

## **Priority 1: Understanding disaster risk**

### **Recommendations**

1. Disaster risk management is to a great extent still dominated by reaction and response, but less so on mitigation, development-based risk reduction and investments leading towards prevention and preparedness. It is crucial to understand the root causes, and consider the disaster risk in a complex systems of natural, societal, economic and technological contexts.
2. In collaboration with the scientific community, disaster management authorities at national and local levels should be engaged in the development of commonly agreed and standardized formulations for collection, analysis, management, application and evaluation of disaster-related data, information, lesson learned, and best practices that can be shared and used for both research and policy making purposes, based on the contexts of global indices and terminologies derived from the Sendai Framework
3. Wide variety of scientific methods and models are used for disaster risk research. Standardized scientific frameworks is required for monitoring, predicting, warning, evaluating and mapping risk for single or multiple hazardous events occurring simultaneously or successively. Disaster risk assessments must be reviewed periodically to reflect the developments in science and technology.
4. Disaster risk mapping using geospatial information system would improve our understanding of exposure to hazards, especially for the most vulnerable communities. In addition to the current methodologies and models developed for hazard zonation maps, there is still a need to share experiences and to map physical and social vulnerabilities and exposure as well as to analyze patterns.
5. Interaction among and across scientists, policy makers, private sectors and key stakeholder groups is critical to translate science based knowledge into disaster risk reduction policies and the practices through establishing and/or strengthening periodic and frequent communications. Funding and investment to science by governments, industry and philanthropic community would bring solid return.

### **Background and key directions**

The numbers of disasters and their associated adverse impacts have increased dramatically in recent years as levels of vulnerability and exposure as well as some hazards have increased in both developing and developed countries. The progress of science and technology alone has not been sufficient to reduce disasters as efforts have been mainly directed towards the understanding of hazards and the comprehension of vulnerability and exposure has been

frequently neglected.

Disasters and disaster risk are not natural, but socially and technologically constructed. They also include technology-based disasters and Natech (Natural Hazard Triggering Technological Disasters). They are systematic and triggered by the occurrence of potentially damaging events or conditions but realized or magnified by different interlinked vulnerability factors including societal perceptions, priorities, needs, demands, decisions and practices and technology. Many of them are a clear expression of the lack of integrated territorial management. To reduce and manage disaster risk, a fundamental shift is required in comprehension of disasters –from a “natural” perspective to their understanding as a social construction so that values, perceptions and behavior can be changed. Consequently, understanding root causes and disaster risk drivers is perhaps one of the most important endeavors to guarantee in the implementation of the Sendai Framework.

Monitoring and assessing risk as well as early warning of disasters represent a great contribution of the scientific community towards disaster risk reduction and disaster risk management.

## **Explanation of recommendations**

### **1. Root causes and disaster risk drivers**

Understanding risk as a systematic problem and understanding vulnerability should be seen as a foundation for disaster risk reduction and management. For example, Forensic Investigations of Disasters (FORIN) is a research framework of IRDR that focuses on the investigation of root causes of disaster risk. Within the FORIN framework magnitude of losses, damage and adverse consequences can be explained to a great extent by human actions and practices as natural hazards are faced. Special emphasis is given to the fundamental social processes that lead to particular “risk drivers” or dynamic conditions that exacerbate existing or create new forms of risk at all levels as human actions are rooted in cultural and social models, and drivers of risk very often are the most evident consequence of the lack of adequate and integrated territorial management.

### **2. Collection, analysis, management and use of disaster data**

During the Third World Conference on Disaster Risk Reduction, member states adopted the framework including reporting on the progress of the seven global targets of the Sendai Framework. Accordingly, national scientific communities agreed to analyze accumulated disaster risk statistics and assist policy making with findings from such analyses. Recent digital development and big data will require more IT support tools, particularly with multi hazards and disaster risks assessments.

As an example, Global Center for Disaster Statistics was recently established and started collecting, analyzing, and archiving disaster damage statistics from countries around the world in cooperation with their corresponding main disaster management agencies. The center is expected to assist the United Nations Office for Disaster Risk Reduction (UNISDR) in monitoring the progress of each country in the achievement of the global targets of the Sendai Framework.

There is a need of having a global unique disasters identifier. The Global Unique Disaster Identifier (GLIDE) is such a tool to allow users to easily share disaster information archived by different organizations in the world.

Disaster risk management organizations of each country are urged to promptly develop a mechanism for collecting, analyzing, managing, and using disaster risk and disaster damage data, so that this information can be used by governments for policy making and practice. When needed, training and capacity building for building disaster risk and disaster damage statistical systems should be provided by countries on which scientific and technological progress to this regard has satisfactorily been achieved.

### **3. Periodic monitoring and assessment of hazards, vulnerability and disaster risk including complex disasters within an agreed scientific framework**

The development of science-based frameworks for disaster risk assessment as a function of the analysis of hazards, vulnerability and exposure could facilitate periodical evaluations to share knowledge and develop better helping tools for decision making and practice.

Research has also been undertaken on the assessment of complex disasters on which concatenation of events leading to technological disasters triggered by natural hazards (NATECH) occur. For example, a disaster involving earthquakes, tsunamis and a nuclear accident (Fukushima type), but also disasters generated by the simultaneous occurrence of different hazards or cascading risks over different time scales.

### **4. Development, updating and provision of information for disaster risk**

Disaster risk mapping would improve our understanding of exposure to hazards, especially for the most vulnerable communities. In addition to the current methodologies and models developed for hazard zonation maps, there is still a need to share experiences and to map physical and social vulnerabilities and exposure as well as to analyze patterns. Among different mapping resources, remote sensing and Geospatial Science offer possibilities to improve the analysis of disaster risk as they have become more accessible worldwide. Traditional environmental knowledge of local people should not be forgotten in this process. In addition, integrated collaborative systems modeling can be applied to involve stakeholders in the

process of co-creating knowledge and better understanding risks.

Disaster risk information should be registered with a unique profile to be followed by all relevant international organizations and countries (with national risk profiles). Furthermore, the methodology and application of proxy data should be encouraged, such as using indirect loss and damage data derived from remote sensing monitoring and its assessment; and development of relevant protocol, industrial standard including following ISO standardization for understanding risk in disaster risk management process should be also facilitated.

In addition, efforts also must be focused on the development of mechanisms aiming at providing the information and platforms for analysis before disasters, as it is also necessary to think more broadly on how scientists could help society to reduce disaster risk in advance, and not only after a disaster event has happened and consequences, including death toll are known.

## **5. Interaction among scientists and policy makers**

Building the interface between science, policy making and practice is not an easy task. There is a need to significantly improve coordination and collaboration between the decision makers and scientists. There is a need to facilitate interaction with stakeholders to improve communication/awareness on risk for decision making and investment; to establish connections/network of platforms with all highly relevant platforms at national level, regional level, user level, and authorized organizational level.

Scientists need to understand the type of information and format required by policy makers. Likewise, scientists should be engaged in a learning process to be able to communicate science in a non-technical fashion to different stakeholders and to discuss the best possible way to reduce disaster risk through science-based initiatives that can be translated into practice.

Policy makers need to understand what science, both natural and social, can provide. They need to communicate what their needs for information are both from the policy perspective as well as for services delivery to the public as well as to organizational entities such as the response community.

People who face hazards should be assisted to manage their own environments more responsibly and equitably over the long term by joining in a global structure that supports informed, responsible, systematic actions to improve local conditions in vulnerable regions. The goal is to enable affected people and populations by strengthening community capacity to engage in coordinated actions by making available, sharing and evaluating accurate information about risk in a timely manner.

## **Priority 2: Strengthening disaster risk governance to manage disaster risk**

### **Background and key directions**

To cope with increases in intensity of hazards due to climate change and increases in exposure to hazards, it has become more important to prepare systems, mechanisms, policies, and legal frameworks for disaster risk reduction and strengthen disaster risk governance. The enhancement of disaster risk governance requires clear visions, plans, authority, and guidelines, coordination within a sector and between sectors, and involvement of stakeholders. In addition, good governance should be highly transparent, inclusive, and comprehensive. Moreover, to ensure good governance, it must be based on scientific evidence and a collaborative relationship between the science and technology community and stakeholders. This relationship should be built using a “transdisciplinary” and “integrated” approach, while keeping in mind that scientific and technological progress has yet to be able to stop both risk building and disaster damage from increasing. Particularly in developing countries, dialogue between academia sector and policy makers and networking of these two actors should be facilitated more rigorously by means of languages widely used by citizens in the area.

Through this process, science should be promoted to play a greater role in local and national platforms for disaster risk reduction and should become capable of providing scientific evidence for making policy decisions according to responsibilities and authority clearly defined in the legal framework of each country.

In local and national platforms with well-defined responsibilities, we should promote dialogues among actors and sectors on disaster risk reduction, especially between scientific sectors and policy makers, promoting the participation through applied research and programs that favour the interaction among academia and the national and local level, facilitate networking

between them and create and implement a systematic framework in which disaster risk assessment is used to make decisions for planning and development based on scientific evidence.

Disaster risk assessment should also be institutionalized to promote planning and development with good understanding of possible socio-economic and environmental impacts of disaster risks on the country. An institutional framework should be established to use risk assessment for decision making.

All actors have responsibilities in the process of construction of risk. Thus, the co-design and co-production of projects and solutions are needed to ensure commitment and collaboration among actors in the public, private, and the non-government and civil society sectors. A legal framework can give sustainability by creating new forms for taking into account disaster risks, like “Risk Impact Assessment”, that ensures that root causes of vulnerabilities are considered, and actors identified in the construction of risk through the development process. Local and national platforms for disaster risk reduction are expected to play a central role to engage not only academia sector and policy makers but also private corporations and groups of citizens in more cross-cutting dialogues.

Risk communication and risk perception are also important since they could influence decision making and political changes. Ethics, justice and inequality are the additional dimensions to be addressed to ensure disaster risk governance focusses on the most vulnerable groups and communities. Cascade events analysis, multihazard knowledge, transdisciplinary approaches, understandable, practical and evidence based scientific information is needed in all sectors, including the community. Data Governance must be taken into account, including policies for ethical data acquisition and sharing for research purposes.

National Platforms should promote the participation of the academia, through membership,

research and programs that are linked to governments' efforts on a permanent basis through bilateral agreements, that benefit both.

### **Recommendations**

- 1. Science should be promoted to play a greater role in local and national platforms for disaster risk reduction by encouraging dialogue between academia sector and policy makers/practitioners with supporting transparency and accountability.**
- 2. Root causes of risk should be considered and inputs of valid traditional knowledge should be included for decision making.**
- 3. The gap between Academia and policy makers should be reduced by establishing communication mechanisms such as DRR education programs and greater support for applied, research.**
- 4. A network linking academia sector and policy makers should be strengthened at the national, local and community level.**
- 5. Access to data including big data should be promoted while ensuring inclusive and ethical processes in its use.**
- 6. Governance systems must be flexible to adapt to emerging risk and complexities of multi-hazards and cascading events, including climate change. Future risk drivers and risk building processes should be understood.**
- 7. Integrate Climate Change Adaptation & DRR governance mechanisms to prevent generation of new risk.**
- 8. Disaster risk assessment should be used for decision making by raising scientific awareness, understanding possible impacts of disaster risks on society, and institutionalizing disaster risk assessment for planning and**

**development both in public and private sector, and increase participation of civil society for this process.**

9. **Understandable, practical, evidence based scientific knowledge is needed for all actors. Joint efforts should be made from platforms to ensure knowledge is disseminated in proper ways according to different types of actors.**



### **Priority 3: Investing in disaster risk reduction for resilience**

#### **Recommendations**

##### [Background]

1. Investment policies and planning should be aligned with Sendai Framework for Disaster Risk Reduction 2015-2030.

##### [For Appropriate Public Investment]

2. (Governments') Investment planning should be an integral part of national plans for Disaster Risk Reduction (DRR).

##### [For Promotion of Private Investment]

3. Private Public Partnerships should be supported to mobilize resources to generate broad ownership for DRR.

##### [For Promotion of Investment to People]

4. To enhance capacity building of decision-makers and achieve appropriate decision-making in DRR, investment to human capital should be encouraged.

##### [Common]

5. Investment planning should be supported by socioeconomic analysis to illustrate the sustainability of DRR measures based on the best available ST&E.
  6. Guidelines for national and private development projects should be developed to include disaster resilience as decision criteria to avoid new creation of disaster risks.
  7. Appropriate communication strategies should be considered an important element in creating awareness not only of risk themselves but also appropriate DRR measures.

#### **Background and key directions**

Hazards vary in type, occurrence site, scale, intensity and frequency; there is no simple pattern that explains how they occur. Meteorological hazards are becoming greater in scale and intensity due to climate change. In addition, people are more likely to be exposed to hazards due to urbanization and particularly the rapid growth of informal settlements in hazard prone regions. Moreover, modern infrastructures and socioeconomic systems make the damage complex, as seen in Fukushima nuclear disaster, or the outbreak of the Ebola virus disease.

For these reasons, we have to accelerate to implement actions to mitigate or avoid possible damage including emerging/future risks. In many countries, increasing in hazard, exposure as well as vulnerability contribute to a dramatic rise in disaster risk, and once a disaster occurs,

greater damage grossly hampers sustainable development. Disaster-related losses cause short- as well as long-term adverse effects on economy, society, health, culture and the environment in any part of the world. All countries face increasing cost for recovery, rehabilitation and reconstruction once a disaster occurs, but in particular, this is an extremely serious issue for developing countries.

The Sendai Framework for Disaster Risk Reduction explains and stresses that proactive planning and investment in disaster risk reduction that is made based on proper risk assessment is highly cost-effective in that it can prevent future disaster-related losses and contribute to sustainable development. Investment by the public and private sectors in promoting the understanding, prevention and reduction of disaster risks by means of structural, non-structural and functional measures is indispensable to enhance resilience in people, communities, nations and its assets, such as environment, economy, health and culture, which are at the basis of sustainable development. All these components are driving forces for technological innovation, health improvement, economic growth, and employment creation. Such investment is also highly cost-effective in protecting life and health, preventing and reducing damage and losses, and conducting recovery, rehabilitation and reconstruction effectively.

In most countries, however, proactive investment in disaster risk reduction is still not common practice, leading to considerable deficiencies in preparedness. To fill this gap in all countries, investment planning should become an integral part of national DRR strategies in accordance with the sustainable development goals (SDGs). Based on this common understanding, the academic community and the private and public sectors are expected to take an action to identify disaster risks that should be reduced by each local community or country, and invite investment to increase resilience in collaboration with national and local authorities and other stakeholders. The ST&E community should reach out to the decision makers and support efforts for proactive investment in disaster risk reduction by developing technologies and methodologies tailored to the needs and conditions of each country, or by studies to facilitate behavioral changes of stakeholders. Innovative approaches to risk communication will be needed to create the necessary awareness and ownership.

### **Explanation of recommendations**

#### **1. Investment policies and planning should be aligned with Sendai Framework for Disaster Risk Reduction 2015-2030.**

The Sendai Framework for Disaster Risk Reduction 2015-2030 emphasizes proactive planning and investment as a basis for effective DRR, abandon traditional reactive approaches to disasters. A basis for such a proactive approach is on one hand a good scientific understanding of the hazard processes as well as the wider socio-economic and cultural context

including the underlying factors, such as poverty, inequity, and conflicts. Governments, businesses and citizens should be able to understand how a disaster can occur and what damages are possible, and form a common understanding. To this end, disaster risk assessment tools with a holistic perspective should be developed to make proper assessment of potential risks inherent in the area or arising from the social context including development. The tools should be adapted to each country and presented with guidelines.

*[For Appropriate Public Investment]*

**2. (Governments’) Investment planning should be an integral part of national plans for Disaster Risk Reduction (DRR).**

The Sendai Framework calls for a significant increase of the number of countries’ national and local disaster risk reduction strategies by 2020. These strategies should be based on sound financial planning. For this purpose, the ST&E community has an important role not only to develop valuation schemes, but also to evaluate and demonstrate the sustainability of proactive investment. It should be taken into account that the DRR measures as well as their cost-effectiveness strongly depends on the socio-economic context. It is critical that DRR measures are in accordance with the SDGs. Without appropriate DRR measures, sustainable development is not possible, and without sustainability, effective DRR is not also possible. Thus, the development of social safety nets and poverty eradication should be an integral part of the DRR measures proposed.

Consensus on DRR policy about the threshold/criteria for investment among entire government needs to be developed on a national level. (e.g., Ministry of Finance should be included). ST&E needs to support National Platforms by providing risk-informed DRR decision integrated in development planning. Development should not increase risk.

*[For Promotion of Private Investment]*

**3. Private Public Partnerships should be supported to mobilize resources to generate broad ownership for DRR on top of Business Continuity Plan.**

With globalized trade and supply chains, local hazards and disaster can increasingly pose worldwide risks. Illustrative examples are the impact of the Great East Japan Earthquake and Tsunami and the Thailand floods in 2011 on worldwide supply chain disruption of automobile components, hard drives and other electronic equipment. These interdependences of resources and risks calls for comprehensive approaches in terms of Private Public Partnerships. The corresponding instruments have partly yet to be developed. The academic sector and policy makers are expected to create the guidelines in this risk reduction of products and services to help such common efforts.

In countries where the private sector is already involved in the overwhelming majority of national land development, the scientific knowledge of the private sector exerts a significant influence over decision-making by the public sector. In order to strengthen the scientific aspect of private sector that plays a critical part in scientific decision-making and to encourage private sector to make well-considered decisions based more on scientific and technological knowledge, the research and investigation section of private sector should be strengthened, for which the academic sector should be more actively engaged in this effort. At the same time, the Private Public Partnership should be strengthened to reduce the environmental and health impact and to enhance the resilience of the community in which both private and public sector lives. The DRR aspect of corporate social responsibility (CSR) with enhancement of mutual communication are welcome for the broad ownership of DRR.

*[For Promotion of Investment to People]*

**4. To enhance capacity building of decision-makers and achieve appropriate decision-making in DRR, investment to human capital should be encouraged.**

Comprehensive view on investment is required. Total amount of investment should be considered, such as by public, private sectors, household, including human capital and national capacity. Investment in DRR is critical for achieving SDGs and UNFCCC Agreements. And achievement of SDGs benefits DRR.

ST&E sector should provide more support to the decision-makers and inform public. Academia should foster future experts (both ST&E and communication) who can be a translator in public and private sectors.

*[Common]*

**5. Investment planning should be supported by socioeconomic analysis to illustrate the sustainability of DRR measures based on the best available ST&E.**

Science and technologies can offer a range of sustainable preventives DRR measures. The further development of these DRR measures need permanent cooperation between ST&E community, decisions-makers and funders of these systems. ST&E needs to provide more evidence-based scientific results for further investment to be promoted by incentive and regulations.

Decision-makers should work closely with the ST&E community in identifying and deploying sustainable methods and technologies for DRR. ST&E assist in understanding that DRR requires big investment and priority needs be identified: “How safe is safe enough?” and “Where to invest?.” ST&E need to cooperate with national (and international) DRR platforms in support of risk-informed investment planning, particular in view of the 2020 milestone: “Basic but practical

before 2020.”

For example, investment for developing people-centered multi-hazard multi-sectoral forecasting system and early warning system with simple and low-cost equipment and facilities should be promoted through the application of latest scientific and technological knowledge. Given the often-heavy reliance on tourism as a key economic driver, integrated disaster risk reduction approach throughout the tourism industry and others is considered as a target for early warning system.

**6. Guidelines for national and private development projects should be developed to include disaster resilience as decision criteria to avoid new creation of disaster risks.**

A prerequisites for encouraging investment in DRR are clear guidelines that give investors, whether governmental, private sector or housed level, a framework on the relevant requirements.

In order to implement comprehensive disaster risk reduction policies using a modest financial resource appropriate for investment in disaster risk reduction from a limited national budget, prioritization of policies for investment is essential. In order to implement the above-mentioned recommendations, this prioritization is a challenging task. In particular, when decision-makers have various constraints of resources of which some cannot be monetarized, ST&E community is expected to contribute to develop a strategy and scientific valuation for planning the resources and fund allocation. The ST&E community should work closely with the public and private sectors in developing a method to evaluate disaster prevention policies comprehensively and scientifically for both measurable and unmeasurable effects in economic terms.

**7. Appropriate communication strategies should be considered an important element in creating awareness not only of risk themselves but also appropriate DRR measures.**

Still too often, resources and expenses in response to exceed those spent in preventive actions. This is often linked to false sense of security in community where disaster did not occur for a long time, or emerging and hitherto unknown risks that are, particularly in relation to climate change. The ST&E community has an important task in not only identifying these risks but also finding innovative schemes of risk communication for raising risk awareness with decisions-makers as well as with the population. At the same time, the ST&E community should develop the communication strategies to raise awareness of DRR measures. Outreach efforts and mutual communication between the clusters and stakeholders will increase the transdisciplinary development of technology and skills necessary for the DRR and sustainability. In order to fill communication gap, trust building among ST&E, public, private and citizens should be established.

Not only the governments, but ST&E community should engage with relevant stakeholders, including women, children and youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of practitioners and older persons in the design and implementation of DRR measures. There are huge demand of communication strategies development with these stakeholders.

#### **Priority 4: “Build Back Better” in recovery, rehabilitation and reconstruction**

##### **Recommendations**

1. The primary goal of recovery, rehabilitation and reconstruction should be “building disaster-resilient communities with long term vision” to be better prepared against possible future disasters while enhancing wellbeing and sustainable development.
2. “Build Back Better” should include “rebuilding health and well-being”, “rebuilding livelihoods,” “rebuilding of safer buildings”, “rebuilding economy” and “rebuilding regional communities,” as common paradigms to be shared by relevant stakeholders in the recovery, rehabilitation and reconstruction process. This can best be achieved by grounding our scientific information and approaches to local contexts in the process of recovery, rehabilitation and reconstruction.
3. The process of recovery, rehabilitation and reconstruction needs to be structured systematically. These processes unfold in parallel and each needs to incorporate targets and processes to enhance wellbeing and sustainable development. Indicators on “Build Back Better” need to be developed to measure the achievements and progress towards building disaster-resilient cities and communities and rebuilding health, livelihoods, economy and regional communities. Post-disaster reconstruction offers greater opportunities for risk reduction than found in normal periods, hence Build Back Better should be considered as an opportunity for changing the culture of safety in the social psyche, especially in developing countries where disaster risk reduction doesn't receive as much of investment as required in normal times.
4. Cities and communities need to continue their efforts for improving and renovating themselves with the aim of building resilient societies. To this end, cities and communities should, prior to disasters and based on scientifically agreed risk assessments on possible disaster damage, plan for disaster recovery, rehabilitation and reconstruction processes and prepare legislations and procedures, land tenures and civic rights, as well as public access to such scientific information, so as to gain prior public consensus on post-disaster actions and to enable their smooth implementation after a disaster.
5. Scientific and technological innovation, and research can provide an essential foundation to support decision makers in civil society, the private sector and government. Case studies and other research tools should be used to identify and assess options to strengthen recovery and rebuilding efforts. Research could focus on issues that include the identification of alternative recovery and rebuilding strategies, sources of funds for reconstruction, evidence to measure the cost and benefit of specific enhancements, risk of delays in recovery time, reduce ecological impacts and public acceptance of change. Focus on required scientific research should be an ex ante effort rather than an ex-post responsibility, in part owing to the relative absence of existing published research dealing with effective approaches to disaster recovery and rebuilding.

## **Background and key directions**

The primary purpose of recovery, rehabilitation and reconstruction is to rebuild health and well-being, livelihoods, economy and regional communities. However, such rebuilding must not be just bringing them back to what they were before the disaster; rather, it should be recovery towards a better future for the city or the region. This means enhancing opportunities for improved human wellbeing and sustainable development through reconstruction that enhances community resilience. In the aftermath of recent disasters, various actions are taken under the name of recovery, rehabilitation and reconstruction. However, such actions are often taken without common understanding of what are the actions which lead to successful recovery, rehabilitation and reconstruction and how can successful recovery, rehabilitation and reconstruction be appreciated, which may not provide evidence informed data to improve future recovery, rehabilitation and reconstruction.

In some cases, communities were not able to return back to their ‘normal lives’. Such challenges are partly caused by the significant deficient contributions of social, health and ecological perspectives in understanding the complexities of recovery, rehabilitation, and reconstruction processes. A disaster provides an opportunity to “Build Back Better.” Ideas and opinions for the realization of a healthy and resilient community and the improvement of livelihoods should be sorted out and presented as common understanding to execute recovery, rehabilitation and reconstruction, with indicators developed to visualize the progress of the recovery process.

## **Explanation of recommendations**

### **1. The primary goal of recovery, rehabilitation and reconstruction should be “building disaster-resilient communities with long term vision” to be better prepared against possible future disasters while enhancing wellbeing and sustainable development.**

With a view to “Build Back Better”, cities and communities should take necessary action during recovery, rehabilitation and reconstruction after a disaster to increase resilience to future hazards. This primary vision requires understanding and addressing systemic risk factors. It should encourage owner-driven reconstruction and community participatory approaches for the re-building of non-physical assets (e.g. health, livelihood) along with physical assets (built environment, basic amenities and infrastructure). All communities will need to have equal access to the process, which also includes children, youth, women, elder people, people with special needs and indigenous communities. The relocation of residential areas, if necessary, to other locations with lower disaster risk is one example to strengthen the structural resilience of cities and communities and thus reduce potential recurring disaster risk.

While relocation of residents to lower risk areas is recommended, it must be stressed that displacement leads to social upheavals and burdens due to overcrowding, uprooting from land of symbolic values and uncertainties (especially of livelihoods). If there is no alternative to relocation, it



needs to be accompanied with skills training for new jobs creation and community building. Any reconstruction activity, and especially relocation, is most effective in achieving enhanced wellbeing, sustainable development and risk reduction when those affected are included in decision-making to achieve a balance between local and wider interests.

2. **“Build Back Better” should include “rebuilding health and well-being”, “rebuilding livelihoods,” “rebuilding of safer buildings”, “rebuilding economy” and “rebuilding regional communities,” as common paradigms to be shared by relevant stakeholders in the recovery, rehabilitation and reconstruction process. This can best be achieved by grounding our scientific information and approaches to local contexts in the process of recovery, rehabilitation and reconstruction.**

Rebuilding health, livelihoods, safer building, economy and communities should be the goals of disaster recovery, rehabilitation and reconstruction. The reconstruction project model, which conceptualizes the relationship between means and ends, should be used as the paradigm for the implementation of recovery, rehabilitation and reconstruction policies. Reconstruction provides a crucial link between recovery and prevention within the continuum of disaster management. It also highlights the need to see disasters as opportunities to implement actions that are not considered as priority, or are difficult to finance, when there is no disaster (e.g. retrofitting, policy review and update, etc.). If reconstruction efforts can prevent a future disaster from happening, such projects/programs can be considered to have enhanced disaster-resilience of homes, cities and communities. Rebuilding should address the physical and mental health of individuals, restore the livelihoods of disaster survivors rebuild houses, restore jobs, and support enhanced disaster resilience for communities and economy in the whole area.

3. **The process of recovery, rehabilitation and reconstruction needs to be structured systematically. These processes unfold in parallel and each needs to incorporate targets and processes to enhance wellbeing and sustainable development. Indicators on “Build Back Better” need to be developed to measure the achievements and progress towards building disaster-resilient cities and communities and rebuilding health, livelihoods, economy and regional communities. Post-disaster reconstruction offers greater opportunities for risk reduction than found in normal periods, hence Build Back Better should be considered as an opportunity for changing the culture of safety in the social psyche, especially in developing countries where disaster risk reduction doesn't receive as much of investment as required in normal times.**

A common yardstick is necessary to evaluate the progress and achievement of recovery, rehabilitation and reconstruction and the extent to which these activities foster long-term human

wellbeing and sustainable development. The monitoring of the reconstruction of health and wellbeing of the population affected as well as its social infrastructure, communities, economy and livelihoods, ecology and the categorization and development of comparable and verifiable indices are necessary steps to take towards the realization of science-based recovery, social-cultural systems, rehabilitation and reconstruction.

In recovery, rehabilitation and reconstruction, two types of indices are needed: macro indices to evaluate livelihood progress concerning a city or community and micro indices to evaluate the progress concerning individual disaster survivors and businesses. It is important to evaluate the extent to which knowledge on science and technology has been able to enhance the disaster resilience of the daily life of the community by transferring the lessons learned to the next generation. Existing macro and micro indices used in normal times can be employed to evaluate the progress made by the country or some areas, while new indices are also essential to evaluate recovery, rehabilitation and reconstruction. These indices need to incorporate systemic risks. New frameworks are needed for understanding and addressing systemic risks specific to a particular context. Guidelines based on scientific evidence should be formulated, provided by multi and interdisciplinary perspectives of science, to help to support the concept of effective and community focused recovery both in the initial and longer term after a disaster.

**4. Cities and communities need to continue their efforts for improving and renovating themselves with the aim of building resilient societies. To this end, cities and communities should, prior to disasters and based on scientifically agreed risk assessments on possible disaster damage, plan for disaster recovery, rehabilitation and reconstruction processes and prepare legislations and procedures, land tenures and civic rights, as well as public access to such scientific information, so as to gain prior public consensus on post-disaster actions and to enable their smooth implementation after a disaster.**

One of the reasons for delays in recovery, rehabilitation and reconstruction after a disaster is that residents and other stakeholders often need a considerable amount of time to form a consensus on the future vision of cities and resilient communities after a disaster. Another reason is that people and even communities and governments tend to forget the disaster aftermaths because of pressing needs and conflicting priorities after some time. A well-accepted vision of the future of the settlement will assist in ensuring the continuum of efforts transgressing the different phases of the disaster. Past cases indicate that recovery can take place faster in communities that had continued addressing such issues before a disaster. Disaster associated trauma makes it difficult to make long-term decisions for their safety and livelihood. A disaster typically brings about confusion in the area and among stakeholders, which interrupts the realization of cities and communities with better resilience to disasters.

Recovery, rehabilitation and reconstruction after a disaster are a great chance for communities to

make transformational changes in social structure to increase their resilience to disasters by learning lessons from past disasters and reenvisioning the existing concept of how a city or community should be structured. Equally important is planning recovery, rehabilitation and reconstruction before a disaster, including preservation of cultural heritage, natural resources and environment. However, since only a limited number of cities and communities have addressed this issue, more action should be taken on this matter including studying methodologies.

**5. Scientific and technological innovation, and research can provide an essential foundation to support decision makers in civil society, the private sector and government as they seek to build back better. Case studies and other research tools should be used to identify and assess options to strengthen recovery and rebuilding efforts. Research could focus on issues that include the identification of alternative recovery and rebuilding strategies, sources of funds for reconstruction, evidence to measure the cost and benefit of specific enhancements, risk of delays in recovery time, reduce ecological impacts and public acceptance of change. Focus on required scientific research should be an ex ante effort rather than an ex-post responsibility, in part owing to the relative absence of existing published research dealing with effective approaches to disaster recovery and rebuilding.**

Build back better is a relatively new concept in disaster risk management. Presently there are relatively few documents available as a guide to support action by decision makers in private industry and government. The international NGO community has a deeper evidence base that could be shared. There would be considerable international benefit if emerging build back better decisions are documented, perhaps in the form of case studies, to share this experience. Some issues that will likely be of interest include the identification of reconstruction alternatives in the period of crisis when most parties are focused on rebuilding as quickly as possible. How are alternative approaches identified? Who makes decisions on preferences and especially trade-offs between local survivor and wider interests, or between risk management and sustainable development? Much concern also focuses on financial issues. Where can funds be sourced to pay for better construction? A process of better construction may increase the time required to rebuild as alternatives are assessed and implemented. Does the risk of delay offset the potential benefits of more inclusive decision-making and construction? In addition, the parties affected by disaster will have specific views about change. Some may prefer a return to old practices while others welcome renewal. What evidence is available about public acceptance of change? Research on critical issues can help facilitate decisions to build back better. Another aspect to consider in building back better is to include resilience to new risks, and in particular those associated to climate change. The reconstruction phase is expected to put in place new regulation/institutional framework and physical infrastructure which will last several years or even decades. During this time span, impacts of climate change are expected to become more severe and need to be included in the planning phase.

## Promotion of interdisciplinary collaboration

### Recommendations

1. **We need to promote and implement interdisciplinary and transdisciplinary collaboration.** Disaster risk reduction cannot be achieved by a single academic discipline or sector - it requires inter- and trans-disciplinary collaboration. Therefore, to implement the Sendai Framework, the national academies of science (or similar groupings) should promote inter- and trans-disciplinary engagement and research.
2. As academics and scientists, **we should engage collaboratively with both the public and private sectors** to provide practical evidence (scientific knowledge) to enable effective investments in disaster risk reduction. We should identify avenues to advance this collaboration.
3. **We underline that disaster risk reduction must address disaster risks derived from entrenched vulnerabilities, human (in)action, and technologies, as well as those triggered by natural hazards.** To assess the full spectrum of disaster risks, including those associated with natural hazards and vulnerability as well as anthropogenic and technological risks, we should develop innovative, integrated approaches and technologies for risk assessment that embrace all science as well as other relevant stakeholder groups.
4. Just as we acknowledge the urgency of inter- and trans-disciplinary collaboration **for advancing understanding of complex (eg mega) disaster events and cascading disasters**, we also recognize the need for interdisciplinary engagement on risk assessment and monitoring, **including emphasis on extensive risk conditions, and complex, compounding risks.**
5. To enhance interdisciplinary collaboration, **we encourage harmonization of definitions and terminology among the disciplines and fields involved.** International organizations and academic communities should play a leading role in strengthening shared understanding of DRR-related concepts and terminology, **also facilitating openness and flexibility to accommodate diverse perspectives** in this evolving field.

### Background and key directions

While interdisciplinary collaboration is critical to inform robust DRR actions, it faces multiple barriers and obstacles. These include conceptual, definitional, methodological, institutional and resourcing constraints. These are in addition to shortcomings in education systems that introduce interdisciplinary thinking too late.

Moreover, as disaster risk reduction is an integrated domain that cuts across a wide range of disciplines and fields to advance sustainable development, it embraces numerous disciplines, as well as policy and practice domains. When optimized through inter- and trans-disciplinary engagement, these characteristics can also contribute to progress beyond the Sendai Framework towards aspirations of the SDGs, Paris Agreement, New Urban Agenda and Humanitarian Summit.

#### **Explanation of recommendations**

1. **We need to promote and implement interdisciplinary and transdisciplinary collaboration.** Disaster risk reduction cannot be achieved by a single academic discipline or sector - it requires inter- and trans-disciplinary collaboration. Therefore, to implement the Sendai Framework, the national academies of science (or similar groupings) should promote inter- and trans-disciplinary engagement and research.

The Sendai Framework provides an opportunity to strategically promote the value of interdisciplinary / transdisciplinary research and collaboration in academic and scientific arenas, especially integrated research on disaster risks. Already, interdisciplinary scientific cooperation at national level has shown encouraging development, signalled by the experience of Japan through Japan Academic Network for Disaster Reduction (JANET-DR), and the United Kingdom Alliance for Disaster Research (UKADR), the efforts of IRDR NCs, as well as numerous other initiatives. For instance, the JANET-DR was established in January 2016 with support from the Science Council of Japan to network 55 academic societies (including associations and unions of societies) in the field of disaster and disaster risk reduction.

Although the JANET-DR has not been able to take concrete actions to implement the Sendai Framework since its establishment, UN and other international organizations should assist countries in creating a mechanism which assists the academic sector in playing a leading role in facilitating interdisciplinary collaboration. Similarly, in March 2015, the Global Summit of Research Institutes for Disaster Risk Reduction and Global Alliance of Disaster Research Institutes (GADRI) was established, consisting of 160 research centers in disaster risk reduction from 35 countries.

GADRI functions as an international network which links different disciplines and is joined by UN and other international organizations including UNISDR, UNESCO, and the European Commission Joint Research Centre (EC-JRC), and thus has potential to serve as a foundation to foster practical collaboration. Initiatives such as

these strengthen communication and collaboration between the scientific communities and other actors as indicated in the Sendai Framework.

2. As academics and scientists, **we should engage collaboratively with both the public and private sectors** to provide practical evidence (scientific knowledge) to enable effective investments in disaster risk reduction. We should identify avenues to advance this collaboration.

To promote science and technology for disaster risk reduction, it is critically important to consider the Sendai Framework, recognizing that both the quality and robustness of the synthesis reports will be informed by the level and depth of interdisciplinary and transdisciplinary collaboration in relation to the four Sendai priorities.

In addition, the successful implementation of science and technology for disaster risk reduction assumes the co-production of scientific knowledge to guide governance and investment. Its prospects for success also advance through flexibility to accommodate diverse perspectives, especially the applied need for DRR actions, (i.e., evidence-based policy implementation, interdisciplinary collaboration among different disciplines and transdisciplinary collaboration among different sectors). Similarly, effective application of science and technology is enhanced through greater investment in human capacity development and sustainability science related to DRR in education, especially higher education systems - extending from post-graduate to under-graduate and secondary school levels. Such measures advance an enabling institutional environment for interdisciplinary collaboration and research.

These interventions should be further strengthened by involving all disciplines and sectors in mutually providing technical support, cooperatively developing training materials, and together creating a platform that allow all actors full access to various types of practical information on disaster risk reduction including good practices. Each country should take necessary action to promote interdisciplinary collaboration in its academic sector and inter-sectoral collaboration among the academic, public and private sectors in order for them to work effectively for common purposes.

3. **We underline that disaster risk reduction must address disaster risks derived from entrenched vulnerabilities, human (in)action, and technologies, as well as those triggered by natural hazards.** To assess the full spectrum of disaster risks, including those associated with natural hazards and vulnerability as well as anthropogenic

and technological risks, we should develop innovative, integrated approaches and technologies for risk assessment that embrace all science as well as other relevant stakeholder groups.

To assess the full spectrum of disaster risks, including those associated with natural hazards and vulnerability as well as anthropogenic and technological risks, we should develop innovative, integrated approaches and technologies for risk assessment that embrace all science as well as other relevant stakeholder groups. For instance, to increase understanding of risks of natural, man-made, technological, and complex disasters and apply appropriate measures to reduce such risks, lessons from past disasters such as the Great East Japan Earthquake should be studied and interdisciplinary collaboration should be encouraged across a wide range of sciences, including engineering, natural sciences, social and health sciences. In the midst of an era in which technology is evolving fast and the environment is changing day by day both locally and globally, new approaches and technologies that can adapt to these changes should be developed and practised.

Initiatives such as IRDR, Future Earth and other Alliances and Programmes around the world are increasingly promoting the generation of knowledge in partnership with society and users of science by revisiting participatory approaches to disaster-related problems, including for example through Co-Design, Co-Production, and Co-Delivery.

Efforts to enhance understanding of increasingly complex disaster risks can be strengthened through new knowledge systems for DRR that integrate scientific, as well as local and indigenous knowledges.

4. Just as we underline the urgency of inter- and trans-disciplinary collaboration **for advancing understanding of complex (eg mega) disaster events and cascading disasters**, we also recognize the need for interdisciplinary engagement on risk assessment and monitoring, **including emphasis on extensive risk conditions, and complex, compounding risks.**

These measures should address conceptual, methodological and other barriers to implementation, and include efforts to advance intergenerational collaboration. The risks of highly complex mega or widespread small and medium-size disasters should be studied seamlessly through collaboration among all stakeholders at all times. These efforts will begin to counter shortcomings inherent in the implementation of separate, parallel disaster risk reduction measures for floods, earthquakes, volcanic eruptions and slope failures.

In addition, recognising that the distribution of DRR-related scientific capacity is uneven within countries, intercountry and regional cooperation are essential for building and embedding capacity for robust, interdisciplinary collaboration. This is particularly relevant to potential mega disasters that are extreme in scale, area and duration, and where the UN, including UNISDR and other international organizations can play a key role.

5. To enhance interdisciplinary collaboration, **we encourage harmonization of definitions and terminology among the disciplines and fields involved.** International organizations and academic communities should play a leading role in strengthening shared understanding of DRR-related concepts and terminology, **also facilitating openness and flexibility to accommodate diverse perspectives** in this evolving field.

For instance, the 2009 UNISDR Terminology on Disaster Risk Reduction was published and translated into several languages, including Japanese (<http://www.preventionweb.net/publications/view/7817>). More recently, in the 2016 United Nations General Assembly, the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction made recommendations to this effect, and revised the UNISDR terminology with some additions. It has been available on the UNISDR website since February 2017.

The harmonization and shared understanding of DRR-related terminology should be advanced continuously - and updated, following critical debate and reflection. Such processes should incorporate the views of multiple stake-holder groups as well as intergenerational dialogue to ensure both the current and future momentum of interdisciplinary and transdisciplinary collaboration.



**Strengthen a national platform for more effective use of science and technology  
for disaster risk reduction in each country**

**Recommendations**

- 1 . National Platform for Disaster Risk Reduction should be organized in a way that the wide range of national expertise of science and technology for DRR could be effectively reflected in its activities.
- 2 . In the countries who are in the process of formulating the national and local disaster risk reduction strategies by 2020 as indicated in SFDRR, the members of the scientific community participating in the National Platform for DRR should contribute to translating the priority actions of SFDRR into local languages, when necessary.
- 3 . The members of the scientific community participating in the National Platform should provide appropriate scientific advice to support the implementation of national policy in disaster risk reduction, and the archiving of annual disaster records, as necessary. In parallel, the policy makers and practitioners in the National Platform should indicate their specific science and technology needs for implementing DRR to the members of the scientific community. This two-way exchange will ensure evidence informed decision for the implementation of DRR at all levels.
- 4 . The cases where active dialogue among the local authorities and scientists & engineers led to disaster prevention or substantial reduction of risk in localities need to be highlighted and others should follow such successes. The members of the scientific community participating in the National Platform should assist the National Platform in compiling such case studies or best practices and publish them with an easy to understand description/summary. Furthermore, such successes should be periodically showcased at the Regional and Global Platforms for DRR so as to enable other countries to learn from such cases.
- 5 . The members of the scientific community participating in the National Platform should assist in compiling and publishing an annual report or publication on disasters which includes how the various sectors in the country have contributed to and have interacted among the sectors for disaster reduction, including scientific analysis of their economic benefits, if possible. Dissemination of such publications by the National Platform will be a powerful tool to gain wide public support for disaster risk reduction in the country and will also suffice as national SFDRR progress report.

**Background and key directions**

The necessity to include scientific and academic institutions as members of the National Platform for DRR is mentioned in the Guidelines on National Platforms for DRR published by ISDR in 2007. Since science and technology for DRR requires a wide spectrum of expertise, inclusion of one specific

institution will not be sufficient to serve the purpose. The 2007 Guidelines do not go into details on how the scientific community should contribute in the National Platform. In the public consultation version of Words into Action guidelines on National Platforms for DRR, which was released in May 2017 by UNISDR, academia is named as one of the components in National Platform and facilitation of knowledge exchange is mentioned as one of their functions. However, this document does not suggest examples of initial actions to be taken by the scientific community in the countries who have newly organized their National Platforms.

Therefore, in this policy brief, we would like to propose easy to understand and actionable first steps to be taken, with the active participation of the scientific community, by the countries who are in the process of newly organizing National Platform for DRR in line with SFDRR and/or for National Platforms who is to start substantial activities. This will encourage meaningful contribution by the scientists and engineers for DRR in these countries. It is recognized that, in some countries where the government has a dominating role in the organization of the National Platform, it may be difficult for other actors to fully participate. However, examples from different countries indicate that, with time, the contribution of the different partners, including the science and technology community, are used in national disaster risk reduction planning.

Furthermore, in the countries where their National Platforms are active and DRR activities are well organized across various sectors according to the local disaster characteristics, we would like to encourage that further institutionalization to be done through compilation of national annual reports on disasters.

### **Explanation of recommendations**

- 1. National Platform for Disaster Risk Reduction should be organized in a way that the wide range of national expertise of science and technology for DRR could be effectively reflected in its activities.**

Since DRR requires involvement of a wide range of scientific and technological expertise, good mechanisms to inclusively reflect the wisdom of the diverse areas of science in national DRR policies are necessary, e.g.: periodic rotation of scientists assigned to the National Platform, organizing several thematic committees under the National Platform and relevant scientists to be members of these committees, organizing cross-sector academic forum to discuss scientific inputs from the scientific community to the National Platform.

- 2. In the countries who are in the process of formulating the national and local disaster risk reduction strategies by 2020 as indicated in SFDRR, the members of the scientific community participating in the National Platform for DRR, should contribute to translating the priority actions of SFDRR into local languages, when necessary.**

The global target (e) of SFDRR calls for: Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020. For the countries tackling this target, SFDRR must be translated in local languages in order to serve as useful guidelines for the formulation of these strategies. For these strategies to meet the actual needs on the ground and to be effective, scientists participating in the National Platforms must have close communication with the national and local policymakers, in their local languages through informed exchange to jointly assess risks and design risk reduction strategies. This step is essential to ensure that science and technology information and recommendation make the ‘last mile’ to reach the most vulnerable groups and communities.

- 3. The members of the scientific community participating in the National Platform should provide appropriate scientific advice to support the implementation of national policy in disaster risk reduction, and by archiving of annual disaster records, as necessary. The policy makers and practitioners in the National Platform should indicate their specific science and technology needs for implementing DRR to the members of the scientific community. This two-way exchange will ensure evidence informed decision for the implementation of DRR at all levels.**

Keeping records of disasters is fundamental for DRR. This recording not only requires gathering data on damages and losses, but also scientific investigation on the causes. Scientists participating in National Platforms must provide relevant advice to these actions, in particular about the type of information to be archived. Such activities will form the basis for incorporation of science in the National Platform activities. The members of the scientific community, especially the academia, will benefit from the inputs of the practitioners in advancing their research. Closer interaction among the policy makers, practitioners and the scientific community will contribute to evidence informed decision making and provision of practical solutions for DRR. Similarly, stakeholders may be more motivated to record information if they see how these records are used to reduce future risks, thus initiating a virtuous cycle of cooperation with the scientific community. It is recognized that, in some cases, National Platform do not have authority nor in-built mechanisms for decision-making or control of the use of funds in DRR projects. Moreover, in some case decisions can be made by people without DRR knowledge. Acknowledging these limitations, it is expected that a demonstration of the relevance of use of science and technology for DRR will influence decision making, as experienced in some countries.

- 4. The cases where active dialogue among the local authorities and scientists & engineers led to disaster prevention or substantial reduction of risk in localities need to be highlighted and such successes should be followed by others. The members of the scientific community participating in the National Platform should assist the National Platform in compiling such**

**case studies and publish them with an easy to understand description/summary. Furthermore, such successes should be periodically showcased at the Regional and Global Platforms for DRR so as to enable other countries to learn from such cases.**

Whenever there is a major disaster, politicians and the mass media will be excited and fiercely call for clarification of the causes of the disaster. However, in cases where disasters were prevented or greatly reduced, they are seldom covered by the media and do not attract political attention. Thus, the success stories of disaster risk reduction are hidden and the preventive efforts by the local authorities and the scientific advice given to them are seldom highlighted. Therefore the opportunities for other localities or other countries to learn from these success stories are lost. On the other hand, in many countries, scientists tend to be evaluated by the publication of the most advanced academic papers and there are few chances that their dialogue with the local communities and local authorities that led to successful reduction of disasters would be considered in this type of evaluation. If the National Platform stands up to gather success stories of active dialogue among the scientists and local authorities which led to prevention or substantial reduction of disasters in their country and report to the public, and if these cases are periodically showcased at the Regional and Global Platforms for DRR, this will provide good motivation for the scientists to get involved with DRR at local levels. These will also increase the opportunities for the scientists to interact closely with local authorities in their local languages.

- 5. The members of the scientific community participating in the National Platform should assist in compiling and publishing an annual report or publication on disasters which includes how the various sectors in the country have contributed to and have interacted among the sectors for disaster reduction, including scientific analysis of their economic benefits, if possible. Dissemination of such publications by the National Platform will be a powerful tool to gain wide public support for disaster risk reduction in the country and will also suffice as national SFDRR progress report.**

When there is a serious disaster, ad-hoc reports on their causes and cascading factors may be published with the participation of scientists. But in peaceful years when there are no major disasters, in many countries, public attention to DRR decreases and this may lead to lighter recognition of DRR efforts. However, if we are to seek sustainable development, continuous and sustained efforts for DRR at various sectors are indispensable. Recently, we are witnessing inter-disciplinary and trans-disciplinary undertakings for DRR in some countries. We must not let these undertakings to be experimental efforts by a limited number of devoted scientists. We need a mechanism to institutionalize and sustain these efforts. If the National Platform can take the initiative to compile an annual report or publication on DRR, including these, it would be effective in awareness raising and gaining public support for DRR.

## Concept of Periodic Synthesis Report

There is no lack of scientific knowledge, but it is fragmented and not easily accessible to policy makers and practitioners. The Sendai Science and Technology Roadmap calls for action to “Synthesize, produce and disseminate scientific evidence in a timely and accessible manner that responds to the knowledge needs of policy-makers and practitioners” (Expected Outcome 1.2).

### Recommendations

- 1 . Summarize the current status of science and technology in disaster risk reduction, as well as status of DRR in higher education. Produce online synthesis system with periodic synthesis report (preferably during the Global Platform) on the state of science and technology. The online and participatory report system would be multi-layered (from global to local), and will have diversity in language, user group (policy makers to practitioners) and age group (including the young scientists). A specific science communication and maintenance strategy would be developed at the inception stage of the synthesis report.
- 2 . In the synthesis report, review three aspects of science and technology in DRR: 1) incorporation of science and technology by policy makers and practitioners, 2) priorities for investment in science and technology in DRR, and 3) impact of science and technology in DRR on people. Specific indicators would be developed under these three major aspects, and global/ regional/ national level analysis would be made. The indicators would be linked to SFDRR four priorities, seven targets and 38 indicators.
- 3 . In the synthesis report, highlight the need for holistic approach, integrating all scientific branches (social, natural and applied sciences). Strengthen collaboration between “cognizing” science and “designing” science in existing disciplines in disaster risk reduction.
- 4 . Identify gaps and opportunities in scientific knowledge for future research funding, as well in education curricula for increasing awareness of disaster risk reduction, which will eventually contribute to sustainable development
- 5 . Consider all aspects of disaster risk reduction, including vulnerability, resilience (systemic view), climate change and population dynamics (future risk) and underlying drivers
- 6 . Address all phases of the disaster cycle, including prevention, early warning, preparedness and response and recovery (Build Back Better) to promote increased resilience in disaster risk reduction
- 7 . Build on previous efforts, including from IRDR, IPCC, Disaster Risk Management Knowledge Centre, etc.

## **Background and key directions**

Adaptation to climate change and reduction of disaster risks are major societal challenges to be addressed in order for human societies to develop sustainably. Science and technology are expected to play a leading role in tackling these challenges.

Science and technology for disaster risk reduction as an academic discipline has two aspects: one is the aspect of “cognizing” science that studies what it is and the other is the aspect of “designing” science that studies what it should be. The aspect of designing science is further divided into two subcategories: “development” science that focuses on the development of engineering approaches and legal systems for disaster risk reduction and “dissemination” science that focuses on the dissemination of developed measures for public use. For science and technology for disaster risk reduction to be effective in solving social issues, close collaboration between cognizing science and designing science, i.e., science of development and dissemination is essential.

To promote science and technology for society, it is necessary to find what society sees as problems in disaster risk reduction and how society wants to cope with them. Once solutions are presented but cannot be implemented easily, it is also important to find out what prevents them from implementation. To take all these steps, research on foresight, especially linking demand driven innovation becomes important. A group of experts in this area are nurtured to take the lead in facilitating discovery of social expectation in the field of disaster research.

Science and technology in disaster risk reduction is an interdisciplinary academic discipline involving science, engineering, information technology, social sciences, behavioral science, and health science and humanities. It is also a practical science aiming at the achievement of a specific goal of disaster risk reduction. Because of this unique nature, the “consilience” of knowledge and wisdom in disaster risk reduction is essential to strengthen science and technology in this area. The Science Council of Japan defines the consilience of knowledge and wisdom as: the creation of a universal system of knowledge and wisdom by establishing the compatibility of knowledge and wisdom based on common concepts, approaches and structures extracted from different disciplines. Applying this to science and technology in disaster risk reduction and common concepts, approaches and structures should be extracted from existing disciplines involved in disaster risk reduction.

## Explanation of recommendations

1. **Summarize the current status of science and technology in disaster risk reduction, as well as status of DRR in higher education. Produce online synthesis system with periodic synthesis report (preferably during the Global Platform) on the state of science and technology. The online and participatory report system would be multi-layered (from global to local), and will have diversity in language, user group (policy makers to practitioners) and age group (including the young scientists). A specific science communication and maintenance strategy would be developed at the inception stage of the synthesis report.**
  
2. **In the synthesis report, review three aspects of science and technology in DRR: 1) incorporation of science and technology by policy makers and practitioners, 2) priorities for investment in science and technology in DRR, and 3) impact of science and technology on people. Specific indicators would be developed under these three major aspects, and global/ regional/ national level analysis would be made. The indicators would be linked to SFDRR four priorities, seven targets and 38 indicators.**

**Why do we need synthesis reports?** The Priority 1 of Sendai Framework highlights that policies and practices for DRM should be based on an understanding of disaster risk in all its dimensions as well as strongly stresses the effort of leveraging the knowledge for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response measures to disasters.

**What are the periodic synthesis reports?** In response to Priority 1 the periodic synthesis reports aim to bridge the communication gap between science and policy as well as to the practitioners. It provides reviews of **scientific solutions** as well as their practical application in various areas of DRM. The reviews of the scientific evidence base are summaries of the recent advances or outcomes of the scientific and technological research activities in the fields relevant to thematic areas of work under the Sendai Framework at global, international/regional and national levels. The process of the preparation of the synthesis reports promotes as well as requires the interdisciplinary and trans-disciplinary way of working together across different scientific branches. The information should be presented in a clear and straightforward manner to reach decision makers in policy and operational community globally in order to strengthen disaster risk governance to manage disaster risk at national and local level.

**The important aspect to be considered at the Science Forum on Resilience:** However, the effects of any communication of risk knowledge as well as consilience of scientific knowledge and wisdom are strongly sensitive to risk perception and capacities that are shaped through current state of local

and indigenous knowledge developed by communities through the history of hazard events to which they have been exposed and has become the basis for local-level decision-making. The Science Forum on Resilience is an opportunity to explore the option to present the modular regional approach in production of Periodic Synthesis Reports as an alternative to a purely global approach. This is the way to address the specific geopolitical and cultural context and related challenges of DRR strategies with sufficient level of detail and provide best-fit scientific solutions to strengthen the resilience of the societies in the region.

**3. In the synthesis report, highlight the need for a holistic approach, integrating all scientific branches (social, natural and applied sciences). Strengthen collaboration between “cognizing” science and “designing” science in existing disciplines in disaster risk reduction.**

The advancement of science and technology in disaster risk reduction, which is both interdisciplinary and practical, requires deeper understanding of disaster risk, and development and dissemination of effective measures. These three should collaborate closely with one another.

**4. Identify gaps and opportunities in scientific knowledge for future research funding, as well in education curricula to increase awareness of disaster risk reduction, which will eventually contribute to sustainable development**

Science and technology for disaster risk reduction as a social issue should start its research with the discovery of social expectations. To this end, it should be fostered specifically to identify research opportunity and provide human resources towards the discovery of social expectations.

**5. Consider all aspects of disaster risk reduction, including vulnerability, resilience (systemic view), climate change and population dynamics (future risk) and underlying drivers**

Despite progress in disaster research, disaster damage has been increasing in both developed and developing countries. Moreover, due to climate change, risks that may lead to new types of disaster have also been increasing. All these suggest that disasters can occur and cause serious damage even when proper prediction is performed and necessary measures are taken to prevent as much damage as possible. Given this possibility, all stakeholders should join the effort to use all available measures to minimize the impact of disaster damage and recovery from it swiftly. It is this capability of a society that is called resilience. Resilience is the most comprehensive concept in disaster risk reduction, and thus the enhancement of resilience should be selected as the common structure in the promotion of science and technology in disaster risk reduction.



**6. Address all phases of the disaster cycle, including prevention, early warning, preparedness and response and recovery (Build Back Better) to promote increased resilience in disaster risk reduction**

The Council for Science, Technology and Innovation of Japan proposes prediction, prevention and response as the key concepts of resilience. Since the enhancement of resilience should be the common structure for disaster risk reduction, these key concepts should be the common concepts in promoting the integration of knowledge and wisdom.

**7. Build on previous efforts, including from IRDR, IPCC, Disaster Risk Management Knowledge Centre, etc.**

Special attention should be given to previous efforts of summarizing science. Work of Intergovernmental Panel on Climate Change (IPCC), Integrated Research for Disaster Reduction (IRDR) as well as the Disaster Risk Management Knowledge Centre (DRMKC). One example of science synthesis report is Asia Science Technology Status Report, published in the First Asian Science Technology Conference on DRR (ASTCDRR), hosted by Government of Thailand and UN ISDR in August 2017, which compiles data from 11 Asian countries, based on specific sets of indicators. Forty-two cases of application of science technology addressing different SFDRR priority areas are highlighted in the report.

Another example of science synthesis answering to the Sendai Roadmap for Science is the report of the DRMKC "Science for disaster risk management 2017: knowing better and losing less", launched at the 2017 Global Platform. It covers the main topics in understanding disaster risk as well as addresses the specific geopolitical and cultural context and related challenges of DRR strategies to strengthen the society's resilience in Europe. It is the result of a complex process of science synthesis with 272 contributors from 172 organizations, spanning scientists, policy makers and practitioners, to produce a coherent book covering all hazards, all actors and all sectors. Although limited to mostly European contributors, much of the process and lessons learnt from the endeavor (as well as the content) are directly useful for a global, UNISDR-driven process.

In 2008, the Integrated Research for Disaster Reduction, a joint initiative by the International Council for Science (ICSU), the International Students and Scholars Services (ISSS) and UNISDR, proposed the Forensic Investigations of Disasters (FORIN), the Risk Interpretation and Action (RIA) and the Disaster Loss Data (DATA) as key methods to facilitate science and technology in disaster risk reduction.