

Post-Foresight agenda: Disaster Risk Reduction Research Prioritisation Exercise

Workshop Report 11 February 2013

1. Introduction

In 2012, two key reports were published by the Government Office for Science which looked at the role of science in disaster risk reduction (DRR). The first of these reports, the 'Use of Science in Humanitarian Emergencies and Disasters' (SHED) report, primarily looked at how Government could improve its use of science advice in predicting and preparing for disasters. The second report on 'Reducing Risks of Future Disasters: Priorities for Decision Makers' looked 20-30 years ahead to examine the future causes and impacts of disasters.

Following the publication of these reports, the Government Office for Science requested that the UK Collaborative on Development Sciences (UKCDS) undertake an exercise to detail and prioritise research gaps that constitute barriers to DRR delivery with the aim of developing a multi-partner, cross-disciplinary DRR research programme.

In part, this activity attempts to address a recommendation from the SHED report, which proposed that 'the Department for International Development (DFID), UK Research Councils and other UK funders of science should further strengthen and improve cross disciplinary working to establish a more effective approach towards engagement between researchers and research users, both in the UK and internationally'.

This report outlines a series of thematic areas where research gaps were identified during a workshop hosted by UKCDS on 11 February.

UKCDS is a group of 14 UK government departments and research funders working in international development

A small coordinating team (the Secretariat) brings this group together with researchers and other key organisations to share knowledge and identify opportunities for collaboration. By stimulating collaboration, UKCDS ensures the best science is funded and used to benefit international development, as well as the UK.

2. Methodology

This workshop sought to begin an exercise that would initially challenge and then take forward the findings of the Foresight report, 'Reducing the Risk of Future Disasters'; with a longer-term objective of establishing a series of possible research priorities for future investment.

The task set at this workshop was to undertake a review of the grey literature (Annex 1) that contributed to the Foresight report, focusing specifically on the suggested research needs and gaps relevant to enhancing the understanding of and improving resilience to disaster events. Prior to the workshop participants (see Annex 2) were assigned reports to review. The findings from this process, along with the research needs identified through the BOND Disaster Risk Reduction Group, were fed back through a structured discussion at the workshop and captured by a rapporteur. The second part of the workshop focused on clustering the research needs and gaps identified based on relatedness; each cluster was then assigned a title that described the quality or characteristic common to all research needs or gaps within a particular cluster.

Following the workshop, desk-based analysis was undertaken to identify and collate the research gaps and needs identified in the supporting papers commissioned by Foresight, which provided the evidence base for 'Reducing the Risk of Future Disasters'. The findings from this process were added to those from the workshop and the clustering exercise was repeated. The key themes discussed in the subsequent section of paper represent clusters identified through combining the findings of workshop and the desk based analysis.

A comprehensive list of all the reports that were reviewed can be found in Annex 1.

3. Findings

Key Themes¹:

3.1. Risk Assessment

Evidence-based DRR interventions should be underpinned by a robust and rigorous assessment(s) of risk to natural hazards. However, more needs to be done to maximise the utility of scientific knowledge and tools in risk assessment. Characterising the outputs from hazard forecasts in terms of their relevance to key impact variables would be one such development. Likewise, methodologies to integrate multi-hazard forecasts with key socio-economic drivers of vulnerability and exposure would help to interpret and calibrate risk accumulation at different geographical contexts and temporal scales.

Risk assessment methodologies also need to be scrutinised if risk-sensitive decision-making is to be sustainably embedded across multiple institutional levels. More work is required to develop 'good enough' methodologies that ensure scientific rigour but can be used when financial resources and technical capacity are constrained. Equally useful would be the development of minimum risk assessment standards that can provide safe-guards against the provision to weak or inaccurate evidence to inform decision-making.

¹ Note, numbering indicates where themes are closely related.

Suggested risk assessment research priorities:

Highest priority

- i. *Advance the understanding of the natural and human processes that generate hazards with a focus on specific geographical regions.*
- ii. *Develop robust methodologies for forward looking, multi-hazard risk assessments. This could include consideration of the connectivity between different hazards, demographic change, urbanisation, exposure, vulnerability and capacity.*
- iii. *Develop robust methodologies that provide good-enough risk assessments which ensure scientific rigour but can be delivered across a range of resource and capacity contexts.*
- iv. Develop approaches to integrate hazard science with other key socio-economic drivers of risk (e.g. those addressing poverty and a lack of good governance) and capacity (e.g. learning practices, information access, flexibility and support for resilient development).
- v. Develop techniques and/or approaches to link meteorological forecast variables (rain, temperature, wind strength) to user-relevant impact variables (malaria incidence, crop yield, river discharge, property damage) and intervening governance variables (that can help explain why certain development contexts are more or less susceptible to strong/weak linkages between meteorological and impact variables).
- vi. Develop improved and robust approaches and systems to validate risk models and mapping, including the integration of decision-making and information access systems into analysis.
- vii. Enhance the understanding of the impact of natural hazards on death, displacement, disability (physiological and psychological), disease and well-being at global and community levels.
- viii. Develop systems analyses of hazard events and impacts through interdisciplinary research over multiple timescales².
- ix. Analyse the links between economic development paradigms and models, and risk trajectories³.

² A suggested approach was to focus on thresholds that can signify interaction points between hazard types. This would help better understand multiple hazard dynamics over multiple timescales and the interaction between natural and human/technological hazards.

³ For example, highlighting how far the macro-economic growth assumptions of contemporary development prefigure risk and loss. This could require a mixed-methods political-economy or institutional economics approach.

- x. Analyse how scales interact to reduce or amplify risk and how this changes depending on context.

3.1.1. Vulnerability

Already recognised in development research, investigations into vulnerability require robust approaches to understand its many aspects and contributing factors. Establishing appropriate methodologies to quantify and embed vulnerability within forward-looking, multi-hazard risk assessments is, and will become, increasingly important. Such assessments will also need to be sensitive to changes in, for example, urbanisation, demography, economic growth and climate change; as well as how such changes will impact on the acute and chronic vulnerability of high-risk individuals and groups.

Developing approaches to systematically address and/or reduce vulnerability is challenging. To alleviate many of the core drivers that lead to sustained vulnerability of certain groups would require powerful actors to relinquish or forego privileges that in turn may undermine their authority. Therefore, identification and analysis of cases where deep-rooted vulnerability has been partly or comprehensively addressed, and the socio-economic and politic circumstances that contributed to this, could be hugely beneficial.

Suggested vulnerability research priorities:

Highest priority

- i. *Develop vulnerability functions and/or analytical tools that can better describe local conditions while also interacting with regional and global hazard modelling.*
- ii. *Identify and analyse cases where disaster management interventions can facilitate resilient and/or transformational development including technological, social and institutional-political change.*
- iii. Improve understanding of how cultural values relate to vulnerability and resilience⁴.
- iv. Develop a step-by-step guide to aid the diagnosis of mental health illness during and following a disaster event to help build the evidence base around the mental health impacts of disasters.
- v. Improve understanding of the interventions that have tackled the causes of deep-rooted and/or underlying vulnerability over various spatial and temporal scales.

⁴ This may include better understanding of the role of emotions, the relative positioning of values and behaviour in determining action, and the influence of knowledge and science on these questions. Sites for research range from the individual to collectives (including the household, family, community, businesses, government, private sector and charitable organisations) with local, national or international reach.

- vi. Improve understanding of the links between disability and/or social difference and disasters.
- vii. Increase understanding of the links between disasters and the drivers of vulnerability⁵.

3.1.2. ***Economic and Non-Economic Loss and Damage of Disasters***

To effectively develop and implement measures to mitigate against the consequences of natural hazards, and limit disaster severity, requires an understanding of their potential impacts over various timescales. Recording economic and non-economic loss and damage associated with past disasters is crucial to this exercise, however, in many countries data of this kind is either incomplete, inaccurate or does not exist. As a minimum standard, developing a framework to record disaster losses coupled with efforts to improve the capacity of local stakeholders to accurately catalogue disaster losses is required.

Whilst historical disaster loss data will provide a useful baseline against which potential future losses might be approximated, the utility of this information is also limited as it represents losses which are both temporally specific and relevant to a particular set of socio-economic and environmental conditions. The ability to forecast potential losses from hazard events that are sensitive to changing exposure and vulnerability as well as hazard magnitude, is vital. Accurate forecasting of medium and longer term loss and damage of disasters will require an understanding of, for example, economic interdependencies at various scales; the fiscal consequences (in terms of public investment decisions) and how these relate to future disaster risk; and the indirect losses and secondary effects, and their evolution over time.

Characterising the costs saved from interventions, the counterfactual, through greater utilisation of appropriate cost/benefit approaches could also provide incentives for decision-makers to implement timely DRR measures.

Suggested economic and non-economic loss and damage of disasters research priorities:

Highest priority

- i. *Identify and analyse the causal agents⁶ of economic and non-economic loss, damage and incidences of injuries from disasters.*
- ii. *Analyse the successes and failures of actions to mitigate loss and damage from disasters.*
- iii. Develop a more comprehensive understanding of the link between disasters and indirect losses and secondary effects, including their evolution over space and time and the effect of intervening economic variables.

⁵ For example, forced displacement, migration, livelihood loss, etc.

⁶ These could derive from hazard, vulnerability and/or exposure.

- iv. Analyse and characterise economic dependencies at different scales to better understand the impact of disasters across space and sector.
- v. Analyse and/or enhance methodologies to determine the attribution for economic and non-economic disaster losses.

3.2. Governance

Good governance is an essential precursor to functional, effective and inclusive institutions at regional, national and local levels. It therefore follows that efforts to promote DRR in fragile and conflict affected states and sub-state contexts, including cities, is often undermined by poor governance delivered through weak and dysfunctional institutions. In such circumstances promoting accountability, transparency and capacity within national and local institutions is clearly vital. Identifying, analysing and drawing out lessons learnt from nations which have recently made the transition to socially responsive and accountable institutions would provide a useful knowledge base from which to initiate this activity. Complementary efforts to identify alternative, non-conventional governance models that build on the strength of communities and cultures could also be explored. Greater understanding of the level of external support required to assist and, crucially, empower communities to manage and share risk within different contexts is needed. Likewise, evidence to determine the transferability and potential scale-up opportunities presented by alternative governance models could lead to the realisation of more substantial impacts.

Suggested governance research priorities:

Highest priority

- i. *Analyse the lessons from historical surprises that have occurred during or after a natural hazard and how these have shaped institutional delivery of response, recovery and subsequent development trajectories.*
- ii. Develop understanding of progressive, flexible and inclusive risk management frameworks, which are able to learn and respond to changing information and the externalities of development.
- iii. Identifying potential alternative governance models or spaces to promote DRR when conventional institutional capacity is limited.
- iv. Investigate the institutional fit of existing DRR institutions at all scales, and assess their suitability under a range of future scenarios including climate and global economic change.

3.2.1. Accountability

In general, it has been shown that accountable governments are more likely to implement DRR measures. Therefore, developing approaches to ensure national and/or local governments are held accountable for not implementing measures to reduce disaster risk should incentivise and enhance their proliferation. The development of robust and transparent methodologies to determine attribution for disaster loss and damage could, therefore, encourage greater prevention and preparedness by governments and the private sector. However, determining attribution for disaster losses is both challenging and politically sensitive; consequently, establishing ethically sound and politically tractable accountability frameworks will be crucial to this endeavour. Another effective approach could be the enforcement of regular monitoring of disaster risk reduction interventions. This could be conducted by disaster risk managers, including international actors, and overseen by an independent regulator, against an agreed set of quality standards. The resulting intervention inventory could be assessed post-disaster as a means of scrutinising government efforts to reduce disaster risk.

Suggested accountability research priorities:

Highest priority

- i. *Analyse the barriers to developing rights-based/social justice approaches that make governments accountable for not putting in place and implementing interventions that encourage prevention, preparedness, and equitable response and recovery.*
- ii. Investigate opportunities to develop and implement frameworks for shared responsibility amongst the state and private sector for risk generated by development decisions and actions⁷.
- iii. Analyse the economic, political and cultural factors that allow ethical considerations focused on people-centred DRR preparedness to surface across a range of political-economies.

⁷ For example, in the placing of industrial or residential zones.

Cross-cutting themes

3.3. Resilience and Transformation⁸

Resilience, and more recently transformation, have received significant traction within development and DRR discourse. However, research is needed to understand both the political and practical utility of these concepts. For the latter, characterisation of the form and function of resilient and/or transformative interventions (including financial, technological, capacity-building, partnership-building, policy frameworks, etc.), along with the implementation of approaches to monitor longer term outcomes, is needed. Exploring the political importance of resilience and transformation will be determined by whether these are concepts that connect with national and local governments, NGOs and the private sector; as well as encouraging joined-up approaches at manage disaster risk across institutional scales, policy mandates and sectoral interests, and socially progressive or conservative development agendas.

Suggested resilience and transformation research priorities:

Highest priority

- i. *Identify the characteristics that define resilient and/or transformative socio-economic development at local and national scales.*
- ii. Analyse whether specific DRR interventions can systemically improve resilience and/or promote transformation.
- iii. Analyse the interpretation and integration of resilience or transformation approaches into risk reduction interventions, organisational imperatives (current and planned), and economic and political norms⁹.
- iv. Analyse how the concept of resilience and/or transformation is being adopted and applied by practitioners, managers, community leaders and policy makers in disaster risk management, and how this relates to subsequent DRR effectiveness (both positive and negative).
- v. Analyse current financial mechanisms (e.g. savings, loans, micro-insurance) to support DRR and community resilience and transformation and suggest means by they could be improved, including novel approaches to enhance the uptake of products.

⁸ Whilst there is not unanimous agreement over the definition of this term, for the purposes of this report it is assumed at transformation is a radical approach or end-point that deliberately challenges the underlying causes of vulnerability, including a process of critical reflection on the values and power structures that underpin risk management.

⁹ This could include consideration of the impact of resilient/ transformative approaches to efficiency, equity and accountability.

- vi. Characterise the organisational change process needed at the practitioner, agency and policy level to promote resilience and transformation in practice.
- vii. Analyse how mental health influences the resilience, capacity and vulnerability of individuals, families and communities across social contexts.

3.4. Communication

Communicating information across and between administrative scales is fundamental to effective disaster preparedness, response and recovery. Despite its importance communication between stakeholders and organisations is frequently sub-optimal, particularly during a disaster event. This can be the case in extreme events where multiple actors override organisational oversight, as well as in extensive risk and everyday events that fall below the radar of all but very local organisations. What is more, risk communication influences, and is influenced by, societal and institutional risk perception, which can result in both positive and negative actions in relation to DRR. To develop compensatory, restorative interventions understanding the drivers of fragmented intra- and inter-institutional communication behaviours and outcomes is needed.

Scientific advice should have a significant role to play in promoting risk based, resilience focused decision-making; however, it often fails to inform the actions of key stakeholders. Mechanisms are needed that facilitate sustained multi-directional communication and trust building, along with the development of novel approaches that can convey uncertain information with transparency and resonance. Establishing how communities and decision-makers interact with, absorb and manipulate scientific information and set scientific agendas will help inform initiatives to promote knowledge exchange. It will also help in building a comprehensive understanding of the barriers to communication.

Suggested communication research priorities:

Highest priority

- i. *Develop strategies to communicate forecasts to the public which translate into action from risk reduction to mitigation and evacuation.*
- ii. *Develop novel communication or presentational approaches that maximise the impact of risk maps or other risk communication tools.*
- iii. *Analyse how communities, organisations and governments interact with, absorb and alter science and how it influence decision-making associated with risk, resilience and transformation.*

- iv. Analyse the co-production of knowledge between science, communities at risk and intermediary translation organisations¹⁰ within different contexts, and subsequent outcomes for risk reduction and response behaviour.
- v. Analyse the ethical challenges for scientists, governments, communities, intermediary organisations and private actors associated with the co-production of knowledge and its relationship with risk and resilience.

3.5. Technology

Development and implementation of existing and new technologies has the ability to provide a step-change in the understanding, response and resilience to disasters. The expansion in ownership of mobile communications and internet use globally, but particularly in the developing world, presents significant opportunities to both researchers, disaster risk managers and decision-makers seeking to improve resilience. Mobile networks and/or the internet offer a platform to crowd-source real-time information on, for example, characterising and validating hazard impacts (primary, secondary and tertiary) and incidence (e.g. through digital syndromic surveillance); effectiveness of the emergency response; and provide greater resolution to data on exposure and the drivers of risk through coupling with remote sensing and population mapping and monitoring.

However, to enhance the utility of the resulting information, technical developments are needed that can allow heterogeneous data-sets to be combined, as well as improvements in the overall accuracy of the data. Also required is greater understanding, through technical and behavioural studies, of how mobile technology can contribute to the coordination of emergency interventions through targeted messaging and building community resilience (e.g. through improving the uptake of pro-poor insurance products).

Greater investment and/or approaches to enhance super-computing capacity is also needed. Accessibility to, and greater investment in, high-performance super-computing is essential to efforts to reduce uncertainty and improve the accuracy of hydro-meteorological forecasts and catastrophic loss models. Exploring novel approaches - such as partnership mechanisms, 'plug and play' applications and model inter-operability - to capitalise on super-computing capacity that resides internationally may provide a cost-effective alternative to concentrating solely on the development of national capacity.

¹⁰ For example, extension workers or development and humanitarian NGOs.

Suggested technology research priorities:

Highest priority

- i. *Develop approaches to apply emerging science and technology to help close the gaps in the understanding of current vulnerability, exposure and hazards and the drivers of risk.*
- ii. Develop novel and cost-effective diagnostic tools for pathogen detection.
- iii. Develop new tools of analysis that can extract useful signals from crowd sourced or biosensor generated datasets.
- iv. Analyse the social and political contexts within which novel technology is developed and applied¹¹.
- v. Develop machine learning-based engines for combining heterogeneous data sources, in addition to physical-based modelling efforts.

3.6. Urbanisation

Over the next four decades, urban populations in Africa and Asia are expected to treble and double respectively. As result, by 2050 most of the global urban population will be concentrated in Asia (53%) and Africa (20%). Levels are urbanisation are also likely to increase across all developing regions during this period. This is likely to have profound effects on exposure and vulnerability to natural hazards due, for example, to the enhanced concentration of financial assets, the proliferation of informal/peri-urban settlements and the accelerated investment in construction. However, systematic evidence-based assessments to identify which cities are hotspots for acutely elevated disaster risk and how this could change over time is currently lacking. The relationship between urbanisation and slow- and rapid-onset hazards and how these will affect risk also need to be coherently built into such assessments.

Concurrent to the assessment of risk is the need to understand what characteristics and interventions infer resilient urban environments and communities – this will need to consider a range of issues ranging from governance approaches, building regulations, critical infrastructure, emergency response planning, social cohesion, etc. Developing approaches to identify these critical factors at multiple scales will be crucial to understanding urban resilience.

¹¹ For example, exploring how the use of technology influences how disaster events unfold; the recording of vulnerability and resilience building capacity; accountability and policy making/ policy response. Also, the negative consequences of technology use or manipulation resulting in policy bias and/or distortion.

Suggested urbanisation research priorities:

Highest priority

- i. *Analyse how changing urban form, function and size¹² are affecting the production and reception of disaster risk locally, and across connected urban systems and into rural hinterlands from megacities to small urban centres.*
- ii. Identify and analyse the features and interventions that enable resilient urban development and how these interventions interact across sector and scale.
- iii. Analyse how climate change risks impact on cities¹³.
- iv. Analyse the socio-economic and political contexts that determine protocols for integrating disaster risk management into development planning, and the impacts of these protocols on risk management.
- v. Identify and analyse the determinants for the performance of disaster risk management in an urban context.
- vi. Identify the determinants of critical infrastructure, including housing, and the guidelines necessary to maintain it.
- vii. Analyse the social contexts that determine the generation and implementation of risk management, including legislation.
- viii. Develop innovative and functional multi-purpose infrastructure to promote DRR.

3.7. Data Collection and Sharing

The on-going development of high quality, open source datasets presents a key opportunity to improve the ability of science to anticipate natural hazards events and their subsequent impacts. Likewise, incomplete and patchy datasets and/or data sharing restrictions substantially limit the utility of hazard science and risk information to inform resilience-focused decision-making. To ensure that data relevant to risk (hazard, exposure and vulnerability) and hazard impacts are comparable requires the establishment of universal standards for data collection and sharing, which consider technical (e.g. input data parameters) and methodological (e.g. good practice guidelines) aspects. However data, particularly relating to local loss and vulnerability in developing regions, remains sparse. Combining data sourced from satellite technology, on-the-ground observations, and crowd-sourced information could help enhance data coverage though data integration techniques need to be improved.

¹² Including demographic change, land-use, peripheral expansion, deeper rural-urban networking and globalisation

¹³ Including natural science and social contexts, and impacts on risk management.

As disasters are fundamentally local events, such efforts need to be complemented by improvements in community-based data collection, sharing and capacity, and the implementation of measures to ensure that it is sustained and institutionalised. Data is also needed to establish appropriate hazard, vulnerability and exposure baselines against which changes overtime can be measured and evaluated to promote appropriate interventions to mitigate disaster risk.

Inventions to support improved DRR datasets:

- i. Development and exploitation of new monitoring technologies that can function alongside existing approaches to gather fundamental field and laboratory data to collectively optimise monitoring efforts.
- ii. Improving geophysical and social data baselines and collection in high risk countries.
- iii. The creation of capable platforms to support and facilitate community-based efforts to collect and share hazard, vulnerability and loss data.
- iv. Build better records of baseline hazard and vulnerability data.
- v. Improving the spatial resolution of sub-national data for risk mapping and in particular its vulnerability and resilience components.
- vi. Improving the supply and use of information and earth observations to reduce risks and build resilience, improving information-sharing systems and information standards.
- vii. Improving public access to disparate data-sets (e.g. topography, transport networks, human health and natural hazard risk zones) to enhance the ability of communities to predict and build resilience to hazard events and disasters.
- viii. Monitoring and evaluation over longer-term reconstruction and recovery.

Annex 1: Documents and reports reviewed

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Annex 3: Comprehensive list of research questions arising from this analysis

Risk assessment

Can the rate of development of institutions be characterised in relation to development in assets, prosperity and urbanisation in rapidly developing countries?

What implications do differential growth rates have on risk accumulation?

How do the perceptions of and attitudes to risk change over time?

Are there triggers/ incidents that affect perceptions and attitudes to risk?

How can the inter-operability of models be enhanced?

How can culture be incorporated into risk assessment?

What methodologies can be employed to develop forward looking, multi-hazard risk assessments that include considerations of the connectivity between different hazards, demographic change, urbanisation, vulnerability, etc.?

What is the connectivity between different hazards at different scales?

What are the processes that cause risk accumulation?

What are the consequences of risk accumulation on disaster impacts?

What methodologies can be used/ developed to allow integrated risk assessment (vulnerability, hazard, exposure)?

What is the effect of climate change on the type and frequency of hazard events?

How can various integrated modelling approaches (hazard, exposure and vulnerability modelling) be used to develop effective risk assessments?

What methodologies can be used to provide good-enough risk assessments that are sensitive to purpose, the availability of resources, capacity, and necessary scientific rigour?

Can minimum standards for risk assessment be developed that are sensitive to purpose, the availability of resources, capacity, and necessary scientific rigour?

Further development in deterministic science that leads to a better understanding of physical systems to contribute anticipation and disaster mitigation.

Systems analysis of hazard events through interdisciplinary research focusing on the regions around plate margins.

Advancing the understanding of the processes that generate hazards with a focus on specific geographical regions.

Integration of hazard science with other key socio-economic drivers of risk (e.g. those addressing poverty and lack of good governance) and are factored into DRR interventions.

Techniques to assimilate raw observations into forecast models.

Further development in numerical forecast models.

Establishing linkages between the meteorological forecast variables (rain, temperature, wind strength) to user-relevant impact variables (malaria incidence, crop yield, river discharge, property damage).

Extensive characterisation of population immunity levels to multiple diseases.

Developing tools to turn gene sequencing data into useful information on pathogen risk.

Better understanding of the relationship between influenza immunity that can be measured and the chance that individuals will become infected, infectious or sick

Improved understanding of the role of travel and trade in the international spread of infection.

Better understanding of the risk factors for death, disability and livelihood loss at community levels to strengthen early warning and disaster preparedness programmes.

Improved and robust approaches and systems to validate risk models and mapping.

Risk assessment of the UK supply chain.

Techniques to quantify the inherent uncertainty in the forecasts.

Empirical calibration of models.

Advancing discovery of previously unknown pathogen reservoirs to provide new inventories of potential threats.

Linking partners with local/research institutes for improved risk assessments

Developing risk analysis tools that can be used in low capacity settings.

What are the risks of greater use of science in decision-making?

Vulnerability

What robust approaches can be developed to quantify vulnerability?

What people-centred approaches can be utilised and developed to assess vulnerability?

Who are the significantly vulnerable groups and how can they be identified?

How can vulnerability be effectively reflected in risk assessments?

Improving vulnerability estimates in the developing countries (e.g. through land use mapping, crowdsourcing) and through development of vulnerability functions for regions with low cat model presence.

How do cultural values and emotion relate to vulnerability?

Are there examples whereby the deep-rooted causes of vulnerability have been comprehensively tackled?

Improving the understanding of the vulnerability of small holder farmers, particularly women, to disasters.

What is the global impact of disasters on people with disabilities?

What approaches can ensure that DRR policies are inclusiveness of needs of vulnerable groups?

How does disability relate disaster impacts?

How are young people affected by disasters and what barriers there are to their involvement in DRR activities at the local and national level?

How does vulnerability vary across medium- and high-risk groups?

Improved understanding of gender-based vulnerability in different contexts (e.g. urban and rural)?

How does conflict contributes to dynamic interplay of factors which make communities vulnerable?

Economic and non-economic costs/ impacts of disasters

Enhance monitoring and evaluation of the direct and indirect impacts of disasters.

Greater analysis that demonstrates the economic benefits of timely DRR interventions.

Demonstration studies and/or cost/benefit analyses showing whether DRR investments are value for money.

Do disasters create greater scarcity and conflict OR an opportunity for peace and reconciliation?

What are the medium- and long-term economic, political and social consequences of disasters?

What are the medium term fiscal implications of disaster in Low and Middle Income Countries, e.g. does investment in recovery heighten risk due to diverting investment away from maintenance of critical infrastructure?

Standardise methods to document the short, medium and long-term costs of disasters.

What approaches can be developed to adequately measure the cost of a disaster?

Identification and characterisations of the economic dependencies at different scales?

Better understanding on the impact of natural hazards on death, disability and disease at global and community levels.

Enhance capacity for rapid research response, to obtain speedy funding, ethical approval, deployment of trained researchers to the field, and supervision in the field

Agree a diagnostic algorithm and hierarchies relevant to mental health impacts of disasters.

Development approaches, embedding within existing systems, to quantify the psychological impact of disaster events.

Develop and apply methods which allow the full range of disaster impacts to be quantified and measured.

collate information about disasters as soon as possible after the event to explain causes of injuries and death, and successes and failures.

Understanding the impact of DRR interventions.

Quantification of loss and damage post-disaster.

Quantifying and characterising the conditions or events that could lead to ecosystem collapse.

Developing robust methodologies to value ecosystem services and biodiversity, and their impact on DRR.

Develop standardised criteria for the relative degree of hazard exposure for people involved in mental health impact studies.

Governance

What institutional frameworks can facilitate the use of indigenous knowledge in DRR decision-making?

Mapping and challenging the instruments of DRR governance in different contexts.

How can science/ evidence assist decision-making under uncertainty?

What formal or informal institutional structures can effectively promote and implement DRR measures in fragile states?

What is the scale at which informal or community groups are most effective at promoting DRM and DRR in different contexts?

What approaches can facilitate the application of risk models to development planning?

What alternative governance spaces can be used to promote DRR when institutional capacity is limited?

Develop protocols for integrating disaster risk management into development planning.

Understanding and building capacity to interpret risk information and integrate it appropriately within decision-making structures.

Building knowledge and capacity to implement progressive and flexible risk management frameworks, which are able to learn and respond to changing information.

Investigating the institutional fit of existing DRR institutions, and assess their suitability under a range of future scenarios including climate change.

Can game theory inform our understanding of the way in which DRR institutions choose to inter-cooperate and coordinate activities?

What lessons can be drawn from historical surprises that have occurred during or after a natural hazard and have prevented effective institutional delivery of response or recovery?

What are the benefits of an integrated approach to DRR across sectors?

What incentive structures are needed to encourage scientists to engage with Disaster Risk Managers?

How can people with disability be integrated into DRR?

Accountability

Developing rights-based/social justice approaches to make governments accountable for not putting in place interventions that encourage prevention or preparedness.

Analysis to determine the attribution for economic and non-economic disaster losses.

What are the economic, political and cultural factors that allow ethical considerations focused on people-centred DRR preparedness to surface in fragile states?

What are the ethical challenges and considerations associated with DRR interventions in fragile states?

What are the ethical challenges and considerations for scientists and practitioners engaging in disaster events?

Resilience

What are the characteristics of resilient socio-economic development at local and national scales?

How can risks, at multiple timescales, be accounted for in development planning?

What approaches/interventions can mitigate the risks of multiple hazards to promote resilience?

Are there targeted interventions that can reduce risks at all spatial and administrative scales?

How can critical infrastructure be identified that support DRR?

What are the necessary safety measures needed to maintain critical infrastructure and support DRR?

Developing multipurpose infrastructure to support DRR.

How can cost/benefit analysis be used to assess DRR measures?

Improved monitoring to assess the effectiveness of pre- and post-disaster interventions by the NGO community.

What financial mechanisms (e.g. savings, loans, micro-insurance) could support DRR and community resilience?

What partnerships are needed for the effective DRR at national and local levels?

What capacity is needed to promote sustained and effective DRR?

Identification of opportunities to connect mitigation, adaptation and development.

The development of mechanisms to connect mitigation, adaptation and development.

Breeding of disease resistant crop variants where resistance is more durable than with current strains.

Understanding which interventions are effective to slow or stop the spread of pathogens without adversely affecting global trade.

Understanding the ethical challenges associated with the role out of micro-insurance schemes.

Analysis on the opportunities and limitations of establishing regional risk pools.

Development of innovative pro-poor financing mechanisms that are scalable and enhance cost-effective disaster resilience in the developing world.

Improving the understanding of why the take-up of insurance in developing countries, even when heavily subsidised or free, is so low.

Understanding how cultural values and emotion relate to resilience.

Are efforts to improve resilience most effective if directed towards individual components of the systems or the system itself, and how is this effected by context?

Greater empirical evidence of how resilience is understood, adopted and applied by practitioners, managers, community leaders and policy makers in disaster risk management - particularly in the developing world.

Analysis and examination of non-conventional disaster mitigation options, e.g. the provision of safe-havens for floods and earthquakes or household-scale damage assessment tools, to assess how individual homes could be affected by different sized hazards.

Development of funding models to assess whether disaster mitigation could be built into mortgages to support higher quality post-disaster reconstruction.

What are community perceptions of resilience?

What approaches and mechanisms can be used to scale up social protection?

How can the resilience of vulnerable groups (women, children, those with disabilities) be targeted and enhanced?

How should the concept of resilience be applied to development, DRR and humanitarian programming?

What is the role of DRR within a wider resilience framework which supports communities to take advantage of opportunities as well as withstanding disasters?

Cost-benefit analyst that illustrates the economic benefits of resilience and DRR interventions.

What organisational change process is needed at the practitioner agency and policy level to promote resilience in practice, including integration into organisational strategy at multiple levels; revision of fund allocation mechanisms at a programme level; generic guidance on how and when to integrate risk assessment and resilience building programme interventions; development of indicators of resilience to determine whether risk has been reduced.

Approaches to roll-out and sustain savings and loans for disaster risk reduction.

Does applying integrated risk management approaches increase development outcomes?

What interventions protect investments in development outcomes?

Developing more anticipatory approaches to reduce disasters risk and conflict.

Are there approaches or protocols that can allow effective local level interventions to be scalable?

What are the limits to economic growth relative to the availability of natural resources, whilst maintaining ecosystems?

Can resilience-building contribute to conflict prevention?

What are the existing linkages between CCA, DRR and agricultural interventions?

How can partnerships between local organisations and capacity, across a range of sectors and integrating expertise on different issues such as health, DRR, climate change adaptation, contribute to the resilience of vulnerable communities?

Understanding the adaptive capacity in fragile states.

Communication

What methodologies ensure that research findings and/or data are legitimate and can be used to promote local DRR (e.g. co-production of knowledge, use of local and indigenous knowledge, etc.)?

Providing clarity of practitioner processes (funding cycles, project programming, current operating standards, good practice guidelines, training programmes, etc.) to facilitate timely interventions by the science community.

Development of novel and effective narratives and approaches for knowledge exchange.

Where and how is science already being used by practitioners to contribute to DRR interventions?

Development of methodologies and approaches to promote effective, people-centred risk communication to enhance preparedness and response.

Can the accuracy of forecasts be enhanced to reduce false alarms?

What approaches and safeguards can be developed to minimise the negative consequences of false alarms?

Developing an understanding of the way in which communities, organisations and governments interact with, absorb and alter science.

Strategies to communicate forecasts to the public in general and those in peril.

Development of novel communication or presentational approaches to maximise the impact of risk maps (e.g. spacial representation of risk maps).

Improving public access to disparate data-sets (e.g. topography, transport networks, human health and natural risk zones) to enhance the ability of community to predict and build resilience to hazard events and disasters.

What type of communication tools and approaches do we currently have to promote resilience and integrated risk reduction measures?

What is the in-country demand for scientific evidence and when and where should it be used?

Can science be more policy perspective?

Can research questions be framing to better reflect organisational requirements?

Enhanced understanding of how learning occurs during adaptation as well as the barriers to learning?

What are the barriers to science making a difference to DRM and DRR?

Technology

How should technologies be used to promote DRR?

How can the effectiveness of technology be monitored?

What technologies should be used to promote resilience?

Development of novel and cost-effective diagnostic tools for pathogen detection (e.g. nanoparticles, microfluidics, etc.).

Further advancement of real-time digital syndromic surveillance.

Greater investment in high performance computing to support catastrophe loss models and hydro-meteorological forecasts.

Development of machine learning-based engines for combining heterogeneous data sources.

Approaches to apply emerging science and technology to close the gap in the understanding of current vulnerability, exposure and hazards and the drivers of risk.

New tools of analysis that can extract useful signals from crowdsourced or biosensor generated datasets.

Can mobile technology improve the uptake of insurance products for those in developing countries with significant liquidity issues?

Development of broad-spectrum antivirals, considering the lessons learnt from antibiotic and antifungal resistance.

Development of meaningful in vitro bioassays able to predict the epidemiological behaviour of a pathogen.

Greater development of technologies appropriate for community-based DRR.

Development of approaches to counter technology injustice and inequalities in technology availability, as applied to DRR (macro vs micro imbalance).

How has technology been used in DRR actions and how can it be used better?

Enhanced techniques to harness supercomputing power to integrate equations forward in time.

Development of laboratory assays to help classifying pathogen reservoirs in terms of the threat they pose in terms of their ability: a) infect people b) be transmitted between people c) be transmitted efficiently enough to cause an epidemic d) make people sick or kill them if they are infected.

Urbanisation

Characterising the features and interventions that enable resilient urban development.

Understanding and identifying climate change risks and impacts on cities.

Developing protocols for integrating disaster risk management into development planning.

Assessment of which cities globally are growing most rapidly and how this is impacting on exposure.

Monitoring the performance of disaster risk management in an urban context.

Identifying critical infrastructure and guidelines to maintain it.

Development of innovative and functional multi-purpose infrastructure to promote DRR.

How does vulnerability relate to urbanisation?

What does resilience mean in an urban context?

How can resilience to under nutrition be achieved and monitored in an urban context?

Data

Development of long term data sets on recovery from disaster events.

Developing standards and protocols for sharing data?

Developing universal standards for archiving environmental parameters for defining hazards and related data.

Analysis demonstrating the benefits of data sharing.

Analysis illustrating the barriers to data sharing in different contexts and at spatial scales.

Development of a framework for collecting disaster loss data.

Development of methodologies and approaches of inter-agency real-time evaluation.

Measuring and monitoring natural capital and its change over time.

Developing high quality, open source datasets through the deployment of satellite technologies, ground (including marine) based observations and experimental programmes – using techniques of data integration developed in the Earth Science and Informatics.

Development and exploitation of new monitoring technologies that can function alongside existing technologies and approaches to gather fundamental field and laboratory data.

Improving geophysical data in vulnerable countries.

Developing the international observational network to gather raw data on atmosphere, ocean, land-surface, cyrosphere) to initialise and evaluate hydro-meteorological and climatological forecasts (space based and ground measurements).

Encourage and incentivise greater sharing of epidemiological data.

Improving the spatial resolution of sub-national data for risk mapping.

The creation of capable platforms to support and facilitate community-based efforts to collect and share hazard risk data.

Improving the accuracy of crowdsourced data through the development of algorithms.

Build improved records of baseline data to give a better understanding of the "normal" diversity of viruses and other micro-organisms that hosts carry to enable the detection of novel threats.

Improving exposure data, in terms of currency and resolution, in the developing world (e.g. through remote sensing of settlement, crowdsourcing, diurnal population mapping and monitoring).

Improving the supply and use of information and earth observations to reduce risks and build resilience, improving information-sharing systems and information standards.

Approaches to improve the coordination and accuracy of crowdsourced data to assist in the response to emergencies.

Systematic monitoring and evaluation of longer term reconstruction and recovery.

Monitoring of long-term disaster recovery.

Forensic studies that are backwards and forward looking (i.e. including recovery).

Improving the quality of data on indirect losses and secondary effects of disasters, including their evolution over time, to strengthen disaster risk management.

Improve options for sample design, sample frames, and denominators.

Other

How is DRR spending defined?

What is DRR funding?

What is has not happened as a result of DRR interventions?

What is the impact of the bifurcation of aid budgets (development and humanitarian) on the effectiveness of DRR investments?

Identifying case studies that illustrate that science has made a difference for DRR and policy making?

What approaches can allow the impact of science in DRR to be tracked?

Understanding the role of science in implementation of the HFA?

What is the penetration of science in informing the DRR activities of NGOs?