The geography of poverty, disasters and climate extremes in 2030

Andrew Shepherd (ODI)
Tom Mitchell (ODI)
Kirsty Lewis (UK Met Office)
Amanda Lenhardt (ODI)
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Lucy Scott (ODI)
Robert Muir-Wood (RMS)

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Met Office
Hadley Centre

RMS

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A crowd of stranded villagers gather on the banks of Ethiopia's Lake Tana

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Acronyms

CARRI	Community and Regional Resilience Institute
CMIP	Coupled Model Intercomparison Project
CRED	Centre for Research on Epidemiology of Disasters
DEC	Disaster Emergency Committee
DRM	Disaster risk management
DRR	Disaster risk reduction
GAIN	Global Adaptation Index
GCM	Global Circulation Models
GSHAP	Global Seismic Hazard Assessment Program
HFA	Hyogo Framework for Action
IADB	Inter-American Development Bank
IF	International Futures
IPCC SREX	The Intergovernmental Panel on Climate Change's Special Report on Managing the Risks of Extreme Events and Disasters
JDU	Janta Dal United
LIC	Low-income country
LMIC	Lower middle-income country
MHI	Multi-hazard Index
MIC	Middle-income country
NDMA	National Disaster Management Authority
OWG	Open Working Group
PVI	Poverty Vulnerability Index
RMS	Risk Management Solutions
UMIC	Upper middle-income country
UNISDR	UN International Strategy for Disaster Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
WMO	World Meteorological Organisation

Executive summary

Key messages

- Extreme weather linked to climate change is increasing and will likely cause more disasters. Such disasters, especially those linked to drought, can be the most important cause of impoverishment, cancelling progress on poverty reduction.
- Up to 325 million extremely poor people will be living in the 49 most hazard-prone countries in 2030, the majority in South Asia and sub-Saharan Africa.
- The 11 countries most at risk of disaster-induced poverty are Bangladesh, Democratic Republic of Congo, Ethiopia, Kenya, Madagascar, Nepal, Nigeria, Pakistan, South Sudan, Sudan, and Uganda.
- Disaster risk management should be a key component of poverty reduction efforts, focusing on protecting livelihoods as well as saving lives. There is a need to identify and then act where the poor and disaster risks are most concentrated.
- The post-2015 development goals must include targets on disasters and climate change, recognising the threat they pose to the headline goal of eradicating extreme poverty by 2030.

Climate change and exposure to 'natural' disasters threaten to derail international efforts to eradicate poverty by 2030. As temperatures warm, many of the world's poorest and most vulnerable citizens will face the growing risks linked to more intense or lengthy droughts, extreme rainfall and flooding and severe heat waves – risks that threaten lives and livelihoods, as well as the hard-won gains made on poverty in recent decades. The impoverishing impact of both climate change and natural disasters is so grave that the UN Secretary General's High Level Panel (HLP) on Post-2015 Development Goals[1] has suggested a target to be added to the first proposed post-2015 development goal on ending poverty: 'to build resilience and reduce the number of deaths caused by disasters'.

We already know that disasters have a distinct geography,[2] that poverty is concentrated in particular parts of the world and that climate change has an impact on extremes of heat, rainfall and droughts in many regions.[3] But how will these patterns overlap in 2030, the probable end point for the next set of development goals, and how serious a threat do disasters and climate change pose to our prospects of eliminating extreme poverty in the next two decades?

This report, *The geography of poverty, disasters and climate extremes in 2030*, examines the relationship between disasters and poverty. It concludes that, without concerted action, there could be up to 325 million extremely poor people living in the 49 countries most exposed to the full range of natural hazards and climate extremes in 2030.[4] It maps out where the poorest people are likely to live and develops a range of scenarios to identify potential patterns of vulnerability to extreme weather and earthquakes – who is going to be vulnerable and why. These scenarios are dynamic: they consider how the threats may change, which countries face the greatest risk and what role can be played by disaster risk management (DRM).

The report argues that if the international community is serious about eradicating poverty by 2030, it must address the issues covered in this report and put DRM at the heart of poverty eradication efforts. Without this, the target of ending poverty may not be within reach.

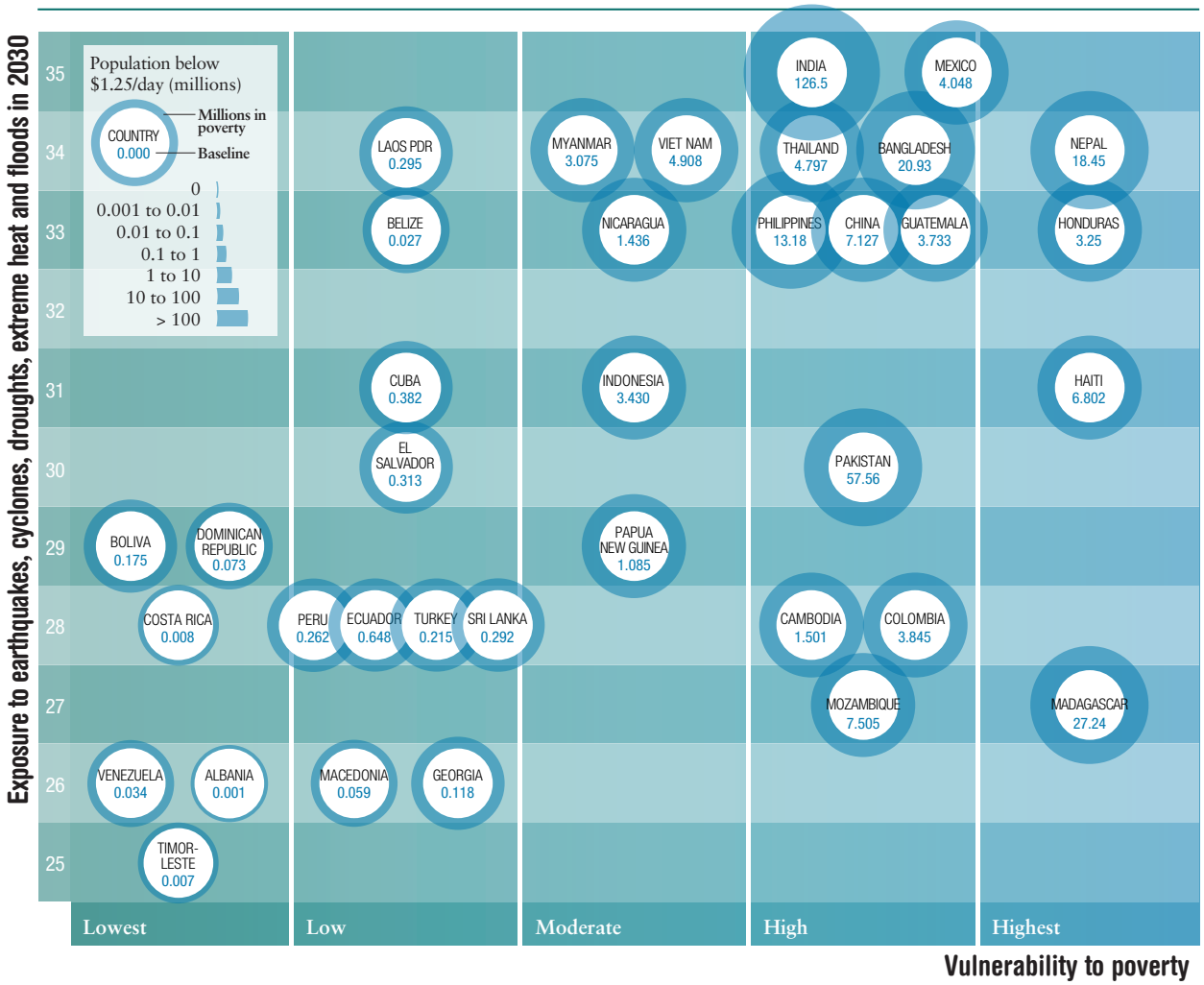
The links between disasters and poverty

In combining climate, disaster and poverty projections, the report finds that high levels of poverty will still be seen in 2030 if we follow a 'business as usual' approach. Discounting earthquake and cyclone exposure, and assessing just drought, extreme temperature and flood hazards alone, reveals that between 176 and 319 million extremely poor people will be living in the 45 countries most exposed to these hazards by 2030. This is a major concern as drought and flood hazards are among the most potent shocks when it comes to causing long-term impoverishment.

Natural disasters spiral into human catastrophes when they entrench the poverty that already exists and pull more people down into poverty as their assets vanish, together with their means to generate an income. The risk of impoverishment is linked to lack access to the markets, capital, assets and insurance mechanisms that can help people to cope and to rebuild. This combination of exposure to climate vulnerability and limited access to social safety nets, to land and to work is a serious risk factor, as is living in a remote rural area.

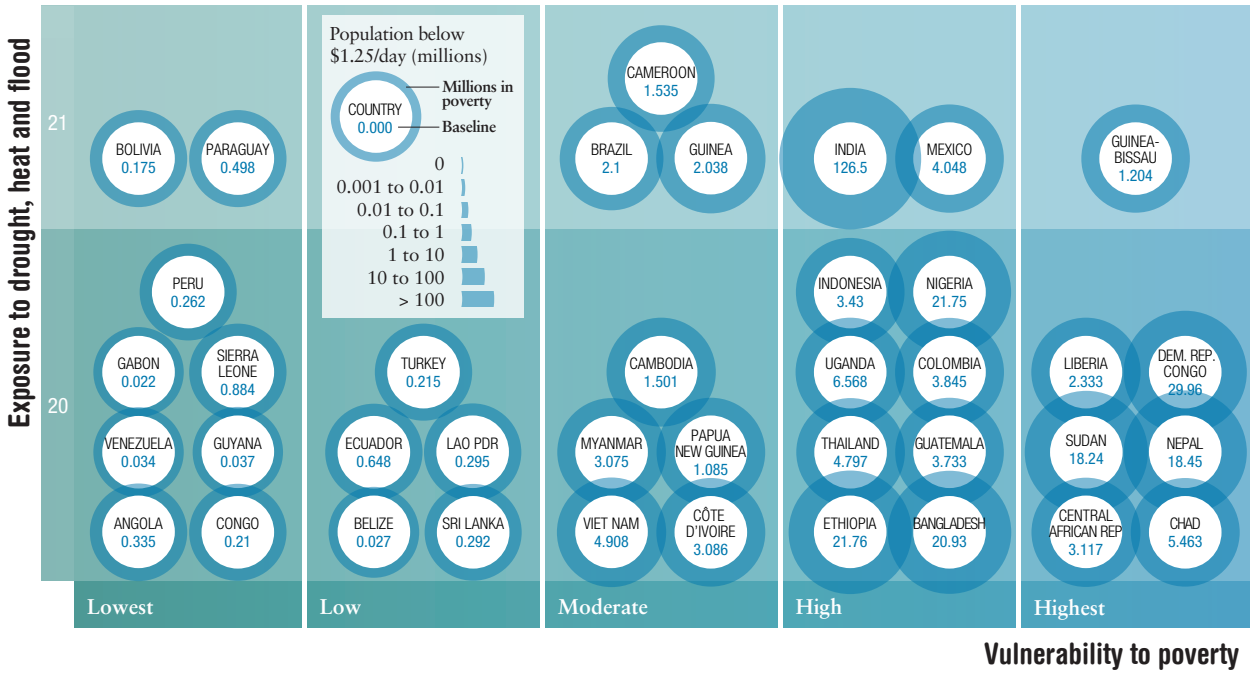
Good DRM can reduce the impact of disasters on poor people, as highlighted by the vast difference in the human impact of natural hazards. In 2010, for example, 11% of those exposed to the Haiti earthquake lost their lives, compared to 0.1% of

Figure A: Projected poverty levels in 2030 in countries ranking highest on the multi-hazard (earthquakes, cyclones, droughts, extreme heat and floods) index[8]



NOTE: The figure shows a set of countries with the highest exposure to the five hazards in 2030, plotted against their 'vulnerability to poverty', which is a measure of the risk they face of future poverty when presented with shocks, such as 'natural' disasters (see Chapter 2). The circles indicate projected poverty numbers for each of the countries in 2030 assuming a baseline projection. This graphic does not account for the capacity of each country to manage disaster risk, which is why the countries plotted here differ from the lists of countries highlighted in the text.

Figure B: Projected poverty levels in 2030 in countries with the highest exposure to droughts, extreme heat and floods



NOTE: The figure shows a set of countries with the highest exposure to the three hazards in 2030, plotted against their 'vulnerability to poverty', which is a measure of the risk they face of future poverty when presented with shocks, such as 'natural' disasters (see Chapter 2). The circles indicate projected poverty numbers for each of the countries in 2030 assuming a baseline projection. These countries differ from figure A as it features just the countries particularly exposed to the three hazards rather than the full list of five hazards included in figure A.

those who experienced the Chile earthquake.[5] In 2008, Cyclone Nargis killed 138,000 people in Myanmar, while Hurricane Gustav, a storm of similar strength, killed just 153 in the Caribbean and US. The fact is that hazard-prone countries with big populations living in poverty, particularly those clustered in sub-Saharan Africa and South Asia lack the capacity to manage disaster risks or the threats from climate change. So, continuing with the status quo will result in millions of poor people left without proper protection in the face of ever-growing disaster threats.

Figure A and B highlight the countries of concern that are assessed in this study. Every one of them is prone to the multiple hazards assessed in this study, and is also likely to see high levels of extreme poverty in 2030. Here, we see that, unless something changes – and changes fast – up to 118 million extremely poor people in sub-Saharan Africa will be exposed to drought, flood and extreme heat hazards alone in 2030:[6] Chad (4-5 million), Central African Republic (3 million), Democratic Republic of Congo (20-30 million), Ethiopia (12-22million), Liberia (1-2 million), Nigeria (14-22 million), Uganda (3-6 million) are countries with the highest concentrations.[7]

When combining all of the data sets,[9] the following findings emerge.

By 2030, 11 countries will have high *numbers* of people in poverty, high multi-hazard exposure and inadequate capacity to minimise the impacts: **Bangladesh, Democratic Republic of the Congo, Ethiopia, Kenya, Madagascar, Nepal, Nigeria, Pakistan, South Sudan,**[10] **Sudan** and **Uganda.**

Another 10 countries have high *proportions* of people in poverty, high multi-hazard exposure and inadequate capacity to minimise the impacts: **Benin, Central African Republic, Chad, Gambia, Guinea Bissau, Haiti, Liberia, Mali, North Korea** and **Zimbabwe.**

Niger, Somalia, and **Yemen** could also feature in this list. While their total exposure to hazards, other than drought, is relatively low, these are countries that have high levels of poverty and low levels of DRM capacity.

Afghanistan, Cameroon, Myanmar and **Papua New Guinea** also endure high exposure to hazard and moderate poverty (with at least 10% of their populations and/or 1 million people under the $1.25 per day poverty line) and limited DRM capacity. While this report

does not focus on the relationship between conflict, fragility, disasters and climate extremes, there is a striking overlap between today's fragile states and the countries that are of greatest concern in terms of poverty and exposure to hazards in 2030.

India represents a special case. It has the highest numbers of people who are still likely to be living in poverty in 2030 and some of the highest exposure to hazards, yet does have the central capacity to manage disaster risk. Given its size India likely needs to be treated as a cluster of separate sub-national entities, with some states causing considerable concern, including Assam, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal.

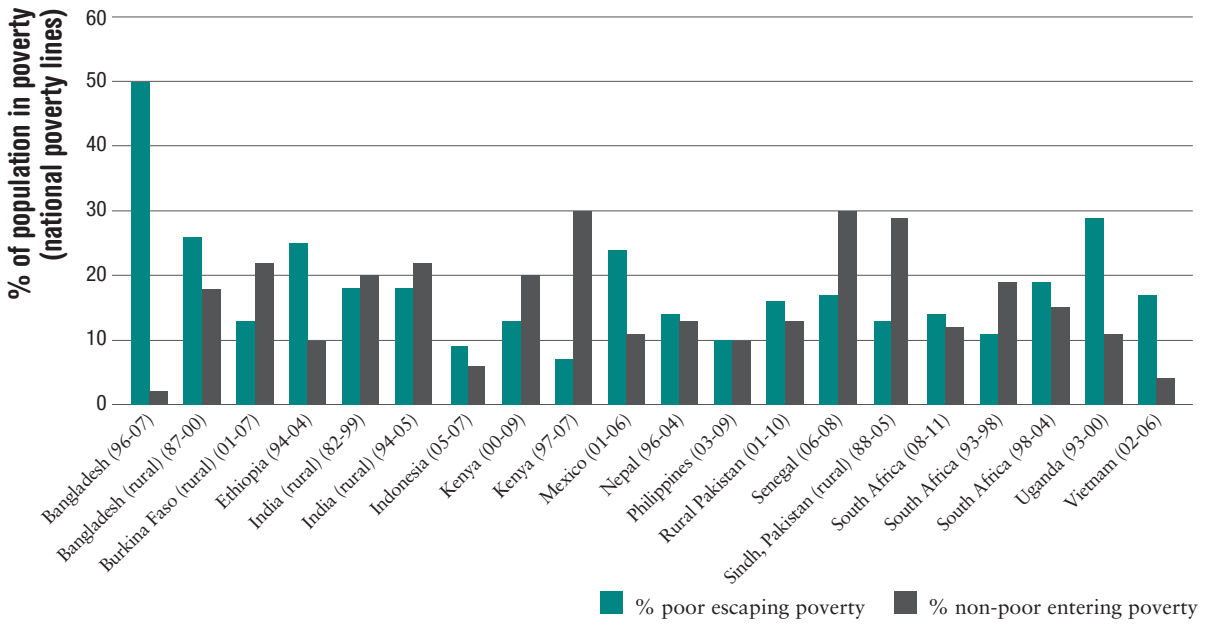
This list of countries and states represents a useful set of targets for serious attempts to end poverty, providing a checklist for international efforts to strengthen DRM systems and link these to poverty reduction efforts.

The disaster threat to poverty reduction

Detailed analysis of data from rural Ethiopia and Andhra Pradesh in India for this study suggests that where drought is a major risk it is also the single most important factor in impoverishment – outstripping, for example, ill health or dowry payments. This counters a view that is common in the literature: that health-related shocks are the biggest factor in impoverishment. It should be noted that this result is only from two drought-prone areas, and would need to be confirmed by further research. Disaster-related impoverishment also appears to have a distinct within-country geography, being largely rural rather than urban. Figure C highlights this stark rural dimension and shows how impoverishment trends can easily cancel out escape routes from poverty in some countries.

The report also examined data from Ethiopia and Andhra Pradesh to explore whether there is an income threshold beyond which the risk of falling into poverty as a result of a disaster is reduced. While initial analysis found different plausible thresholds (suggesting that any threshold would be context-specific), further analysis suggested that the probability of impoverishment falls as household prosperity rises, rather than any particular income level acting as a threshold. Further research could explore this issue in more detail to find out if such thresholds exist. If so, they would be a useful aid to poverty reduction and DRM planning.

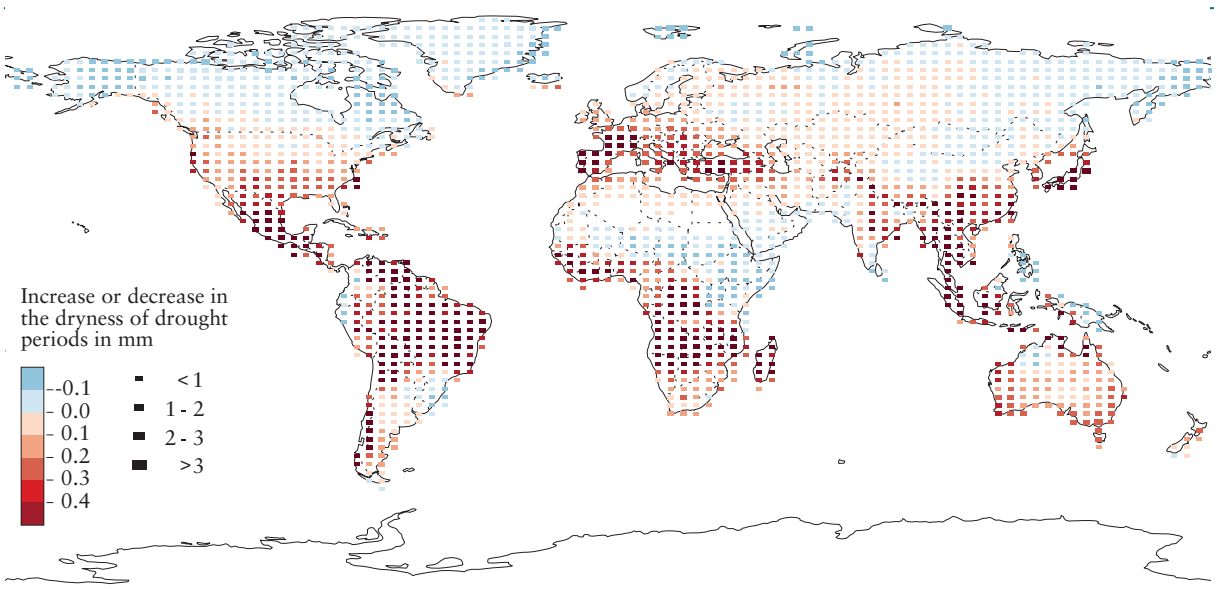
Figure C: Impoverishment trends can cancel out progress



SOURCE: Lenhardt, A. and Shepherd, A. (2013) '*What happened to the poorest 50%?*', Chronic Poverty Advisory Network, Challenge Paper 1.

NOTE: The figure shows historic poverty averages for the dates attached to each country name. While it highlights an overall positive trend in poverty reduction, for particular countries and geographies, for certain periods of time, impoverishment rates can cancel out escapes from poverty.

Figure D: Projected change in the global drought hazard indicator between 1971-2000 and 2021-2050



NOTE: The drought hazard indicator is a measure of how exposed an area is to droughts. This is measured as the deficit in rainfall during periods when the rainfall is below average, i.e. when rainfall is below average, how dry it is. The absolute measure of drought by this means is the shortfall of precipitation, compared to the mean precipitation at the time of year, in an average dry spell. The figure shows the change in drought by highlighting the increase or decrease in the dryness of drought periods, in mm. Blue squares indicate that droughts are getting less severe, red, more severe. The larger the square, the greater the agreement between multiple climate models.

Analysis of trends suggests that poverty will be concentrated in particular areas in most countries in the future and in rural or disadvantaged regions in particular.[11] However, an assessment of poverty, hazards and DRM efforts in five countries of concern – Ethiopia, Haiti, Madagascar, Nepal and Pakistan – finds that DRM policies and systems rarely focus on poverty or target the most disaster-prone regions explicitly. This may be explained by DRM programming being directed to high-value assets and to saving lives rather than protecting livelihoods. We need, therefore, risk modelling and mapping to focus the combined efforts of DRM and poverty reduction, and make them fit for purpose.

How climate change will shape hazard trends by 2030

Climate models suggest that the severity and distribution of some hydro-meteorological hazards will change in the near future – even by 2030. Figure D, for example, shows how one indicator of the average drought severity will change between the late 20th century and the middle of the 21st. It shows the strong likelihood of more drought hazard in parts of Central and South America, Southern Europe, Eastern and South-eastern Asia and in a broad belt spanning southern Africa. These trends are particularly important for countries and areas that are likely to have high poverty rates in 2030, such as Democratic Republic of the Congo or northern India where drought exposure is only expected to increase.[12] While climate change will become an increasingly important driver of changing hazard geography in the next two decades, the distribution of hazard exposure we see today will remain a strong predictor of exposure in 2030.

Recommendations

This report argues that the post-2015 development goals must recognise the threat posed by disasters and climate change to the global headline goal of eradicating extreme poverty by 2030. The current Millennium Development Goals have not paid sufficient attention to the risk factors that push people into poverty and this should be rectified; including recognition of the role played by disasters. Poverty eradication efforts need to look beyond those living in poverty today to raise people above and beyond extreme poverty and reduce the risk of poverty reversals at a later date. This means addressing the risk factors – including disasters. This is crucial if the promise of a world free from extreme poverty is not to evaporate, just as this goal appears to be within reach.

We recommend, therefore, that a goal on ending poverty is coupled with targets on tackling key impoverishment factors, where natural disasters are a significant component and that these factors become the cornerstones of international and national efforts to reduce poverty overall. Accordingly, the post-2015 framework should monitor progress beyond the $1.25 per day poverty threshold to monitor higher thresholds, such as $4 per day, beyond which the risk of falling into poverty would be greatly reduced. Identifying such thresholds requires further research.

Within a development context focused on eradicating poverty, international efforts to reduce disaster risk should concentrate on the countries at greatest risk of disaster-induced impoverishment and target specific sub-national trends. DRM efforts should focus on saving livelihoods as well as lives, giving equal weight to social protection and asset-building approaches alongside early warning systems. Disaster resilience efforts should also have clear strategies to reduce the poverty and build the assets of those affected by disasters, engaging people in long-term livelihood programmes. Beyond political commitment, this will take upfront and recurrent international investment in DRM until national revenues and individuals can adequately take on the challenge of providing protection. However, this is currently an underfunded area with just 40 cents in every $100 of official development assistance (ODA) spent on reducing disaster risk. $9 in every $10 dollars spent on disasters is spent after the disaster has struck. Over the last 20 years, the countries highlighted in this report as being at greatest threat of disaster-induced impoverishment in 2030 have seen an average of just $2million of ODA spent on reducing disaster risk each year.[13] This needs to change, with more money targeted to maximising disaster resilience and poverty reduction at the same time.

About this report

The report is structured in six sections. Section 1 outlines the links between disasters, poverty and impoverishment. Section 2 maps out the geography of poverty in 2030, while Section 3 highlights the projected geography of 'natural' hazards. Section 4 examines the capacity of the countries at greatest risk to reduce disaster risk and respond to disasters. Section 5 brings the analysis together to build a picture of both poverty and hazard risk in 2030, together with today's disaster risk management and adaptive capacity[14] highlighting possible variations to the trends and providing in-depth country analysis. Finally, Section 6 sets out possible policy responses for future international agreements, development cooperation, countries of concern and actions by the research community.

1

Introduction

When Hurricane Mitch devastated countries in Central America in 1998, the World Food Programme (WFP) announced that development had been 'set back by at least 20 years'.[15] WFP is not alone in claiming that disasters have caused significant increases in poverty, as seen most recently in data gathered on the impact of the 2010 earthquake in Haiti and the 2011 drought in Djibouti (World Bank, 2013a).

In May 2013, the UN Secretary General's High Level Panel Report on the Post-2015 Development Agenda proposed a set of goals and targets (United Nations, 2013). Under goal 1: 'End Poverty', it included a target to: 'build resilience and reduce deaths from natural disasters by x%'. A month earlier, the Chair's Summary of Open Working Group meeting on Sustainable Development Goals[16] had raised similar concerns about people falling into poverty (or back into poverty) as a result of disasters and the impact of climate change. With the number and scale of 'natural' disasters escalating, and worrying predictions of the extent of disaster losses – in human, economic and developmental terms – in the future (IPCC, 2012), the question of exactly when and how the impact of disasters and climate change reverses hard-won development gains is now firmly on the policy agenda.

Given this framing of disasters within a goal on poverty reduction, the first part of this report pieces together the evidence on why some natural hazards turn into human disasters, with long-term impoverishing effects, while others do not. It does so by examining case histories, household panel data and broader literature. The second part of the report looks to the future, to consider the size of the challenge we face if we aim to eliminate poverty. By using models of trends in poverty, resilience, hazards and climate impacts, the study considers the world in 2030 and beyond. In doing so, we identify a set of countries and sub-regions that we expect to have high levels of poverty or risk of poverty, to be hazard prone, and to lack resilience and risk management capacity in 2030. These are the countries and sub-regions where if disasters happen, they are likely to cause long-term impoverishment. Some countries and regions are looked at in more detail to analyse particular hotspots. The report's conclusion presents recommendations for donors, international policy and national approaches on the basis of the findings.

1.1 Hazards, exposure and vulnerability

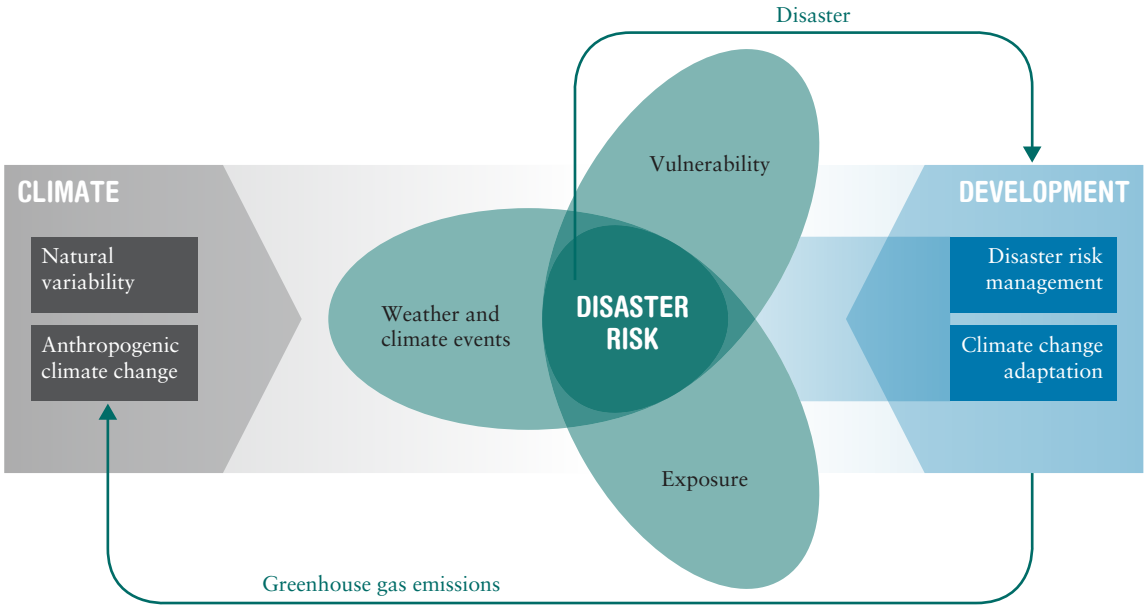
The transformation of hazards into disasters is far from 'natural'. It reflects structural inequalities that are rooted in the complex political economy of disaster risk and development (O'Keefe et al., 1976; Blaikie et al., 1994). With this in mind, the severity of disaster impacts depends on the nature of the hazard; the existing levels of vulnerability; and the extent of exposure to disaster events (Figure 1). A community's disaster risk is dynamic: it varies across time and space and is driven heavily by interacting economic, socio-cultural and demographic factors. Indeed, high levels of vulnerability and exposure are often the result of skewed development processes, such as those linked to demographic transition, rapid and unplanned urbanisation and the mismanagement of natural resources (IPCC, 2012).

Poverty is one of the strongest determinants of disaster risk, as well as shaping the capacity to recover and reconstruct. The poorest people in a community are often affected disproportionately by disaster events, particularly in the long-term. However, poverty is by no means synonymous with vulnerability. Indeed, vulnerability is shaped by wider social, institutional and political factors that govern entitlements and capabilities, with issues such as gender, ethnicity and caste relations exerting a strong influence over levels of disaster risk and adaptive capacity. It is the social institutions and power relations associated with each of these issues that determine vulnerability to disasters. How they influence vulnerability depends partly on the nature and type of disaster.

Slow-onset and rapid-onset disasters

This report concerns the potential long-term impacts of disasters. A key distinction has been made between slow- and rapid-onset events. Not surprisingly, rapid-onset disasters receive the greatest attention, given their vast and visible human and economic costs. Typically, disasters associated with earthquakes, tsunamis, landslides and floods fall under this category.

Figure 1: The links between the core concepts of disasters, development and climate change



SOURCE: IPCC (2012).

They occur suddenly, and are difficult to predict precisely or far in advance – happening in seconds or minutes in the case of earthquakes and landslides, or hours and days in the case of storms and floods (Twigg, 2004).

Slow-onset disasters, however, take far longer to unfold and are also influenced by social, political and environmental factors. The slow-onset disasters with the greatest impact are often associated with drought, which can spread out over months or even years, with major implications for water resources and food security. Other slow-onset disasters are relevant. For example, pollution and natural resources degradation can, if built up over many years, lead to disaster even if the impacts are not felt for decades to come (Twigg, 2004).

This distinction between rapid- and slow-onset disasters is, however, somewhat artificial. While individual hazards may be categorised in this way, their interactions with vulnerability and exposure (that determine whether a hazard turns into a disaster) tend to be both short and long-term (Twigg 2004).

Types of disasters and their impacts

The most catastrophic individual disaster events, in terms of direct impacts on housing, are earthquakes and tropical cyclones. The potential for destructive earthquakes is highest in the vicinity of the principal tectonic plate boundaries. Large earthquake disasters may reflect either a major (magnitude 7+) earthquake close to a principal city (as experienced by Port au Prince, Haiti, in 2010), or a 'great' (moment magnitude above 8.5) earthquake (as in the Indian Ocean in 2004) that affects a subduction zone-plate boundary, with its regional impacts accompanied by a destructive tsunami. In most earthquakes it is vibrational building collapse that causes the greatest impact, but in mountainous terrain, landslides become the principal causes of damage, disruption and loss of agricultural land. Large regional earthquakes can also cause localised far field 'basin' amplification of vibrations, as seen in Mexico City in 1985.

Tropical cyclones form over the oceans and reach their highest intensity between 10 and 25 degrees from the equator. The principal cause of lost lives and the destruction of buildings comes from the storm surge and associated wave action. The largest storm surges are associated with the broadest and most intense storms, in

particular where they reach landfall in delta coastlines, as shallow coastal waters amplify the surge. In the strongest storms, the direct effects of the wind can cause building damage over a swathe that may be tens of kilometres wide and extend more than 100km inland. Slow moving tropical cyclones can carry with them intense (200-300mm) rainfall, often leading to flooding even further inland (e.g. Hurricane Floyd in 1998).

The hazards that have the greatest impacts on agricultural livelihoods are droughts, regional floods and large volcanic eruptions. Regional droughts reflect persistent deficits in rainfall, but the degree to which a drought results in crop failures will be, in part, a function of the availability of wells and other irrigation systems. Regional floods are the result of persistent inland precipitation, including rainfall from tropical cyclones. Flooding last longest, and is most extensive, in shallow and large river systems (as seen on the Lower Indus in Pakistan in 2011 and 2012). In some countries, run-off is accelerated by deforestation, while the encroachment of river channels and the occupation of flood plains by informal settlements only exacerbate the human impacts.

It is clear that, even though underlying conditions of vulnerability are important, hazards need to be extreme and they need to be rare if they are to be intensive and disastrous at scale – with a less than 2% probability of hitting the same territory within the next 12 months (i.e. unlikely to occur again, on average, in the next 50 years). It is important to acknowledge some of the reasons why extremes often manifest such intense 'clustering'. While all earthquakes are associated with an exponentially decaying swarm of aftershocks, another major earthquake can sometimes be triggered. It is common for volcanic eruptions to persist for years. Storms may follow similar tracks for a period of a few weeks. Reduced ground moisture can lead to increased temperatures, which reduces rainfall still further. At the same time, saturated ground means that any new episode of extreme rainfall may generate further flooding.

1.2 The impact of disasters on poor people

Much of the analysis of post-disaster impacts focuses on the number of people affected, mortality rates, and the immediate macroeconomic fallout. While this evidence is useful to understand the scope and severity of a crisis, as well as a government's preparedness capacity, it does little to illustrate the longer-term impacts of disasters on the poor. The poor are seen as the most vulnerable to the effects of natural hazard shocks, and research suggests that disasters can have long-run economic consequences for those in the lowest wealth quintiles (Dercon 2004; Carter et al. 2007). The lack of longitudinal data on household welfare before and after disasters makes it difficult to untangle the impacts of natural hazards on the poorest, although some studies do exist that confirm their vulnerability. The 2008 UNDP Human Development Report (HDR), for example, concluded that disasters can affect people through five channels: death and disability, sudden loss of income, depletion of assets, loss of public infrastructure and macroeconomic shocks (UNDP, 2007). The contribution by Fuentes and Seck (2008), to the 2008 UNDP HDR highlighted a set of long-term disaster impacts (Table 1).

Chapter 2 includes a brief analysis of the effects of drought and other shocks in Andhra Pradesh, India and rural Ethiopia. Chapter 3 also draws out the impact of drought as well as four other hazards – earthquakes, cyclones, flooding and extreme temperature, while chapter 5 pulls this analysis together.

TABLE 1: RESIDUAL EFFECTS OF DROUGHT ON CHILDREN IN AFRICA

Country	Evidence
Ethiopia	Children aged five or less in drought-prone areas are 36% more likely to be malnourished and 41 per cent more likely to be stunted if they are born during a drought year. This translates into some 2 million 'additional' malnourished children.
Kenya	Being born in a drought year increases the likelihood of children being malnourished by 50%.
Niger	Children aged two or under who were born during, and affected by, a drought year are 72% more likely to be stunted.
Zimbabwe	Children born during drought-affected periods are, on average, 2.3 cm shorter. A delayed start of schooling results in a loss of 0.4 years of school life, which leads to a 14% loss of lifetime earnings.

SOURCE: UNDP (2007)

Coping with shocks

The same disaster can destroy the asset base of one poor household, pushing it into poverty, while having only a transient impact on the welfare of another household. Understanding the different impacts of disasters is important when exploring household coping mechanisms. This is often measured through per-capita household consumption, which reveals how effectively households smooth their consumption in the aftermath of a disaster and for how long they are forced to survive on much less. Even disasters considered well handled by governments and NGOs can have serious impacts on consumption and nutrition (de la Fuente and Dercon, 2008), and understanding how families cope allows policy-makers to design recovery programmes that embrace poverty reduction.

The ability of households to cope varies greatly, depending on the type and severity of a disaster, and not all of these elements are beyond their human control. Poor households can still build effective 'buffers' against disasters in order to increase their capacity to cope capacity in the aftermath of a major shock. For households in low-income countries, the most effective safeguard is a large asset base that they can draw upon. However, the poorest households are the least likely to have sufficient income, savings, and assets to do so (del Ninno et al., 2001). Instead, they rely on other coping strategies, including remittances, microfinance programmes, risk pooling, borrowing, and the sale of their assets. Used in the right contexts and in the right combinations, these strategies can improve livelihood security (Paul and Routray, 2011).

Drivers of impoverishment and the impact of disasters

A number of underlying drivers of impoverishment exacerbate the long-term impact of disasters on vulnerable groups of people. These include: a lack of income diversification; gender *and* income inequality; and a lack of entitlement to key assets and resources, such as markets/capital, insurance, social safety nets, land, media and information, and education. Each driver relates to particular deficiencies in, or restricted access to, the various capitals associated with the sustainable-livelihoods framework (comprised of physical, natural, human, financial, and social capitals). If addressed appropriately through targeted policies, these drivers can be reversed to trigger improved returns on endowments, allowing the accumulation of assets and creating opportunities to escape poverty. Investment in education is a prime example (Baulch, 2012a).

The impacts of endowments (or the lack of them) and impoverishment on vulnerability to disasters is, however, complex and far from linear. Little et al. (2006), for example, find that the drought in Ethiopia did not have a uniform impact on impoverishment for agricultural households. In fact, 'some very poor households actually came out of the 1999-2000 drought better than when the event began, while some of the wealthier households benefited both from a favourable livestock market and increased opportunities to share herd out animals in the post-drought period'. They suggest that asset ownership 'is a better predictor of long-term welfare and household viability than is consumption, income, or other 'flow' variables that are subject to massive measurement problems and dramatic, short-term changes. Asset endowments (social and economic) largely determine a household's or individual's future capacity to earn income and withstand shocks' (Little et al., 2006).

Of course, wealthier groups tend to have a higher capacity to recover from economic losses than lower income groups over time and, in many cases, wealthy groups are able to exploit local disaster economies. Indeed, disasters can affect how a society functions and its underlying structures. Two views are interesting to explore in this context. The first describes an 'accelerated status quo' – i.e. change is path dependent and limited to a concentration or speeding up of pre-disaster trajectories, which remain under the control of powerful elites both before and after an event (Pelling and Dill, 2010). Klein (2007) describes this in the context of the shift in power from local to central actors after Hurricane Katrina. The second outlines a 'critical juncture' – i.e. a fundamental shift in the structure and composition of a political regime. Olson and Gawronski (2003) highlight a shift to more egalitarian political systems after earthquakes in Mexico City (1985) and Nicaragua (1972). Both views point to the strong influence (both positive and negative) of a disaster can have on political, social and institutional environments long after the disaster itself (Pelling and Dill 2010). They may also point to the potential to exploit windows of opportunity to re-shape critical infrastructure and socio-economic structures in the aftermath of a disaster.

Although the effects of a disaster can have visible consequences on the welfare of vulnerable groups, it is more difficult to make an empirical links between natural disasters and living standards empirically. De la Fuente and Dercon (2008) suggest a 'double causality': a two-way relationship between vulnerability to natural disasters and poverty where 'disentangling the direction of the causal impacts is rather challenging, especially in terms of the intensity of the effects of the events and not only their incidence'. Traditionally, the various types of shocks that people may face are placed in two categories that reflect the extent to which individuals/households (idiosyncratic) or the community as a whole (covariate) are affected. Given that people's livelihoods are shaped by the dynamics (and interactions) of these two categories, the interventions and policy responses vary in each case (Shoji, 2008). Baulch (2011) argues that it is difficult to determine which has the strong effect on impoverishment – the impact on the individual/household or the area-wide shock – as it very much depends on the context. He stresses that 'the jury is therefore still out on whether, and in which environments, individual and households level shocks are more important drivers of chronic poverty than more widespread shocks' (Baulch, 2012a).

1.3 Case studies of disasters and poverty

This report explores the nature of disasters and their impact through four separate case studies: Bangladesh; Ethiopia; Haiti and the Philippines. Each case study reflects a variety of different geographic locations, hazard types, and risks (see Box 1, Box 2 and Table 2). In doing so, we explore the short and long-term effects of particular types of disasters on poverty levels and consider what factors pave the way for impoverishment risk. The full case studies are included in Technical Annex A.

1.4 Conclusion

Disasters result from the juxtaposition of extreme (or repeated) hazards and the vulnerability and inadequate protection of the people affected. Given the growing numbers of people living in exposed areas, and without a sufficient reduction in their vulnerability, disaster risk is increasing in a number of regions and will continue to do so for some time (GAR, 2011). Where disasters do strike, they tend to have the greatest long-term impacts on those people living in the poorest quartile or quintile. Beyond their impact on incomes, disasters can lead to long-term setbacks in health, education and employment opportunities through malnourishment, stunting and missed schooling, for example.

Case studies and literature suggest that disasters also cause impoverishment and this can lead to a cycle of losses that contributes to poverty traps and block or slow efforts to reduce levels of poverty. Disasters can also lead to 'fire sales', with the poorest people selling off the few assets they have, or consuming those assets, depleting their holdings still further, deepening their poverty and undermining their human capital.

However, it is important to note that not every disaster leads to such negative long-term impacts and recovery can be relatively quick in some countries compared to others – with notable differences between and among socio-economic groups.

Where disasters do strike, they tend to have the greatest long-term impacts on those people living in the poorest quartile or quintile. Beyond their impact on incomes, disasters can lead to long-term setbacks in health, education and employment opportunities.

BOX 1: KEY HAZARDS IN THE FOUR CASE-STUDY COUNTRIES

The principal hazards in Bangladesh are earthquake (from faults related to plate boundaries in the east and north of the country) and tropical cyclone winds and storm surges, as well as flooding from high rainfall and snowmelt in the catchment basins of the Ganges and Brahmaputra. Major earthquake catastrophes occurred in 1762 and 1897. There have also been catastrophic storm surges, including the surge in 1970 (when a 10 metre surge drowned more than 300,000 people). Finally, Bangladesh has been hit by several severe flood events, including the floods in 1988, 1998 and 2004.

The principal hazard in Ethiopia is drought. The worst famine in the history of the country was in 1983-1985, known as the Great Famine, when one million people died and relief was hindered by the war with Eritrea. In 2003, a drought led to a famine that claimed the lives of tens of thousands.

The principal hazards in Haiti are earthquakes along the two lines of the E-W Caribbean/North American tectonic plate boundary that run through the north and south of the country. The country also lies at the very heart of the hurricane belt. The capital, Port au Prince, was destroyed in earthquakes in 1751 and 2010, while northern cities were destroyed in an earthquake in 1842. The most frequent disasters in Haiti are floods, many of them associated with passing hurricanes.

The Philippines faces a full range of hazards, including floods, El Nino-induced droughts, typhoons, earthquakes, landslides, and volcanic eruptions. The country is situated along the Pacific Ring of Fire, a geological region characterised by active volcanos and frequent earthquakes. This island nation is also exposed to storm surges and sea-level changes. While the government has been pro-active in implementing national disaster risk reduction initiatives, the country remains prone to disasters, with a typhoon in 2009 killing 956 people.

BOX 2: THE IMPACT OF DISASTERS ON POVERTY IN THE FOUR CASE-STUDY COUNTRIES[17]

Though households in the poorest quintiles across the four case-study countries (Bangladesh, Ethiopia, Haiti and the Philippines) are affected, the impact of disasters is felt across all wealth groups. In Haiti, for example, the wealthier segments of the population lost high percentages of their savings, assets and wealth immediately after the 2010 earthquake (see Technical Annex A). However, it is important to recognise the relative impacts that the earthquake had on the poorest member of society, for whom even a small reduction in wealth can have long-term negative effects on livelihood. Post-disaster assessments of the earthquake also reveal that the wealthiest are much more able to recover and return to pre-disaster conditions than the poorest households.

Lower rates of employment and heavily reliance on temporary jobs among those in the lowest wealth quintiles also points to the longer-term impacts of disasters on the poor. In Bangladesh, for example, recovery after the 1998 flood varied according to occupational groups. Between 50% and 70% of professionals and people employed in formal sectors – such as those working in business, service holders and highly-skilled workers – recovered fully after the flood. This compares with just 26-35% of those in low-skilled employment, including those working in petty business, factory workers and day labourers. Experiences from the impact of drought in Ethiopia confirm that poorer households have a far lower capacity to cope capacity, often reverting to the sale of their already limited productive assets and reducing their consumption at the expense of their own long-term welfare. These asset-poor households also have the hardest time recovering, with considerable impacts on their livelihoods still visible ten years after the Great Famine of the 1980s.

TABLE 2: THE COMPLEX RELATIONSHIP BETWEEN POVERTY AND DISASTER IMPACTS IN THE FOUR CASE-STUDY COUNTRIES

Case study	Key findings
Bangladesh – 1998 flood	The 1998 flood led to significant human displacement, concerns over access to safe water and sanitation, as well as heightened levels of illness and food insecurity. The most important direct impacts of the flood at household level were the loss of agricultural production, the reduction of employment opportunities and the loss of assets. Each of these led to considerable reductions in household incomes and wealth. While the absolute losses of assets were higher among richer households, poorer households experienced greater relative losses. The impacts were largest among dependent workers and day labourers. While the extent of the flood was greater than that of previous hazards, the flood caused less damage and loss than hazards in the past. This is attributed to: a more transparent and accountable political environment; better disaster preparedness and investment in disaster risk reduction; and a more open society, characterised by economic growth and poverty reduction over the 1988-1998 period.
Ethiopia – 1983-1985 drought	The Great Famine that emerged from the drought was the result of a combination of environmental, political and economic factors. The long-term negative economic impacts of the drought were felt most severely by poorer households. Wealthier households were, in general, able to sell off assets and rebuild them quickly once the crisis was over. In subsequent droughts during the 1990s, poorer households resorted to reduced consumption and, as a result, lower body mass was seen among both children and adults. Off-farm opportunities proved important for the protection of assets, both during a drought and in the subsequent recovery period.
Haiti – 2010 earthquake	The impacts of the January 2010 Earthquake were felt differently by different socio-economic groups. Household-level data suggest that the wealthiest households were affected disproportionately in the immediate aftermath of the earthquake. Their asset losses were far higher, at 86.5% than the asset losses experienced by poor households (17.6%). In addition, the loss of one or more income-earners was highest among wealthy households than any other income group. Inequality may explain this, in part, with the urban poor having relatively few assets to lose. In addition, many important livelihoods assets upon which poorer groups depend may either fail to be formally recorded or may have low absolute economic value (such as informal housing). However, the long-term impacts were greater among the poorest households, as the wealthiest were able to make a faster recovery. As of June 2010, 16% of poor households had returned to pre-earthquake levels of absolute savings, assets and wealth. After the earthquake, poor households were more heavily dependent on temporary jobs and were prone to adopt unsustainable coping strategies, such as reduced consumption or pulling children out of school.
Philippines – 2009 typhoon	Poverty is the single most important factor in determining disaster vulnerability in the Philippines. In 2009, the country was hit by tropical storm Ondoy and typhoon Pepeng in quick succession. Of the 9.3 million people severely affected by these two hazards, the poor were affected disproportionately. Those hit hardest were those who had been self-employed before the typhoon, including fishermen, farmers, small-business owners and informal-sector workers. Their households suffered long-term impacts from the disruption in their livelihoods, as they shifted to less capital intensive (and less profitable) occupations. Even though social protection programmes were initiated (with support targeting the worst-affected areas) poorer households still suffered disproportionately. Self-employed workers who depend on their own capital to make a living were the most negatively impacted by the typhoon and struggled even with access to government and international assistance. Lack of capital was the biggest impediment to recovery. In general, the poor in both rural and urban areas lacked access to formal sources of credit and were, therefore, forced to borrow from informal money lenders who charge exorbitant interest rates.

2

The geography of poverty in 2030

2.1 Introduction and definitions

Forecasting poverty rates 15 years from now is a risky enterprise. Who, in 1980, would have predicted the remarkable achievements made by China by 2000? There will almost certainly be changes, but what those changes will be and where is hard to fathom. Most projections extrapolate from existing trends and apply a multiplier or divider on two variables – economic growth and inequality – to construct optimistic or pessimistic scenarios, and then generate a range of possible outcomes. The projections in this chapter, on the other hand, are based on a complex model of the world economy and society, which is updated continuously, and in which there are some intricate relationships among the variables that make up the model. Given the multiple causation of trends in poverty (it is not just a matter of growth and inequality, although these can be seen as good proximate determinants), it seems sensible to use the best possible tool for the job. However, this does mean that the baseline scenario is not a forward projection of past trends, but the best possible guess at the future.

This chapter does several things to build a foundation for an examination of the geography of poverty and disaster risk in 2030.

1. It projects national headcounts and ratios forward for low-income countries (LICs), lower middle-income countries (LMICs), and upper middle-income countries (UMICs), based on the International Futures model (IFs) (Box 3), building in varied optimistic and pessimistic scenarios. In doing so, it identifies where the poverty hotspots are likely to be in 2030.
2. It situates these projections in relation to other recent projections.
3. It develops the Poverty Vulnerability Index (PVI), which is used subsequently with the Multi-hazard Index (MHI) developed in Chapter 3 to project (in Chapter 5) those places where disaster-poverty hotspots are likely to be found.
4. Providing the number of people in poverty in 2030 was not the main aim of the exercise, but the chapter gives some top line ranges of global and regional numbers drawn from the baseline and optimistic scenarios.
5. For a small number of the high poverty countries in 2030, this chapter projects sub-national poverty ratios to 2030 in a simpler way (using national data sources) and analyses the causes of high poverty in those sub-national areas. This will enable national policy-makers to zero in on those areas that are likely to remain significantly and chronically poor in 2030.
6. It analyses a small number of panel data sets to establish the extent to which disasters associated with hazards feature as causes of impoverishment or continued poverty, by comparison with other shocks (health and

BOX 3: POVERTY PROJECTIONS USING THE INTERNATIONAL FUTURES MODEL

The International Futures (IFs) model is a large-scale, long term data-modelling system developed at the Frederick S. Pardee Center for International Futures at the University of Denver. It contains and regularly updates internationally representative data sources on demographic, economic, energy, agricultural, socio-political and environmental subsystems for 183 countries, with data series dating back as far as 1960. The system facilitates the development of scenarios based on user-generated assumptions about the drivers of a future condition, producing structure-based, agent-class driven dynamic projections.[18] The IFs model continues to expand and has been adopted by a number of forward-looking research and reporting agencies, including the fourth Global Environmental Outlook Report at the United Nations Environment Programme (UNEP). Technical Annex B has more details.

other idiosyncratic shocks, as well as conflict). This will help to establish the extent to which it is disasters that are responsible for poverty.

7. The chapter also includes an initial exploration of whether a vulnerability threshold, above which people would not, in general, be vulnerable to falling into extreme poverty as a result of a disaster, might make sense.

Poverty is defined here in conventional monetary terms, using different international poverty lines; $0.75 (per day) for severe poverty, which is also a proxy for chronic poverty (McKay and Perge, 2011); $1.25 for extreme poverty; $2 for moderate poverty; and $4 representing a hypothetical level beyond which vulnerability to poverty might be reduced significantly.

We have relied mainly on the IFs model's baseline projection of poverty, which is derived from the interaction of the 1,500 or so variables in the model. In addition, we have created an optimistic and pessimistic scenario by selecting a number of variables as drivers of poverty reduction and resilience, and used multipliers to create the optimistic and pessimistic outcomes (see Table 4 for the variables and the multipliers). Therefore, not only have population, and economic growth been taken as drivers (as in other modelling exercises projecting poverty forwards), so too have a number of governance and human development indicators, as well as some other factors.[19] Inevitably, the selection of variables to manipulate is subjective, but the baseline projection is not affected by them, only the variance from the baseline.

The UN Secretary-General's High Level Panel's report (United Nations, 2013) suggests that 'getting to zero' extreme poverty should be the central goal for the post-2015 framework. The President of the World Bank has already committed the Bank to 'getting to zero' by 2030, which has been translated as reaching 3% incidence of extreme poverty. There is a somewhat euphoric (and also somewhat context-free) public discussion about the feasibility of this ambition, with zero extreme poverty said by some pundits to be 'around the corner'. A number of serious projections have been made, including one for the World Bank on which the 3% figure is based and other independent projections that have all used the same data.

The biggest difference between the IFs and other models is that the IFs has a large number of parameters built into it (over 1,500). These interact according to the instructions of the model builders to produce projected outcomes, including the baseline projection used in this report. For our pessimistic and optimistic scenarios, the parameters we have selected for variation do not include inequality but they do include growth, which are the only two parameters manipulated explicitly in other projections.

Two features of the IFs model may explain the more pessimistic results. From the interactions of the variables in the model, it produces worsening inequality for most countries. And while the share of consumption in GDP is initially, at 58%, a little above that in the other projections (54%), the IFs builds some decline into that ratio going forward, based on the existing trend, and the resulting 2030 share is 55%. To allow for these factors, we focus more on the baseline and optimistic scenarios in this report.[20]

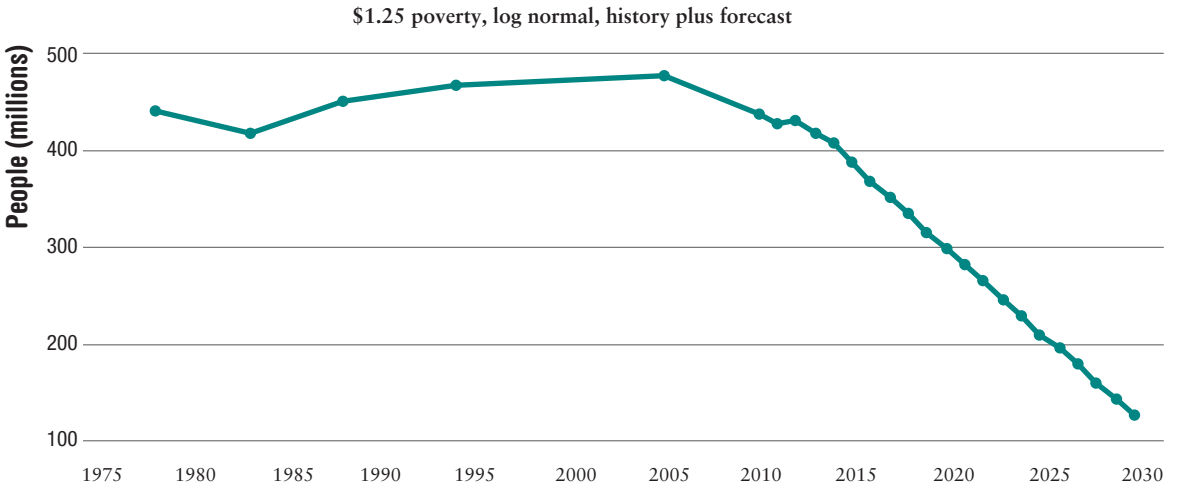
The range of results is substantial in all projections, reflecting the high level of uncertainty. According to Edward and Sumner (2013, p. 2): 'it is startling just how much difference changes in inequality could make to the future of global poverty – to both the numbers of poor people and the costs of ending poverty. The difference between poverty estimated on current inequality trends versus a hypothetical return to "best ever" inequality for every country could be an extra 1 billion $2 poor people in one scenario.'

There is agreement among the other projections that China will eradicate extreme poverty by, say, 2022. Only Ravallion (2012) raises a doubt (intuitive but untested) – that it could be progressively harder to reduce poverty below some threshold proportion of the population – say 10%. In the IFs baseline, China ranks 35th on extreme poverty in 2030, with 7 million people still living on less than $1.25 per day. In other words, there is projected to be significant extreme poverty (the optimistic-pessimistic scenario range is 3.7–13 million people). After China, all projections agree: India and Sub-Saharan Africa are the main locations of future extreme poverty.

India is of particular concern, given its vast population size. The IFs baseline projection (126 million people) is high compared to Edward and Sumner's 2013 pessimistic scenario (static income distribution and low growth) result of 84 million, which is closer to the IFs

Figure 2: The IFs baseline projection for India

SOURCE: Hughes, 2012.



optimistic scenario result of 51 million. This is not surprising, given the worsening income distribution built into the IFs model, which is, in turn, related to the assumption in the model that consumption growth in India will have to yield to savings and export growth, as it did in China in recent decades. Worsening inequality is certainly plausible for India, given that its Gini index is in the mid-30s and is rising in urban areas if not in rural, which is generally consistent with China's experience of inequality that has increased alongside faster growth and industrialisation. The latest projection from the IFs for India is even more pessimistic (Figure 2).

Given the levels of state fragility inside India, and the depth of social discrimination faced by its scheduled tribes and, to a lesser extent, its citizens from scheduled castes, and the geographical overlay between these two factors, it is plausible that India will struggle to come close to eradicating extreme ($1.25 per day) poverty in 15 years. It could be argued that even the rate of poverty reduction in India forecast in the IFs model is very rapid.

2.2 National poverty projections

Ideally, deprivation would be measured multi-dimensionally, and distinctions would be drawn between chronic and transitory poverty. However, we have restricted the analysis to income/consumption poverty for this limited exercise in projection, which uses the IFs model. Using other outcome measures would have required a much longer study. A measure of severe poverty ($0.75) is used alongside the usual $1.25 and $2 per day poverty lines, and countries that are expected to score highly on both the $0.75 as well as the $1.25 measures are seen as the most vulnerable, as the poorer you are the less resilience you have against shocks, and the further you are from reaching up to the poverty line. This enables the analysis to give a stronger weighting to countries with high numbers of severely poor people. Further work using the IFs model could also use human-development outcomes and other indicators to produce a more accurate prognosis for chronic poverty.

The optimistic and pessimistic scenarios for this analysis were generated using the parameters and multipliers shown in Table 4. These combine the poverty parameters used in Cantore (2011), which were based on an expert discussion, and resilience parameters taken from the World Risk Report 2012 (Alliance Development Works, 2012). The multipliers used are derived from Cantore (2011) and were extended to other parameters.

Extreme poverty ($1.25 per day) in 2030 will be evenly split between today's LMICs and LICs, with LICs exceeding LMICs on severe poverty ($0.75 per day) according to the IFs baseline projection (Figure 4). The optimistic scenario, not surprisingly, shifts the balance towards LICs, 'especially for a poverty line of $0.75 per day' (Figure 5).

BOX 4: POVERTY AND POPULATION FORECASTS FOR RWANDA

It is worth noting that the projections produced for this report, like others, are subject to the baseline years that they use and to the underlying assumptions about key indicators, such as population growth. This can lead, in some cases, to diverging results for individual countries when compared to other projections. Results for Rwanda demonstrate both possibilities for divergence. A historical view of poverty in Rwanda based on the earliest available data (Figure 3) shows that Rwanda managed to reverse its poverty trends only after a long period of poverty increases. While recent years have seen significant investment in, and attention paid to, Rwanda, the outcomes of these efforts are not yet captured in the most recently available data (2010). Furthermore, high population growth rates are projected to continue in Rwanda, and while these rates are expected to slow the total population predicted to rise from 10.62 million people in 2010 to 17. 4 million by 2030. So, while the proportion of people living below $1.25/day in Rwanda may fall, the numbers of poor people will be affected by this continued population growth.

Figure 3: Poverty and population forecasts for Rwanda

SOURCE: Hughes, 2012.

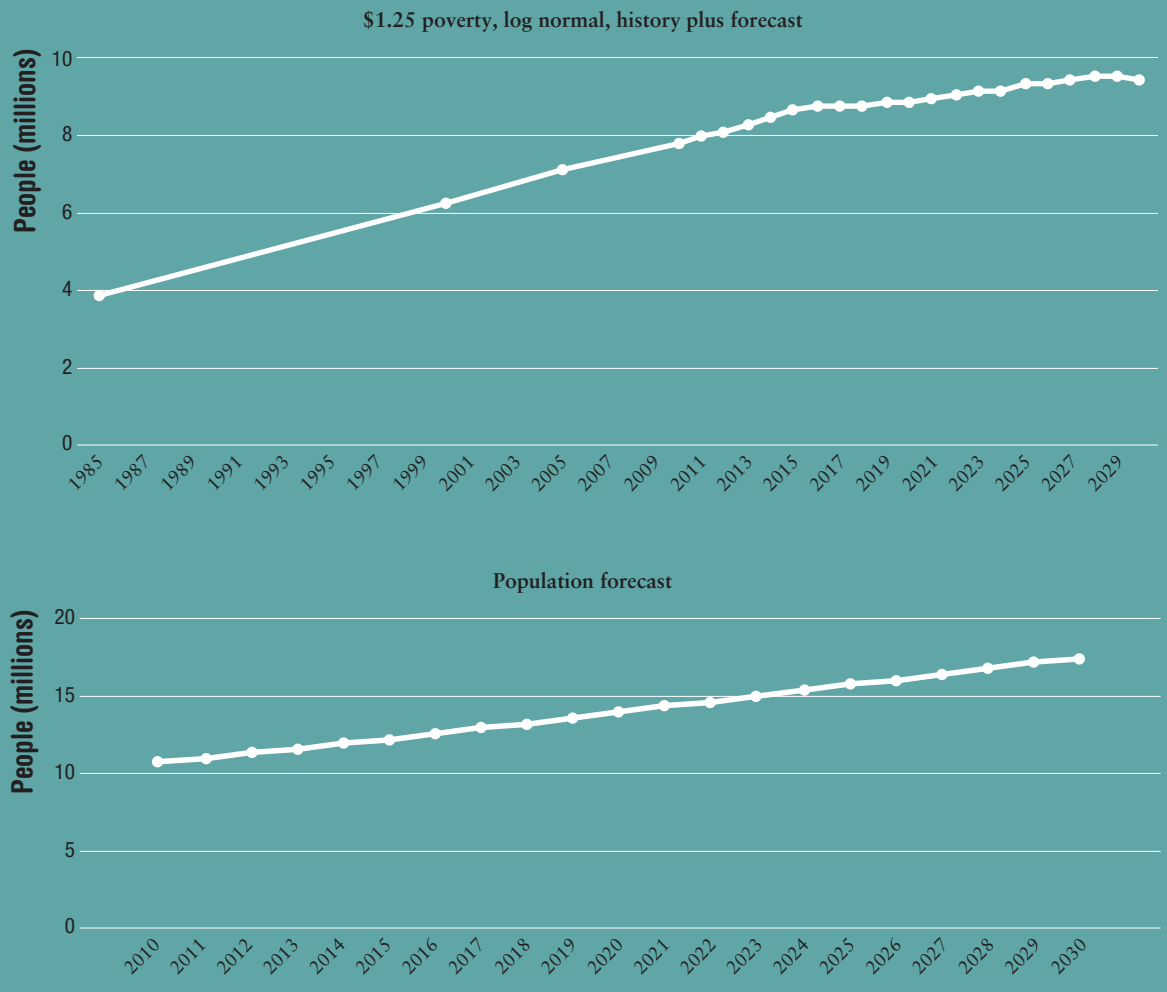


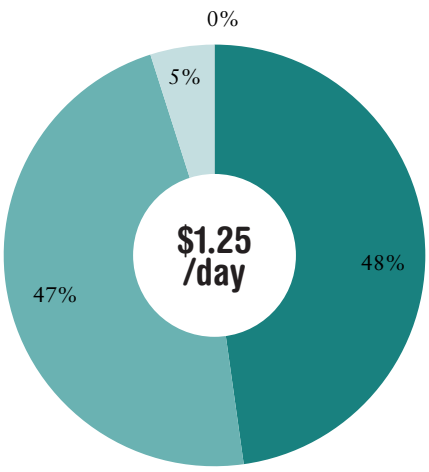
TABLE 3: IFS SCENARIO PARAMETERS[21]

Poverty and resilience-scenario variables	Transmission channel	Optimistic multiplier	Pessimistic multiplier
Agricultural productivity	An increase of agricultural productivity increases agricultural output and domestic food supply.	1.2	0.8
Total fertility rate	An increase in the fertility rate increases food demand and prices but can increase labour supply and output.	0.8	1.2
Total factor productivity	An additive component of the growth rate representing output enhancing technological change.	0.01 (additive)	-0.01 (additive)
Government expenditure on infrastructure	An increase of infrastructure parameters boosts economic growth and development.	1.2	0.8
Government expenditure on health	An increase of public-health expenditure lowers households' health costs.	1.2	0.8
Government expenditure on education	An increase of public education expenditure lowers households' schooling costs.	1.2	0.8
Government transfers to households	Transfers to skilled and unskilled workers improve demand, growth and the capabilities of individuals.	1.2	0.8
Government effectiveness	An increase of this parameter increases effectiveness of national governance.	1.2	0.8
Government corruption	A decrease of this parameter reduces the incidence of government corruption.	0.8	1.2
State failure risk/ internal war	A decrease of this parameter decreases the likelihood of state failure and/or internal war.	-0.3 (additive)	0.3 (additive)
Gender empowerment	An increase in women's empowerment enhances women's capabilities and broader social relations.	1.5	0.5
Malnutrition	A decrease in the incidence of malnutrition reduces child mortality and enhances learning at school.	0.8	1.2
Access to improved sanitation	Improved access to sanitation reduces health risks from poor sanitation services.	1.1	0.9
Access to safe water	Improved access to safe water reduces health risks from unsafe water sources.	1.1	0.9
Social capital	An increase of the social relations in each country increases knowledge and output.	1.5	0.5

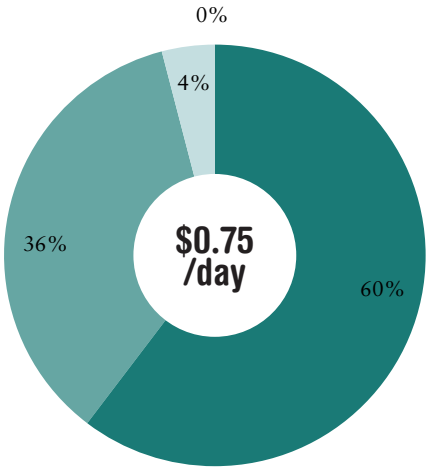
TABLE 4: NUMBERS OF LOW- AND MIDDLE-INCOME COUNTRIES IN THE TOP 10 POVERTY COUNTRIES IN 2030, BY HEADCOUNT (AND PROPORTION) – BASELINE AND OPTIMISTIC SCENARIOS

Scenario	Baseline				Optimistic			
Poverty line	$0.75	$1.25	$2	$4	$0.75	$1.25	$2	$4
LICs	6 (9)	6 (9)	5 (9)	4 (8)	7 (9)	6 (9)	6 (9)	4 (8)
LMICs	4 (1)	4 (1)	4 (1)	5 (2)	3 (1)	4 (1)	3 (1)	5 (2)
UMICs	0 (0)	0 (0)	1 (0)	1 (0)	0 (1)	0 (0)	1 (0)	1 (0)

Figure 4: Proportion of poverty in 2030 by country category (IFs baseline scenario)



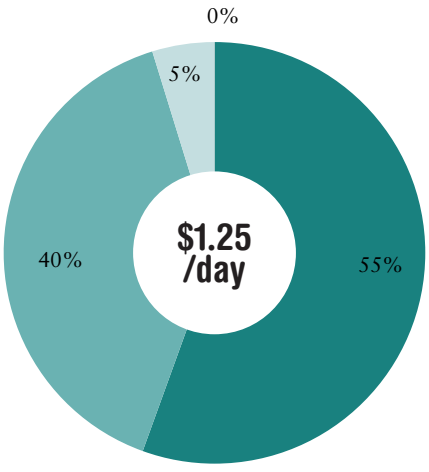
Total projected poverty headcount: **624,268,400**
of which India: **126,500,000**



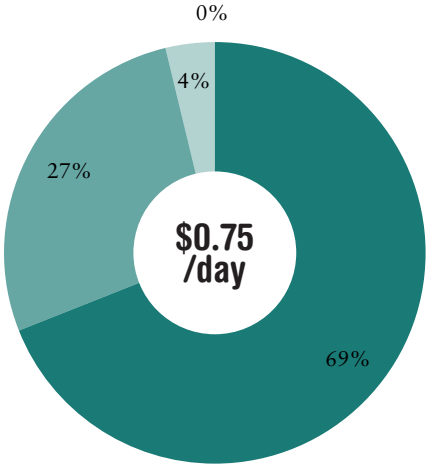
Total projected poverty headcount: **229,913,100**
of which India: **29,020,000**

LICS LMICS UMICS HICS

Figure 5: Proportion of poverty in 2030 by country category (IFs optimistic scenario)



Total projected poverty headcount: **182,436,400**
of which India: **50,600,000**



Total projected poverty headcount: **58,282,900**
of which India: **8,743,000**

LICS LMICS UMICS HICS

TABLE 5: HIGHEST POVERTY HEADCOUNTS AND PROPORTIONS PROJECTED IN 2030, IFS BASELINE

$0.75/day (millions)		$0.75/day (% of pop)	
India	29.02	Madagascar	57.03
Madagascar	20.24	Burundi	50.17
Pakistan	13.8	Swaziland	43.04
Democratic Republic of Congo	13.01	Rwanda	36.17
Tanzania	12.46	Haiti	36.03
Nepal	10.93	Malawi	34.52
Malawi	9.11	Central African Republic	33.89
Sudan	6.946	Guinea Bissau	31.98
Nigeria	6.765	Somalia	31.6
Rwanda	6.293	Comoros	28.57
$1.25/day (millions)		**$1.25/day (% of pop)**	
India	126.5	Burundi	77.5
Pakistan	57.56	Madagascar	76.74
Democratic Republic of Congo	29.96	Swaziland	62.9
Tanzania	27.43	Malawi	60.31
Madagascar	27.24	Rwanda	54.03
Ethiopia	21.76	Guinea Bissau	53.12
Nigeria	21.75	Haiti	51.22
Bangladesh	20.93	Comoros	51.07
Nepal	18.45	Central African Republic	49.2
Sudan	18.24	Somalia	48.76
$2/day (millions)		**$2/day (% of pop)**	
India	396	Madagascar	93.58
Pakistan	151	Burundi	89.77
Bangladesh	58.04	Guinea Bissau	79.77
Ethiopia	54.36	Swaziland	78.81
Democratic Republic of Congo	50.68	Malawi	78.12
Nigeria	47.14	Somalia	76.12
China	45	Eritrea	69.76
Tanzania	43.56	Haiti	68.83
Madagascar	33.21	Central African Republic	68.47
Philippines	31.09	Comoros	68.17

We have analysed both headcounts and proportions in poverty in 2030. These two measures give very different lists of countries, with the situation in the countries with the greatest headcount being driven by population size and predicted growth; while the top countries in terms of proportions of the population who are poor are, in most cases, countries with smaller populations. Only one UMIC (China) figures among the top ten countries and only at $2 per day. Of all countries today, China has the capacity and resources to both eradicate poverty and manage disasters.

For the purposes of this report, we can rule out UMICs as a substantial risk.

The division between LICs and LMICs varies somewhat between the two measures – headcount and proportion. In terms of proportion and under the various poverty lines, poverty in 2030 is first and foremost a problem for today's LICs (some of which will, of course, be MICs by then) (Table 7).

But in terms of numbers, and looking at *both* $0.75 and $1.25 poverty lines, **India, Nigeria, Pakistan**, and **Sudan**, are LMIC countries to watch. **Among LICs, Bangladesh, the Democratic Republic of Congo (DRC), Ethiopia, Madagascar, Nepal** and **Tanzania** are also likely to be among the top poverty countries in 2030 in terms of the numbers of people who are vulnerable to poverty (Figure 6).

The highest vulnerability to poverty lies in sub-Saharan Africa, Asia and Central America. Even in the optimistic scenario, there are countries in the highest vulnerability category, most of them in Africa.

This analysis also refers to the optimistic scenario (Table 7 and Figure 7) – to see if other countries feature despite a positive scenario. This points to three additional LICs which, even if things go well, will struggle to eradicate poverty by 2030: **Burundi, Malawi** and **Rwanda**. In these countries, there would be large numbers of poor people to be affected if massive hazards were to occur, especially if adequate disaster risk governance capacities are not in place.

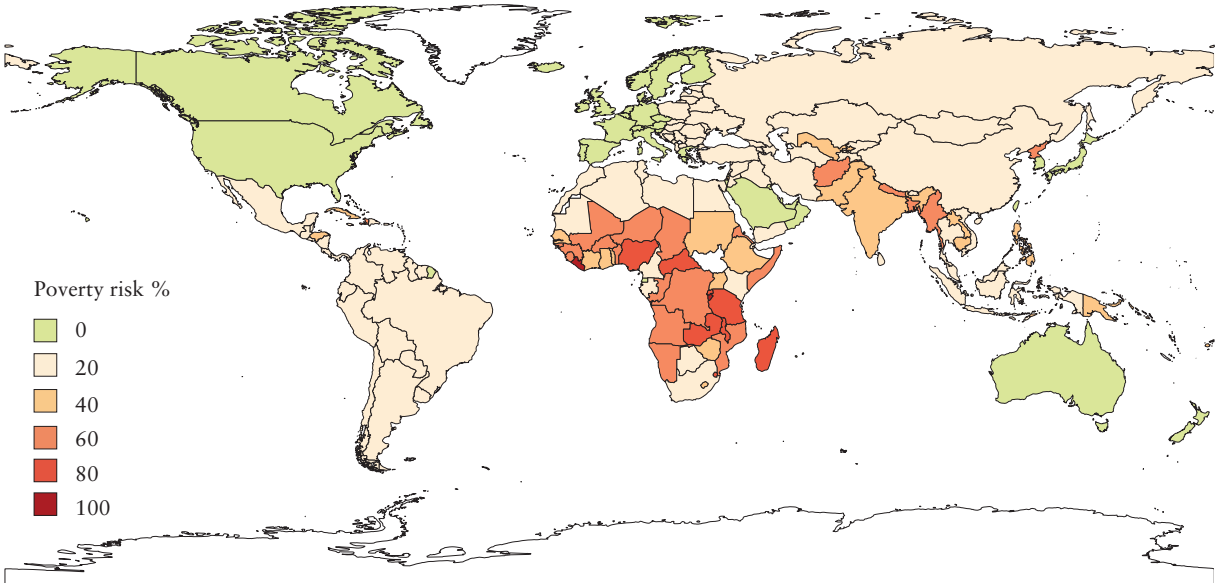
Taken together, this gives us a short list of 13 countries that will be extremely prone to poverty in 2030.

The full set of projections (for various poverty lines) and the optimistic and pessimistic scenarios are given in Technical Annex B.

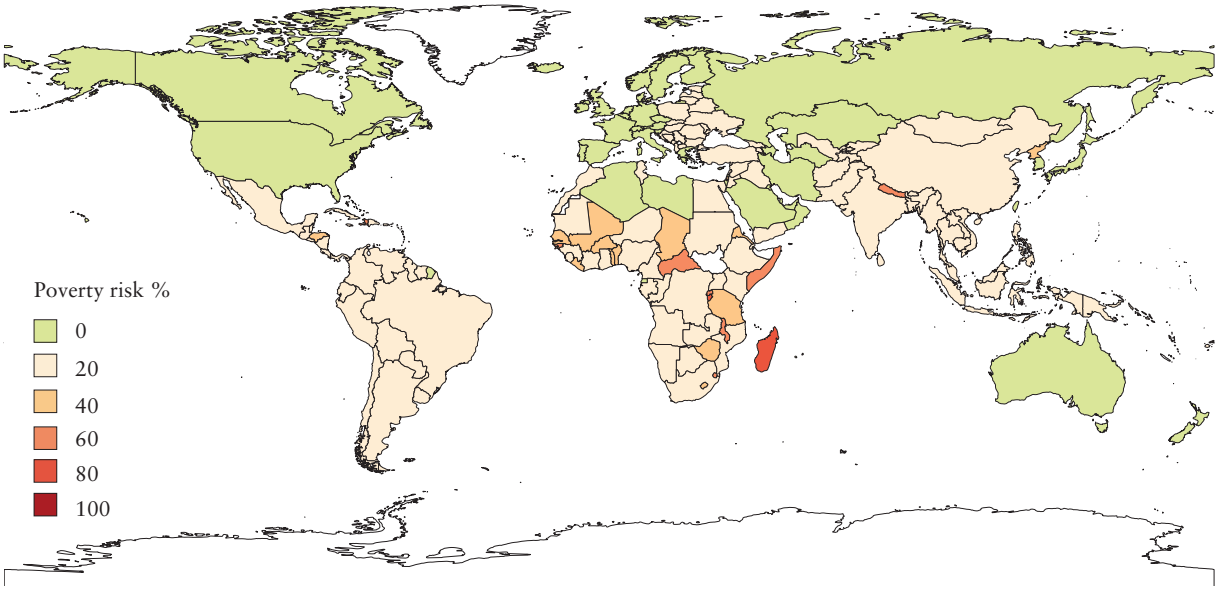
Finally, and using these projections, we have constructed the Poverty Vulnerability Index (PVI), which combines a number of indicators into one index of poverty in 2030, with the most vulnerable being those with the highest proportions of people living on less than $0.75 per day, and the lowest vulnerability category being countries with more than 10% of the population, and more than one million people, living on less than $4.00 per. Box 5 explains the detail and locates countries across the index. Figures 8 and 9 show that the highest vulnerability to poverty lies in sub-Saharan Africa, Asia and Central America. Even in the optimistic scenario, there are countries in the highest vulnerability category, most of them in Africa, and then a spread of countries across Africa and Asia in the next category.

Figure 6: Poverty in 2010 and 2030 ($0.75 and $1.25 a day poverty lines), IFs baseline

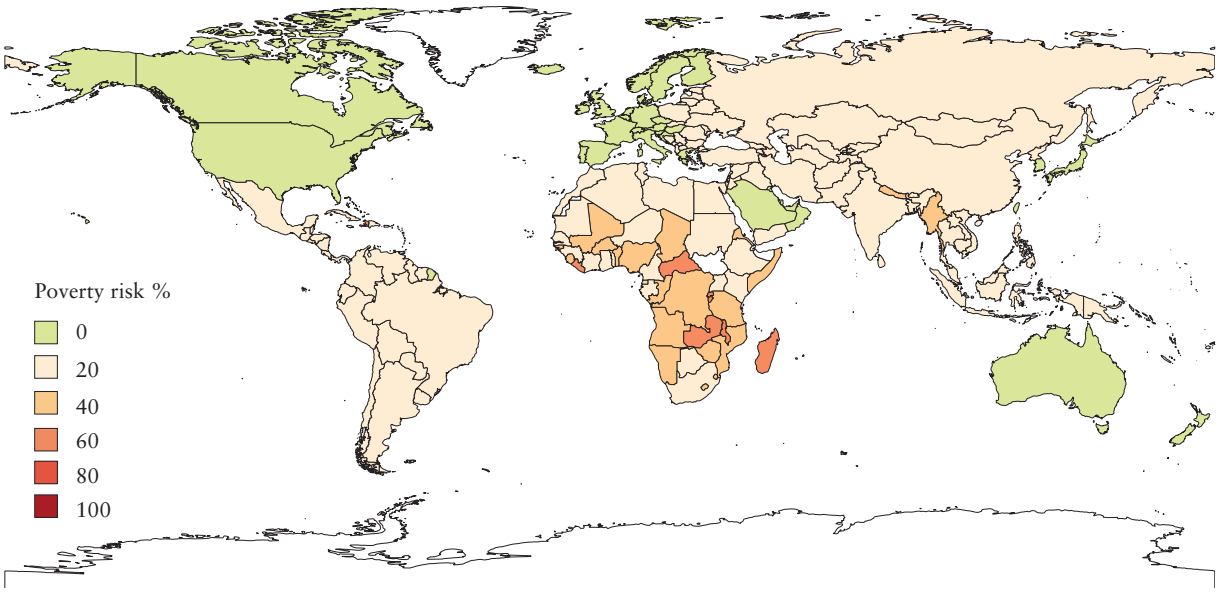
Poverty risk at $1.25 line in 2010



Poverty risk at $0.75 line in 2010



Poverty risk at $1.25 line in 2030



Poverty risk at $0.75 line in 2030

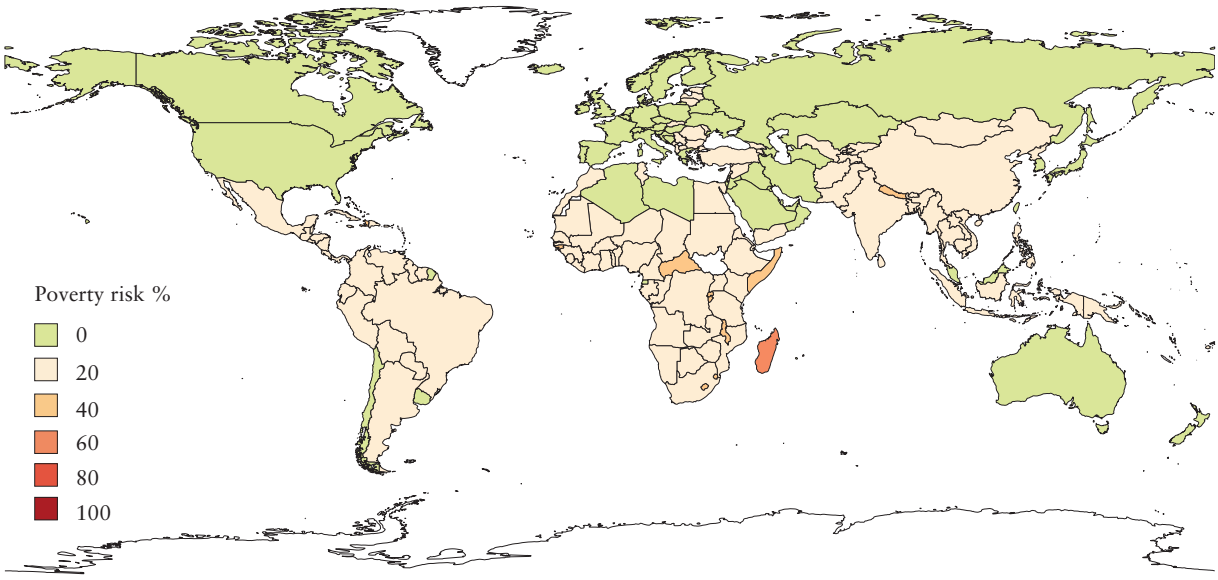


TABLE 6: TOP 10 COUNTRIES IN THE OPTIMISTIC AND PESSIMISTIC SCENARIOS, HEADCOUNTS AND PERCENTAGES ($0.75, $1.25, AND $2 A DAY POVERTY LINES)

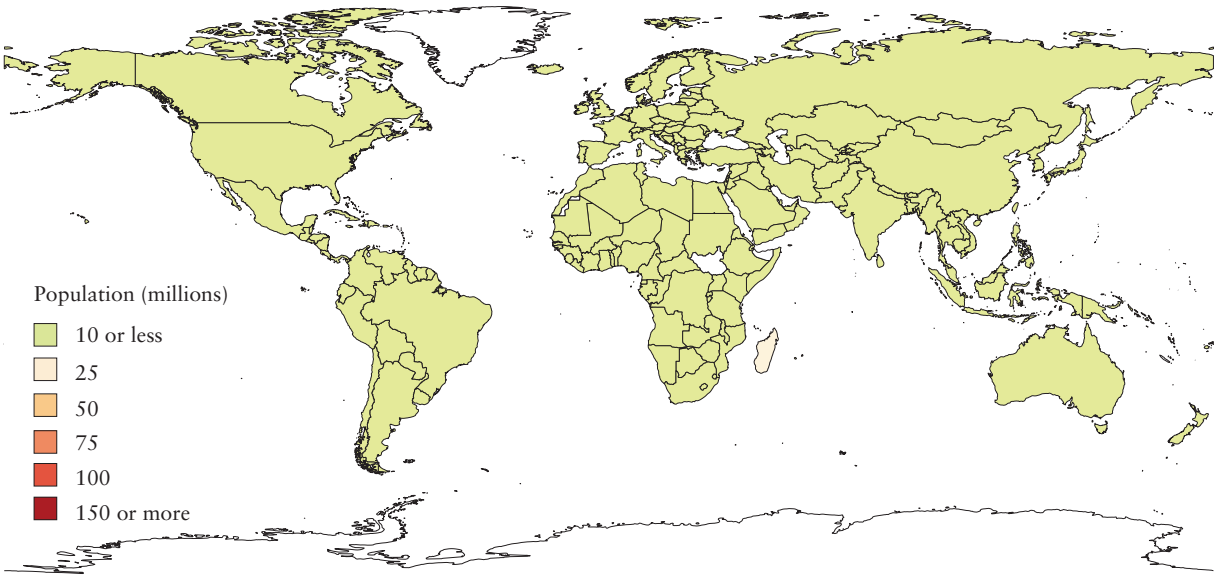
Optimistic	$0.75/day (millions)		$1.25/day (millions)		$2/day (millions)	
1	Madagascar	15.23	India	50.6	India	209.8
2	Nepal	8.963	Pakistan	28.5	Pakistan	101.7
3	India	8.743	Madagascar	22.19	Bangladesh	44.22
4	Democratic Republic of Congo	7.805	Democratic Republic of Congo	19.87	Democratic Republic of Congo	36.55
5	Tanzania	6.957	Tanzania	17.81	Ethiopia	35.34
6	Malawi	6.653	Nepal	15.48	Nigeria	32.51
7	Pakistan	5.099	Bangladesh	14.12	Tanzania	31.68
8	Burundi	4.636	Nigeria	13.9	Madagascar	29.26
9	Sudan	4.316	Malawi	12.58	China	27.41
10	Rwanda	4.269	Sudan	12.34	Nepal	22.93
Optimistic	**$0.75/day (% of pop)**		**$1.25/day (% of pop)**		**$2/day (% of pop)**	
1	Madagascar	46.48	Burundi	68.33	Madagascar	89.27
2	Burundi	39.72	Madagascar	67.69	Burundi	83.66
3	Swaziland	35.52	Swaziland	55.37	Guinea Bissau	72.96
4	Haiti	33.45	Malawi	51.98	Swaziland	72.83
5	Central African Republic	29.48	Haiti	48.22	Malawi	71.06
6	Malawi	27.48	Comoros	47.46	Somalia	68.83
7	Rwanda	26.44	Guinea Bissau	44.99	Haiti	65.89
8	Comoros	26.05	Central African Republic	44.13	Comoros	64.46
9	Somalia	25.63	Rwanda	43.03	Central African Republic	63.64
10	Guinea Bissau	25.47	Somalia	41.17	Eritrea	63.42

TABLE 6: CONTINUED

Pessimistic	$0.75/day (millions)		$1.25/day (millions)		$2/day (millions)	
1	India	83.93	India	289.3	India	704.9
2	Tanzania	26.45	Pakistan	88.39	Pakistan	193.2
3	Pakistan	24.58	Tanzania	47.25	Bangladesh	87.62
4	Madagascar	22.98	Bangladesh	37.11	Ethiopia	77.48
5	Democratic Republic of Congo	16	Nigeria	36.96	China	77.31
6	Nepal	13.49	Democratic Republic of Congo	36.61	Nigeria	72.94
7	Nigeria	12.88	Ethiopia	36.21	Tanzania	63.82
8	Malawi	12.36	Madagascar	30.79	Democratic Republic of Congo	60.66
9	Ethiopia	10.53	Nepal	22.4	Indonesia	48.34
10	Burkina Faso	9.412	Sudan	22.06	Philippines	45.41
Pessimistic	**$0.75/day (% of pop)**		**$1.25/day (% of pop)**		**$2/day (% of pop)**	
1	Madagascar	60.06	Burundi	83.5	Madagascar	95
2	Burundi	56.77	Madagascar	80.48	Burundi	93.61
3	Swaziland	52.98	Swaziland	72.33	Malawi	85.98
4	Rwanda	48.47	Malawi	70.19	Swaziland	85.9
5	Malawi	43.06	Rwanda	66.57	Niger	83.92
6	Somalia	37.25	Occupied Palestinian Territories	66.14	Somalia	82.89
7	Haiti	37.13	Burkina Faso	57.52	Guinea Bissau	80.58
8	Central African Republic	36.93	Tanzania	56.53	Burkina Faso	80.57
9	Occupied Palestinian Territories	35.89	Somalia	56.16	Occupied Palestinian Territories	79.54
10	Nepal	31.87	Comoros	54.45	Rwanda	79

Figure 7: Poverty in 2010 and 2030 ($0.75 and $1.25 a day poverty lines) IFs optimistic scenario

Total population predicted in poverty at $0.75/day in 2030 - optimistic scenario



Total population predicted in poverty at $1.25/day in 2030 - optimistic scenario

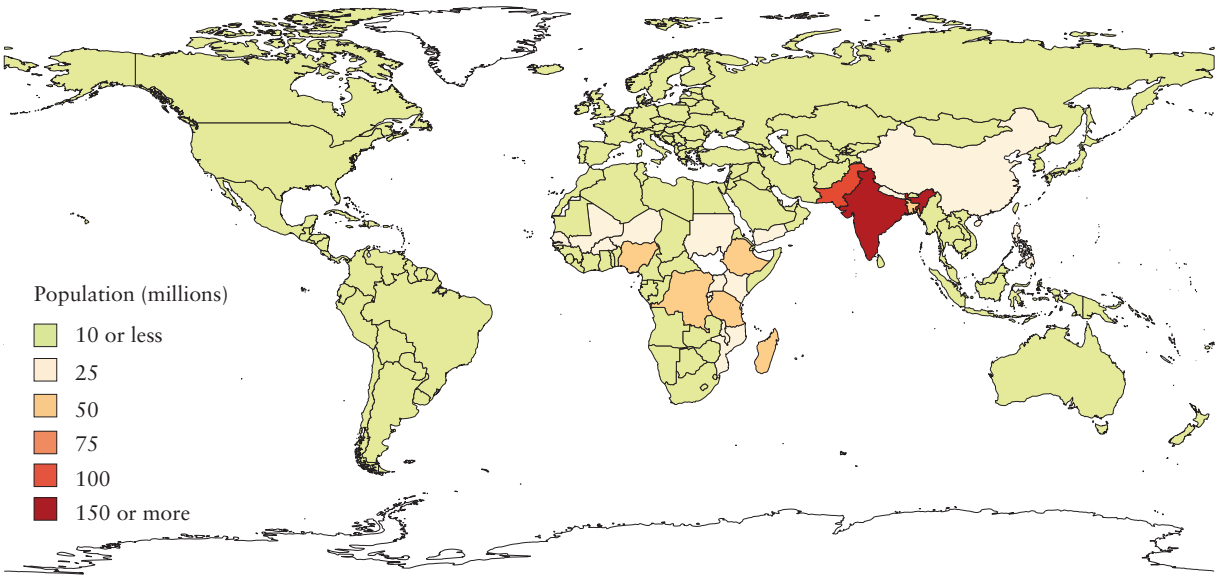


Figure 8: Vulnerability to poverty in 2030 - IFs baseline scenario

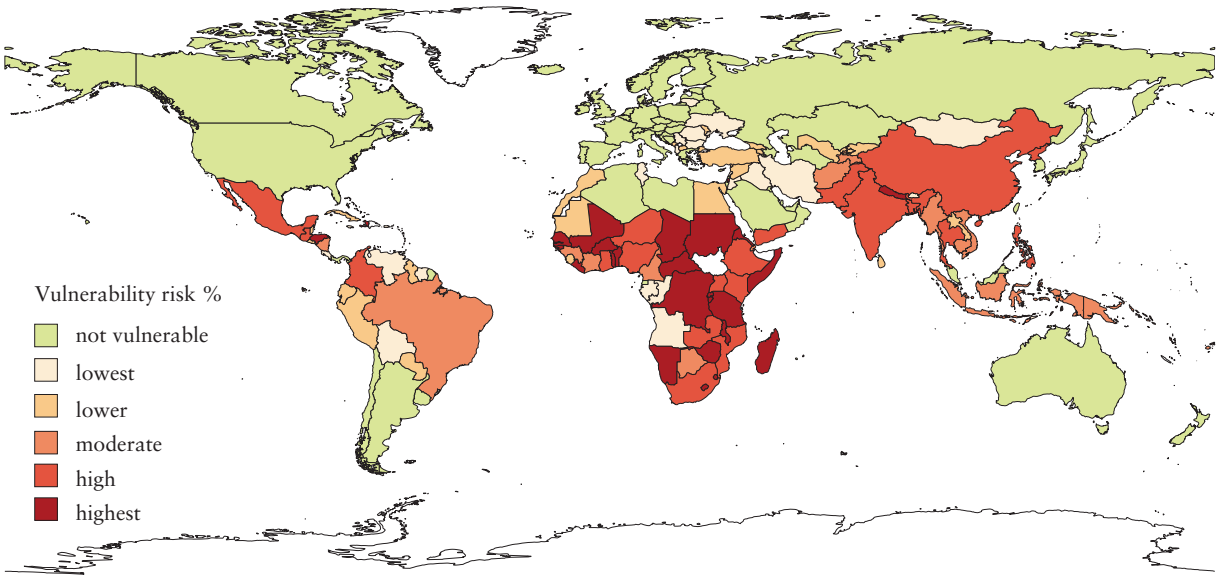
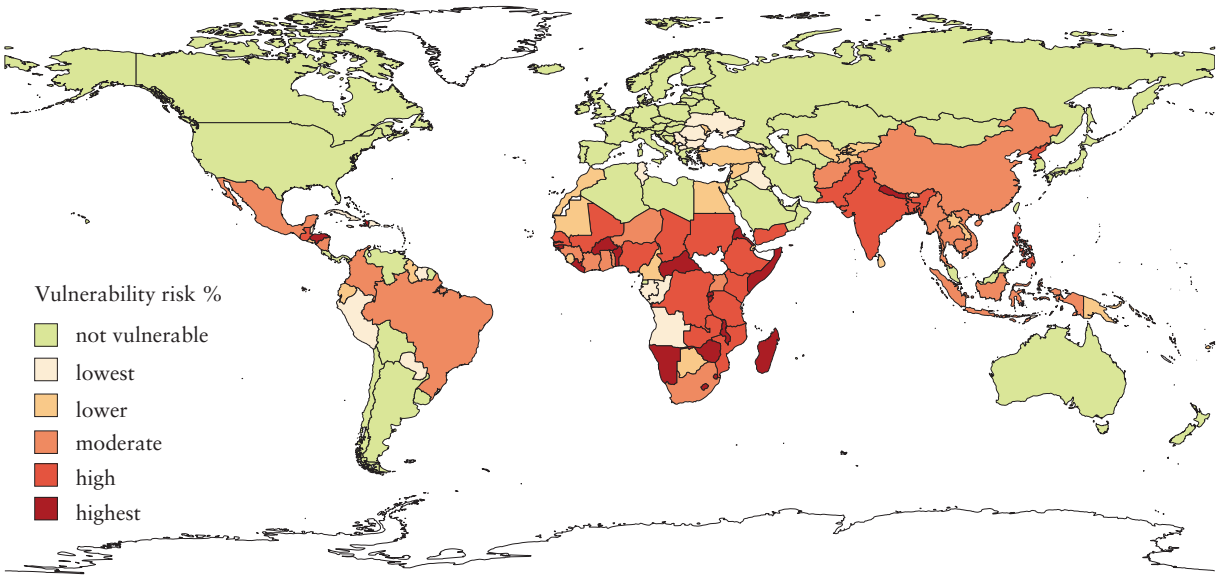


Figure 9: Vulnerability to poverty In 2030 - IFs optimistic scenario



BOX 5: COMPARISONS TO RECENT PROJECTIONS

The results obtained for this report are more pessimistic than some other projections developed recently in terms of the proportions and numbers projected to be in poverty in 2030. However, this report is primarily concerned with ranking countries rather than the sheer numbers in poverty to combine the analysis with hazard vulnerability and disaster-risk management (DRM) capacity. For this study we have resisted giving overall poverty numbers, as that would court controversy and distract from the purpose of the report. However, here we situate our projections in the context of other recent projections. It should be noted that previous projections that use the IFs model have been close to those of the World Bank (e.g. Hughes et al., 2009). Three recent projections are detailed in the following table, all of which vary rates of economic growth and income distribution to produce different scenarios and all rely on the same data. The key difference between the projections below and those produced for this report is the complexity of the IFs model used in this study, which draws upon more than 1,500 indicators to forecast, while allowing scenarios to be developed using a number of different parameters beyond economic growth and income distribution (see Table 4 for a list of parameters used in this report).

TABLE 7: COMPARISONS WITH RECENT PROJECTIONS

Source and comment	Outcome(s) (% of population under the $1.25 a day poverty line)	Method
Ravallion (2012)	3% - 15% by 2030, omitting China. 0.2 to 0.8 billion people. Growth rate of 4.5% required (close to trend 4.3% in 2000s) + stable inequality to get to 3% with less than $1.25 a day. Lower levels of inequality would allow lower levels of growth. But inequality has been on the rise in recent years.	Low trajectory: the developing world outside China will return to its pre-2000 pace of poverty reduction from 2012 onward, although China will remain on track. Optimistic: the recent success against extreme poverty in the developing world as a whole will be maintained. Key question: whether the rate of poverty reduction slows down, say below 10%.
Chandy et al. (2013) Assumes that the 'baton' of poverty reduction is passed from China to India, because there are many people in India just behind the poverty line. However, India's poorest people, while not as poor as Africa's, are multi-dimensionally deprived in many cases, and subject to strong social discrimination. Many poor people live in conflict affected or fragile states. A big assumption is that these will come up to the poverty line.	Baseline projection: 5.4% or 386 million people. Scenarios: optimistic-growth: 3.1%. Pessimistic (growth): 9.7%. Optimistic (distribution): 3.2%. Pessimistic (distribution): 9.7%. These combined produce a range of: 1.4% - 15.2%. Both factors (growth and equality) are needed to get to the zero zone (<3%) and this seems unlikely. Progress declines after 2020 (baseline), or 2027 (best case), because the remaining poor are further from the poverty line. The main problems are found in Africa and in fragile- and conflict-affected states.	Baseline projection: growth in private consumption (or GDP) is discounted by a common discount based on the ratio of survey and national accounts-based consumption growth; and distribution remains the same as 2010. Population growth is taken as the UN medium variant-population projection. Scenarios vary by 2% p.a. for consumption growth and a 0.25% variation in consumption shares of the poorest 40% and richest 10%.
Edward and Sumner 2013 'Little evidence for most 2030 poverty being in fragile states.' But figures belie this (see extended debate).	Big range of possibilities depending on economic growth and inequality. Overall $1.25 a day: with varying growth rates: 300/500 million – 800/900 million people (survey/NA means). 300 million people in poverty (3-4%) requires optimistic growth and 'best ever' country-specific distribution. If current inequality trends continue, with low growth, poverty could increase to affect 1.3 billion people. The resulting range is 300 million to 1.3 billion people. Most extreme and $2 per day poverty will be found in African and low-income countries. India: $2 a day: 0–850 million people. $1.25 a day: 84 million under a static inequality scenario and a pessimistic growth scenario, or 0 under other scenarios.	'Poverty levels in the future are very dependent on future growth, so it is worth noting that while we consider the pessimistic forecast to be a reasonable lower-bound to global growth, at least one reviewer has suggested that even this scenario may still be too optimistic so that even the worst-case outcomes in these figures may be exceeded' (p50-51). Unfortunately, most of the analysis of location of poverty relates to the $2 poverty threshold.

BOX 6: CONSTRUCTING THE POVERTY VULNERABILITY INDEX

The Poverty Vulnerability Index (PVI) was constructed by setting the highest vulnerability category to include those countries projected by the optimistic scenario to have the largest proportion of people living below $0.75/day in 2030. The optimistic scenario is used because the IFs projections for poverty are higher than other projections. The index points, therefore, to those countries likely to face high rates of poverty despite the major factors determining levels of poverty being projected as optimistically.

It is assumed that countries in the highest vulnerability category would face greater difficulty bouncing back from a disaster because a larger proportion of the population would already be living in poverty, would be unable to contribute to rebuilding, would be more likely to be affected and would be in the greatest need of resources to recover.

The second highest vulnerability threshold includes those countries projected to have more than one million people living below $1.25 per day in 2030, based on the assumption that such a high number of people in poverty would affect a country's disaster resilience, though to a lesser extent than having a high proportion of people living in poverty. The subsequent categories were based on the same principles, using higher poverty lines of $1.25, $2.00 and $4.00 per day respectively.

The following table shows the full PVI results for the baseline scenario:

TABLE 8: FULL POVERTY VULNERABILITY INDEX RESULTS FOR THE BASELINE SCENARIO

Highest vulnerability >10% at less than $0.75/day	**High vulnerability** >1,000,000 at less than $0.75/day	**Moderate vulnerability** >10% at less than $1.25/day and >1,000,000 at less than $1.25/day	**Lower vulnerability** >10% at less than $2.00/day and >1,000,000 at less than $2.00/day	**Lowest vulnerability** >10% at less than $4.00/day and >1,000,000 at less than $4.00/day	**Not vulnerable** <10% at less than $4.00/day and <1,000,000 at less than $4.00/day		
Madagascar	India	Occupied Palestinian Territories	Kyrgyzstan	Belize	Lithuania	Poland	Czech Republic
Burundi	DRC	Tonga	Djibouti	Cuba	Mongolia	New Zealand	Switzerland
Swaziland	Tanzania	Togo	Tajikistan	Republic of Macedonia	Costa Rica	Bahamas	Austria
Haiti	Pakistan	Gambia	Fiji	Georgia	Bolivia	Uruguay	Denmark
Central African Rep	Sudan	Niger	Moldova	Paraguay	Albania	Israel	Germany
Malawi	Nigeria	Sao Tome & Principe	Botswana	Lebanon	Jordan	Spain	Brunei
Rwanda	Bangladesh	Nicaragua	Samoa	Puerto Rico	Panama	Italy	Finland
Comoros	Ethiopia	Solomon Islands	St. Vincent and Grenadines	Congo; Rep.	Barbados	Slovenia	Iceland
Somalia	Philippines	St. Lucia	Papua NG	Romania	Maldives	Cyprus	Ireland
Guinea Bissau	Mali	Micronesia	Cape Verde	Bulgaria	Slovakia	Azerbaijan	Japan
Nepal	Kenya	Vanuatu	Syria	Serbia	Equatorial Guinea	USA	Kazakhstan
Lesotho	Senegal	China	Cameroon	Bhutan	Venezuela	Malta	Kuwait
Eritrea	Chad	Viet Nam	Grenada	Timor-Leste	Oman	Saudi Arabia	Luxembourg
Honduras	Yemen	Uganda	Mauritania	Jamaica	Malaysia	Singapore	Norway
Benin	Korea DPR	Thailand	Guyana	Gabon	Iran	Hong Kong	Qatar
Liberia	Mozambique	South Africa	El Salvador	Dominican Rep	Estonia	France	Sweden
Zimbabwe	Zambia	Colombia	Montenegro	Suriname	Portugal	Trinidad	Taiwan
Namibia	Guatemala	Mexico	Sierra Leone	Tunisia	Argentina	UK	Turkmenistan
Burkina Faso		Ghana	Armenia	Peru	Belarus	Belgium	UAE
		Myanmar	Laos	Iraq	Croatia	Libya	
		Cote d'Ivoire	Egypt	Angola	Chile	Australia	
		Afghanistan	Morocco	Ukraine	Latvia	Bahrain	
		Indonesia	Uzbekistan	Mauritius	Algeria	Netherlands	
		Brazil	Sri Lanka		Hungary	Korea South	
		Guinea	Ecuador		Greece	Russia	
		Cambodia	Turkey		Bosnia	Canada	

2.3 The place of disasters in poverty dynamics

There is a continuum of shocks, from the individual and through the community, to the regional, national and global levels. The point at which shocks are most significant in terms of impoverishment and chronic poverty along this continuum depends on the specific context. So, for example, area-wide shocks such as drought or rain failure are most important in semi-arid environments such as Ethiopia and Pakistan. Infectious diseases (for animals as well as people), crop diseases and pests are more important in densely populated coastal areas. Coastal areas that are also low lying are subject to flooding and storms, as are earthquake-prone countries around the Pacific 'ring of fire' (Baulch, 2012b).

There is widespread agreement that it is the combination or sequence of shocks, together with low levels of resilience (caused by poor levels of endowments and limited returns to them) which results in some people becoming impoverished or remaining poor. However, there is little research about which combinations and sequences matter in which contexts. We could hypothesise that the most common impoverishing combinations are those that combine environmental and individual shocks, because the individual shocks are common to most people and, to some extent predictable, (e.g. ill health in old age; funeral or marriage expenses) and the environmental shocks are widely experienced, thus undermining the potential for relief based on social solidarity.

We analysed panel data responses for two drought-prone parts of the world – Andhra Pradesh (AP) in India and Ethiopia.[22] In both, drought was by far the most common negative event recorded between survey rounds by both those slipping down into poverty as well as those on other poverty trajectories, such as those escaping poverty and the chronically poor. Those staying out of poverty in AP and, to a lesser extent, in rural Ethiopia, did not record drought as a negative event so often (Figure 10).

Few of those who remained in poverty or slipped into poverty reported no shocks, in contrast to those who moved out or stayed out of poverty. In AP, the former reported far more episodes of drought.[23] In Ethiopia, only those staying out of poverty were less likely to report drought as a major event.

In these two surveys, ill-health and/or death come second to drought in terms of the number of reports. There are only a few occasions on which they are reported as often (e.g. for chronically poor rural Ethiopians, who may have a particularly high death rate and disease burden). This is the opposite of what was expected. However, these results are very preliminary, and significant further analysis is both possible and desirable, as demonstrated by other work on shocks and impoverishment in, for example, Bangladesh.

Bangladesh is a flood prone country, where the opposite ranking of environmental and individual shocks has been observed. Although floods are by far the most frequently reported shock, the insignificant impoverishing impact of floods has been attributed to the emergency assistance system, which targets the most flood-damaged areas and the poor within those areas (Baulch, 2012c). On the other hand, ill-health and dowry, both singly and in combination, have powerful effects on poverty dynamics.

A number of panel data sets have good questions on disasters,[24] and further work might reveal greater differentiation in the ranking of different types of hazard (drought/flood/landslide/earthquake etc.) in terms of their association with various trajectories of well-being. And further statistical analysis would help to get at the causes of poverty dynamics, as opposed to the associations we have been able to analyse here.

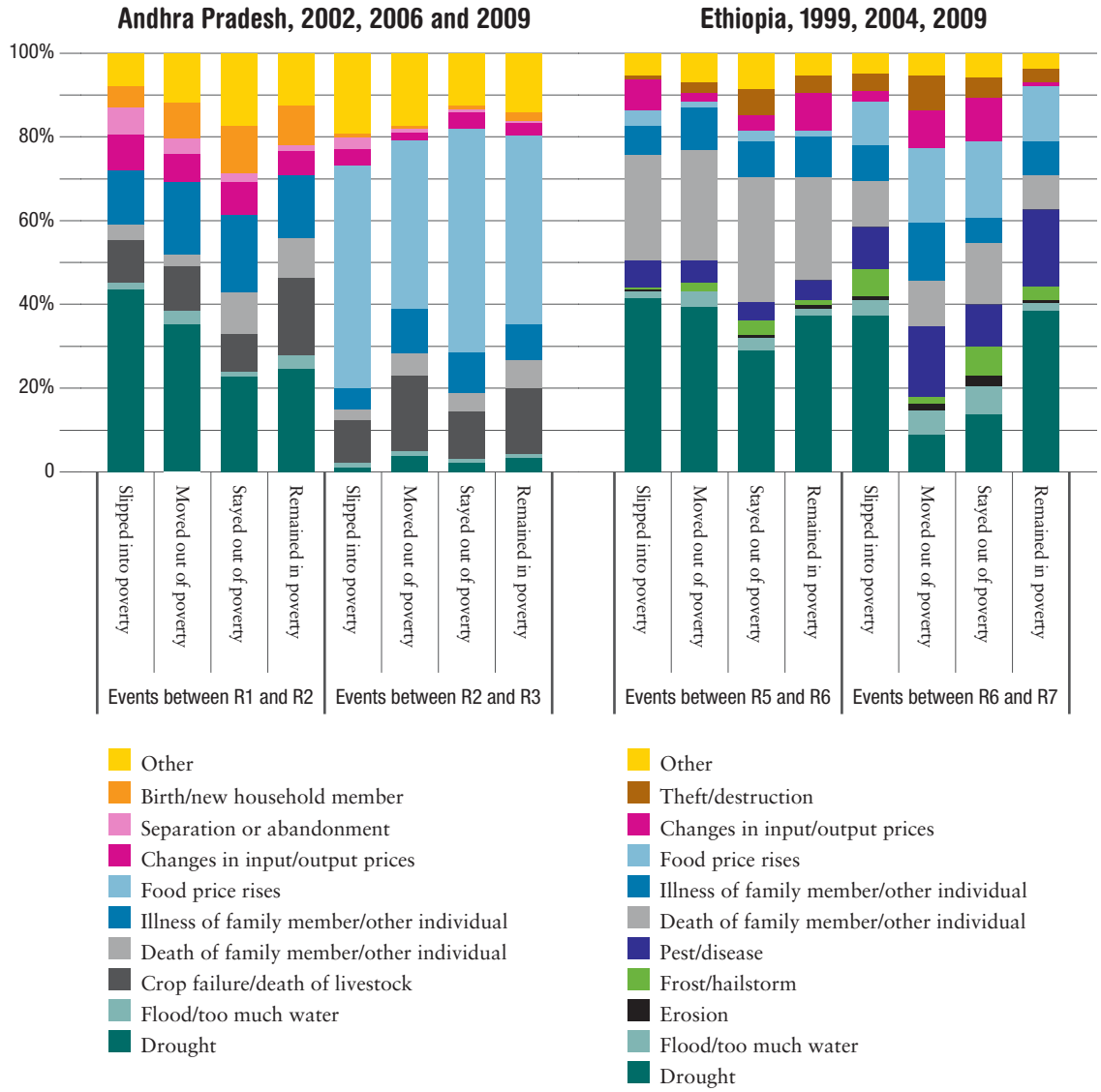
2.4 Resilience thresholds?

For Latin America it has been estimated that $10 per day is the income/consumption level that constitutes the lower boundary of the middle class (Lopez-Calva and Ortiz-Juarez, 2011), and this was the amount used by Sumner (2012 and 2013) to estimate a threshold for resilience to impoverishment. By contrast, the 2012 Uganda Poverty Status Report talks of the middle class beginning at twice the extreme poverty line, with the insecure non-poor consuming more than poverty line consumption, but less than twice the poverty line. Between 2005/6 and 2009/10 67% of middle class households remained middle class, indicating a certain level of security (Government of Uganda, 2012).

A limited amount of work has been possible during the preparation of this report to identify whether any household income/consumption thresholds exist, above which impoverishment is unlikely. Three rounds of the Ethiopian Rural

Figure 10: Andhra Pradesh, India and Ethiopia: prevalence of shocks for households

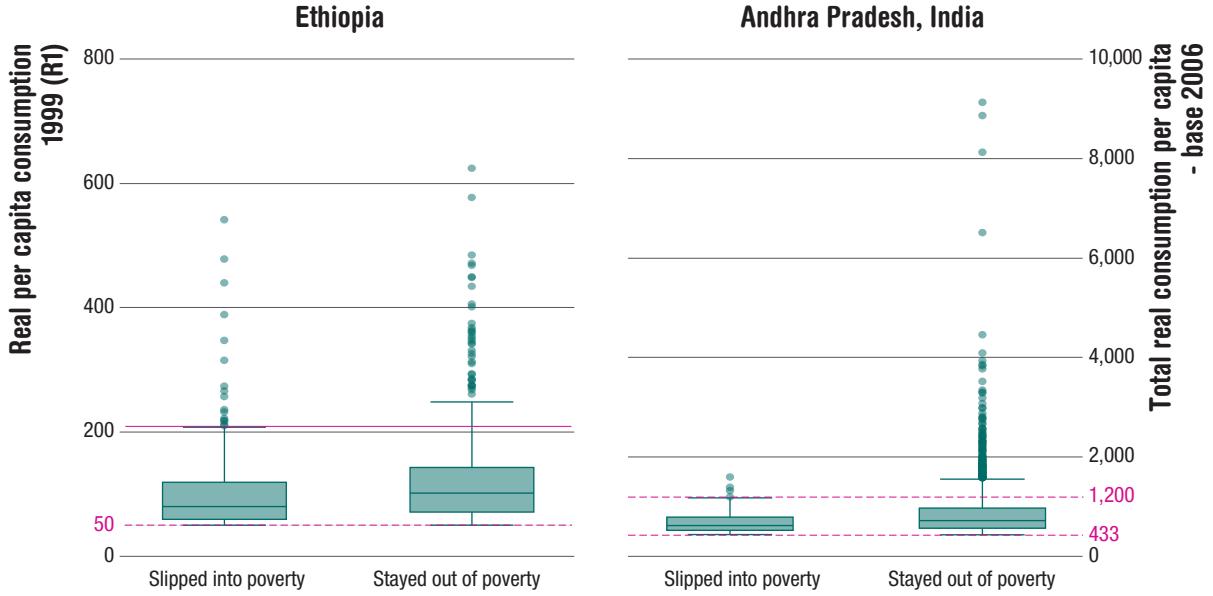
SOURCES: Young Lives panel dataset, Andhra Pradesh; Ethiopia Rural Household Survey. The data includes only those households reporting shocks.



Household Survey (see above) were analysed. With the per capita poverty line set at 50 birr per month (Dercon et al., 2012), the threshold identified is 200 birr, four times the poverty line. The data for the first two rounds are shown in Figure 11. Excluding the outliers, all households that were slipping into poverty were below the 200 birr threshold. Some 50% were in the blue box containing the majority of households; 25% were between the box and the 200 birr line; and 25% were just under the blue box. The results were similar for the second and third rounds of the survey.

The Andhra Pradesh Young Lives Survey produced a similar result for rural areas, although the apparent threshold was significantly lower, at just under three times the rural poverty line or around 1,200 rupees per capita per month when compared to a rural poverty line set at 433 rupees per capita per month. This indicates that, if there are thresholds, they vary from context to context.

Figure 11: Identification of vulnerability thresholds in rural Ethiopia (left figure) and Andhra Pradesh, India (right figure)



Given that more than three quarters of the population of many LICs have consumption levels under $4 per day, it is wise to look at a variety of possible thresholds. Further analysis of the Ethiopian data suggests that, while initial household per-capita consumption is a far better predictor of the likelihood of being in poverty at the time of the next survey round than a model with no predictors that probability declines steadily as initial household per-capita consumption increases. This was tested up to a household per-capita consumption level of 350 birr, or seven times the poverty line.

If initial household per capita consumption is 50 birr (on the poverty line) then the probability of living in poverty at the time of the next survey round is 0.592. If initial consumption is 100 birr (twice the poverty line) then the probability of living in poverty in the next round is 0.525. And if initial consumption is 200 birr (four times the poverty line) then the probability of living in poverty in the next round is 0.392. This suggests there is no threshold as such.

Resilience thresholds may be difficult to pin down empirically for households (as are the poverty traps at the other end of the equation – see *Journal of Development Studies* Special Issue June 2013). Nevertheless the very idea of a resilience threshold is (like that of a poverty trap) intuitive. Further work could also seek to demonstrate that *countries* (as opposed to households) that reduce the proportion of their people living beneath the higher $2 or $4 per day poverty lines are also likely to be more resilient to disasters, where they have higher tax takes and public expenditure profiles. However, these variables are also likely to be over-determined by the nature of political regimes and political settlements, which begs the question: do these include a commitment to prevent famine, disaster-related deaths and contain disaster-related impoverishment?

2.5 Sub-national geographical poverty traps in 2030

A separate exercise was carried out for sub-national regions within Ethiopia, India, Madagascar, Nepal, Nigeria and Pakistan, countries expected to have substantial populations living in extreme poverty in 2030 under all the indicators explored in section 2.2. The projections of poverty ratios for the states, regions or provinces of these countries were made on the basis of historical trends. Population projections were then used to calculate the numbers of poor people.

Optimistic and pessimistic scenarios were derived by using the IFs coefficient of variation of poverty outcomes for each country, and applying them to the regional projection. The purpose of the exercise was to identify sub-national regions that are likely to be particularly poor in 2030, to identify whether they are also disaster-prone and should, therefore, be seen as poverty-disaster hotspots of particular concern.

Before presenting the findings, two caveats are in order:

First, the projections are made simply on the basis of past trends rather than any sort of modelling. This does lead to some absurd results, with 100% of the people in some regions being poor in future. A more sophisticated approach would be to apply the IFs model to sub-national trends.[25] Even apparently 'simple' projections are not that simple in reality: in the case of Madagascar, for example, the rate of change varied significantly depending on whether the baseline for projection was 1993-2010 or 2001-2010.

Second, the variations between optimistic and pessimistic projections seen at the national level in the IFs analysis have been replicated uniformly at the sub-national level. The approach tends, therefore, to underestimate the actual range of performance, which could be expected to vary from region to region.

Sub-national projections were made for six countries, based on available statistics on poverty trends over the past 20-30 years. Optimistic and pessimistic scenarios were derived using the coefficients of variation realised in the national (IFs-based) analyses. This is a crude exercise; but four out of the six

TABLE 9: SUB-NATIONAL ENTITIES WITH MORE THAN ONE MILLION POOR PEOPLE PROJECTED IN 2030[26]

Country	State/Region/Province	% in poverty	Millions in poverty (figures in brackets: optimistic scenario)
Ethiopia	Oromia	22	14 (2)
	Somale	42	3)
	Amhara	9	2) (less than 1 million)
	Afar	61	1)
	Addis Ababa	30	1)
	Tigray	16	1)
India*	Uttar Pradesh	18	52 (5)
	Madhya Pradesh	34	35 (4)
	Bihar	18	28 (3)
	Andhra Pradesh	13	12 (1)
	Orissa	24	23 (2)
	Karnataka	16	15 (2)
Madagascar**	Fianarantsoa	100	5 (4)
	Mahajanga	100	5 (4)
	Toliara	83	5 (4)
Pakistan	Punjab	10	14 (5)
	North-West Frontier Province	20	7 (2)
	Balochistan	14	2

* India has 13 states with over one million projected poor people in 2030. Only the top three are listed here. Even on the optimistic projection, India has six states with over one million and two (Maharashtra and West Bengal) with just under one million. There are also high urban headcounts (over 20%) in Assam, Bihar, Haryana, Uttar Pradesh and West Bengal. India justifies a report in its own right, based on National Statistical Survey regions which are sub-state and would give a picture with a finer grain.

** All of Madagascar's provinces have over one million poor in 2030.

SOURCE: Technical Annex B

countries realised intuitively plausible results, although 100% in poverty in two regions of Madagascar seems unlikely, even though today's figures are high and the poverty trend is worsening. Available trends for Nepal and Nigeria did not seem plausible and are not, therefore, presented in the text.

Using the optimistic scenario, sub-national regions with major numbers of people (over 1 million) still in extreme poverty include six Indian states, three (and probably all four)[27] Pakistan provinces, three provinces in Madagascar, and only Oromia in Ethiopia. Of these Orissa, Uttar Pradesh, Bihar and Andhra Pradesh have been particularly exposed to hazards (flooding and drought); Punjab and North-West Frontier Province to flooding and earthquakes, and Balochistan to drought; and the three Madagascar provinces to floods, droughts and cyclones.

A brief literature review was undertaken on a number of sub-national regions with either high numbers of people or high proportions of people in poverty to explore the causes of their poverty and examine disaster-proneness (summarised in Table 10). This revealed some common features: low and poor patterns of economic growth in highly agrarian economies with low levels of infrastructure and social service coverage, and relatively poor governance, which includes institutional discrimination and/or the failure to protect against encroachment on resources. In some cases, governments even seem hostile to their own population or parts of it.

2.6 Conclusion

This chapter concludes that even in an optimistic scenario, there will still be very high levels of vulnerability in 2030, as indicated by projected income poverty.

UMICs can be ruled out as countries of concern for the purposes of this report. Among LICs and LMICs, however, there are countries that are projected to have high headcounts of both severe and extreme poverty in 2030, putting large numbers of people at risk in the event of major disasters. However, at least some of these countries are expected to be able to prepare for – and manage – such disasters.

A group of 13 highly vulnerable LICs and LMICs have been identified, using both the IFs baseline projection as well as an optimistic scenario created for this report to identify countries that would still have a substantial poverty problem even under a best case scenario. The list features: India, Nigeria, Pakistan, Sudan among LMICs, and Bangladesh, Burundi, DRC, Ethiopia, Madagascar, Malawi, Nepal, Rwanda and Tanzania among LICs.

TABLE 10: EXAMPLES OF REGIONS THAT ARE CHRONICALLY POOR, THE CAUSES OF THEIR PERSISTENT POVERTY AND THEIR EXPOSURE TO HAZARDS

Country/region	Causes of chronic poverty	Hazard exposure
India: Bihar/Uttar Pradesh	High levels of landlessness, low agricultural and other wages; agricultural dependence; systemic social (caste and gender) discrimination, low levels of education; low historical economic growth and non pro-poor growth patterns; but new pro-poor state governments emerging.	Flooding (Eastern Uttar Pradesh) but also earthquakes, wind, cyclone and drought (due to dry spells). (Chopde et al., 2007)
Pakistan: Sindh and Baluchistan	Difficult terrains for farming and isolation; limited land and livestock holdings; low levels of education; strong gender-based inequalities; dual economy in Sindh – poor connections to Karachi from its hinterland.	Coastal areas of Badin, flood-prone arid areas in Rajanpur, drought-prone areas of Khuzdar
Ethiopia: Afar, Oromia, Somale	Low levels of savings in a pastoral economy; very low economic diversification; isolation (infrastructure and social services) and discrimination; poor governance.	Drought

India is a special case and is included on the list of highly vulnerable countries because of the sheer numbers of poor people who are projected to be living in several of its states in 2030. India's biggest states are the size of substantial countries, and deserve to be analysed as such. Several already have very large projected numbers of poor people – three have over 20 million, and three have over 10 million. The undivided Uttar Pradesh alone has 52 million So even if India is forecast to have the resources to limit the impact of disasters on poverty, it may be that the capacities and the politics will continue to lag behind.

While these figures are within the ranges produced by other projections of poverty to 2030, they are at the pessimistic end of the spectrum, probably because worsening inequality and falling consumption as a share of growing GDPs are built into most countries' trajectories under the IFs model. These are plausible assumptions, given the experience of sustained and faster growth in East Asia.

Turning to the sub-national regional level, it is possible to identify a number of regions that are likely to be chronically poor through to 2030, in those countries that are expected to have high extreme poverty. Ethiopia has only one region in the optimistic projection, Oromia, and two others (Somale and Amhara) with more than two million in the simple projection. In Madagascar, three regions have over five million people living in poverty in the simple projection and over four million in the optimistic projection. In Pakistan, three provinces have over two million. In India, as we have noted, several big states have very large numbers of people projected to be living in poverty in 2030. These regions have certain characteristics in common: they are all agrarian, isolated and poorly governed character, with large swathes of their populations experiencing discrimination.

The initial panel data analysis and literature review carried out for this report suggest that shocks are indeed associated both with impoverishment and chronic poverty, and, where drought is the major hazard, that drought is associated more often with impoverishment than ill health or death. In stark contrast, where disaster relief programmes are effective and well-targeted to poor people (as with Bangladesh's flood relief programmes), environmental shocks may be less important than the individual and personal shocks experienced by almost everyone, such as ill health in old age.

Finally, the idea of a resilience threshold was explored in a very preliminary way, just for one country and one Indian state (Ethiopia and Andhra Pradesh). However, there was little evidence for a definite resilience threshold; and if there were such thresholds they would probably vary substantially from country-to-country.

Among LICs and LMICs there are countries that are projected to have high headcounts of both severe and extreme poverty in 2030, putting large numbers of people at risk in the event of major disasters.

3

The geography of hazards in 2030

3.1 Introduction and methodology

Natural hazards can be defined as environmental agents likely to cause harm to life or the environment. For weather and climate-related hazards, the World Meteorological Organisation (WMO) defines natural hazards as 'severe and extreme weather and climate events that occur naturally in all parts of the world, although some regions are more vulnerable to certain hazards than others' (WMO, n.d.)

To assess the spatial and temporal characteristics of natural hazards that are relevant to poverty and disaster risk, five key hazards have been selected for their relevance to major natural disasters in areas with high poverty: earthquakes, droughts, floods, high temperatures, and tropical cyclones. These hazards account for the main observed geophysical, climatological, meteorological and hydrological natural disasters as identified by the Centre for Research on Epidemiology of Disasters (CRED). These new hazard indices were created in order to make use of the latest climate projection data, recently made available through the CMIP5 (Coupled Model Inter-comparison Project) dataset of climate projections for the IPCC Fifth Assessment Report (IPCC AR5). The indices use, therefore, the most up-to-date projections available. Generating new indices allows each hazard to be evaluated separately, but also makes it possible to combine the indices to evaluate total hazard in a single metric. This approach is designed to be as easy as possible for non-climate scientists to access, and in this case can be incorporated with other measures relevant to the study, as the indices have been designed to be compatible with the data generated by the IFs model for the poverty and vulnerability of populations.

Eighteen climate model runs were evaluated within this study and the models and institutions are listed in Table 11.

For all the five hazards under consideration, this chapter explores how the current hazard can be assessed in terms of its geography and severity. For the four weather/climate-related hazards (droughts, floods, high temperatures, and tropical cyclones) there is an additional focus on whether there is evidence to suggest that their geography and probability are likely to change over the next 20 years.

3.2 Global hazard indicators

Indicators are useful tools for the comparison of values across different locations. In this case, a set of indicators for five key hazards have been used to evaluate how 'hazard-prone' different regions and countries are, relative to each other. However, indicators are also a simplification of what are, in reality, complex patterns. Therefore, the indicators have been chosen to reflect the hazards, but they also reflect the short timescale available for processing the data, and the limitations of the

TABLE 11: CLIMATE MODEL RUNS USED IN THE HAZARD INDEX ANALYSIS

Climate model centre	Model runs
Beijing Climate Center Models	BCC-CSM1-1; BCC-CSM1-1-M
Beijing Normal University	BNU-ESM
Canadian Centre for Climate Modelling and Analysis	CANESM2
The National Center for Atmospheric Research	CCSM4
National Science Foundation, Department of Energy, National Center for Atmospheric Research	CESM1-BGC
Geophysical Fluid Dynamics Laboratory	GFDL-ESM2G; GFDL-ESM2M
Met Office Hadley Centre	HADGEM2-CC; HADGEM2-ES
Institute for Numerical Mathematics	INMCM4
Institut Pierre-Simon Laplace	IPSL-CM5A-LR; IPSL-CM5A-MR; IPSL-CM5B-LR
Max Planck Institute for Meteorology (MPI-M)	MPI-ESM-LR; MPI-ESM-MR
Norwegian Climate Centre	NORESM1-M

data available. Each hazard indicator was analysed individually and they were then combined to form the single, Multi-hazard Indicator (MHI). The individual hazards, at the resolution of the climate models for the historic period (1971-2010) and for the 2030s (2021-2050) are mapped and available with other supporting analysis at www.metoffice.gov.uk/climate-guide/climate-change/impacts/poverty. The data for the historic period comes from the WATCH dataset (Weedon et al., 2010), and the climate projections use the publically available climate models from the CMIP5 multi-model ensemble dataset, developed for the IPCC AR5. Here, we explain each hazard and the key aspects of its geography.

Drought

Drought can be defined as 'a period of abnormally dry weather long enough to cause a serious hydrological imbalance' (IPCC, 2012). There are several different types of drought including meteorological, agricultural and hydrological (Burke and Brown, 2008; IPCC, 2012); this research focuses only on meteorological drought (an absence of precipitation) to provide an indication of changes in drought risk. Further work would be required to assess agricultural drought (the use of soil and surface processes) and hydrological drought (e.g. river runoff).

The main indicator of drought used in this report is a measure of the length and intensity of periods of abnormally dry conditions at each location. It should be noted that the 'normal' conditions used as a reference are taken from the historic period (1971-2010) rainfall at each location. The indicator shows the deficit of rainfall over a period, compared to the climatology for that time of year. It highlights changes in the driest periods, and although the definition of drought is not extreme in the sense of having a long return period, it does describe the driest conditions and is more useful, therefore, to illustrate changes in the most severe events, than looking only at changes in mean precipitation.

Analysis for this study showed that the spatial pattern of changes in drought for both severity and length are very similar. Both indicate an increase in drought conditions for much of South America and southern Africa. Severity is also projected to increase in South-East Asia, and the Mediterranean.

The level of future drought hazard may be under-represented in the Sahel region, given that the historic period (1971-2010) was extremely dry in comparison to the longer historical record.

Although both drought severity and length were analysed, only one index could represent drought in the multi-hazard index that was used to assess overall hazard exposure. In this case, the severity was used as a measure of the overall deficit in precipitation in a region. This meant that no distinction is made between short, severe droughts, and longer spells of only slightly low rainfall and therefore may be too general to capture nuances between drought and the magnitude and severity of its potential impact on poor people.

Note that Madagascar, the top poverty hotspot in 2030, also features in this (and subsequent) analyses of high hazard risk. In addition, South Asia is at risk of both high poverty levels and drought hazard; but drought risk also increases in southern Africa, which includes Malawi and Swaziland as possible high poverty countries in 2030.

Extreme high temperature

Extreme high temperature can be associated with heat stress and heatwaves, as well as severe impacts on ecosystems and the physical environment (IPCC, 2012). Individual short-term temperature extremes can inflict significant heat stress on humans and the environment, while prolonged exposure not only increases the severity of the stress, but can also have social and economic impacts.

The high temperature hazard indicator derives from the 95th percentile of the daily maximum temperature (Orlowsky and Seneviratne, 2011; Sillmann et al., 2013a-b) to identify changes in short-term high temperature events. This is not necessarily a very 'extreme' event, in terms of its return period, but it does represent how the higher values of the distribution will change (i.e. the hottest days), rather than changes in the mean, making this indicator a better representation of exposure to extreme temperatures, now and in the 2030s. The hottest days of the year are, by definition, at the very limits of the annual climatology, and often result, therefore, in increased stress on agricultural systems, health and ecosystems, particularly for those countries that are most vulnerable to weather and climate events.

The IPCC's SREX report (IPCC, 2012) highlights the consensus across the latest research, which is also in agreement with the IPCC's 4th Assessment Report (Meehl et al., 2007), that high extremes in temperature will increase in both magnitude and duration, and that corresponding cold temperature extremes will decrease throughout the 21st century.

The analysis of today's extreme high temperatures indicates that regions in northern and central Africa, central Australia, the Middle East and South Asia have some of the hottest temperatures.

Parts of southern and eastern Europe are projected to see the largest increases in high temperatures by the 2030s, although there is a higher level of confidence for increases across large parts of the US, North Africa, the Middle East and central Asia, as well as southern Africa and South America. All of the models included in this study agree on an increase in the hottest temperatures across the whole landmass. Malawi and Swaziland are of particular importance when we link these high temperature projections with the poverty analysis in Chapter 2.

Flood

Flood, like drought, is a complex process. It refers to the unusual inundation of the land over large areas. Flood hazard is assessed principally from hydrological data collected on river flows; for large rivers this may extend back up to 100 years. The timescale over which precipitation is significant will reflect the scale of the river system. While small streams respond directly to short periods of a few hours of intense rainfall, flooding in the largest river catchments reflects rainfall totals over periods of weeks. While a comprehensive assessment of flood requires detailed knowledge of local systems, this is not possible for a short study like this; instead an indication of the flooding hazard associated with intense rainfall can be made by examining the 95th percentile of daily precipitation. This gives some indication of regions of intense heavy rainfall, but does not address flooding caused by longer-term rainfall excess, or the way individual catchments may respond to rainfall.

The change in the 95th percentile of daily precipitation over a time period can be used as an indicator for short-term flooding events (Frich et al., 2002; IPCC, 2012). For this indicator, the daily precipitation amount over the historic period (1971-2000) is analysed and the 95th percentile calculated. The same methodology is used to calculate the 95th percentile of precipitation in the future time period (2021-2050). The difference between these periods provides information on how heavy precipitation events, which could lead to flooding, may change in the future. The 95th percentile of precipitation is not necessarily a very 'extreme' event, in terms of its return period, but again, it represents how the higher values of the distribution will change (i.e. the wettest days), rather than changes in the mean. For vulnerable countries, however, or those where poverty leaves little capacity to invest in resilience or recovery from weather and climate events, flooding within the natural variability of the current climate often has very negative impacts.

The Intergovernmental Panel on Climate Change's Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (IPCC's SREX) (IPCC, 2012) notes that it is difficult to provide a single definition of extreme or heavy precipitation for global analysis, and that there is less confidence in model projections for precipitation than for temperature (IPCC, 2012). Although some research indicates an increase in the frequency and/or intensity of heavy precipitation events in the 21st century, IPCC SREX (2012) reports that the latest studies highlight the uncertainties in precipitation projections, especially at regional scales.

Not surprisingly, the tropics experienced the heaviest rainfall days in the historic period, particularly Central and South America, the Sahel, South Asia, South-East Asia and northern Australia. The East and north-west coasts of North America, parts of southern South America, Madagascar, New Zealand and Japan also experienced relatively high levels of heavy rainfall hazard.

Projections for the 2030s show the largest increases in heavy rainfall in the northern mid-latitudes, but with increases across South-East Asia, South Asia, the Sahel, parts of South America and New Zealand. The spatial pattern of heavy rainfall does not differ significantly in the future projections, but changes in land use, including deforestation and urban expansion over this same period will also affect the relationship between heavy rainfall and flash flooding, which may well have a larger impact on the change in the hazard than the changing climate.

Again, Madagascar, South Asia, the Sahel and southern Africa emerge as poverty-hazard hotpots.

Tropical cyclone

The resolution of the current generation of Global Circulation Models (GCMs) is not, in general, fine enough to model the structure and intensity of a tropical cyclone system. Therefore, probabilistic tropical cyclone hazard models are based on developing a catalogue of the tracks, wind fields and rainfall footprints of past storms. Track information, including intensity at landfall, is generally available for most tropical cyclone basins dating back to at least 1950.

Tropical cyclones affect five regions of the world in particular, with cyclones forming in the Atlantic affecting the Caribbean and east coast of North America, cyclones in the north Pacific affecting the east coast of Asia, and to a lesser extent the west coast of North America. Tropical cyclones affect the Pacific Islands and Australia in the south Pacific, while cyclones in the Indian Ocean can make landfall across South Asia and, occasionally, the southern coasts of the Middle East.

Evidence summarised in the SREX report (IPCC, 2012) noted that observed changes in tropical cyclones demonstrates a low confidence in any regional changes in intensity since 1950. For future projections, the same report states that the number of tropical cyclones is likely to decrease or remain static until the year 2100, but that mean maximum wind speed and associated rainfall are likely to increase in some regions. There is low confidence about which regions will be most impacted by changes in cyclone activity. Therefore, it is not possible to give confident guidance on the potential changes in future regional tropical cyclone activity on the basis of current climate-model projections. Instead, we use the present-day tropical cyclone hazard for the future time period in this study.

The overlay of tropical cyclone landfall data with poverty in 2030 indicates that Bangladesh and northeast India are particular hotspots.

Earthquake

Earthquakes are the only non-meteorological hazards considered within this study. External data from the Global Seismic Hazard Assessment Program (GSHAP) has been mapped to assess the hazard levels worldwide. As expected, these show the highest level of hazard along the major fault lines in the earth's crust, with the regions around the Pacific Rim facing the highest hazards, but also much of Asia and southern Europe.

Given the length of geological timescales relative to this project, it is not appropriate to consider the change in earthquake hazard by the 2030s. The present-day hazard is assumed to remain valid throughout the period.

Earthquake-event mapping shows that the earthquake hazard does not correspond closely to poverty hotspots, but the potential for earthquakes to lead to impoverishment is, nevertheless, significant. Analysis of the earthquake-hazard event data shows that earthquakes are more frequent in countries that are better equipped to deal with the consequences than the previous four weather-related hazards considered here.

3.3 The Multi-hazard Indicator

In order to evaluate how the five hazards included in this assessment combine, we have developed the Multi-hazard Indicator (MHI). This assigns a 'hazard rating' on a scale of 1 to 7, to each of the hazard indicators at a given location, at the resolution of the climate models used. This information is also aggregated by country, taking the highest level of hazard that occurs anywhere (on any grid points) within the area of that country. The MHI value is simply the sum of the hazard indicator level for each of the contributing five hazards. This method means that each hazard has an equal weighting in the combined hazard indicator, so that no single hazard is considered to be more significant than the others.

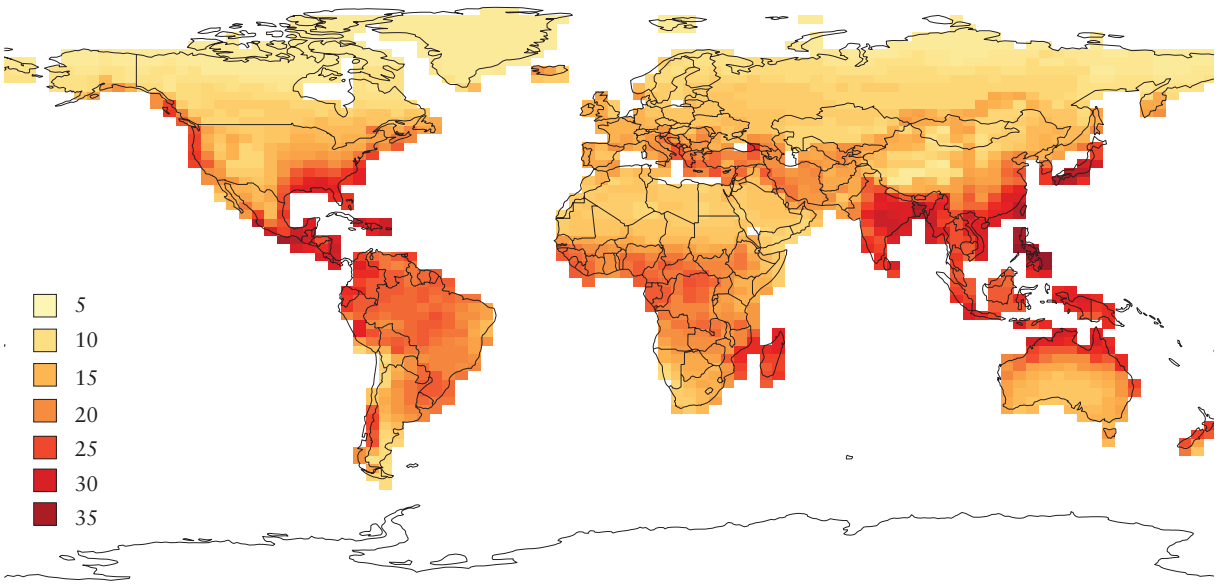
Gridded Multi-hazard Indicator

Figures 12-14 show the globally mapped and combined MHI in Figure 12 (the historic period), Figure 13 (the 2030s) and Figure 14 (the change in the hazard between the historic period and the 2030s).

The historic period shows that the regions with the highest hazard are: the east coast of North America; Central America; South, South-East and East Asia; Northern Australia; and Madagascar. Most of South America has elevated MHI levels as does the Sahel region. This pattern of hazard remains the same in the future period, but small changes in hazard are projected. The level of hazard increases for nearly all areas, but particularly for North and South America, sub-Saharan Africa and central, northern and East Asia.

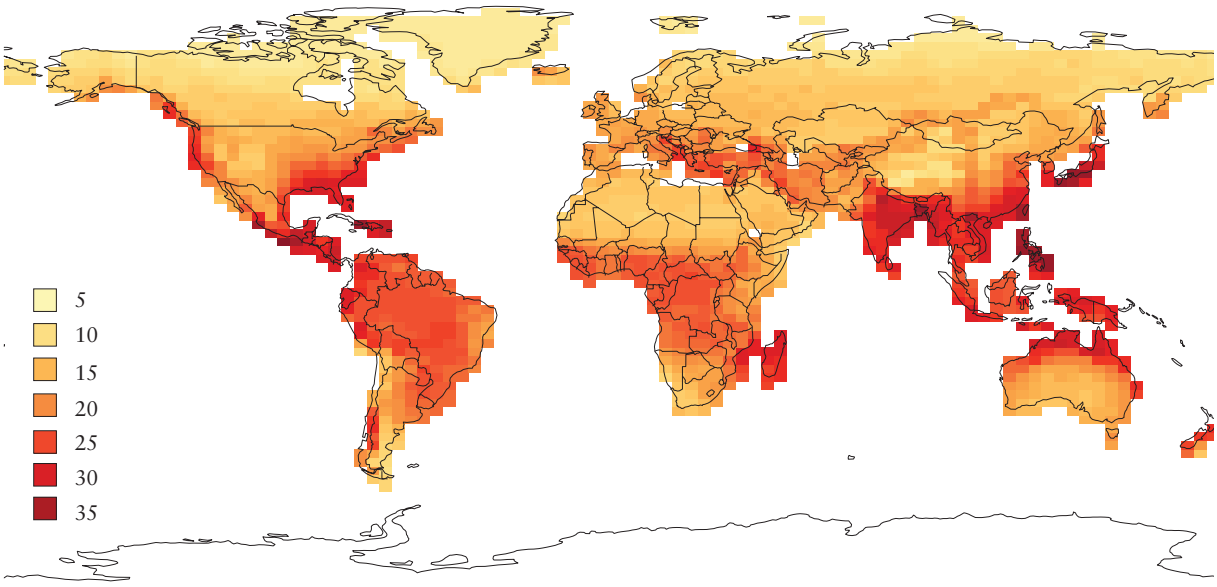
The overlap between hazards and poverty hotspots in 2030 is particularly marked in South Asia and Madagascar, and sub-Saharan Africa is likely to experience increased hazard levels.

Figure 12: Historic global Multi-hazard Indicator



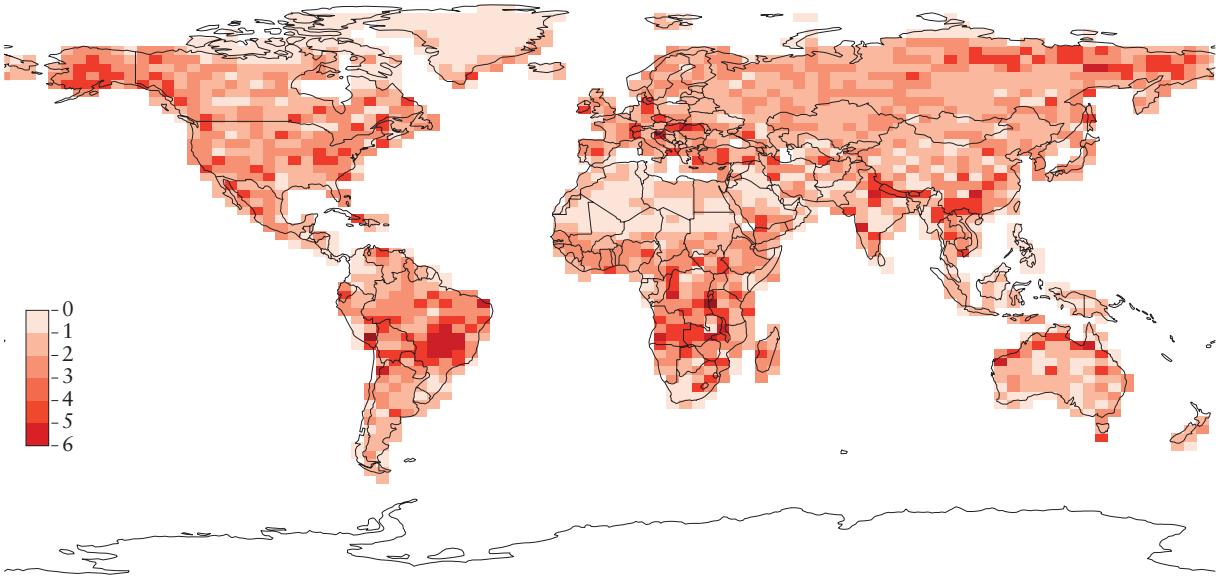
This shows the combined hazard exposure for drought, flood, high temperature, tropical cyclone and earthquake for the period (1971-2000).

Figure 13: Global Multi-hazard Indicator for the 2030s



This shows the combined hazard exposure for drought, flood, high temperature, tropical cyclone and earthquake for the 2030s.
NOTE: changes from the historic period are included only for drought, flood and high temperature) (see Technical Annex C).

Figure 14: Change in the global multi-hazard indicator from the historic period (1971-2000) period to the 2030s



NOTE: This measure captures changes in drought, flood and high temperature only.

Plots of the MHI distribution have been produced for each of the sub-regions of particular focus within this study: East Africa, West Africa, southern Africa (Madagascar) and South Asia. These are included in Annex C and show the same data as the global plots in Figures 12-14, but as a close up for each region.

Multi-hazard Indicator by country

Hazards may occur in different parts of a single country, but can affect the whole of that country from an economic and governance perspective. In order to compare the information about the hazard, with national-level data on poverty and vulnerability, the MHI can be aggregated at a national level. Figures 15 & 16 show the MHI value by country for the historic period (Figure 15) and for the 2030s (Figure 16).

The national-level value was derived by calculating the highest hazard value that occurs in a given country for each indicator, combining the highest hazard in any region of the country, regardless of whether two hazards occur in that same region. One feature of this method, it should be noted, is that the larger the country, the more likely it is to include an area with high exposure for a given hazard, pushing up the resulting MHI value for that country as a whole. This issue does not occur when looking at the hazard at a grid-box level, as in Figures 12-14.

The countries with the highest multi-hazards, now and in the future, are in North America, South and East Asia and, to a lesser extent, Australia, Russia and countries in South America and sub-Saharan Africa. From a poverty perspective, South Asia and sub-Saharan Africa are the regions of highest concern.

The pattern of hazard at a national level does not change much over time. Some countries see an increase in hazard level, but the methodology of taking a 'worst case' approach to hazards within national borders means that the increases in hazard at a local level seen in the gridded hazard data, are less obvious at a national level.

Table 12 lists those countries with MHI values of 25 or over, according to this analysis, both for the historic period and the 2030s. Many countries have the same hazard level, and these are grouped together and listed in alphabetical order. The cut-off value of 25 is used here as a way to sample a reasonable number of the most hazard-prone countries.

A number of developed countries are very hazard-prone, and this highlights the fact that disasters are not just about the hazard, but about the resilience and coping capacity of a country. Chapter 4 will explore this relationship in more detail.

Figure 15: Present day Multi-hazard Indicator by country

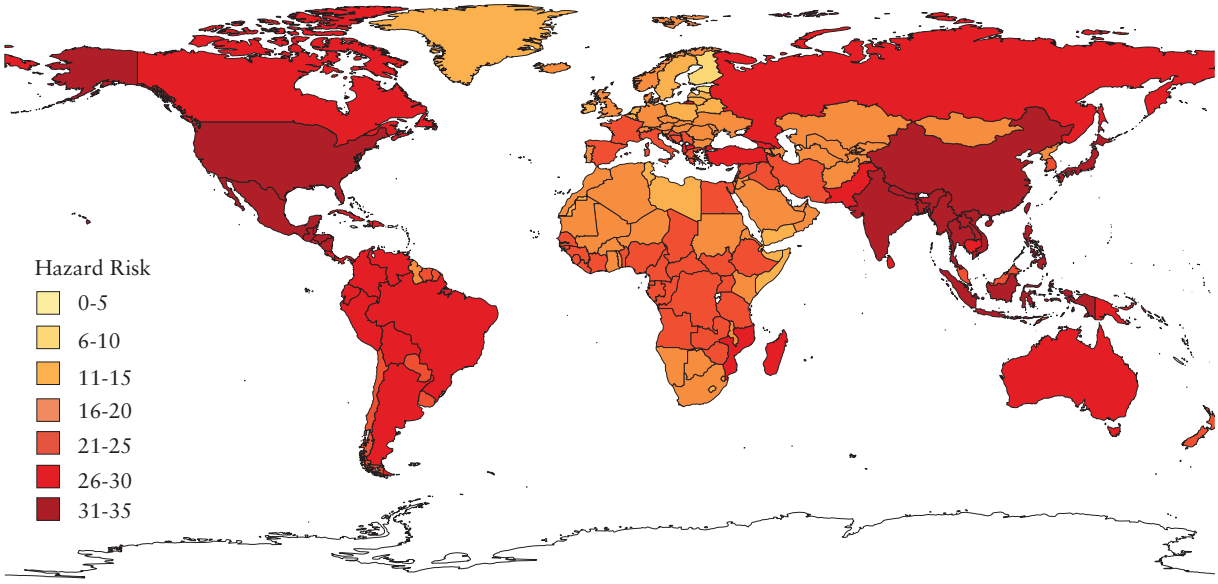


Figure 16: Future Multi-hazard Indicator by country

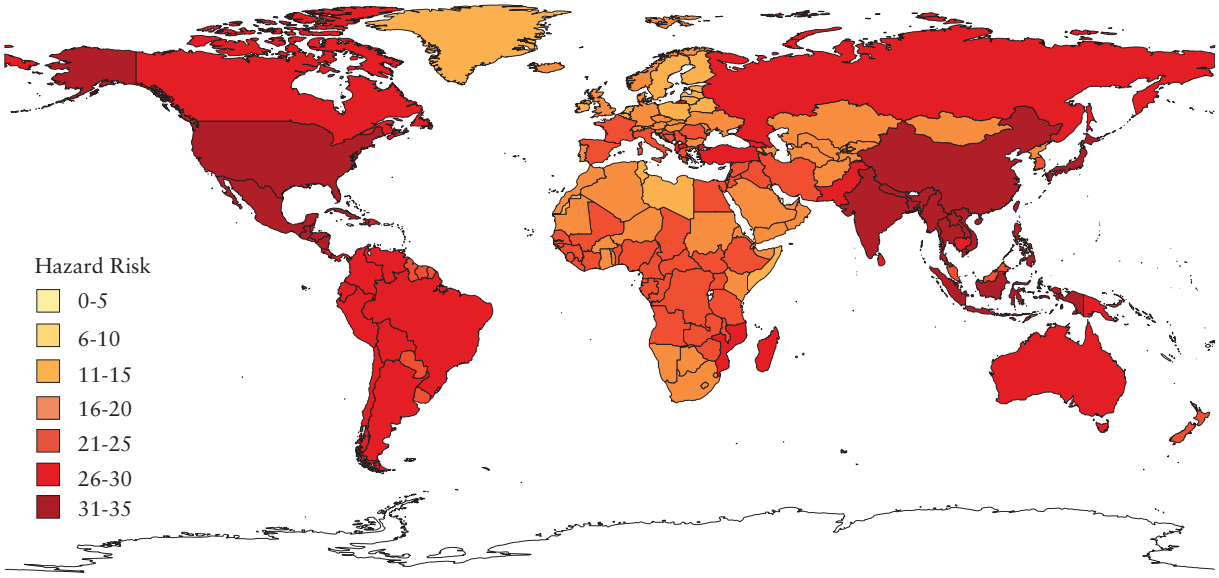


TABLE 12: COUNTRIES WITH MULTI-HAZARD RATINGS OF 25 OR OVER IN THE HISTORIC PERIOD (1971-2000) AND THE 2030s

Historic period (1971-2000)			2030s		
Ranking	Country	Hazard	Ranking	Country	Hazard
1	India	35	1	India	35
	Mexico	35		Mexico	35
	United states	35		United states	35
4	Bangladesh	34	4	Bangladesh	34
	Lao pdr	34		Lao pdr	34
	Myanmar	34		Myanmar	34
	Thailand	34		Nepal	34
	Viet nam	34		Thailand	34
9	Belize	33		Viet nam	34
	China	33	10	Belize	33
	Guatemala	33		China	33
	Honduras	33		Guatemala	33
	Nicaragua	33		Honduras	33
	Philippines	33		Japan	33
15	Japan	32		Nicaragua	33
	Nepal	32		Philippines	33
	Taiwan	32	17	Taiwan	32
18	Indonesia	31	18	Bahamas	31
19	Bahamas	30		Cuba	31
	Cambodia	30		Haiti	31
	Canada	30		Indonesia	31
	Cuba	30	23	Cambodia	30
	El salvador	30		Canada	30
	Haiti	30		El salvador	30
	Pakistan	30		Pakistan	30
	Russia	30		Russia	30
27	Australia	29	27	Argentina	29
	Dominican republic.	29		Australia	29
	Papua new guinea	29		Bolivia	29
30	Argentina	28		Brazil	29
	Bolivia	28		Dominican republic.	29
	Brazil	28		Papua new guinea	29
	Colombia	28	33	Colombia	28
	Costa rica	28		Costa rica	28
	Panama	28		Ecuador	28
	Sri lanka	28		Panama	28
	Turkey	28		Peru	28
38	Ecuador	27		Sri lanka	28
	Madagascar	27		Turkey	28
	Peru	27	40	Madagascar	27
41	Albania	26		Mozambique	27
	Georgia	26	42	Albania	26
	Macedonia	26		Chile	26
	Mozambique	26		Georgia	26
	Venezuela	26		Former yugoslav republic of macedonia	26
46	Chile	25		Venezuela	26
	Timor-leste	25	47	Malaysia	25
				New zealand	25
				Timor-leste	25

3.4 Drought hazard

Of all the hazards analysed in this study, drought is the one linked most closely to poverty. For this reason, this section looks exclusively at drought hazard, to explore how its geographic distribution for the historic period (1971-2010) and in the 2030s (2021-2050) coincides with the geography of poverty.

The indicator for drought used in this study is a measure of the deficit of rainfall during periods when amount of rainfall falls below the climatological average for the time of year. This deficit is summed over the period of below-average rainfall. This means that an acute but short-lived drought will have a similar drought-hazard level as a longer-term but low-level shortfall in rain.

The map of average drought severity (Figure 17) indicates that parts of South and Central America, central Africa and Madagascar, the eastern United States and South, South-East and East Asia see the largest shortfalls in rainfall during drought periods.

In tropical regions, most notably in South-East Asia, these droughts are relatively short-lived. In areas with high precipitation, such as the tropics, the absolute precipitation shortfall can be quite large, even for droughts that last only a short time.

The drought-hazard maps highlight countries for which earthquakes and tropical cyclone hazards are less important, but that are still exposed to weather and climate events. In particular, more low-income countries and countries in sub-Saharan Africa are affected by drought, where other hazards may not have such a large impact. It should be noted however, that the meteorological definition of drought as outlined in the drought indictor used in this report, may not reveal much about the human impacts of drought, which can be explained more by issues of access to food, availability of social protection and conditions for production in previous seasons. There are also likely to be complex links between the exact nature of drought conditions, with the severity, duration and periodicity of drought being important factors intersecting with human vulnerability and exposure.

There is relatively low confidence on the changes in drought that are projected by the climate models, but there is some level of agreement on increases in drought for some important regions where poverty levels are also high (Figure 19) (also see Technical Annex D) In addition to Southern Europe and Japan, which have relatively strong signals for increasing drought hazard, much of the increase in drought exposure is seen across Central America, South America, sub-Saharan Africa and Eastern and South-East Asia.

Figure 17: Historic global drought-hazard indicator for the period 1971 to 2000

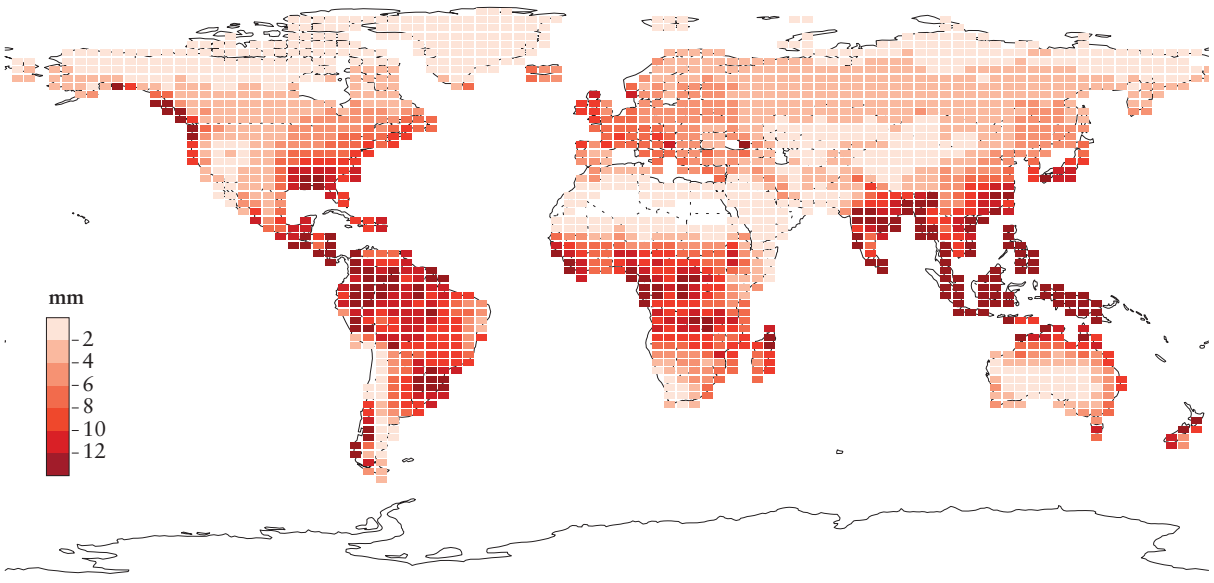
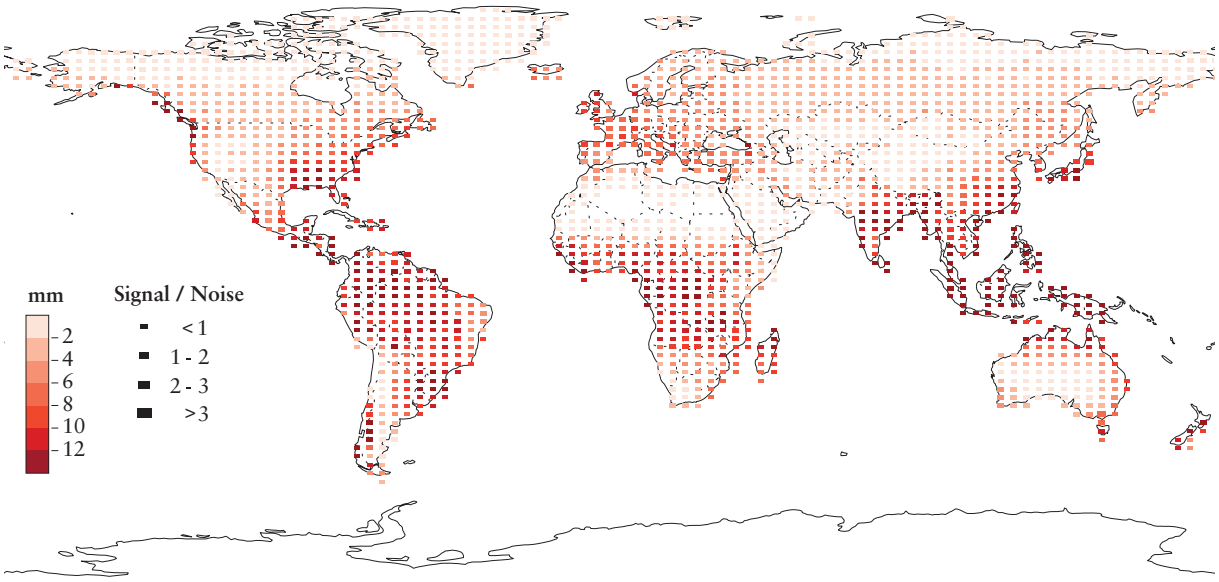
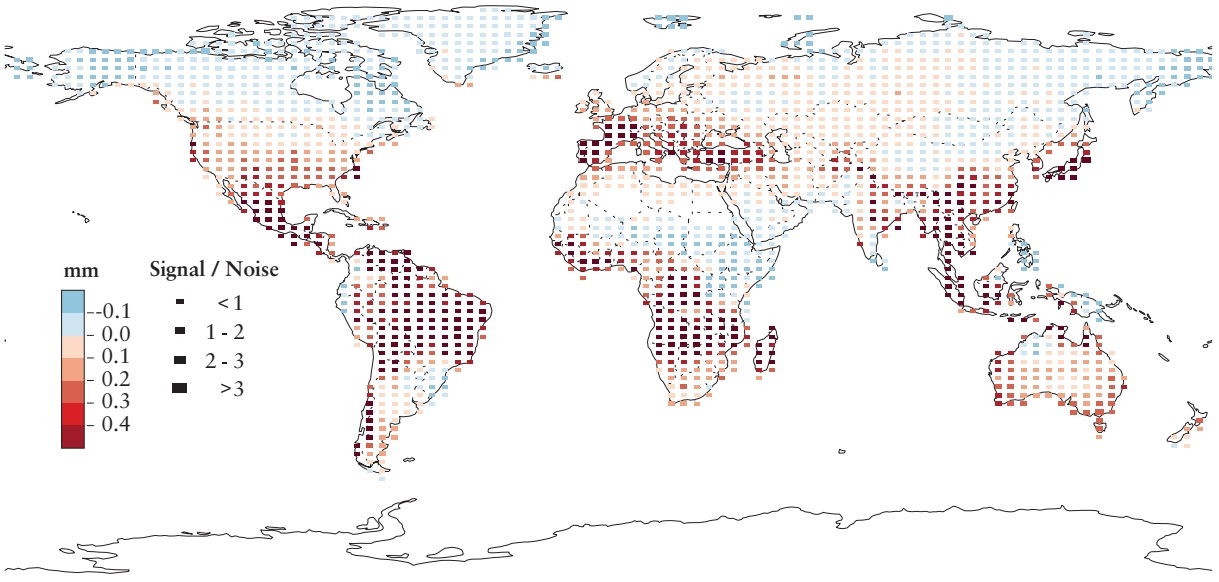


Figure 18: Future global drought-hazard indicator for the 2030s



NOTE: The size of the data point indicates the level of agreement between the climate models on the signal for change. The larger the data box, the higher the agreement in the change among the models shown.

Figure 19: Change in global drought-hazard indicator between the historic period (1971-2000) and the 2030s



NOTE: The size of the data point indicates the level of agreement between the climate models on the signal for change. The larger the data box, the higher the agreement in the change among the models shown.higher the agreement in the change among the models shown.

For each of the sub-regions of particular focus within this study (East Africa, West Africa, Southern Africa (Madagascar) and South Asia), plots of the drought indicator distribution have been produced. These are included in Annex D. They show the same data as the global plots in Figures 17-19, but as a close up for each region.

3.5 Summary

The analysis of hazard worldwide, for the historic period and the change for the future, raises a number of interesting conclusions. The first is that the hazard in the historic period accounts for the majority of the future hazard in the 2030s. There is an increase in hazard levels over time, according to this study, but this increase is small compared to the underlying hazard.

The second conclusion is that there is no linear relationship between hazard and disaster. The most hazard-prone countries are not always those least able to cope, and some large, developed nations such as the United States, have some of the highest exposure to hazards when we consider the whole country.

Finally, the pattern of hazard exposure is highly influenced by the pattern of earthquakes and tropical cyclones. Those regions that are not exposed to these hazards give low values of overall hazard. The east coast of North America, South Asia, East and South-East Asia and East Africa have the highest levels of hazard rating and this does not change over time.

The hazard in the historic period accounts for the majority of the future hazard in the 2030s. There is an increase over time, according to this study, but this is small compared to the underlying hazard.

4

Risk governance capacity, and the capacity to respond

4.1 Introduction

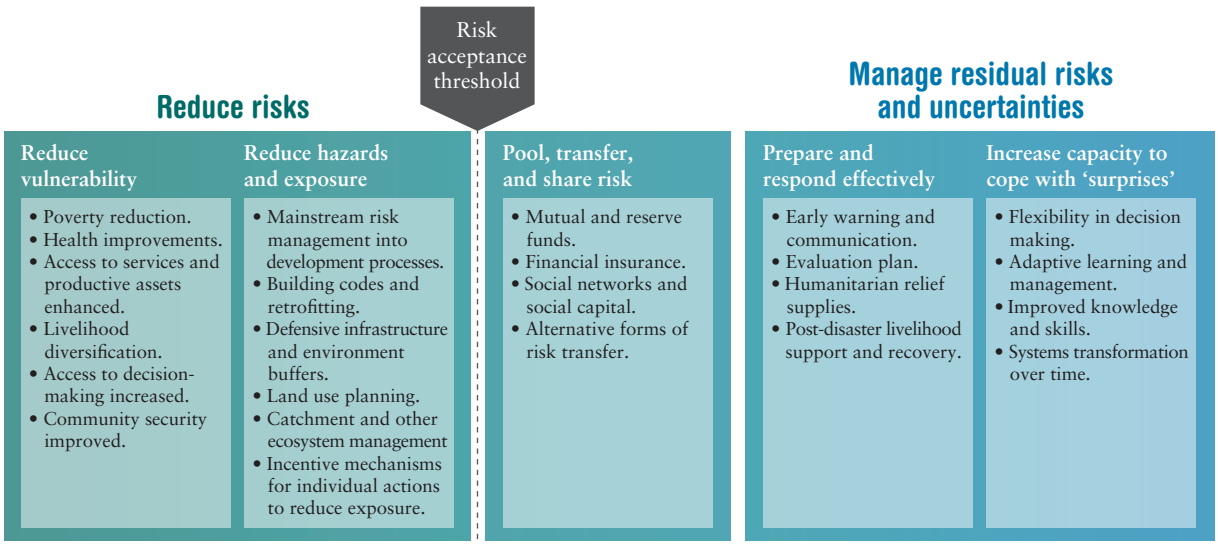
This chapter builds on the previous chapters to examine the adaptive and risk-governance capacity of countries that are projected to have high levels of poverty and to be particularly hazard prone in 2030. It first discusses what constitutes good adaptive and risk-governance capacity and why it matters, before examining ways to assess the relative effectiveness of a countries' capacity to manage disaster risk. It concludes by presenting a categorisation of countries' capacity, based on a joint assessment of three indicator sets. These categories will be used to shape the synthesis of data presented in Chapter 5 and the indications of which countries will face the greatest risk of impoverishment in 2030.

4.2 The nature of disaster risk management capacity

The IPCC SREX report and the Global Assessment Reports from 2011 and 2007 respectively provide strong insights into what an effective system of disaster risk management (DRM) looks like for a country, with a suite of activities (Figure 20). IPCC SREX (2012) concluded that: *'Effective risk management generally involves a portfolio of actions to reduce and transfer risk and to respond to events and disasters, as opposed to a singular focus on any one action or type of action Such integrated approaches are more effective when they are informed by and customized to specific local circumstances. Successful strategies include a combination of hard infrastructure-based responses and soft solutions such as individual and institutional capacity building and ecosystem-based responses'.*

There is no automatic correlation between a country's level of wealth or its position on the human development index and the quality of its DRM capacity. Countries such as Chile, Colombia, Indonesia, Mexico and the Philippines have been leaders in creating world-class national DRM capacity, often in advance of many European countries. Such a focus has been driven, predominantly, by the need to manage frequent and intensive exposure to

Figure 20: Functions and activities of a national disaster risk management system



SOURCE: IPCC, 2012

natural hazards, where improvements in DRM tend to be taken in fairly large leaps following significant disaster events and their impact, rather taking place on a more incremental basis over time.

4.3 Methods of assessing disaster risk management capacity now and in the future

Many indices exist to measure the level of disaster risk across countries. Some include the assessment of risk-management effectiveness, often from the perspectives of coping capacity or resilience. This is the case for the World Risk Index, UNOCHA's Global Focus Model, CARRI Community and Regional Resilience Model and the IADB indicators of Disaster Risk and Risk Management. Only some of these (World Risk Index, Global Focus Model, World Development Report 2014)[29] are global in their scope, whereas regional or national assessments are more detailed. Many of the indicators used are much broader than a simple focus on traditional DRM systems, and include elements on equity, environmental health and educational attainment.

Other indices focus on climate change adaptation and the adaptive capacity of countries, such as those prepared by the Global Adaptation Index (GAIN), DARA and Center for Global Development (CGD). Again, these again include broad indicators around political stability, technology access and trade freedoms. A study by Lassa (2010) suggests that there are strong correlations between wider indicators of good governance and the effectiveness of disaster-risk reduction regulatory quality, so there is likely to be a reasonable inference of risk-management effectiveness by employing such indicators. However, it is almost impossible to predict the effectiveness of DRM at a country level in 2030. Consider for example, the changes experienced as a result of the Arab spring, and our ability to have predicted these changes in 1995. The approach taken here is not to predict the effectiveness of DRM in 2030, but rather to use indicators of adaptive capacity that give some sense of a country's relative ability to manage change and deal with shocks and stresses compared with others. Consequently, the rankings and scoring of countries listed in section 4.4 use the 'adaptive capacity' score of the World Risk Index (for specific indicators and description of the Index, see Technical Annex D and E) and the 'Governance' Readiness Index of the Global Adaptation Institute (see Technical Annex F). The initial list of 'high poverty' countries in 2030 derived from analysis in Chapter 2 was based on modelling that also included 'resilience' type indicators, so these countries are already those with a 'lack of resilience' emerging over this period that has served to leave high levels of residual poverty (see Table 4).

The analysis presented in section 4.4 also includes qualitative information derived from the Hyogo Framework for Action (HFA) Monitor. This is a country self-reporting mechanism that assesses progress against a set of indicators under the five thematic areas of the HFA (UNISDR, 2005). Scores for selected relevant indicators, also included in Table 13, provide a more focused assessment of DRM capacity (particularly on legal, regulatory and enforcement frameworks on DRR policies, see Technical Annex G).[30] The HFA monitor also provides the source of some contextual commentary on the relative strength of DRM in the countries included in the assessment at this stage. However, as this is self-reporting, the data should be treated with considerable caution. The need to include this dataset in this analysis is symptomatic of a wider lack of consistent, independent and comparable data on DRM effectiveness.

4.4 Disaster risk- management capacity in selected countries

Table 14 takes the high hazard and high-poverty countries in 2030 and uses three indicator frameworks to develop a comparative composite assessment score.[31] Figure 21 presents a global map of this data for all countries.

Using a crude categorisation of countries based on the 'composite assessment score', some judgements can be made about the relative effectiveness of DRM and adaptive capacity in each high hazard, high-poverty country (Table 12). Based on the literature presented in three Global Assessment Reports for Disaster Reduction (UNISDR 2009, 2011, 2013) and by the Intergovernmental Panel on Climate Change (IPCC, 2012), we can conclude that relatively high DRM capacity can minimise the potential for long-term losses resulting from the impacts of hazards on vulnerable, exposed people. However, there may still be some classes of extremes, clustered events and very high magnitude events that cause long-term impacts that simply overwhelm a system's capacity, however sophisticated, so the potential for long-term impacts can never be completely eradicated.

TABLE 13: ASSESSMENT OF THE ADAPTIVE CAPACITY AND RISK MANAGEMENT CAPACITY OF HIGH POVERTY AND HIGH HAZARD COUNTRIES

Country	**HFA Monitor combined score** (1.1, 4.4, 4.6, 5.2, 5.4) score between 1-5 (5 best)	**World Risks Index 'Lack of Adaptive Capacity' score** (lower score best)	**GAIN 'readiness' index score** (higher score best)	**Composite assessment score** (with 0 being worst, 5 being the best)
Afghanistan	2.2	74.26	0.128	1.3
Bangladesh	3.2	61.03	0.321	2.8
Burkina Faso	3.6	64.32	0.452	3.2
Burundi	2.6	56.44	0.264	2.6
Cameroon	–	59.01	0.325	2.7
Central African Republic.	–	61.12	0.23	2.1
Chad	–	67.74	0.218	1.7
China	4	46.39	0.299	3.4
Colombia	3.8	42.76	0.362	3.7
Cote d'Ivoire	1.8	61.64	0.246	2.0
Democratic Republic of Congo	–	–	0.22	2.2
Ethiopia	3.8	63.37	0.252	2.6
Guatemala	3.2	53.04	0.388	3.2
Guinea	3.8	64.91	0.240	2.5
Guinea Bissau	1	–	0.319	2
Haiti	2.8	67.48	0.307	2.4
Honduras	3	47.4	0.375	3.3
India	3.8	60.18	0.406	3.3
Indonesia	3.6	48.83	0.389	3.5
Kenya	2.8	55.8	0.334	2.9
Liberia	–	64.22	0.421	2.8
Madagascar	3.2	63	0.344	2.8
Malawi	3.2	57.15	0.467	3.4
Mali	3	69.85	0.448	2.8
Mexico	4	43.12	0.428	4.0
Myanmar	2.4	–	0.163	2.0
Nepal	2.6	55.76	0.307	2.7
Nicaragua	3.2	48.21	0.375	3.4
Niger	2.4	71.93	0.342	2.2
Nigeria	4	62.63	0.242	2.7
North Korea	–	–	0.233	2.3
Occupied Palestinian Territories	2.4	–	–	–
Pakistan	3.4	65.35	0.205	2.3
Philippines	2.8	43.03	0.335	3.3
Papua New Guinea	2.4	56.27	0.372	2.8
Rwanda	3.4	51.73	0.436	3.5
Senegal	3.8	59.76	0.407	3.2
Somalia	–	–	0.084	0.8
South Sudan	–	–	–	–
Sudan	–	55.22	0.131	1.8
Tanzania	3.6	51.73	0.46	3.7
Thailand	4	42.72	0.359	3.8
Uganda	–	54.59	0.335	2.9
Viet Nam	3.6	46.56	0.375	3.6
Yemen	1.2	61.58	0.19	1.6
Zambia	4.2	53.31	0.476	3.9
Zimbabwe	–	51.73	0.227	2.5

Figure 21: Global map of disaster risk management and adaptive capacity by country

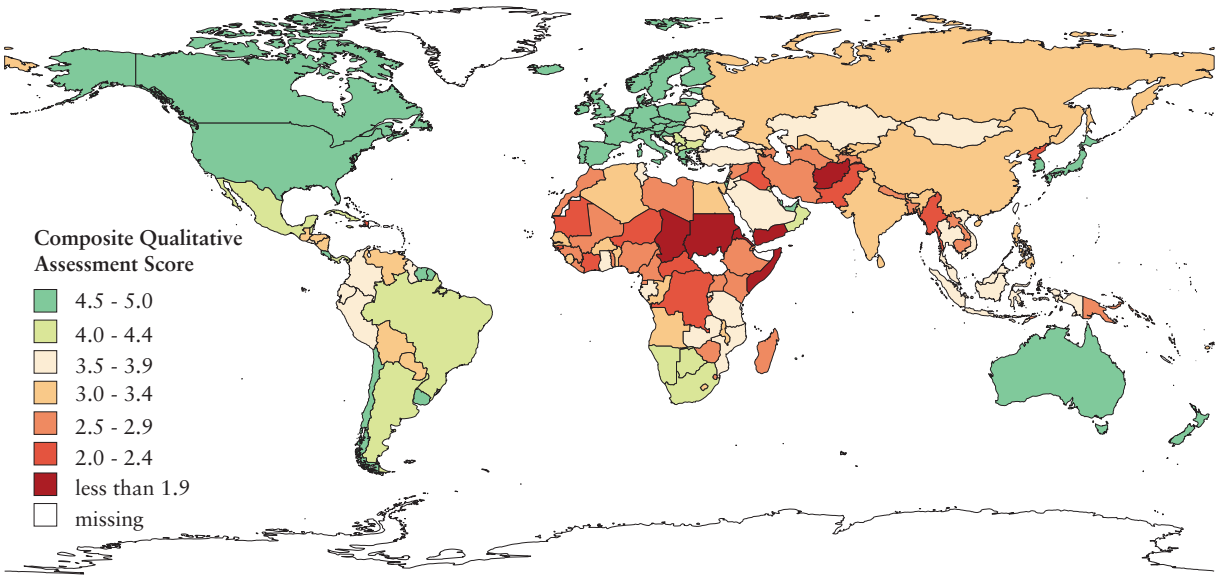
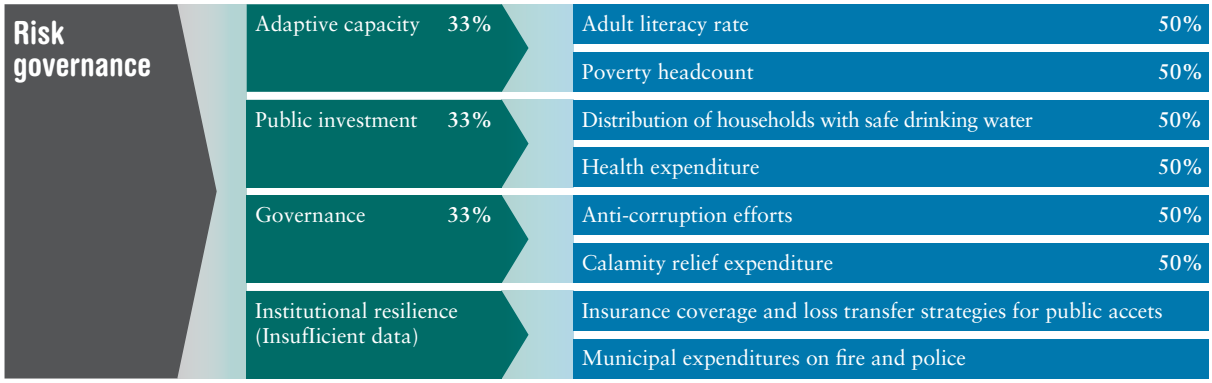


TABLE 14: CATEGORIES OF COUNTRIES ACCORDING TO THEIR CURRENT DISASTER -RISK MANAGEMENT CAPACITY AND THEIR ABILITY TO MANAGE AND COPE WITH FUTURE SHOCKS AND STRESSES

Category of Disaster risk management capacity	High-hazard, high-poverty country (2030)
Category 1 (3.5-4.0 on relative score): relatively good DRM and adaptive capacity, with a high chance of minimising long-term disaster impacts now and in the future.	Colombia, Indonesia, Mexico, Rwanda, Tanzania, Thailand, Viet Nam, Zambia
Category 2 (3.0-3.4): better than average DRM and adaptive capacity with a good chance of minimising long-term disaster impacts now and in the future.	Burkina Faso, China, Guatemala, Honduras, India, Malawi, Nicaragua, Philippines, Senegal
Category 3 (2.5-2.9): average DRM and adaptive capacity, with potential danger of disasters having long-term impacts now and in the future.	Bangladesh, Burundi, Cameroon, Ethiopia, Guinea, Kenya, Liberia, Nepal, Nigeria, Madagascar, Mali, Papua New Guinea, Uganda, Zimbabwe
Category 4 (2.0-2.4): poor DRM and adaptive capacity, with high likelihood that disasters will cause long-term impacts now and in the future.	Central African Republic, Cote D'Ivoire, Democratic Republic of Congo, Guinea Bissau, Haiti, Myanmar, North Korea, Pakistan
Category 5 (1.9 or less): very poor DRM and adaptive capacity, with disasters very likely to cause long-term impacts now and in the future.	Afghanistan, Chad, Somalia, Sudan, Yemen

Figure 22: Sub-national risk governance index[32]



There is insufficient data for the Occupied Palestinian Territories (OPT) or South Sudan to make a judgement, but we can assume that neither country is placed in category 1 and 2.

While assessing DRM capacity at the national level is useful, what is often more relevant to the needs of policy-makers is an understanding of different capacities at the sub-national level. This allows country actors to decide where to focus regional efforts, and evaluate whether they need to strengthen local capacity. However, if assessing national DRM is difficult, attempts to analyse local DRM are impractical, if not futile. Disaggregated data for districts or states is often lacking, and where it is available there may be weaknesses in its collection and interpretation. Few low-income countries have the amount and quality of data needed to undertake effective assessments of sub-national DRM. The UN International Strategy for Disaster Reduction (UNISDR) is undertaking efforts to improve this situation by collecting questionnaire survey based data through local mayors.

In attempting to make progress, and demonstrate the feasibility of analysing sub-national DRM capacity, we explore the case of India. We use a risk-governance index adapted and expanded from the World Risk Index (Figure 22) and applied across India's 28 states and seven union territories. The index is based on a core understanding that an actor's ability to respond effectively to disasters is very much influenced by the country's socioeconomic structure and its existing service delivery capacity. Unpacking disaster governance in countries like India requires an examination of how the society in question deals with an array of risks that would be heightened in times of disaster, such as health and safety risks, as well as taking into account the existing infrastructure and level of government accountability. This index draws on four indicators – adaptive capacity, public investment, governance and institutional resilience – to create a composite picture of a DRM regime. For further methodological details of the sub-national index and its indicators see Technical Annex E.

The first apparent observation is that not all of the required information is available for all states/territories across India (Table 15). With a complex and composite index such as this, there are sufficient data for only 13 of the 37 sub-national units, although most of the major states can be included. As such, any analysis and ranking is weakened in terms of the extent to which it can claim to represent different capacities across India.

Many of the results are as to be expected, in terms of the outputs that are generated from a DRM index. For example, Gujarat, which is considered to be one of the best-governed states in the country, emerges at the top of the ranking. It has a robust economy and has had a stable government for the past decade. Andhra Pradesh, which comes in second because of its high spending on calamity relief, has historically been a powerful southern Indian state.

However, the index also produces a number of counterintuitive findings. Bihar secures the third spot, above states that are thought of as far more advanced in terms of development progress, such as Kerala (which loses out because of its poor availability of safe drinking water); Tamil Nadu (which comes lower down because of its low spending on health and calamity relief); and Maharashtra (which has

TABLE 15: RISK GOVERNANCE INDEX FOR INDIAN STATES AND UNION TERRITORIES

State or Union Territory	Weighted score*
Andhra Pradesh	6.39
Arunachal Pradesh	-
Assam	5.66
Bihar	6.15
Chhattisgarh	-
Dadra and Nagar Haveli	-
Daman and Diu	-
Goa	-
Gujarat	7.3
Haryana	5.4
Himachal Pradesh	-
Jharkhand	-
Jammu and Kashmir	-
Karnataka	5.4
Kerala	5.2
Lakshadweep	-
Madhya Pradesh	5.2
Maharashtra	5.1
Manipur	-
Meghalaya	-
Mizoram	-
Nagaland	-
Odisha	5.4
Punjab	-
Rajasthan	-
Sikkim	-
Tamil Nadu	4.3
Tripura	-
Uttar Pradesh	5.6
Uttarakhand	-
West Bengal	5.2
Andoman and Nicobar Islands	-
Chandigarh	-
Delhi	-
Puducherry	-

* Higher scores signify higher levels of risk governance. States markers with (–) have insufficient data to compile within the DRM index.

BOX 7: UNPICKING THE RELATIONSHIP BETWEEN POLITICS, GOVERNANCE AND DISASTER RISK MANAGEMENT (DRM) IN BIHAR STATE, INDIA

The Indian State of Bihar has endured a range of protracted crises that have included caste violence, a guerrilla war led by leftist revolutionaries and frequent natural disasters. Until 2005, Bihar was also widely considered to be one of India's worst-governed states, with extremely low economic development, high rates of crime and an unresponsive polity. Since 2005, when the centre-left Janta Dal United (JDU) Government took over, with Nitish Kumar as Chief Minister, the State has seen some dramatic improvements. Crime rates are falling (e.g. the numbers of murders and robberies have fallen by 13% and 46% respectively since 2006)[33] and Bihar has become one of the fastest growing states in India, recording double-digit economic growth in 2010 and 2011.[34] This has led to growing calls for a replication of Bihar's model of good governance in other parts of South Asia that are suffering from development deficits.[35] These changes have also translated into the State's improved capacity to deal with natural disasters. For example, in the eight years before the change in Government (1997-2004), Bihar lost an average of 372 individuals to natural disasters every year.[36] This death toll fell to an average of 254 in the eight years following the JDU's coming to power (2005-2012).[37] Similarly, average yearly economic losses from natural disasters more than halved in the same period.[38]

one of the lowest rates of health expenditure of all the ranked states). For decades, Bihar had been one of the most corrupt and least developed states in India but it has made major improvements in a number of areas since a new political regime took over the state eight years ago. Bihar's rank may also reflect the strides that this State has made in investing in a number of development-related activities (explored in Box 7).

4.5 Conclusion

Understanding the capacity of actors (whether countries, districts or households) to deal with disaster risk is integral to targeting support for DRM, and composite indices and rankings are an important tool in this process. Table 13 shows the practical use that such exercises have in distilling complicated and multi-faceted concepts (such as adaptive capacity and risk management capacity). They help donors, NGOs, and national and local governments decide where to focus their efforts and prioritise their capacity-building activities (both hard and soft). However it is important to remember that such indices have a number of inherent weaknesses. For example, there are a number of process-based elements (such as innovation, flexibility and forward-looking planning) that are very difficult to quantify. Assigning 'weights' to each of the different variables also proves challenging, particularly as certain variables may be more important in different contexts.

An index is, however, very useful at the national level. The relative availability of data and the diversity of different indices and methods applied at the national scale make outputs relevant to international and national decision-makers. However, this is not the case at the sub-national level. As the case of India demonstrates, shortcomings in data availability make comparisons and rankings difficult. In addition, few indices have been adapted to reflect the characteristics of DRM at the local level. Though there will be considerable overlap, the selection of suitable indicators will be different at national and local levels. With this in mind, a DRM index should never be taken to represent a holistic and complete representation of an actor's capacity to deal with disasters. Nor should the rankings (such as a top ten list) be acted upon without fully understanding the limitations of the approach applied. An index is simply a useful indication, and one that needs to be complemented with further qualitative information and analysis.

There is no automatic correlation between a country's level of wealth or its position on the human development index and the quality of its capacity to manage disaster risks.

5

Bringing the analysis together

5.1 Introduction

This chapter brings together the analysis in chapters 2-4 and identifies the countries at greatest risk. These 'top risk' countries are those that are likely to have large numbers of extremely poor people in 2030, with significant extensive/intensive disaster risk and hazard exposure, and major shortfalls in disaster risk management. In particular this chapter:

- investigates the overlay between high poverty vulnerability and hazard incidence in 2030
- aggregates the numbers of people likely to be poor in 2030 in the top hazard-prone countries, using two indicators: the Multi-hazard Index, and a combined heat-flood-drought measure
- asks what difference the quality of disaster risk governance makes to the resulting picture
- features map overlays
- suggests two technical measures – risk modelling and mapping – that can help countries focus more effectively on the hazard-poverty overlay in their disaster risk management strategies
- examines the overlays between hazards, poverty and disaster risk governance at sub-national levels.

5.2 The geography of hazard risk and poverty 2030

The analysis starts with the incidence of extreme and severe poverty in 2030 and explores the extent to which countries with high projected poverty levels are also subject to hazards. Then, in order to project the numbers of poor people in the most hazard-prone countries, the analysis returns to the top multi-hazard countries identified in Chapter 3 as well as the top countries exposed to heat, floods and drought, and examines the likely incidence of extreme poverty in those countries in 2030.

There is considerable overlap between the countries with the highest and high vulnerability to poverty in 2030 as revealed in Chapter 2's Poverty Vulnerability Index (PVI), and the countries with the highest exposure to hazards, as measured by the Multi-hazard Index (MHI) in Chapter 3. Of the countries with the highest vulnerability to poverty in 2030 (as measured by the highest *proportions of the population* under $0.75 a day in both baseline and optimistic scenarios) **Benin, Central African Republic, Chad, Democratic Republic of Congo, Gambia, Guinea Bissau, Haiti, Liberia, Madagascar, Malawi, Mali, Nepal, South Sudan, Tanzania, Zimbabwe** (**LICs**) and **Honduras, Occupied Palestinian Territories, Senegal, and Sudan** (**LMICs**) and **Namibia** (**UMIC**) all have a score of at least 20 on the MHI. Of the countries with a high vulnerability to poverty (as measured by the highest *numbers of people* under $0.75 a day in both baseline and optimistic scenarios), **Ghana, Guatemala, India, Nigeria, Pakistan, Philippines,** (**LMICs**), **Bangladesh, the Democratic People's Republic of Korea, Ethiopia, Kenya, Mali, Mozambique, Tanzania Uganda** and **Zambia** (**LICs**), and **China, Colombia, Mexico,** and **Thailand** (**UMICs**) all score over 20 on the MHI. This then gives us a list of 37 countries that are likely to be prone both to high proportions or high numbers of people in poverty and exposed to hazards.

In addition there are other 'countries to watch', where there are likely to be more than 10% of the population and more than a million people living on under $1.25 a day and that also have high exposure to multiple hazards in either scenario: **Cameroon, Indonesia, Nicaragua, Papua New Guinea, Viet Nam,** (**LMICs**), **Afghanistan, Côte d'Ivoire, Guinea** and **Myanmar** (**LICs**), and **Botswana, Brazil** (**UMICs**).

On the MHI, 20 is taken as a cut-off point for this exercise in identifying the top poverty and hazard-prone countries, as this level includes both the countries that experience all five of the hazards in the MHI, as well as the top countries that experience only three, which includes the majority of sub-Saharan countries that are exposed to drought, heat and floods but not cyclones or earthquakes.

The Poverty Vulnerability Index (PVI) is a composite index (see chapter 2) projecting a country's vulnerability to poverty in 2030, which tries to include those countries that have both the highest hazard risk and large numbers or proportions of people likely to be in poverty in 2030. The PVI is

also measured at two levels – at $1.25 a day per person as well as $0.75 a day – to give adequate emphasis to the special challenges that face countries where large proportions or numbers of poor people are severely poor – way below the $1.25 poverty line. There are five resulting levels of vulnerability to poverty from non-vulnerable (most countries) through to the highest vulnerability. It is the high and highest vulnerability categories that should be of most concern. The circles in Figure 23 represent the level of future vulnerability to poverty, and not simply the proportion or numbers of people in poverty. The countries of greatest concern are those in Figure 23 that have at least a moderate MHI and at least a high PVI.

This analysis can then be inverted to look initially at countries with the highest incidence of hazards and calculating their predicted levels of poverty. The geography of hazard risk and the numbers of people in poverty in 2030 is analysed by global developing region in Table 16. When taking all five hazard indicators into account for the top 49 countries identified in Chapter 3, and looking at both the baseline and optimistic poverty scenarios from Chapter 2, Asia has over half the population of poor people on all four poverty indicators, and three-quarters to four-fifths of those living on less than $1.25 a day in its high multi-hazard countries. Therefore, in terms of exposure to the greatest range of hazards, Asian countries in the top 49 are likely have the most widespread and significant poverty problem in 2030.

There are likely to be particular 'hotspots' in 2030: Madagascar features at the top of nearly every list of poverty projections and has a high hazard vulnerability. More broadly, East Africa is likely to experience the highest level of change through to 2030, with the densely populated Ethiopian highlands particularly affected by increased drought risk, discussed further below.

Central and North-East India – India's poorest and most hazard-prone region – should be seen as a special case because the numbers of people in poverty are still likely to be massive in 2030. This is discussed separately in section 5.8 below.

The MHI has a bias towards countries (mostly in Asia and North America) that score high on cyclones and earthquakes as well as drought, floods and extreme temperature (See Technical Annex H). There are, of course, many developing countries that do not experience cyclones and earthquakes, but that are, nevertheless, extremely hazard prone (see section 5.3). We know that drought and flood hazards, even on their own, can be very damaging and impoverishing (see Chapter 1), so the study has also examined the overlay between a combined

Figure 23: Hazards and vulnerability to poverty in 2030 – overlaying the Multi-hazard Index and the Poverty Vulnerability Index

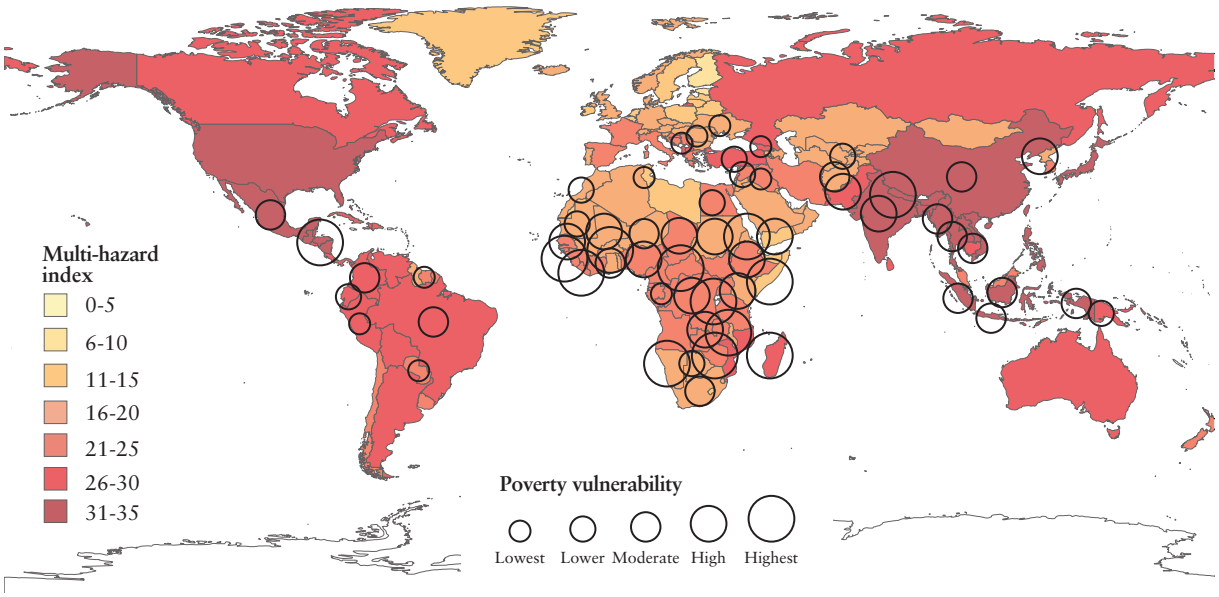


TABLE 16: TOTAL POVERTY PROJECTIONS FOR THE TOP 49 MULTI-HAZARD COUNTRIES IN 2030 – BASELINE SCENARIO (MILLIONS OF PEOPLE)

	Global	Asia	Latin America and the Caribbean	Sub-Saharan Africa
$0.75	105	69	13	23
$1.25	325	263	27	35
$2.00	890	787	54	48
$4.00	2,024	1,830	132	61

NOTE: the global total for Table 16 includes small numbers of poor people in other regions.

TABLE 17: TOTAL POVERTY PROJECTIONS FOR THE TOP 49 MULTI-HAZARD COUNTRIES IN 2030 – OPTIMISTIC SCENARIO (MILLIONS OF PEOPLE)

	Global	Asia	Latin America and the Caribbean	Sub-Saharan Africa
$0.75	57	31	9	17
$1.25	178	132	20	26
$2.00	556	478	39	39
$4.00	1 527	1 373	101	51

NOTE: the global total for Table 17 includes small numbers of poor people in other regions.

TABLE 18: TOTAL POVERTY PROJECTIONS FOR THE TOP 45 COUNTRIES PRONE TO DROUGHT, EXTREME HEAT AND FLOODS IN 2030 – BASELINE AND OPTIMISTIC SCENARIOS (MILLIONS OF PEOPLE)

Poverty indicators $ a day	Global	Asia	Latin America and the Caribbean	Sub-Saharan Africa
Baseline 1.25	319	185	15	119
Optimistic 1.25	176	92	10	75

NOTE: the global figures include other regions.

drought-heat-flood indicator and poverty. It is also drought, heat and floods that have been identified by the IPCC SREX (2012) to be most affected by climate change. Just assessing drought, heat and floods draws in a number of sub-Saharan Africa countries, which have experienced regular and impoverishing disasters that do not feature highly on the MHI. Table 18 below includes the 45 countries that achieve a rank of 20 or more.

Drought-heat-flood-prone countries in sub-Saharan Africa with significant populations of poor people (over 1 million) in 2030 include: **Cameroon, Central African Republic, Cote d'Ivoire, Chad, Guinea, Guinea-Bissau, Liberia, and Uganda. The Democratic Republic of Congo, Ethiopia and Nigeria all have over 20 million projected poor people, and Sudan has 18 million**. The poverty figures for many of the top drought-heath-flood-prone African countries in the optimistic scenario are similar to those in the baseline scenario, indicating how widespread severe poverty is still likely to be in 2030 in these countries.

This is a very significant finding, as it indicates that a number of countries in sub-Saharan Africa are likely to remain extremely prone to disasters unless strong disaster risk management systems emerge and disaster resilience is placed at the very heart of poverty reduction efforts. If the report was able to analyse drought separately, arguably the most impoverishing hazard, the top countries would be likely to include a greater number of Sahelian countries, which, as explained in Chapter 3, experienced a dry baseline period, so do not figure highly in the projections to 2030. The further research needed on this issue is discussed in Chapter 6.

Nevertheless, even on the drought-heat-flood indicator alone, and on the optimistic scenario, South Asian countries, **India in particular (51 million Bangladesh (14 million)and Nepal (15 million**) are still highly vulnerable on both counts, as shown in Figures 24 and 25.

The difference between the two analyses are (i) the analysis that moves from vulnerability to poverty takes 20 as a cut-off point on the MHI in order to include benchmark disaster-prone countries like Sudan, while the analysis that starts with the top multi-hazard countries takes 25 as a cut-off point, in effect, as it focuses on the top 50 countries; (ii) the PVI-based analysis measures the future likelihood of poverty, while the MHI-based analysis simply uses the numbers of poor people in 2030, on both baseline and optimistic poverty projections, to give a range of the numbers of people who are likely to be living in poverty in the most hazard-prone countries.

Figure 24: Poverty in drought-heat-flood-prone countries in 2030 – baseline scenario

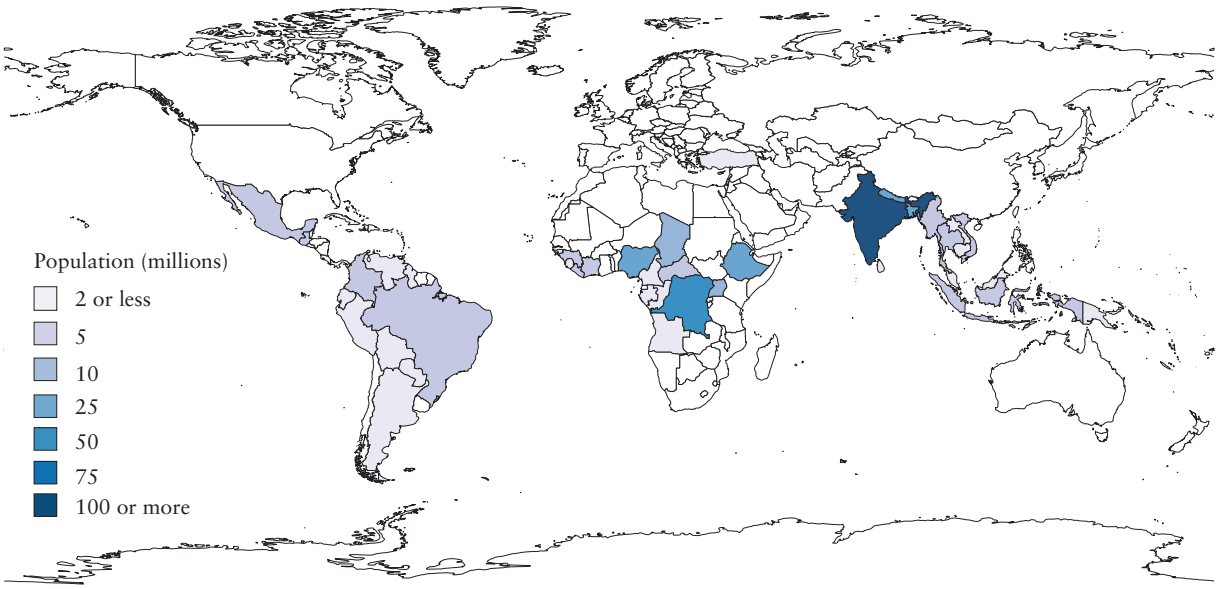
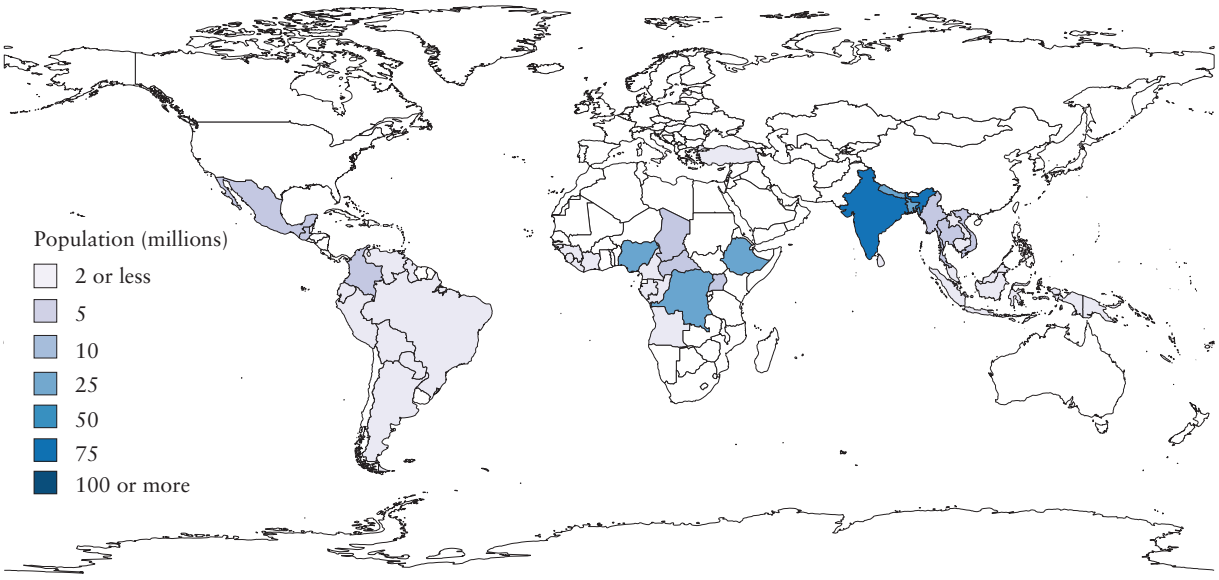


Figure 25: Poverty in drought-heat-flood-prone countries in 2030 – optimistic scenario



5.3 What difference does the quality of risk governance make to this picture?

The potential to minimise the loss of life and long-term impoverishment is enhanced, and significantly, in countries that already have well-developed DRM capacities. We have not been able to project DRM to 2030 as we have for vulnerability to poverty or exposure to hazard. All we can do is assume that today's DRM index remains the same, and use adaptive-capacity indicators to highlight a country's ability (or inability) to manage change successfully. This is not an unreasonable assumption in the case of most countries that have poor capacity today, as it will almost certainly take more major disasters and significant political and/or policy change to alter the situation over a 15-year period. Countries do, of course, turn around and improve performance – recent examples include Brazil and Senegal, where significant investment is now being made in DRM capacity. And it is entirely possible that some of those in the list below will also improve their capacity to manage the risk of disasters in the coming years and turn around their DRM capacity.

Therefore, we can remove certain countries from our list of the countries of the highest level of concern – those with a high score on the DRM index developed in chapter 4. This would leave the following as the top countries of concern overall: Afghanistan, Bangladesh, Benin, Central African Republic, Chad, Democratic Republic of Congo, Gambia, Guinea Bissau, Haiti, Myanmar, North Korea, Pakistan, Somalia, South Sudan, Yemen, Cameroon, Ethiopia, Kenya, Liberia, Nepal, Nigeria, Madagascar, Mali, Papua New Guinea, Uganda and Zimbabwe.

Out of these: **11 countries are all of concern on all three indicators (hazards, poverty and DRM), and are likely to have a large number of people still living in poverty in 2030: Bangladesh, Democratic Republic of the Congo, Ethiopia, Kenya, Madagascar, Nepal, Nigeria, Pakistan, South Sudan,**[39] **Sudan, and Uganda.**

We can add India to this list, to bring the total to 12. This country, with the highest numbers likely still in poverty and among the highest hazard risk, falls into the higher DRM categories, but needs to be treated at the sub-national level for DRM as there is significant variation across its states – see section 5.8 below.

In addition, **Niger, Somalia,** and **Yemen** could also feature – although they have lower hazard risk, they have both high poverty vulnerability and low DRM capacity. **Afghanistan, Cameroon, Myanmar** and **Papua New Guinea** also have high hazard risk (over 20) and moderate vulnerability to poverty (at least 10% of their population and more than one million living under the $1.25 poverty line) and low DRM.

This list suggests that the problem countries that are likely to have both high poverty and hazard exposure in 2030, together with low DRM capacity, are likely to be countries that are among today's LIC and LMIC fragile or conflict-affected states, plus India. The exceptions might be Bangladesh, Ethiopia and Uganda. In India, the sub-national analysis shows that the problem is largely concentrated among the country's fragile or poorest states.

A number of countries were identified in chapter 2 as being likely to struggle to manage any disasters that may hit them because they have high proportions or number of people living on less than $2 or $4 a day: Madagascar, Malawi, Nepal, and Somalia, with Burundi and Niger also appearing among LICs, and Pakistan, Sudan, Yemen and Zambia among LMICs. Of these, all except Zambia feature in the above lists. If a short list of extremely vulnerable *countries* was required, this might be it.

Finally, looking only at countries with extraordinarily high hazard risk, we find that the combinations of the highest hazard and poverty risks in 2030 are in six countries (four of them in South Asia) – Bangladesh, Haiti, India, Madagascar, Nepal and Pakistan – as highlighted in red in Table 19. Of these, India has DRM of reasonable quality at national level, but its poorest states – which bear primary responsibility for DRM – do not (see below).

A further 10 countries have smaller numbers but high proportions of people living in poverty as well as high hazard risk and low DRM capacity: Benin, Central African Republic, Chad, Gambia, Guinea Bissau, Haiti, Liberia, Mali, North Korea and Zimbabwe.

TABLE 19: POVERTY AND HAZARD RISK, 2030 – TOP COUNTRIES

	$0.75/day (million)	**Hazard rating**		**$0.75/day** (% of pop)	**Hazard rating**
India	29.02	35	Madagascar	57.03	27
Madagascar	20.24	27	Burundi	50.17	-
Pakistan	13.8	30	Swaziland	43.04	18
Congo; D.R.	13.01	22	Rwanda	36.17	-
Tanzania	12.46	21	Haiti	36.03	31
Nepal	10.93	34	Malawi	34.52	22
Malawi	9.11	22	Central African Republic	33.89	22
Sudan	6.946	22	Guinea Bissau	31.98	23
Nigeria	6.765	23	Somalia	31.6	15
Rwanda	6.293	-	Comoros	28.57	-

	$1.25/day (million)	**Hazard rating**		**$1.25/day** (% of pop)	**Hazard rating**
India	126.5	35	Burundi	77.5	-
Pakistan	57.56	30	Madagascar	76.74	27
Congo; D.R.	29.96	22	Swaziland	62.9	18
Tanzania	27.43	21	Malawi	60.31	22
Madagascar	27.24	27	Rwanda	54.03	-
Ethiopia	21.76	22	Guinea Bissau	53.12	23
Nigeria	21.75	23	Haiti	51.22	31
Bangladesh	20.93	34	Comoros	51.07	-
Nepal	18.45	34	Central African Republic	49.2	22
Sudan	18.24	22	Somalia	48.76	15

5.4 Patterns of variation in hazard risk among the top countries of concern that lack good disaster risk management

The nature of poverty (its extent and depth) and the nature of combined hazard risk vary across these countries – all of them highly vulnerable to poverty, exposed to many hazards, and lacking good disaster-management capacity. There is a group of countries in South Asia (**Bangladesh, India, Nepal and Pakistan,** plus **Haiti and Madagascar, which is subject to all five hazards or all except earthquakes, and that are also in the highest and high poverty-vulnerability categories.**

There is then a second group of countries that is subject to drought, flood and temperature hazards. These are entirely African: **Cameroon, Central African Republic, Cote d'Ivoire, Chad, Democratic Republic of Congo, Ethiopia, Guinea Bissau, Liberia, Nigeria, South Sudan, Sudan,** and Although these countries do not have the highest hazard scores, this is because they are only affected by three of the five hazards. Potentially, **Niger, Somalia and Yemen** could also fall into this category, though their multi-hazard scores are lower than 20.Of the top countries affected by drought-heat-flood and poverty in 2030 (see above) none have a DRM score above 3.

While conflict and fragility have not been central features of this report, it is important to recognise the overlaps between conflict, disasters, poverty and poor governance capacity. A recent report by Harris et al. (2013) examines the link between conflict risk and disaster risk in detail, and finds a complex set of inter-linkages that mean that conflicts do not always exacerbate disaster risk. Harris et al. (2013) have also developed a rudimentary index of particular problem countries,[40] which highlights a considerable degree of overlap between the countries listed here and those blighted by the conflict-disasters nexus. Many of the proposed recommendations from that report also hold true for this report, including the need to embed disaster risk assessment within conflict analysis, ensure that disaster risk reduction finance reaches the most fragile states and initiate joint disaster risk reduction and conflict prevention programming wherever it makes sense.

5.5 In-depth country investigation

Five countries (Pakistan, Ethiopia, Madagascar, Nepal and Haiti) have been identified as examples to reflect the greatest intersection of high levels of poverty and a high risk of disasters in 2030 that may be inadequately managed, and where disasters are, therefore, likely to have significant effects on impoverishment and chronic poverty. Over the past 20 years, each of these countries has experienced one or more major disasters that has led, very clearly, to significant and lasting impoverishment. The purpose of the investigation is to draw out suggestions about the policy and programming tools that may help to reduce the risk of such impacts.

Table 20 identifies the principal likely risks, the likely characteristics of poverty in 2030, and the measures that are already in place in each of these countries to manage disaster risk. In each one of them, extreme poverty in 2030, like extreme poverty today, will be largely rural. In most of them, poverty will become more geographically concentrated, particularly in remote or disadvantaged regions. By contrast, hazard risk is not necessarily concentrated in the same regions – for example in Nepal.

DRM policies and systems do not seem to focus either on poverty or target the most disaster-prone regions explicitly. There is, therefore, a need for risk modelling and mapping to focus the efforts of DRM, and render them more fit for purpose.

5.6 Sub-national poverty and hazard projections

Bringing together the sub-national analysis of poverty projections from chapter 2 and the regional hazard maps from chapter 3, it is possible to identify some regions that are likely to be extremely prone to both poverty and hazards in 2030.

For Madagascar, arguably the country at greatest risk worldwide, all its provinces have a MHI of over 20, and the north – Antsiranana, Mahajanga and Toamasina – are at particularly high risk. All three provinces are projected to have over one million poor people in 2030, even in the most optimistic scenario, and Mahajanga, in particular, is projected to have very high poverty levels.

In South Asia, Bangladesh and Myanmar, together with central and north-east India, have the highest MHI. Central and northeast India is precisely where the world's biggest concentration of extreme (and severe) poverty is projected to be.

In Ethiopia the highest hazard grid overlaps with Oromia, the poorest region in 2030, as well as Amhara, another potentially high poverty region.

In West Africa, Nigeria is clearly a major concern given its sheer numbers of poor people, although chapter 2 was not able to produce a convincing disaggregated projection. Much of the country is likely to have high poverty rates and high numbers of people living in poverty in 2030. As mentioned previously, the hazard risk in the Sahel may be structurally underestimated in the calculation, given the high hazard incidence during the baseline period.

At this point in time, we are not able to say anything systematic about sub-national DRM capacities. This would require substantial additional research (see Chapter 6). The sub-national hazard and poverty projections were also crude. This could be the focus of substantial additional research, especially for geographically big countries.

TABLE 20: SCHEMATIC ANALYSIS OF THE INTERSECTIONS BETWEEN HAZARDS, POVERTY AND DISASTER RISK MANAGEMENT IN 2030 FOR FIVE COUNTRIES OF TOP CONCERN[41]

Pakistan	
Principal risks	Large earthquakes in the mountainous north of Pakistan as well as along the western side of Pakistan (as around Quetta). Floods originating in the foothills of the northern mountains or caused by landslide or glacier dam failures in the heart of the Karakoram mountains will have their greatest impact in the broad plains where the Indus River and its tributaries emerge from the mountains. Example: Sindh province was devastated by 2010 July floods (10 years of rain fell in three weeks), then devastated again the following autumn when monsoon rains triggered flash flooding. Around 1.8 million people were left homeless, and the loss of 2.2 million acres of crops exacerbated chronic malnutrition
Poverty characteristics	Poverty is likely to remain widespread in 2030, with high numbers of people affected in the plains (Punjab and Sindh) and high proportions in the hills/mountains and Baluchistan. It is particularly intense and intractable in Baluchistan and rural areas throughout the country. The Benazir Income Support Programme is a recent and successful universal social protection programme.
Disaster risk measures	A weak early-warning system. Post-2005 earthquake, the Government of Pakistan has set up the National Disaster Management Authority (NDMA) as an integrated management structure to link preparedness and early disaster recovery to longer term reconstruction/rehabilitation. The DEC (Disaster Emergency Committee) report on 2010 and 2011 flooding in Pakistan identified major shortcomings in Pakistan's DRM system: the diffuse and disconnected nature of the national DRM structure calls for one agency with complete oversight. The NDMA has yet to achieve that level of control. A Building Code was first introduced in Pakistan in 1986, but the code was not adopted as part of Government regulations and was not enforced. After the earthquake of October 2005, when more than 74,000 people were killed, work was begun on a new Code that was introduced across the country in August 2007. All new buildings are now required to follow the code requirements. While improvements in seismic resistance were achieved in the building stock that replaced the stock destroyed in 2005 it is too early to know whether the code is being fully enforced across all those areas of Pakistan zoned as areas of high earthquake hazard.
Ethiopia	
Principal risks	The principal hazard in Ethiopia is drought. Droughts are recorded throughout the country's history – the most calamitous of the past 50 years occurring from 1983-1985 when more than 400,000 people are estimated to have died in northern Ethiopia during the Great Famine, at a time of considerable political unrest.
Poverty characteristics	The distribution of economic growth in Ethiopia has not been equal over the past 20 years, with growth in many cash-crop producing areas (as well as areas well-connected to roads) and stagnation and destitution in other areas. The majority of poor people live in rural areas where there is a high degree of pressure on land resources and problems of soil degradation and climate variability (especially low and erratic rainfall). Migration from rural to urban areas, however, remains low. Land rights reform is still a pressing issue as is access to fertiliser and seeds (Dercon and Porter, 2011). Poverty in 2030 is likely to be concentrated in Oromia. In 2004, the Ethiopian Government launched the National Food Security Programme and the Production Safety Net Programme to lift millions of food-insecure rural people move out of poverty.
Disaster risk measures	On paper it looks like there is a good DRM system – dependable early warning system and timely response; an efficient and comprehensive multi-million dollar risk transfer financing mechanism; a co-ordinated DRM structure extending to local levels. However, inadequate focus on particular parts of the country where chronic drought and insecurity have presented significant challenges to effective DRM. Assessments also suggest that there is a lack of focus on sustainable post-disaster recovery.
Madagascar	
Principal risks	The principal hazards are wind and rainfall-related flood damage from westerly moving tropical cyclones. In 2004, the island was hit by Cyclone Gafilo, the most intense tropical cyclone ever known from the south-western Indian Ocean, which killed more than 360 people, destroyed the homes of 200,000, and caused damage worth more than 5% of the island's GDP. Agriculture is badly affected both by wind damage and by flooding. On average, two cyclones hit Madagascar every three years, making it very difficult to achieve full recovery between disasters. In some years the island is hit by multiple storms.
Poverty characteristics	Poverty is pervasive (affecting over two-thirds of the population in 2005) and the number of poor people grew by 2 million from 2001 to 2005. Looking to the future from 2010, and given population growth rates (3.1% for the poor; 1.8% for others) reducing poverty will require an economic growth rate of 6% per year.[42] Poverty in 2030 is likely to be widespread.

TABLE 20: CONTINUED

Disaster risk measures	Early warning and preparedness have greatly improved (e.g. for cyclones). The national DRM body operates by consensus and has inadequate powers. Significant improvement in east coast cyclone management achieved in 2008. In Madagascar, while housing could be strengthened so as to prevent wind damage in cyclones, there is less that can be achieved around protecting crops and agriculture from wind or flood damage. Infestations of insects and locusts have also occurred after cyclone impacts to agriculture (as in 2013) again requiring rapid intervention in affected areas. The principal action is to support the creation of ex ante schemes for providing funding to farmers whose crops have been damaged.
Nepal	
Principal risks	The greatest hazards are earthquakes and floods. The biggest disaster potential concerns large earthquakes, in particular those originating on the northerly dipping Indian-Asian plate boundary overthrust system that emerges at the base of the Himalayan foothills to the south. The last large earthquake in the vicinity of the plate boundary was in 1934. For the largest earthquakes close to the country, there is a potential high level of property damage in the Kathmandu Valley (which has shown strong amplification effects in past earthquakes) as well as widespread landslide disruption of roads and mountain villages across the territory.
Poverty characteristics	Nepal's poverty is concentrated, regionally and ethnically, in the West and among the relatively landless. The Maoist rebellion was, to a large extent, about addressing identity-based discrimination, which lies at the basis of chronic poverty. The 2007 Comprehensive Peace Agreement and new Constitution laid out the principles for addressing the resulting inequalities. Data on outcomes are eagerly awaited but, given the country's limited implementation capacities, may be disappointing.
Disaster risk measures	Lack of early warning system and preparedness, although a strategy is now in place and the UN Risk Reduction Consortium is working with the Government. No adequate national platform for DRM, but district committees are in place. Slow process of reconstructing government after the Comprehensive Peace Agreement and interim Constitution.
Haiti	
Principal risks	Earthquakes are the principal hazard in Haiti, with two East-West strands of the plate boundary between the American and Caribbean plates passing to the north and south of the country, The 2010 earthquake was located on an unrecognised blind fault next to the plate boundary to the south of Port au Prince. The fault rupture that originated about 25km to the west of the city was estimated to be 65km long, with a magnitude of M7.0 (USGS). There remains a potential for a comparable magnitude earthquake to occur either to the east of west of this fault rupture, bringing further strong tremors to Port au Prince, The last time the city was destroyed in an earthquake was in 1751. Earthquakes of a similar size to that experienced in 2010 affected the plate boundary through northern Haiti in 1770 and 1842. As a result of large scale deforestation, Haiti is also very exposed to flooding from intense rainfall events, often associated with slow-moving tropical storm systems. In 1999, flooding associated with passing hurricanes left more than 9,000 people dead. In 2004 there were two episodes of flooding, each of which killed more than 3,000. Flooding is the extensive high frequency risk in Haiti.
Poverty characteristics	An analysis by the World Bank highlights the relation between low income and such factors as poor access to credit, lack of infrastructure, low educational levels and limited social capital. Other studies indicate that the main causes of poverty are inequality of access to inputs – tools, water, good land and knowledge – and lack of equity in income distribution, coupled with power structures that preserve inequalities. There is a clear link between poverty and vulnerability in Haiti, where poor households have a limited capacity to respond to recurrent natural crises or the effects of political instability. Haitians living in rural areas have suffered as a result of increasing pressure on available resources. Because of pressure on land for agriculture, exacerbated by urban encroachment on arable flatlands and irrigated land, the agricultural sector consists mainly of small-scale subsistence farms. Average land holdings are less than 1 hectare in size. A context of unclear property rights, a vicious circle of environmental degradation, little available technology and credit, and weak market infrastructure make it difficult to develop sustainable agricultural income. At present, 80% of farms fail to produce enough to feed household members, who resort to non-farm activities for complementary income. And the country imports high levels of its food requirements. Seasonal or permanent migration is a common strategy, with people moving to cities, to the neighbouring Dominican Republic or, if the opportunity exists, to North America or Europe.[43]
Disaster risk measures	As of 2012, there was still no national building code in Haiti. International agencies involved in reconstruction since 2010 have been applying international codes, such as ACI-318, Euro code 8 and the Canadian National Building Code. However the means to supervise a building code in Haiti's different municipalities is largely absent. However, there is now a National Resilience Plan and the country is a considerable focus for the Political Champions for Resilience Group, a collection of international agencies and donor countries committed to making Haiti's development much more resilient.

5.7 Sub-national poverty, hazard projections and disaster risk management capacity: the case of India

A brave attempt to analyse India's current state level DRM capacities was made in chapter 4. Two following observations can be made when we combine these very tentative quantitative results with the projected disaggregated poverty analysis in chapter 2 and the projected hazard maps in chapter 3.

1. There is a strong overlay between the likely incidence of hazards and poverty in 2030 in northeast India. Assam, Madhya Pradesh, Odisha, Uttar Pradesh, and West Bengal all high poverty states in areas subject to high Multi-hazard indices and all have significantly lower DRM capacity than some other states. DRM capacities do change over time even in high poverty states – witness the high rank achieved by Bihar (a state that was also high poverty and high multi-hazard), which was attributed to its remarkable improvements in its development and governance performance over recent years. How Bihar has achieved this, and exactly what it has achieved, would be worth further investigation.

2. High levels of poverty do not, of themselves, prevent a strong showing on DRM. In addition to Bihar, Andhra Pradesh, for example, is known for its comparatively good administration, which includes response to hazards as well as public investment in infrastructure and services. The other high poverty states, except Bihar, all have significantly lower scores.

It is perhaps worth recalling that Bangladesh, in the same high multi-hazard region, has honed its flood disaster prevention efforts to such an extent that participation in a flood relief programme can improve individual and household well-being.

Some of India's states are likely to have large numbers of poor people and high hazard risk in 2030. India as a whole has relatively good DRM capacities. In general, however, the poorer states with large numbers of poor people need stronger DRM capacities. The apparent turnaround achieved in Bihar may signal what can be done, but this needs further analysis.

5.8 Conclusions

We conclude that 37 countries are likely to have both high poverty incidence or numbers of poor people in 2030 and high levels of hazard risk.

However, if countries with good current DRM capacities are removed, 21 countries remain of concern. Of these, Ethiopia, India, Nigeria and Pakistan are countries that are likely to still have very large numbers of extremely poor people.

The countries with the highest *incidence* of severe (<$0.75 a day) poverty are not generally those with the highest hazard risk. However, countries with the highest hazard risks are those with large *numbers* of people under $0.75 or $1.25 a day, and those with more than 10% of the population under the $1.25 a day threshold. These include middle-income countries that would be expected to manage their own disasters well, in addition to others that could not be expected to do so at the moment, and that need significant transformation of their DRM capacities as well as their underlying vulnerability.

The numbers of poor people in high hazard countries varies, according to our research. The biggest numbers by far are in Asia, and almost all of these are in South Asia: on the Multi-hazard Index, the range is 132-263 million poor people in 2030; and on the drought-heat-flood indicator alone the range is 92-185 million. Even on the optimistic scenario for poverty and for the drought-heat-flood projection, South Asia accounts for nearly half the global total of people living in poverty. This includes: Bangladesh (14-21 million), India (51-127 million), and Nepal (15-18 million).

On the drought-heat-flood indicator alone, sub-Saharan Africa accounts for most of the other half of the world's poor people – a range of 75-119 million. Significant countries include: Cameroon (1-1.5 million), Central African Republic (3 million), Cote d'Ivoire (2-3 million) Democratic Republic of Congo (20-30 million), Ethiopia (12-22 million), Niger (4-8 million), Nigeria (14-22 million), Sudan (12-18 million), and Uganda (3-7 million).

Among countries with high future poverty and hazard risk and low current DRM capacity, there are two clusters in terms of prevalent hazards: a group of largely South Asian countries (Bangladesh, Nepal and Pakistan, plus Haiti and Madagascar) which experience all five of the major environmental hazards, and another group of largely African countries experiencing droughts, high temperatures, and flooding (Cameroon, Central African Republic, Cote d'Ivoire Chad, Democratic Republic of Congo, Ethiopia, Guinea Bissau, Liberia, , Nigeria, South Sudan and Sudan).

A closer analysis of five of these countries revealed an absence of consideration for the impacts of disasters on poverty and the poor, and an absence of sub-national targeting in DRM policies and systems.

6

Policy responses

As Chapter 5 has highlighted, there are a number of countries projected to have high poverty levels and high hazard exposure in 2030, and low DRM capacity. This final chapter of the report presents a set of recommendations for international agreements, development cooperation, domestic policy and research on how to deal with the problem of poverty associated with 'natural' disasters and how to approach the high concern countries identified in this report.

6.1 Recommendations for future international agreements

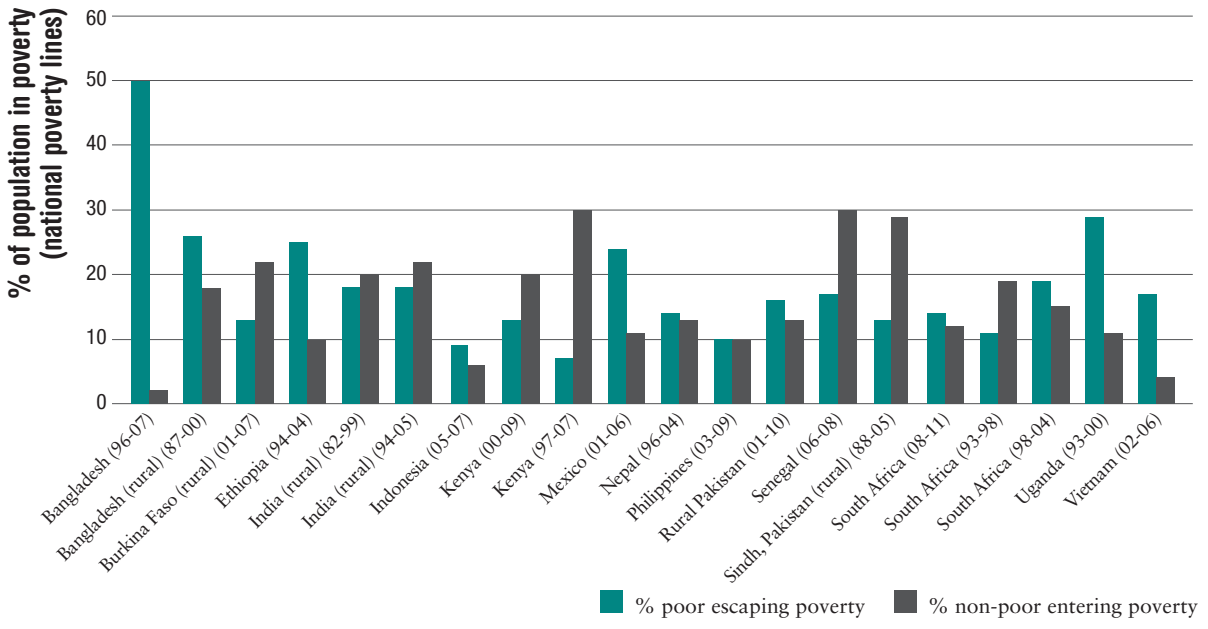
A number of international agreements are due to be negotiated in 2015. These include successors to the Millennium Development Goals, the Hyogo Framework for Action, and the Kyoto Protocol. Disasters and DRM have the potential to feature prominently in all of these successor agreements, making coherence absolutely vital.

Successor to the Millennium Development Goals

Resilience to disasters has featured prominently within the consultative processes of both the High Level Panel and Open Working Group (OWG). A dedicated OWG session on disasters is proposed in January 2014, responding to the prominent position of 'natural' disasters in the Rio+20 *The Future we Want* agreement (2012). The case for their inclusion in a post-2015 development framework is underlined, and quite rightly, by disasters' clear importance in impoverishing people and in keeping them poor, and the significance of the way in which impoverishment can cancel out hard-won development progress (Figure 26). The question is how should disasters be included? Typically, this is done by presenting evidence for the need for goals, targets or indicators.

The aim should be to motivate, first and foremost, better DRM, and in particular a better focus on reducing the impacts of disasters; and the targeting of DRM measures to disaster-prone sub-national regions and poor populations. But it should also encourage greater efforts to eradicate poverty, especially in the 'window' of time before it becomes extremely challenging to adapt to the effects of climate change.

Figure 26: Impoverishment trends can cancel out progress



SOURCE: Lenhardt, A. and Shepherd, A. (2013) '*What happened to the poorest 50%?*', Chronic Poverty Advisory Network, Challenge Paper 1.

This report suggests that, from a technical standpoint, DRM can be enhanced by the better modelling and mapping of hazards and their impoverishing effects. However, more effective delivery of DRM is largely a political matter, which will be driven by the occurrence of further impoverishing disasters, and the development of political 'settlements' or social contracts between state and citizen that insist on better DRM.

What can an international framework contribute to this? First, an acknowledgement that having targets that are focused on reduced impoverishment would help to draw attention to disasters. This would motivate social protection investments, conflict prevention and management, as well as DRM, and it is significant that the High Level Panel grouped social protection, land rights and disaster resilience within a poverty eradication goal. The Panel's suggestion to: 'Build resilience and reduce deaths from natural disasters by x%' is a strong option, although it does not fully capture the impoverishment dimensions posed by disasters. It fails, for example, to incentivise actions that address the full range of human, economic, social and psychological impacts that disasters can inflict on livelihoods and communities (Mitchell, 2013). However, given strong agreement that the post-2015 goals should centre on eradicating extreme poverty, and given the substantial geographical overlap between extreme poverty and disaster risk in 2030, a disaster-reduction target should certainly remain as a core factor in a goal on ending poverty.

There are calls for a more comprehensive suite of targets and indicators, as seen at a recent meeting in New York (see Technical Annex J). These emphasise the impact of disasters on economic growth, which is unlikely to figure strongly in the rest of the post-2015 framework. From the perspective of this report, and in a post-2015 framework centred on the eradication of extreme poverty, it is more relevant to place DRM firmly alongside social protection, health-systems improvement and conflict management, under an over-arching poverty goal, as the four major means of combatting impoverishment, rather than anywhere else.

Successor to the Hyogo Framework for Action

The Hyogo Framework for Action (HFA) (2005-2015) mentions poverty six times and poor people just three, with little or no explicit inclusion or reference to evidence that links disasters to poverty or impoverishment. Nonetheless, the UNISDR Global Assessment Reports in 2009 and 2013 identified a close correlation between extensive disaster risk and high levels of poverty and that it is small-scale disasters, when aggregated that account for the majority of disaster losses experienced by poor people.

With this report shedding further light on the link between disasters and impoverishment, the relationship between poverty and disasters should, therefore, be a dominant feature of the successor to the HFA. The agreement should refer explicitly to the separate policy responses required to deal with extensive disasters, as compared to the policies required to tackle long-return period, high magnitude mega-disasters. Emphasis on the role of poverty in influencing the extent of disaster impacts is also important to ensure that a successor to the HFA extends its engagement with influential line-ministries, such as those responsible for economic and human development, finance and planning. However, the question to be answered here is: what could motivate the disasters 'community' to accept a stronger focus on poverty?

The projections presented in chapter 3 of this report highlight how the frequency and severity of some hazards is expected to change, even in the short- to medium-term, adding to today's disaster risk in regions that are already exposed. Well-established science serves to tie increasing levels of GHG emissions and other anthropogenic activities over the last decades directly to some of the changes in extreme weather events we are experiencing now and will experience in the coming 20 years. To avoid the worst impacts of climate extremes from 2030 and beyond, cutting GHG emissions now is a major priority and represents a key DRM measure.

Further, poor countries are already experiencing loss and damage to their livelihoods, economies, cultures and society as a result of the more frequent or severe hazards associated with climate change. Greater attention is also needed to ensure that vulnerable countries have the resources and technical capacity to adapt to the changing profile of disaster risk. This has spawned the 'loss and damage' track of the climate negotiations, which explores what can be done to help small island states and least developed countries deal with the incremental impacts.

This report provides a new angle on these discussions by highlighting the potential role of climate change-related disasters in causing impoverishment. It has also explored the potential use of a 'resilience threshold' as a policy tool to chart social and economic progress in the poorest societies. However, the work to date has found little evidence of such a threshold. And if there is one, it would be quite context-specific, and not easy to generalise in international terms.

6.2 Recommendations for development cooperation

Within a development context focused on eradicating poverty, international efforts to reduce disaster risk should concentrate on the countries at greatest risk of disaster-induced *impoverishment*. Disasters and climate extremes in such countries can trigger long-term reversals in human development, particularly among the poorest members of society. Here, policy interventions should assess the sub-national distribution of those living below national poverty lines (and a $1.25 line) together with the distribution of exposure to hazards by using disaster and climate-risk assessments and models to specifically target areas where these overlap. In such areas, it is crucial to reduce the causal drivers of impoverishment risk. This requires investment in disaster-smart asset building and social-protection schemes, and ensuring that DRM efforts become a cornerstone of poverty-reduction interventions. It is also wise to emphasise improvements in the education outcomes of poor households, given that education is a portable asset, useful in a crisis (Bird et al., 2010). In addition, local, context-specific channels of impoverishment need to be addressed – social discrimination and exclusion, and impoverishing social norms.

DRM should, therefore, be focused on saving livelihoods as well as lives, and social safety nets should receive the same attention as early warning systems. Social protection *systems* are required that are capable of expansion or intensification in the event of a disaster. Disaster-relief efforts should also involve clear strategies to reduce poverty and build the assets of victims by engaging them in longer-term livelihoods programmes. This will take upfront and recurrent international investment support until such time as national /revenues can provide the necessary support.

Development cooperation should have a strong focus on today's fragile and conflict-affected states, which overlap significantly with the countries of highest concern identified in this report. While there has been some progress in increasing OECD country aid for such countries, this is very uneven, and there are some that remain virtual aid 'orphans'. The key concern here should be to help build political settlements that address the key sources of impoverishment that underpin protracted violent conflict and insecurity. However, actually agreeing on what to do is something that has, for the most part, eluded donor countries that aim to work together in fragile and conflict-affected states as recommended by the Paris/Accra/Seoul agreements on aid effectiveness. This remains, therefore, a difficult but important area for international action.

India represents a special case. As this report has shown, South Asia is a hotspot in terms of both present and future poverty and growing exposure to hazards, including climate change. India's poorest states represent a similar problem to that of fragile states elsewhere: they experience low levels of government capacity in a constitutional situation where much is expected of state governments, including DRM; they have had low rates of poverty reduction and their poorest people experience high underpinning levels of social discrimination. While India, as a whole, has a progressive political settlement, which includes the prevention of famine, the capacity to implement this settlement is very variable across the states. The efficacy of basic services and social protection systems also varies considerably. There is considerable scope for the international community to work alongside the Government of India with the governments of the poorest states. The improvement achieved in the state of Bihar over the past eight years demonstrates what can be done with more stable and progressive state government in place. This illustrates the importance of political change in turning fragile and conflict-affected states around. And development cooperation can support such progressive political change where it happens.

6.3 Recommendations for countries of concern

Poverty-reduction approaches

The projections made for this report suggest that a 'business as usual' scenario is unlikely to lead to the eradication of extreme ($1.25 a day) poverty by 2030 – the conclusion, arrived at in ways, of all recent exercises in projection. There will still be substantial extreme poverty in South Asia and sub-Saharan Africa. Whereas India is expected to take the 'baton' of poverty reduction from China, this report concludes that the overlay of poor, low-capacity states in northeast India with the deepest social discrimination against the poorest groups and the large numbers of chronically poor people in that region mean that considerable poverty will remain, even under an optimistic projection.

Many countries in sub-Saharan Africa, where the incidence of severe poverty ($0.75) is significant, will also find it difficult to bring enough of their people up to the $1.25 poverty line.

In both South Asia and sub-Saharan Africa, measures to contain the expansion of, if not reduce, inequality will be needed alongside sustained economic growth.

Impoverishment is a strong feature of the poverty dynamics in many of these countries; and environmental shocks are an important cause of impoverishment. Measures to address the causes of impoverishment are needed, alongside perhaps more politically popular measures to promote inclusive growth. DRM systems need to sit alongside social-protection systems, which should be designed to be capable of expansion in crisis. And the low wage rates, low returns to economic activity, social discrimination and social norms that keep people very poor need to figure in national policy-making.

In order to give appropriate emphasis to understanding impoverishment, countries need to take a dynamic approach to the analysis of poverty and wellbeing, tracking households through panel surveys and related qualitative research, focused on understanding the dimensions and causes of changes over time, and developing policies to accelerate and sustain escapes from poverty, prevent impoverishment and address chronic poverty. Different policies, including DRM, will achieve these different objectives.

Recommendations:

The national political settlement (or social contract) needs to reflect a commitment to avoid impoverishment as a political and policy priority. The international community can support national moves towards honouring this commitment.

In order to understand why people slip into impoverishment and why they stay poor, countries should invest in panel household-survey data and associated qualitative research. The international community can support this financially and methodologically, and by training national analysts.

Risk assessments

While disaster risk assessments at national level are becoming more common, they are not yet comprehensive in their coverage. The observed and projected data provided in chapter 3 on the climate-change impacts on drought, heat and rainfall frequency and severity also highlight the importance of treating disaster risk assessments as dynamic rather than static exercises, requiring regular updating to capture the latest scientific knowledge. At present, the majority of disaster risk assessments do not integrate data on sub-national variations in DRM or adaptive capacity. This is important, as the report recognises that strong adaptive and DRM capacity can mitigate much of the impoverishment risk. Integrating poverty data within such assessments, as a proxy for vulnerability, can make the exercise simpler in some cases as such data are more ready available in some countries. These overlays will highlight particular areas of concern. At present there is little conclusive evidence to suggest that the five key countries of concern discussed in Chapter 5 are taking an active approach to targeting efforts towards the most risk-prone, high-poverty areas.

Recommendations:

Disaster risk assessments, updated at least every five years, are required for each of the countries of concern listed in this report. Such assessments should also integrate sub-national data on poverty variations by district and data on DRM and adaptive capacity. This will serve to highlight the magnitude of the impoverishment threat posed by disasters in different sub-national jurisdictions and indicate where investment and action is required. Care should be taken to ensure that the process for developing disaster risk assessments is locally appropriate, owned by key agencies and generates information shaped by demand from local decision-makers who are able to use the assessments to identify policy options available to them. Findings should be embedded within wider development policies to ensure that the principles of DRM are mainstreamed across various sectors.

Development plans need to take a longer-term vision into account, going beyond traditional 3-to-5 year planning cycles, in order to ensure that vulnerable countries are prepared for changing future risk, as well as preventing maladaptation. Not all future risk can be foreseen effectively, given the inherent complexity of disaster risk and the overlaps between various drivers of change. However, an emphasis on flexible and forward-looking decision making will be key to ensuring that decision-making is dynamic and can respond to changing risks, capacities, and priorities.

6.4 Recommendations for the research community

Securing 'disasters' within the poverty eradication agenda

The HLP report has presented the opportunity for disasters to be considered as a key element of the poverty-eradication agenda, but there are very few longitudinal quantitative assessments of the link between 'natural' disasters, poverty and impoverishment. Further analysis of

household panel data will shed more light on this relationship, and be particularly helpful in establishing which underlying conditions and which hazard events cause the most significant long-term poverty impacts and whether intensive or extensive disasters are the most damaging. In addition, there are two other applied research priorities: (1) better risk modelling and mapping – applying global models to countries and sub-national regions, on a selective, priority basis; and (2) greater understanding of the political economy of DRM in developing countries, and the opportunities and barriers to more effective implementation.

A 'resilience to poverty' line?

Poverty lines have long been an obsession across the international development community, with intensive debates on what income figure constitutes extreme or severe poverty. Such figures are enshrined in the current MDGs. Much less consideration has been given to a vulnerability threshold – a 'resilience to poverty line' (or 'livelihoods protection' line in food security literature) – that tries to identify what level of income and asset mix constitutes enough of a buffer to ensure that people do not fall into extreme poverty when faced with livelihood shocks of any kind. The very preliminary work undertaken for this report suggests that any such threshold is likely to be context specific. However, it also suggests that it may be not be feasible to find clear thresholds, given that vulnerability to impoverishment may simply increase as income/consumption diminishes. More research is needed to investigate what is happening here.

The sub-national level

There is a significant need for better understanding of the overlays between poverty, hazard risk and DRM at sub-national levels, especially, but not only, in the geographically larger countries. It is possible to use the IFs model to analyse and project poverty at sub-national level, as this is something the modellers are in the process of incorporating, and this would require significant new work with the model. As hazard maps become more accurate, more sub-national hazard overlays will become possible. The biggest gap in data at present is on sub-national DRM capacity.

Drought indicators

There has been considerable progress made in measuring drought and the development of food insecurity early warning systems, particularly those that look a few weeks or months ahead, based on a more nuanced understanding of drought and better regional climatology. Initiatives such as the Famine Early Warning System Network have developed sophisticated indicator and alert approaches on a regional basis that link drought, food availability and food access. This is invaluable. The exercise conducted in this report, based on assessing the exposure of poor people to projected drought (as defined meteorologically) in 2030 compared to a baseline climatology in the late 20th century has limited value. This is because drought, defined here as the deficit of rainfall during periods when the amount of rainfall falls below the climatological average for the time of year, cannot show the complex relationships between lack of rainfall, yield, food access, asset distributions, social protection and a range of other factors that impact nutrition and famine risk. For example, this measure of drought shows that in 2030, the UK is more drought-prone than Niger and many other parts of West Africa. If indeed drought and famine risk projections into the future are of interest, more research is needed to identify a suitable indicator framework that is able to probe vulnerability and exposure to drought in a more refined way.

Recommendations:

Cross-country panel data analysis of disaster impacts on household incomes over multi-year periods is required to establish a quantitative evidence base on the disaster-poverty links.

Further research is required to establish whether a 'resilience to poverty' line exists, whether it is reasonably consistent across countries with similar levels of human development and what constitutes this threshold from both an income and human development perspective (e.g. levels of assets, health access, educational attainment).

Additional research is needed to develop a more nuanced metric for projected drought and famine risk given the complex interactions between lower than average rainfall, production, food access and the wider context.

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Endnotes

1. http://www.post2015hlp.org/

2. UNISDR Global Assessment Report 2009.

3. Intergovernmental Panel on Climate Change Special Report on Managing the Risk of Climate Extremes and Disasters to Advance Climate Change Adaptation 2012.

4. According to the World Bank, 1.2 billion people still live on less than $1.25 per day, despite massive strides on poverty in the past 30 years. (http://www.worldbank.org/en/news/press-release/2013/04/17/remarkable-declines-in-global-poverty-but-major-challenges-remain). The numbers of people living in extreme poverty in sub-Saharan Africa actually increased from 205 million in 1981 to 414 million in 2010.

5. http://www.scidev.net/global/disasters/news/un-disaster-framework-in-danger-of-not-reaching-goals.html

6. The multi-hazard index approach used to assess hazard exposure in 2030 biases results towards those countries exposed to earthquakes and cyclones. To counter this, we have developed a separate index just assessing exposure to weather events and hydro-meteorological hazards (droughts, extreme heat and floods). This second index highlights a much greater number of sub-Saharan African countries.

7. The range given here is a function of the poverty model used to generate these figures, with the lower projection being an 'optimistic scenario' and the higher projection being a 'pessimistic scenario'.

8. Highest vulnerability >10% at less than $0.75/day. High vulnerability >1,000,000 at less than $0.75/day. Moderate vulnerability >10% at less than $1.25/day and >1,000,000 at less than $1.25/day. Lower vulnerability >10% at less than $2.00/day and >1,000,000 at less than $2.00/day. Lowest vulnerability >10% at less than $4.00/day and >1,000,000 at less than $4.00/day. Not vulnerable <10% at less than $4.00/day and <1,000,000 at less than $4.00/day. Hazards: Drought, extreme precipitation, temperature, cyclones, earthquakes. The Multi-hazard Index goes from 0 to 35.

9. Future vulnerability to poverty and hazard projections, as well as a measure of DRM and adaptive capacity based on existing observation.

10. South Sudan poverty numbers are modelled on pre-secession Sudan poverty figures.

11. Measurement of urban poverty is difficult and likely to produce low estimates. However, fragmented evidence suggests that disasters are less likely to cause long-term impoverishment impacts in urban areas than in remote rural areas.

12. Just considering drought hazard alone, as defined by a deficit of rainfall during periods when the amount of rainfall falls below the climatological average for the time of year actually does little to highlight risks of food insecurity. In this index, a country like Niger has a lower drought exposure than the UK. This is related to the baseline period in the late 20th century – which in the Sahel has been especially dry – and a period in the mid-21st century, which is projected to be wetter compared to the baseline. This means Niger is considered to have low projected drought hazard. However, we know from research that the relationship between drought and food insecurity is highly complex and often has relatively little to do with rainfall deficits. This also supports our choice to include an index covering drought, heat and flood, which helps to normalise these idiosyncrasies.

13. Data on financial investments in disaster risk reduction taken from Kellett, J. and Caravani, A. (2013) *Financing Disaster Risk Reduction: International Aid over 20 Years*. Overseas Development Institute. The figure of $2 million per year is taken from an assessment of 13 of the 22 countries highlighted in this report for which data is available. Bangladesh is not included as it is a radical outlier, receiving nearly a US$1 billion for disaster risk reduction over the last 20 years, nearly 8 times more than any other country on the list.

14. No projection of disaster risk management capacity was possible for this study; as a proxy it has used a measure of today's capacity combined with adaptive capacity. See Chapter 4 for more detail.

15. http://news.bbc.co.uk/1/hi/world/americas/207820.stm

16. http://sustainabledevelopment.un.org/content/documents/1742130419%20Concluding%20Summary%20for%20Co-Chairs.pdf

17. See Technical Annex A for more detail.

18. For a detailed summary of this model see Technical Annex B and Hughes (2009).

19. Note that the model could be re-run with other outcomes, including those for human development, in a deeper study.

20. Discussion with Barry Hughes, John Evans Professor and Director, Frederick S. Pardee Center for International Futures, Josef Korbel School of International Studies, University of Denver, Denver, Colorado.

21. Parameters were updated from Cantore (2011) and expanded to include disaster resilience indicators from the World Risk Report. The national projections explored the possibility of including separate sets of poverty reduction and resilience drivers. In practice, however, there was no substantial overlap among the plausible variables available in the IFs model to drive these outcomes. It made sense, therefore, to run poverty and resilience together. This is an indication of how difficult it is in practice to separate out poverty and resilience both conceptually and empirically.

22. These are not comparable. Further work with the Young Lives datasets could generate comparable cross-country results.

23. Figure 10 shows for Andhra Pradesh between 2002 (Round 1) and 2006 (Round 2) households slipping into poverty were most likely to have experienced episode of drought. There is not really a consistent story in terms of significant differences between the poverty dynamics groups in terms of reporting drought – households slipping into poverty are significantly more likely than those staying out of poverty and remaining in poverty to have experienced drought as a main event, but not significantly more likely than households which moved out of poverty.

24. Uganda national panel survey (2005/06 and 2010/11); Tanzania national panel survey (2008/09 and 2010/11); Ethiopia rural household survey (last two rounds 2004 and 2009); Young Lives (Andhra Pradesh, Ethiopia, Peru, Viet Nam – all for the last two rounds in 2006 and 2009) also has accompanying life histories; Philippines round 2, 2003-4, has a shocks module,; South Africa Kwazulu-Natal last two waves of the Kwazulu-Natal Income Dynamics Study (although one issue with this is one of the options for a shock is 'crop failure' – but there are also questions on drought, flood). There may also be shocks modules in panel data sets for Bangladesh, Nepal, Nicaragua, Pakistan and Viet Nam.

25. This could be explored with the IFs modellers at the University of Denver for future work, as there is now sub-national data in the model for some countries.

26. The references used to create this table are available in the reference list at the end of the Technical Annex.

27. There was no plausible projection possible for Sindh.

28. UP has been divided into two states.

29. The 2014 World Development Report (World Bank, 2013b) includes a new 'Index of Risk Preparation', focused on preparedness for all risks, not just disasters. It comprises measures of assets and services across four categories – human capital, physical and financial assets, social support and state support. The indicators include average years of total schooling, immunisation rates, the proportion of households with less than $1000 in net assets, a composite indicator of access to finance, the percentage of the workforce contributing to a pension scheme, the proportion of respondents stating that 'in general people can be trusted', the percentage with improved sanitation facilities and an indicator based on gross public debt as a percentage of state revenues. The index presents very similar findings to those shown in section 4.4.

30. The final column, 'qualitative assessment score' is based on a normalisation of the different indices, to revert all scores to between 1-5, keeping the basic scale and then averaging, keeping equal weighting (The world risk index score was reversed).

31. All indicators have been re-scaled to be between 1 and 10. Data for calamity relief expenditure and anti-corruption efforts is only available for key states.

32. http://www.telegraphindia.com/1130505/jsp/7days/story_16860725.jsp#.Uh22CZK1FqU

33. http://articles.timesofindia.indiatimes.com/2013-03-30/india/38145207_1_capita-income-rs-other-backward-states

34. http://www.himalmag.com/component/content/article/4836-building-on-bihar.html

35. http://disastermgmt.bih.nic.in/Statitics/Statistics.htm

36. http://disastermgmt.bih.nic.in/Statitics/Statistics.htm

37. http://disastermgmt.bih.nic.in/Statitics/Statistics.htm

38. South Sudan poverty numbers are modelled on pre-secession Sudan poverty figures.

39. The top 20 countries with high levels of fragility, as well as disaster risk, poverty and vulnerability to climate change are, in order: (1) Somalia, (2) Afghanistan, (3) Niger, (4) Guinea-Bissau, (5) Burundi, (6) Chad, (7) Sudan, (8) Democratic Republic of Congo, (9) Guinea, (10) Haiti, (11) Zimbabwe, (12) Ethiopia, (13) Central African Republic, (14) Bangladesh, (15) Liberia, (16) Sierra Leone, (17) Timor-Leste, (18) Burkina Faso, (19) Myanmar and (20) Rwanda. While this is not surprising, with some exceptions, existing state fragility is a reasonable indicator of high poverty and low risk governance/adaptive capacity, particularly in the context of drought exposure both now and in 2030.

40. The references used to create this table are available in the reference list at the end of the Technical Annex.

41. Institut National de la Statistique (2011).

42. IFAD (n.d.): http://www.ruralpovertyportal.org/country/home/tags/haiti

Design: www.stevendickie.com/design

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203 Blackfriars Road
London SE1 8NJ, UK

Tel: +44 (0)20 7922 0300

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