HUMANITARIAN FUTURES PROGRAMME

planning from the future

WORKING DRAFT

MAKING SPACE FOR SCIENCE-HUMANITARIAN POLICY DIALOGUE:

UNLOCKING THE POTENTIAL FOR EFFECTIVE CRISIS PREVENTION, PREPAREDNESS, RESPONSE AND EARLY RECOVERY

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Humanitarian Futures Programme, King's College London

Executive Summary

Science and technology can directly reduce vulnerability to a range of disasters – both for existing threats and increasingly complex future crises. However, to do so, the extent to which science informs disaster prevention, preparedness, response and early recovery needs to be improved, both in terms of understanding emerging threats and potential opportunities, as well as building the capacity of those with humanitarian responsibilities[1] to appropriately apply evolving scientific learning.

The Humanitarian Futures Programme, King's College London, believes that a first and vital step for achieving this objective is to institute a systematic and sustained two-way dialogue between scientists and humanitarian policymakers. This essential dialogue should enable scientists and humanitarian policymakers to have a greater appreciation of each others' "language", their respective objectives, and how they might best interact. The improved understanding which such dialogue can support will, in turn, enable the framing of questions which more closely align with the needs of vulnerable and crisis-affected communities, thereby improving both the utilisation of scientific knowledge as well as the process of scientific discovery itself.

This report draws on the experience of HFP and its collaboration with an extensive range of scientists and humanitarian policymakers to assess the extent to which assumptions about the importance of science-humanitarian policy dialogue are justified and assess the criteria for making this dialogue effective. The report concludes with preliminary suggestions about ways in which this dialogue can be promoted, sustained and made more effective. These suggestions are based upon learning from HFP's work in Asia, Africa, Europe and North and South America, undertaken in collaboration with scientists from across a variety of disciplines and research institutes and those with humanitarian responsibilities working at community, national, regional and international levels.

This work has demonstrated that humanitarian policymakers are both important *end-users*[2], of science, employing scientific learning to appropriately inform humanitarian decision making and also play an increasingly vital role as *intermediaries*, bringing scientific learning to the communities and partners with whom they work, and enabling the concerns of those most directly affected to inform the focus of future scientific research.

HFP's efforts to foster more effective science-humanitarian policy dialogue have led to tangible results. Within each of its missions to support future planning within UN Country Teams in the Central African Republic, the Philippines, Ecuador, the Comoros, Venezuela and Tajikistan, as well as in its work with the Economic Community of West African States, HFP created *Futures Groups,* bringing together scientists from across a range of disciplines with senior humanitarian policymakers to asses the relevance of the latter's future plans. In the UK, HFP has also supported an extended *two-way exchange* between climate scientists and humanitarian policymakers. Both these sets of activities have created new spaces for direct science humanitarian policy dialogue, allowing scientists to clarify the levels of certainty within relevant areas of scientific learning, and, in some cases, preventing the development of inappropriate projects. Engagement with scientists in a wide range of countries has led to the *identification of new crisis drivers* and a *new understanding of the potential dimensions of known crisis drivers*, including the wide-ranging impacts of climate change within countries dependent on the waters of the Himalaya Kush or 'Third Pole'. HFP work in Tajikistan has included the trialing of SMS communications technology, exploring the potential of *harnessing technological developments* to better address existing and future vulnerabilities.

Most importantly, HFP activities have identified and demonstrated the considerable potential which enhanced science-humanitarian policy dialogue holds for strengthening capacities to better meet future humanitarian challenges. At the same time, the devastating impacts of recent crises, including the 2010 earthquake in Haiti, highlight the urgency for reviewing **the level of scientific literacy required to enable humanitarian policymakers to effectively engage with evolving scientific learning**, and for **better defining the forms of collaborative frameworks which can harness respective scientific and humanitarian competencies**.

Increasing recognition of the urgent need to strengthen science humanitarian dialogue

A growing number of scientists support strengthened engagement with humanitarian organisations. This is, in part, due to a renewed focus on *accountability* in terms of ensuring the transparency and accuracy of scientific knowledge, and its 'usability' and relevance for end users. The issue of accountability also encompasses concerns over the extent to which humanitarian policymaking is effectively and routinely informed by scientific learning. While heightened awareness of *the increasing frequency and intensity of disasters and the changing types, dynamics and dimensions of future crises* are

also strengthening recognition of the significant social, economic and political imperatives for supporting an enhanced science-humanitarian policy dialogue.

Challenges to strengthening science-humanitarian dialogue

There remain significant challenges to strengthening effective science humanitarian dialogue. A number of these are rooted in the longstanding divides between scientists and the end users of science – whether policymakers or vulnerable communities. Amongst these are lack of shared objectives and terminology and competition over the resources available for addressing existing and potential, future vulnerabilities. Other constraints appear to be more specific to efforts which seek to strengthen humanitarian capacities, including the need to develop **understanding of the humanitarian relevance of scientific learning** and a failure to invest in the collaboration required to enable effective dialogue.

There also remain challenges in improving end users' access to scientific knowledge that can be utilized in practical and useful ways. It is, in particular, becoming increasingly evident that there remain real *challenges in effectively communicating scientific learning*. These include conveying appropriate understanding of scientific uncertainty, matching the timeframes of scientific research to humanitarian agendas and translating scientific learning into sectoral and geographical areas of humanitarian concern. These challenges hamper efforts to align humanitarian planning and scientific knowledge and thereby heighten the risk of maladaptation

Humanitarian policymakers recognise the *current low levels of organisational capacity to effectively integrate emerging scientific learning on issues of future vulnerability.* Indeed HFP's work suggests that such organisational capacities may be even lower than policymakers acknowledge. It is also clear that policymakers find it difficult to conceptualize the potential impact of issues far outside their areas of experience. While there is significant willingness for an improved dialogue, from both scientists and humanitarian policymakers, HFP has found that insufficient attention and resources are being made available to support the increasingly critical dialogue on addressing foreseeable crises and reducing future vulnerabilities. Given the changing dimensions of future crises, this dialogue gap should concern all with humanitarian roles and responsibilities. This is not to imply that dialogue between scientists and humanitarian policymakers does not exist at all. It is rather to say that such dialogue is, for the most part, currently limited to pilot studies, individual organisations, or to a specific geographical or sectoral focus, and, on the whole, it has failed to promote effective generic learning and understanding about how best to support effective science-humanitarian policy dialogue.

Approaches which have enabled more effective science humanitarian policy dialogue

In its efforts to strengthen science-humanitarian policy dialogue, HFP has explored and documented the effectiveness of a range of approaches and processes. Those which were found to have been most effective shared a number of common features, including:

- **The more clearly defined the focus for science humanitarian policy dialogue, the more effective the engagement.** This demands strengthening humanitarian policymakers' capacities to ask the right kind of questions to the right kind of people, and building scientists' understanding of the multi-hazard environments in which humanitarian decision making takes place.
- **The dialogue should be contextualised and crossdisciplinary**. This enables a more holistic understanding of the inter-linkages between different risks within specific decision making contexts, reducing the likelihood of inappropriate or maladaptive humanitarian engagement. The development of agreed frameworks and shared standards for measuring vulnerability can support appropriate prioritization within multi-hazard environments.
- **Dialogue needs to be an effective two-way exchange** to ensure that the information produced is tailored to end users' needs and that those most affected are able to inform the focus of future research.
- **Building collaborative approaches** which allow for differences of opinion amongst both scientific and humanitarian communities and support open discussion about the current limitations of both scientific understanding and the capacities to operationalize this. An inclusive and transparent approach can also help address concerns over the ownership of collaborative networks and the products which they develop.
- **Identifying space for regular, ongoing dialogue** both within and between humanitarian organisations and scientific institutions. The establishment of continuous channels for dialogue is essential if it is to result in outcomes which remain relevant and develop as scientific learning and humanitarian decision making contexts evolve.

- The development of a space for effective dialogue is partly dependent on **identifying leaders and champions** within both scientific institutes and humanitarian organisations who will support investment in such collaboration.
- **Demonstrating the practical benefits** of investing in science-humanitarian policy dialogue for all participants, especially the end users most affected by the issue of dialogue focus.
- **Building on established networks of trust.** Humanitarian organisations offer scientists a huge and largely untapped channel for both gathering and disseminating scientific learning amongst at risk communities. For their part, scientists can facilitate humanitarian policymakers' access to a range of scientific expertise within their own and related fields of expertise, provide guidance on the criteria by which humanitarian policymakers should be gauging scientific expertise, and support their participation within research setting agenda.
- **Taking advantage of coinciding interests** in strengthening the dialogue. Scientists and humanitarian policy makers are likely to invest greater efforts in strengthening dialogue where funding for science directly relevant to future vulnerability is made conditional on demonstrating impact for those end users most directly affected, and where humanitarian aid becomes conditional on ensuring that assistance is appropriately informed by scientific learning.

Recommendations for supporting more effective science humanitarian policy dialogue

Arising out of its analysis to date, HFP has developed a number of recommendations that it believes are vital for science-humanitarian dialogue to effectively inform planning for existing and emerging crises and to address widening vulnerability:

- **Examining the role of science-humanitarian policy intermediaries**, the types of organisations which should take on this function and the roles which they should play. Intermediaries are often seen to oversimplify or misrepresent knowledge exchange between different communities. Overreliance on such facilitators has also on occasions resulted in failure to develop the organisational capacities required to effectively engage with and integrate scientific or humanitarian learning. There is growing recognition of the important intermediary role which those with humanitarian responsibilities are already undertaking. There is now an urgent need to consider how this role might evolve, and the level of scientific literacy, resources and capacities which science-humanitarian policy intermediary roles require.
- **Building a database of cases where science has effectively informed humanitarian policymaking and developing frameworks which measure both the impact of enhanced science-humanitarian policy dialogue and the effectiveness of different dialogue approaches in informing humanitarian policymaking processes.** Together these bodies of evidence can support efforts to raise the priority and resources accorded science-humanitarian policy dialogue. These resources will also support the identification of generic learning from across geographic, organisational, sectoral and issue-specific initiatives concerning those approaches which have been most effective in supporting effective science-humanitarian policy dialogue.
- **Engaging psychological and communication expertise** to develop forms of information and methods of dissemination which are best able to support effective integration of scientific learning within different humanitarian policymaking contexts, particularly where scientific learning is uncertain and emerging.
- **Incentivising the application of science to address future vulnerabilities** through developing new forms of sectoral recognition and accountability. The scientific and humanitarian communities remain, in large part, self-referential. There is a need to both ensure that humanitarian work is appropriately informed by the best available science, and to review the validity of existing scientific peer review processes. While not denying the importance of continued space for 'blue skies' thinking, there is a need to challenge assumptions over the differential value of theoretical and applied science.

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Annexes

I Some useful resources on promoting science policy dialogue

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Acronyms

CDKN	Climate and Development Knowledge Network
DFID	Department for International Development, UK Government
ECOWAS	Economic Community of West African States
ELRHA	Enhancing Learning and Research for Humanitarian Assistance
EQUIP	End-to End Quantification of Uncertainty for Impacts Prediction
HFP	Humanitarian Futures Programme
INGO	International non-governmental organisation
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	International Panel on Climate Change
NERC	Natural Environment Research Council
OSAT	Organisational Self-Assessment Tool
UNCT	UN Country Team
UKCDS	UK Collaborative in Development Science
UNISDR	United Nations International Strategy for Disaster Risk Reduction
USAID	US Agency for International Development

Acknowledgements

This report has drawn on the wealth of experience and expertise which scientists from a broad range of disciplines and those with humanitarian responsibilities working at community, district, national, regional and international levels have been willing to share with the Humanitarian Futures Programme. It is intended as a working draft, bringing together evolving learning from across efforts to strengthen science-humanitarian policy dialogue. The report was developed by the HFP team, with particular input from Lucy Pearson, during her internship with HFP while undertaking her MA at King's College London.

1.0 Introduction.

The aim of this report is to consolidate learning from the Humanitarian Futures Programme's (HFP) experience of supporting effective dialogue between scientists and organisations with humanitarian responsibilities on issues of present and future vulnerability. The paper sets out the imperative for a stronger and more sustained science-humanitarian policy dialogue, outlines a range of methodologies HFP which has explored since 2006 and identifies both constraints and a number of approaches and processes that have proved successful in overcoming these to support more effective dialogue.

Based on programme learning, the report concludes with four key recommendations that HFP believes are vital to ensure that humanitarian action is better informed by practical and appropriate scientific expertise and, in turn, that research priorities are informed by the needs of end users[3], reduce vulnerability and address the demands of increasingly complex and diverse crisis drivers of the future. Annex I notes some useful science-humanitarian policy resources, while Annex II lists referenced HFP materials.

1.1 HFP's rationale for focusing on the need to strengthen science-humanitarian policy dialogue

HFP believes that there are important ways in which scientific knowledge and emerging discovery can reduce crisis risks and directly improve the prevention, preparedness and response capacities of those with humanitarian responsibilities[4]. As the types of crises and their dimensions and dynamics expand and diversify, '(m)erely improving upon what has been done in the past will not be enough to meet the challenges of the future'[5]. More effective dialogue on issues of future vulnerability between scientists and those with humanitarian responsibilities is vital both for ensuring that policymakers are aware of evolving scientific learning and that emerging scientific and technological developments can appropriately inform and best support efforts to cope with future crises.

The evolving dimensions of future crises have highlighted the social, economic and political imperatives of strengthening science humanitarian policy dialogue:

'It's very easy to make the case for science…Without science, we wouldn't be aware of most of the threats we now face, let alone know how to deal with them …If there are going to be any human beings left to rule the world by the end of this century, they'll have huge problems to solve: climate change, global warming, water and food shortages, population growth, emerging new infectious diseases, the exploding demand for energy, threats to ecosystems and biodiversity, to name but a few. These horrors have three features in common.

- *First they all demand better understanding.*
- *Second the timescale for coming up with potential solutions is years or decades: certainly beyond the attention span of your regular vote-seeking politician.*
- *Third, they are not parochial national issues, but international in scale. Solving them will need rulers with global vision, whose inspiration comes from evidence and understanding.'*

Colin Blakemore, Professor of Neuroscience, Prospect Magazine, December 2010[6]

1.2 Social imperatives for enhancing science-humanitarian policy dialogue

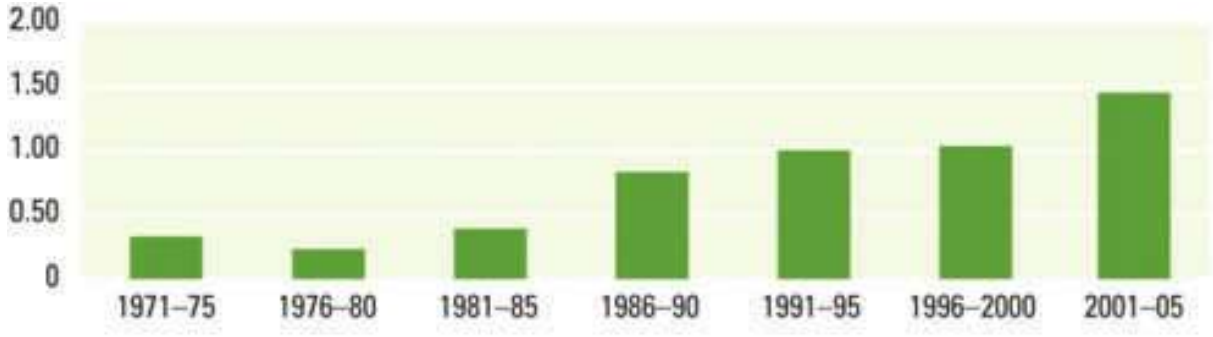
The 2008 World Disasters Report noted that more than 201 million people were affected by natural disasters[7]. 98% of all those affected by natural disasters between 1998-2007 suffered from climate-related ones. While Figure 1 (page 6) starkly depicts this clearly rising trend, Oxfam report that by 2015 the number of people affected by climate related disaster is likely to reach at least 375 million per year**8**.

Many more people are likely to be affected by biological and technological disasters. The recent three-fold devastation wrought by earthquake, tsunami and radiation leakage from damaged nuclear power facilities in Japan, together with subsequent review of dependence on nuclear power within many developed economies, also demonstrate the growing interconnectedness and globalised impact of natural and technological disasters.

Japanese earthquake scientists published data on slip deficit in 2003 which strongly correlates with the mapping of earthquakes which took place in March 2011 (see Figure 2 over the page). It is not clear how this scientific data informed those with humanitarian responsibilities within the public and private sectors. While systems which monitor p-waves alert

Japanese people by text a couple of minutes before the arrival of an earthquake, warning them of its imminent arrival and instructing them to take cover, this did not prevent the deaths of tens of thousands from the 2011 tsunami. There remains a clear need to consider how scientific understanding can better support those with humanitarian responsibilities, both with

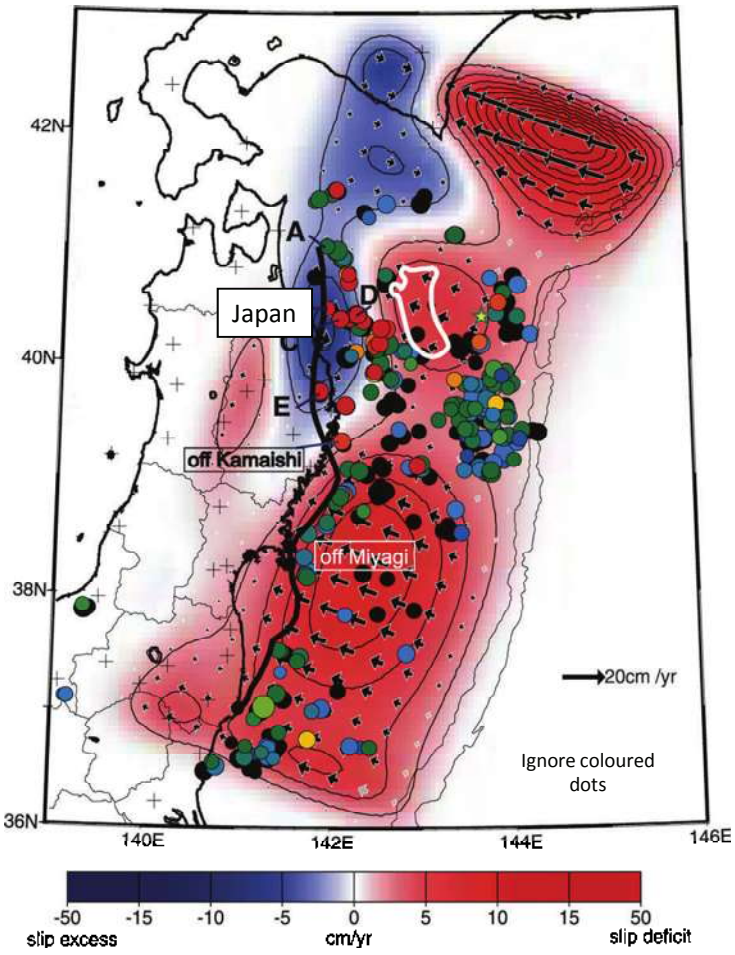
Figure 1: Increasing numbers of people affected by climate related disasters



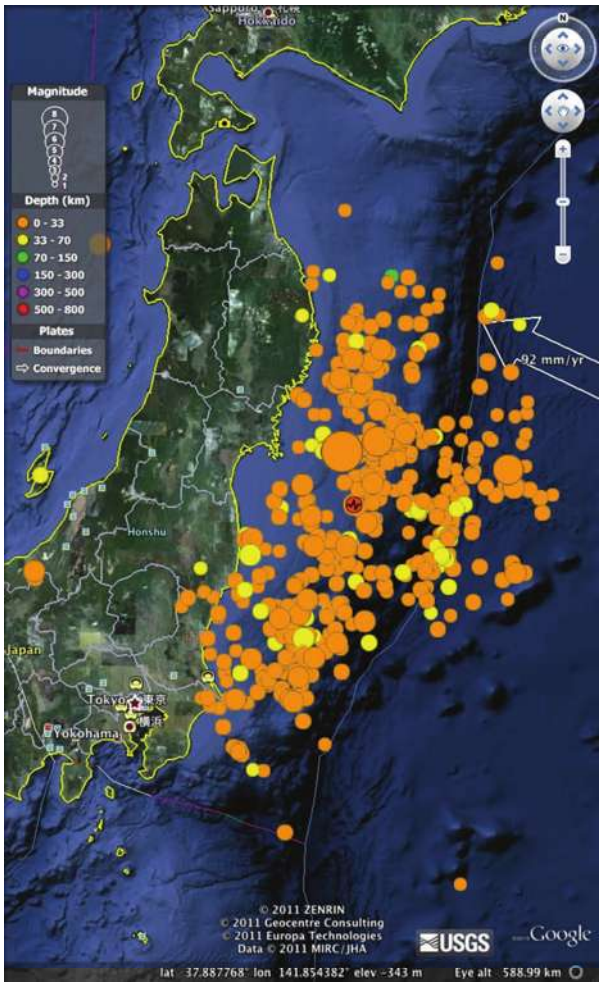
Number of people affected by climate related disasters per 5 year period (billions)

Source: World Development Report; CRED 2009

Figure 2: Comparison between research published in 2003 on 'Repeating earthquakes and interplate aseismic slip in the northeastern Japan subduction Zone', by Toshihiro Igarashi, Toru Matsuzawa and Akira Hasegawa' and Earthquakes mapped in period 8-15 March 2011[9]



Slip-deficit from modelled GPS (Igarashi 2003 JGR). Similar to the slip patch on Friday 10 March?



Earthquakes in period 08=15 March 2011

respect to crisis response and, even more importantly, for infrastructural planning and economic development.

1.3 Economic imperatives for enhanced science-humanitarian policy dialogue

The economic costs of both natural and technological disasters continue to grow, as figures 3 and 4 clearly demonstrate, both as countries become more developed and as globalization results in far-reaching consequences of localised disasters.

But the links between natural and technological disasters, vulnerabilities and development are complex. According to a series of senior scientists and government planners in China interviewed in HFP-commissioned research in 2009[10], crises are now regarded as posing serious obstacles to national economic and social development. Between 1990-2008 direct economic losses caused by natural disasters accounted for 3-6% of China's GDP and approximately 20- 30% of its fiscal revenue[11]. Intensive infrastructure construction has exacerbated the frequency and intensity of floods, droughts, earthquakes, landslides, water pollution and other disasters in recent years, while unregulated economic activities has also led to mining accidents, fires, gas leaks, collapsed bridges and public health incidents[12]. Interviewees highlighted the difficulty in reconciling the desire to improve national living standards through economic development with the need to prevent geological disasters caused by anthropogenic environmental degradation[13].

It is clear that economic development and humanitarian planning which are not effectively informed by scientific understanding heighten risk and expose vulnerabilities amongst increasing numbers of people. Ensuring that scientists can inform future strategy and planning is an issue not only of accessing relevant scientific expertise. Those with humanitarian responsibilities must also be willing to accord sufficient space for the science policy dialogue which more appropriate planning requires.

Figure 3: Estimated damages (US $ billion) caused by reported technological disaster 1900-2009[14]

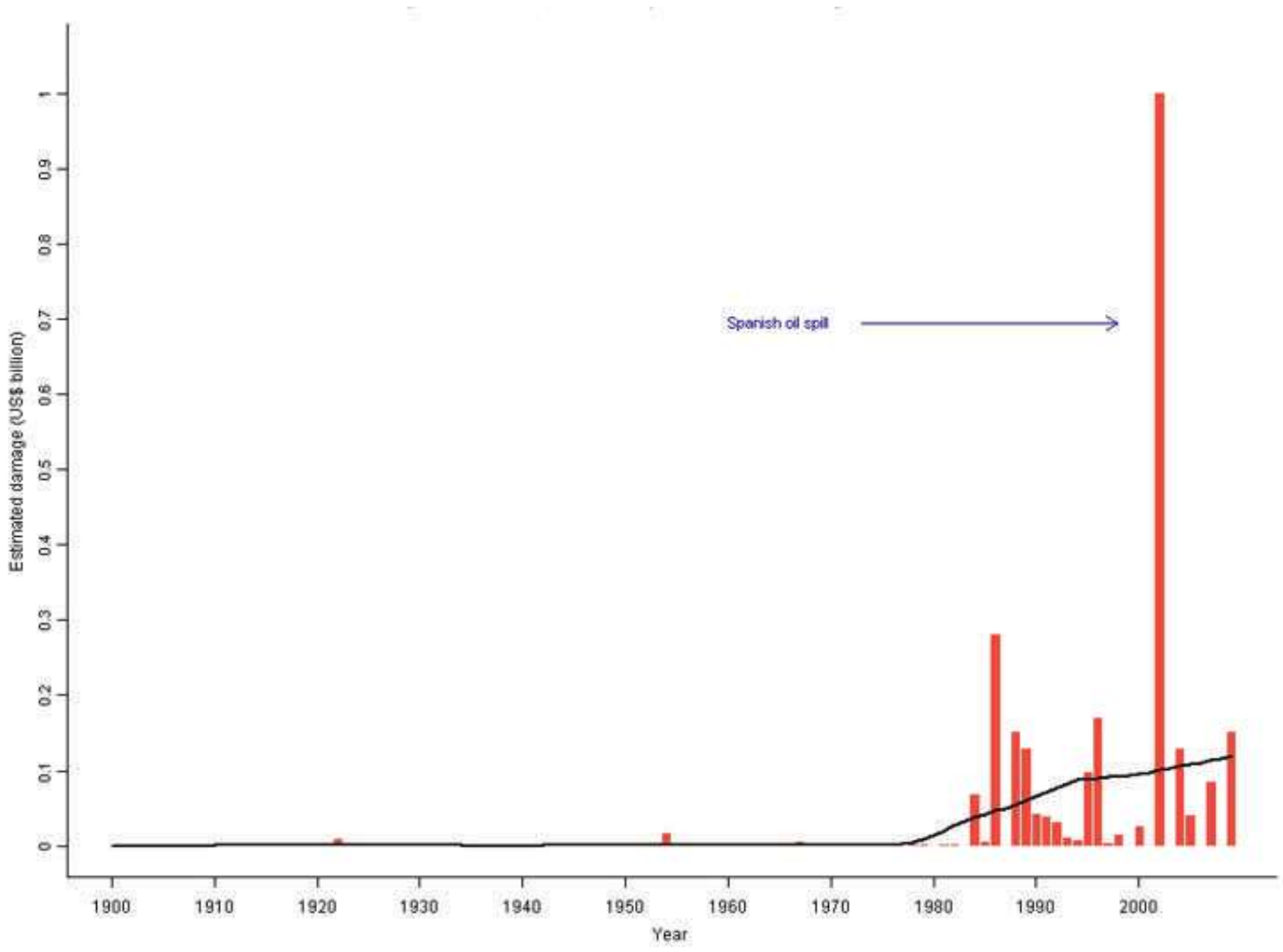
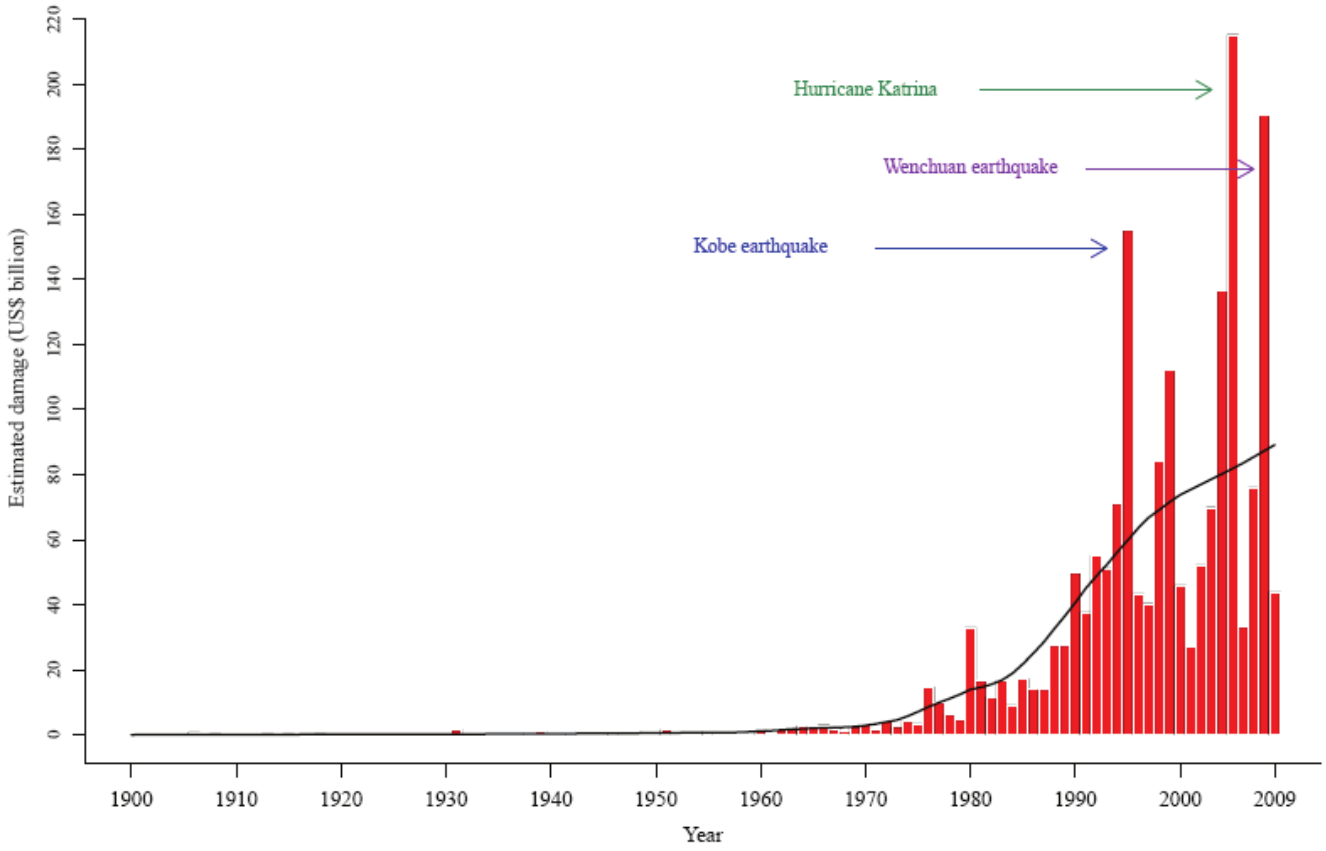


Figure 4: Estimated damage (US$ billion) caused by reported natural disasters 1900-2009[15]



EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Universite Catholique de Louvrain, Brussels—Belgium

1.4 Accountability and the Political imperatives for enhancing science-humanitarian policy dialogue

"*An accountable government should not only be able to cope with public affairs in normal conditions, but to respond promptly and calmly in the face of an emergency,*"

(Senior government policymaker interviewed in China in 2009)

"*Science isn't just for scientists. All should have a voice in ensuring that it's applied optimally - and to the benefit of both the developing and developed world.*"[16] *"There seems no scientific impediment to achieving a sustainable world beyond 2050 where the developing countries have narrowed the gap with the developed, and all benefit from further scientific advances that could have as great and benign an impact as information technology and medical advances have had in the last decade."*

Professor Sir Martin Rees, 2010 Reith Lectures[17]

Where there are evident ways in which science could support improved planning amongst those with humanitarian responsibilities, there remains a need to engender sufficient political motivation to support these linkages. Historically national governments have shown themselves to be largely reactive, responding to rather than preventing emergencies. Reactive response better fits political time frames, even when this does not make economic sense. Non-governmental organisations' work is also largely reactive. This is, in large part, due to donors' preference for investing in measureable outcomes. It is easier to achieve support for food aid distributions than the reduction of vulnerabilities to potential disasters.

More fundamentally there are major concerns regarding the governance of emerging scientific and technological learning and enabling non-governmental actors' access to both existing knowledge and to the research table where decisions are made regarding the focus of ongoing and future research. The divides between those who can access scientific learning and those who cannot are growing. Such divides are apparent between both developing and developed countries, as well as between governments, corporate sector and non-governmental actors within individual nation states[18]. The Sussex Manifesto is an initiative advocating for radical changes to 'the ways in which innovation is shaped, through: agenda setting, funding, capacity building, organisational arrangements and monitoring, evaluation and accountability',

based on research which demonstrates that 'approaches that actively link science with the interests of excluded communities can help shift the distributional outcomes of innovation towards the needs of the poorest groups'[19].

The demands for accountability of both scientists and those with humanitarian responsibilities are increasing, on the part of funders, donors and disaster-affected communities. As was evident in the earthquake in Haiti in 2010, access to international communication technologies are now widely available amongst poor, disaster-affected communities. Moreover, with the changing dynamics and dimensions of crisis drivers, communities with higher levels of economic development are also likely to be more directly affected, resulting in changing humanitarian needs, including many with chronic illnesses and growing numbers of ageing people. Used to a high standard of living, these populations are likely to be particularly demanding of political authorities and make use of readily accessible channels for communicating these views.

Scientists' Accountability

Scientists are under increased pressure to demonstrate the relevance and value of their research. The International Council for Science (ICSU) in November 2010 issued an advisory note, which noted that 'Scientists have a special duty to communicate findings that have implications for human survival or well being, including threats to the environment'.[20] The International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) Subcommittee for Crisis Protocols developed a Professional conduct of scientists during volcanic crises.[21] The UK Natural Environment Research Council (NERC) has initiated a Science Impacts Database[22] and a significant number of its research calls now require that proposals include impact plans. NERC has also supported the development of two pilot consortia to promote resilience through enabling a group of scientists to work with humanitarian and development organisations and partnering communities at risk of respectively earthquakes and volcanoes[23].

Humanitarian policymakers are keen to push scientists to 'go the last mile' and ensure transfer of knowledge through the most relevant existing channels[24] and the adaptation of technology for specific user contexts[25]. As one humanitarian policy maker remarked 'We're willing to use new technology but most of the new technology is not worth using.'[26]

Scientists, for their part, have recognised that those with humanitarian responsibilities are both end users of science – for informing their policy and programme work – and act as intermediaries - providing a huge, and largely untapped capacity for both gathering and disseminating scientific learning. Humanitarian organisations operate in extremely difficult environments, including situations of internal and international conflict and a range of disasters, where infrastructure and the provision of basic services have been destroyed and trust between communities and with local and national government has often been destroyed. Humanitarian organizations and the communities and partners with whom they work can extend science policy dialogue through established and extensive networks of trust.

Accountability of those with humanitarian responsibilities

Since the 1990s and the crises in Somalia and Rwanda, accountability has been a growing concern amongst those with humanitarian responsibilities. There is need to extend this accountability to ensure that humanitarian planning is appropriately informed by evolving learning within all relevant scientific fields[27].

While there have been repeated initiatives to enhance capacities for needs-based assessment for humanitarian response and evidence-based development, in reality scientists have rarely been afforded a full place in strategic planning processes. Scientists report that they often feel their findings are used to illustrate predetermined policies, rather than to inform underlying strategies[28]. An earthquake scientist recently engaged in partnering with NGOs expressed his amazement that disaster risk reduction planning has not been routinely informed by evolving earthquake science[29]. He had assumed that humanitarian policymakers had established systems for engaging with emerging scientific learning concerning relevant areas of future vulnerability.

Scientists have repeatedly raised concerns about the dangers of maladaptation and heightened risk where humanitarian work is not effectively informed by scientific learning. They have, for example, questioned the advocacy messaging and toolkits designed to address climate change and promote adaptation which are not effectively informed by climate science[30]. A number of humanitarian and development collaborative climate change adaptation initiatives have proposed assessing whether their work is adequately 'climate proofed' without fully engaging climate scientists in either the project development or review processes. The dangers of failure to secure effective scientific engagement are well exemplified within HFP's work to support future planning with the UNCT in the Central Africa Republic.

The mission included a forum bringing together a cross-disciplinary group of in-country scientists with senior humanitarian planners to discuss proposed UNCT projects.

While the inclusion of a fishing project was recognised as innovative, participating climate scientists raised concerns about the sustainability of this initiative, given that climate projections indicate that the flow of the River Obangi, where the project was to have been sited, will significantly reduce over the coming decades. Climate scientists' concerns over the risks of ill-informed humanitarian and development planning have been heightened given the significant amounts of funding which are anticipated will be made available for climate adaptation in the coming few years.

1.5 Methodologies employed within HFP work to support science-humanitarian policy dialogue

This report seeks to assess the degree to which the programme rationale (see above Section 1.1, Programme rationale) on the importance of strengthening science policy dialogue is borne out through reviewing and synthesizing learning emanating from the work which HFP has undertaken in Asia, Africa, Europe and North and South America. Over the course of this, HFP has undertaken individual *interviews* with more than 75 scientists[31] from across a wide variety of disciplines in many different countries and more than 100 humanitarian policymakers[32] working at community, national, regional and international levels. A list of relevant HFP documents is included in Annex II.

In seeking to strengthen science-humanitarian policy dialogue, HFP has explored the effectiveness of different approaches through which this dialogue can be facilitated. HFP has identified learning from relevant complementary initiatives and developed a number of innovative approaches, trialing these with a diverse range of actors in different contexts. Programme learning has been specifically developed through employing the following dialogue approaches:

- *Futures Groups.* In 2008 and 2009 HFP undertook a series of missions to support future planning within UN Country Teams (UNCT) in the Central African Republic, the Philippines, Ecuador, the Comoros, Venezuela and Tajikistan, as well as with the Economic Community of West African States (ECOWAS). Each of these assessment missions incorporated a Futures Group workshop, bringing together scientists from across a range of disciplines and humanitarian and development planners, to discuss both the drivers of future crises and emerging scientific learning and technologies which could help address these drivers. Through desktop research and individual interviews, HFP also compiled workbooks of future humanitarian drivers tailored to inform a number of these missions.
- *Trialing a series of approaches for promoting science-humanitarian policy dialogue*. To explore the effectiveness of different approaches through which this process can be facilitated, HFP has employed a variety of dialogue approaches including: scenario development exercises, technology policy fairs, issue-specific seminars and collaborative, two-way exchange. A diverse group of scientists and policymakers have participated in these dialogue events.
- *Ongoing collaborative, two-way exchange between climate scientists and humanitarian and development policymakers and the communities and partners with whom they work.* Organisations partnering in the ongoing, two-way exchange have included climate scientists from the UK Met Office Hadley Centre and the universities of London, Liverpool, Oxford and Sussex and humanitarian and development decision makers from CAFOD, Christian Aid, Plan International, Oxfam GB and the Red Cross, while a much larger group have participated in the climate science humanitarian policy exchange working group. From 2010-2011 working group meetings have been co-hosted by: the UK Natural Environment Research Council (NERC), the UK Collaborative in Development Science (UKCDS)[33], and the End to End Quantification of Uncertainty for Impacts Prediction (EQUIP), while the Royal Society co-hosted a Policy Lab on the climate science required for humanitarian planning[34]. The Foreign and Commonwealth Office supported an initial exchange team visit to Nairobi and Arusha to introduce and discuss the approach with partners in Kenya[35], and the exchange has developed a proposal to undertake demonstration studies in Kenya and Senegal.

This report also draws on learning from across the wider range of HFP programme work and, in particular:

A series of studies on international, regional and local crisis drivers, developed through interviews with scientists and humanitarian decision makers in China, Russia and India, and international collaborative research bringing in specific individual expertise and undertaken in partnership with, amongst others, Tufts University, the Stockholm Environment Institute, China Dialogue and University College London.

Participating in pilot consortia to support more effective use of earthquake and volcano science by humanitarian organisations and amongst at risk communities. HFP has participated in two of the consortia which have received NERC funding for scoping research to promote resilience to natural hazards amongst at risk communities[36].

Over the course of its efforts to strengthen science-humanitarian policy dialogue, HFP has both identified generic learning on effective approaches for strengthening science-humanitarian policy and identified opportunities to share this evolving learning with those engaged in complementary efforts. For instance, the first climate science humanitarian policy exchange working group hosted by NERC in July 2010 specifically showcased a number of approaches which have successfully supported strengthened dialogue. These included: individual and collective exchange, card games, participatory research and café style discussions[37]. HFP has also produced a series of briefing papers and reports, disseminated these on the HFP website and to a wide range of programme contacts, and presented emanating learning at a wide range of fora.

2.0 Challenges to effective science humanitarian policy dialogue

"The humanitarian sector needs to restructure its relationship to predictable climate-related threats. One option is to evolve towards knowledge-based entities that can rapidly absorb and act upon information about risks: taking humanitarian action before a disaster."

(Pablo Suarez and Arame Tall, 'Towards forecast-based humanitarian decisions)[38]

Action to prepare for future crises remains severely constrained by the current operational humanitarian framework, including national policy makers not equipped to tackle the international and regional dimensions of many emerging crisis drivers, funding frameworks which are insufficiently flexible to support the new kinds of collaborative work now required, and overstretched organisational capacities which do not allow individuals the flexibility to take on new areas of work.

In the countries in which it has worked, HFP has found that the dialogue between scientists and those with humanitarian responsibilities on future vulnerability is receiving insufficient focus and resources. Where the dialogue is active, this is often on a pilot basis and with a specific geographical-, sectoral-, discipline- or organizational-focus, with limited possibilities to share generic learning about those science policy approaches which have proved most effective. A growing number of humanitarian policymakers and scientists recognise the need for increased dialogue and HFP's efforts to promote this have been widely welcomed[39]. Institutions and funding bodies focusing on promoting science policy have also been extremely supportive of the programme's science policy initiatives[40]. Yet, even so, it has proved extremely difficult to identify the resources required to develop sustainable dialogue.

A number of the challenges to strengthening more effective science humanitarian policy dialogue are rooted in the long-standing divides between scientists and the end users of science. Others appear to be more closely associated with specific constraints to efforts which seek to strengthen humanitarian capacities to more effectively engage scientific learning in preparing for future crises. HFP work has highlighted the following challenges:

- **Building shared understanding which transcends linguistic, scientific and sectoral language differences.**

'*(A) major barrier…exists in identifying those developments that impact on humanitarian operations but are not reported using humanitarian vocabulary.'*

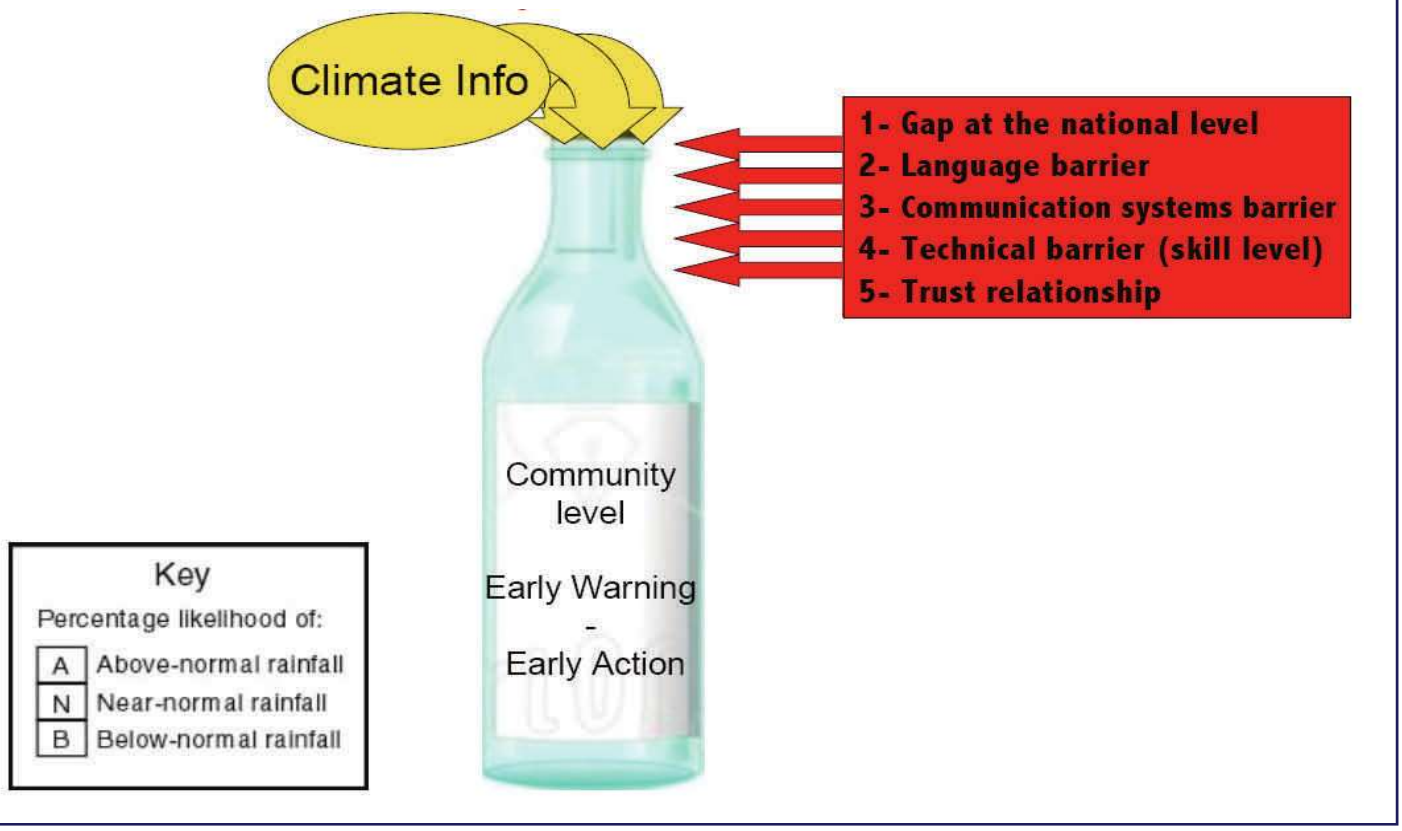
(Scientist interviewed by HFP 2007)[41]

Language constraints continue to undermine a productive dialogue between scientists, humanitarian policymakers and vulnerable, crisis-affected communities. Misunderstandings over who are considered the 'end users' of climate information have, for example, been unearthed over the course of the HFP-supported climate science humanitarian policy exchange[42]. Based on the experience of the International Federation of the Red Cross and Red Crescent Societies (IFRC) in transferring climate information to communities at risk in West Africa, Figure 6 clearly demonstrates a number of the many different elements to consider in overcoming language barriers, including issues of technical expertise, providing the information in languages and formats and through channels trusted by, and media appropriate for, intended 'end users'. Efforts to address language differences also need to encompass the development of agreed terminology and shared metrics for measuring vulnerability as well as collaborative review of the effectiveness of different approaches for strengthening effective science-humanitarian policy dialogue.

The Prompt Assessment of Global Earthquakes for Response (PAGER)[43] and Benfield Grieg Hazard Research Centre Operation Manual on "Communication during volcanic emergencies"[44] are both excellent examples of initiatives which support communication of science in formats and language understandable to non-scientists.

But enabling the use of scientific learning extends beyond its effective communication. It requires identification of the humanitarian relevance of scientific learning, as well as the willingness of scientists to engage in supporting appropriate application within specific humanitarian decision making processes.

Figure 5: Bottlenecks to climate information transfer to communities at risk, based on the IFRC/ West Africa experiences in 2008 [45]



- **Differences in time frames**

There is, in general, a disjuncture between scientific and technical research and development timelines and the planning timeframes to which those with humanitarian responsibilities generally work. In interviews with senior humanitarian decision makers, strategic planning time frames were found to range from three to ten years, with the most frequent being the five-year strategic plan[46]. The timeframe in part depends on the funding base of the humanitarian organisation, with greater flexibility enabled through 'free money' or assured funding.

- **Using uncertainty as a justification for inaction**

"*Climate modelling is difficult and is dogged by uncertainties. But* ***uncertainty*** *about exactly how the climate will respond to extra greenhouse gases* ***is no justification for inaction.*** *If you were riding a fast-moving motorcycle in fog near a cliff-edge, and you didn't have a good map of the cliff, would the lack of a map justify not slowing the bike down?"*

(David MacKay, Chief Scientist, UK Department for the Environment and Climate Change)[47].

Humanitarian end users of scientific information are used to dealing with uncertainty, but need this uncertainty conveyed to them in an accessible way. Clearly it should be easier for humanitarian policymakers to engage with scientific learning which has higher levels of certainty. Yet the types of uncertainty differ across scientific disciplines. While earthquake scientists, for example, now understand a great deal about how and where earthquakes occur, this does not yet translate into precise predictions of when the earthquake will take place. Climate science clearly exhibits different levels of uncertainty across different time frames and different regions (see Box 2). The skill of seasonal forecasting, for example, exhibits regional variation. Where emerging science is not able to effectively communicate the range of uncertainty in temporal, geographical and sectoral applications relevant to humanitarian and development planning, the risks of maladaptation are heightened[48].

Initiatives which have sought to develop tools to communicate scientific uncertainty in accessible formats have already proved effective in strengthening humanitarian planning. For example, Kogami is the leading disaster risk reduction NGO for earthquake and tsunami hazard in Padang, Indonesia. The science which Kogami use for their community-based hazard awareness and preparedness initiatives tends to be simple, non-technical and uncontested. One of the key tools used to inform their disaster risk reduction work is the zonal map presented in figure 7[49]. This has already supported more appropriate community response to an earthquake in September 2009.

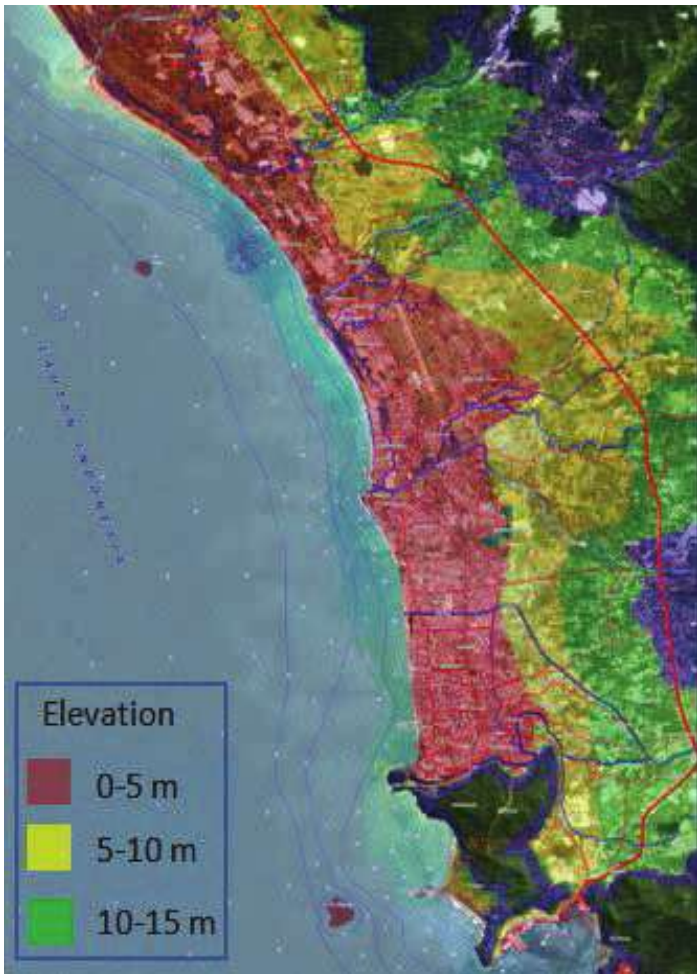


Figure 6: *Zonal map of Pandang City, Indonesia, employed by the Indonesian NGO Kogami, depicting evacuation routes across elevation levels. The map depicts evacuation routes over a shaded topographic digital elevation model of Padang City, with land elevations (metres above sea level) categorised and colour-coded using red (0-5m), yellow (5-10m), green (10-25) and blue (25-100m) shades. Combined messages communicated in conjunction with the maps include: land lower than 5 m above sea level is dangerous; land between 5 and 10 m above sea level is relatively safe, but be alert; land above 10 metres is safe. Depending on the area inhabited, communities are encouraged to use the zonal map to plan an evacuation to an area 10 m above sea level, by either moving inland to high ground or moving to an evacuation structure, within 30 minutes of a tsunamigenic earthquake.*

- **Constraints to conceptualising the implications of the dimensions of future crises**

In facing future crises '*we will have no wisdom from the past to rely on.*'

(Human rights campaigner interviewed by HFP in India in 2009)

'Climate change has opened up peoples' planning horizons like no other issue.'

(Humanitarian policy maker, interviewed by HFP in Britain in 2007)

Box 1: What are we asking from practitioners?: An example from climate science

- Deal with climate data at inappropriate resolution
- Translate climate change projections into meaningful impacts on the ground
- Deal with uncertainty i.e. be wrong some of the time
- Absorb the inherent risk of being wrong without demonstrable gains from using new information

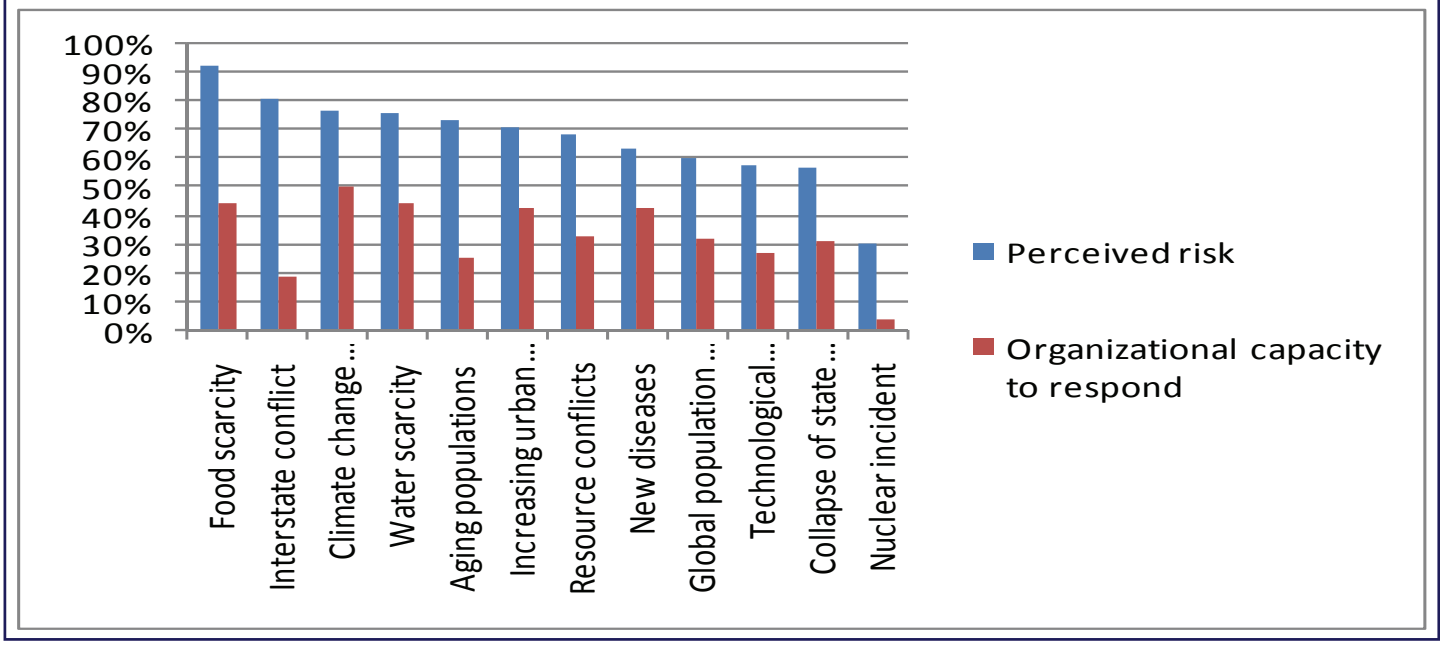
From the presentation by Richard Washington, Oxford University, to the climate science humanitarian policy exchange workshop on 30 March 2010

"(F)rom my personal experience there have been few snow storms in winter in Tibet, as a result, herders on the plateau are unprepared for such conditions and do not make take precautionary measures, such as preparing fodder for livestock. Thus when storms hit, residents are very vulnerable."

(Climate scientist, interviewed by HFP in China in 2009)

The inappropriateness of the current humanitarian framework for facing future crises has been increasingly noted[50]. HFP has found that humanitarian policymakers are more open to engaging with issues already widely recognised as of concern to future vulnerability. Findings from the Organisational Self-Assessment Tool (OSAT) (see Figure 7) which HFP has employed with 260 individuals from across a broad range of organisations[51] indicate that humanitarian policymakers focus on those risks already known to heighten current and future vulnerability, such as food and water security, new diseases, and climate change. Less consideration is given to newly emerging risks which lie beyond the usual areas of focus of humanitarian organisations, such as nuclear incidents, cybernetic and infrastructure collapse and technological systems failures. While respondents acknowledged the current low levels of organisational capacity to effectively identify and deal with identified threats, HFP's science policy work indicates that organisational capacity may be even lower than policymakers themselves recognise[52]. Such findings correlate with conclusions from the international survey of more than 600 developing and developed country stakeholders – including science and technology researchers, intermediary organisations and policy makers working at all levels - which was undertaken by the Overseas Development Institute in 2008. This survey found that '(m)any policymakers, other than those in environment and health ministries, rarely use scientific advice or research to inform the conceptualization, formulation or implementation of policies at national or sub-national level'.[53]

Figure 7: Findings from the HFP Organisational Self-Assessment Tool comparing proportions of high perceived threat risk and level of organisational capacity to respond



HFP activities clearly demonstrate that science-humanitarian policy dialogue can heighten humanitarian policymakers' awareness of the need to consider new areas of vulnerability, such as the potential for exploiting identified genetic differences[54], as well as deepening understanding of the potential dimensions of known crisis drivers. The engagement of scientists and researchers from across the Himalaya Hindu-Kush region within a joint project undertaken by HFP, University College London and China Dialogue led, for example, to increased understanding of the wide-ranging and interconnected impacts of climate change within countries dependent on the waters of the 'Third Pole'[55].

Amongst humanitarian and development decision makers, there are real differences of opinion between those who would like to promote increased application of innovative technological or scientific solutions and those who think the focus should be concentrated on wider application of existing technologies and approaches which have already proven effective, such as mosquito nets.[56]. As the joint University of Glasgow and Oxfam "High science in low-technology emergency settings" project notes, 'Many advances in science have the potential to contribute to novel solutions to'… humanitarian… 'problems. However, the reality is that many "novelties" that made the limelight decades ago still haven't been absorbed… (or at least not effectively). Previous research has shown limitations to many so called "advanced" technologies… Some of the common shortcomings are the inability of these technologies to cope with field conditions typically encountered in resource-limited humanitarian emergency contexts…***If technological step changes…are to occur a concomitant change may also be needed with regards to the skill set of those utilising such advances.'***[57]

In the face of pressing existing needs, there will always be difficulties in garnering support for efforts to prevent or reduce potential future crises, whether these are pandemics or conflicts. However there is now the added difficulty of enabling people to conceptualise potential future crises, the dimensions of which may lie far outside their area of experience and understanding. The development of approaches which support this process may be strengthened through engaging communications and psychological expertise

- **Insufficient investment in the collaboration required to strengthen science-humanitarian policy dialogue**

'*The expectation that collaboration can occur without a supporting infrastructure is one of the most frequent reasons why it fails…This (collective impact) requires a fundamental change in how funders see their role, from funding organizations to leading a long-term process of social change. It is no longer enough to fund an innovative solution created by a single nonprofit organization or to build that organization's capacity. Instead, funders must help create and sustain the collective processes, measurement reporting systems, and community leadership that enable cross-sector coalitions to arise and thrive*.'

(J Kania and M Kramer, Stanford Social Innovation Review) [58]

Bringing together scientists and those with humanitarian responsibilities to discuss issues of future vulnerability is, in

many cases, a new area of collaboration, which falls largely outside established funding frameworks. It is already clear that such collaboration offers huge potential to support better planning for future crises and there are many different forms of possible collaboration. It can be light, and does not necessarily require the establishment of well-staffed centres and institutes.

If it is to be effective, there nevertheless remains a need to recognise and support the potential of strengthened science humanitarian policy dialogue. A recent report of the Institute of Mechanical Engineers noted the potential for the UK DFID to enable its international partners to access the scientific and technological expertise in the UK[59]. Governmental partners interviewed within HFP's work have identified that DFID could act as a two-way conduit to support science humanitarian policy collaboration, identifying best practice in, for example, climate change adaptation from amongst its regional and country partners to share with relevant UK government departments and research councils, and, in turn, effectively supporting the development of appropriate climate science to inform the work of DFID and its partners[60].

- **Constraints of a *range* of end users accessing scientific learning**

While there is growing recognition amongst those with humanitarian responsibilities that local, community preparedness and response measures are most effective in preventing and addressing crises[61], there are particular barriers preventing the direct access of both non-governmental organisations and community decision makers to scientific learning. Technical barriers may act as a significant constraint to the development of scientific information in geographical and temporal scales relevant to non governmental and community decision makers, as is the current case with emerging climate science. Existing science policy initiatives are, moreover, often centralized.

More worrying is the failure to address these barriers through the science humanitarian policy resources which are available. Resources for developing climate information and the organizational capacities to use these have, for example, targeted the requirements of governmental actors[62]. Yet evidence from work undertaken by the IFRC in West Africa clearly demonstrates the potential for supporting non-governmental organisations' access to climate information which can appropriately inform humanitarian planning. In 2008, the IFRC employed precipitation forecasting in West Africa to launch its first pre-emptive flood preparedness appeal and inform prepositioning of emergency supplies[63], while effective use of such forecasts in East Africa enabled Kenyan farmers to yield bumper harvests[64]. As noted above, the Indonesia NGO Kogami has also already enabled at risk communities to benefit from earthquake and tsunami science[65].

- **Ineffective current intermediaries**

China will double its number of science communicators to four million by 2020, according to the Chinese Association for Science and Technology.'[66]

It is not practical for every humanitarian organisation to develop in-depth scientific expertise in all areas of future vulnerability, nor do scientific institutions all need to develop operational humanitarian outreach. Hence there has been considerable discussion about the roles of intermediary or 'boundary' organisations in supporting strengthened science humanitarian policy dialogue. Yet intermediary translators or facilitators are often seen to dilute, oversimplify or incorrectly transfer knowledge between different communities. Overreliance on such facilitators has also been seen to result in failure to develop the organizational capacities required to effectively engage with and integrate scientific learning.

It is important to recognise that intermediaries can play a range of functions, including informing, linking, matchmaking, supporting focused and strategic collaboration, and building sustainable institutions.[67] Each of these functions employs different approaches and has different intended and unintended outcomes. For example, the Futures Groups which HFP convened with ECOWAS and the UNCTs in Tajikistan, the Comoros and the Central African Republic identified the potential for these organisations to undertake dual convening and standard setting roles with regard to strengthening the science policy dialogue required to better prepare for the future.

- **Issues of ownership and closed 'systems'**

Concerns have been expressed with regard to the 'ownership' of the expertise and products developed through science-humanitarian policy dialogue[68]. The importance of ensuring organisational brand does not favour collaboration and gives rise to a plethora of parallel, uncoordinated but closely related activities. This has, for example, been evident in the development of independent climate change adaptation resources amongst international organisations.

Many of the scientists interviewed during the course of HFP activities identified that humanitarian policymakers prefer to invest in the same closed group of trusted scientists and scientific bodies, rather than allowing for differences of opinions within and across scientific disciplines and developing collaborative research and investing in identifying new sources and areas of expertise[69].

4.0 HFP learning on those approaches which have enabled more effective science policy dialogue

'The main issue is about identifying what the problem is and being able to communicate in order to do something about it.'

Scientist interviewed by HFP in 2007[70]

'(Open scientific debate) ensures that any scientific consensus that emerges is robust and firmly grounded. Even wider discussion is needed when what's in contention is not the science itself, but how new findings should be applied.'

Professor Sir Martin Rees, The Scientific Citizen, Transcript of the first Reith Lecture, 2010[71]

The devastating impacts of recent crises, including the 2010 earthquakes in Haiti and Pakistain and the three-fold 2011 disaster in Japan, highlight the urgency for reviewing the level of scientific literacy required to enable humanitarian policymakers to effectively engage with evolving scientific learning, and the forms of collaborative frameworks which can harness respective scientific and humanitarian competencies[72].

HFP experience has clarified that the more clearly defined the issue of science humanitarian policy focus, the greater the success of the dialogue. Scientists and humanitarian policymakers participating in HFP's 2007 Futures Group workshop concurred that the '(t)he humanitarian-scientist dialogue needs to be operationally-driven, problem-based and initially focused on specific issues of future human vulnerability.'[73] Subsequent work has, however, highlighted the importance of ensuring that the dialogue is contextualized and developing cross-disciplinary approaches even within a more clearly defined focus for the dialogue, as portrayed in Figure 8.

Those with humanitarian responsibilities need to understand enough about emerging scientific understanding and innovation to be able to frame humanitarian-related concerns in ways which scientists can understand, while scientists, in turn, need to develop sufficient understanding about the multi -hazard risk environments in which scientific learning is going to be used to be able to support the effective application of their expertise and skills (see Box 2: p21, Learning to ask the right kind of questions to the right kind of people).

Learning from across HFP activities to date has also made clear the need to support the development of frameworks for dialogue which are:

Figure 8: Give us specific decisions please[74], Dave Stainforth, Centre for the Analysis of Time series and Grantham Research Institute on Climate Change and the Environment, London School of Economics.

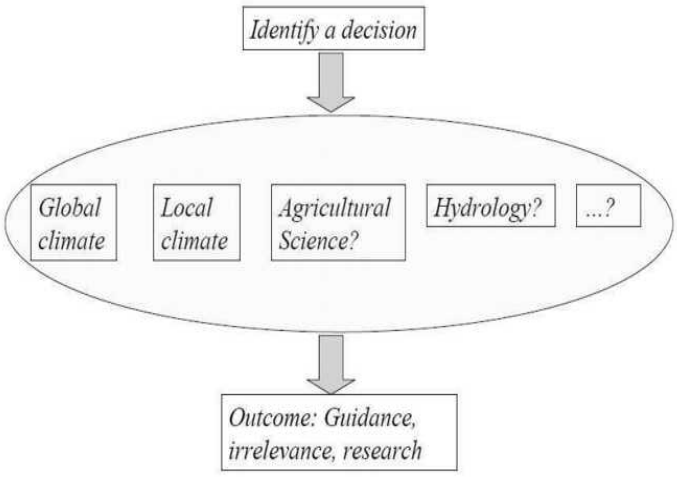
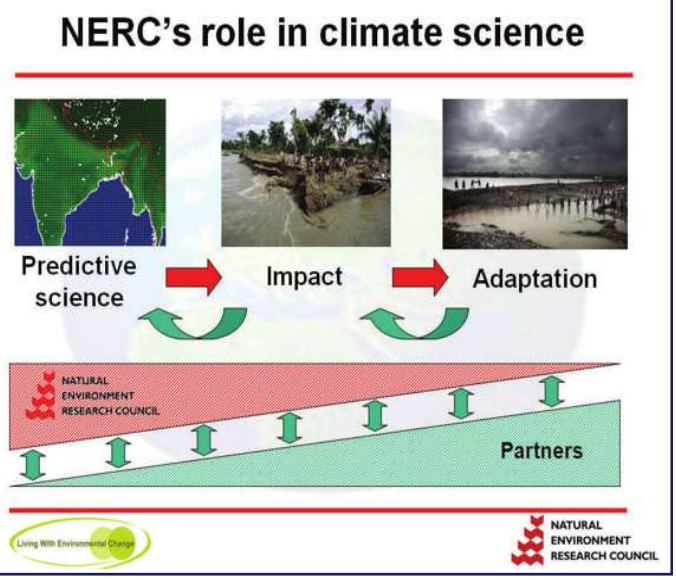


Figure 9: NERC's role in climate science[75]



- **Ongoing**

Ongoing approaches enable the dialogue to develop as scientific learning and humanitarian policymaking contexts evolve. While ongoing, the dialogue may take place at different levels of intensity and between different groups of partners at various stages within the dialogue process. Potential differential levels of dialogue are clearly portrayed with Figure 9, which considers the levels of NERC engagement with partners through the process of developing and applying climate science.

- **Direct**

It is evident that direct dialogue between scientists and humanitarian policymakers can support the development of

information which is relevant and tailored for specific humanitarian planning processes, and also offers the potential for those end users most affected to be able to articulate their concerns and appropriately inform the focus of ongoing and proposed future scientific research. Direct dialogue has, for example, brought climate scientists and non-governmental humanitarian climate change policy makers to consider the types of climate information which can best support different levels of humanitarian decision making[76], while earthquake and tsunami scientists have been able to support effective community disaster risk reduction efforts through direct telephone and email correspondence with national NGOs[77].

Scientists are keen to avoid potential misinterpretation by non -experts and prefer developing agreed interpretation of a specific area of science through direct discussion amongst a group of physical and social scientists with humanitarian colleagues. However, the challenge may lie in scaling up this direct dialogue to address the extremely diverse information requirements of the wider body of organisations with humanitarian responsibilities. There also remains the challenge of identifying and sharing generic learning about how best to support effective dialogue from across the range of direct, issue-specific science humanitarian policy dialogues.

- **Collaborative**

The need to allow for differences of opinion and avoid 'selective science'[78] has, been evident from HFP research on future crisis drivers undertaken in the areas of , amongst others, pandemics[79] and climate science. Individual exchanges, such as those undertaken between the Institute of Development Studies and the InterGovernmental Authority on Development's Climate Prediction and Application Centre (ICPAC)[80] or between the University of Ulster, Kogami and Concern International[81] are faster operationally and sustainable if both parties are committed to continuation of the exchange. However they do not necessarily allow for differences of scientific opinion nor automatically translate into wider organisational or sectoral change.

Resources to engage scientific expertise are extremely limited within humanitarian organisations, and particularly amongst non-governmental actors. It is highly unlikely that resources will be sufficient to commission engagement from across scientists with different points of view, or indeed that humanitarian policymakers have the scientific expertise to identify which are the most important differences with which to engage[82]. Pooling resources can better support difference of scientific opinion, as well as facilitating joint learning, within science humanitarian policy dialogue.

- **Contextualised**

Recognition of the need to contextualize scientific learning to make it 'useful' has been growing amongst both humanitarian policymakers and scientists[83]. There have been important efforts to better integrate existing and community and indigenous knowledge and emerging scientific learning, whether this be with regard to climate science[84] or tsunamis.

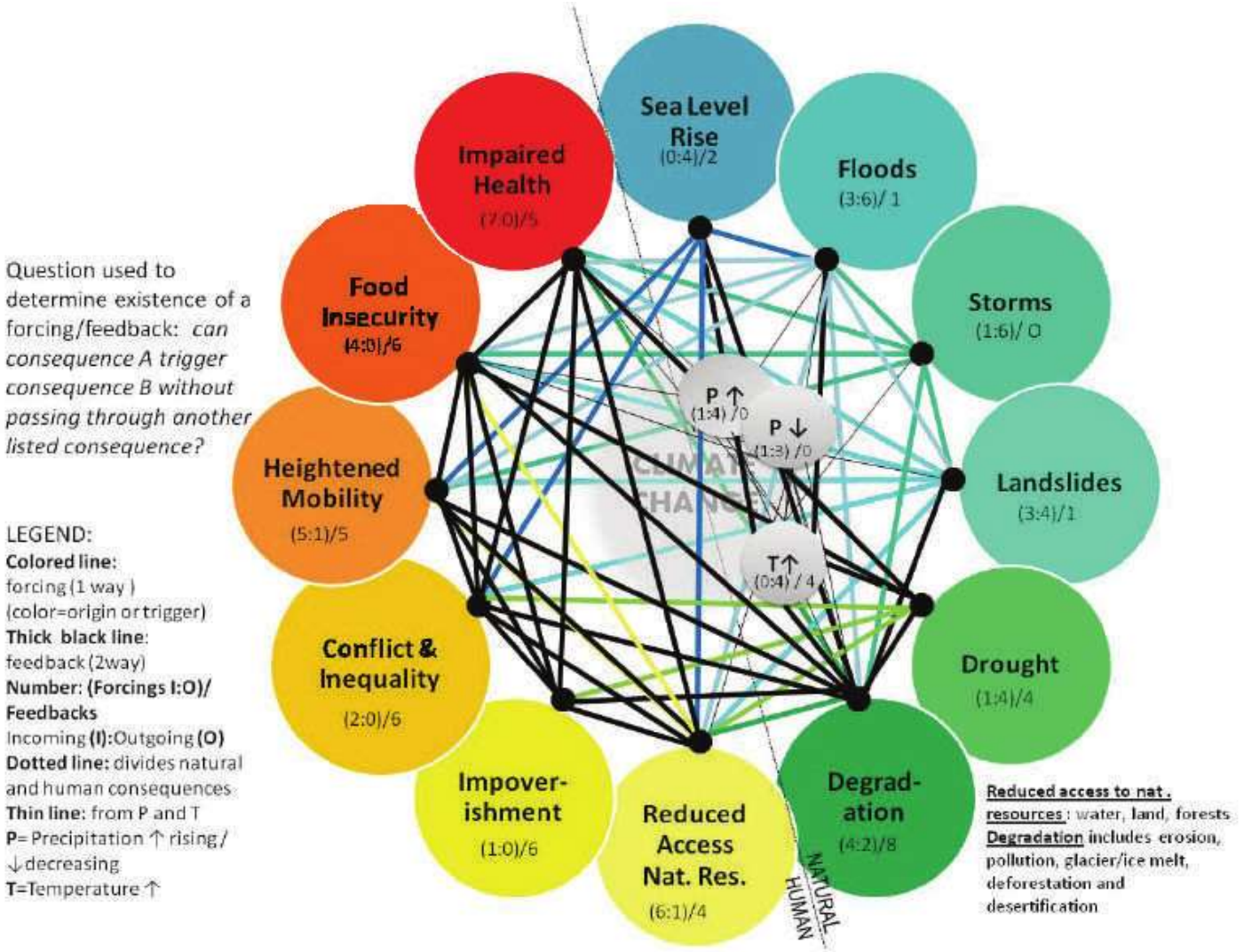
Contextualisation requires identification of the complex interlinkages between underlying vulnerabilities and future crisis threats to enable appropriate prioritization and integration of scientific learning at different levels of decision-making. For example, the Stockholm Environment Institute's report on Climate change and its humanitarian impacts[85] commissioned within the joint HFP/Tufts University Humanitarian Horizons project, includes a diagram (see Figure 10, p20) which depicts the vital importance of contextualizing climate science within humanitarian and development planning. The ability to appropriately rank risks also requires developing shared objectives, and agreed frameworks and metrics to enable comparison and appropriate prioritization across existing and future risks and vulnerabilities.

- **Practically demonstrate the benefits of enhanced science humanitarian policy dialogue.**

Scientists and humanitarian policymakers and the partners and communities with whom they work have understandably been more willing to invest time in engaging with science-humanitarian policy dialogue initiatives which have demonstrable benefits. For example, HFP's second mission with the UNCT in Tajikistan explored the potential role of innovation, communication and technology in supporting the ability of practitioners to understand and prepare for the diverse factors affecting human vulnerability. As follow up, HFP partnered with Google-founded InSTEDD to determine how their innovative tools for early disease detection and disaster response might be applied in the Tajikistan context. The pilot employed the InSTEDD-developed small group SMS communication software, called GeoChat, that allows select individuals to communicate with each other simultaneously through "radio broadcast"-like messages that can also be instantaneously mapped anywhere in the world on a web-accessed computer. This pilot supported community-resilience, enabling participating communities to themselves identify, map and share areas of vulnerability[87].

The willingness to engage in science humanitarian dialogue which offers both immediate and longer-term benefits has also been evident within the exchange between climate scientists and humanitarian policy makers which HFP initiated

Figure 10: Potential forcings and feedbacks between climate change consequences, Stockholm Environment Institute[86]



in the UK in 2009. The group has established an ongoing series of discussions hosted by different participating institutes, new organisations regularly contact HFP wishing to engage with this initiative and the National Centre for Atmospheric Science (NCAS), Walker Institute for Climate System Research, has proposed the development of an African Gateway, which specifically recognizes the value of continuing and extending the exchange initiative. Community, non-governmental and governmental partners in Kenya and Senegal have welcomed the exchange approach and are keen to undertake demonstration studies to support more effective use of climate, and in particular seasonal forecasting, within all levels of humanitarian and development decision making.

- **Take advantage of coinciding interests**

Efforts to strengthen science-humanitarian policy interaction are more likely to succeed where they support co-inciding priorities and interests amongst scientific institutions and humanitarian organisations. The Futures Groups which HFP undertook within its work with a number of UNCTs supported both the UNCT[88] desires to consider new convening and standard setting roles, and provided a much sought after avenue for local and regional scientists to inform UN and government strategic planning processes. Equally, the climate science humanitarian policy exchange was able to take advantage of the fact that scientists have long been seeking to identify an opportunity to operationalise their climate science, while humanitarian and development policy makers have been anxious to develop direct communication with climate scientists. This has subsequently led partners to identify opportunities for integrating elements of the climate science-humanitarian policy dialogue within their ongoing programmes, research and networks. Christian Aid is, for example, investigating the possibility of the dialogue being linked with the Development and Environment group of BOND (the UK membership body for non-governmental organisations working in international development), while there may be an opportunity for a regional exchange workshop within the EU FP7 Quantifying Weather and Climate Impacts on Health in Developing Countries (QWeCI) programme.

- **Visionary leadership which affords organisational space to engage with scientific learning**

Humanitarian partners have repeatedly raised the need for champions to promote new approaches for dealing with future crises within their organisation. Reflecting on the efficacy of the multi-disciplinary working groups employed within the recently completed Quantifying and Understanding the Earth System (QUEST) project, a lead scientist similarly identified that effective science policy dialogue requires leadership which is 'both visionary and practical'[89]. HFP work on the qualities required for effective strategic leadership in 21st Century organisations has echoed this, specifically highlighting the need for leaders to be able to:

- ✓ Ask critical questions,
- ✓ Maximize collaboration through situating themselves at the nexus of different, inter-connected sectors and
- ✓ Balance the capacity to be more anticipatory with taking on evolving capacities which allow for greater certainty in planning[90].

Strengthened science humanitarian policy dialogue will greatly strengthen these leadership capacities. However, affording organizational space for the dialogue requires that leaders already value the importance of this process in supporting effective leadership.

Box 2: Learning how to ask the right kind of questions to the right kind of people:

HFP efforts to strengthen science policy dialogue on issues of future vulnerability have demonstrated that the more clearly defined the question, the better the answer. To ask the right kind of question:

You need to know what you can know

To be better prepared for potential future humanitarian crises, there is a need to ensure we worry about the right things: to focus solution seeking by distinguishing resolvable from (currently) irresolvable problems; to better delineate 'known unknowns' from the 'unknown unknowns', and develop appropriate frameworks for addressing both areas. What is clear is that 'You can't wait on certainty'. There remains a need to make decisions in the absence of quantitative information.

You need to know who to talk to

The degree of concern afforded an issue of future vulnerability can vary depending on an individual's level of understanding of:

- The theoretical scientific learning
- The potential impact
- The levels of current scientific certainty

Knowledge of existing resilience and vulnerabilities within an at-risk community or region.

An issue may, for example, be very differently ranked by individual scientists and according to individual humanitarian policymakers and community decision makers' understanding of how emerging trends may impact upon existing community vulnerabilities.

You need to know how to ask a question which will give you a useful answer

One scientist interviewed made clear that '*We are under no obligation to answer stupid questions.*'[91] Scientists have recommended that humanitarian policymakers explicitly request clarity on the levels of certainty and understanding of potential impact upon which their advice is operating. For their side, humanitarians have urged scientists to develop better understanding of the 'thresholds in physical systems' and 'thresholds in humanitarian decisionmaking' so that they have a better understanding of 'the diverse set of concerns that determine people's actual choice under uncertainty: what do people need to weigh, beyond the physical aspects of the hazards, before deciding whether to act or not'[92].

5.0 Recommendations and proposed next steps for supporting more effective science-humanitarian policy dialogue

Emerging scientific learning and increasing global interconnectedness make strengthened science-humanitarian policy dialogue more important than ever. Both the evolving nature of future crisis and the practical benefits of such dialogue identified through the course of the report suggest that there is enormous potential in scaling up the success of discipline, organisation and geographic-specific pilots to promote better understanding and application of scientific learning.

Those who fund, develop or use science need to invest in building effective 'spaces' for regular science-policy dialogue on issues of future vulnerability. Amongst the areas of science-humanitarian policy dialogue which this study has identified as requiring specific consideration are included:

- **Examining the role of science-humanitarian policy intermediaries**, the types of organisations which should take on this function and the roles which they should play. There is growing recognition of the important intermediary role which those with humanitarian responsibilities are already undertaking. There is now an urgent need to consider how this role might evolve, and the level of scientific literacy, resources and capacities which undertaking science-humanitarian policy intermediary roles will require. The need to raise understanding and appropriate use of statistical information has, for example, been repeatedly raised across a range of HFP's work on science policy dialogue.
- **Building a database of cases where science has effectively informed humanitarian policymaking and developing frameworks which measure both the impact of enhanced science-humanitarian policy dialogue and the effectiveness of different dialogue approaches in informing humanitarian policymaking processes.** Together these bodies of evidence can support efforts to raise the priority and resources acorded science-humanitarian policy dialogue. These resources will also support the identification of generic earning from across geographic, organization, sectoral and issue-specific initiatives concerning those approaches which have been most effective in supporting effective science-humanitarian policy dialogue.
- **Engaging psychological and communications expertise to develop forms of information which are most able to support the integration of scientific learning within humanitarian policymaking**, particularly where scientific learning is uncertain or emerging.
- **Incentivising application of science to address future vulnerabilities** through developing new forms of sectoral recognition and accountability. The scientific and humanitarian communities remain, in large part, self-referential. There is a need to both ensure that humanitarian work is appropriately informed by the best available science, and to review the validity of existing scientific peer review processes. While not denying the importance of continued space for 'blue skies' thinking, there is a need to challenge assumptions over the differential value of theoretical and applied science.

HFP proposes ongoing revision of this report as a working document which brings together evolving learning from across efforts to strengthen science-humanitarian policy dialogue. Specifically, HFP will continue to:

1. Identify and develop approaches which are effective in supporting science-humanitarian dialogue and share this learning across discipline, sector and geographic-specific science policy initiatives. HFP has, for example, sought to share learning gained through supporting the climate science-humanitarian policy dialogue within similar efforts which aim to promote resilience through enabling scientists to more directly support communities at risk of earthquakes and volcanoes. HFP is keen to extend and strengthen this role.
2. Develop a 'toolkit' or guide for science-humanitarian policy dialogue, drawing together innovative and effective approaches with illustrative case studies, and available in both written and on-line formats.
3. Support efforts to institute systematic and sustained two-way dialogue between scientists, humanitarian policy makers and vulnerable and crisis-affected communities. As a first step, HFP intends to gauge interest in developing a science-humanitarian policy practitioners' network and to identify opportunities to integrate this within forthcoming meetings and events.

Annex 1: Some useful resources for learning on science humanitarian policy dialogue

Centre for Research on the Epidemiology of Disaster (CRED) EM-Dat, The International Disaster Database

http://www.emdat.be/

Climate Change Agriculture and Food Security (CGIAR), http://www.ccafs.cgiar.org/

Disasters Round Table of National Academies, http://dels-old.nas.edu/dr/index.shtml

Enhanced Learning and Research for Humanitarian Assistance (ELRHA), http://www.elrha.org/

Food and Nutrition Technical Assistance (FANTA) II, http://www.fantaproject.org/

Harvard Humanitarian Initiative, http://hhi.harvard.edu/

InTERRAgate, http://www.interragate.info/

Information Technology for Humanitarian Assistance, Cooperation and Action, http://www.ithaca.polito.it/

MIT Joint Program on the Science and Policy of Global Change, http://globalchange.mit.edu/

NERC, Science Impacts Database, http://sid.nerc.ac.uk/list.aspx

PAGER (Prompt Assessment of Global Earthquakes for Response), http://earthquake.usgs.gov/earthquakes/pager/background.php

Partners for Humanitarian and Risk Education Expansion, http://www.phree-way.org/

Royal Society Science Policy Centre, http://royalsociety.org/policy/

SciDev, http://www.scidev.net/en/

Science and Technology Policy Research (SPRU), University of Sussex, http://www.sussex.ac.uk/spru/

Social, Technological and Environmental Pathways to Sustainability (STEPS), University of Sussex, http://www.steps-centre.org/

UK Collaborative for Development Science, http://www.ukcds.org.uk/

UN GlobalPulse, http://www.unglobalpulse.org

WeADAPT, Stockholm Environment Institute, http://www.weadapt.org.uk/

World BankGlobal Facility for Disaster Reduction and Recovery (GFDRR), http://www.gfdrr.org/gfdrr/

Annex II: Bibliography of HFP materials

Available on the HFP website www.humanitarianfutures.org

Humanitarian Futures: Practical Policy Perspectives, ODI/ HPN Network Papers, No 46, 2004

Integrated Action Plan mission reports:

- Integrated Action Plan Central African Republic, 2007
- Comoros
- Ecuador
- Tajikistan I and II
- Venuzuela

HFP workbooks of humanitarian crisis drivers tailored for each mission

Humanitarian crisis drivers of the future, HFP project undertaken for USAID, 2008-2010, with outputs including a series of project notes on interviews undertaken in India, China and Russia to inform the project, and three individual reports:

- Revisiting Pandemics from a Futures Perspective
- The waters of the Third Pole
- Urban catastrophes: The Wat/San dimension

Stockholm Environment Institute, Climate change and its humanitarian impacts, a report commissioned within the joint HFP/Tufts University Humanitarian Horizons project, 2009

Report to ECOWAS Beyond 2020: Crisis drivers in West Africa's Future, 2008

Reports of Future Group workshops in the UK, 2006

Dimensions of Crisis Impacts: Humanitarian Needs by 2015, report for DFID, 2007

Report of the HFP Futures Group workshop, October 2007

Promoting the dialogue between scientists and humanitarians, HFP Briefing paper, 2007

Review of the dialogue between scientists and humanitarian policy makers on issues of human vulnerability, intern report, 2008

HFP Seminar series 2007-2009

Planning for future climate change crises, 2009

Exchange as a tool for science-humanitarian dialogue: learning from a series of pilot exchanges between climate scientists and humanitarian policy makes, 2009

Strategic leadership in 21st Century humanitarian organisations, A Scoping Study, 2009

Visman, E, A Morse, C Caminade and M Edwards, Making climate science useful, CLIVAR exchanges, Vol 15 No 1, 2010

Suarez, P and A Tall, Towards forecast-based humanitarian decisions: climate science to get from early warning to early action, paper commissioned by HFP, 2010

Wilby, R, How climate science can effectively inform humanitarian and development planning and programmes – a climate scientist perspective, paper commissioned by HFP, 2010

Reports of exchange workshops:

- March 2010 at King's College, London
- July 2010 at the Natural Environment Research Council
- November 2010 at the UK Collaborative in Development Science

January 2011 at the End to End Quantification of Uncertainty for Impacts Prediction (EQUIP) conference

Report of the exchange team visit to Nairobi and Arusha, February-March 2011

Policy Lab, co-hosted at the Royal Society, June 2010

End Notes

1. This report employs the term 'those with humanitarian responsibilities' and 'humanitarian policymakers' to encompass policymakers, decision makers and practitioners working at community, national, regional and international levels within both the humanitarian
2. HFP activities to support science policy dialogue have unearthed significant differences in understanding as to who constitutes 'end users' of scientific knowledge. As documented in the HFP briefing paper 'Exchange as a tool for science humanitarian dialogue' (HFP, 2009 p15), While both climate scientists and humanitarian policymakers employed the term 'end users', 'each employed the term to cover widely diverging groups of users of climate information, ranging from community associations to national and regional meteorological institutions'.
3. HFP activities to support science policy dialogue have unearthed significant differences in understanding as to who constitutes 'end users' of scientific knowledge. As documented in the HFP briefing paper 'Exchange as a tool for science humanitarian dialogue' (HFP, 2009 p15), While both climate scientists and humanitarian policymakers employed the term 'end users', 'each employed the term to cover widely diverging groups of users of climate information, ranging from community associations to national and regional meteorological institutions'. Humanitarian decision makers themselves were also considered 'end users' of science – employing scientific learning to appropriately inform humanitarian decision making, as well as being intermediaries, bringing scientific learning to the communities and partners with whom they work, and enabling community concerns to inform the focus of future scientific research.
4. This report employs the term 'those with humanitarian responsibilities' and 'humanitarian policymakers' to encompass policymakers, decision makers and practitioners working at community, national, regional and international levels within both the humanitarian and development sector, as well as other sectors which impact on future vulnerability. The range, activities and importance of the diverse range of humanitarian actors is evolving rapidly.
5. P 24, Humanitarian Emergency Response Review, for the Department for International Development (2011), http://www.dfid.gov.uk/Documents/publications1/HERR.pdf
6. Blakemore, C, If I ruled the world, Prospect, January 2011, p5, http://www.prospectmagazine.co.uk/2010/12/should-scientists-rule-the-world/
7. International Federation of Red Cross Red Crescent Societies (2008) World Disasters Report 2008.
8. Forecasting the numbers of people affected annually by natural disasters up to 2015, Shamanthy Ganeshan, Oxfam GB, Research Intern (Economist) & Wayne Diamond, Oxfam GB, Global Research Methods Adviser, http://www.oxfam.org.uk/resources/policy/climate_change/downloads/forecasting_disasters_2015.pdf
9. Information provided by Dr. Gerald Roberts, Reader in Earthquake Geology, Department of Earth and Planetary Sciences, Birkbeck, University of London, citing research from the Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University, Sendai, Japan, published in Journal of Geophysical Research Volume 108 No B5, 2249, 2003
10. HFP, The water of the Third Pole, Humanitarian Crisis drivers of the future, 2010.
11. Statistics of the National Bureau of Statistics and Ministry of Civil Affairs.
12. Statistics from the State Supervision and Management Administration of Production Safety show 12 million deaths have been caused by such accidents each year, more than 70 million people have been injured, with direct and indirect economic losses amounting to about 250 billion).
13. Guo Zhenchun,"Major Types of Geological Hazards and Predisposition in Guizhou and Its Preventive Suggestion", Guizhou Geology, 2003(2).
14. http://www.emdat.be/technological-disasters-trends
15. http://www.emdat.be/natural-disasters-trends
16. Professor Sir Martin Rees, Reith Lectures, Lecture 1: The Scientific Citizen, ://www.bbc.co.uk/radio4/features/the-reith-lectures/transcripts/2010/
17. Professor Sir Martin Rees, Reith Lectures, Lecture 2: Surviving the Century http://www.bbc.co.uk/radio4/features/the-reith-lectures/transcripts/2010/

18. HFP, Promoting the dialogue between scientists and humanitarians, Briefing paper, 2007
19. The New Manifesto developed within the Social, Technological and Environmental Pathways to Sustainability Centre (STEPS) at the University of Sussex, http://www.anewmanifesto.org/manifesto_2010/
20. International Council for Science Committee on Freedom and Responsibility in the conduct of science (IFRS) Advisory Note on Science Communication, http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/3596_DD_FILE_ICSU_Sci_Comm n_Adv_Note_Dec2010.pdf and Communication: a responsibility of all scientists, Editor by David Dickson, SciDev, http://www.scidev.net/en/editorials/communication-a-responsibility-of-all-scientists.html. Recent controversies over climate science data and reliance on existing, closed peer-review processes have led a number of US scientists to overcome their reticence to engage with political debates and 'risk' their credibility. They have now developed a rapid response team charged with providing climate information to the media and the public. *Scientists have a duty to engage with the public on climate change, Guardian, 8 November 2010, http://www.guardian.co.uk/environment/cif-green/2010/nov/08/climate-science-bad-information and Do Scientists Have a Special Responsibility to Engage in Political Advocacy?, 13 September 2010, http://bigthink.com/ideas/24012*
21. Bull Volcanol (1999) 60 :323–334 Q Springer-Verlag 1999ORIGINAL PAPER
22. NERC Science Impacts Database, http:///sid.nerc.ac.uk/list.aspx
23. http://www.nerc.ac.uk/research/programmes/resilience/events./note.asp
24. Including Rural Knowledge Centres in India, as identified within HFP India Mission 2009, and Peoples Research Centres in Bangladesh, as identified within Action Aid presentation to the climate science humanitarian policy exchange dialogue meeting 2010.
25. P12, HFP, Promoting the dialogue between scientists and humanitarians, 2007.
26. P13, HFP, Promoting the dialogue between scientists and humanitarians, 2007.
27. SPHERE standards have, to some degree, incorporated environmental concerns. There is a need to review how SPHERE standards, HAPI and ECB Good Enough Guides incorporate and are informed by relevant science.
28. Scientists interviewed for the 2007 HFP Briefing Paper, Promoting the dialogue between scientists and humanitarians.
29. Within discussion undertaken during a pilot to support increased usage of earthquake science within DRR, it became clear that at least two INGOs operational in Haiti prior to the 2010 earthquake failed to sufficiently prioritise earthquakes within their contingency planning.
30. HFP, Planning for Future Climate Change crises, 2009.
31. HFP interviews with scientists in 2008, 10 in India: 4 in China: 7 in Russia. In the UK: 18 in 2007 and 10 in 2008. As well as interviews undertaken within the Integrated Action Plan with UNCTs in CAR, Comoros, Tajikistan, the Philippines and Ecuador in 2007/8.
32. HFP interviews with policymakers in 2008, 9 in India, 2 in China, 1 in Russia. In the UK 26 in 2007 and 18 in 2008. As well as interviews undertaken within the Integrated Action Plan with UNCTs in CAR, Comoros, Tajikistan, the Philippines and Ecuador in 2007/8.
33. The UKCDS is a cross-departemental, cross-research council government initiative to maximize complementarity, coherence and impact of UK research in development science.
34. Professor Tim Palmer and UN Assistant Secretary General Margareta Wahlstrom presented at the Royal Society/HFP Policy Lab on extreme weather events held in June 2010, see: http://www.humanitarianfutures.org/main/content/policylab
35. Report of the exchange team visit to Nairobi and Arusha, March 2011, www.humanitarianfutures.org
36. As noted in Section 1.4 above.
37. A report of the July 2010 workshop cohosted by NERC and HFP is available at http://www.humanitarianfutures.org/main/fgnercworkshop
38. Suarez, P and A Tall, Towards forecast-based humanitarian decisions: Climate science to get from early warning to early action, Paper commissioned by HFP, March 2010 available at www.humanitarianfutures.org
39. The approach has been welcomed not only within activities undertaken in the UK. The Futures Groups undertaken within HFP missions for UNCTs in the CAR, Tajikistan and the Comoros were, for example, particularly welcoming of this approach.

40. As noted earlier in Section 1.5, the Royal Society, NERC and UKCDS have all co-hosted science policy fora with HFP.

41. P12, HFP, Promoting the dialogue between scientists and humanitarians, 2007.

42. See footnote 2.

43. PAGER is an automated system that produces content concerning the impact and potential scope of significant earthquakes, http://earthquakes.usgs.gov/earthquakes/pager/background.php

44. Benfield Grieg Hazard Research Centre, Operations Manual for the Caribbean, http://www.bgs.ac.uk/research/international/DFID-KAR/ADD018_COL.pdf

45. Tall, A. (2010). Climate forecasting to serve communities in West Africa. World Climate Conference-3. Procedia Environmental Sciences1: 421-431.

46. HFP, Promoting the dialogue between scientists and humanitarians, 2007. Planning timeframes for disaster risk reduction and development work vary greatly and are generally longer.

47. P11, 'Sustainable energy without the hot air'. http://www.withouthotair.com/

48. HFP India Mission, 2009, HFP exchange work 2009-present.

49. University of Ulster, Concern, British Geological Survey, Integration of science of high probability unpredictable hazards into disaster reduction programmes: Lessons from Western Sumatra, http://www.elrha.org/uploads/Final%20ELRHA%20Report-%20UU-Concern.pdf

50. Humanitarian Futures: Practical Policy Perspectives, ODI/ HPN Network Papers, No 46, 2004, and the Humanitarian Emergency Response Review commissioned by UK DFID, 2011, http://www.dfid.gov.uk/Documents/publications1/HERR.pdf

51. These include humanitarian policy makers within government ministries, regional institutions, UN agency head and country offices, INGO networks and national and international non-governmental organisations.

52. OSAT respondents ranked their organisation's incorporation of climate change within policies, capacity and operations as higher than most other risks. Nevertheless the ongoing exchange between climate scientists and humanitarian policymakers which HFP has supported since 2009 has highlighted the very varying capacities of policymakers to effectively engage with relevant areas of climate science. This raises the spectre of major organisational weaknesses when facing risks for which policymakers consider there to be even less organisational capacity.

53. P2, Jones, H, N Jones, D Walker and C Walsh, Strengthening Science-Policy Dialogue in Developing Countries, ODI Background Note, December 2009.

54. HFP, Promoting the dialogue between scientists and humanitarian, 2007.

55. HFP, The waters of the Third Pole, Humanitarian drivers of the future, 2010.

56. Promoting the dialogue between scientists and humanitarian, 2007.

57. University of Glasgow, Oxfam, High science in low-technology emergency settings: a forseeable horizon or height of folly, ELHRA small grant project trial report, http://www.elrha.org/uploads/Final%20ELRHA%20Report-%20Glasgow-Oxfam.pdf

58. P41, Kania, J and M Kramer, Collective Impact, Stanford Social Innovation Review, Winter 2011

59. P9, The Institute of Engineering, Population explosion: Can the planet Cope, 2011, http://www.imeche.org/news/archives/11-01-12/Population_Explosion_Can_the_Planet_Cope.aspx . Similar findings are echoed with the 2011 UKCDS review of UK investment in climate research.

60. The DFID/UK Met Office Hadley Centre Climate Science Research Partnership supports the development of climate science for Africa. It includes, but places less emphasis, on engaging the full range of end users within an ongoing, two-way dialogue to develop accessible climate information.

61. Tsunami Evaluation Coalition Synthesis report, Joint evaluation of the international response to the Indian Ocean tsunami, January 2007.

62. Both the World Meteorological Office's 2009 Global Framework for Climate Services and the UK DFID-supported Climate Development Knowledge Network funding have prioritized governmental end users' climate information requirements.

63. Suarez, P and A Tall, (2010) Towards forecast-based humanitarian decisions: Climate science to get from early warning to early action. Paper commissioned by the Humanitarian Futures Programme

64. Kenya Red Cross Society, Lessons Learnt – el Nino Floods

Interventions, 2009

65. http://www.elrha.org/uploads/Final%20ELRHA%20Report-%20UU-Concern.pdf

66. Ding Jie, China to double science communicators by 2020, 8 September 2010, http://www.scidev.net/en/news/china-to-double-science-communicators-by-2020-1.html

67. Michaels, S, Matching knowledge brokering strategies to environmental policy problems and settings, Environmental Science and Policy 12, 2009, pp 994-1011. Howells, J, Intermediation and the role of intermediaries in innovation. Research Policy 35 (2006) 715-728. Lorentzen, J and R Mohammed, 'To each according to his (or her) needs. Where are the poor in innovation studies?', March 2010, SPRU, Nick Fest. Klerkx, L, A Hall and C Leeuwis, 'Strengthening agricultural innovation capacity: are innovation brokers the answer?', International Journal of Agricultural Resources, Governance and Ecology, Vol 8 No 5/6, 2009, p409-438.

68. IDRC/Climate Change Adaptation in Africa, Integrating meteorological and indigenous knowledge-based seasonal climate forecasts to the agricultural sector, September 2010, http://www.idrc.ca/uploads/user-S/12882908321CCAA_seasonal_forecasting.pdf

69. HFP, Science Humanitarian policy dialogue, 2007 and HFP Strategic leadership in 21st Century humanitarian organisations, A Scoping Study, 2009

70. Promoting the dialogue between scientists and humanitarians, HFP Briefing paper, 2007

71. http://www.bbc.co.uk/radio4/features/the-reith-lectures/transcripts/2010/

72. '*The need to limit opinions to one's field of professional competence.* A final responsibilty is that the volcanologist should remember, and if necessary remind the civil authorities, that the decision to evacuate involves not simply the numerical assessment of the hazard probability but also the off-setting of this against the economic and social consequences of evacuation. Most volcanologists have little or no expertise in sociology or economics and are therefore not in a position to provide the best judgement as to what constitutesthe limit of acceptable risk. This is emphatically not a case of avoiding a responsibility: it is a case of limiting one's opinion to one's field of professional competence.' John Tomblin, Seismic Research Unit, University of the West Indies, Trinidad, Journal of Volcanology and Geothermal Research, 5 (1979) 213--215 213

73. P5, Report of the Futures Group workshop, October 2007.

74. From David Stainforth's presentation to 'Tolerating the right kind of uncertainty'. a workshop co-hosted by the Liverpool University and HFP at the End-to-End Quantification of Impacts Project (EQUIP) conference, January 2011.

75. From Ned Garnett's presentation to the first climate science humanitarian policy working group, held at NERC in July 2010.

76. HFP exchange discussions and meetings in the UK and with partners in Kenya and Senegal.

77. Personal communication and http://www.elrha.org/uploads/Final%20ELRHA%20Report-%20UU-Concern.pdf

78. P36, HFP, The Waters of the Third Pole, 2010.

79. P 5-6, HFP, Revisiting Pandemics from a Futures Perspective, Humanitarian crisis drivers of the future, 2009

80. As outlined within the IDS presentation to the first climate science-humanitarian policy working group co-hosted with NERC in July 2010, see further workshop report at http://www.humanitarianfutures.org/projects/current/futuresgroup.

81. P, University of Ulster, Concern, British Geological Survey, Integration of science of high probability unpredictable hazards into disaster reduction programmes: Lessons from Western Sumatra, http://www.elrha.org/uploads/Final%20ELRHA%20Report-%20UU-Concern.pdf

82. P1029-1031, Stirling, A, Keep it Complex, Nature 468, December 2010, http://www.nature.com/nature/journal/v468/n7327/full/4681029a.html

83. See, for example, p40, The Institute of Engineering, Population explosion: Can the planet Cope, 2011, http://www.imeche.org/news/archives/11-01-12/Population_Explosion_Can_the_Planet_Cope.aspx

84. IDRC/Climate Change Adaptation in Africa, Integrating meteorological and indigenous knowledge-based seasonal climate forecasts to the agricultural sector, September 2010, http://www.idrc.ca/uploads/user-S/12882908321CCAA_seasonal_forecasting.pdf and 'Participatory downscaling' developed by Dominic

Kniveton, University of Sussex, for the HFP exchange workshop in Nairobi, February 2010, http://www.humanitarianfutures.org/sites/default/files/Report_of_exchange_team_visit_to_Nairobi_and_Arusha_23_February%20final%20%282%29.pdf

85. Available from www.humanitarianfutures.org

86. P36, Stockholm Environment Institute, Climate change and its humanitarian impacts, report for the HFP/Tufts University Humanitarian Horizons project, November 2009.

87. HFP, Integrated Action Plan, Final report of the HFP Phase II Mission to Tajikistan, 2009, http://www.humanitarianfutures.org/main/sites/default/files/IAP%20Tajikistan%20Report%20(Phase%202).pdf

88. See above Section 1.5.

89. p2, Prentice, C, Why Working Groups Work, QUEST, July 2010.

90. HFP, Strategic leadership in 21st Century humanitarian organisations, A Scoping Study, 2009.

91. P15, HFP, Promoting the dialogue between scientists and humanitarians, 2007.

92. P8, 2010, Suarez, P and A Tall, Towards forecast-based humanitarian decisions: climate science to get from early warning to early action, paper commissioned by HFP .