Issue Brief: Integrated Science for Sendai Framework Implementation

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Implementation of the Sendai Framework will benefit from a broad but clear understanding of the range of knowledge services science can provide. The science and technology communities are diverse and dynamic. The need for some knowledge services is well established in policy and practice – for example monitoring and evaluation and technical risk assessments, though gaps in application remain; other services, such as decision analysis or risk root cause analysis are only beginning to be developed and applied. Despite our growing understanding of risk, losses increase. This supports ongoing calls for science to be evaluated, and re-organised to enter a new level of conversation with policy, practice and those at risk. Policy and practice actors also have to reflect on their relationship with science if the breadth of science-action relationships, from service to critical friend and catalyst, are to be valued and fostered. This is Sendai's call to science and science users.

The role of science is formalized in the first of the Sendai Framework's four priority areas: Understanding disaster risk. Paragraph 23 states *"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment".* This ambition goes beyond the capacity of any one science approach requiring any science road map to work hard on developing a multidisciplinary agenda[2].

Disaster Risk Reduction (DRR) science is in a good position to deliver on this enhanced mandate. DRR scientists stand out from those in many other fields in already having trusted relationships with policy and practice. There are many personal examples of science and technology-led gains for DRR. This evidence base is increasingly being formalised so that detailed lessons can be learnt[3]. Recent success with early warning systems is just one example of joined up science and technology connected to practical delivery on the ground[4]. The result has been a reversal in net-mortality associated with extreme events[5].

Sendai does not stand alone, and this has implications for the role of science. Science is central also for achieving and monitoring progress towards the Sustainable Development Goals and new deals for development and climate change adaptation finance and associated national policies. The role of science has also been recognised within consultations to inform the World Humanitarian Summit,

[1] IRDR is an international science programme cosponsored by ICSU, ISSC and UNISDR,. http://www.irdrinternational.org/

[2] Pearson L and Pelling M (2015) The UN Sendai Framework for Disaster Risk Reduction 2015–2030: negotiation process and prospects for science and practice, *Journal of Extreme Events*, 2 (1) doi: 10.1142/S2345737615710013

[3] UNISDR (2013) *Using Science for Disaster Risk Reduction* http://www.unisdr.org/files/32609_stagreport2013assembled.pdf

[4] Cutter SL, Ismail-Zadeh, A., Alcantara-Ayala, I., Altan, O., Baker, D.N., Briceño, S., Gupta, H., Holloway, A., Johnston, D., McBean G.A., Ogawa, Y., Paton, D., Porio, E., Silbereisen, R.K., Takeuchi, K., Valsecchi, G.B., Vogel, C. And Wu, G. (2015) Global risks: Pool knowledge to stem losses from disasters *Nature* 522: 277–279 (18 June 2015,) doi:10.1038/522277a

[5] Rogers D and Tsirkunov V (2010) *Costs and Benefits of Early Warming*, UNISDR Global Assessment Review Background Paper Systemshttp://www.preventionweb.net/english/hyogo/gar/2011/en/bgdocs/Rogers_&_Tsirkunov_2011.pdf

taking place in May 2016[6]. Some have criticised individual frameworks, and the culture of indicator-based goal setting as producing a fragmented vision of development. In response, science can play a key role in augmenting as well as supporting these formal frameworks. Science can provide technical and conceptual linkages to show how individual indicators and targets or goals are interconnected. Science then has a role to play in helping reveal the connections between the grand aspirations of the 2015 frameworks, the detailed calculus of monitoring indicators, and change on the ground.

As the first of the landmark UN frameworks agreed in 2015, the Sendai Framework brings the science community an opportunity to share its experiences and lessons with other communities of practice. The UN Science and Technology Major Group was active in shaping the Sendai Framework and other 2015 frameworks, indicating considerable scope for joined-up learning and for collaboration across science disciplines and practitioner groups[7]. Sendai provides UNISDR a key role to play in defining this agenda within the UN family and more broadly. This also increases the global relevance of the science and technology engagement with the Sendai Framework and any resulting roadmap that might articulate priorities and phasing for science and science investment. These lessons show that:

DRR science can help with:

- **Reducing uncertainty, or at least making clearer the levels of confidence and uncertainty relevant to specific decision making contexts**
- **Ensuring greater equity in research investment to prioritise those issues with greatest potential to support those most at risk**
- **Clarifying the right questions to ask to achieve a stated goal and opening opportunities for decision makers to inform research agendas**
- **Understanding the need to work on policy and human behaviour if science is to lead to changed outcomes on the ground**
- **Making decision-making processes more transparent and inclusive**
- **Improving the measurement of baselines for framing and monitoring progress**

DRR science provides these services through its ability to:

- **Originate new,robust knowledge**
- **Assess and provide guidance on the quality and appropriate use of existing knowledge sources**
- **Broker knowledge by sharing perspectives on risk and resilience across sectors and scales of governance**
- **Guide independent evaluation through rigorous and participatory monitoring from the local level up to national and international accountability mechanisms**
- **Originate novel evidence and analysis to enable policy evolution**

With these abilities comes the recognition that science has the potential to cut through political and cultural impasses. Science is not immune to being corrupted or poorly implemented and can be used to justify perverse decisions or judgements. But when used with rigour and transparency, science

[6] WHS themes of resilience and partnership recognise the need to create stronger linkages between humanitarian work and global development and climate change action to manage and find solutions to situations of prolonged crises, increase the predictability of response in advance by forging preparedness and response agreements for natural hazards between governments and the international community, increase government investment in reducing exposure and vulnerability, and disaster preparedness, convene an independent advisory group to adapt and get ready for new humanitarian challenges and risks, and synthesis of the consultation process for the WHS https://www.worldhumanitariansummit.org/bitcache/e29bc4269edb7eaeceb5169a8f41275327a701c8?vid=555558&disposition=inline&op=view

[7] IRDR Issue Brief: Disaster Risk Reduction and Sustainable Development. http://www.irdrinternational.org/wp-content/uploads/2013/12/IRDR-ICSU-Brief-DRR-SD.pdf

and evidence-based approaches are able to reduce risk even where political sensitivities are high. Science has the capacity to reach across sectors and political boundaries. This is especially important for DRR and climate change adaptation where risk reduction requires a combination of structural and local measures. Science then is a tool to be deployed with care. It is important not to undermine its independence while also bringing science closer to the policy and practice communities to increase its positive impact for risk reduction and sustainable development.

Science, like policy, is not fixed. There are many interpretations of what is and is not science. How science is framed within the Sendai implementation process will influence considerably the range of expertise, and so the breadth and depth of insight that Sendai can build on. DRR science has three key traditions (see Box 1). Each is vibrant and offers something to Sendai implementation.

Box 1: Three current traditions in disasters science

- First, descriptive science approaches, principally deployed in the natural and physical sciences and engineering underlie much hazard assessment and associated mitigation and early warning policy work, including safe building codes, risk aware land-use planning and resilient critical infrastructure.
- Second, interpretative social science approaches have been used to inform social and economic policy for vulnerability reduction and risk and impact management.
- The third tradition sees a broadening out of science to include decision-making processes as a key subject along with vulnerability and hazard analysis. This tradition sees the rise of citizen science, action research, transdisciplinarity and co-production approaches.

Some would say that with the rise of these traditions, knowledge services for DRR have gone beyond technical science parameters and instead occupy a broader space of inclusive knowledge production – all have in common a desire to make science relevant to decision-makers[8]. This requires a roadmap for the implementation of Sendai that can recognise and then position the diversity of science appropriately to benefit from its ability to deliver across accuracy, understanding and inclusion.

Integrating knowledge services with action for disaster risk reduction is currently most common at the project level. The best early warning systems bring together hazard and vulnerability analysis with an understanding of the behaviour of individuals, crowds and economies once a warning is issued[9]. Computing power as well as anthropological awareness is needed to make early warning as relevant as possible to the behaviour of people at risk[10]. At the national level integrated approaches have even more potential to move science from describing problems to proposing solutions. New Zealand's integrated approach to recovery from the Christchurch Earthquake has produced innovations in early warning, land-use planning and experiments in local democracy as well as economic and social development. Christchurch and Wellington are now two of the Rockefeller 100 Resilient Cities[11].

The process of enabling science to strengthen disaster preparedness and build resilience often brings together organisations that have not worked together before or do not have a well-established understanding of each other's ways of working. There's a lot of talk about co-production,

[8] Donovan, A., & Oppenheimer, C. (2015). Resilient science: The civic epistemology of disaster risk reduction. *Science and Public Policy*, scv039.
[9] UNISDR (2010) *Early Warning Practices can Save Many Lives: Good Practices and Lessons Learned* http://www.unisdr.org/files/15254_EWSBBLLfinalweb.pdf
[10] UK Government Office for Science (2012*) Reducing risk of future disasters: priorities for decision makers* https://www.gov.uk/government/publications/reducing-risk-of-future-disasters-priorities-for-decision-makers
[11] http://www.100resilientcities.org/cities/entry/christchurchs-resilience-challenge#/-_/

and not so much on how to concretely put this into action. As a first step, jointly developing shared principles can support the building of a common understanding and shared approach, including on respective accountabilities, amongst the diverse group of actors whose effective collaboration is essential for developing scientific understanding of risk; this supports specific decision making processes. Programmes including such principles for collaboration have enabled the development of user-relevant Climate Information Services within the DFID-funded Adaptation Consortium[12] and Euporias climate services development[13]. Increasing evidence of the need for the providers of risk information to be accountable for appropriate communication of the probabilistic nature of the information as evidenced in l'Aquila Italy earthquake, foreasts of hurricaines in the Philippines and principal rain seasons in Kenya. The Climate Services Partnership working group on Climate Services Ethics has just issued a white paper on ethical framework for climate services[14].

Sendai does not have to build its roadmap from scratch. Several international programmes have developed integrated science approaches. The Global Earthquake Model originated as a natural science hazard observation agenda but now includes social variables and produces integrated risk analysis with scope for behavioural analysis[15]. Global reinsurers routinely deploy mixes of natural, social and behavioural science in their work. At a strategic level, Integrated Research on Disaster Risk (IRDR) exists to facilitate integration and science-policy/practice collaboration as a programme of the International Council for Science, International Social Science Council and UNISDR[16].

IRDR's integrated approach has led to a revision of global loss data classifications and championed a common framework across insurance, government and UN agencies[17]; promoted integrated science approaches to the root cause analysis of risk[18], and brought social and behavioural sciences together to better understand why it is that good science does not always lead to risk reduction[19]. A review of the academic literature has revealed key opportunities for integration across gaps between medical, engineering, social and political sciences[20].

The urgency of integrating science into DRR practice and using science as a critical friend to policy was demonstrated only weeks after the signing of the Sendai Framework. Devastation following the 7.8 earthquake in Nepal, April 2015, was not a surprise. Scientists had warned of a large event for decades with some even predicting the exact epicentre location[21]. Yet when the event came, lack of preparedness and the depth to which development had accumulated vulnerability was clear.

Science is an essential component for avoiding preventable catastrophe. Science though needs to be more expansive than it has been and to embrace wider knowledge production processes, without reducing its core values of rigour and independence. This is essential if science can leap from advising from the outside to being understood from the inside of the risk management decision-making world. It is this gap that is yet to be bridged and that the Sendai Framework provides an opportunity to meet.

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[12] http://www.adaconsortium.org/index.php/what-we-do/what-we-do.html
[13] http://www.euporias.eu/symposium
[14] http://www.climate-services.org/wp-content/uploads/2015/09/CS-Ethics-White-Paper-Oct-2015.pdf
[15] http://www.globalquakemodel.org/
[16] http://www.irdrinternational.org/
[17] http://www.irdrinternational.org/projects/data/
[18] http://www.irdrinternational.org/projects/forin/
[19] http://www.irdrinternational.org/projects/
[20] Melanie Gall, Khai Hoan Nguyen, Susan L. Cutter (2015). Integrated research on disaster risk: Is it really integrated? *International Journal of Disaster Risk Reduction, Volume 12, June 2015, Pages 255-267*
[21] Bollinger, L, Sapkota SN, Tapponnier P, Klinger Y, Rizza M, Van der Woerd J, Tiwari DR, Pandey R, Bitri A and Bes de Berc S (2014). Estimating the return times of great Himalayan earthquakes in Eastern Nepal: evidence from the Patu and Bardibas strands of the Main Frontal Thrust. *Journal of Geophysical Research*, doi: 10.1002/ 2014JB010970.