creating the national and local conditions to manage risk:** reaching Sendai Framework Target E (Substantially increase the number of countries with national and local disaster risk reduction strategies), exploring progress in establishing the basis for national and local risk-informed decision-making and investment across all-of-State-institutions at national and local levels.

4. **Introducing the hazard and risk scope of the Sendai Framework:** introducing biological, technological and environmental hazards and risks – identifying impacts, interrelationships with natural hazards, and existing measures – and providing a preliminary investigation of the dynamic interactions with systemic risks that shape the interface with the Sendai Framework and other international agreements.

The first chapter of GAR19 will be based on a combination of: a) an analysis of risk reduction in the Sustainable Development Goals of the 2030 Agenda, b) inputs from the Sendai Framework Monitor – the tool used by governments to register and evaluate their progress made towards reaching the global targets of the Sendai Framework and SDGs 1, 11 and 13 – and will include detailed analysis of countries' progress in reaching the Sendai Framework global targets, and c) a qualitative and quantitative analysis of the efforts made by countries, including in respect of developing and retro-fitting national loss accounting systems and developing disaster-related statistics.

The second chapter of GAR 19 will present and analyse global trends in risk to natural hazards; an introduction to the additional hazards and risks prescribed in the Sendai Framework is provided in Chapter 4. This chapter will introduce the Global Risk Assessment Framework (GRAF), and the shift to inclusive, collaborative modelling and assessment approaches able to provide systems risk perspectives; including through intercomparison of a wide range of existing models, assessments and risk indices.

The chapter will further examine how innovation and emerging technologies can help contextualize global risk models for local action, using drought and water stress-related impact models as an example to predict migration and conflict.

Target E of the Sendai Framework which tracks the 'number of countries with national and local disaster risk reduction strategies', is due by 2020. **The third chapter** of GAR19 will therefore examine diverse cases of the development of Sendai-compliant local, national and regional disaster risk reduction strategies and plans, identifying those that have proved successful in enabling multi-scale risk informed decision-making.

By examining differing approaches and contexts, assessing conducive and hindering factors and identifying good practice[7], this chapter will present elements that can inform and guide countries and local authorities developing Sendai-compliant disaster risk reduction strategies – and how these support the implementation of the SDGs. Investigation will focus as much on the contributory aspects of (integrated) design, development and implementation, as to the impact of such strategies and plans on the national and local risk landscape – current and future. The chapter will present case studies of disaster risk reduction strategies at national and sub-national levels in a range of different contexts[8], including those integrated within or linked with sustainable development strategies and plans, climate adaptation strategies and plans, and those developed in fragile contexts.

The fourth chapter will introduce the expanded hazard and risk scope of the Sendai Framework by providing a preliminary examination of key biological, technological and environmental hazards and risks, how such risks have evolved over time, and how such risks manifest in social, ecological and human systems and behaviors. The chapter will explore related natural and human drivers and will be informed by the measures taken by countries and partners in addressing these risks at all scales, from international, transboundary initiatives, to local prevention and reduction efforts. This will include an analysis of the various institutional and legal frameworks, risk management practices and national, regional and international standards that governments apply in addressing man-made hazards. It will also examine consistency or dissonance with similar measures established to address risks posed by natural hazards in the period prior to the adoption of the Sendai Framework.

[7] including aspects of inclusiveness and equality, governance and sustainability

[8] drawing from national country cases, as well as local surveys developed by partners at city level

1. Implementation of the Sendai Framework for Disaster Risk Reduction and disaster risk-informed Sustainable Development

Since its adoption at the World Conference for Disaster Risk Reduction in 2015, Member States and non-State stakeholders have been developing and executing actions to implement the Sendai Framework for Disaster Risk Reduction (Sendai Framework), to deliver its expected outcome and goal, and realize both global and nationally-determined targets and priorities.

In parallel, in 2016 and 2017, Member States engaged in an intergovernmental process to develop the terminology to guide follow-up, as well as the global indicators to measure progress in the achievement of the outcome and goal, as well as implementation of the seven global targets of the Sendai Framework. The United Nations General Assembly endorsed on 2 February 2017 the recommendations of the Open-ended Intergovernmental Expert Working Group on indicators and terminology relating to disaster risk reduction (OIEWG) in adopting Resolution A/71/644. This was succeeded by the endorsement by the UN Statistical Commission at its 48th Session in March 2017 of the Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs)[9], wherein the indicators recommended by the OIEWG were adopted for measuring the disaster-related targets of SDGs 1, 11 and 13, and identified the UNISDR as the custodian agency for these targets.

On the basis of the recommendations of the OIEWG, the UNISDR has developed the Sendai Framework Monitoring System (SFM). By employing the SFM, Member States and other stakeholders are able to report on their progress in implementing the goals and targets of both the Sendai Framework and disaster-related SDGs. This in turn allows the appraisal of the impact of measures taken to reduce disaster risk and promote risk-informed sustainable development, inter alia against trends in losses and damage. The information generated can then inform the determination of successful actions to be adopted to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability, increase preparedness for response and recovery, and strengthen resilience.

The UNISDR continues to support these efforts and the roll-out and maintenance of the on-line SFM, which has been available since 1 March 2018. It also provides support to the establishment of national disaster loss accounting systems, initially building on an upgraded version of DesInventar and with plans to develop and make available a new national disaster loss accounting tool which will integrate seamlessly with the online Sendai Framework Monitoring System.

As of March 2018, through the online Sendai Framework Monitoring System (SFM), countries have been able to report on progress on measuring the global targets of the Sendai Framework and disaster risk reduction-related targets of the SDGs using identical indicators and datasets. The Sustainable

[9] Note by the Secretary-General - E/CN.3/2017/2*

Development Goals Report, which is submitted every year to the High-Level Political Forum (the HLFP), draws on data collected and reported by countries using the SFM.

Chapter One will review progress made in implementing the Sendai Framework in the context of the contribution of these efforts to the achievement of the SDGs. It provides a snapshot of the current state of reporting by Member States on the implementation of the Sendai Framework in relation to the seven global targets, as well as reporting on specific custom indicators measuring nationally-determined targets, drawing on outputs from the SFM as well as complementary sources. It will also identify progress countries have made in developing disaster-related data, including national disaster loss databases, disaster-related statistics, disaster-related geospatial and earth-observation data, as well as monitoring and reporting capabilities.

1.1 Risk Reduction in the Sustainable Development Goals of the 2030 Agenda

The interdisciplinary nature of risk and the factors that allow its creation, prevention, reduction or propagation however, require risk to be considered in all decisions at all scales and in all dimensions. Risk-informed decision making and resilience building can therefore be considered an essential pre-condition for achieving all of the SDGs, a relationship, which will be explored in this Subchapter and will be further elaborated in subsequent GARs, and which will go beyond the indicators common to both.

The hardwiring of disaster risk reduction within the monitoring architecture of the 2030 Agenda, is evidence of the indivisibility of the two agendas, and the interdependent nature of their outcomes. The use of common indicators to monitor progress in achieving the global targets of the Sendai Framework and the SDGs, allows the use of multi-purpose datasets in integrated monitoring and reporting. Through the SFM, national monitoring and reporting on progress in achieving Sendai Framework Targets A to E now also allows countries to report on progress in achieving the following goals and targets of the 2030 Agenda:

- SDG 1 – End poverty in all its forms everywhere
- SDG 11 – Make cities and human settlements inclusive, safe, resilient and sustainable, and
- SDG 13 – Take urgent action to combat climate change and its impacts.

With the monitoring and reporting architecture of the SDGs having been approved by the national statistical offices (NSO) of respective countries, the adoption of common metrics for the two agreements has generated particular interest in the statistical community – inter alia as this invites the application of the Fundamental Principles of Official Statistics to disaster-related data, and the application of statistical metadata. The establishment in 2017 of the Global Partnership for Disaster-related Statistics is one manifestation of the burgeoning work in this area. This Subchapter will extrapolate analyses in the context of the SDGs, and examine global and national efforts to integrate disaster-related data in national statistical systems.

1.2 Sendai Framework for Disaster Risk Reduction – Progress Review 2015 - 2017

Member States agreed to a set of 38 indicators to measure global progress in the implementation of the Sendai Framework and the 2030 Agenda. These indicators, will assist the measurement of progress in achieving the seven global targets, and support the analysis of global trends in the reduction of risk and losses. With the expansion of the scope of the Sendai Framework and recognizing that trends will be identified over time, analyses of progress and trends will be conducted both punctually and longitudinally, inter alia to inform the mid-term review of both the Sendai Framework and the SDGs, as well as the determination of the new goals and targets of the post-2030 era. These analyses will be documented in biennial GARs.

In addition to the indicators employed to measure achievement of the global targets, Member States have the option to define custom targets and indicators. These specific nationally determined instruments will assist Member States apply greater context specificity to national and local strategies and plans to reduce disaster risk, and the measurement of progress in achieving the four priorities of the Sendai Framework. Such custom targets and indicators assure both relevance and alignment of Sendai-compliant strategies with the priorities of respective countries and will subsequently be reflected in the national reports of the countries submitted in the SFM.

This Subchapter presents a summary of the reporting of countries for the period 2015 – 2017 against the global targets and indicators, and will include a trend analysis based on submissions received at the time of writing, and may be supplemented by other available historical data. It will provide an analysis of the reporting provided by countries and intergovernmental organizations (IGOs) on adopted custom indicators.

1.2.1 Thematic review of progress

This Subchapter will provide additional granularity to the analysis of progress in implementing the Sendai Framework, through a detailed analysis of specific elements of selected targets. The product of dedicated investigation and research, together with relevant partners – for example the World Meteorological Organisation (WMO) and early warning systems – this Subchapter is expected to draw insights of additional value to countries and other stakeholders determining optimal pathways for risk-informed development.

1.2.2 Beyond the indicators

The Sendai Framework and risk-informed sustainable development represent a step change in the manner in which societies understand and manage risk. Such change requires the transformation of behavior and practice in multiple dimensions at all scales; data, policy, planning protocols and the development of implementation capacities to name but a few. This is not an easy undertaking for any society, governments have however been investing in putting in place the necessary pre-requisites to meet

international commitments made under the 2030 Agenda, the Sendai Framework, and the Paris Agreement. This progress, while significant in some circumstances, may not be effectively captured in the outcome oriented global targets and indicators that were adopted by Member States. This Subchapter will therefore seek to capture the significant progress made by many countries in establishing the pre-conditions for accelerated implementation, monitoring and reporting of the Sendai Framework, and by extension the SDGs. This analysis will allow a more informed interpretation of progress reported by countries to date.

2. Global Risk Trends

The current approach to global risk assessment, and the initial probabilistic hazard models that underpinned it (represented in the Global Risk Model), that were developed by the UNISDR for GAR13, GAR15 and the GAR Atlas 2017, succeeded in providing comparable open-access disaster risk metrics across countries and hazard categories as a means of raising risk awareness, making a significant contribution to promoting the risk-based discourse that resulted in the adoption of the Sendai Framework. The Global Risk Model included probabilistic global hazard models[10], and regional models[11] – that reflected in part the scope of the Hyogo Framework for Action – and applied principally to economic losses in the built environment and loss of life.

The Sendai Framework however, significantly broadened the range of hazards and risks, to include small- and large-scale, frequent and infrequent, sudden and slow onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks. Furthermore, the integration of the Sendai Framework and the 2030 Agenda demands greater understanding and address of inter alia social and environmental vulnerability, as well as dynamic interactions with systemic risk – be it in respect of food, health, water or energy systems for example. This widening of scope and complexity demanded a review of the Global Risk Model and the data, vulnerability functions, exposure layers, methodologies and outputs that it used and generated, as well as the working practices and modalities adopted.

Consequently, in November 2017 UNISDR consulted over 110 leading risk modelling and assessment experts – including risk data providers, risk modelers, risk communication experts and end-users of risk assessments – spanning all regions of the world and perspectives from high-, middle- and low-income countries, on a future Global Risk Assessment Framework (GRAF).

The GRAF seeks to increase the scientific foundation and use of risk assessment outputs for decision-making, through the establishment of an inclusive and open collaborative, providing data, evidence and tools to decision-makers at all levels, to prevent risk creation, reduce risk and accelerate progress towards sustainable societies and systems. The GRAF will seek to translate outputs for decision-makers – including by applying geospatial and earth observation data for the visualization of risk – obviating the need for translation / interpretation of modelled outputs; skills that decision-makers are generally lacking.

The GRAF will approach risk from a systems perspective, revealing the dynamic interactions between hazards or shocks, exposure, and importantly vulnerabilities, with social, ecological and economic systems. It aims to consider correlations between direct and indirect risk factors and potential impacts

[10] for earthquake, tsunami, riverine flood, cyclonic wind and storm surge

[11] for volcanic ash in the Asia-Pacific, drought in parts of Africa and the Middle East, and a proof of concept for hurricane wind in the Caribbean, applying a climate change scenario

and consequences on all sectors of society, so that the cascading effects of changing behavior on risk can be better understood and mitigated.

In this transitional phase, the second chapter of GAR 19 will present key risk trends as identified by a wide range of partners expected to contribute to the design and iterative development of the GRAF through to 2030. Risk trends will be presented pertaining to both 'traditional' hazard categories – for example, water-related risk (including flood and storm surge), earthquake, volcano, tsunami and landslide risk – and will in a later chapter examine 'additional' hazard categories – such as health-related risks and dangerous substance release.

GAR19 will include a specific focus on drought, as an exemplar of the proposed approach for the design and development of the GRAF. As a precursor to a GAR Special Report on Drought in 2020, the drought component will be the collaborative product of leading partners in the field and is expected to provide an updated global map of (relative) risk of drought impacts (with a focus on agriculture), including analysis of hazard, exposure and vulnerability. Providing the introduction for further investigation in the Special Report and the GRAF, this component is expected to examine the complex nature of assessing global drought risk, the propagation of drought and related impacts (direct and indirect) across economic and environmental sectors.

This chapter will provide a stress-test of the SFM outputs as well as other findings on the current state of implementation of the Sendai Framework summarized in Chapter One. By contextualizing current progress with global risk trends, the pathways selected by stakeholders towards achieving the global targets of the Sendai Framework and the SDGs by 2030 can be better evaluated, and where necessary, options for refinement or course correction identified.

2.1 Global Risk Trends and the Global Risk Assessment Framework (GRAF)

This Subchapter will introduce and feature ongoing work in the development of the GRAF. While outputs available for GAR19 will not yet be able to correlate all hazards, risks and impacts, the impact of specific hazards on the Sendai Framework global targets and relevant targets of the SDGs, will be assessed in this chapter, by reflecting the impact of various hazards on different sectors.

GAR19 will describe the GRAF – which will be developed in an iterative process through to 2030 – and will present the work of some of the first contributors. It will begin to address the expanded scope of the Sendai Framework, and situate these in the context of work towards the achievement of the global targets of the Sendai Framework and the 2030 Agenda.

An initial list (non-exhaustive) of potential contributors includes inter alia:

- The Global Flood Partnership, with the World Resources Institute providing analysis on water-related risk, stemming from floods, cyclones etc.
- The Global Earthquake Model providing an analysis of global earthquake risk.
- The Global Volcano Model providing an assessment of volcanic risk, landslide etc.
- The Norwegian Geotechnical Institute (NGI) providing a perspective on coastal risk, including tsunami, wind and storm surge.
- A collaborative network of organizations providing an introduction to global drought risk (see below).
- The Joint Resource Centre of the European Commission (JRC) providing trends on wildfire risk.
- The UN Conference on Trade and Development (UNCTAD) and the JRC providing insight into disaster impact on critical infrastructure, including a focus on SIDS.

The chapter will also provide details on the way forward and how the GRAF will complement the SFM, the monitoring of progress in achieving the SDGs, the commitments and targets of the New Urban Agenda (the NUA) and ultimately the Paris Agreement.

2.2 Global Drought Risk examined

This Subchapter (*to be further defined by the GAR Drought Group*[12]) will dive deeper into aspects of systemic risk, demonstrated through the example of drought risk. By mapping relative risk of drought impacts on different sectors including secondary and cascading effects, this Subchapter will illustrate pathways to systems risk assessment, assessing natural and human-induced causes and determinants of drought. As a precursor to a 2020 GAR Special Report on Drought, it will examine the consequences across economic and environmental sectors for example, and potentially the corollary impacts on inter alia food security and food systems, water access and availability, markets, employment and energy distribution, or related socio-political and security outcomes.

The Subchapter is expected to highlight the complex nature of assessing global and localized drought risk, describing the propagation of drought through the hydrological cycle, the potential for amplification from climatic instability, and related direct and indirect impacts across various sectors.

The work is expected to provide an analysis of the long-term data required to estimate the probability of occurrence of a certain drought severity, the potential to identify anomalies and pre-cursor signals in advance of the onset of severe drought conditions, and the exposure and vulnerability based on social, economic and infrastructural indicators at national, subnational and administrative unit level, using the Global Human Settlements Layer (GHSL).

[12] as recommended by the GAR Advisory Board

In providing a global perspective on drought risk (and drought risk management), this Subchapter serves as the basis for future GAR work on drought – and initiates the work towards a Special GAR Report on Drought (proposed for 2020).

This Subchapter will summarize the contributions of a number of the world's leading experts and initiatives, including the Global Drought Observatory (GDO) of the Joint Research Centre of the European Commission (JRC), and potentially the:

- Agricultural Model Intercomparison and Improvement Project (AgMIP)
- Africa Risk Capacity (ARC)
- Chinese Research Academy of Environment Sciences
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Food and Agriculture Organization (FAO)
- Global Water Partnership (GWP)
- Group on Earth Observations Global Agricultural Modelling (GEO-GLAM) initiative
- Indian Institute of Human Settlements (IIHS)
- Indian Council of Agricultural Research (ICAR)
- Integrated Drought Management Programme (IDMP)
- International Institute for Applied Systems Analysis (IIASA)
- League of Arab States
- Makere University
- Marsh & McLennan
- National Drought Mitigation Center (NDMC), United States
- National Oceanic and Atmospheric Administration (NOAA), United States
- The South Centre
- UN Convention to Combat Desertification (UNCCD)
- UN Environment Programme (UNEP)
- University of Wisconsin-Madison
- World Academy of Science
- World Food Programme
- World Meteorological Organisation, Agricultural Meteorology Programme

Additional inputs may include for example, ongoing analyses of the World Resources Institute and Deltares (water stress and its socio-economic impacts), CIMA Foundation and the International Maize and Wheat Improvement Center (CIMMYT). Through collaboration with partners modelling migration and conflict potential linked to water stress and food insecurity in both the African and the Arab States regions, drought will be examined as a potential trigger for migration and conflict.

2.3 Contextualizing global risk trends – making global risk data locally applicable

Innovative methods of correlating data in the development of risk models are being developed in multiple domains – for example, in the prediction of human migration and displacement in situations of drought and conflict, or in predicting conflict risk due to water stress. Similar correlations could be imagined when modelling health risks and other risk.

Such approaches can be relevant to and informative for a number of countries – including those lacking critical datasets and limited capacity. Such countries can benefit from existing data sources from earth observation, historical loss data, and socio-economic indicators; all of which can be used to contextualize global risk data, so that risk models can be developed which are financially accessible and are fit for decision-support. In this way, countries can develop (modelled) products that go beyond the offer of global models. While full national or local risk assessments are desirable, these can be prohibitively costly – whether in terms of time and / or financial cost.

This Subchapter showcases how global trend analysis, while undeniably a useful tool to contextualize global progress in implementing the Sendai Framework and disaster-related SDGs, can also be applied at the local level to support risk-informed decision-making.

In addition, the Subchapter will examine how to develop next generation 'holistic' modelling, simulations and visualizations that accurately depict and build a shared understanding of the medium- and long-term future conditions of the complex, non-linear, interlocking and dependent systems of the planet to better live with and manage uncertainty, considering the effects of climate change, extreme weather, geoengineering, resource depletion, fresh water availability, food security, public health and safety, as well as earthquake, tsunami, landslide, volcanic or other hazards.

2.4 Effective communication of risk – information that creates the case for action

This Subchapter will examine the ways in which risk assessments and modelling results are being communicated, and under which conditions they are or are not being applied to decision-making. The Subchapter will consider common shortfalls and propose principles for successful risk communication. It will assess end-user needs and analyze positive cases of risk communication to develop good practices, with the potential for replication. It will consider cultural differences in various regions of the world, governance structures and frameworks that are more or less receptive to risk information, the need for different risk information products for different end users, sectors, and purposes. Partners to be considered for this Subchapter include the British Broadcasting Corporation (BBC), the Economist Intelligence Unit (EIU), Global Facility for Disaster Risk Reduction (GFDRR), Nanjing University, the Royal Melbourne Institute of Technology (RMIT), the Stockholm Environment Institute (SEI), University of Stuttgart, among others.

This Subchapter will investigate the communication of risk at the science / policy / investment interface, identifying strong and weak examples to illustrate that even when risk information is relevant and

contextualized, if communicated poorly in terms of the needs and capabilities of end users then it is rarely applied in decision-making, with all the associated consequences that this entails in terms of risk creation, propagation and accumulation. If risk information is communicated in a format that resonates with decision-makers, is understandable, and can readily apply without the need for significant modification or interpretation, then this greatly enhances the likelihood that planning, and the formulation of development, climate adaptation, or stand-alone disaster risk reduction strategies is undertaken in a risk-informed manner as called for by the Sendai Framework, the Paris Agreement, the NUA and the 2030 Agenda.

The provision of scenarios and options, inter-relationships, dependencies and correlations between hazards and risks, with clear explanation of uncertainty, at relevant geospatial and temporal scales – rather than the provision of precise risk information about specific hazards and risks – will over time build both trust about what is communicated to decision makers, and build collective intelligence about the prevailing risk conditions and the importance of proactive rather than reactive behaviors to support the transition from expecting risk information to confidently taking risk-informed decisions and actions.

2.4.1 Risk-informed sustainable finance

In this vein, this Subchapter will provide a special feature on the relationship between the Sendai Framework and the GRAF with Sustainable Finance. It will examine some of the impediments to the effective transmission and application of available risk information, within and between the science, policy and investment communities, with the view to providing a persuasive case for the erosion of traditional silos. It will examine how this facilitates the wider adoption of inter-disciplinary, holistic approaches and solutions by decision makers – that are promoted by the Sendai Framework and will be supported by the GRAF – and the connection with the rapid developments and growing awareness in green finance and investment in both private and public sector contexts[13], to realize the potential for significant reductions in finance needs resulting from the application at scale of systems-based approaches[14].

[13] For example: The UNEP Inquiry into the Design of a Sustainable Financial System; the EU High-Level Expert Group Report on Sustainable Finance and the subsequent adoption of the Action Plan: Financing Sustainable Growth; the G20 Green Finance Study Group; the Financial Stability Board's Taskforce on Climate-related Financial Disclosures; Financial Centers for Sustainability: Reviewing Experience and Identifying Options in the G7; etc.

[14] https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/infrastructure-productivity

3.0 Creating the national and local conditions to manage risk

With Chapter One analyzing the progress to date in implementing the global targets of the Sendai Framework and the SDGs and providing disaster loss trends, and Chapter Two comparing progress to the current and future global risk trends and the development of the GRAF, Chapter Three will drill-down to disaster risk reduction action at national and local levels.

With the achievement of global Target E of the Sendai Framework by 2020 as the point of departure, this Chapter will examine aspects of the enabling environment for risk-informed decision-making and behavior, examining triggers of behavioral change, sound risk governance and sustained use and application of risk information. Target E calls on countries to 'substantially increase the number of countries with national and local disaster risk reduction strategies by 2020', based on the assumption that Sendai-compliant disaster risk reduction strategies at national and local scales are a necessary precondition to reach the other six targets by 2030.

Featuring real-world national and sub-national cases, the Chapter will assess examples of successful disaster risk reduction strategies at national and local level, the processes which resulted in a successful outcome, and where feasible, the impact of Sendai-compliant strategies. The Chapter will feature detailed case studies of strategies which have either been developed as dedicated stand-alone strategies, or embedded in development, sectoral or climate adaptation strategies and plans.

Not all countries have developed national and local disaster risk reduction strategies. Numerous countries are implementing strategies at the national and local levels that contain disaster risk reduction elements, that may not necessarily be labelled as disaster risk reduction strategies, which may be equally, if not more, successful in reducing risk and increasing resilience. GAR19 will assess the integration of disaster risk reduction into a range of national and local strategies and plans, and explore the aspects of the relationship between the quality of governance, risk management and sustainable societies.

National disaster risk reduction strategies will be assessed according to the ten components of Sendai-compliant national strategies[15]:

i. Have different timescales, with targets, indicators and time frames
ii. Aims at preventing the creation of risk
iii. Aims at reducing existing risk
iv. Aims at strengthening economic, social, health and environmental resilience
v. Address the recommendations of Priority 1, Understanding disaster risk: Based on risk knowledge and assessments to identify risks at the local and national levels of the technical, financial and administrative disaster risk management capacity

[15] Technical guidance for monitoring and reporting on progress in achieving the global targets of the Sendai Framework for Disaster Risk Reduction (UNISDR, 2018) https://www.unisdr.org/we/inform/publications/54970

vi. Address the recommendations of Priority 2, Strengthening disaster risk governance to manage disaster risk: Mainstream and integrate disaster risk reduction within and across all sectors with defining roles and responsibilities

vii. Address the recommendations of Priority 3, Investing in disaster risk reduction for resilience: Guide to allocation of the necessary resources at all levels of administration for the development and the implementation of disaster risk reduction strategies in all relevant sectors

viii. Address the recommendations of Priority 4, Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction: Strengthen disaster preparedness for response and integrate disaster risk reduction response preparedness and development measures to make nations and communities resilient to disasters

ix. Promotes policy coherence relevant to disaster risk reduction such as sustainable development, poverty eradication, and climate change, notably with the SDGs and the Paris Agreement

x. Have mechanisms to follow-up, periodically assess and publicly report on progress.

As stipulated in the Sendai Framework, **local** disaster risk reduction strategies will be assessed based on their alignment to **national** disaster risk reduction strategies, however the assumption is that national disaster risk reduction strategies a) exist, and b) are in line with Sendai Framework requirements. This is however not always the case, and as much of the activity to understand and reduce risk takes place at the sub-national level, the Chapter will also consider local disaster risk reduction strategies. This will include strategies or plans that may not be aligned to the national disaster risk reduction strategy, but are nevertheless effective in addressing disaster risk, or those that are being developed in a stand-alone manner, in the absence of national disaster risk reduction strategy.

The Chapter will draw on lessons learned from the Making Cities Resilient Campaign and examine instances – including in informal settlements – where effective design and development of urban disaster risk reduction strategies have resulted in decisive action, successful implementation and strengthened resilience of vulnerable communities.

The Sendai Framework is inclusive and universal in nature, and therefore applicable in all countries. Furthermore, with the Sendai Framework and the 2030 Agenda integrated on strategic, conceptual and technical[16] levels, this Chapter will explore how such efforts respond to the theme of the HLPF 2019 - 'Empowering people and ensuring inclusiveness and equality'. In this respect, the Chapter will also examine how disaster risk reduction strategies are being developed in fragile contexts. However, countries which are considered fragile or are exposed to risk in combination with insufficient coping capacity of the state, system and / or communities to manage, absorb or mitigate those risks, often deprioritize disaster risk reduction. Chapter Three therefore will assess how disaster risk can be addressed effectively in fragile contexts and examine factors that are conducive to or hinder such efforts.

[16] including through the use of common metrics for the measurement of global targets of both agreements

3.1 Stand-alone disaster risk reduction strategies and plans

The development of stand-alone national and local disaster risk reduction strategies and plans represent a dedicated target in the Sendai Framework. This Subchapter will examine cases of disaster risk reduction strategies and plans developed and implemented by countries and cities, and investigate the impact of the implementation of such strategies on disaster risk and losses.

Case studies will be elaborated in collaboration with partners and developed following a call for papers to be issued in 2018. Potential partners include universities and university networks and research institutions such as the University of Melbourne, the University of Geneva, the Periperi U Network, the University of Tokyo, the University of Bristol, and Florida International University, amongst others.

3.2 Disaster risk reduction integrated in development strategies and plans

This Subchapter will examine cases of national and local development strategies and plans within which are embedded disaster risk reduction elements. It will assess to which extent risk-informed development or sectoral strategies and plans are successful in reducing risk, as compared with stand-alone disaster risk reduction strategies and plans.

Potential partners for case study development include the UN Development Programme (UNDP), the Lee Kuan Yew School of Public Policy, the Blatavnik School of Government, and other university and research partners. The Subchapter will explore the relationship between the SDGs and the Sendai Framework, and provide insight into sectors involved in the development of such strategies and conducive contextual drivers for successful implementation.

3.3 Disaster risk reduction integrated in climate adaptation strategies and plans

This Subchapter will examine cases of national and local climate adaptation strategies and plans in which disaster risk reduction elements have been integrated, or vice versa. It will assess the extent to which disaster risk-informed climate adaptation strategies and plans are successful in reducing risk. Possible partners for case study development would be the UN Framework Convention on Climate Change (UNFCCC), UN Environment, the Intergovernmental Panel on Climate Change (IPCC) Secretariat, and associated networks, universities and research partners.

The Subchapter will examine substantive linkages between the Paris Agreement and the Sendai Framework, and provide insight into sectors involved in the development of such strategies and conducive contextual drivers for successful implementation.

3.4 Disaster risk reduction strategies developed in fragile contexts

This Subchapter will examine cases of national or local disaster risk reduction strategies or plans that have been developed and successfully implemented in fragile contexts. Examples that may be considered, include South Sudan and Ethiopia from Africa, Colombia from Latin America, and Lebanon from the Arab States.

Possible collaborating partners could be Bahir Dar University / Periperi U (to write a case study on Ethiopia), the Overseas Development Institute (ODI), the Internal Displacement Monitoring Centre (IDMC), UN High Commissioner for Refugees (UNHCR), the International Organisation for Migration (IOM), the International Federation of Red Cross and Red Crescent Societies (IFRC), the Organisation for Economic Cooperation and Development (OECD) and the UN Office for the Coordination of Humanitarian Affairs (UNOCHA).

Relevant to all Subchapters, so as to support analyses of the local perspective, a survey will be commissioned together with United Cities and Local Governments (UCLG) to determine progress in reaching relevant global targets of the Sendai Framework (Target E) and the SDGs. More than 2,000 cities known to be working on disaster risk reduction will be invited to participate in the survey. In parallel, a call for papers will be issued to develop detailed case studies on effective local disaster risk reduction strategies and plans.

4.0 Introducing the hazard and risk scope of the Sendai Framework

Chapter 4 will provide a preliminary introduction of some of the additional hazards, risks and dynamic interactions that need to be considered following the adoption of the Sendai Framework by Member States, and which will need to be identified and understood collectively for inter-disciplinary solutions to be identified and successfully executed. Failure to address the interconnections and inter-dependencies of these hazards and risks in the context of dynamic systems will impede achievement of the goals and outcomes of both the Sendai Framework and the 2030 Agenda.

Through the elucidation by expert bodies, a preliminary set of the hazards and risks that were included by Member States in 2015 will be introduced, highlighting key causal factors and drivers of such risks, as well as the corollary impacts that these risks incur when realized – direct, and to the degree possible, indirect.

The Chapter will also include an analysis of the various institutional and legal frameworks, risk management practices and national, regional and international standards that have been established to assist governments and other stakeholders regulate and guide the management of man-made hazards and risks.

The Chapter will also introduce aspects of the systems thinking that is enshrined in the Sendai Framework, examining the dynamic interactions with systemic risks.

Sendai's additional hazard and risk categories – an introduction

In 'order to reduce disaster risk, there is a need to address existing challenges and prepare for future ones by focusing on monitoring, assessing and understanding disaster risk and sharing such information and on how it is created….' (Paragraph 14, Sendai Framework).

'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 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' (Paragraph 15).

The identification, description and analysis of the multitude of hazards and risks referred to in these two paragraphs of the Sendai Framework will likewise be an iterative process requiring the engagement and commitment of a wide spectrum of partners.

This Chapter begins the exploration through the lenses of biological, technological and environmental hazards and risks, observing the definitions agreed upon by the OIEWG and endorsed by the UN General Assembly in 2017. It will present preliminary comparative analytics contrasting disaster risk governance approaches established to manage disaster risk related to natural hazards, with those addressing man-made hazards. Analysis will explore commonalities and differences from the institutional and normative perspectives – including national, regional and international standards – and how existing frameworks, conventions, agreements, organization and cooperation arrangements may be conducive to integrated and holistic disaster risk management – as called for by the Sendai Framework.

4.1 Biological hazards

'Biological hazards are of organic origin or conveyed by biological vectors, including pathogenic microorganisms, toxins and bioactive substances. Examples are bacteria, viruses or parasites, as well as venomous wildlife and insects, poisonous plants and mosquitoes carrying disease-causing agents' (OIEWG, 2016[17]).

To be led by the WHO, this Subchapter will introduce a preliminary suite of biological hazards for consideration by risk management decision-makers in all sectors, geographies and scales.

Contributing organizations (provisional, non-exhaustive):

WHO, Centre for Disease Control (CDC), the International Science Council (ISC) / International Council of Scientific Unions (ICSU) / International Social Science Council (ISSC), the International Union for Conservation of Nature (IUCN), Public Health England, UN Environment, University of Surrey, World Organisation for Animal Health and the World Wildlife Fund (WWF).

4.2 Technological hazards

'**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' (OIEWG, 2016[18]), known as a Natech.

'The number and magnitude of man-made disasters worldwide has risen since the 1970s and continues to grow in both frequency and impact on human wellbeing and national economies particularly in low and middle-income countries.' (Words into Action, UNISDR 2018)

To be led by the EC JRC, this Subchapter will introduce a preliminary suite of technological hazards for consideration by risk management decision-makers in all sectors, geographies and at all scales.

4.2.1 Chemical / industrial hazards

A chemical accident is defined as "any unplanned event involving hazardous substances that causes or is liable to cause harm to health, the environment or property, such as loss of containment of hazardous substances, explosions, and fires".[19] The impact at a local level of a chemical or industrial accident[20] can be significant for the surrounding community and may also lead to contamination having a substantial and long-term impact on the environment and livelihoods. (Words into Action, UNISDR 2018).

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

[18] idem

[19] OECD Guiding Principles on Chemical Accidents Preparedness, Prevention and Response. 2003

[20] The terms "chemical accident" and "industrial accident" are used interchangeably in this Sub-Chapter.

This Section will explore trends in damage and loss where data are available, and discuss aspects of performance measurement, governance and capacity. It will examine gaps in our knowledge identifying areas for further enquiry – including in respect of direct and indirect consequences – and in using a framework for qualitative and quantitative measurement, provide a perspective on risk. It will consider the impact of the Sendai Framework, inter alia in addressing knowledge gaps.

Contributing organizations (provisional, non-exhaustive):

JRC with UNECE, EC DG Environment, International Association of Chemical Councils, OECD, UN Environment and WHO.

4.2.2 Nuclear / radiological hazards

The International Atomic Energy Agency (IAEA) defines an emergency as a 'non-routine situation or event that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human life, health, property or the environment'[21]. This includes nuclear and radiological emergencies. 'It also includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard. A nuclear or radiological emergency is an emergency in which there is, or is perceived to be, a hazard due to the energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction, or radiation exposure.'[22]

In introducing this aspect of Sendai Framework hazards and risks, this Section will inter alia examine the evolution in nuclear safety assessment methodologies (probabilistic and deterministic), the incorporation of accident conditions in nuclear power plant design, and the challenges to ensuring the safety of nuclear facilities that remain. These may include examining knowledge gaps in human, organizational factors, ageing effects and financial concerns, and the interaction with natural hazards.

Contributing organizations (provisional, non-exhaustive):

IAEA, Institut de Radioprotection et de Sûreté Nucléaire, JRC and Karlsruhe Institute of Technology.

4.2.3 Natech hazards

'The impacts of natural or man-made hazard events on chemical installations, pipelines, offshore platforms and other infrastructure that process, store or transport dangerous substances can cause fires, explosions and toxic or radioactive releases.' These multi-hazard events can have 'major social, environmental and economic impacts', requiring 'a comprehensive understanding of the interdependencies of human, natural and technological systems' (Words into Action, UNISDR 2017).

This Section will examine the current state of the art and areas for further development, including data paucity. In exploring contributory factors of Natech risk creation, as well as risk reduction measures, the Section will discuss potential metrics to measure progress throughout the period of the Sendai Framework and the 2030 Agenda.

[21] IAEA Safety Glossary (2016 revision)
[22] Idem. 2016

Contributing organizations (provisional, non-exhaustive):

JRC with IFRC, UNEP / UNOCHA Joint Environment Unit and WHO.

4.3 Environmental hazards

'Environmental hazards can be created by environmental degradation, physical or chemical pollution in the air, water and soil' (OIEWG, 2016[23]). These may incur direct impacts, and through inter alia the depletion of resources such as air, water and soil, the destruction of ecosystems and the extinction of wildlife, can result in increased occurrence and intensity of hazards, and the greater vulnerability of people and societies.

To be led by UN Environment, this Subchapter will introduce environmental hazards through the lens of the Sendai Framework, examining the dynamic interactions with inter alia economic, ecological, social, health and infrastructure systems for consideration in risk-informed decision-making across sectors, geographies and scales.

Contributing organizations (provisional, non-exhaustive):

UN Environment, FAO, IUCN, OECD, Stockholm Environment Institute, UNEP Clean Air Coalition, UNEP / UNOCHA Joint Environment Unit, WHO.

4.4 Systemic risk, the Sendai Framework and the 2030 Agenda

'Paradigms are not corrigible by normal science' said Thomas Kuhn[24], '…paradigm change is a value change', the sort of change in value that the Sendai Framework exhorts. A transition from one paradigm to another – from managing disasters to managing risk – and from managing 'conventional' hazards to engineering an improved understanding of the dynamic interactions with systemic risks. Exploring the facilitation of a 'new system of relations'[25], that allow future theories and solutions to emerge that are 'wider in scope, more accurate in prediction, and solve more problems'.

This Subchapter will provide a preliminary investigation of the systemic risks that are embedded within the complex networks of an increasingly interconnected world, and that shape the dynamic interactions with the Sendai Framework, the 2030 Agenda, the Paris Agreement and the New Urban Agenda, and are ultimately the determinants of exposure and vulnerability at all scales.

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

[24] Kuhn, T. Structure of Scientific Revolutions (1962)

[25] accredited to Herbert Butterfield *The origin of modern science.* 1946 – describing the process of paradigm change as "handling the same bundle of data as before, but placing them in a new system of relations with one another by giving them a different framework."

An improved understanding of such systemic components, including systems reverberations, feedback loops and sensitivities to change will be imperative if societies are to comprehend the new context that will determine the creation of risk, and its impact once realized, and thereby extend the horizons for societal decision-making to achieve the goal of safe, resilient and sustainable societies for all.

Implementation Timeline (*provisional*)

2018

20th March:	GAR Advisory Board – consultation on GAR19 Concept Note
19th May:	Call for Papers by UNISDR
03rd June:	Identification of Authorship teams (Chapter, Subchapter, Section); initiate desk review
15th June:	Selection of abstracts for development of GAR19 Papers
1st June – 30th September:	Lead Authors (Chapter, Subchapter, Section) research and drafting
15th August:	Submission of GAR19 input papers (following the Call)
31st August:	Submission of risk data for Chapter Two
15th September:	Deadline for Sendai Framework Monitor data for GAR19
30th September:	Subchapter lead authors submit Background Papers
1st November:	Initiate layout and editing
15th November:	Chapter lead authors submit final chapters to Coordinating Lead Author
15th December:	Zero Order Draft (ZOD)

2019

8th January:	GAR Advisory Board – ZOD review
31st January:	First Order Draft (FOD)
1st – 15th February:	FOD Peer Review
1st February – 7th April:	Summary for Policy Makers (SPM) drafting
7th March:	Second Order Draft (SOD)
15th March:	Final Report
1st February – 30th April:	Final layout, editing, translation, production (digital – main report, hard copy – SPM)
15th May:	Launch @ Global Platform 2019