DRR Research Agenda – ZOD V5

A Research Agenda for Global Science in Support of Risk-Informed Sustainable Development and Planetary Health

9 April 2021

Prepared by the DRR Research Agenda Core Group; sponsored by the IRDR, ISC and UNDRR.

Contact: Ben Payne B.A.Payne@massey.ac.nz

'At no point in human history have we faced such an array of both familiar and unfamiliar risks, interacting in a hyperconnected, rapidly changing world. New risks and correlations are emerging. Decades-old projections about climate change have come true much sooner than expected. With that come changes in the intensity and frequency of hazards. Risk really is systemic, and requires concerted and urgent effort to reduce it in integrated and innovative ways.' (SRSG, GAR2019)

Foreword

Acknowledgements

Content

Executive summary

The emerging Global risk landscape of a pandemic, dramatic changes to climate and biodiversity, social and financial crises, digitalisation and hyperconnectivity, inequalities and vulnerabilities, pose new challenges for disaster risk reduction and its associated areas of climate change adaptation and risk reduction through the Sustainable Development Goals. The trend is for more severe complex impacts with increasing concern about and acknowledgement of systemic, compound, and cascading risks and impacts. Rapid political, social and technological developments in addition to planetary change are contributing to the shifting landscape. The risks can appear to be existential posing a threat to humanity's existence. The arrival of the Anthropocene Era, where humanity is the major force of planetary change, is clear recognition of our situation; with talk of tipping points, planetary boundaries and biodiversity and ecosystem collapse (Folke et al, 2021).

To meet these challenges DRR needs to be reimagined with much broader reach working collaboratively across sectors, disciplines and types of knowledge. One overriding need is to go well beyond siloed thinking and "business as usual" if we are to address these closely linked global imperatives successfully. For risk science, the need now is to maximise the impact risk science can have on changing this future towards better outcomes. To achieve this, risk scientists and knowledge holders have to integrate and reach beyond the traditional networks of our existing disciplinary fields.

This Agenda sets out some important areas where additional actionable knowledge is likely to result in reduced risk and vulnerabilities and improved human well-being. It is intended for those working in DRR and related areas of global risk, climate change adaptation and development. We believe it is relevant to those interested in improving current DRR practice as well as those who see the need for more fundamental changes.

The Agenda was commissioned by the ISC (International Science Council) and UNDRR (UN Disaster Risk Reduction office) and the development has been led by the IRDR (Integrated Research on Risk program). From the outset the emphasis has been on a collaborative co-design approach with wide iterative consultation. The Agenda has engaged with and reflects the priorities and interests of groups well beyond traditional DRR research and practice, to build the evidence base needed for risk-informed decision-making in all geographies, sectors and scales. To help support additional engagement a number of specialist groups were organised covering among other areas, indigenous knowledge, technology, and the private sector.

The research priorities:

The priorities highlight that although much scientific research and progress has been achieved in DRR over the past decade, much of this knowledge is unused due to lack of effective collaboration between science, policy and practice. Silos and significant disconnections remain within and between disciplines, and also between knowledge producers and potential knowledge users. This lack of integration and trans-disciplinary focus has reduced the capacity and impact of disaster risk science in addressing macro societal challenges, like alleviating poverty and reducing vulnerability and exposure to all forms of disaster risk.

Based on iterative consultations with a wide range of interests and [stakeholders, actors] the following priority areas have been identified:

1- **Address today's complex Global Risk landscape: How disaster risk reduction can accelerate the transition to a peaceful, safer, equitable, sustainable world within the context of DRR.**

Key questions: How can research inspire better work to understand the complex interconnections of systemic, compound and cascading risks and impacts, and their connections with vulnerability and exposure.

Potential early result: what form do comprehensive risk assessments, that include systemic impacts and vulnerabilities, need to take for global and existential threats?

2- Addressing inequalities, injustices and marginalisation

Key question: How can risk science and knowledge support the most marginalised people and communities to ensure that "no one is left behind", as part of ensuring inclusive justice and equity across humanity?

Potential early result: how to support the development of tools that enable practitioners to justify considering risk and its distributional impacts, when defining development strategies (for example for poverty reduction and social development and inclusion, or infrastructure)?

3- Enabling transformative governance and action

Key question: Risk reduction, climate adaptation and the achievement of Sustainable Development Goals are intrinsically linked – how can transdisciplinary science and knowledge transform access to and participation in governance structures and actions to reduce disaster risk?

Potential early result: what is known across science and other sources of knowledge including commerce, about integrative governance and action for DRR, climate change adaptation and the SDGs?

4- Measurement to help drive progress

Key question: What do we need to measure and how can measurement be designed to incentivise improved risk knowledge and risk reduction?

Potential early result: how can we best measure progress in addressing Priority Themes 1-3 and 6-7 drawing on current knowledge and experience?

5- Understanding the implications of new thinking on hazards.

Key Questions include: How can we best identify and understand new forms and newly common extreme forms of hazards; as well as their intersection with vulnerabilities and other hazards? The ISC/UNDRR 2020 report on Hazards Definition and Classification identifies over 300 hazards, many new to DRR.

Potential early result: how to develop and action impact-based warnings drawing on multiple disciplines and agencies as well as the private sector and civil society?

6- harnessing technologies, data and knowledge for risk reduction.

Key question: what factors impede and what support emerging technologies in achieving their promise of risk reduction – rather than risk creation and risk shifting; and how can the technologies be better used to support the SDGs and risk reduction? Rapid technological advances are driving major changes in our lives and have the potential to contribute to all aspects of risk reduction and disaster management. This theme seeks to inspire research that

takes the opportunities to maximise positive impact.

Potential early result: what factors impede and what support the technologies in achieving their promise of risk reduction – rather than risk shifting or creation?

7- Foster interdisciplinary and multi-stakeholder collaboration

Key question: Why is so much knowledge apparently unused? There are many areas where it is well applied which could provide starting points for learning and change.

Potential early result: what are the most effective ways of developing and supporting networks of practice and knowledge to enable exchange and development of ideas and interaction with those in policy and practice?

8- Supporting regional and national science and knowledge for policy and action.

Key question: what are the distinctive research priorities of different global regions? Regions have distinctive mixes of hazards, exposures and vulnerabilities, which are influenced by complex root-causes, interdependencies, capacities and governance structures.

The Agenda concludes with a section on implementation. In summary, this Research Agenda is intended to help connect knowledge, policy and practice, foster innovative thinking and encourage greater research investment in priority areas. The Agenda also can help connect scientists across disciplines and encourage new types of partnerships to work across traditional silos to find new approaches to address today's global challenges.

1. Introduction

Solutions to the combined risks and crises facing humanity and the planet can be found through the collaborative efforts of all types of relevant knowledge and policy resources to drive change. Many of the major global crises and threats are well known: the Covid-19 pandemic, climate change, ecosystem and biodiversity collapse, and financially and socially induced risks. Less well known are the day-to-day crises and risks impacting much of the globe through inequalities and vulnerabilities, often exacerbated by globalisation and digitalisation. Disaster risk has therefore come to occupy a central place in global development with science required to work more effectively, innovatively and collaboratively. Coherence between the Sendai agreement and parallel major UN frameworks concerned with addressing risks, e.g. the SDGs (Sustainable Development Goals), Paris Agreement on Climate Change, New Urban Agenda, Addis-Ababa Action Agenda and Agenda for Humanity will assist with addressing inequalities and instilling risk reduction as a critical function of development.

The global risk landscape is undergoing rapid and profound changes across DRR (Disaster Risk Reduction), climate change and sustainable development (Steffan et al. 2015). The arrival of the Anthropocene Era, where humanity is the major force of planetary change, is clear recognition of our situation (Folke et al. 2021). The trend is for more severe complex impacts with increasing concern about and acknowledgement of complex, cascading and systemic risks, with impacts that cascade through social, economic and environmental systems. This reflects the growing interconnectivity and interdependence across socio-economic systems, as well as physical, biological, environmental, social, and cyber systems; and highlights the issue of physical and socio-economic tipping points within and across these systems. The Covid-19 pandemic is not only a cascading and systemic risk but lacks clear boundaries in space or time. The virus and the response it has engendered highlight the complexity of global risk, including the weakness of large-scale risk governance that is often disconnected from local governance efforts, and the fragility of our systems. Existing approaches to thinking about and managing risk are being overwhelmed by the pandemic's systemic nature. It also shows the potential for existential risks that can fundamentally alter how humanity lives, even if not threatening our existence.

Rapid political, social and technological developments in addition to climate change are contributing to the shifting landscape. One overriding need is to go well beyond siloed thinking and "business as usual" if we are to address these closely linked global imperatives successfully. Returning to, and supporting, business as usual is what many disaster support systems are set up to achieve; this entrenches existing vulnerabilities and other risk drivers and often does little to reduce risk or inhibit its increase. Disaster recovery offers opportunities which are sometimes, but often not, taken to address risk and undertake transformative change.

Contemporary DRR can claim major reductions in the human toll from disasters through for example warning systems and emergency action. However, our trajectory urgently needs to change and DRR research needs to change with it. Achieving this requires reimagining DRR, to extend it from a singular focus on major events, to a proactive inclusive approach with climate adaptation, vulnerabilities and development to address the causes as well as consequences of disaster.

To identify knowledge gaps and priorities, and to build the evidence base needed for risk-informed decision-making in all geographies, sectors and scales, the Agenda developed here has engaged with and reflects the priorities and interests of groups beyond traditional DRR research and practice. This consultative process is set out below and in Appendix 1.0. It includes disaster risk scientists, researchers, academics, and technical institutions in both the public and private sectors, traditional and Indigenous knowledge holders, as well as funders of research and practice.

This new research agenda helps to both identify the needs of [stakeholders, actors] working at country, regional and international levels and to itself be guided by those needs. It will also guide the development of research to address those needs, as well as to help solve broader issues. The Agenda's audience are all those engaged in DRR work as practitioners, policy makers and researchers, as well as in related areas connected with risk identification, reduction and management. This extends to those working on all aspects of vulnerability, and to those funding research and practice for risk and development, as well as the associated areas of human and planetary change.

The Agenda also calls for an integrated, inclusive systemic approach to risk reduction with prominence given to the issues of justice and equity.

This Agenda document contains the detailed rationale and process for developing for the Agenda (including a set of key questions guiding the work), a review of the trends and status of disaster risk knowledge, the research priorities comprising the Agenda, and an implementation guide. Additional detail and supporting material is found in appendices and hyper-links.

[INSERT BOX ON TERMINOLOGY – Box 1: we have had feedback on a variety of terms including gendered terminology and "natural disasters". We try to eliminate these, but sometimes we quote from others. We should also cover the idea of "science" vs "knowledge".]

2. Developing the Research Agenda

2.1 Organisation

The Agenda was commissioned by the ISC (International Science Council) and UNDRR (UN Disaster Risk Reduction office) with the development led by the IRDR (Integrated Research on Disaster Risk program). From the outset the emphasis has been on a collaborative co-design approach with wide consultation.

Two groups were established to support the development of the Agenda (see Appendix 2.0, Tables 1 and 2 for details of the groups and the consultation process): a Core Group, and an Expert Review Group (ERG). The Core Group is responsible for guiding the development of the Agenda and providing input, while the ERG provides input and commentary from diverse perspectives. Membership of the Core Group consists of representatives of the ISC, UNDRR, the IRDR Scientific Committee and IRDR Executive Director and other IRDR and external members. The Expert Review Group consists of Core Group members, plus IRDR ICoE's (International Centre's of Excellence) and National Committees, representatives of the Science and Technology Advisory Groups (STAGs), as well as a wide range of people from diverse backgrounds (science, advocacy, funders, private sector) outside the IRDR community. In practice a small sub-group from the CG oversaw the detail of the development. [Show this in a diagram.]

To ensure that sectors and sources of knowledge that are often excluded were included, a number of specialist sub-groups were established from ERG. These included: indigenous knowledge; the private sector; information and communication technology; early career science communities.

2.2 Process

The Agenda was developed iteratively through multiple consultations with, and input from, the [stakeholder, actor] groups mentioned above. The formal iterations are set out in an Appendix. In addition, the iterative consultation process included the following steps:

- An informal survey of the IRDR Community (IRDR SC, IPO, ICoEs, NCs) to help establish the initial draft research priorities.
- A review and analysis of the published largely scientific literature (see Appendix), to help establish the state of research, gaps and needs across DRR, resilience and other themes. 'Disasters science' spans the natural and social sciences, which means it is not an established single branch of science, nor does it fit neatly into a single, well-established scientific discipline. Rather it is found in environmental, earth, economics, geography (human and physical), engineering, sustainability, ecology, sociology, political science, law, education, health, anthropology, and more, including specific branches of these sciences, such as: climatology, hydrology, oceanography, remote sensing, and many others. Publications for this review came from Scopus and Google Scholar databases, and a survey disseminated across IRDR networks (Science Committee members, International Centers of Excellence (ICoEs), National Committees (NCs) and members of the Research Agenda Core Group.
- A penultimate draft of the Agenda will be presented at the 2021 IRDR Conference. The conference will be asked to endorse the agenda.

2.3 Principles and key questions guiding agenda development

The development of the Agenda is informed by a number of principles. These were developed by the Core Group to act as a set of normative guidelines and highlight what the Agenda should aim to achieve. However, they are not intended to be prescriptive or binding. In summary, the principles are about: encompassing global risk and including systemic and emerging risks; advancing coherence across the substantive areas encompassed by major Global agreements on DRR, climate, SDGs, and other critical issues as part of the 2030 resilience agenda; emphasising collaboration and being inclusive of disciplines, regions and forms of knowledge; promotes ethical and inclusive forms of knowledge and research; being relevant to policy and practice; and is flexible and adaptable to changing circumstances. [To be shown in a diagram.]

The Agenda:

1. Is responsive to the new Global risk, development and planetary health contexts and actively supports coherence across major UN agreements on DRR, climate change, planetary health, Sustainable Development Goals etc.
2. Takes a systemic and multi-risk perspective, capturing emerging, dynamic, complex and cascading risks, and gives attention to the appropriate response space.
3. Is focused on policy relevance and outcomes.
4. Aims to inform processes to implement and achieve collaboratively the Sendai Framework for DRR, the Paris Agreement on climate change, and the SDGs targets, as part of the 2030 resilience agenda.
5. Is based on consultation, and proactively promotes collaboration across disciplines, domains and [stakeholder, actor] groups – in line with the Sendai principle of transdisciplinary collaboration;
6. Recognises DRR as essential to the development process and improved human well-being.
7. Engages with traditional and other forms of knowledge, and where practicable promotes co-production of knowledge.
8. Promotes ethical inclusive approaches to research and research results.
9. Includes consideration of how research is funded, and how the results could be implemented.
10. Aims to go from theory to practice by focusing on impact for both policy and practice;
11. Is flexible and adaptable to changing circumstances.

2.4 Key questions guiding the agenda development

- The development of the Agenda is guided by some key questions that flow from the global risk landscape set out above and informed by a review of DRR efforts to date (Appendix 3.0). The overarching questions are how transformation to a lower risk, more sustainable world can be achieved; and what pathways to transition, from where we are to where we need to be, are or could be available? Among other issues this indicates that we need to gain an understanding of the rapidly changing global risk, including social and environmental tipping points; an understanding of hazards in today's science and political context; and how these complex transboundary risks might best be governed.
- What model of governance will address these complex transboundary risks? A fundamental issue for science itself is that science needs to change: it needs to be much more collaborative, trans-disciplinary, accepting of and working with other sources of knowledge, and those who fund and implement the evidence generated by science.

3. Why a new Agenda is needed - Context and rationale

Why is a new global risk -science research agenda needed, rather than amending the present settings of risk science networks, platforms and research programmes? The rationale for a new risk science research agenda is found in: changes in thinking about disasters and risk; the emerging global risk landscape; the need for coherence across the areas encompassed by major global agreements relevant to reduction of risks and vulnerabilities (Appendix 3.0).

3.1 The emerging global risk landscape

[TABLE AND NOTE ON THE OVERARCHING RISK DISCOURSE TO BE ADDED. DRAFT AT APPENDIX 3.0. - provide an overview of these tables as an info-graphic that is hyperlinked to the detailed tables.] The tables (see Appendix 3.0) seek to provide an overview of the current state of global risk literature, highlighting prominent and emerging areas of research post the SREX 2012 report.

The global risk landscape is undergoing rapid and profound changes across DRR, climate change and sustainable development. The trend is for more severe complex impacts and there is increasing concern about and acknowledgement of complex, cascading and systemic risks: unprecedented climate and weather shocks and stresses being associated with economic and humanitarian crises potentially driving large scale movements of people, as well as crises precipitated by accelerated warming in polar regions and major changes to ocean ecosystems, are some of the more obvious signs of these changes. The Covid-19 pandemic is not only a cascading and systemic risk lacking boundaries, but is itself framed in many different ways (e.g. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7526906/). The virus and the response highlights the complexity of global risk as it plays out over multiple scales in space and time, the weakness of large scale risk governance, and the fragility of our systems. In keeping with many high profile risks, Covid-19 is portrayed in mainstream media alternatively as war, as a fairness issue, as a geo-political issue, as a public health issue, and as about competence of politicians, the public sector and leadership – among other framings. At different times and from different perspectives, these may all be reasonable.

This rapidly evolving landscape is characterised by multiple definitions and frames varying by sector, discipline, circumstances and worldviews – however even within and across disciples there can be distinctive risk ways of defining and framing risk.

Approaches vary from the mathematical precision of engineering, insurance and financial modelling

and analysis; the approaches used by the society and technology research community, and cultural and social theorists, with Ulrich Beck for example arguing that risk is an alternative to class as a way of framing society in the contemporary world; the increasing use of the SDGs to frame risk for corporations [https://www.unpri.org/sustainable-development-goals/the-sdgs-as-a-risk-framework/308.article]; and the strong social justice frames brought to bear by environmental and climate justice, human rights and labour advocates.

Risk can be shifted between organisations, agencies and people in a way that transfers and exacerbates vulnerabilities (Eriksen et al, 2020). This is not simply the risk shifting of insurers, but for example the legal shifting of risk from power companies onto the people of Texas evident during the 2021 winter storm (XX).

SMALL BOX:

In the January 2021 winter storms the Texas power grid partly failed. This left some 5 million without power for days during record cold. The deregulated nature of the grid meant that wholesale electricity prices increased by a factor or nearly 200. Individual consumers faced electricity bills of up to $1000 a day. Water supplies ceased, affecting consumers and fire fighting, as well as retail and many other key services, and some retail power companies went bankrupt.

There are also sectors where risk can appear to be ignored: for example risk can appear to be treated as an externality in current development models; and groups that focus on the perceived benefits for example through economic analysis to argue that the risks are small compared with the benefits. Many countries, sectors and companies have their own standards and protocols for formally assessing risk, often drawing on the ISO-1300, the international risk standard, which frames risk in terms of failure to meet objectives.

This indicative list of ways of seeing risk has now been joined by a range of concepts highlighting risk as an immense challenge for both humanity and the planet: systemic, complex and cascading risks, and risk as existential (for an up-to-date summary see Folke et al. 2021; see table of publications at Appendix 1.0; policy oriented examples include: GAR 2019; CSER; the 2020 UN Development Report; Global Risk Report 2021 of the World Economic Forum). These concerns have led to new fields with a focus on global catastrophic and existential risks which are events that can bring humanity to collapse (eg see the Centre for the Study of Existential Risk (CSER); Rethinking Human Development. https://council.science/actionplan/human-development/).

The idea of Anthropocene Risk (Keys et al., 2019 https://www.nature.com/articles/s41893-019-0327-x) is an attempt to explain emerging global risks and how they arise, with humanity seen as the main driver of change on the planet [https://link.springer.com/content/pdf/10.1007/s13280-021-01544-8.pdf]. Understanding Anthropocene risk requires holistic and systemic approaches. These more complex risks, or ways of thinking about risk, are emerging as sub-disciplines with their own substantial research efforts. They reflect a merging of global environmental change, escalating inequalities, digitalisation, economic and social issues and crises, which are creating both new forms of larger risks and uncertainties, and also entrenching end exacerbating many day-to-day risks.

The focus on global risk stems from growing concern about the prospects for humanity and the life supporting capabilities of the planet. The threats are seen as complex and intensifying, but are subject to a range of interpretations. Regardless of the exact severity of the threat, the implications are high levels of disruption to the lives and livelihoods of much of humanity, disruption or partial cessation of the global flows of goods and services, including the ecosystem services underpinning humanity, and undermining future and reversing past achievements of the SDGs, climate adaptation and disaster risk reduction.

This global focus should not obscure the reality for many people that it is the everyday risks, vulnerabilities and crises they face that are of major concern. Global risk is nevertheless important here to the extent that it is connected to, and a driver of, these local issues.

Consistent with ways risk is framed and viewed, and with the imperative of collaboration across disciples, sectors and forms of knowledge, this agenda uses multiple framing in developing its priorities. Risk is highly pluralistic in nature, with multiple interconnections, dimensions, multiple scales and complex multiple impacts. We need to work with these multiple framing and with uncertainty and surprise across planetary and social systems.

4. The disaster risk field – recent evolution and emerging issues.

Part of the global risk landscape consists of a number of major global agreements ultimately concerned with improving the condition of humanity and the planet through risk reduction, including disaster risk. The agreements and their associated institutions provide one important avenue for policy development and implementation. In addition to the Sendai Framework for DRR, they include the SDGs, Paris Agreement on Climate Change, Post-2020 Global Biodiversity Framework, New Urban Agenda, Addis-Ababa Action Agenda and Agenda for Humanity.

These agreements and others highlight that DRR is recognised as a mainstream development issue, but needs to go much further (for details of published research see Table at Appendix 3.0). The field struggled to gain traction in the development process although the issue has long been discussed with Cuny's 1983 publication on "Disasters and Development" being an early argument for the integration of the fields. This is despite the rhetoric of risk, vulnerability and resilience, and the 1990s UN decade on disaster reduction, with its attempts to drive a "culture of prevention". DRR has been viewed historically as focused on preparation and response for specific events, rather than on identifying and tackling the underlying causes and drivers of risk through identifying and addressing the factors underlying and exacerbating disaster risk.

To complement the review of the broad disaster risk literature mentioned above and to help identify gaps in knowledge and priorities for the field, a review and analysis of recent DRR focused research publications was undertaken. A summary note and table are at Appendix 4.0. This review identified the fluid and contested nature of the contemporary field reflecting new knowledge generation from diverse and inter-related disciplines. A change in risk understanding from 'natural' to 'systemic' is apparent, and the conceptual links between disaster risk, climate change and sustainable development are multiple and complex, with publications on these links particularly popular since the advent of the 2030 Agenda. Major issues include the growing disconnect between knowledge and action; the integration of approaches for a holistic understanding of risk is lacking; and the systemic, cascading and transboundary nature of risk in a globalized and interconnected world needs to be reconciled with current systems of risk governance, which seem unable to tackle global risk - with some exceptions such as financial risks – or do much for the day-to-day risks people face.

Today, DRR increasingly needs to deal with these complexities surrounding risks and impacts; and is now increasingly framed more as a proactive, inclusive approach working to integrate with climate adaptation, inequalities, vulnerabilities and development to address the underlying causes of disaster. The global agreements mentioned above provide policy avenues for improving the condition of people and the planet through risk reduction – and to some, extend the scope of the risk reduction task to re-tooling our social and economic systems. Synergies and coherence across the areas covered by these agreements could drive dramatic improvements in DRR.

This is a major change because the agreements listed above did not exist before 2015, making integration across the domains they cover at best ad hoc and often unofficial. Change is also seen in the rise of trans-disciplinarity which needs to extend to include forms of knowledge beyond science and scientists. Traditional science alone is not sufficient to deal with the complex risk environment we currently face, with its emerging risks and growing uncertainties. There are many institutions working on these risks, including research organisations, think tanks and others with major influence such as the WEF, World Bank and European Commission. The affiliations of those in the agenda's CG and ERG highlight the diversity.

The 2020 review of hazards terminology https://council.science/wp-content/uploads/2020/06/UNDRR_Hazard-Report_DIGITAL.pdf with its reappraisal and reframing of what hazards should be included within the scope of the Sendai agreement highlights this shift in thinking. Drawing on Sendai, the review shifts the definition of hazard from phenomena to also include human activities and processes:

> "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation". [Note that in practice some substances were also included.]

The Report sets out a strong case for an "all- hazards approach to achieve risk reduction as a basis for sustainable development". This is intertwined with the systemic complex nature of the contemporary hazards landscape, epitomising the evolution of the whole DRR field:

> "interconnected, cascading and complex nature of natural and human-induced hazards, including their potential impact on health, social, economic, financial, political and other systems, are all interlinked in the discussions on sustainable development and climate change adaptation."

The current situation is given added urgency in our "complex, hyperconnected, overheated, fast-paced world", where under pressure social and ecological systems can reach their tipping points as argued in GAR-2019.

5. Research priorities within the Global Risk landscape:

This section sets out draft research priorities. The priorities have been developed through the consultations undertaken as part of Agenda development (see Section 4), through gaps and needs identified by the analysis of published material (Section XX and Appended), and by examination of key documents including GAR and the 2020 Hazard Terminology and Classification report. The field is very dynamic with new issues and priorities certain to emerge. These priorities should be read with other major research priority setting exercises in mind such as the 2021 Horizon Europe (Section 5); The 2020 UN Research Roadmap for Covid-19 Recovery; the Earth Commission, the report prepared for the 2021 Nobel Summit (Folke et al. 2021), and the 2019 IPBES Global Assessment Report on Biodiversity and Ecosystem Services.

[These consultations identified that much scientific research and progress has been achieved in DRR, but that much knowledge remains unused. Silos and significant disconnections remain within and between disciplines, and also between knowledge producers and potential knowledge users. This lack of integration and trans-disciplinary focus has reduced the capacity and impact of disaster risk science in addressing macro societal challenges, including alleviating poverty, reducing vulnerability and exposure to all forms of disaster risk, and improving risk governance.

Implementation of many aspects of these higher-level themes will require major change, and in some cases transformation (whether social and behavioural, institutional, political, policy based and

other aspects of transformation within the current risk science and research paradigm). Consequently, a key overarching question is how transformation can be achieved?

It is acknowledged that transformation will rely on identifying diverse pathways to transition, and collectively defining a vision of where risk science should be in a decade from now, how this will be achieved, and how success will be measured.

In seeking to encourage change towards an integrated approach to risk reduction and human well-being across sectors, funders, sources of knowledge - including trans-disciplinary risk science - the research priorities are set out in a way that includes macro level issues, as well as more specific technical concerns, and priorities at regional levels (including the complexities of regional differences, development and implementation challenges). The priorities are set out under broad themes, with additional detail in an appendix. Examples where rapid impact or early results are likely to be achieved are highlighted. These are provided as indicative examples where due to a combination of existing knowledge and capacity, as well as institutional support, rapid results are likely.

The priority themes are:

- **Understanding risk creation and perpetuation: systemic, cascading and complex risks;**
- **Addressing inequalities, injustices and marginalisation;**
- **Enable transformative governance and action to reduce risk;**
- **Measurement to help drive progress;**
- **Understanding the implications of new thinking on hazards;**
- **Harness technologies, innovations, data and knowledge for risk reduction;**
- **Foster multi-stakeholder collaboration for solutions to risk challenges;**
- **Support regional and national science and knowledge for policy and action.**

By way of overview, Figure 5-1 illustrates how the themes or research priorities discussed in the following subsections fit together as a whole. Importantly, the themes should not be viewed as mutually exclusive. Each area of research fits with the overall objective of augmenting the global risk science ecosystem to better address the challenges faced due to intensifying global, regional and local risk context.

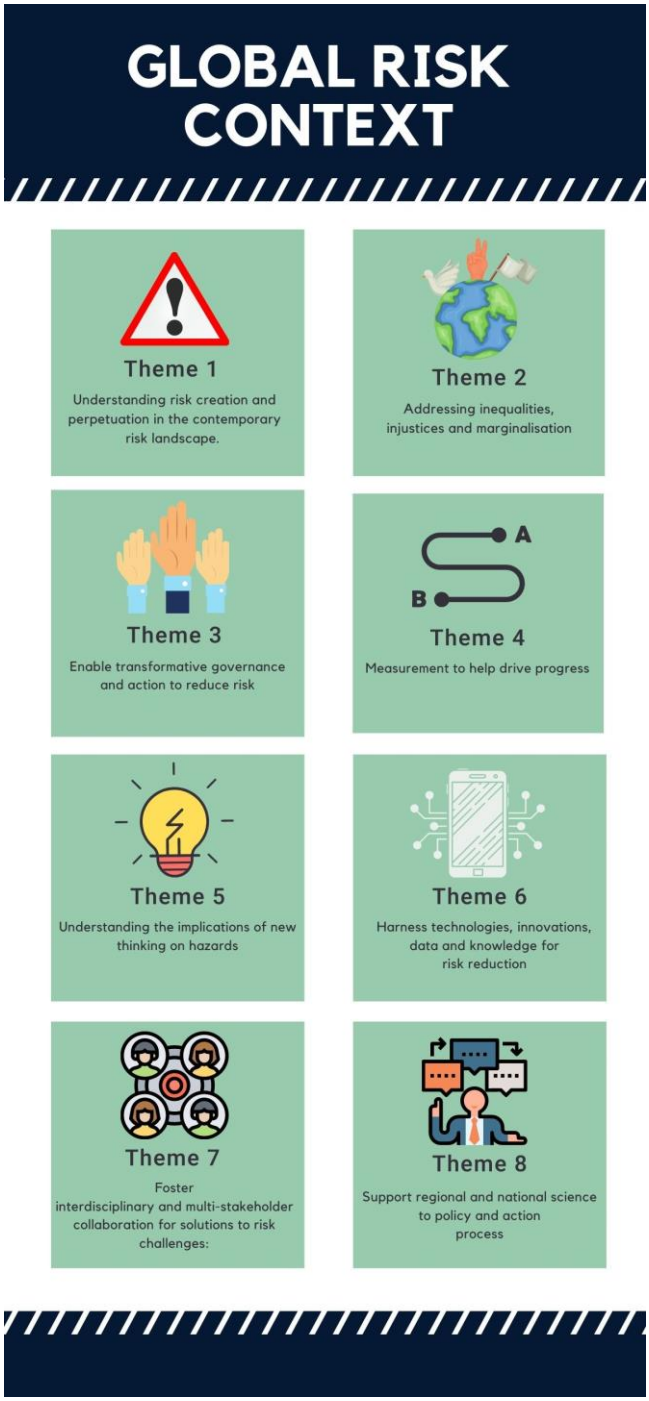

Figure 5-1: An overview of the eight research priority areas

5.1 Theme 1: Understanding risk creation and perpetuation in the contemporary risk landscape: systemic, cascading and complex risks (also see under "Hazards" below).

The rapidly evolving global risk landscape demands better understanding of the complex and systemic risks and bio-physical and social tipping points, and interdependencies that increasingly confront humanity and the planet. Knowledge of these underpins risk reduction action and avoidance of "tipping points" which could lead to sudden increases in vulnerability, through loss of livelihoods, food and water security, among other issues, for large sections of humanity. This

highlights that many aspects of these global risk issues are grounded within the Sustainable Development Goals, which need to take account of disaster risk as well as the transition risks accompanying change to a more sustainable world (ILO, 2015; xx). This is because climate change, disasters and unaddressed inequalities and issues of justice can rapidly undermine development gains and lead to the perpetuation and deepening of poverty and other drivers of risk.

Recommendation 6 of the 2020 Hazards Terminology report supports this priority: "There is an urgent need to investigate further the direct and indirect linkages and effects of natural, biological, technological and other human-induced hazards to identify better and understand cascading and complex hazards and risks in a systematic way. The shift towards a broader view and a more context-dependent definition of hazards requires a systematic approach to risk that considers hazard, vulnerability, exposure and capacity together and better understands their complex interactions..."

Potential rapid impact: how can comprehensive risk assessments, that include systemic impacts and inequalities and vulnerabilities, be undertaken for global and existential threats? What framing and form do such risk assessments need to take?

5.2 Theme 2: Addressing inequalities, injustices and marginalisation

Key to reducing risk is further understanding of the dynamic nature of exposure, vulnerability, resilience and capacities. In particular, how can risk science and knowledge best ensure justice and equity across humanity, and support the inclusion of the most disadvantaged and marginalised people and communities. Included in this conceptualisation of marginalisation is marginalisation of sources of knowledge outside mainstream science, including indigenous knowledge. Consultations emphasised the need to better understand how the concepts of resilience and vulnerability guide practice. Models of resilience should not overlook power asymmetries, and there are multiple states of 'desired' or 'aspired for' resilience across different global contexts. Practice needs to ensure inclusion of the most marginalised as part of ensuring that no one is left behind as set out in the SDGs and Sendai Framework. [https://www.odi.org/sites/odi.org.uk/files/resource-documents/12304.pdf]

At a strategic level, one of the most challenging questions for global risk and the SDGs concerns how to address global inequalities in their many forms? Consideration should be given to alternative approaches to addressing inequalities as proposed for example by Thomas Piketty (2014). Confronting inequities, injustices and rising vulnerabilities through new social and economic systems at different scales from local to global should be examined (Folke et al. 2021, provide a current analysis). Recent OECD reports examine potential alternative economic systems pre and post Covid (OECD 2019; 2020).

Potential rapid impact: how can science support the development and adoption of tools that enable practitioners to robustly justify considering risk, and its distributional impacts, when defining development strategies (for example for poverty reduction and social development and inclusion, or infrastructure).?

It is a fundamental element of DRR and the SDGs that "no-one is left behind", yet many marginalized and less visible people are excluded from risk and vulnerability reduction programs. How can we ensure that the most marginalized are included? One issue is the reliable identification of such groups. Rights based approaches, as used in country reports by the UN Special Rapporteur on Extreme Poverty and Human Rights offer one way forward.

5.3 Theme 3: Enable transformative governance and action to reduce risk

What formal and informal governance arrangements across the public, private and non-profit sectors can promote synergies between the major global agreements to reduce risk and vulnerabilities?

The use of the SDGs for framing risk is under examination in the commercial world, and it offers an opportunity to achieve both conventional risk reduction as well as the normative goals of the SDGs. However, much more may be needed – in many cases regeneration is required beyond sustainability per se. Understanding the role of different actors including mediating actors is key to providing better support for systemic risk governance. A systemic approach to governance will require a move away from institutional and scientific divides that create arbitrary separations for instance between DRM and development.

The rationale to enhancing governance coherence and the interrogation of governance structures across the substantive areas covered by major global agreements offers opportunities to: avoid duplication across complementary research areas, and missed opportunities for trans-disciplinary social reach and capacity development; enable stronger science and knowledge based contribution to the SDGs, Paris Climate Change agreement, New Urban Agenda and other international agreements; and enhanced use of existing coherent networks (i.e. ASEAN; http://www.iai.int) within risk science. Coherence here refers to consistency, synergies and being mutually reinforcing.

Full, or even partial achievement of any one of Sendai, Paris or the SDGs requires achievement of the others. The overarching question is how can science best contribute to this essential integration and critical reflection for risk reduction? Therefore, coherence across the global research network and the identification and examination of what is already known will allow focus on producing the required knowledge. Another approach would see emphasis on informal networking and governance structures, possibly aided by technology.

Potential rapid impact: what is known across science and other sources of knowledge including commerce, about integrative governance and action for DRR, climate change adaptation and the SDGs?

5.4 Theme 4: Measurement to help drive progress

What do we need to measure and how can measurement be designed to incentivise improved risk knowledge and risk reduction?

Recommendation 5 of the Hazards Terminology Report is to

> …"operationalise parameters for exposure, vulnerability and capacity, building on the UNGA definitions. … Much work has been done in defining and standardising parameters for exposure in the context of natural or geophysical hazards, and in defining indicators of vulnerability for disaster risk reduction, but no consensus exists in the definition or application of exposure or vulnerability for use in risk assessment across the list of hazards within the broad scope of this report. …"

There are many indicators for the constituents of risk, but they are subject to many shortcomings. A challenge is to develop indictors or measurement tools that incentivize positive change. There is some existing work in this area: for example the development of indicators to drive risk literacy and awareness, and associated behavioural transformations, at a societal scale https://www.cser.ac.uk/research/science-global-risk/ Measurement is especially an issue in

understanding systemic and complex risks, as well as existential risks, where our knowledge is limited.

Potential rapid impact: how can we best measure progress in addressing Priority Themes 1-3 and 6-7 drawing on current knowledge and experience?

5.5 Theme 5: Understanding the implications of new thinking on hazards.

The ISC/UNDRR 2020 report on Hazards Definition and Classification redefines hazards in the context of DRR, drawing on the Sendai Framework. The redefinition of hazards goes far beyond the traditional hazards of floods, drought, storm fires etc, and extends to most biological, technological, societal hazards including violence, and by extension the hazards that climate adaptation and the SDGs are explicitly intended to avoid or redress. https://council.science/wp-content/uploads/2020/06/UNDRR_Hazard-Report_DIGITAL.pdf The report:

> "was guided by the definition of 'hazard' adopted by the United Nations General Assembly (UNGA) in February 2017; namely, "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation". [Note that in practice some substances were also included.]
>
> "Hazard information when combined with exposure, vulnerability and capacity is fundamental to all aspects of disaster risk management, from multi-hazard risk assessments for prevention and mitigation to warnings and alerts, to disaster response and recovery, long-term planning and public awareness."

Sources of knowledge and experience outside science, such as local and indigenous knowledge, would be especially valuable in many contexts in this priority.

Understanding new forms, or newly common, extreme hazard behaviour: this is related to the need to understand emerging complex and systemic hazards and risks. These are emerging on the traditional DRR suite of hazards, for example, extreme flame behaviour in wildfires, extreme heat and atmospheric changes interacting with other potential hazards; as well as occupational hazards; chemical hazards such as persistent organic pollutants and endocrine disruptors; and economic and livelihood hazards arising from Globalisation, and now from Covid-19.

Understanding interactions with other hazards, vulnerabilities etc. These have typically been seen as fairly linear and obvious, such as extreme heat and wildfires, but can be very complex and potentially systemic as with Covid-19 that highlights the coupled interactions between human/social environment and nature – and this is with respect only to the virus, rather than the impacts of the disease.

Targeted impact-based forecasts and warnings. Improved early warnings, in terms of reliability and lead-time, are desirable for all hazards, and essential for many where warnings are poorly developed. Accurate forecasts of hazard behaviour are the key input for warning messages. Assessment of exposure to the hazard provides information on likely impacts in the areas needing the forecast and warning (e.g: Relief Web, 2021: n.p). [https://reliefweb.int/report/world/climate-adaptation-summit-invest-early-warnings-and-early-action]

> "We need more impact-based forecasting to help bridge the gap between early warning and early action, by warning for not just what the weather will be, but what the weather will

do," … "But to provide good early warning services you need good observations" … "As extreme weather events increase, we must prioritize support to people most exposed and most vulnerable to climate hazards and stresses,"… See also https://www.crews-initiative.org/en This is also a major focus of the Hi-Weather project led by WMO, among other regional and global initiatives.

Potential rapid impact: how to develop and action impact-based warnings drawing on multiple disciplines, agencies as well as the private sector and ecivil society?

5.6 Theme 6: Harness technologies, innovations, data and knowledge for risk reduction

Rapid technological advances in Artificial Intelligence, digitalisation and analytical capacity, among other areas, and the very widespread adoption of mobile devices and social media, are driving major changes in our lives and have the potential to contribute to all aspects of risk reduction and disaster management. They can also create new risks and vulnerabilities. Specific discussion points emphasised on-going technical developments of relevance to DRR as set out below. In addition to our consultations, this section draws on the expertise of the groups at the Fraunhofer Institute and ETH Zurich working on emerging technologies, DRR and the public. [https://css.ethz.ch/en/center/CSS-news/2021/01/trend-analysis-civil-protection-2030.html] It also draws on the expertise of the international Codata group, and AIR at the Chinese Academy of Sciences.

Modelling and technical capacity are currently very limited with respect to global and lower level systemic, cascading and compound risks. Some models such as global climate models and models of the global economy are well resourced and widely used despite many uncertainties. Improved understanding of the emerging global risk landscape is at least partly dependent on better modelling of the underlying processes. Global information and communication technologies can help with risk reduction and the achievement of the SDGs, but they are also leading to other forms of inequality.

- Digitalisation is the defining technological trend of our era. The increased connectivity where everything is being connected to everything else, our dependency, or over-reliance, on such systems including for logistics and retail, and their huge energy requirements, increases social and economic vulnerabilities and creates new systemic risks. These new types of risk affect all stages of DRR and are not well understood.
- Artificial Intelligence (AI), Machine Learning and Natural Language Processing. AI capabilities are expected to develop rapidly and promise greatly enhanced analytical capability. This is especially the case in complex and novel risks.
- Big data and social media, offers the ability to widen the social reach of risk information and to guide engagement at national and international levels to influence social change, as well as humanitarianism. It can greatly expand the scope of inclusion through crowd-sourced data and analysis (Akter & Wamba, 2019) [https://link.springer.com/article/10.1007/s10479-017-2584-2]. Through its capacity to visualize, analyze and predict disasters, big data is changing humanitarian operations and crisis management.
- A fundamental issue concerns the interaction between people and the new technologies: we need to understand what factors impede and what support the technologies in achieving their promise of risk reduction – rather than risk shifting or creation; and how the technologies can be better used to support the SDGs and risk reduction eg through enhanced public engagement (such as UNDP-Oxford-Peoples-Climate-Vote-Results.pdf), and organisation.

Potential rapid impact: what factors impede and what support the technologies in achieving their promise of risk reduction – rather than risk shifting or creation?

5.7 Theme 7: Foster interdisciplinary and multi-stakeholder collaboration for solutions to risk challenges: Bringing actionable knowledge to policy and practice

Researchers and knowledge holders across DRR and risk science frequently observe that there is much in the way of research results and other knowledge which appears useful, actionable, and pertinent to the policy or practice issue in question, yet lies unused [Albris et al 2020; ISC 2020] – well articulated in the European Environment Agency's reports on "Late Lessons from Early Warnings". This issue was raised directly or indirectly in most of our consultations, and affects policy and practice across public, private and non-profit sectors.

However, there are many exceptions where research does inform policy and practice. These include, for example, the ICT sector, reinsurers, aviation safety and in the public domain much of the health sector, surveillance and military equipment. There is also extensive knowledge held by practitioners in the form of experience and practice. Unlike modern science, this knowledge is often poorly documented and therefore less recognised.

Why are research, discussions and policy debates seemingly not influencing change? For a start, knowledge needs to be in actionable form to be useful for the risk reduction task. And the challenge is to develop effective ways of ensuring it informs policy and practice, in an environment of competing personal, institutional and political priorities, and often hostile to science and technical expertise. The transdisciplinary nature of risk science and knowledge, bridging sectors and [stakeholders, actors] may be central to finding solutions.

Potential rapid impact: what are the most effective ways of developing and supporting networks of practice and knowledge to enable exchange and development of ideas and interaction with policy and practitioners? There are many existing international and national networks, however most are weak with integrating research and practice.

5.8 Theme 8: Supporting regional and national science and knowledge for policy and action

[Points listed below come from CG and ERG members. The section is to be completed by CG and ERG members.]

Each region of the world (based on UNDRR or IPCC regions?) is likely to have its own unique concerns and priorities for both disaster risk reduction and global risks. While the Global risk priorities set out above apply in most places, the details, priorities and day-to-day lives of the people will vary. Regions have distinctive mixes of hazards, exposures and vulnerabilities, with their associated interdependencies, capacities and governance structures and trends. They also have their own approaches to, and priorities within, the SDGs and other global agreements, as well as trends in demographics, economies, livelihoods, governments and human security. Capacities here refer to the availability of resources, as well as expertise, trained people and governance. It is also likely that regional priorities are important at the global level, and should be part of a re-appraisal of the existing priorities.

Members of the IRDR community were asked to identify regional concerns where different from the Global priorities already identified. This was seen as a starting point in identifying current key

regional issues and priorities. Some examples follow. Further regional engagement is required.

- *South and Central America* - focused on vulnerabilities;
- *North America* - institutional complexities arising from complexity of vertical and horizonal governance responsibilities;
- *Asia* - Issues of coherence and governance
- *Pacific and other SIDs* - Climate change and justice issues are seen as key: mitigation, retreat, climate evacuation/diaspora. The context is one of small countries with rapid urbanisation, low levels of development and services of all kinds including those related to the SDGs, and low capacities.
- *Africa* – governance, especially for transboundary risks. Large population movements.
- *Europe* – all hazards of significance with climate and industrial hazards dominating. A challenge is the development of models of integrated risk management incorporating justice and equity concerns. The context is one of many very different countries, with the EU providing a coherent overarching body assisting with risk reduction and management.

6. Implementing the Agenda

THIS SECTION OF THE AGENDA IS SET OUT AS A FRAMEWORK. WE ARE SEEKING INPUT IN EACH SECTION, AND ALSO SEEK EXAMPLES ILLUSTRATING DIFFERENT WAYS OF IMPLEMENTING POLICY INTO PRACTICE AND OF ACHIEVING RISK AND VULERABILITY REDUCTION.

This Agenda aims to serve the needs of DRR within the broad context of the Global risk landscape in the leadup to 2030, but needs to be aware that decisions taken in the decade to 2030 will have influence for many years after that date.

Research and knowledge need to be known to and adopted by those in a position to implement the knowledge. The literature is replete with approaches, guides and frameworks for changing policy and practice [for examples see: https://impsciuw.org/implementation-science/research/frameworks/; https://health-policy-systems.biomedcentral.com/articles/10.1186/s12961-015-0005-z]. This section does not intend to list or add to these. An important issue is that many published approaches to a greater or lesser extent assume a so called "rational" rule-bound process where there are clear points for input to policy or changes to practice. In some policy areas, some jurisdictions and some disciplines, processes work like this and follow a more or less predicable pattern. However, funding is almost always an issue and even if rules and procedures are changed to ensure greater sustainability and equity, inadequate resources, lack of compliance and enforcement, other policies working against new rules, all work to undermine change. This occurs even in jurisdictions with reasonable transparency where for example powerful lobby groups and elements in mainstream media can counteract change desirable for reasons of sustainability, DRR or equity. Typically, change has to negotiate elements of power differentials, including market power, various degrees and types of corruption, institutional rigidity, politicians and other leaders devoted to the status quo or to change that reinforces this, as well as personal, organisational and other competing agendas. Uncertainties and scientific disagreements can also lead to delays in implementation, and can be used to undermine otherwise sound programs.

This section first comments on the field of research and practice known as implementation science, and second looks at possible elements of a plan of action for implementing the agenda.

This video from the Centre for the Study of Existential Risk suggests some approaches at the policy

level, and is included here as an example.
https://m.youtube.com/watch?v=kaGDMeMR0cc

6.1 Implementation science:

Implementation science concerns (Bauer M and Kirchner J. (2020):

> "the methods and strategies to promote the uptake of effective interventions into practice, programs and policies. The discipline comes from the long realisation that the apparent effectiveness and attractiveness of change does not by itself ensure implementation. Implementation depends on a wide range of contextual, incidental and deliberate barriers and support."

[See also Chapter 4 in the 2021 UN Covid Recovery Framework. https://www.un.org/en/pdfs/UNCOVID19ResearchRoadmap.pdf]

Depending on the issue at hand, data infrastructure is increasingly seen as central to the implementation and monitoring of policy. The infrastructure includes the organizational structures, systems and technologies involved in all aspects of data collection, protection and use. Such infrastructure can help integrate and make accessible ideas and information form diverse sources. This would assist risk science, as it is inherently an integrating domain that draws from, and contributes to, a wide range of disciples, forms of knowledge and professions.

An issue in much implementation is the ned to adjust and adapt as implementation proceeds. Rapid learning systems use the best available evidence and local data to inform decisions and commit to learn from their experiences as quickly as possible so as to enable continuous improvements and to contribute to the global evidence base.

> "to rethink how to address the present need for more knowledge in disaster risk reduction constructively—as one thing seems certain: we will not need less knowledge going forward" (Albris, Lauta and Raju, 2020: pp. 10).

The precautionary principle

The precautionary principle (or precautionary approach) is a broad epistemological approach to change and innovations with potential for causing harm when extensive scientific knowledge is lacking. The principle emphasises caution, pausing and review before implementing innovations that may prove disastrous. As such, the precautionary principle is of practical relevance as much to risk assessment as to risk management.

Precaution calls for deliberate and comprehensive attention to contending policy or technology pathways (Stirling, 2007). Far from being in tension with science, precaution offers a way to be more measured and rational about uncertainty and ambiguity, acknowledging that attempts to assert a single aggregated picture of risk are neither rational nor 'science-based'.

6.2 An action plan for Implementing the Agenda

[How can groups and organisations help with implementation and what can this Agenda do for them?]

Networks and communities of practice:

One of this Agenda's research priorities concerns the need for interdisciplinary knowledge including experience, working with those in policy and practice. This would include a wide range of existing

networks, for example, among many others, those hosted by the ISC, UNDRR, GAR, IPCC, Future Earth, GAUDRI, IRDR, La Red, Periperi U, private sector and non-profits. There are also many faith-based networks active in disaster risk reduction and supporting affected people – the international connections of such groups can be particularly effective in mobilising support and expertise. There are some connections across these groups, but they need strengthening and linking with networks of practice and policy. Often these are in the form of professional associations for all types of work and interests, local government groupings and higher level inter-governmental forums. [please add specific examples]

There are incentives for these existing networks and hopefully new networks and communities of practice to take an active role in promoting and implementing the agenda. The main incentive is to reduce the chance that disasters will affect the people and communities, their livelihoods and businesses. An incentive would also be to lessen the impact of disasters on the security of food, water and supply chains. Another incentive for some groups is to develop positions on common interests as a step in influencing policy and practice. [The indigenous caucus organised as part of the development of this Agenda is an example of *that could continue as a higher level international/transnational policy discussion on disaster risk.*]

This Agenda aims to contribute and complement other Global science processes and activities; is focused on 2030 in line with the UN Agenda for 2030, and beyond; and needs to develop a range of collaborative implementation approaches with [stakeholders, actors] in industry, finance, health and other sectors to ensure relevance and uptake of research progress and possible solutions by society and in the mechanisms of risk governance, policy and decision making.

Acknowledging transition risk

The concept of "just transitions" comes from concern that those employed in some sectors will lose their livelihoods as economies are decarbonised. Major restructuring has happened many times in history with examples including automation or mechanisation of the British coal mining, agricultural sector, and much manufacturing. https://www.wri.org/climate/expert-perspective/toward-just-transition Many affected in this way historically have not found new comparable employment. However, the immediate severe disruption to most national economies and many economic sectors by Covid-19 provides good examples of rapid adjustment by government, commerce and civil society. One limitation of these good examples from Covid-19 is that changes are generally seen as temporary, whereas permanent shifts are required to bring economies into line with climate change adaptation and decarbonisation, and to implement the SDGs. Unfortunately, there are also many cases where authoritarian power has been extended and basic rights as set out in the SDGs ignored or reduced under cover of the Covid-19 pandemic.

BOX - Some definitions:

Just Transition is a vision-led, unifying and place-based set of principles, processes, and practices that build economic and political power to shift from an extractive economy to a regenerative economy. This means approaching production and consumption cycles holistically and waste-free.

"A just transition for all towards an environmentally sustainable economy … needs to be well managed and contribute to the goals of decent work for all, social inclusion and the eradication of poverty." Guidelines for a just transition towards environmentally sustainable economies and societies for all" International Labor Organization (2015) A Short History of Just Transition. https://www.oecd.org/environment/cc/g20-climate/collapsecontents/Just-Transition-Centre-report-just-transition.pdf

"Transition risks arise as a result of climate policies, technological developments and changes in preferences and behaviours that contribute to a transition to a low-carbon economy and society." IRGC (2021). Risk governance and the low-carbon transition.pdf.

The need for actionable knowledge

Refocusing and augmenting the existing risk science ecosystem so that new and pre-existing knowledge is available in forms that are actionable, is a key priority in implementing this agenda. This means supporting progress towards enhanced integration between science and other sources of knowledge, with communities of practice and policy. The aim being to improve the accessibility and inclusion of risk science at the forefront of wider discussions beyond the DRR realm, including societal risk, sustainability and development.

This means working with those expected to implement the agenda, at whatever level from international organisations through to communities and households. Extending the ethos that grounds this Agenda, this means a greater emphasis on co-production of knowledge with [stakeholders, actors] and a deepening or relationships between the science community and wider knowledge and implementation communities. This approach will ensure [stakeholders, actors] have ownership and see the risk-based knowledge developed by diverse processes of co-production as their own, as useable and informative, and hence it should be better implemented.

Overall, the success of this agenda will rely on the relationships built during the process of design and implementation and the buy-in achieved and invested in across disciplines and sectors.

[input required – are their other approaches to achieving actionable knowledge?]

Funders/donors are a critical part of this process

[See also Chapter 4 of the 2021 UN Report on Covid-19 recovery research discusses this issue under "Science of science".]

Implementation of the priority areas requires funding. Funders and donors are part of the development process of the agenda research priorities, to encourage investment in the identified areas.

Ideally, research funding would contain incentives to help promote the aims of the agenda, DRR, climate change adaptation and the SDGs: this would mean funding and research that is more inclusive and more focused on practical impacts. The best way to achieve these aims is itself a research question. Some major funders of research provide at best limited support for the type of applied work called for in this agenda science. For example in the United States, the National Science Foundation prefers to fund less applied work, even on transformation. Other sources of funding exist from the various agencies but their research programs are relatively small. [Input on gaps/limitations in current funding and funding mechanisms, especially outside of major events.]

7. Adaptability: maintaining relevance

The Global risk landscape is very dynamic in terms of both anticipated risk such as climate change, and surprises like Covid-19. The new global risk science research agenda needs to remain relevant as needs and priorities shift: it needs to be adaptable and flexible. This will require a process for regular monitoring of the global risk landscape, and review and updating as needed of the Agenda. Evolving priorities need to be seen as desirable in a highly uncertain environment and necessary to

ensure the currency of the Agenda. Change in these circumstances is in no way a criticism of the original Agenda, rather it is an acknowledgement that it is designed to evolve. To do this we need to better identity knowledge needs and gaps, and build in the flexibility to address new priorities as they emerge. This also indicates a need for a mechanism for renewal and updating of priorities to ensure that priorities written in 2021 are not static and redundant by 2030.

Glossary

Abbreviations and Acronyms	Definition
AAAA	Addis-Ababa Action Agenda
Agenda for Humanity	Annex to the Report of the Secretary-General for the World Humanitarian Summit (2 February 2016)
AI	Artificial Intelligence
ASEAN	Association of Southeast Asian Nations
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
Ex-ante	Before a disaster event
Ex-post	After a disaster event
GAR	Global Assessment Report on Disaster Risk Reduction
ICoEs	International Centers of Excellence
IoT	Internet of Things

IPCC	Intergovernmental Panel on Climate Change
IRDR	Integrated Research on Disaster Risk
IRDR ED	Integrated Research on Disaster Risk: Education
IRDR SC	Integrated Research on Disaster Risk: Scientific Committee
IRDR Science Plan	A Science Plan for Integrated Research on Disaster Risk
ISC	International Science Council
NCs	National Committees
The New Urban Agenda	
The Paris Agreement	The Paris Agreement on Climate Change
Post-2020 Global Biodiversity Framework	Convention on Biodiversity Post-2020 Global Biodiversity Framework
PPMW systems.	Public Participatory Monitoring and Warning systems.
STAGs	Science and Technology Advisory Groups

SDGs	Sustainable Development Goals
Sendai Agreement	Sendai Framework for Disaster Risk Reduction (2015 – 2030)
UN	United Nations
UNDRR	United Nations Office fro Disaster Risk Reduction
WEF	World Economic Forum
2021 Horizon Europe	Horizon Europe Strategic Plan (2021-2024)

921

References and sources

[References for work cited in the literature reviews are found in the relevant appendices]

Akter, S., & Wamba, S.F. (2019) Big data and disaster management: a systematic review and agenda for future research. Ann Oper Res 283, 939–959. https://doi.org/10.1007/s10479-017-2584-2

Albris, K., Lauta, K. C., & Raju, E. (2020). Disaster Knowledge Gaps: Exploring the Interface Between Science and Policy for Disaster Risk Reduction in Europe. International Journal of Disaster Risk Science, 11(1), 1–12. https://doi.org/10.1007/s13753-020-00250-5

Bauer M and Kirchner J (2020) Implementation science: what is it and why should I care. Psychiatry Research. Vol 283, January 2020, 112376.

CREWS (2021) Climate Risk & Early Warning Systems. https://www.crews-initiative.org/en

CSER. Centre for the study of Existential Risk, University of Caimbridge. https://www.cser.ac.uk/research/science-global-risk/

Cuny, F. C. (1983) Disasters and Development. Oxford University Press

Eriksen et al, (2020) Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance?

ETH Zurich (2021) https://css.ethz.ch/en/center/CSS-news/2021/01/trend-analysis-civil-protection-2030.html

Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Scheffer, M., Österblom, H, Carpenter, S. Chapin III, R., F. S., Seto, K. C., Weber, E. U., Crona, B. I., Daily, G.C., Dasgupta, P., Gaffney, O., Gordon, L. J., Hoff, H., Levin, S. A., Lubchenco, J., Steffen, W & Walker, B. H. (2021). Our future in the Anthropocene biosphere. Ambio, 50: 834 – 869. https://doi.org/10.1007/s13280-021-01544-8

GAR (2019) Global Assessment Report on Disaster Risk Reduction. https://gar.undrr.org/report-2019

IAI ( ). Source: http://www.iai.int

ILO (2015; 2017) Internatonal Labour Organisation, Labour Standards. Source: https://www.ilo.org/global/standards/lang--en/index.htm

ISC (2019) Rethinking Human Development (Action Plan 2019 – 2021). Source: https://council.science/actionplan/human-development/).

Keys, P. W., Galaz, V., Dyer, M., Matthews, N., Folke, C., Nyström, M., & Cornell, S. E. (2019). Anthropocene risk. Nature Sustainability, 2(8), 667–673. https://doi.org/10.1038/s41893-019-0327-x

OECD 2019; 2020

Piketty, T. (2014) Capital in the Twenty-First Century. London: Harvard University Press.

ReliefWeb (2021) Source: https://reliefweb.int/report/world/climate-adaptation-summit-invest-early-warnings-and-early-action

SRSG

Steffen, W., W. Broadgate, L. Deutsch, O. Gaffney, C. Ludwig. 2015. The trajectory of the Anthropocene: The great acceleration. The Anthropocene Review 2: 81–98.

UNDP (2021) The Peoples' Climate Vote, 26 January 2021. https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/The-Peoples-Climate-Vote-Results.html (accessed date / time).

UNDRR (2020) Hazard definition and classification review (Technical Report). Source: https://council.science/wp-content/uploads/2020/06/UNDRR_Hazard-Report_DIGITAL.pdf

UN Development Report (2020) XXXX

UNPRI (Principles for Responsible Investment) (2017) Sustainable Development Goals. Micro risks: A risk framework. The SDG Investment Case, 13 October 2017, at https://www.unpri.org/sustainable-development-goals/the-sdgs-as-a-risk-framework/308.article

WEF (2021) The Global Risks Report 2021 16th Edition, http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf

Appendices

[see separate document]

[The appendices are under development]

List of Appendices

Appendix 1.0: **Agenda Consultation and Development Process (as of April 2021)**

Appendix 2.0: **Members of the Leadership, Core and Expert Review Groups**

Appendix 3.0: **Global Risk Science Landscape Overview.**

Appendix 4.0: **Summary of key concepts, framings and emerging gaps from the literature review.**

Appendix 5.0: **Details of research priority areas from Section 5.**

Appendix 6.0: **The IRDR 2008 Science Plan summary**