A Background Paper on:

Strengthening the Role of Science and Technology for Disaster Risk Reduction in the Arab Region

UNISDR acknowledges with appreciation the work of Dr. Wadid Erian, Prof. of Soil Science at Cairo University, and Senior Advisor on Climate Change Adaptation and Disaster Risk Reduction for the League of Arab States for conducting this through analysis and drafting this document as a background paper prepared specifically for the discussion on establishing the Arab Science and Technology Advisory Group (ASTAG) for Disaster Risk Reduction.

This Background Paper provides basic knowledge on the role of science in the Sendai Framework for Disaster Risk Reduction: 2015-2030; prompts discussion about the needs to improve science delivery for disaster risk reduction (DRR) in Arab Region; and intends to facilitate moving forward after Sendai to identify how Arab countries want to use science, evidence and technology for disaster risk reduction.

1. Background

Climate change, sustainable development, development finance and disaster risk reduction policies are entering a new phase. Throughout 2015, governments will attend a series of meetings to agree new international frameworks, the first of which was the Third World Conference on Disaster Risk Reduction in Sendai, Japan in March. Next on the agenda are: the Third International Conference on Financing for Development in Addis Ababa, Ethiopia in July; the Sustainable Development Goals will be agreed in September; and, the United Nations Convention for Climate Change Conference of Parties in Paris, France in December. The convergence of these agreements presents a unique opportunity for coherence across these inter-related policy challenges in the post-2015 era, (Carabine 2015)[1].

the role of science and technology in providing evidence for policy is gaining prominence, with demand growing for multidisciplinary enquiry to address the complex and inter-related problems of climate change, disasters and sustainable development, (Hellmuth et al 2011[2], ODI and CDKN 2014[3] and ICSU 2014[4]).

Innovations in methods, tools and analyses have made significant leaps in finding solutions, and more data is becoming widely accessible (Royal Society 2014)[5].

The communication of this scientific evidence to policymakers increasingly is becoming a key challenge, (Smajgl and Ward 2013)[6]. Also there is a recognized need for international science partnerships to provide more than assessments of scientific information, particularly where different kinds of knowledge can contribute solutions, for more explicit links to decision making, (Hulme et al 2011)[7].

The need for capacity-building for different kinds of actors is paramount to ensure policy support can be provided, (Hulme et al 2011 and Brooks et al 2011[8]). With the changing nature of the science-policy interface, science advisory services and initiatives must evolve to meet these challenges.

Countries and organizations have identified a range of science and technology related needs, including through the preparatory and drafting process for the Sendai Framework for DRR. Across regions and development levels, countries are seeking to address the gaps they face in scientific capacities and information.

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[1] Carabine E. 2015. "Revitalising Evidence-based Policy for the Sendai Framework for Disaster Risk Reduction 2015-2030: Lessons from Existing International Science Partnerships", PLOS Currents Disasters. http://currents.plos.org/disasters/article/policy-for-the-sendai-framework-for-disaster-risk-reduction-2015-2030-lessons-from-existing-international-science-partnerships-2/

[2] Hellmuth, M.E., Mason, S., Vaughan, C., van Aalst, M. and Choularton, R. (eds) (2011) A better climate for disaster risk management. International Research Institute for Climate and Society (IRI), Columbia University: New York, USA.

[3] ODI and CDKN (2014) The future framework for disaster risk reduction: a guide for decision-makers. 2nd Edition. Overseas Development Institute and Climate and Development Knowledge Network: London, UK

[4] ICSU (2014) Future Earth. Available at: http://www.icsu.org/future-earth [08/12/2014]

[5] Royal Society (2014) Resilience to extreme weather. The Royal Society Policy Centre Report 02/14. The Royal Society: London, UK

[6] Smajgl, A. and Ward, J. (2013) A framework to bridge science and policy in complex decision making arenas. Futures, 52: 52-58

[7] Hulme, M., Mahony, M., Beck, S., Görg, C., Hansjürgens, B., Hauck, J., Nesshöver, C., Paulsch, A., Vandewalle, M., Wittmer, H., Böschen, S., Bridgewater, P., Chimère Diaw, M., Fabre, P., Figueroa, A., Luen Heong, K., Korn, H., Leemans, R., Lövbrand, E., Norowi Hamid, M., Monfreda, C., Pielke Jr., R., Settele, J., Winter, M., Vadrot, A.B.M., van den Hove, S. and van der Sluijs, J.P. (2011) Science-policy interface: beyond assessments. Science, 333(6043): 697-698.

[8] Brooks, T.M., Lamoreux, J.F. and Soborón, J. (2011) IPBES ≠ IPCC. Trends in Ecology & Evolution, 29(10): 543-545.

It is hoped that understanding these priorities and challenges will help decision-makers and scientists in developing the implementation plan to consider how science, technology and innovation can be enabling factors for DRR. An implementation plan of action underpinned by scientific evidence has the potential to save lives, more accurately target investment, and contribute to greater resilience over the coming decades, (Calkins 2015)[9]. He added that consultations on the post-2015 sustainable development, climate change and DRR agreements have seen the global science community, governments, and international agencies call for a better mobilization of science and technology to support these resilience efforts.

They believe that to strengthen DRR decision-making at community, local, national and international level, it is necessary to provide a robust and accessible scientific evidence-base.

After extensive consultation, governments have now adopted the successor to HFA, the Sendai Framework for Disaster Risk Reduction: 2015-2030 (SFDRR), and agreed priorities for progress in mitigating, preparing for and recovering from disasters. This process culminated in the Third UN World Conference for DRR (14-18 March 2015, Sendai, Japan) where the SFDRR was agreed by 187 UN member states. The Sendai Framework sets the aim to achieve '*the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries'* (para 16), (UNISDR 2015)[10].

The Sendai Framework recognizes the cross-cutting nature of DRR policy and calls on a range of stakeholders to help governments. It is clear that the countries priorities are clustered and clear, showing that there is a demand for greater science in DRR decision-making and solutions. Promoting research; increase technology transfer mechanisms; open data; communication of usable evidence and user's needs; education and training; and lastly, international cooperation all contributing to national capacity building. As identified, the main difficulties with existing delivery are gaps in knowledge, lack of coordination and a gap in capacity to use scientific evidence for policy-making, (Calkins 2015).

The SFDRR signals a clear mandate to the science, technology, and innovation community to work together with governments in developing and sharing the knowledge and solutions needed to improve the resilience of communities, save lives and reduce disaster losses Following on from the adoption of the SFDRR, the international science community is gathering as a key stakeholder to help countries implement SFDRR. UN, governments and all stakeholders will work to translate these goals and commitments into concrete executable actions, (Carabine 2015).

The means of implementation will call for urgent mobilization and more effective use of resources for DRR; however where to focus those efforts and resources is yet unclear.

2. Work to prioritize gaps in delivery of science for disaster risk reduction

Recent work on the science gaps voiced by governments and scientists have identified a range of science and technology related needs, including through the preparatory and drafting process for SFDRR. Across regions and development levels, countries are seeking to address the gaps they face in scientific capacities and information.

[9] Calkins J, 2015. "Moving Forward after Sendai: How Countries Want to Use Science, Evidence and Technology for Disaster Risk Reduction", PLOS Currents Disasters, http://currents.plos.org/disasters/article/moving-forward-after-sendai-how-countries-want-to-use-science-evidence-and-technology-for-disaster-risk-reduction/

[10] UNISDR, (2015) Sendai Framework for Disaster Risk Reduction: 2015-2030. United Nations Office for Disaster Risk Reduction. http://www.wcdrr.org/uploads/Sendai_Framework_for_Disaster_Risk_Reduction_2015-2030.pdf

It is hoped that understanding these priorities and challenges will help decision-makers and scientists in developing the implementation plan to consider how science, technology and innovation can be enabling factors for DRR.

Country priorities are clustered and clear, showing that there is a demand for greater science in DRR decision-making and solutions. The main themes identified by countries were around knowledge creation, translation, coordination and a gap in capacity to use scientific evidence for policy-making.

Specifically highlighted priorities contributing to national scientific capacity were: increasing research and practitioner engagement; increasing technology transfer and innovation mechanisms; open data and knowledge sharing; communication of usable evidence and user's needs; education and training; and lastly, international cooperation.

3. Role of science and technology in SFDRR

Translating the role of science from the SFDRR text into outcomes with the implementation science community [to include science, technology and innovation researchers, funders, and decision-makers] is necessary to establish coherent and collaborative approaches to DRR practice, science and policy. As a starting point for discussion and an idea of where we want to go, strengthening communication and capacity building to deliver four key functions

In consultation prior to the 3rd World Conference on DRR, the scientific community represented by the Major Group on Science and Technology reached consensus that the enhanced role of science to support SFDRR implementation should focus the mobilization of efforts and resources around four functions, namely:

- Assessment of current state of scientific knowledge on disaster risks and resilience (what is known, what is not known, what are the uncertainties, etc.)
- Synthesis of scientific evidence in a timely and accessible manner
- Scientific advice to decision-makers through close collaboration and dialogue to identify needs from policy- and decision-makers, including at national and local levels, and review policy options based on scientific evidence
- Monitoring and review, ensuring that scientific data and information can support and be used in monitoring progress towards DRR and resilience building.

  In addition, two cross-cutting aspects of foundational support would need to be strengthened to ensure an effective science-policy interface:

- Communication and engagement of policy-makers and stakeholders in science to ensure needs are identified and met, and conversely, a stronger involvement of scientists in policy processes to provide scientific evidence and advice.
- Capacity building to ensure that all countries can have access and ability to effectively use scientific information.

  The role of science and technology is clear in many parts in the Sendai Framework for DRR, the main paragraphs and **Statement text concerning the** international science and technology cooperation are presented in (table 1).

Table 1. International science and technology cooperation in Sendai Framework, after Calkins 2015

Paragraph	Statement text
Priority 1	**Understanding disaster risk**
25 (g)	Enhance the scientific and technical work on disaster risk reduction and its mobilization through the coordination of existing networks and scientific research institutions at all levels and all regions with the support of the UNISDR Scientific and Technical Advisory Group in order to: strengthen the evidence-base in support of the implementation of this framework; promote scientific research of disaster risk patterns, causes and effects; disseminate risk information with the best use of geospatial information technology; provide guidance on methodologies and standards for risk assessments, disaster risk modeling and the use of data; identify research and technology gaps and set recommendations for research priority areas in disaster risk reduction; promote and support the availability and application of science and technology to decision-making; contribute to the update of the 2009 UNISDR Terminology on Disaster Risk Reduction; use post-disaster reviews as opportunities to enhance learning and public policy; and, disseminate studies
Priority 2	**Strengthening governance and institutions to manage disaster risk**
27 (e)	Develop and strengthen, as appropriate, mechanisms to follow-up, periodically assess and publicly report on progress on national and local plans […]
28 (a)	[…] create common information systems, and exchange good practices and programs for cooperation and capacity development […]
28 (b)	Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate.
28 (c)	[…] to forge partnerships, periodically assess progress on implementation and share practice and knowledge on disaster risk-informed policies, programmes and investments, including on development and climate issues, as appropriate, as well as promote the integration of disaster risk management in other relevant sectors.
Priority 3	**Investing in disaster risk reduction for resilience**
31 (a)	Promote coherence across systems, sectors and organizations related to sustainable development and to disaster risk reduction in their policies, plans, programmes and processes.
31 (c)	Promote cooperation between academic, scientific and research entities and networks and the private sector to develop new products and services to help reduce disaster risk, in particular those that would assist developing countries and their specific challenges.
Priority 4	**Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction**

Paragraph	Statement text
34 (b)	Promote the further development and dissemination of instruments, such as standards, codes, operational guides and other guidance instruments to support coordinated action in disaster preparedness and response and facilitate information sharing on lessons learned and best practices for policy practice and post-disaster reconstruction programmes
Section VI	**International cooperation and global partnership**
48 (c)	The United Nations Office for Disaster Risk Reduction (UNISDR), in particular, to support the implementation, follow-up and review of this framework through: preparing periodic reviews on progress, in particular for the Global Platform and, as appropriate, in a timely manner with the follow-up process at the United Nations, supporting the development of coherent global and regional follow-up and indicators and in coordination, as appropriate, with other relevant mechanisms for sustainable development and climate change and updating the existing Hyogo Framework for Action Monitor accordingly; participating actively in the work of the Inter-Agency and Expert Group on Sustainable Development Indicators: generating evidence-based and practical guidance for implementation in close collaboration with States, and through mobilization of experts; reinforcing a culture of prevention in relevant stakeholders, through supporting development of standards by experts and technical organizations, advocacy initiatives, and dissemination of disaster risk information, policies and practices, as well as providing education and training on disaster risk reduction through affiliated organizations; supporting countries, including through the national platforms or their equivalent, in their development of national plans and monitor trends and patterns in disaster risk, loss and impacts; convening the Global Platform for Disaster Risk Reduction and supporting the organization of regional platforms for disaster risk reduction in cooperation with regional organizations; leading the revision of the United Nations Plan of Action on Disaster Risk Reduction for Resilience; facilitating the enhancement of, and continuing services, the Scientific and Technical Advisory Group of the International Disaster Risk Conference in mobilizing science and technical work on disaster risk reduction; leading, in close coordination with States, the update of 2009 Terminology on Disaster Risk Reduction in line with the agreed terminology by States; and maintaining the stakeholders' common registry
50	The Conference recommends to the General Assembly the establishment at its sixty-ninth session of an open-ended intergovernmental working group, comprised of experts nominated by Member States, and supported by the United Nations Office for Disaster Risk Reduction (UNISDR), with involvement of relevant stakeholders development of a set of possible indicators to measure global progress in the implementation of this framework in conjunction with the work of the inter-agency expert group on sustainable development indicators. The conference also recommends that the Working Group considers the recommendations of the Scientific and Technical Advisory Group on the update of the 2009 UNISDR Terminology on Disaster Risk Reduction by December 2016, and that the outcome of its work be submitted to the General Assembly for its consideration and adoption.

See also, **Annex 1** is Sendai Framework SFDRR, and **Annex 2**: Science paragraphs from SFDRR with examples of proposed outcome interpretations to prompt discussion.

The main themes which emerged from the statements as illustrated by Calkins (2015) are:

- Theme 1. Increase scientific research and practitioner engagement:

  This theme emerged as support for specific research areas and identification of gaps in knowledge and inclusion of practitioner. Promote scientific research into risk patterns and trends, as well as the causes and effects of disaster risk in society; and engage with the National/Sub-National research and practitioner community involved in DRR to strengthen the science-policy interface.

  Gaps were specified as drought and desertification; agriculture and food production; permafrost melting; risk and economic assessment; post-disaster recovery; disaster risk trends, patterns, and responses; and social factors.

- Theme 2. Technology Transfer and Innovation: The development, accessibility and transfer of technology and critically, continued technical support once applied.

  This theme was characterized by the following priorities includes: innovation and new technology in DRR, open data and accessible research; transfer of technology data and implementation of transferring mechanisms; transfer of technology for multi-hazards and response; knowledge and technology sharing and transfer; develop, through scientific and technical innovation, new methodologies on disaster risk management research and risk modeling; and a need for technology transfer and capacity building mechanism to enhance the implementation.

- Theme 3. Open data access, knowledge management and sharing, capacity to generate good data: The collection, sharing and use of data on disasters and on DRR is essential. Member States clearly requested that information is made available and accessible at regional, national, and local levels.

  This theme was characterized by the following priorities: knowledge management, synthesis, and sharing: open data and accessible research; strong data and knowledge management systems with seamless sharing of information and the creation of a central data and information clearing house of all existing programs, policies, best practices, scientific papers and evidence based recommendations and competencies that relate to DRR and climate change adaptation.

- Theme 4. Communication and education: To support and expand information campaigns and public education on DRR leading to greater community resilience. As well as for local empowerment, to facilitate local access to data and increase collection and exchange of local and traditional knowledge in DRR

  Countries describe gaps in: awareness raising activities and visible programs; policy briefs on various issues related to DRR/M and general education of the population. This is also reflected in priorities to: intensify information campaigns and public education on disaster management to prevent epidemics; increase risk education and training programs; teach DRR information in schools (Universities); support science communication and public education to ensure strong dialogue among stakeholders for science role in DRR/M; and to promote use of indigenous and/or traditional knowledge.

- Theme 5. Strengthen coordination and cooperation structures, both trans-boundary and trans-disciplinary: Increasing coordination of international and national partnerships, cross-disciplinary working and the benefit of existing initiatives, including to strengthen and increase the benefit of existing regional hubs/centers of excellence.

Problems that were identified included: lack of data, research and coordination between international initiatives; need for information sharing and networking between the related sciences organizations.

In fact, scientific information, technology and innovation for successful disaster risk reduction and resilience has long been recognized as essential by the international community, (Southgate, et al, 2013)[11]. The UN International Strategy for Disaster Reduction (UNISDR) has specified that successful disaster resilience requires scientific and technical capacities with inputs from physical, social, economic, health and engineering disciplines, (UNISDR 2009)[12]. Recent reviews have highlighted many case study examples of science, technology and innovation being successfully used and communicated for disaster risk reduction and management, (Southgate, et al, 2013).

Innovations in methods, tools and analyses have made significant progress in finding solutions, and data availability (UNISDR 2009,2011, 2013 and 2015)[13].With the gravity of disaster risk escalating around the globe, it is now vital that such knowledge is shared and becomes accessible in a form that can directly support coordinated action. The implementation approach needs to take into account the extraordinary, dynamic and localized nature of disasters and needs to be able to deliver relevant information to decision-makers at national and local levels, in a timely.

Many existing programs, initiatives and resources already seek to generate and communicate evidence on DRR at all scales. Building on, reinforcing and informing their important and extensive work will be essential. Notwithstanding these strong scientific foundations, science and technology is not yet having a sufficient impact on DRR; meanwhile disaster losses are continuing to increase. Innovative, fast-acting, responsive and forward-thinking approaches are urgently needed by governments, the global science community and other societal stakeholders to strengthen links between scientific information and evidence-based decision making.

Particular care must be taken to ensure that those countries which, currently, appear to possess little science capacity locally can benefit from such stronger links, and acquire locally-based capacity over time.

In March 2014, UKCDS hosted a meeting with partners Overseas Development Institute (ODI), International Council for Science (ICSU), UNISDR, and UNESCO. These early formal consultation meetings called for an international science 'mechanism' as the best way to ensure science underpinned SFDRR policy and practice, as did the 'pre-zero draft' of the new Framework.

However, subsequent discussions moved from favoring a new mechanism to favoring a strengthening approach as the best way to ensure that science plays the role it could and should in implementing the Framework: *'Enhance the scientific and technical work on disaster risk reduction and its mobilization through the coordination of existing networks and scientific*

[11] Southgate, R.J. et al., (2013) Using Science for Disaster Risk Reduction. Report of UNISDR Scientific and Technical Advisory Group

[12] UNISDR (2009) Reducing Disaster Risks through Science. Issues and Actions: The Full Report of the ISDR Scientific and Technical Committee

[13] UNISDR (2009, 2011, 2013 and 2015) Global Assessment Report

research institutions at all levels and all regions with the support of the ISDR Science and Technology Advisory Group' (para 25g).

3.1. What needs to change in order to improve science delivery for DRR

For answering the question we need to highlight the level of scientific gaps and /or scattered research works. To understand the level of the gap we could refer to how Intergovernmental Panel on Climate Change IPCC report is dealing with diversity of topics and regions, for example IPCC report in 2014, has expanded, as has the geographic distribution of authors contributing to the knowledge base for climate change assessments, as shown in (figure 1).

Arab region as illustrated in the figure is one of the lowest contributed regions with reviewed scientific articles to the IPCC. Multidimensional vulnerability driven by intersecting dimensions of inequality in many drylands areas and in partially Arab region and Africa are in needs for more attention in risk assessments, as vulnerability increases when people's capacities and opportunities to adapt to climate change and adjust to climate change responses are diminished.

In fact the unequal distribution of publications presents a challenge to the production of a comprehensive and balanced global assessment. Although Authorship of climate change publications from developing countries has increased, it still represents a small fraction of the total.

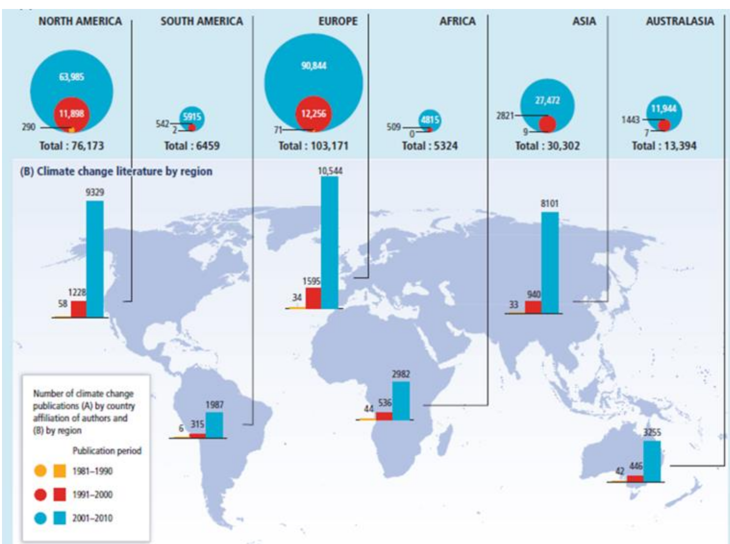

Figure 1, illustrates:

(A) Number of climate change publications in English (as of July 2011), summed by country affiliation of all authors of the publications and sorted by region. Each publication can be counted multiple times (i.e., the number of different countries in the author affiliation list).

(B) Number of climate change publications in English with individual countries mentioned in title, abstract, or key words (as of July 2011) sorted by region for the decades 1981–1990, 1991–2000, and 2001–2010.

The Arab region is not very well bio physical climate change threats are not very well identified at the IPCC report 2014, but we could extract some major trends such as, e.g. an expected precipitation decrease over the next century for large parts of the Arab region is likely expected, a likely increase in the frequency, consecutive duration and intensity of droughts, reduction in groundwater recharge rates.

Furthermore, over 60% of the Arab region's water supply flows across international borders which further engenders political tensions between communities, stakeholders and countries and necessitates equitable appropriation of available water among riparian. The unique increasingly acute threats in the Arab region is focused mainly in, the scarcity of freshwater, food insecurity and the growing socio-economic challenges (poverty, unemployment, displacement and conflicts), particularly as populations grow, rapid urbanization continues and the pressure to shift water from agriculture to domestic and industrial uses increases.

in the Arab region with such expected severe changes there is a needs to science to be organized, strengthen and put in a clear road map to give scientific answers or to increase the scientific background and contribution for moving from risk crises to risk management, building resilience and better understanding for social and nature sciences relationship in the Arab region.

Due to the climate change biophysical pressure, the social pressure and the low level of communities' resilience, as shown in figure (2), after IPCC (2014)[14], and at the same time explained the reasons of many ecosystems that play vital protective and provisioning services are being degraded beyond the point of recovery, and illustrate the inequality distribution reasons of the risks and as sectors and territories with high levels of income live beyond their means, consuming environmental resources and exporting risks to and from other areas.

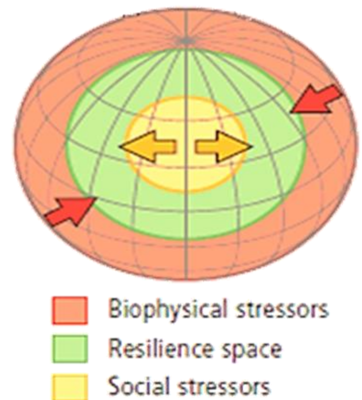

Figure.1 Multiple Stressors that affecting our world in multi scale levels.

In fact the characteristics and severity of impacts from climate extremes depend not only on the extremes themselves but also on exposure and vulnerability as explained by IPCC (2012[15] and 2014).
There for changes in landscape of water management and food security due to increased hazards, exposure and vulnerability in regional, national and community levels could be one of the major challenges that affect Arab region stability.

Science clearly plays an important role at the international level in informing policy on key issues such as climate change, biodiversity and ecosystem protection and sustainable development. The inception of new science and technology partnerships in the past few years indicates a regeneration of science advisory services at the international level, recognizing that scientific inputs are only one component of the science-policy interface.

The need for an improved science-policy interface and evidence-based approach to DRR has been recognized by UN member states in the SFDRR. The Framework provides a comprehensive list of functions for incorporating science and technology in future DRR action. This is to be commended and is a demonstration of commitment from the international community for evidence-based decision making in facing the challenges of the post-2015 era.

[14] IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A:Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

[15] IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)], Cambridge University Press, Cambridge, UK and New York, NY, USA, 582 pp.

What is missing from the agreement is clarity on what governance, structures and functions might look like in practice.

These arrangements will have implications for how LAS / UNISDR / partners can implement the aspirations of member states. It will be necessary to prioritize actions and execute these rapidly to achieve a successful outcome by 2030.

3.1.1. Science and policy

Two coordinated and integrated processes are necessary for effective DRR. One is the generation of scientific evidence, which could involve strengthening the intergovernmental process around DRR. The other is for promoting the use of that science and technology to create evidence-based policy, through the influence and engagement of a network of academic and research institutions, UN bodies, private sector, NGOs and communities. There should be allowance as much as possible for continuous engagement between scientists and policy makers in procedures and reporting, such that the needs of governments and other stakeholders can be met.

3.1.2. Partnerships

There are a range of new and established partnerships that have responsibilities and capacities for generating evidence of relevance to DRR. It is important that these sources of evidence are built upon as a foundation, that lines of communication are strengthened and that collaboration between/across partnerships be achieved. There should be procedures in place to share in the generation of evidence across these partnerships and integrate sufficiently to avoid duplication and build on existing networks, institutes and DRR platforms. Appropriate points of contact and procedures for engaging with a range of stakeholders including policymakers, the private sector, NGOs, civil society and others should also be included in new governance arrangements.

3.1.3. Post-2015 agenda

There are few links to the post-2015 agenda in SFDRR. Close association between the Sustainable Development Goals and UNFCCC agreements will be necessary to achieve a successful outcome for the Sendai Framework, but will be difficult in practice. It will be the responsibility of an enhanced UNISDR. Scientific and Technical Advisory Group to ensure that collaboration be transparent and consultative to maximize engagement of all stakeholders in these processes.

3.1.4. Capacity building/ Capacity Development

There are fundamental conceptual differences between capacity building and capacity development, as capacity development is generally considered to be Longer-term perspective, more comprehensive, and seeks to capitalize on existing national capacities as a starting point to change and transformation from the inside. Capacity building is more associated with "mechanical" processes and with technical cooperation, suggesting that capacity do not exist initially and so has to be built. The reason for mentioning this is the large variation that exists within the region and even within targeted national institution. There is a need to technical cooperation and to skills development; training, technology transfer as well as outside actors providing support to countries led processes.

There are several approaches that can be taken to build capacity for evidence-based policy at the international level. These include providing training for a new generation of leaders or scientists, providing technical training on specific issues in response to identified gaps and needs, or coordinating the capacity of national and regional bodies or institutions.

The ways in which capacity can be built should be decided in consultation with stakeholders to ensure capacity building objectives match with perceived needs. It is important for achieving capacity-building objectives to clearly identify the link between need and action and get the buy-in of those involved. It is also important to recognize the flexibility required to respond to differing needs.

4. Reasons that science, technology and innovation community have to receive as long-term support.

4.1. Gaps in Science and Science Application in DRR

An all-hazard, risk-based, problem-solving approach should be used in disaster risk reduction research to address the multifactorial and interdependent nature of the disaster risk chain and to achieve improved solutions and better-optimized use of resources. This requires collaboration and communication across the scientific disciplines and with all stakeholders, including representatives of governmental institutions, scientific and technical specialists and members of the communities at risk to guide scientific research, set research agendas, bridge the various gaps between risks and between stakeholders, and support scientific education and training, (Southgate et al 2013)[16].

The main gaps in achieving this could be highlighted on the following key sources of gaps:

- The chasm between science and society is wide and deep, illustrated most recently by events in climate science Kahneman (2011)[17] and calls for increasingly politicized management of NSF-funding, (Covello et al 1988)[18]. Scientists tend to blame it on society, but scientists also share the blame,(Covello et al 1988). It is thus essential that the scientific community—and scientists as individuals—begin to re-think our approach to doing science. This is particularly salient for biologists who study how natural systems work, given the widespread influence of human activities on Earth's life-support systems and the profound dependence of humanity on other living things.
- Scientists distance themselves from society in four ways[19], sometimes inadvertently, sometimes intentionally.

- First, they tend to pursue a research agenda they are passionate about, often without thinking about how the energy devoted to a particular project serves society.
- Second, most scientists regard their job as finished when they report their results in a specialized research journal, adding a notch to their publication count. The need for and pressure on researchers to publish in academic journals to gain academic credit makes it less attractive for them to spend their time and energy (re-) articulating their ideas for practitioners or for people in developing countries who may be able to take advantage of research findings to improve their personal situation.
- Third, scientists counsel that advocating for a particular societal position compromises their scientific credibility, so much so that the general credo is: "If you want to succeed as a hard

[16] Southgate RJ, Roth C, Schneider J, Shi P, Onishi T, Wenger D, Amman W, Ogallo L, Beddington J, Murray V. Using Science for Disaster Risk Reduction. 2013. www.preventionweb.net/go/scitech

[17] Kahneman D. 2011. "Thinking Fast and Slow". New York: Ferrar, Straus, and Giroux;

[18] Covello VT, von Winterfeldt D, Slovic P. 1988. "Risk Communication" In: Travis CC, editor. "Carcinogen Risk Assessment". New York: Plenum; pp. 193–207.

[19] http://leopoldleadership.stanford.edu/

scientist doing original research you do have to be a little careful about public communications," as climate scientist James Hansen put it, Fischhoff (2009)[20], and

- finally, many scientists feel that dealing with societal issues is some other profession's problem, something that <u>requires too much time</u> and for which they <u>have little support</u> or expertise

Bridging the science-to-society gap in biology will require that scientists must first articulate how (or if) their research agenda contributes to society; this is especially important in cases where society funds the research.

Extension could play an important role in building research-society links, the required shift in what society needs—not just science for science's sake, but to also using science to help recognize and solve societal problems—means that the goals of communicating science have to shift as well.

Society now needs information from scientists not just in the form of interesting facts assembled in hard-to-find places, but especially as recommendations about how to manage the biosphere to maintain what humans depend on for their physical, economic, and emotional well-being. Scientists, after all, are the people paid to produce and collect the knowledge that is relevant to the world.

- The change in what society needs from scientists has come about rapidly, largely within the past five decades, as human populations tripled and caused previously unfathomable changes to emerge in the biosphere. The speed at which the world changed means that while society moved on, we continued doing science under an old scientific model (albeit with increasingly sophisticated modern techniques), and also under the now out-dated assumption that it is somebody else's job to fix society's problems. The first step required is acknowledge and absorb the implications of genuine science failures (e.g. 2004 Indian Ocean earthquakes and Tsunami, drought in Syria 2008 and the upraised conflict, Darfur crises, increased migration trends to urban areas and number of slums.).
- It's important to recognize that many of society's major problems are biological in nature[21]. These threats include emerging diseases as more and more people come into contact with wildlife; wholesale modification of a large proportion of Earth's ecosystems such that critical ecosystem services may be detrimentally affected; and loss of species at a rate that may rival or exceed that of mass extinctions. Because biologists understand and can foresee such problems, it is incumbent upon biologists to begin developing appropriate solutions.
- Hundreds of thousands of people have lost their lives due to the collapse of buildings during earthquakes in the last two decades; billions of dollars of financial loss have also been sustained. Building vulnerability generally results from a lack of understanding of engineering science and poor enforcement of building codes. The problem is most severe in developing countries where populations are growing, towns and cities are expanding and buildings are more vulnerable to damage, (Jain 2008 [22]and Maqsood and Schwarz 2010[23]). In fact recognizing the function of <u>engineers</u> in their own language as intermediaries in

[20] Fischhoff B. 2009."Risk perception and communication." In: Detels R, Beaglehole R, Lansang MA, Guilford M, editors. Oxford Textbook of Public Health. 5th Ed. Oxford: Oxford Univ Press; pp. 940–952

[21]http://blogs.nature.com/soapboxscience/2013/05/22/bridging-the-science-to-society-gap-part-1-reachingoutsci

[22] Jain SK. 2008 "Historical developments in India towards seismic safety and lessons for future". Proceedings of the 14th World Conference on Earthquake Engineering, Beijing, China.

[23] Maqsood ST, Schwarz J. 2010. "Comparison of seismic vulnerability of buildings before and after 2005 Kashmir Earthquake". Seismological Research Letters.; 81(1):85-98

turning hazard science information into actions, (e.g earthquakes building codes, floods control, land use planning) and that in developing countries with limited financial and/or human resources (few trained engineers) is creating major challenge.

- A wide gap exist between science and decision making, as most decisions are made quickly, based on feelings, past experiences, associations, habits, trivial consequences, or obvious preferences. The understanding of decisions requirements is important, they require a significant amount of deliberation because the decision problem involves one or several of the features: important consequences, uncertainty, conflicting objectives, multiple stakeholders, complexity of the decision environment and need for accountability; for these types of decisions, science almost always does or should play a role. Unfortunately, scientific information is rarely accessible in a format useful for decision making. Scientific knowledge is not easily accessible to lay people and policy makers, (Von Winterfeldt 2013)[24].

- Ensure all relevant communities are involved in developing end to end thinking about the response to risk (such as going beyond consulting the medical profession for responding to heat waves, reduce crop losses by drought mitigation and combating desertification, reducing dust storms negative impacts, controlling flash floods and floods to increase water availability)

- Ensure in cost / benefit analyses that the full long term implications of the action included – e.g. how building floods defense encourages more development which can increase the risk and thus, the cost associated with it, Cost benefit analysis (CBA) can provide information on the economic rationale for implementing disaster risk reduction (DRR) initiatives.

  The use of CBA for DRR is gaining prominence and becoming an essential tool in not only purveying the economic return of DRR but also, and perhaps more critically, strengthening the economic argument for greater global advocacy and investment in mainstreaming a 'culture of preparedness, The inherent limitations of CBA, including the limited ability to quantify social impacts (e.g., empowerment of women) and heavy reliance on the quality of data available, requires that CBA sits within a complimentary analysis of qualitative impacts[25].

- In the risk assessment/identification process, capacity is often associated with the capacity or capability of the technical body or organization that is responsible for conducting risk assessments or managing the risk assessment process, and the technical capability and capacity includes the collection and analysis of data as well as the understanding of results, dissemination and maintenance of results, as well as how to include improved quality assessment in the development of hazard and risk data in particular where there is a multiplicity of perspectives available.

  At the meantime recognize the significance of uncertainty and attempt to properly include it in a probabilistic perspective and communicate around its implications,

- Recognize the systemic cascading nature of many risks; the term 'systemic risk' refers to risks that are characterized by linkages and interdependencies in a system, where the failure of a single entity or cluster of entities can cause cascading impacts on other interlinked entities.

[24] Von Winterfeldt D, 2013 "Bridging the gap between science and decision making ",Pans, vol. 110, pp 14055–14061
[25] http://www.preventionweb.net/files/globalplatform/entry_bg_paper~nepalcba.pdf

Because of greatly increased international interdependency, shocks occurring in one country can potentially have major and bidirectional systemic impacts on other parts of the world (Kleindorfer, 2009)[26], although the full extent of these impacts is not well documented. Moreover, major interlinked events, such as melting of glaciers, will bring increased levels of hazard to specific areas, and the initial impacts of such changes can extend to second- and third-order impacts (Alexander, 2006)[27]. This can apply to the contiguous zones of many countries, such as shared basins with associated flood risks, which calls for transboundary, international mechanisms (Linnerooth-Bayer et al., 2001)[28]. A few examples can illustrate the cascading nature of the financial and economic impacts from disaster.

- Due to Hurricane Katrina in 2005, the International Energy Agency announced a coordinated drawdown of European and Asian oil stocks totaling 60 million barrels (Bamberger and Kumins, 2005)[29], and reportedly oil prices rose not only in the United States but also as far away as Canada and the United Kingdom.
- The international impacts of climate-related disasters can extend beyond financial consequences, international trade, and migration, and affect human security more generally. O'Brien et al. (2008)[30] report on the intricate and systemic linkages between DRR, CCA, and human security, and they emphasize the importance of confronting the societal context, including development levels, governance, inequality, and cultural practices.
- To the extent that weather extremes contribute to migration, it can result in a huge burden to the destination areas (Barnett and Adger, 2007[31]; Heltberg et al., 2008[32]; Morrissey, 2009[33]; Tacoli, 2009[34]; Warner et al., 2009[35]).

  As part of this burden, the conflict potential of migration depends to a significant degree on how the government and people in the transit, destination, or place of return respond. Governance, the degree of political stability, the economy, and whether there is a history of violence are generally important factors, (Kolmannskog, 2008)[36].

[26] Kleindorfer, P.R., 2009: Climate Change and Insurance: Integrative Principles and Regulatory Risk. INSEAD Working Paper No. 2009/43/TOM/INSEAD, INSEAD, Fontainebleau, France, ssrn.com/abstract=1456862.

[27] Alexander, D., 2006: Globalization of disaster: trends, problems and dilemmas.Journal of International Affairs, 59, 1-22.

[28] Linnerooth-Bayer, J., R. Loefstedt, and G. Sjostedt (eds.), 2001: Transboundary Risk Management. Earthscan Publications, London, UK.

[29] Bamberger, R.L. and L. Kumins, 2005: Oil and Gas: Supply Issues after Katrina. Congressional Research Service, Library of Congress, Washington, DC.

[30] O'Brien, K., L. Sygna, R. Leichenko, W.N. Adger, J. Barnett, T. Mitchell, L. Schipper, T.Tanner, C. Vogel, and C. Mortreux, 2008: Disaster Risk Reduction, Climate Change Adaptation and Human Security. GECHS Report 2008:3, prepared for the Royal Norwegian Ministry of Foreign Affairs by the Global Environmental Change and Human Security (GECHS) Project.

[31] Barnett, J. and W.N. Adger, 2007: Climate change, human security and violent conflict. Political Geography, 26, 639-655.

[32] Heltberg, R., P.B. Siegel, and S.L. Jorgensen, 2008: Climate Change, Human Vulnerability and Social Risk Management. World Bank, Washington, DC.

[33] Morrissey, J., 2009: Environmental Change and Forced Migration - A State of the Art Review. Background Paper, Refugee Studies Centre, Oxford Department of International Development, Queen Elizabeth House, University of Oxford, 48 pp., www.rsc.ox.ac.uk/events/environmental-change-and-migration/ EnvChangeandFmReviewWS.pdf.

[34] Tacoli, C., 2009: Crisis or adaptation? Migration and climate change in a context of high mobility. Environment and Urbanization, 21, 513-525.

[35] Warner, K., M. Hamza, A. Oliver-Smith, F. Renaud, and A. Julca, 2009: Climate change, environmental degradation and migration. Natural Hazards, 55(3), 689-715.

[36] Kolmannskog, V., 2008: Future floods of refugees. Norwegian Refugee Council, Oslo, Norway.

Syria conflicts that took place after two long cycles of drought combined with land degradation that affected Syrian rural areas and fragile communities of the steppes led to the political instability and accelerated the conflict (Erian et al 2014)[37].

- A further rationale as with outbreaks of cholera after the Haiti earthquake, ten months after suffering "the largest urban disaster in modern history" – a devastating 7.0-magnitude (MMS) earthquake on January 12, 2010 that killed over 316,000 and affected 3 million – Haiti faced an outbreak of cholera.

– Acknowledge that the principle of, "build back better" (BBB), Boano (2009)[38], Khasalamwa (2009)[39] and Ozcevik et al.(2009)[40] proposed that the reconstruction phase should be used to not only restore communities to their pre-disaster states, but to take the opportunity to create safer, more sustainable and resilient communities, underpinned by the theory of (BBB) (Clinton, 2006[41]; James Lee Witt Associates, 2005[42]), where resilience is defined as the capacity to absorb stress or destructive forces through resistance or adaptation (Twigg, 2007)[43].

  Creating disaster resilience in vulnerable communities is important for the future to cope with the adverse effects of climate change. That concept in many cases is typically overcome by the urgent need to replace building stock rapidly after a disaster,

– Protecting Development from Disasters, that reflect "successes" in actions taken to reduce risk, and express non-events or disasters successfully avoided, Access to education and healthcare, stable employment and livelihoods, safety and security, as well as opportunities for women, are all threatened in countries that are prone to disasters.

  Costs are incurred during the immediate recovery period, but often it takes decades for a country and its population to recoup the full losses from a disaster, and

– Recognize that long recurrence intervals of extreme events (and in particular earthquakes) mean that a few decades of disaster experience may provide a very imperfect sample of the true risk.

4.2. The context for scientific engagement[44]

There are several high-level issues that provide important context for the Sendai Framework and that need to be recognized in order to elicit a strong and effective response from the scientific community

4.2.1. The global climate and sustainable development agendas

[37] Erian W, B Katlan, N Assad and. S Ibrahim 2014. "Effects of Drought and Land Degradation on Vegetation Losses in Africa, Arab Region with Special Case Study on: drought and conflict in Syria, South America and Forests of Amazon and Congo Rivers Basins", Background paper prepared for the 2015 Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland: UNISDR

[38] Boano, C. 2009. Housing anxiety and multiple geographies in post-tsunami Sri Lanka. Disasters, 33(4), 762-785

[39] Khasalamwa, S. 2009. Is 'build back better' a response to vulnerability? Analysis of the post-tsunami humanitarian interventions in Sri Lanka. Norsk Geografisk Tidsskrift - Norwegian Journal of Geography, 63(1), 73 - 88.

[40] Ozcevik, O., Turk, S., Tas, E., Yaman, H. & Beygo, C. 2009. Flagship regeneration project as a tool for post-disaster recovery planning: the Zeytinburnu case. Disasters, 33(2), 180-202.

[41] Clinton, W. J. 2006. Lessons Learned from Tsunami Recovery: Key Propositions for Building Back Better Office of the UN Secretary-General's Special Envoy for Tsunami Recovery

[42] James Lee Witt Associates 2005. Building Back Better and Safer: Private Sector Summit on Post-Tsunami Reconstruction, Washington DC, James Lee Witt Associates, LLC.

[43] Twigg, J. 2007. Characteristics of a Disaster-Resilient Community - A Guidance Note. DFID Disaster Risk Reduction Interagency Coordination Group

[44] The Sendai framework for disaster risk reduction: the challenge for science

The awareness and readiness of the science and technology community to reduce disaster risk is relatively high in the immediate aftermath of a major disaster, but falls away as the event recedes. Disaster risk reduction can also be seen as a niche concern, in contrast to higher profile scientific research into climate change. The post-Sendai process should therefore aim to 'mainstream' disaster risk reduction; framing it as a perennial priority that is fundamental to sustainable development, and making it a higher priority for scientific research and funding. Close alignment between the Sendai Framework, Financing for Development discussions, and the forthcoming Sustainable Development Goals, climate change agreement and 2016 World Humanitarian Summit will be essential.

4.2.2. Supply and demand for science and technology

Successful implementation of the Sendai Framework will require clear articulation of both disaster risk reduction needs and scientific and technological possibilities. The two should be effectively linked, with science and technology developments focusing on specific needs at local, national, regional and global levels. Risk assessments, particularly at the local level, should be communicated using the latest widely available communications technologies, in a manner that is responsive to the perceptions and priorities of different stakeholder groups.

4.3. Specific challenges for science[45]

Participants discussed the areas of science that need greater attention or investment in order to deliver the commitments in the Sendai Framework, as well as the organizations or networks required.

4.3.1. Gaps in scientific knowledge and capacity

- Disaster risk reduction research should be interdisciplinary, intersectoral, transboundary and transnational, and should address multiple hazards.
- Greater emphasis should be placed on understanding how to prevent disasters, in addition to understanding how to respond to and recover from them.
- Our current understanding of how risks escalate is poor and would benefit from further research, including into the social, economic and institutional factors that contribute to risk, and into the transfer of risk between different stakeholder groups. Further research into how risks are initially created – with the aim of anticipating and mitigating risk creation – would also be beneficial.
- Greater support for monitoring, early warning and response technologies is needed. As remote sensing technologies increase in resolution and scope, a more strategic approach to the planning and provision of such systems is required.
- Data on risk-related phenomena – including people's changing vulnerability and exposure to hazards over time – are essential inputs to disaster risk reduction efforts. Systematic and regularly updated approaches to data collection and communication, including risk and hazard maps, are therefore essential.
- There is a lack of awareness of existing scientific research, partly due to limited funds for collating it and limited mechanisms, beyond peer-reviewed journals and formal publications, for sharing it freely.
- The gaps in scientific knowledge and capacity differ between countries. A country-by-country capability analysis would be a useful way of identifying future priorities and areas

[45] Same Source

for investment. It would also help generate more accurate national and local risk assessments.

- Gaps in scientific knowledge and capacity are answers to the questions:
  - What data is relevant? how is loss data useful? How will countries use loss data in 2030 to measure progress/implementation?
  - When this is known, what of this relevant data is available at the national level?
  - What is the national capacity to fill any data gaps?
  - What is the national capacity to use this data?
  - What are already available to use this data?
- Risk information more relevant and useful to countries and cities at national and subnational level a simple DRR matric(s) needed
  - Should include information on hazards, vulnerability, exposure, coping capacity and allow identification of how changes these impact the risk outputs
  - Would allow countries to show the cost benefits of DRR investments and consider different policy options to reduce their risk
  - Represents a country's risk profile and allows monitoring over time
  - Could separate out risk metric by hazards
  - A DRR matric is a useful communication tool for monitoring progress

4.3.2. Translating and applying research[46]

The most significant scientific gap appeared to be in translating and applying existing research. The following observations and recommendations were made:

- The questions posed by policymakers may not be those that scientists can or want to answer. Risk governance frameworks should include forums that allow these communities to work together to develop questions and answers.
- Scientists, policymakers and stakeholders from civil society should collaborate in the co-design, coproduction, and co-delivery of knowledge.
- Scientific advice provided to policymakers in the aftermath of disasters should be scrutinized more closely to understand how risks can be reintroduced or escalated.
- The synthesis of scientific knowledge should take into account practicalities such as the timing of funding cycles (for planning new research) and the implementation timelines of the Sendai Framework and other associated frameworks.
- Universities could be more effective at providing scientific advice to local authorities and city administrations. More education and training (eg through e-learning and summer schools) for civil servants and scientists at local levels would be helpful and could be integrated into UNISDR's 'Making Cities Resilient' campaign.
- Intermediaries such as publishers, the media and national statistical offices should help translate science into other societal contexts. They should help disseminate research and metrics, as well as shifting the disasters narrative towards lives saved, damage prevented and return on investment.
- Scientists or intermediaries need to more clearly convey the uncertainty (and implications of uncertainty) around scientific findings. They also need to provide more
- complete cost-benefit analyses that reflect the long-term implications of actions (eg how building a flood defense can encourage more development, which in turn can increase the risk and thus the cost associated with it).

[46] The Sendai framework for disaster risk reduction: the challenge for science

- There should be incentives for scientists to share their research in an accessible and timely manner, demonstrating its impact on policymakers and consumers.
- There is currently a major international drive towards 'open data' and 'open science'. The post-Sendai process should take advantage of this, for instance by engaging with ICSU's Committee on Data for Science and Technology (CODATA).

4.3.3. Organizational Arrangements to Implement

- UNISDR is in the process of establishing a scientific and technical partnership for the implementation of the Sendai Framework, consisting of major scientific and technical institutes, research centers and networks as well as UN scientific organizations. The scope and functions of STAG are also being enhanced, as well as its representation of disciplines, regions and gender. The terms of reference for the partnership and STAG are being finalized.
- UNISDR is working with relevant UN agencies to develop a joint UN proposal on disaster risk reduction indicators for the Sustainable Development Goals.
- UNISDR/STAG should work closely with UN-HABITAT which is responsible for monitoring Sustainable Development Goal 11 (make cities and human settlements inclusive, safe, resilient and sustainable).
- STAG is already reviewing the terminology in the Sendai Framework to ensure that terms such as 'affected people' and 'man-made hazards' are commonly understood. In order to monitor and evaluate progress against the Sendai Framework, UNISDR/STAG could work with CODATA to develop a strategy for collecting, storing and analyzing data, and produce a standardized set of disaster risk information. A UNISDR/STAG convened working group could also oversee a formal review process of disaster risk reduction undertaken by member states every 3 – 5 years. An annual informal peer review process, supported by nominated 'champion' states, should also take place.
- International 'networks of networks' could be created through the convening power of existing organizations (eg ICSU/ISSC/IRDR, IAP/TWAS, IPCC/SREX).
- Other international organizations (eg WMO, WHO, World Bank, FAO, EU, AU) could serve as useful models for incorporating disaster risk reduction science into their respective programmers and into the sustainable development agenda
- Good practice should be collected and shared through existing bodies and platforms, such as UNISDR regional offices and Prevention Web.
- Professional body/bodies could be created to convene the disaster risk reduction science community and ensure it is represented and supported across all sectors.

4.4. Synthesis of Scientific evidence in a timely and accessible manner

- **<u>Basics:</u>**
  - <u>Synthesis</u> (of scientific knowledge and related knowledge bodies),
  - <u>Make science more easily accessible</u> (enhance use by non-academic stakeholders),
  - Needs: mutual trust and understanding of constrains of all parties concerned, Leadership / authority (includes professionalization / profiling the DRR science community across sectors)
  - Interdisc / sectoral / national / multi-national : foresight approaches as model
  - Timeliness: reflect potential impact of such synthesis work:
  - Understand funding cycles (in case new science would be requested as part of the synthesis) more than 5 years cycles , incentives / rewards?

- Reflect Science for DRR implementations timeline (targets / indicators; reviews), but also associated frameworks 2017/ 2020/ 2022 review? / 2030: vision/impact

– **Implementation (fora / accessibility):**

- Go beyond niched / specialized for a (science conferences; Journals); potential of STAG Conference to create a different model of synthesis,
- Build human capital to absorb scientific evidence (HEI, Peri Peri U)
- International: consider existing organizations: ICSU/ISSC/IRDR, IAP/TWAS, IPCC/SREX, etc.
- Strengthen STAG and regional platforms through S&T meetings;
- Involve National Platforms / learn from other frameworks (ODI) UN and intergov. Org.s: WMO, WHO, FAO, EU, AU, etc. to incorporate DRR science as cornerstone into development agenda (systemic/cascading risks)
- Challenge to establish exchange with local authorities (through community engagement?): place-based approaches
- Alliances with civil society for co-design, co-production and co-delivery and hence also for the synthesis of all knowledge forms of relevance for science
- Involve intermediaries: media, publishing organizations (for dissemination)

– **Implementation (Themes):**

- **Data** as subset for synthesis of knowledge for risk-sensetive decision- making (planning, investment, etc) Interdisc / -sectoral / - national / multi hazards,
- **Current databases** (and processed visualizations) incompatible, not universally known and used
- **Ensure openness to needs:** interdisciplinary/-sectoral / - national / multi hazards (e.g. new requirements under SFDRR:bio) (systemic & cascading risks; etcetc): current organizational arrangements insufficient
- **Explore potential** of IT capabilities for open science, citizen science, etcetc): horizon scanning!
- Explore formats for integration of data owners into the process (public, corporate, NGOs): data sharing ; accessibility
- **International:** consider convening power of existing organizations: ICSU/ISSC/IRDR. IAP/TWAS, IPCC/SREX, etc.
- **Leadership:** LAS (scientific specialized agencies and Unions) and existing science advisory bodies.

4.5. Scientific evidence to Decision Makers

4.5.1. Challenges and opportunities

– **Challenges:**

- Lack of data, quality, acquisition and sharing
- Limited understanding on the importance of science for DRR (limited Knowledge of stakeholders and/or improper communication of science)
- Limited quantification of the "impacts"
- priorities and activities - research and development - needs for expansion and extension
- Lack of monitoring and follow-up mechanisms
- limited number of "local champions"
- Signposting, organogram of expertise / publishing informal links
- Scientist as a decision maker,

- the questions posed at scientists not necessarily what scientists want to answer, many because answers and solutions do not always need innovations, but rather technology and not only science,
  Universities are not yet working really well at national level in providing scientific advice (in moderate and low income countries), at local level more difficult to get scientific advice;
- proposed solution; **that require** more education and training at the national and local level for both public servants and academics;
- Casual processes that result in escalation of risk and cascading multi-faceted processes, where currently the understanding of these, processes is very weak- which poses challenges in improving accountability for the construction of risk;
- Geopolitical arrangements
- We don't actually know what the questions for the future will be;
- Extend existing international humanitarian/ development links to build human capacity via for instance postgraduate NGO internships, Skills and knowledge transfer, resource sharing, knowledge management and legacy.

– O**pportunities and Proposed solution**:

- Scientist as a decision maker
- Scientists should offer advice in response to demand in participatory forums and accounting for social, economic and institutional factors contribution to vulnerability, and integration of social and natural science (e.g. social vulnerability);
- More research effect to be directed at understanding risk transfer during and after construction of risk, Lesson learned in sharing and collaborating with other countries.
- Scientists should offer advice in response to a demand in participatory forums.

– **Organizational Details**

- DRR as a tool for effecting change;
- Academia can learn from knowledge sharing, dissemination and communication practices from outside academia including technology and innovation forums;
- Local level training and education for both civil servants and the scientific community should use various tools including e-learning and "summer schools".; and
- International support and technology sharing from industrialized to developing countries should be based on long term commitment.