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Incorporating Climate Change and Growth into the Post-2015 Framework for Disaster Risk Reduction

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Abstract

Since the early 1980s, total economic losses from natural perils have more than tripled in real terms. Without strong and progressive interventions, climate change and the continued growth of populations and wealth in hazard-prone areas will push the human and economic costs of disasters to even higher levels. Recent reports, such as the 2012 Special Report of the Intergovernmental Panel on Climate Change (IPCC), show that addressing these trends will bring new and additional challenges for disaster risk management (DRM). The period 2012-2015 is an important opportunity to address these risks, as international focus on disaster risk ramps up in the preparation of the Post-2015 Framework for Disaster Risk Reduction, the successor to the Hyogo Framework for Action (HFA) 2005-2015. This paper aims to inform this process by evaluating how the principles of the HFA may need to evolve in the new Framework to help tackle these challenges. We consider whether the Priorities for Action of the HFA are suitable to encourage and inform action that is consistent with the strategies laid out by the IPCC and others. From this, we draw a set of preliminary recommendations for the Post-2015 Framework. It is hoped that this analysis will provide a foundation for further discussion, investigation and consultation.

Summary of Policy Implications

- The Post-2015 Framework for Disaster Risk Reduction provides an opportunity to raise awareness of the implications of climate change and exposure growth for disaster risk and to provide an appropriate platform that can encourage and inform actions that will help to address them as part of disaster risk management.
- Our analysis suggests that the Strategic Goals and Priorities for Action of the Hyogo Framework for Action (HFA) 2005-2015 provide the right foundation for tackling these challenges. But, we conclude that to address the emerging risks will require a scaled-up and more urgent implementation of the HFA's Priorities for Action.
- The Post-2015 Framework will also need to go further, including, for example, a stronger emphasis on the need to manage the underlying drivers of long-term trends in risk, as opposed to just current risk factors, and a strategic goal that emphasises DRM as a progressive, flexible, learning process, rather than a one-off.
- Growth and urbanisation are likely to remain the two greatest drivers of increases in disaster risk. To help address these trends, the successor to the HFA will need to be more strongly integrated with the structure and processes of the Post-2015 UN Development Agenda, and the successor to the Millennium Development Goals.

I. Introduction

The economic and human costs of disasters are rising. Since 1980, total economic losses from all natural perils globally have increased by $34 billion per decade (in real terms, Neumayer and Barthel, 2011). Increasing damages have been observed in most countries, but the greatest impacts, in terms of lives lost and long-run impacts on human development have fallen on developing countries (Hoeppe and Gurenko, 2006). Over this period, weather catastrophes alone have caused almost 1.2 million fatalities and led to direct damages amounting to US$610 billion in low and lower middle income countries[i]. Unless the impacts of natural perils can be systematically reduced, past development gains will be at risk and human security increasingly threatened (World Bank 2010a).

The 2012 Special Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that there is strong evidence that *exposure* growth has been the major driver of the global trend in losses (Handmer *et al*., 2012). While economic growth tends to be beneficial for disaster risk management (DRM), through reducing societal vulnerability (UNISDR, 2007), it has also been associated with an accumulation of assets in hazard-prone (typically, urban) areas. Population growth similarly increases exposure. In a much richer, more populous world, it may be little wonder then that losses are rising (Hallegatte, 2011). But, surprisingly, in many regions, losses are rising more quickly than aggregate wealth (UNISDR, 2009). This suggests that DRM is failing to keep pace with increasing exposure. It also suggests that such macro-scale trend analyses hide a much more complex reality, where local factors such as poverty, political instability and environmental degradation can play a significant role in driving levels of risk. Climate change will add to these challenges.

Many recent reports have stressed the urgent need to reduce risks and build resilience to disasters (Cutter *et al.* 2012; Dfid 2011; Foresight, 2012; UNISDR 2011a; World Bank 2010c). This has been the central goal of the Hyogo Framework for Action 2005 - 2015 (HFA). This framework, summarised in Figure 1, describes a comprehensive set of actions that a country can take to strengthen its risk governance capacities. It was developed through a participatory process, adopted by the World Conference on Disaster Reduction in 2005 and subsequently endorsed by 168 Member States of the United Nations (UN). The HFA process has been successful in increasing understanding and knowledge of the priorities for risk reduction (UNISDR, 2012), as well as in galvanising dialogue and cooperation between stakeholders and governments. By offering a framework for evaluation, the HFA aims to catalyse strategic, action-oriented planning. In 2010-2011, the UN International Strategy for Disaster Reduction (UNISDR) carried out a mid-term review of the progress of countries against the HFA. It reported that, in general, progress has been made in a number of areas of the HFA since 2005, such as developing the policy, legislative and institutional foundations for DRM, but it found that there are still many weaknesses in capacities (UNISDR, 2011b).

The UN General Assembly requested that UNISDR facilitate the development of a Post-2015 Framework for Disaster Risk Reduction (DRR), to succeed the HFA. This process provides an important opportunity to consider how the priorities of the HFA might need to evolve to help to tackle the challenges posed by climate change and exposure growth through raising awareness and providing the right platform to encourage and inform appropriate action. In this paper, we consider what new elements this platform may need to include.

Recent governmental and intergovernmental reviews, like the 2012 Special Report of the IPCC, suggest that addressing these challenges will require changes in the way that societies manage disaster risks, particularly for developing countries. In this paper, we compare the Priorities for Action of the HFA to the policies, measures and approaches recommended by

the IPCC and others (including Dfid 2011; Foresight, 2012; UNISDR 2011a, b; World Bank 2010a, c). From this analysis, we make specific suggestions for the Post-2015 Framework. We do not address the structure of the Post-2015 Framework in this paper; it is not yet clear what form the Post-2015 Framework will take, so we assume that it will resemble that of the HFA. Our aim is to use the available scientific and economic evidence to inform the political debate and provide a foundation for consultation and dialogue. The first outline of the framework is due in 2013, to be finalised in 2014, ready for consideration and adoption at the World Conference on Disaster Reduction in 2015.

Figure 1: Summary of the Hyogo Framework for Action 2005-2015 (UNISDR, 2007).

<table>
<tr><td colspan="5">Expected Outcome
“The substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries”</td></tr>
<tr><td rowspan="5">⇓ STRATEGIC GOALS ⇓</td><td rowspan="5">The integration of disaster risk reduction into sustainable development policies and planning

The development and strengthening of institutions, mechanisms and capacities to build resilience to hazards

The systemic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes.</td><td rowspan="5">⇓ PRIORITIES FOR ACTION ⇓
And key activities (in reduced form)</td><td>1. Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation</td><td>- DRR institutional mechanisms, designated responsibilities
- DRR as part of development policies and planning
- Legislation to support DRR
- Decentralisation of responsibilities and resources
- Assess resources and capacity
- Foster political commitment
- Community participation</td></tr>
<tr><td>2. Identify, assess and monitor disaster risks and enhance early warning</td><td>- Risk assessment and maps
- Indicators on DRR/vulnerability
- Early warning
- Scientific and technological development
- Regional and emerging risks</td></tr>
<tr><td>3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels</td><td>- Information sharing and cooperation
- Cross-discipline networks
- Use of standard DRR terminology
- Risk education (inc. in schools)
- Training and learning on DRR at all levels
- Public awareness and media</td></tr>
<tr><td>4. Reduce the underlying risk factors</td><td>- Sustainable ecosystems and environmental management
- DRR strategies integrated within climate adaptation
- Food security for resilience
- DRR integrated into health sector
- Protection of critical public facilities
- Recovery schemes and social safety nets
- Vulnerability reduction with diversified income options
- Financial risk sharing mechanisms
- Public-private partnerships
- Land use planning and building codes
- Rural development plans and DRR</td></tr>
<tr><td>5. Strengthen disaster preparedness for effective response at all levels</td><td>- Disaster management capacities: policy, technical and institutional capacities
- Dialogue, coordination and information exchange between disaster management and development sectors
- Regional approaches to disaster response, with DRR focus
- Review and exercise preparedness and contingency plans
- Emergency funds
- Voluntarism and participation</td></tr>
</table>

We begin by briefly summarising the current evidence on how risk is likely to evolve over the next two decades. Section III then draws together the evidence on how strategies may need to change to reduce risks and build resilience in a world where risk is changing. We focus on hydrometeorological perils[ii] and three policy areas: the balance between ex-ante and ex-post measures; the design of strategies to cope with uncertainty; and the role of insurance. Section IV then considers the challenges for institutions. We conclude with a set of recommendations for the Post-2015 Framework for DRR.

II. The Changing Risk Environment

Risk is characterised by three components. The *hazard* describes the physical characteristics of the peril (e.g. its frequency and severity). The *vulnerability* is determined by the circumstances of a community, system or asset that make it susceptible to the damaging effects of a peril[iii]. Finally, the *exposure* is defined by the people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Hazard, vulnerability and exposure are each changing constantly. Below we review the major drivers.

Firstly, over the next few decades, population growth, urbanisation and economic growth will continue to increase the *exposure* to natural perils in many regions. Most of this growth will occur in urban centres, which tend to be located in hazard-prone areas, close to coasts and major rivers (UNISDR, 2011a). Today, 52% of the global population (3.6 billion people) live in urban areas and this is expected to rise to around 63% (5.6 billion people) by 2040 (UNDESA, 2012); the change in urban-rural balance being most dramatic across Africa and Asia. Over the coming decades, these trends are likely to have a dominant influence on risk, particularly at the regional and global levels. For example, Hanson *et al.* (2011) concluded that the combined influences of population and economic growth and urbanisation would lead to more than a doubling of the number of people exposed, and an eight-fold increase in the value of economic assets exposed, to storm surges in the world's largest cities by the 2070s. The number of people located in hazard-prone areas is expected to rise most rapidly in developing countries, particularly the Asian megacities (Figure 2). Conversely, the total value of exposed economic activity and assets, including buildings, infrastructure and businesses, is likely to increase most rapidly in the developed and emerging economies.

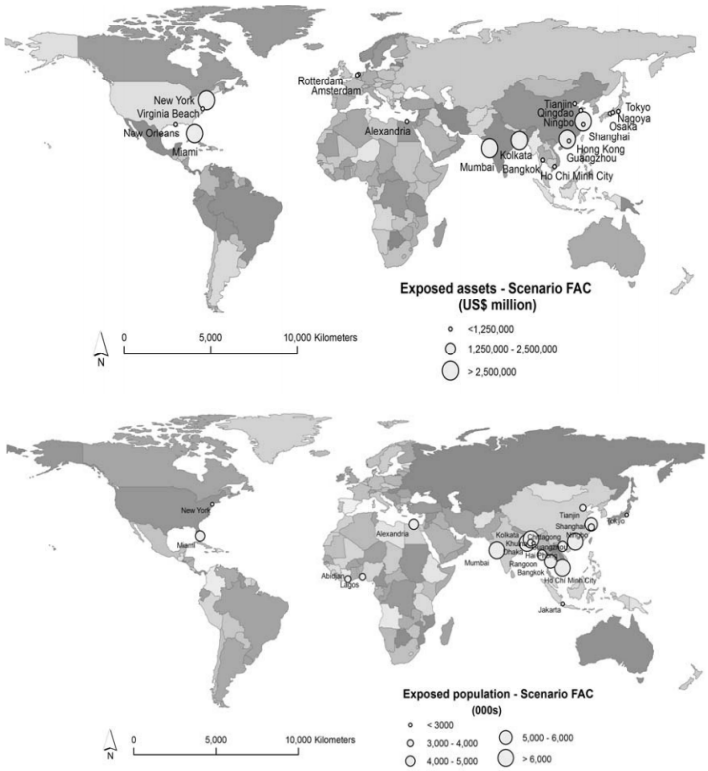

Figure 2. Top 20 cities in terms of exposed assets (top) and population (bottom) in the 2070s, assuming climate change, subsidence, population and economic growth and urbanisation (Hanson et al. 2011).

Secondly, hazard levels are also changing, possibly more rapidly than in the past. There is growing evidence that human-caused climate change has already adjusted the characteristics of rainfall and temperature extremes in many parts of the world (Seneviratne

et al. 2012). The IPCC's 2012 Special Report suggests that globally, on average, the world will see a shift toward more severe weather events over the coming decades (Table 1). Some regions could see reductions in one type of hazard and increases in another, while others could become susceptible to new perils. There is also significant uncertainty over the scale and types of changes we will experience, particularly at the local level.

Natural Peril	**Projected global changes (up to 2100) with respect to the late 20th century**
Temperature extremes	*Virtually certain*[iv] decrease in the frequency and magnitude of unusually cold days *Very likely* increase in length, frequency and/or intensity of warm spells and heatwaves over most land areas.
Heavy Rainfall and Flooding	*Likely* increase in frequency of heavy rainfall events over most land areas and *medium confidence* that this will contribute to rain-generated local flooding (but *low confidence* in projections of future flood risk due to insufficient evidence).
Tropical Storms	*Likely* decrease or no change in frequency of tropical cyclones *Likely* increase in mean maximum wind speed, but possibly not in all basins *Likely* increase in heavy rainfall associated with tropical cyclones
Extratropical Storms	*Likely* impacts on regional activity (low confidence in detailed projections) *Medium confidence* in a reduction in the numbers of mid-latitude storms *Medium confidence* in projected poleward shift of mid-latitude storm tracks
Droughts	*Medium confidence* in projected increase in duration and intensity of droughts in some regions
Extreme water levels	*Very likely* that mean sea level rise will contribute to upward trends in extreme coastal water (surge) levels.

Table 1: Examples of conclusions of the 2012 IPCC Special Report (Seneviratne et al. 2012)

Natural climate variability also affects the severity and frequency of perils. For example, the El Nino Southern Oscillation (ENSO)[v] has a major influence on the risk of drought, flooding and storms around the tropics (Holland, 2009). Indeed, there is evidence that for some perils, the affects of natural climate variability may remain larger than the human-caused trend until at least around 2030, and longer in some cases (Parry *et al.* 2007).

At a local level, human activities have direct and immediate affects on hazards. For example, environmental degradation and land-use change are increasing the severity of hazards in some areas. The 2005 Millennium Ecosystem Assessment reported that many ecosystems that regulate natural perils, such as forests, mangroves, wetlands and coral reefs, are in decline (Hassan *et al.* 2005). In some countries, groundwater extraction is causing subsidence, creating major problems for many rapidly developing cities (Hanson *et al.* 2011).

Increases in exposure and hazard do not necessarily translate into rising risk if there is a corresponding increase in protection. There is evidence that the number of people killed (as a proportion of the population) in natural disasters is falling; one sign that vulnerability to natural perils is, on average, decreasing in many areas (UNISDR, 2009). But, the ongoing increase in losses from hydrometeorological perils proves that any vulnerability reductions are failing to keep pace with the trends in exposure and hazard by some significant margin.

There is also evidence that vulnerability is increasing for many communities. For example, almost 1 billion people live in informal settlements around the world's fastest growing cities and this is rising at a rate of 25 million per year (UNISDR, 2009). The urban poor are more vulnerable due to their living conditions, weak governance and lack of investment in infrastructure (Satterthwaite, 2007); thus, many countries are seeing growing urban hotspots in vulnerability. Conflict, political instability, poverty and disasters themselves can also increase the vulnerability of communities (UNISDR, 2011a).

When combined, the expected trends in exposure, hazard and vulnerability suggest that the damages from hydrometeorological perils will continue to grow over the coming decades.

But there is considerable uncertainty over the scale of the increases. Lavell *et al.* (2012) highlights that estimating the impacts of future natural perils is at least as challenging as projecting climate change, involving predicting the behaviour of complex systems under stressed and novel conditions, and the interplay with other risk factors, such as resource scarcity and rising demand for food, water and energy. An important factor will be to what extent societies can curb the long-term drivers of risk and implement effective DRM.

The evidence suggests that at the global level, society can expect a shift toward more *intensive risk* in the future; that is, a greater fraction of losses coming from more catastrophic events (UNISDR, 2009b; Figure 3). Already mortality and losses are concentrated in a small number of '*mega-disaster'* events; between 1975 and 2008, almost 80 per cent of deaths (1.8 million people) from natural perils were caused by only 0.25 per cent of recorded disasters (UNISDR 2009). In the future, *intensive risk* could rise as more people and assets are concentrated in exposed regions, and the intensity of weather extremes increases due to climate change. As the magnitude of the direct losses grows, we may also expect to see more long-lived negative impacts on economic growth, poverty alleviation and development in the poorest countries (Hallegatte *et al.* 2007). In addition, globalisation could mean that disasters generate economic disruption more widely across the world[vi]. Conversely, *extensive risk*, associated with more frequent, lower impact events, could decline in many regions as a result of the reductions in vulnerability associated with economic and social development.

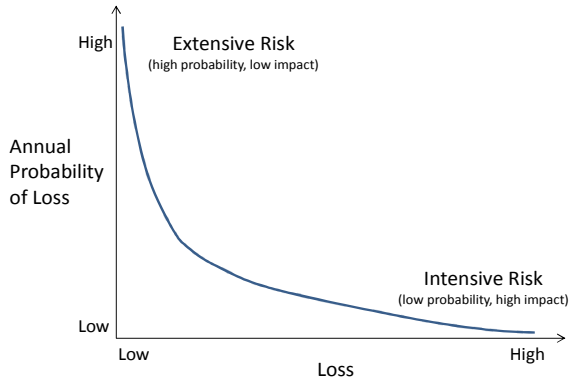

Figure 3. Diagram illustrating a classic probability-loss curve, showing the extensive risk (high probability, low impact) and intensive risk (low probability, high impact). A shift toward more intensive risk will mean that the probability-loss curve becomes more 'fat-tailed'.

Risk is expected to increase most strongly in the rapidly growing low and lower-middle income countries, where reductions in vulnerability have in the past failed to keep pace with the rapid increases in exposure (UNISDR, 2009). Here, risk is likely to be increasingly concentrated in urban centres, particularly those of small to medium size (second-tier cities), where governance capacities are lower and growth is less likely to be matched by investments in DRM (UNISDR, 2009 and 2011a). These trends have implications for the way risk management strategies are designed, which is discussed in the following Section.

III. Implications for Disaster Risk Management Strategies

An integrated disaster risk management strategy calls for a wide range of policies and measures. In this Section, we provide some introduction to DRM strategies and then present the latest thinking on how these might need to change where risk is increasing. Firstly, *disaster risk reduction* (DRR) measures aim to reduce the *direct* impacts of natural perils

before an event occurs through reducing levels of hazard, vulnerability and exposure (Figure 4). This can include structural measures, such as flood protection and restoring mangroves, and non-structural measures, such as land-use planning, diversified livelihoods and improved risk awareness. But, it is impossible to eliminate all risk; a further group of measures is available to help manage these *residual* risks, through reducing the impacts of natural perils *during and after they occur*. This group includes preparedness (early warning systems and emergency planning), disaster management (emergency and humanitarian response), risk transfer (such as insurance and social safety nets) and recovery. With the exception of disaster management and recovery, all these measures can be classified as *ex-ante*, that is, they are all implemented in advance of an event. In this section, we review current evidence on how the emerging risks outlined in Section II alter the mix of policies and measures that will deliver the best socio-economic outcomes.

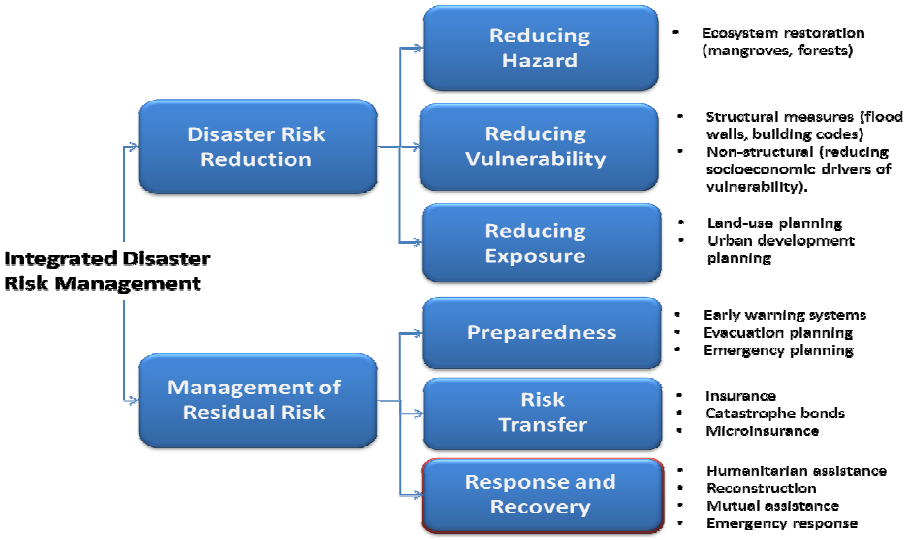

Figure 4. Schematic illustrating the components of an integrated disaster risk management strategy and examples of specific measures. Ex-post measures, implemented after a disaster, are circled in red.

A comprehensive strategy requires both *ex-ante* and *ex-post* measures. Ex-ante DRR is the only approach that can limit the immediate, *direct* fatalities and damage from natural perils. Ex-post measures, such as emergency response, humanitarian relief and assistance, post-disaster financing, reconstruction and rehabilitation, are crucial for a speedy recovery and for reducing the *indirect* impacts of disasters (Figure 5), such as disease, malnutrition and long-run effects on poverty alleviation and development (World Bank, 2010a).

Figure 5: Examples of potential direct and indirect impacts from natural hazards that may be alleviated through the measures shown in Fig. 2. Source: based on Hallegatte et al. (2007) and UNISDR (2009).

Greater Emphases on Ex-Ante DRR

The main focus of DRM in developing countries has been ex-post response (Lal *et al*. 2012; Dfid, 2011). Yet, international organisations, as well as academic research, have long highlighted the economic and social benefits of a greater emphasis on acting ahead of time (ex-ante), to reduce risk and build resilience before events occur (for example, Royal Society, 1992). Indeed, the HFA places a strong emphasis on DRR (Figure 1). Recent reviews suggest that the expected trends in risk strengthen the case for *ex-ante* action (Cutter *et al.* 2012).

Firstly, on purely economic grounds, ex-ante action has been shown to be several times more cost-effective than ex-post (World Bank 2010c) and where risk is rising, the benefits of DRR, relative to the costs, are even greater (Figure 6). Secondly, without ex-ante DRR, the direct losses and fatalities from perils will continue to grow.

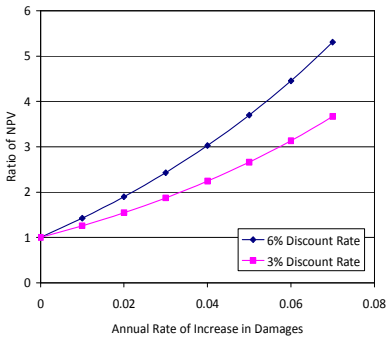

Figure 6: An illustrative cost-benefit analysis[vii] showing the relationship between the annual rate of increase in damages and the net present value (NPV) of an investment in DRR (expressed relative to the case where risk is unchanging) for two discount rates (6% and 3%). Source: authors' calculation.

The expectation of post-disaster assistance can actually discourage DRR (Kunreuther, 2006). In addition, disaster relief can be slow and insufficient and puts considerable strain on national governments and communities, diverting resources away development and poverty alleviation (UNISDR, 2009b). Together, this means that as risks increase, an overreliance on ex-post measures will become progressively less effective and more costly.

However, the evidence also points toward the need for a more long-term approach (Ranger and Garbett-Shiels, 2012). Traditional ex-ante DRR and the HPA itself, focus on managing current risks. This is an important foundation (Smit and Wandel, 2006), but to tackle the challenges of climate change and rapid exposure growth will also require a more *anticipatory* approach. The rationale is as follows. Firstly, strategic decisions are made every day that affect the societal vulnerability and exposure to natural perils for decades to come. For example, urban developments in coastal areas and environmental degradation have a significant effect on risk and are effectively irreversible. Better DRR cannot fully compensate for such activities and indeed, can create a false sense of safety that promotes further risk-taking (e.g. the 'levee effect'[viii]). A failure to better manage these decisions now will commit societies to a more risky development path. Secondly, for long-lived investments with high-sunk[ix] costs, such as infrastructure and buildings, it is often cheaper and easier to take account of future risks upfront, rather than making costly retrofits later (Fankhauser *et al.* 1999). Thirdly, the speed and scale of the changes in risk could limit the ability to manage risks in a reactive mode; for example, it will take time to build capacity and implement substantial new policies and programmes and therefore, it is important to act ahead of time.

In summary, the risks posed by climate change and exposure growth call for a more forward-looking and long-term approach to risk management than is currently practiced, with a greater emphasis on reducing risks before a disaster strikes. While the HFA does stress the need for ex-ante risk reduction and tackling the underlying *risk factors* (Figure 1), it does not

explicitly recognise the changing nature of risks, the benefits of acting now to address the *long-term drivers* of trends in risk or the need to anticipate long-term changes in policy and investment decisions today. We suggest that the Post-2015 Framework for Disaster Risk Reduction should place greater and more explicit emphasis on these needs.

Flexible, progressive interventions

While experts can identify the major trends in risk (Section II) it is not possible to know exactly how risks will evolve in the future, even in probabilistic terms (Lempert et al. 2003). If not managed well, uncertainty can lead us to take too much, not enough or the wrong types of risk management measures, leading to greater risks and costs, or wasted investments (Ranger and Garbett-Shiels, 2012). Evidence suggests that the high degree of uncertainty calls for a new approach to DRM, where long-term strategies, policies and measures are designed to be flexible and robust enough to cope with a broad range of possible future risk scenarios (Cutter *et al.* 2012). Given what is at stake, we suggest that a Post-2015 Framework should be designed to encourage such as approach. High uncertainty may also provide an even greater rationale for reducing risks ex-ante[x].

What does this mean in practice? Many types of DRR measures will reduce disaster risk whatever the future brings. These so-called *'no-regret'* measures include, for example, poverty alleviation, improving urban governance, diversifying rural livelihoods, health and education, insurance, restoring ecosystems, information (climate and risk) and building human and institutional capacity to manage risks (Cutter *et al.* 2012; World Bank 2010b).

However, there may be some difficult choices and trade-offs, particularly for example, where decisions concern long-lived infrastructure and buildings. For example, a decision over whether to increase investments in water infrastructure to maintain existing agricultural production, or to take the chance of shifting to less water intensive crops depend on long-term rainfall projections (O'Brien *et al.* 2012). To design robust strategies, recent literature and practice recommend that, rather than making one-off decisions now, planners should adopt a more flexible and progressive approach, which reduces risk incrementally (Fig. 5), while avoiding foreclosing future options (WRI 2011[xi]). Practically, a more flexible approach may involve strategies and measures that have wider safety margins or that can be adjusted over time in response to changing circumstances (Fankhauser *et al.* 1999). For example, the Thames Barrier in London can be over-rotated to protect the city if there is greater than anticipated sea level rise (Reeder and Ranger, 2011). A suite of tools are available to help inform decisions in such circumstances (Ranger *et al.* 2010).

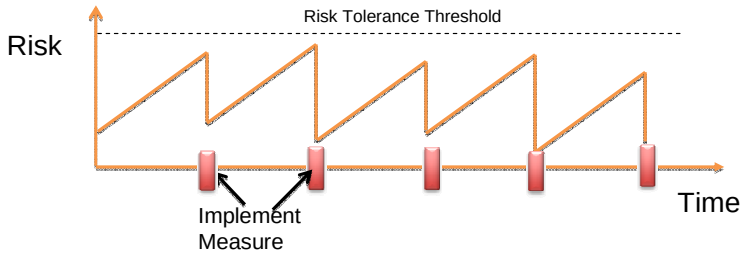

Fig 5. Illustration of the evolution of risk within an adaptive risk management approach

Robust approaches are not necessarily more expensive. But, they do require a more forward-looking and long-term approach that is supported by governance structures which enable regular monitoring and reviews of progress, flexible and adaptive planning, and learning and effective responses to new information (Pahl-Wostl 2009).

The guidance of the HFA provides no information on dealing with changing and uncertain risks in DRR. We suggest that a post-2015 Framework should include a more explicit recognition and guidance on changing and uncertain risks, including a strategic goal that emphasises DRM as a progressive, flexible, learning process, rather than a one-off.

Coupling DRR and Insurance

It is well understood that appropriately-designed insurance markets can play a positive role by helping to manage those risks that cannot be cost-effectively reduced (Warner *et al.* 2009). By sharing risks across groups, insurance (and risk transfer[xii] more widely) increases the financial resilience to natural perils, speeding recovery and reducing the long-run (*indirect*) impacts of disasters. While the availability and use of risk transfer instruments has been limited in low income countries[xiii], their increasing application in some development programmes and profile in international climate negotiations (Warner *et al.* 2009), suggests the need for a greater investigation of their application in a landscape of increasing risk.

Firstly, in an environment of more *intensive* risk (Section II) risk transfer could become a more important tool, as the capacity to absorb the highest losses may be reduced (Cutter *et al*. 2012). But, risk transfer is not a silver bullet solution. It does not reduce the *direct* impacts of disasters. This means that without ex-ante DRR, impacts will continue to increase. Where risk is rising, insurance will also become more expensive (Herweijer *et al.* 2009) and could eventually become unaffordable or unavailable[xiv].

A solution now widely recognised (e.g. Warner et al. 2009) is to couple ex-ante DRR and risk transfer. Indeed, well-designed risk transfer can actually incentivise DRR[xv] and so could play an important role in an environment where risk is rising (Kunreuther 2006). Based on this evidence, we conclude that insurance could play an increasingly important role in the future, but should support DRR rather than replace it. The guidance of the HFA stresses the benefits of public-private partnerships in delivering risk reduction (UNISDR, 2007); we suggest that a Post-2015 Framework can better inform action by providing more explicit guidance on the role of insurance and innovative ways to couple DRR and insurance.

IV. Practical Challenges for Risk Governance

In this Section, we consider the practical challenges brought about by the emerging risks described in Section II and the approaches outlined in Section III for institutions[xvi] and risk governance. The institutions involved in DRM in many least developed countries already struggle to manage current disaster risks (UNISDR 2011b), and we conclude here that the emerging challenges of climate change and rapid exposure growth could add to these. From the literature, we identify four main areas of additional practical challenges. We review the evidence on practical approaches to overcome these challenges and compare these to the recommendations to the HPA. In general, we conclude that the Priorities for Action set out by the HFA provide the right foundation for tackling these challenges, yet, there are some new areas which require attention, particularly those related to dealing with uncertainty.

Challenge 1 - A greater focus on ex-ante risk reduction

There are several existing barriers to ex-ante DRR in developing countries, including financial constraints, weak risk governance and a lack of capacity and information (Lal *et al*. 2012; Dfid, 2011). A particular challenge is that ex-post response, which brings tangible, immediate benefits, is often more politically appealing and broadly supported than investments in risk reduction, which can entail greater upfront costs but less immediate, certain and visible

benefits (O'Brien *et al.* 2012; Seck, 2007). This existing challenge may create a significant barrier to dealing effectively with the challenges of climate change and exposure growth, which as Section III suggests, call for a greater emphasis on ex-ante risk reduction. Indeed, this barrier may be worsened in this case, as for many decisions, the uncertainties and stakes will be higher, decisions more urgent and options more disputed[xvii] (O'Brien *et al.* 2012). Also, long-term risks are often seen as requiring less immediate attention than pressing issues such as economic growth, health and education (O'Brien *et al.* 2012).

The first Priority for Action of the HFA is to *"ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation*" and lays out a series of specific actions toward this goal, including: strengthening institutional mechanisms; integrating DRR within other policy agendas; and fostering political commitment (Figure 1). These objectives are consistent with those emphasised for climate change adaptation (Lal *et al*. 2012; World Bank 2010a). We conclude that the emerging challenges of a changing and uncertain risk environment underline the urgency of these activities laid out by the HFA.

Challenge 2 - Managing the long-term drivers of trends in risks

Section III called for more emphasis on tackling the long-term drivers of trends in risk. Yet, the 2011 assessment of progress against the HFA highlighted the lack of progress in this general area (the Fourth Priority for Action) in many developing countries (UNISDR, 2011b). The evidence points to several (interlinked) barriers to action. Firstly, at the national level, responsibility for DRM is often held within the Civil Defence and Ministries of the Interior, or a National Disaster Management Authority (Thomalla *et al*. 2006) which do not have the mandate, or sufficient influence within government, to address the most important drivers of risk, such as development planning (World Bank 2008; UNIDSR 2011b). Secondly, managing the underlying drivers of rising risk often involves complex policy challenges. For example, reducing migration into hazard-prone informal urban settlements requires addressing underlying issues, such as rural employment, changing livelihoods and wealth inequalities (Cutter *et al.* 2012). Thirdly, efforts can be constrained by competing political and economic pressures for development and poverty alleviation, a lack of incentives, social norms or a lack of capacity for enforcement (Mitchell *et al.* 2012; Hallegatte, 2011)[xviii].

The urgency of avoiding committing societies to vulnerable development paths identified in Section III strengthens the importance of making progress on the fourth Priority for Action of the HFA, but importantly, that there is a need for greater emphasis on managing the *long-term* drivers of trends in risk, such as environmental degradation and urbanisation in hazard-prone areas. UNISDR (2007) provides guidance here. The more recent literature also provides some lessons; for example, there is evidence that progress could be made through:

1. *Seizing opportunities to reduce long-term risks when they come about naturally, for example during reconstruction following a disaster or during urban redevelopment.* For example, this strategy has proved successful (but not the norm) in Mumbai, Delhi and New Orleans (O'Brien *et al.* 2012).
2. *Building high-level leadership and identifying champions.* The Kiribati Adaptation Program (KAP) is guided within the Office of the President, ensuring high-level champions and leadership. With this support, on the basis of extensive consultation, the KAP is successfully integrated across national development strategies and sectoral plans, and tied directly into all priorities and activities identified by the government planning documents (Mitchell *et al.* 2012).
3. *Ensuring attractive alternatives.* For example, incentivising development away from coastal areas by providing businesses with safe development zones connected to

ports by efficient transport networks and by providing cheap, rapid public transport from job centres to safe residential areas that can be developed (Hallegatte, 2011).

We conclude that a Post-2015 Framework for Disaster Risk Reduction should entail a greater emphasis on taking action now to curb the underlying drivers of long-term trends in risk, as opposed to just current risk factors. It should provide a more explicit link to interconnected policy issues, such as sustainable (climate-resilient) development and growth. It should also provide updated guidance and case studies on innovative policies and partnerships to tackle long-term trends in risk whilst not foregoing the benefits of growth.

The integration of development policy and disaster risk management should also be reflected at the international policy level. To help facilitate this, the successor to the HFA will need to be strongly integrated with the Post-2015 UN Development Agenda.

Challenge 3 - Technical capacity and decision making

The complexity and uncertain nature of long-term risk bring several additional challenges to the institutions involved in DRM. Firstly, the lack of technical capacity and risk information can already create a barrier to DRM (Prabhakar *et al*. 2009). To tackle these new challenges, additional skills and data may be required. While there is evidence of progress in developing these capacities within some institutions (for example, within those responsible for climate change adaptation) the institutions involved in DRM are often not integrated with these (UNISDR 2011; Schipper and Pelling 2006). Secondly, the nature of risks and uncertainties may raise fundamental psychological barriers to action[xix] that can adversely affect judgements about the allocation of efforts to address risks (Cutter *et al*. 2012).

There are also a number of existing barriers to be overcome; for example, risk assessments and decision analyses are important, but have little value if they are not integrated appropriately within institutional decision making structures. Lal *et al*. (2012) found limited evidence that national systems are explicitly integrating knowledge of future changes in risk. There are significant gaps in our understanding of the capacity of institutions to deal with changing and deeply uncertain risks (Prabhakar *et al.* 2009; Lal *et al.,* 2012).

The HFA stresses the need to identify, assess and monitor disaster risks (Priority 2), as well as activities to enhance the use of knowledge (Priority 3), but we argue that these activities must be implemented in a way that explicitly recognises the need to deal effectively with changing and uncertain risks. Given the evidence gaps in this area, further work is required to develop a set of relevant and informative guidance.

Challenge 4 - Implementing flexible, progressive decision making processes

The emerging risks call for a more flexible and progressive approach to DRM (Section III) but there is little evidence on how this can be achieved in practice (Lal et al., 2012) and how such an approach would fit within current institutional frameworks. There is evidence of barriers to learning in some areas; for example, a survey of Sub-Saharan African countries suggested that few would review, update and improve their DRM plans over time (World Bank 2008). There is also evidence of a lack of information and knowledge management within DRM organisations, which has constrained the ability of the organisations to learn from changing circumstances (FAO 2008; World Bank 2008). Better understanding this capacity is an important area of future research. The goals and priorities of the HFA provide little explicit guidance on potential approaches to overcome these challenges. In particular, they do not emphasise DRM as a progressive, flexible and learning process. A high level review of the literature suggests some initial recommendations, for example:

1. *(a) Implementing processes to regularly review the effectiveness of DRM and (b) building appropriate governance structures that integrate this knowledge progressively into decision making at multiple-levels, from local to national.* For example, the Cayman Islands have a National Hurricane Committee that assesses the response to hurricanes at several levels and identifies successes and failures. Findings are incorporated into the National Hurricane Plan (Tompkins 2005).
2. *Structuring risk management programmes (and associated institutional frameworks) with long-term mandates, which allow flexibility in plans, and a clear mandate for monitoring, review and updates*. For example, the Yangtze River project in China addresses flooding issues in the basin through a 30 year master plan with regular 5 year updates (Pittock and Xu 2010).

There is a need for more work in this area to develop a more comprehensive and tested set of recommendations that could inform future action.

V. Conclusions

The changing and uncertain nature of the emerging risks associated with climate change and exposure growth will bring new challenges for disaster risk management (DRM), particularly in developing countries. The evidence suggests that to manage these trends, will require a more forward-looking, flexible and progressive approach to DRM than is observed in practice, with a greater emphasis on ex-ante risk reduction and on managing the underlying drivers of the long-term trends in risk. Such approaches have been argued for decades, yet the emerging trends and risks further stress the need for their adoption.

There is evidence that action could come up against several existing and new barriers. We conclude that to tackle the emerging risks will require a scaled-up and more urgent implementation of the HFA's Priorities for Action, particularly those concerning the integration of disaster risk reduction into sustainable development policies and planning.

We conclude that in some areas, the Post-2015 Framework for Disaster Risk Reduction will need to strengthen or extend the priorities of the HFA to tackle these trends, including: (i) stronger emphasis on the need to manage the underlying drivers of *long-term* trends in risk (as well as current risks), including providing practical guidance; (ii) greater recognition of the need to understand and deal with changing and uncertain risks within HFA Priorities 2 (on risk assessment and early warning) and 3 (on using knowledge to build resilience); and (iii) a strategic goal that emphasises DRM as a progressive, flexible, learning process, rather than a one-off. We have also identified areas where further research is required to inform the Post-2015 Framework, in particular, on the practical applications of approaches to cope with uncertainty in decision making. This set of recommendations is preliminary but it is hoped that they will provide a basis for discussion and consultation.

Finally, this paper has demonstrated that *climate-resilient* development is central to managing disaster risk over the long-term, as core development decisions made today will influence risk significantly, and sometimes irreversibly, for decades to come. Achieving this goal will require a greater integration of disaster risk (and adaptation) into core development policy at all levels, from local to international. Hence, to address future disaster risk, the successor to the HFA will need to be strongly integrated with the Post-2015 UN Development Agenda.

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[i] Countries with a gross national income per capita of less than $11,905 US in 2010. Data supplied by Munich Re.
[ii] Hydrometeorological perils are defined as phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. They include tropical cyclones (typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, storm surges, floods, drought, heatwaves and cold spells.
[iii] Vulnerability has both physical (such as the quality of housing and protective infrastructure) and social and institutional aspects (such as low levels of health care, lack of access to early warnings and a lack of vehicles for evacuation). The term also incorporates resilience, the capacity to recover from events when they occur.
[iv] The likelihood and confidence statements in Table 1 are expert judgements by the IPCC on the robustness of conclusions given current knowledge. For example, *virtually certain* indicates a >99% probability, *very likely,* a >90% probability and *likely,* a >66% probability, based on expert judgement of the available evidence. A confidence statement indicates the type, amount, quality, and consistency of evidence; for example, a low confidence suggests little available research or little consistency between findings at present. A likelihood statement implies high confidence.
[v] ENSO is a pattern of climate variation (mainly across the Pacific) that follows a cycle of roughly 4 – 5 years.
[vi] The floods in Thailand in 2011 caused major disruption to supply chains of electronics across the world, and many poor communities were severely affected by global food price increases in 2008 (WEF 2010). Conversely, access to global food, financial (insurance) and energy markets can increase the resilience to local weather.
[vii] The actual ratios of NPV also depend on the size of the costs and benefits. Here, the cost-benefit analysis assumes an upfront cost of $100,000 and annual benefits accrued at a rate of $10,000 per year. The benefits of DRR are assumed to grow at the same rate as the annual average damages. The decision maker is risk neutral.
[viii] For example, building flood defences can encourage people to build homes behind them, as observed, for example, in New Orleans prior to Hurricane Katrina (Montz and Tobin 2008).
[ix] Sunk costs are costs that cannot be recovered.
[x] For example, if the decision maker were ambiguity adverse (Lempert et al. 2003).

[xii] Risk transfer includes any mechanism whereby an individual or organisation (the insured) transfers part of their risk to an insurer in return for a payment (the premium). If the insured experiences a loss, the insurer pays out a previously agreed amount.
[xiii] There are a number of barriers to extending the use of insurance in developing countries, including affordability and a lack of local capacity and distribution networks (Warner et al. 2009). However, recent innovations in risk transfer, such as micro-insurance, sovereign catastrophe bonds and regional risk pooling, attempt to increase the accessibility of risk transfer for lower-income countries and are now evolving from the initial pilot phase.
[xiv] In developed markets, increasingly catastrophic losses have led private insurers to withdraw from some markets (Priest et al. 2005, Botzen and van den Bergh, 2008). This has resulted in insurance becoming unavailable to many households, reducing their resilience.
[xv] Pilot projects have trialled innovative approaches to promoting DRR through the design of risk transfer, such as the Wind Hazard Mitigation programme in Florida, which offers premium discounts for homeowners that invest in verified risk reduction measures, and the Harita micro-insurance scheme in Ethiopia, which enables the insured to pay premiums through work on risk reduction (Warner et al. 2009).
[xvi] We focus on institutions for two reasons. Firstly, the quality of a country's governance of risk will have a significant influence on the evolution of risk and its underlying drivers over the coming decades (UNISDR, 2011a). Secondly, a forward-looking and long-term approach to DRM (Sections III) may require a greater role for national and regional government, in delivering public goods and in building the legislative and regulatory frameworks, incentives and partnerships to stimulate and support effective action by other actors.
[xvii] Responding rationally to slow-onset long-term drivers, such as climate change, can be inhibited by difficulties in making trade-offs across time and between options with uncertain benefits (Cutter et al. 2012; O'Brien et al. 2012).
[xviii] For example, industrial areas on the coast tend to have a higher economic productivity than those inland (associated with transport networks and cheaper access to markets) and so attract further development.

[xix] Individuals often underestimate the likelihood of rare but catastrophic events (but conversely, when disasters occur, people's estimates of their future risk are temporarily inflated) (Weber *et al.* 2004) and can misjudge external drivers of risk and overestimate their own response capacity (O'Brien et al. 2012; Hertwig et al. 2004).