TECHNICAL ANNEXES

The geography of poverty, disasters and climate extremes in 2030

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Technical annexes

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The references used to support the Technical Annexes are included in a separate reference list at the end of this document.

Cover image: A crowd of stranded villagers gather on the banks of Ethiopia's Lake Tana Andrew Heavens, 2006.

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1 Technical annex A: Disaster case studies (Chapter 1)

Bangladesh: the 1998 flood

Bangladesh is one of the most disaster-prone countries in the world, featured within the top 10 most exposed countries in the 2012 *World Risk Report*. According to the OFDA/CRED International Disaster Database, between 1980 and 2010, Bangladesh was struck by 234 disasters, including: 108 storms, 68 floods, 27 epidemic events, 19 extreme temperature waves, 7 earthquakes and 3 droughts. If storms are the most deadly disasters in Bangladesh, floods affect the largest number of people.[1] The most severe events include the 1988, 1998 and 2004 floods that affected around 45 million, 30 million[2] and 36 million people respectively.

In Bangladesh, high exposure to natural disaster is coupled with very high population densities (1,024 people per square kilometre in 2002)[3] and high poverty levels. These factors make Bangladeshi society one of the most vulnerable to natural disasters in the world.

According to the UNDP-BDP Poverty Group, the best available data for monitoring poverty in Bangladesh are the high (about $1.45/day ppp) and low (about $1.19/day PPP) Cost of Basic Needs (CBN) poverty lines included in the PRSP and published by the Bangladesh Bureau of Statistics.[4] According to these poverty lines, both absolute and extreme poverty levels have dropped since the early 1990s. Absolute poverty has decreased from 58.8% in 1991 to 40% in 2005 and extreme poverty fell from 42.7% to 26% over the same period. Two interesting facts emerge. First, both absolute and extreme poverty levels are higher in rural areas over the whole period. About 85% of Bangladesh's very poor people live in rural areas. Second, the pace of poverty reduction was much slower between 1995 and 2000 than between 1990 and 1995 or 2000 and 2005, falling from 51% to 49.8 % for absolute poverty and from 34.4% to 33.7% for extreme poverty. This period coincides with one of the largest floods in the country recent history: the flood of 1998.

The impact of the 1998 flood on household wealth

If floods are annual events in Bangladesh, the 1998 floods were unusual for both their depth and duration. While floods cover 18% of the land area over the monsoon season (July-August) in normal years, in 1998, the water was above the danger level for an average of 59 days until mid-September, inundating 68% of the total area.[5] The 1998 flood affected around 980,571 houses and killed over 26,500 cattle across Bangladesh. It led to wide population displacements (1,049,525 people), deterioration of sanitation and water access as well as increased illness and food insecurity levels. 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, which caused a major reduction in household incomes and wealth.

1 PreventionWeb (n.d.) 'Bangladesh: Disaster Statistics'. Brussels: OFDA/CRED International Disaster Database. http://www.preventionweb.net/english/countries/statistics/?cid=14
2 Del Ninno et al. (2001). 'The 1998 Floods in Bangladesh Disaster Impacts, Household Coping Strategies, and Response'. Washington D.C.: International Food Policy Research Institute. http://www.ifpri.org/sites/default/files/publications/rr122.pdf.
3 Bangladesh is the eighth most populous country in the world with a total population of 135.7 million people and a population growth rate of 1.7 % per annum in 2002 (World Bank, 2004).
4 McLeod, D. (2007). 'Is Poverty increasing in Bangladesh? Reconciling national and global monitoring estimates'. Final report to UNDP-BDP Poverty Group. http://www.fordham.edu/economics/mcleod/PovertyTrendsinBangladesh.pdf.
5 Del Ninno et al. (2001) 'The 1998 Floods in Bangladesh Disaster Impacts, Household Coping Strategies, and Response'. Op. cit.

Severe flooding led to substantial crop losses representing 24% of the total value of anticipated agricultural production for the year. The rice crop losses, which represented half of the total agricultural loss, amounted to 2.04 million tons.[6]

Data collected by an IFPRI household survey between 1998-1999 in seven flood-affected *thanas* (administrative units) of rural Bangladesh showed that for the 55% of households that lost assets, the average loss represented around 16% of their pre-flood total value of asset (around Tk 6,936).[7] In Dhaka, the flood affected mainly the eastern part of the city. Nearly 83% of houses in the affected areas were under three feet of water or more and 60% of houses remained flooded for more than 60 days. If the percentage of households that lost assets were similar among poorer and richer households, average losses were higher for the richest households: Tk 8,858 for the richest quintile compared to Tk 5,868 for the poorest quintile. However, asset loss amounted, on average, to more than 30% of pre-flood total assets value for the poorest quintile compared to only 11% for the richest quintile. In other words, if richer households lost more valuable assets, poorer households experienced a bigger relative shock as a result of the floods because they had fewer assets to begin with.

The flood also disrupted economic activities, leading to reduced labour participation and earnings. The average of monthly days worked fell during the floods. Day labourers were affected disproportionately by the reduction of monthly working days, which fell from 19 days/month in 1997 to 11 days in July 1998 and reached 16 days in November 1998 – still three days less than the average for the previous year. Similarly, wage earnings fell after the flooding period and had not recovered to 1997 levels by October 1998. Average monthly earnings between July and October 1998 were respectively 16.5% and 46% below 1997 average levels for dependent workers and day labourers.[8]

People reacted to the flood by using a wide range of coping strategies. The most common were borrowing, purchasing food on credit, modifying eating behaviour and selling assets. The percentage of rural households taking a loan to buy food increased from 7% the month preceding the flood to 15.9% in October 1998. At the same time, more than 60% of rural households exposed to the flood had an outstanding loan. In Dhaka, nearly 44% of affected households had to borrow money to survive.[9] While the poorest households borrowed to buy food, the richest households borrowed a greater amount of money for rebuilding, farming and business reasons. Almost 50% of all households interviewed by IFPRI in rural Bangladesh reported purchasing food on credit between July and October 1998. Although the percentage of households purchasing food on credit is lower among the richest quintiles, these households were able to obtain larger amounts and to buy more expensive food. It also appears that skipping meals was an important coping strategy for 20% of interviewed rural households. Some 16% of rural households and 19% of affected households living in Dhaka sold assets to cope with the floods. While rural households tended to sell cattle and trees, urban households sold jewellery and furniture.

Conclusion:

Although the 1998 flood was bigger in scope and duration than the 1988 flood and had the same depth, it resulted in less loss and damage. According to a World Bank study, one explanation is that response was more effective thanks to a more transparent and accountable political environment, an increase in preparedness, and DRR investment, a rise in NGOs and a more open society characterised by economic growth and poverty reduction over the 1988-1998 period.[10] Recovery was said to be impressive after the 1998 floods given the relatively low level of new external resources that flowed into Bangladesh, for example in comparison to Honduras after Hurricane Mitch. However, a survey carried out among affected households in Dhaka city three months after the end of the floods shows that levels of recovery greatly varied according to occupational groups. While 50% to 70% of business people, service holders and professionals (doctor, engineers and teachers) fully recovered from flood damages, only 26% to 37% of those from low-income groups including rickshaw–pullers, factory workers and day labourers had completely recovered.[11] Moreover, the IFPRI 1998-1999 survey in rural

6 Ibid.
7 Ibid.
8 Ibid.
9 Jahan, S. (2000) 'Coping with flood: the experience of the people of Dhaka during the 1998 flood disaster'. Australian Journal of Emergency Management. http://www.em.gov.au/Documents/Coping_with_flood_the_experience_of_the_people_of_Dhaka.pdf
10 PreventionWeb. (n.d.). 'Bangladesh: Disaster Statistics'. Op. cit.
11 Jahan, S. (2000) 'Coping with flood : the experience of the people of Dhaka during the 1998 flood disaster'. Op. cit.

Bangladesh shows that there was a 28% and 24% increase in the number of households living below the lower poverty line and upper poverty line respectively in the year following the flood, which suggest that many households had not recovered completely from the flood by November 1999. Quantitative data for the long term impacts of the flood are not readily available.

Ethiopia: the 1983-1985 drought and the resulting 'Great Famine'

Located in the Horn of Africa, one of the continent's most drought-prone regions, Ethiopia experienced significant turmoil from its exposure to droughts, famines, and conflict over the course of the 20th century. Though per-capita income levels remain amongst the lowest in the world, the country has seen significant GDP growth in the last decade, with extreme poverty falling from 38.7% of the population in 2005 to 29.6% in 2010.[12] In spite of recent economic growth, most Ethiopians remain exposed to disaster impacts, with more than 82% of the population living in rural areas and with agriculture accounting for nearly half of GDP.[13]

Ethiopia is extremely susceptible to droughts and floods, which have claimed the lives of over 300,000 people since 1980.[14] Though floods cause significant economic damage, droughts are the main source of disaster mortality and their effects are greatly magnified by rural poverty. The worst of these droughts resulted in the 1984-1985 Great Famine, which occurred in the midst of a civil war and put millions at risk of starvation. The famine became so severe that it provoked a high-profile international response involving rock stars, millions of pounds of foreign aid, and a huge Western media campaign.[15] The famine marked a watershed in Ethiopia's DRM policies, and since then the government and the international community have cooperated to create a national early-warning system, a major safety-net programme, and regular needs assessments for drought-prone regions.[16] Nonetheless, food security remains an issue, with major droughts affecting the country in 1991-92, 1999-2000, and 2002-03.[17]

In spite of the initiatives in place, Ethiopia's poor rural households have remained extremely vulnerable to the effects of droughts and suffer long-term setbacks as a result of their exposure. Dercon et al. (2005) found that, comparing the highest and lowest quartile of households in terms of the severity of their suffering during the 1984 drought, the lower quartile experienced income growth that was between 4 to 16 percentage points lower throughout the 1990s.[18] These households have limited coping capacity in the face of a drought, and are often forced to sell productive assets and reduce consumption at the expense of long-term welfare.[19] Asset-poor households have the hardest time recovering: ten years after 1984, the cattle holdings of Ethiopian households were still one-third lower than they were just before the famine.[20] The power to purchase cattle was eroded severely during the famine, so those who resorted to selling their livestock did so at great disadvantage.[21] Furthermore, selling assets like cattle can have serious consequences for future income generation, which explains why some of the poorest households resorted to 'asset smoothing', taking some of the most extreme measures to hold onto their cattle.[22] On the other hand, households in upper and middle-income terciles had more assets to sell and were, therefore, able to shed some of their livestock and personal possessions. For these

12 World Bank (n.d.). 'Ethiopia Overview'. Retrieved May 20, 2013, from http://www.worldbank.org/en/country/ethiopia/overview.
13 Central Intelligence Agency (August 2013). Ethiopia. From The World Factbook. Retrieved September 16, 2013, from https://www.cia.gov/library/publications/the-world-factbook/geos/et.html.
14 PreventionWeb (n.d.). Ethiopia - Disaster Statistics. Retrieved April 24, 2013, from http://www.preventionweb.net/english/countries/statistics/?cid=59.
15 Public Broadcasting Service (n.d.). Ethiopian Highlands. From PBS.org. Retrieved April 24, 2013, from http://www.pbs.org/wnet/africa/explore/ethiopia/ethiopia_overview_lo.html.
16 Bailey, R. (April 2013) Managing Famine Risk. London: Chatham House. Retrieved April 23, 2013, from: http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/0413r_earlywarnings.pdf.
17 De la Fuente, A., Dercon, S. (2008) 'Disasters, growth, and poverty in Africa: Revisiting the microeconomic evidence' Background paper prepared for 2009 Global Assessment Report on Disaster Risk Reduction. Geneva: UNISDR.
18 Dercon, S. et al. (2005) 'Shocks and Consumption in 15 Ethiopian Villages, 1999-2004'. Journal of African Economies, Vol. 14(4), pp. 559-585.
19 De la Fuente, A., Dercon, S. (2008) 'Disasters, growth, and poverty in Africa: Revisiting the microeconomic evidence'. Op.. cit.
20 Dercon, S. (2002) 'Income risk, coping strategies and safety nets'. World Bank Research Observer 17 (2): 141-166.
21 Webb, P., et al. (1992) Famine in Ethiopia: Policy Implications of Coping Failures at National and Household levels. IFPRI Research Report 92. Washington, D.C.: IFPRI.
22 Little et al. (2006) 'Moving in Place': Drought and Poverty Dynamics in South Wollo, Ethiopia. Journal of Development Studies, Vol. 42, No. 2, 200–225, February 2006

households, income from asset sales was more than twice that of asset sales from the lower income tercile, providing a buffer from the most serious effects of the drought.[23]

This bifurcated experience of drought has significant health consequences – in subsequent drought shocks in the 1990s, poorer households that resorted to reducing consumption had worse child health indicators and a low adult body-mass index as a result of significantly reducing food intake.[24] [25] While shocks prompt wealthier households to sell off assets and rebuild them relatively quickly, poor households may lose out permanently. For those without a significant asset base, remittances have proved to be a vital source of revenue. Mohapatra's study showed that recipients of remittances did not resort to selling livestock.[26] Additionally, access to off-farm opportunities have proved important for protecting assets both during a drought and the subsequent recovery period. The study by Carter et al. on shock-induced poverty traps reveals that this, in conjunction with access to social institutions, is particularly important for those in the lower wealth quintiles.[27] For those without off-farm income opportunities and remittance flows, reducing consumption is the only viable coping strategy that allows them to hold onto assets in times of stress.

Even with national programmes and international crisis monitoring, Ethiopia's poor have struggled to cope with the effects of droughts for decades. In 2005, the government launched a National Safety Net Programme to alleviate the impoverishing effects of droughts on the poorest.[28] The programme is designed as an asset protection mechanism, which allows families to maintain their consumption without diminishing asset endowments. By providing alternate sources of income through public works programmes, the five-year timeframe is designed to allow poor households to accumulate assets through work, with a built-in food option for areas where the market does not deliver adequate grain to sustain the community during droughts. This programme is an important step forward for Ethiopia's most vulnerable people, notably those in lower income brackets who have no access to remittances or non-farm sources of income. Building a significant asset base to draw upon during times of disaster will allow the poorest to recover without sacrificing their health and possessions.

Haiti: 2010 earthquake

Haiti is highly prone to a wide range of natural hazards. According to the OFDA/CRED International Disaster Database, from 1980 to 2010, Haiti witnessed 74 natural disasters that affected 10 million people and resulted in 233,919 deaths.[29] Floods and storms are by far the most recurrent natural disasters in the country, with 39 and 27 episodes recorded since 1980 respectively, in addition to 4 drought events, 2 epidemics and 1 earthquake. However, the magnitude-7 earthquake that struck Haiti in 2010 was by far the most catastrophic natural disaster witnessed by Haiti during this period, affecting 3.7 million people, leading to 222,570 deaths and total losses of around $8 billion.[30]

In the context of Haiti, natural disasters are coupled with poor governance, conflict-related hazards and susceptibility to economic shocks, as well as high levels of vulnerability and poverty. Each plays a strong role in influencing the country's ability to tackle natural disasters. Haiti is ranked 8 out of 170 countries for levels of susceptibility by the 2012 *World Risk Report*, which means that an extreme event triggered by a natural hazard is very likely to cause harm, loss and disruption. In Haiti, high susceptibility is accompanied by poor public infrastructure, poor housing conditions exacerbated by rapid unplanned urbanisation, poor nutrition, low economic capacity, etc. Moreover, despite the creation of its Risks and Disasters management National System

23 Webb, P. et al. (1992) Famine in Ethiopia: Policy Implications of Coping Failures at National and Household levels. IFPRI Research Report 92. Washington, D.C.: IFPRI.
24 Yamano, T. et al. (2005) 'Child growth, shocks and food aid in rural Ethiopia'. American Journal of Agricultural Economics, Vol. 87(2), pp.273-288.
25 Dercon, S. and P. Krishnan (2000) 'In Sickness and in Health: Risk-sharing within households in rural Ethiopia', Journal of Political Economy, Vol. 108 (4), pp.688-727
26 Mohapatra, S. et al. (2012) 'Remittances and natural disasters: ex-post response and contribution to ex-ante preparedness'. Environ Dev Sustain (14):365–387
27 Carter, M. et al. (2007) 'Poverty Traps and Natural Disasters in Ethiopia and Honduras'. World Development Vol. 25 (5), pp. 835-856.
28World Bank. (n.d.) 'The Productive Safety Net Programme in Ethiopia'. Retrieved May 30, 2013, from http://info.worldbank.org/etools/docs/library/207058/The%20Productive%20Safety%20Net%20Programme%20in%20Ethiopia.pdf.
29 PreventionWeb. (n.d.) 'Haiti: Disaster Statistics'. Brussels: OFDA/CRED International Disaster Database. http://www.preventionweb.net/english/countries/statistics/?cid=74.
30 Ibid.

(SNGRD) in 1997 and a national plan in 2001, Haiti still ranks amongst the lowest 10 ranking countries for both coping and adaptive capacity.[31]

Historically, poverty levels have been very high in Haiti. Between the 1980s and 2000, absolute poverty rates remained stable, with 60% of the population and 50% of households below the poverty line.[32] With an average population growth of 2% per annum, the number of absolute poor people increased from 3.7 million in 1987 to 4.62 million by 2000. However, the number of extremely poor has decreased from 2.75 million in 1987 to 2.40 million in 2000, reflecting a slight improvement in living conditions among the poorest over this period. Trends shifted after 2000 and poverty levels (both absolute and extreme) started to increase drastically. In 2011, the UNDP *Human Development Report* showed very high poverty rates, reaching 76% for absolute poverty and 56% for extreme poverty.[33] Some 74% of the poor lived in rural areas where the principal activity is agriculture and where social services are very poor. In these rural areas absolute poverty reached 88% and extreme poverty 67% in 2011.

To examine the impacts of natural disasters on poverty levels in Haiti, we focus on the most damaging disaster of Haiti's recent history: the 2010 earthquake, looking at its short and longer-term impacts at the household level.

The impacts of the 2010 earthquake on households:

The 2010 earthquake had drastic consequences on housing conditions. More than 82% of households living in areas struck by the earthquake saw their houses destroyed. Areas with high concentrations of poor people, such as Gressier and Léogâne, were particularly affected. The earthquake also had a direct impact on markets, the economy and the state of food security in Haiti. The earthquake destroyed many companies and led to a 25% rise in food commodity prices, which affected households that derived their main sources of income from trade and skilled work. As a consequence, food insecurity rose after the earthquake. Over half of the households interviewed in the post-earthquake rapid assessment reported that they had contracted debts by borrowing money from relatives or friends for example, mainly to cover food needs. Before the earthquake, 44% of households owned food stocks, but only 17% of households had remaining stocks one month after the earthquake. The Coping Strategies Index shows that after the earthquake, compared to 2007, more households were relying on coping strategies such as eating less preferred food, limiting portion size at meals, limiting adult consumption or reducing the number of meals per day.[34]

Different impacts on rich and poor households:

The rapid post-earthquake assessment assessed the impact of the earthquake across different wealth groups. Households were divided into terciles according to their scores on the Wealth Index (poorest, average and wealthiest).[35] The post-earthquake rapid assessment shows that 23% of households belonging to the poorest tercile before the earthquake experienced a wealth reduction after the earthquake, compared with 58% of households belonging to the average tercile and 61% of households of the wealthiest tercile. As a result, if before the disaster, each tercile included approximately 33% of households, after the quake, 52% of households were part of the poorest group, 30% were in the average group and only 18% were part of the wealthiest group.

Some 10% of households living in the surveyed areas had lost one family member or more. Of the wealthiest households, 11.5% had experienced the death of one or more income earners, compared with 8.7% for all other groups. Regarding savings and assets, wealthier households were affected disproportionately by the earthquake.

31 Alliance Development Works (2012) World Risk Report 2012. Retrieved June 20, 2013, from http://www.ehs.unu.edu/file/get/10487.pdf
32 Montas, R. (2005) 'La Pauvreté en Haiti : Situation, causes et politiques de sortie'. LC/MEX/R.879. Commission Economique pour l'Amérique Latine et les Caraïbes (CEPALC). http://www.eclac.org/publicaciones/xml/1/22701/R879.pdf
33 UNDP (2011) 'Rapport sur le développement humain (RDH) 2011 en Haiti'.
http://www.undp.org/content/dam/haiti/docs/mdg/RDH%202011%20en%20Haiti.pdf.
34 Coordination Nationale de la Sécurité Alimentatire (CNSA) (2010) 'Rapid post-earthquake emergency food security assessment: Haiti'.
http://home.wfp.org/stellent/groups/public/documents/ena/wfp221395.pdf.
35 Ibid.

In February 2010, 86.5% of the richest households experienced assets losses, compared with only 17.6% of the poorest.

Data from the 2010 Haiti earthquake suggests that the wealthiest households were affected disproportionately, losing greater levels of absolute savings, assets and wealth than the poorest households directly after the event. However, a World Bank analysis shows that wealthiest households recovered faster, as by June 2010, 16% of them had returned to their pre-earthquake situation, while the poorest households had more to lose.[36] The rapid post-earthquake assessment highlights the fact that poorest households depended more on temporary jobs than the other groups after the earthquake and adopted non-sustainable strategies, e.g. reducing healthcare expenses, selling assets and eating seeds, while wealthier groups did not, in general, resort to these strategies as much. This suggests the existence of a poverty trap: the poorest households kept losing more and more after the disaster, while a considerable proportion of the richest households managed to recover.[37]

The Philippines: national disaster risk reduction but local distress after the 2009 typhoon

According to the 2012 World Disasters Report, the Philippines is the third-most disaster prone nation on earth.[38] Located in the western Pacific Ocean, its population of nearly 95 million people faces typhoons, floods, droughts, tropical storms, volcanos, and earthquakes.[39] Though in recent years the Government has shifted its attention to reducing and managing these disaster impacts, the frequency of disasters still hinders efforts to reduce poverty in the country.[40] The proportion of the population living below the official poverty line has fallen only modestly in the past two decades, from 33.1% in 1991 to 27.9% in 2012. Poverty remains largely a rural phenomenon, although urban poverty has grown substantially and now accounts for one-third of all those who live beneath the poverty line.[41]

Although the Philippines has seen over 300 disasters since 1980, or more than 12 each year on average, studies on the long-term welfare impacts are few and far between.[42] This is, in part, because of the difficulty of discerning the impoverishing consequences of covariate stresses, as much of the population is exposed to many types of natural hazards and may experience several over the course of a year. More recently, the Government has prioritised DRR, signing the HFA in 2005 and issuing the Mindanao declaration in 2012. Between 2006 and 2010, the Philippines was the second biggest recipient of DRR aid from bilateral donors.[43] This increased focus on DRR has been accompanied by increased scholarship on disaster effects at the household level. Because much of this work has been done in the last five years, long-term consequences for the most vulnerable remain undocumented. However, these studies, coupled with Post-Disaster Needs Assessments (PDNAs), have allowed for better understanding of underlying vulnerabilities.

The impacts of the 2009 typhoon

Regardless of the type of hazard, a 2004 World Bank report emphasised that poverty is the single most important factor in determining disaster vulnerability in the Philippines.[44] Indeed, the case of the tropical storm Ondoy and the Pepeng typhoon in 2009 support this line of analysis. The storms occurred in succession, with

36 Echevin, D. (2011) 'Vulnerability and Livelihoods before and after the Haiti Earthquake'. Policy Research Working Paper. Washington D.C.: World Bank. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2011/10/21/000158349_20111021085837/Rendered/PDF/WPS5850.pdf
37 Ibid.
38 Pellini, A., et al. (May 2013) 'Towards policy-relevant science and scientifically informed policy'.London: Overseas Development Institute. Retrieved June 12, 2013, from http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8431.pdf.
39 PreventionWeb. (n.d.). Philippines – Disaster Statistics. Retrieved May 16, 2013, from http://www.preventionweb.net/english/countries/statistics/?cid=135.
40 World Bank-NDCC (2004) Natural Disaster Risk Management in the Philippines: Enhancing Poverty Alleviation through Disaster Reduction. Washington D.C.: World Bank - Natural Disaster Coordinating Committee
41 Asian Development Bank (2009) Poverty in the Philippines: Causes, Constraints, and Opportunities. Retrieved May 16, 2013 from http://www.adb.org/sites/default/files/pub/2009/Poverty-Philippines-Causes-Constraints-Opportunities.pdf.
42 PreventionWeb. (n.d.). Philippines – Disaster Statistics. Op. cit.
43 Sparks, D. (2012) 'Aid Investments in Disaster Risk Reduction'. Briefing Paper. Global Humanitarian Assistance.
44 World Bank-NDCC (2004). Op. cit.

typhoon Pepeng hitting with enough severity to qualify as a disaster event (in that, statistically speaking, such an event occurs once every 50 years).[45] Over 9.3 million people were severely affected and damages were equivalent to 2.7% of GDP.[46] The World Bank's Post-Disaster Needs Assessment chronicled the losses to agricultural and commercial sectors, which saw $3.2 billion and $1.9 billion in loss and damages, respectively.[47] Of the 9.3 million people bearing the brunt of these losses, the poor were affected disproportionately, particularly those who had been self-employed before the typhoon, including fisherfolk, farmers, small-businesses owners and informal-sector workers.[48] These households suffered long-term impacts from the disruption in their livelihoods, as they tended to shift to less capital intensive and less profitable occupations.[49] This coping strategy was accompanied by a pattern of borrowing to cover the overall reduction in income they experienced. Borrowing to meet basic consumption needs can result in a vicious cycle, in which multiple loans are taken out to service the original debt. 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 exorbitantly high interest rates, though in cities microfinance institutions were marginally more prevalent than in rural areas.[50]

Borrowing, in conjunction with reducing consumption, increased poverty levels in the affected regions. The Post-Disaster Needs Assessment (PDNA) reported that it expected an additional 480,000 people to fall into poverty as a result of the storms. Rizal, one of the regions hit hardest, saw the poverty incidence among families almost double, from 5.5% in 2006 to 9.5% in 2009. In 2012, the incidence of poverty had gone down somewhat, but recovery was still far off, with 7.6% of families still below the poverty line.[51] These figures hide the depth of suffering – increased transient poverty is a consequence of disasters for some vulnerable households, but long-term losses for those who are already poor are largely undocumented and leave the poorest even more vulnerable to future disaster events.

The limitations of social protection schemes

Recognizing the need for some form of social protection to bridge the financing gap between pre-disaster employment and post-disaster coping, the Government of the Philippines provided livelihood assistance to many of the affected areas. A study by the Institute of Philippines Culture details this assistance, which was channelled through existing social protection programmes, a Cash or Food for Work programme, or emergency grants or loans. Of the 18 communities surveyed, 16 responded that the assistance was not sufficient to cover their long-term livelihood recovery needs.[52] Indeed, households that received NGO and government support resorted to more stressful coping strategies than those that did not (such as selling productive assets, taking children out of school, and taking loans from moneylenders) because they suffered extremely high economic losses.[53] Most respondents in the IPC study emphasised that lack of capital was the biggest impediment to recovery. This financing gap suggests a larger role for micro-insurance schemes that reduce the extent to which the poor deplete assets after a typhoon, allowing for a faster recovery.

Even with national commitment to DRR and social protection mechanisms in place, the poor still suffer the most in the wake of a disaster. In the Philippines, self-employed workers who depend on their own capital to make a living were the most negatively impacted by the 2009 typhoon and struggled even with access to government and international assistance. The typhoons were a catalyst for more local government attention to disaster preparedness initiatives, such as training local government personnel, purchasing new equipment, and disaster

45 GFDRR (2010) Philippines. Typhoons Ondoy and Pepeng: Post Disaster Needs Assessment. Retrieved May 30, 2013, from http://gfdrr.org/docs/PDNA_Philippines_MainReport.pdf.
46 Ibid.
47 GFDRR (2010) Executive Summary: Philippines. Typhoons Ondoy and Pepeng. Op. cit. Retrieved May 25, 2013, from https://openknowledge.worldbank.org/bitstream/handle/10986/2777/646280v10ESW0P0BOX361542B000PUBLIC0.pdf?sequence=1.
48 Institute of Philippines Culture (December 2011) 'The Social Impacts of Tropical Storm Ondoy and Typhoon Pepeng'. Manila, Philippines. Retrieved from http://siteresources.worldbank.org/INTPHILIPPINES/Resources/TheSocialImpactsofTropicalStormOndoyandTyphoonPepengFINAL.pdf.
49 Ibid.
50 Ibid.
51 National Statistical Coordination Board (April 2013) 'Poverty Incidence unchanged, as of first semester 2012'. Manila: Republic of the Philippines. Retrieved from May 17, 2013 from http://www.nscb.gov.ph/poverty/defaultnew.asp.
52 Institute of Philippines Culture (December 2011) 'The Social Impacts of Tropical Storm Ondoy and Typhoon Pepeng. Manila, Philippines'. Op. cit.
53 Morsink, K. et al (2011) 'Impact of Micro insurance on vulnerability of low income households in the Philippines: the case of typhoon re-housing insurance'. Enschede: Institute of Governance Studies, University of Twente.

awareness campaigns, but vulnerability still remains high among poor self-employed households.[54] Without targeted interventions to ensure access to capital and wage-earning opportunities, disasters will remain an impediment to poverty-reduction in the country.

54 Institute of Philippines Culture (December 2011). The Social Impacts of Tropical Storm Ondoy and Typhoon Pepeng. Manila, Philippines. Op. cit.

2 Technical annex B: The IFs model (Chapter 2)

The projections used in this report have used the most common income-projection method, the lognormal form. This allows income distribution disaggregation, which is necessary to arrive at poverty estimates along different poverty lines. The parameters used to calculate income levels in the IFs model are average income and the standard deviation from it. To estimate these parameters, the model uses national average consumption and the country's Gini coefficient. This is expressed as:

$IncomeLTILN_r = f(LogNormalDistribution, CperCap, Gini_r, NSNARAT_r)$

Where:

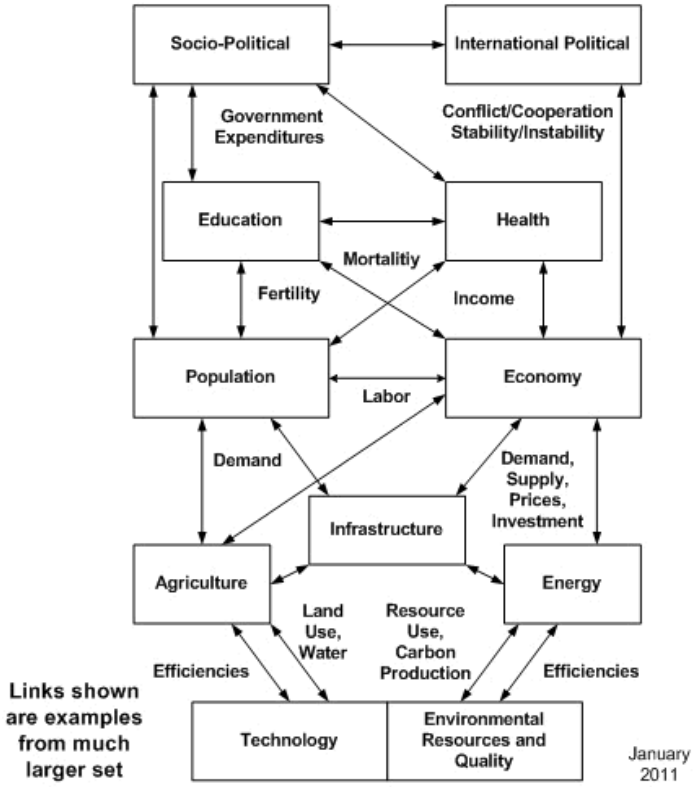
- *IncomeLTILN$_r$* is the percentage of people living on less than $1.00 per day (lognormal) in country *r*
- *CperCap* is household consumption per capita in 2000 $ at PPP
- Gini is the Gini coefficient for country *r*
- *NSNARAT$_r$* is the ratio of national survey poverty level to household consumption from national headcount data computed in the initial model year (2000).

These estimates use national accounts and household survey data, both sourced from the World Bank. To reconcile discrepancies between these two estimates the IFs models converts national mean income, measured by GDP per capita in 2000 PPP dollars to an equivalent household mean consumption.[55]

The sub-models that interact in the model are summarised in figure A1. There are numerous underlying relationships between parameters within the model; these can be found in the IFs contents menu. This diagram illustrates the broader relational functions across the model. The interaction of these functions results in the baseline scenario presented in the report.

55 This is done by using a reverse calculation of the mean consumption from the available data of the Gini coefficient and the population share with consumption below $1.00/day PPP, both using national household survey data.

Figure A1: The IFs model



Source: Hughes, 2012.

The drivers selected to create the optimistic and pessimistic scenarios for this analysis build on those used by Hughes et Al. (2009), Cantore (2011) and the indicators used by the World Risk Report (Alliance Development Works, 2012). Table A1 provides a list of poverty and disaster drivers in IFs optimistic and pessimistic scenarios.

Figures A1 to A26 provide maps showing the poverty levels in 2010 and projected poverty levels in 2030 at different poverty lines ($0.75, $1.25, $2) for the optimistic and pessimistic scenarios.

Table A1: List of poverty and disaster drivers in IFs optimistic and pessimistic scenarios

IFs (2008) parameters	Cantore's (2011) parameters	Poverty and Disasters parameters
Fertility rate	Fertility rate	Fertility rate
Female labour participation	Agricultural productivity	Agricultural productivity
Economic investments	Total factor productivity	Total factor productivity
Education expenditure	Secondary and tertiary education survival rate	Government expenditure on education
Effectiveness of government expenditures	Effectiveness of government expenditures	Government expenditure on health
Free market	Social capital	Social capital
Infrastructure	Infrastructure	Government expenditure on infrastructure
Production of renewable energy	Production costs of renewable and fossil fuel energy	Government effectiveness
R&D expenditures	ODA%	Government corruption
Trade protection	Government expenditures on education, health, pensions and other categories	Gender empowerment
Domestic social transfers to unskilled workers	Domestic social protection transfers for skilled and unskilled workers	Domestic social protection transfers to unskilled workers
		Malnutrition
		Access to improved sanitation
		Access to safe water
		State failure risk/internal war

Figure A2: % of population predicted in poverty at $0.75/day in 2010 (optimistic scenario)

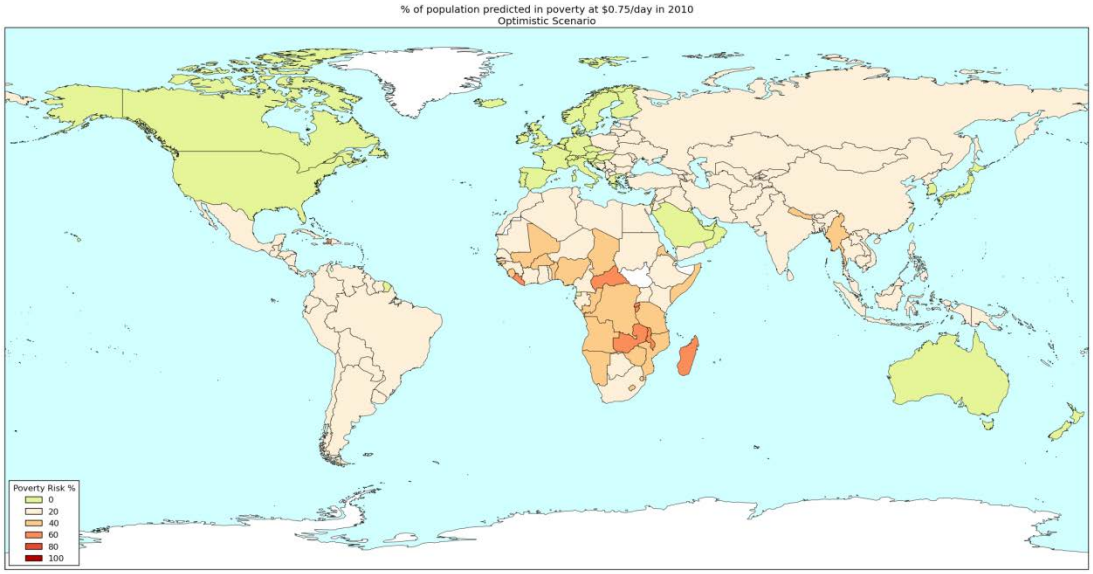


Figure A3: % of population predicted in poverty at $0.75/day in 2010 (pessimistic scenario)

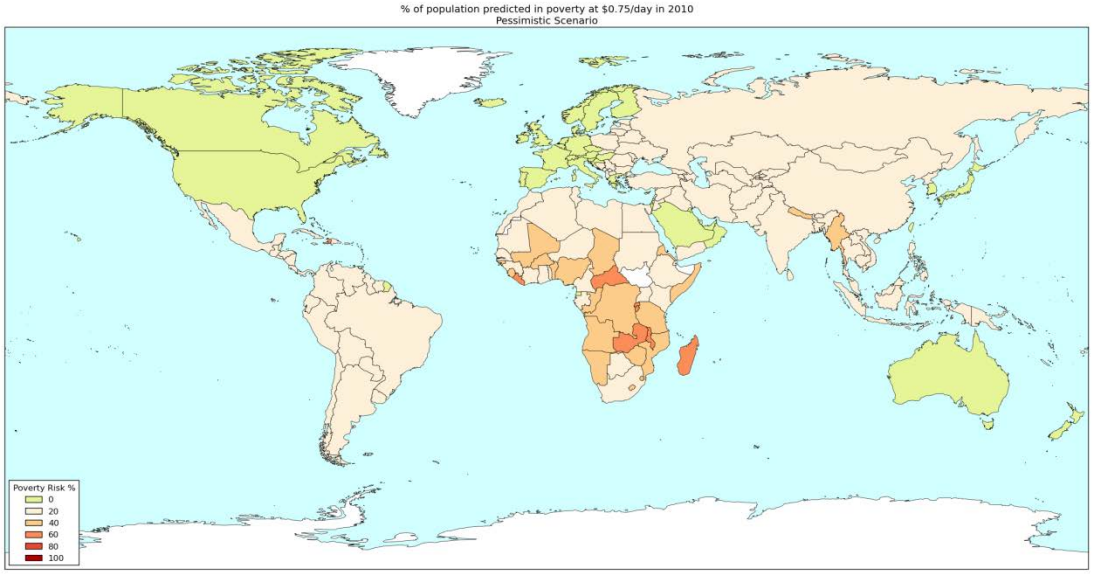


Figure A4: % of population predicted in poverty at $0.75/day in 2030 (optimistic scenario)

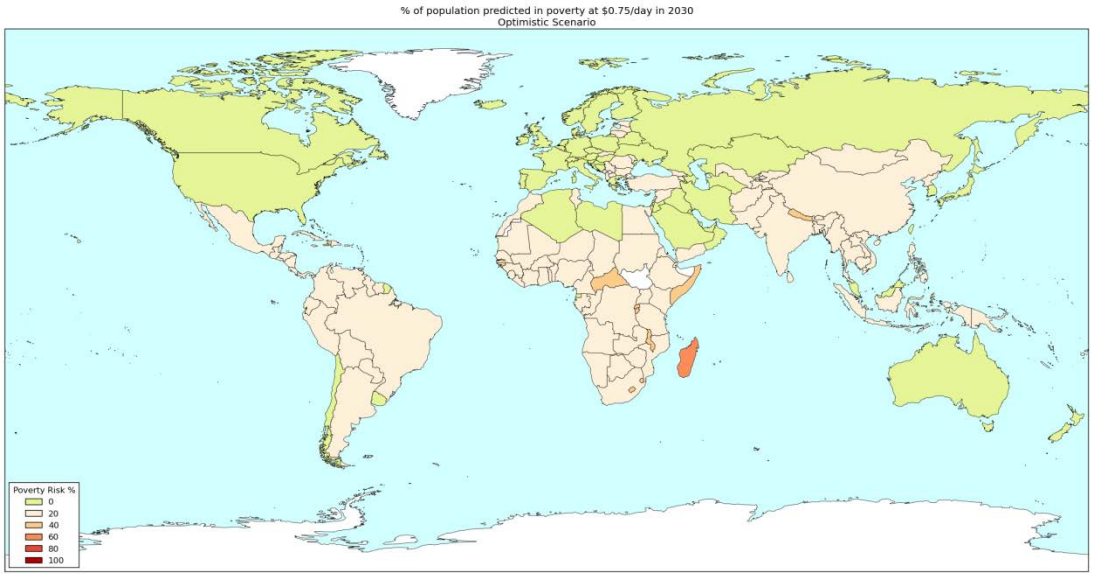


Figure A5: % of population predicted in poverty at $0.75/day in 2030 (pessimistic scenario)

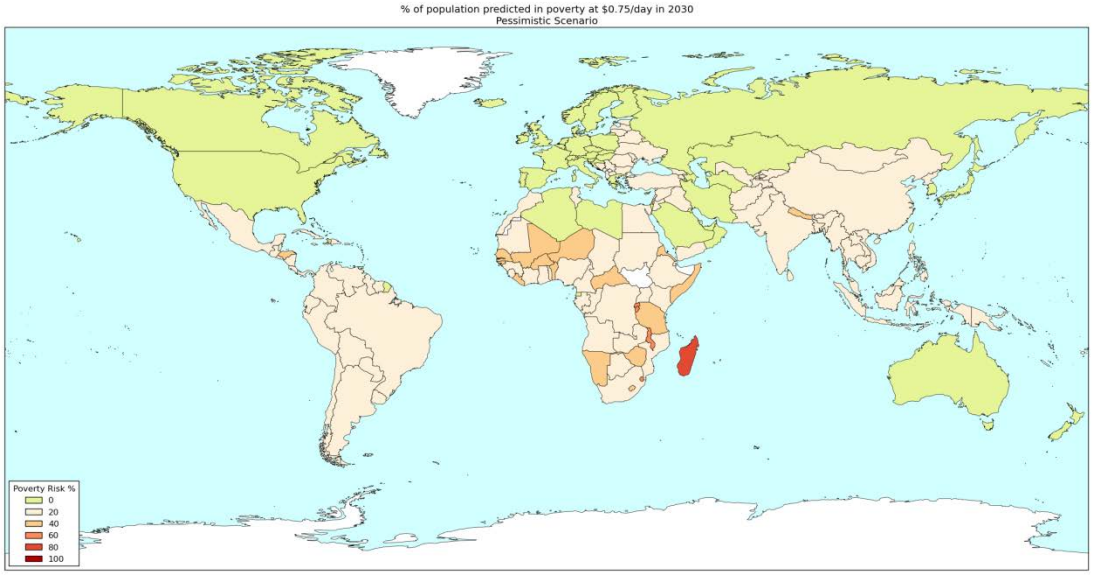


Figure A6: % of poulation predicted in poverty at $1.25/day in 2010 (optimistic scenario)

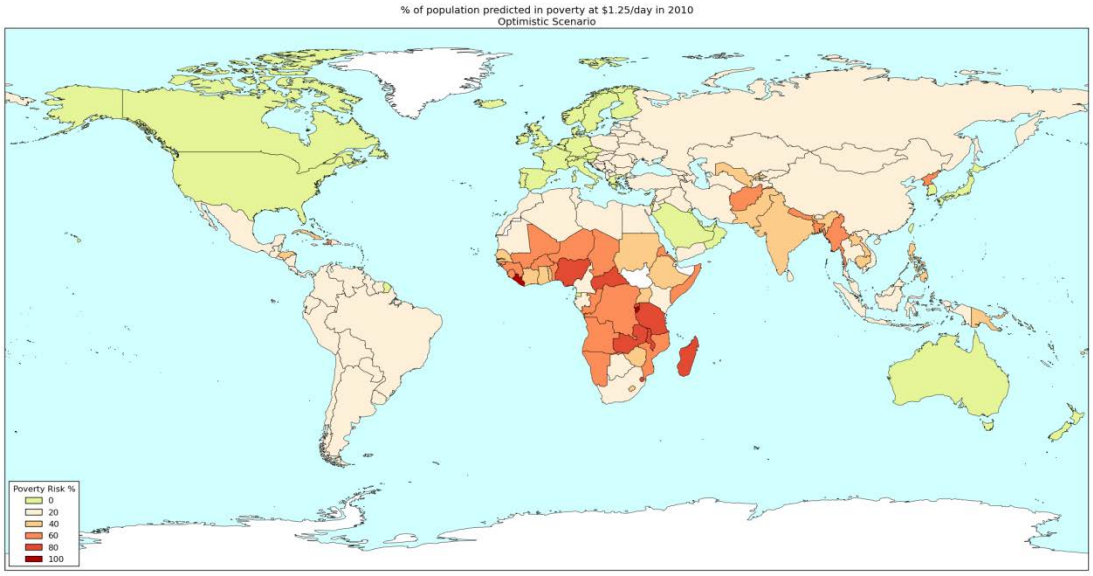


Figure A7: % of poulation predicted in poverty at $1.25/day in 2010 (pessimistic scenario)

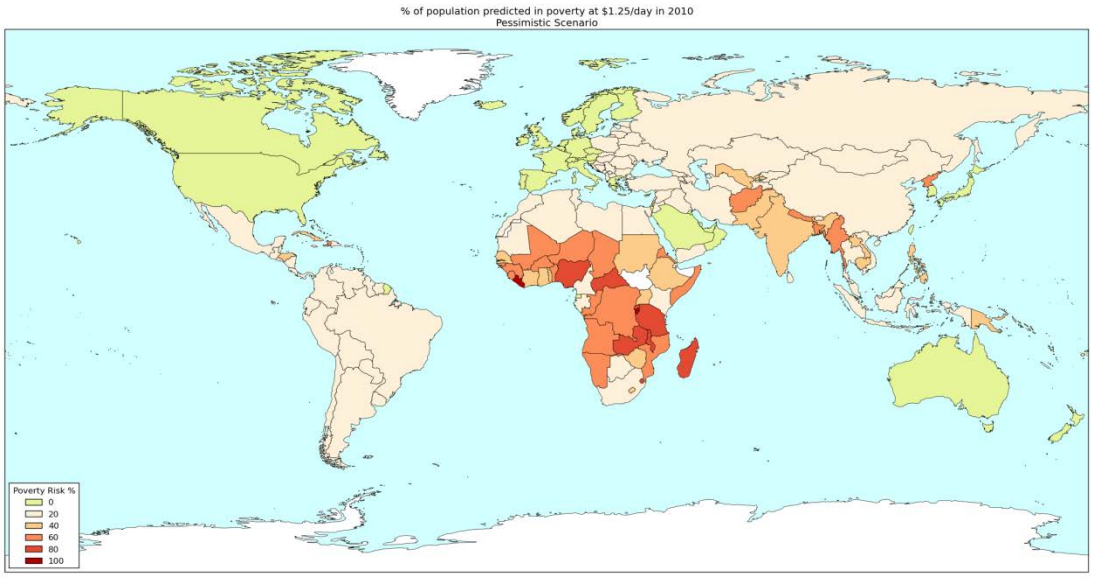


Figure A8: % of poulation predicted in poverty at $1.25/day in 2030 (optimistic scenario)

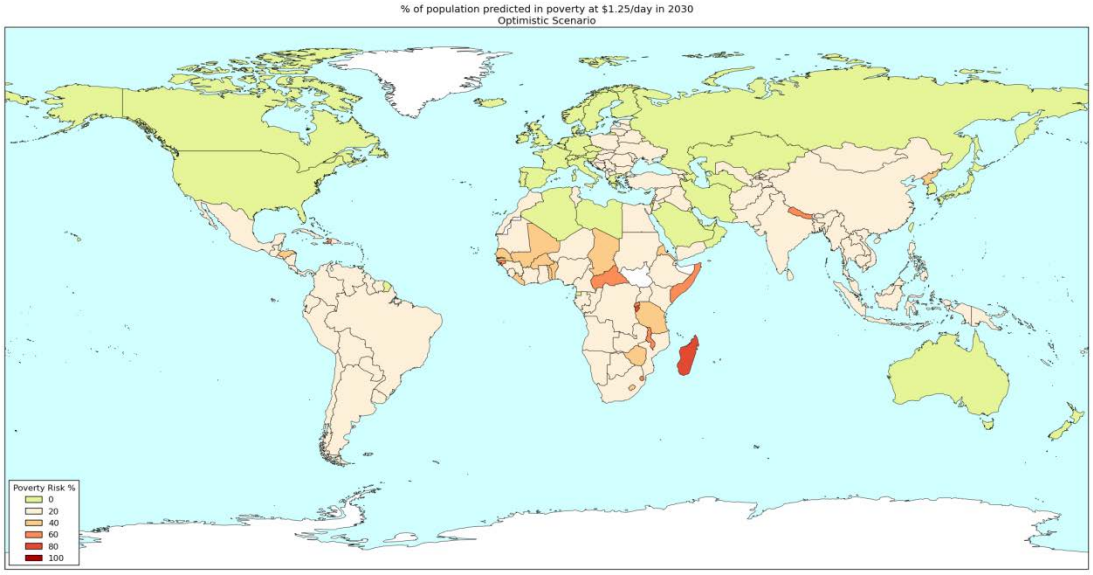


Figure A9: % of poulation predicted in poverty at $1.25/day in 2030 (pessimistic scenario)

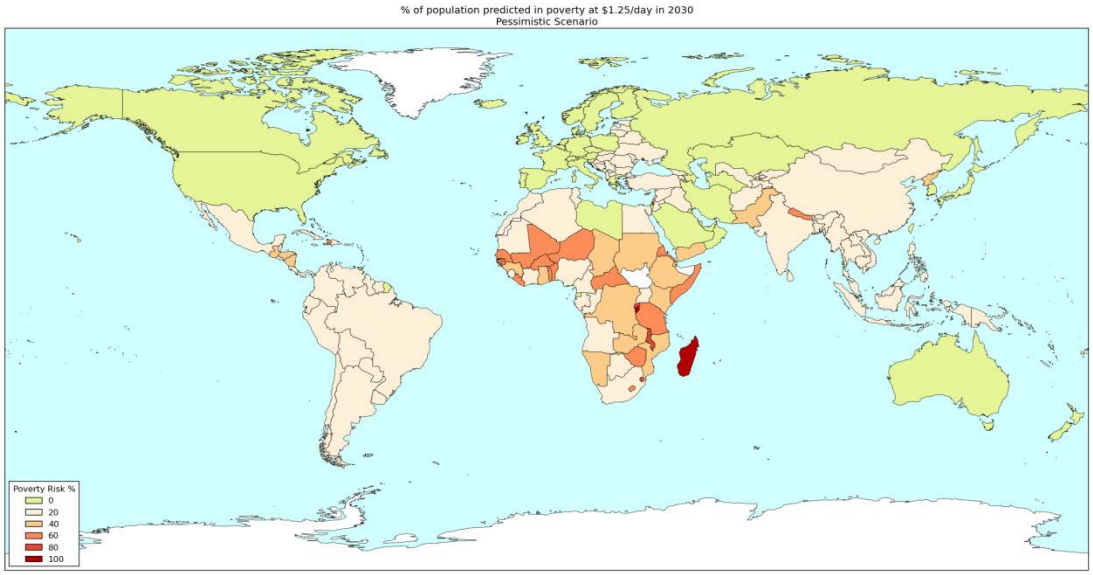


Figure A10: % of poulation predicted in poverty at $2.00/day in 2010 (optimistic scenario)

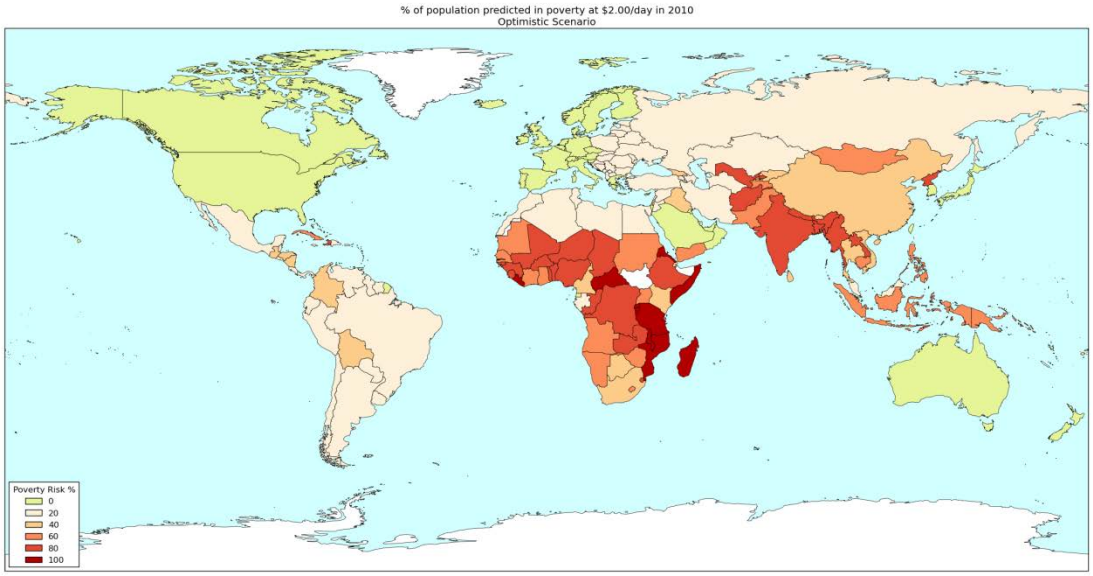


Figure A11: % of poulation predicted in poverty at $2.00/day in 2010 (pessimistic scenario)

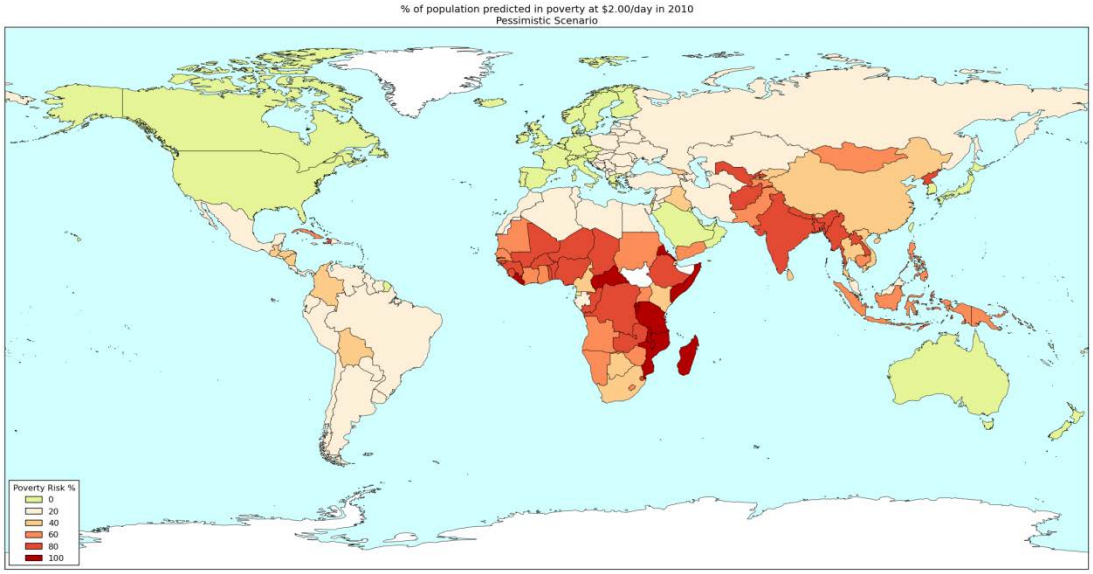


Figure A12: % of poulation predicted in poverty at $2.00/day in 2030 (optimistic scenario)

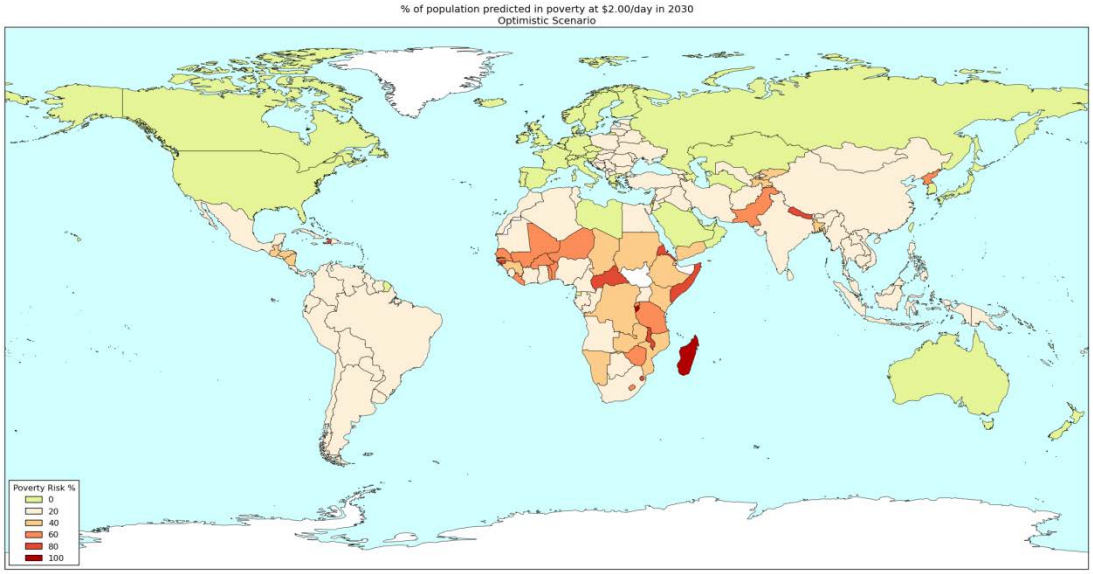


Figure A13: % of poulation predicted in poverty at $2.00/day in 2030 (pessimistic scenario)

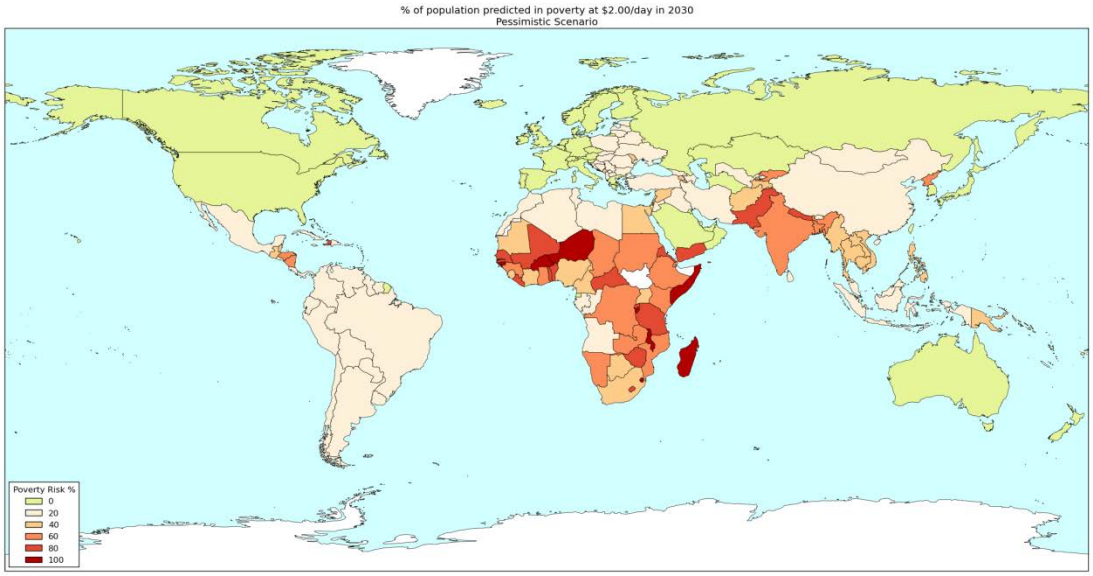


Figure A14: Total population predicted in poverty at $0.75/day in 2010 (optimistic Scenario)

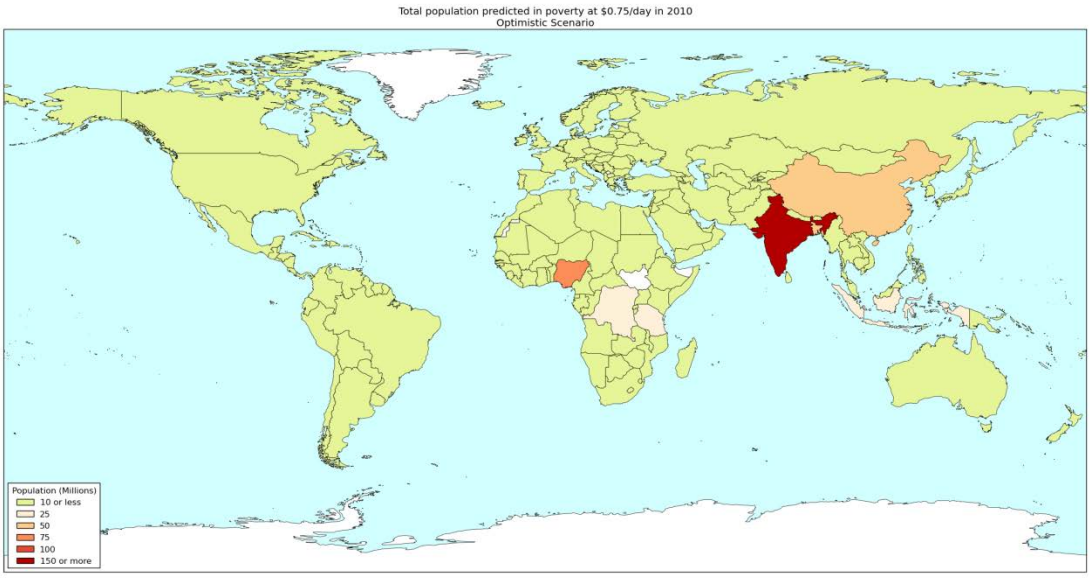


Figure A15: Total population predicted in poverty at $0.75/day in 2010 (pessimistic scenario)

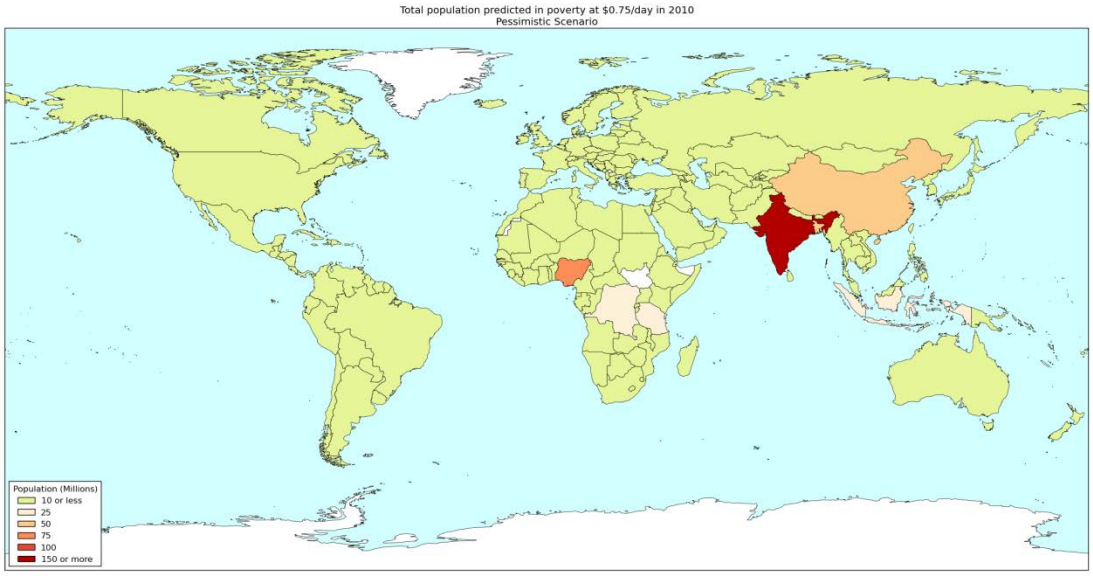


Figure A16: Total population predicted in poverty at $0.75/day in 2030 (optimistic scenario)

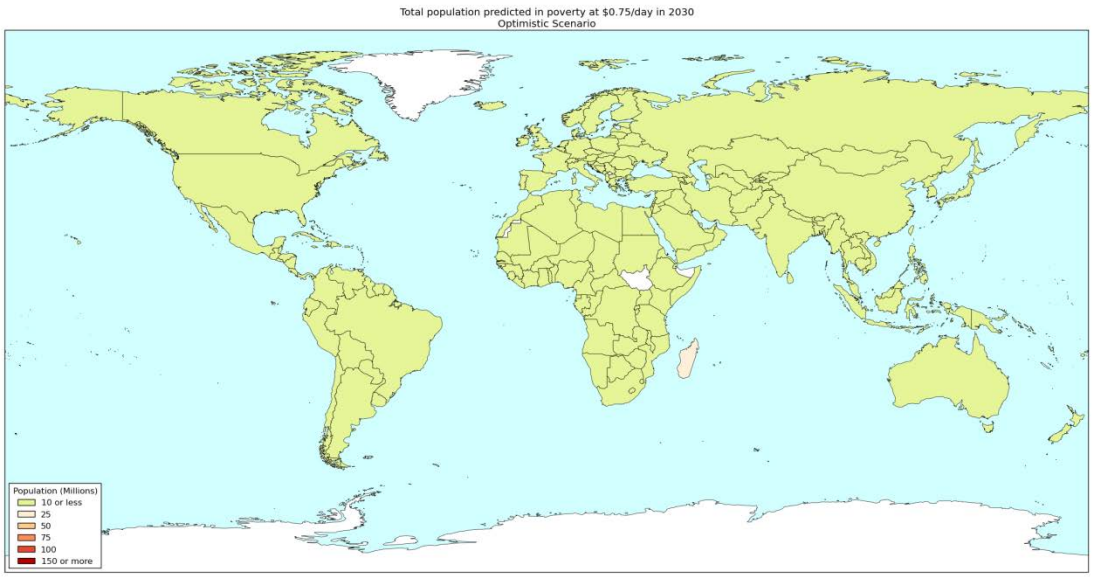


Figure A17: Total population predicted in poverty at $0.75/day in 2030 (pessimistic Scenario)

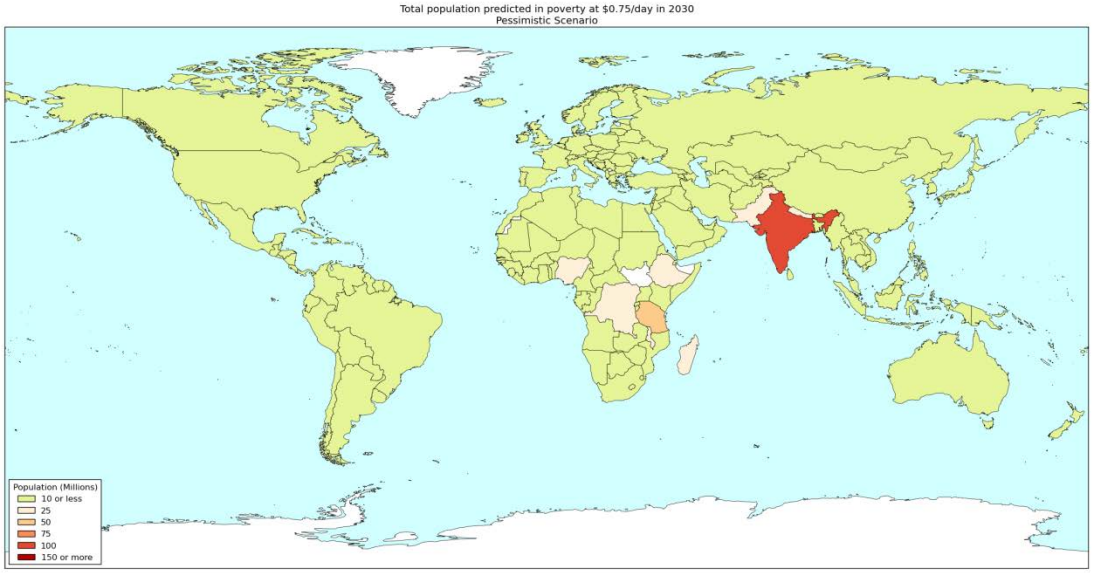


Figure A18: Total population predicted in poverty at $1.25/day in 2010 (optimistic scenario)

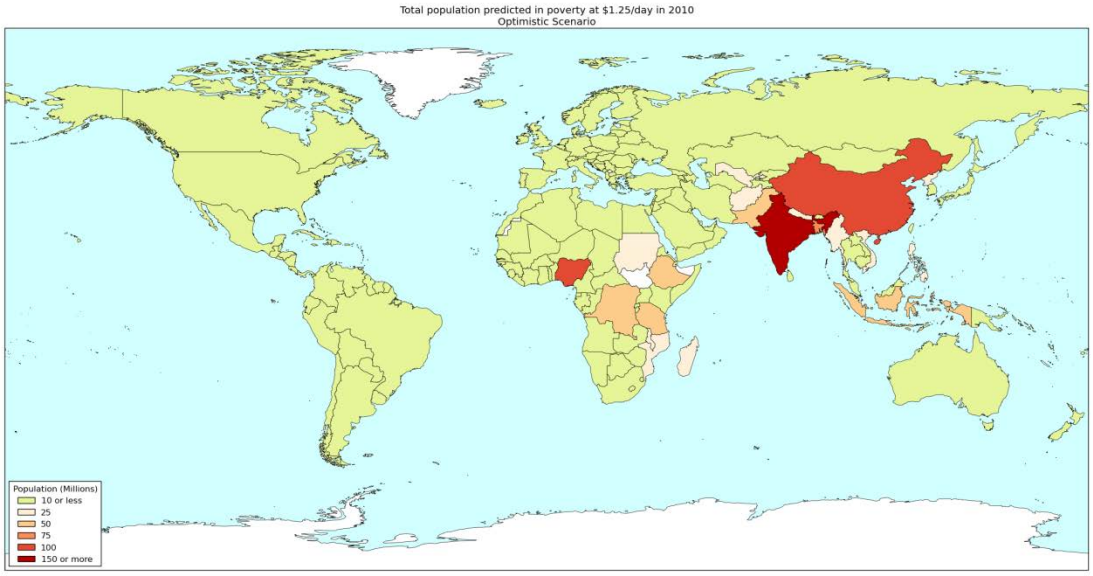


Figure A19: Total population predicted in poverty at $1.25/day in 2010 (pessimistic scenario)

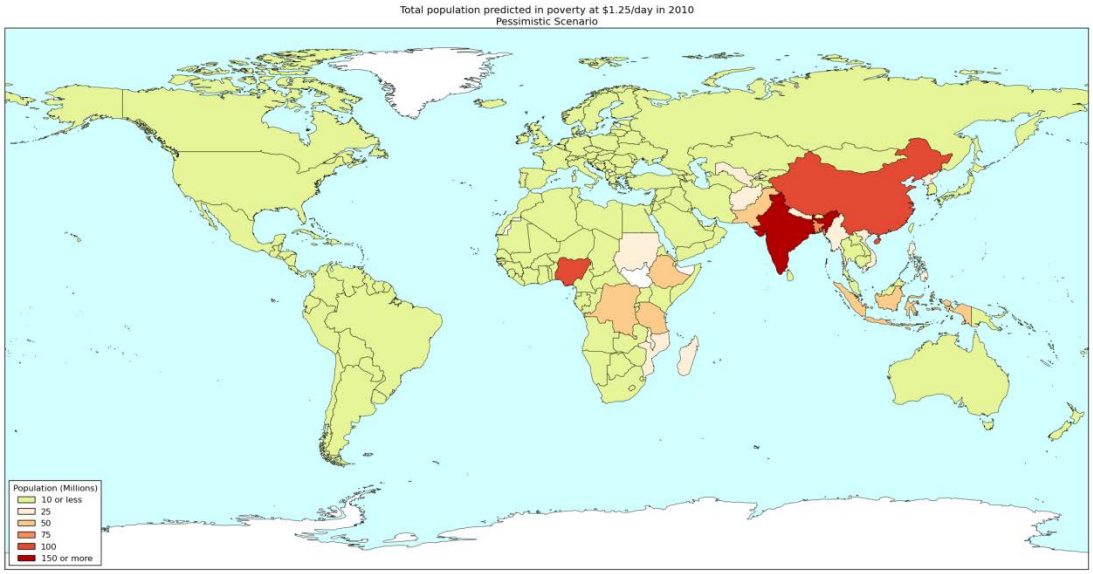


Figure A20: Total population predicted in poverty at $1.25/day in 2030 (optimistic scenario)

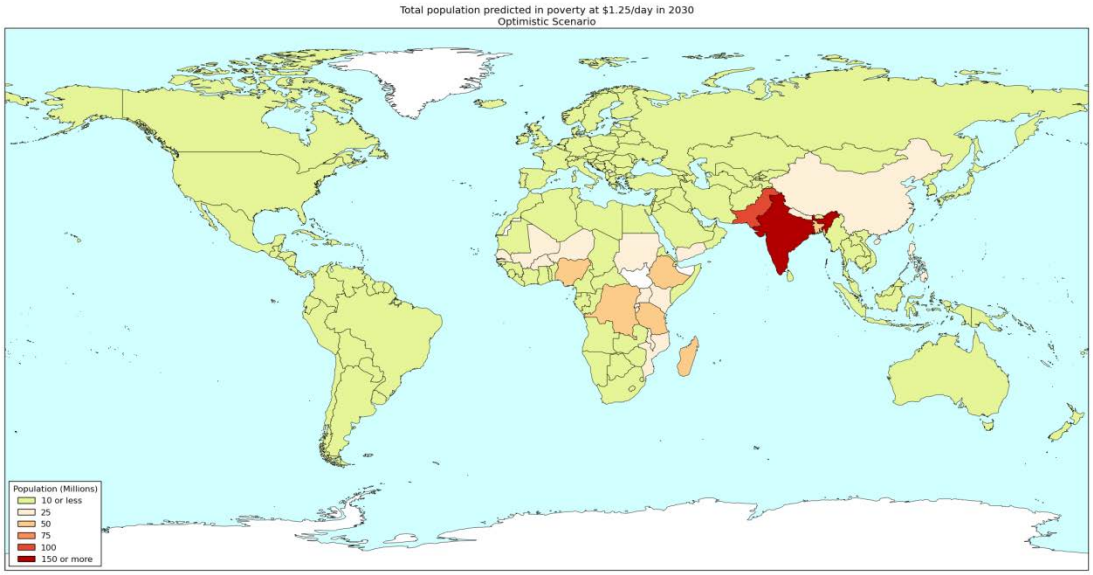


Figure A21: Total population predicted in poverty at $1.25/day in 2030 (pessimistic scenario)

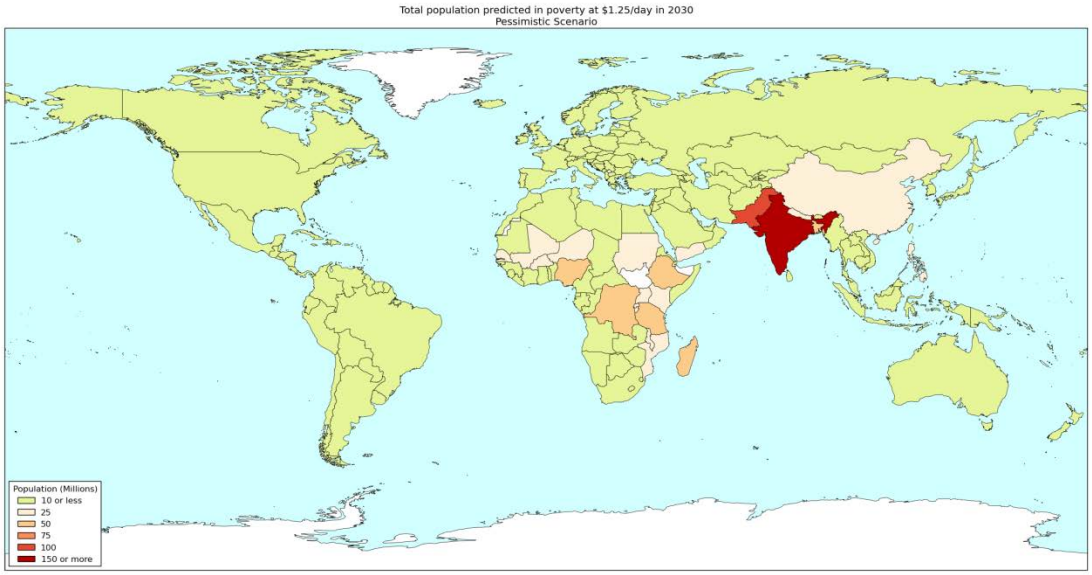


Figure A22: Total population predicted in poverty at $2.00/day in 2010 (optimistic scenario)

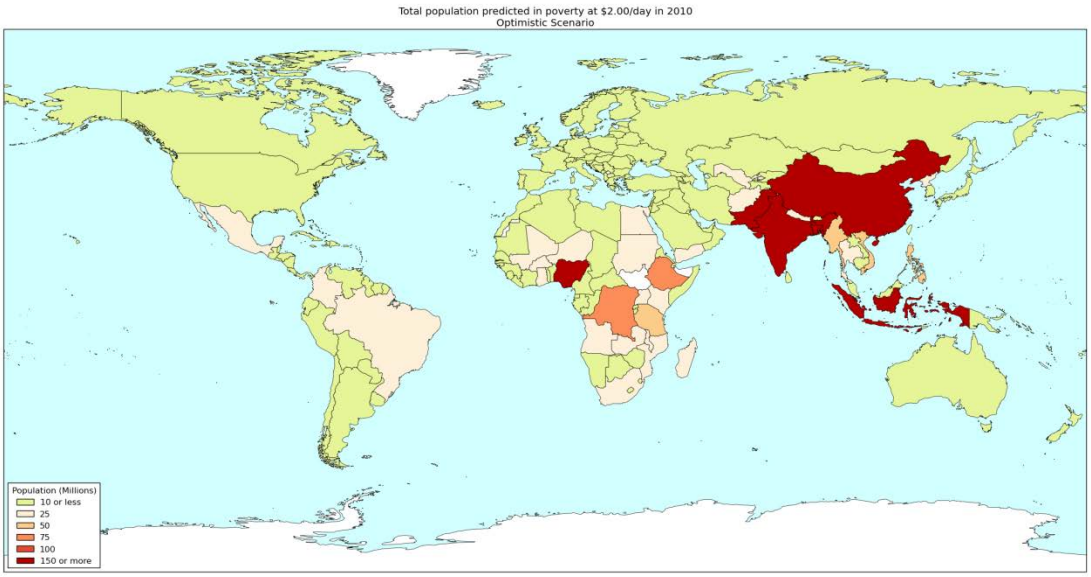


Figure A23: Total population predicted in poverty at $2.00/day in 2010 (pessimistic scenario)

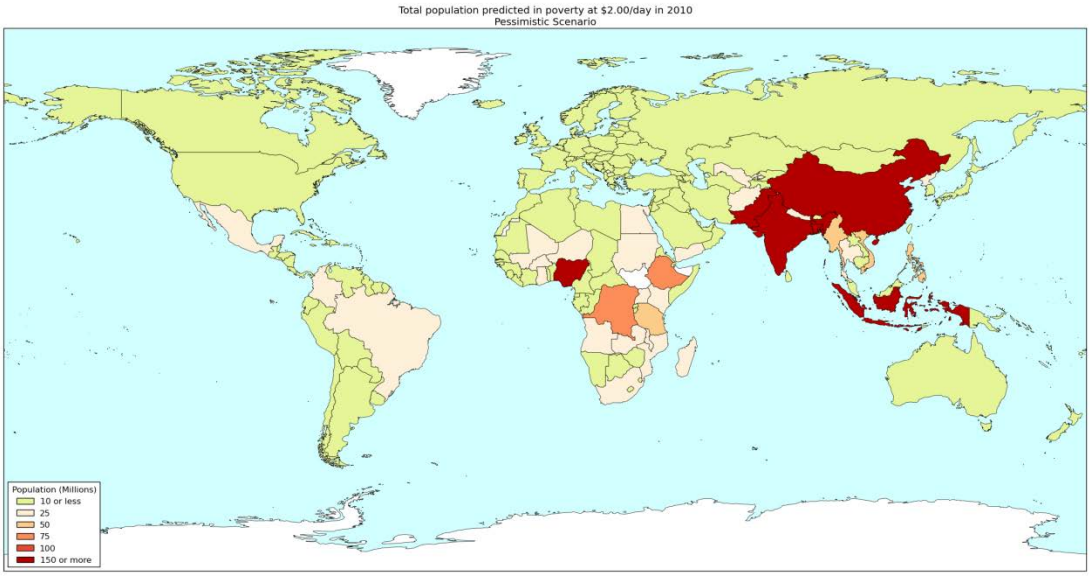


Figure A24: Total population predicted in poverty at $2.00/day in 2030 (optimistic scenario)

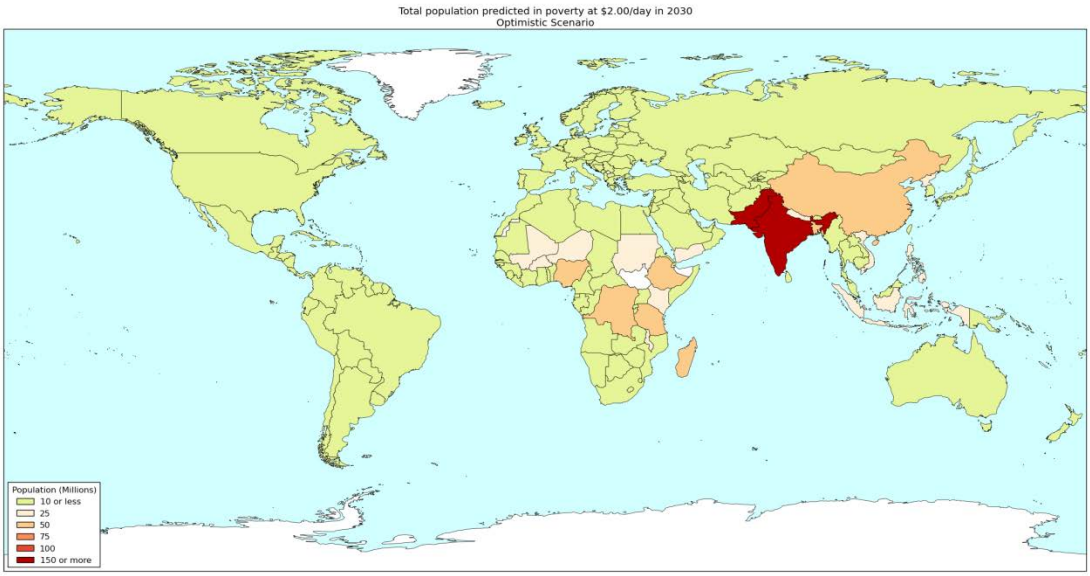
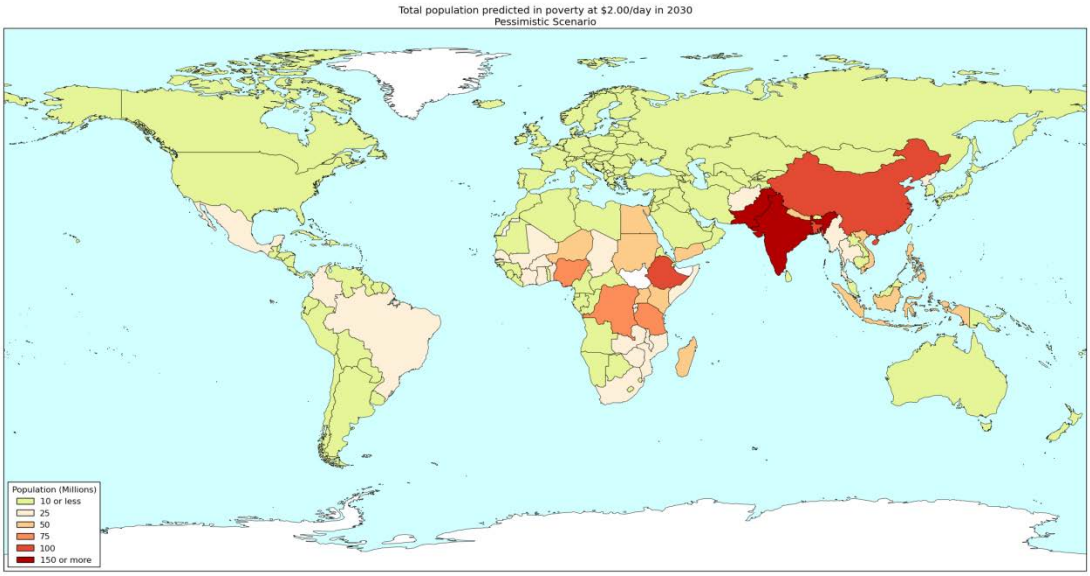


Figure A25: Total population predicted in poverty at $2.00/day in 2030 (pessimistic scenario)



3 Technical annex C: Sub-national hazards (Chapter 3)

The regional variation of the multi-hazard indicator is shown in the following sections, both for the present-day historic period, and for the 2030s. As with the global projections, only the modelled hazards (drought, high temperature and flood), change over time, and the difference between the future and present-day hazard profiles is small.

East Africa

The hazard indicator over East Africa shows the greatest change over time, with increasing high temperature over the highlands of Ethiopia having an impact on the future hazard.

Figure A26: Present-day regional variation of multi-hazard indicator for East Africa

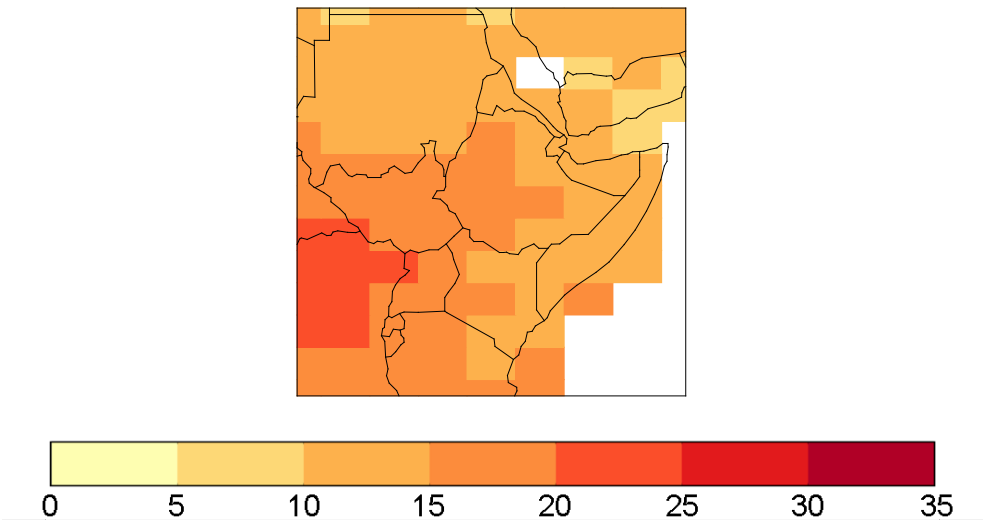
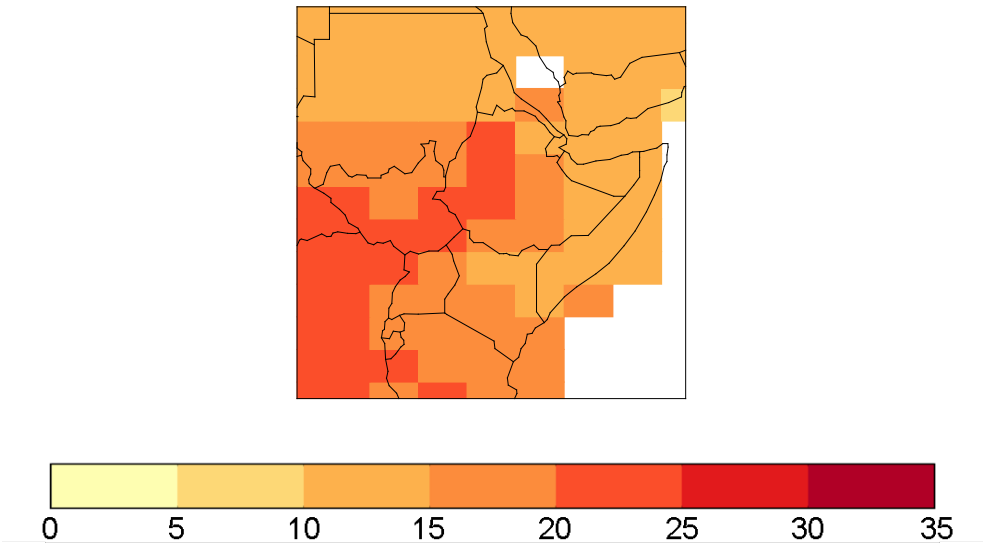


Figure A27: Regional variation of multi-hazard indicator for East Africa for 2030s



Madagascar

Madagascar has a particularly high level of hazard overall, with northern Madagascar most severely hazard-prone. Here, it is the additional levels of drought hazard, as measured by the indicator, that account for this regional difference.

Figure A28: Present-day regional variation of multi-hazard indicator for Madagascar

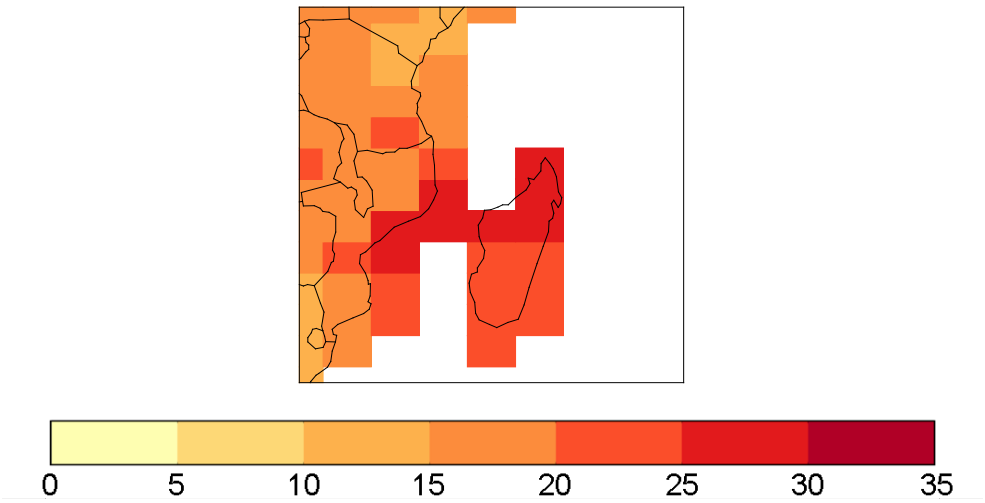
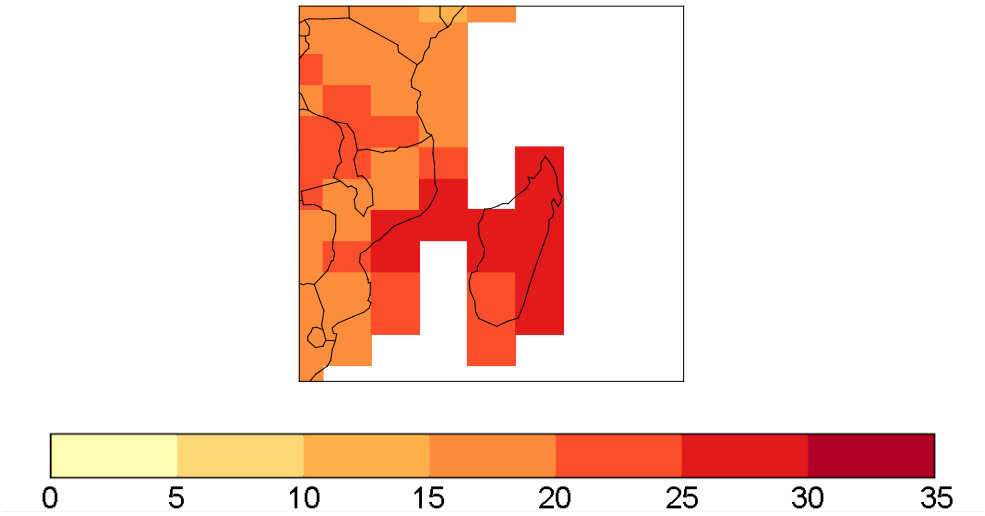


Figure A29: Regional variation of multi-hazard indicator for Madagascar for 2030s



West Africa

West Africa has a lower level of hazard than might be expected. This is, at least in part, a function of the way the indicators have been calculated. The drought indicator takes a definition of drought as the lower end of the rainfall distribution during the historic period. As 1970-2010 was a particularly dry period in the region, this makes the threshold for drought extremely dry, and under-represents the drought hazard.

West Africa also sees some increase in the hazard by the 2030s. This is mostly because of increases in both the high temperature and drought hazard indicators. In terms of potential impoverishment, given the already high historic figures for the Sahel, the increase in dry and hot weather across the Sahel is extremely worrying. Benin, Burkina Faso, Mali, and Senegal all feature in the highest vulnerability category (Chapter 2), and Nigeria is likely to remain a poverty hotspot through to 2030 – parts of northern Nigeria might be affected by growing drought hazard.

Figure A30: Present-day regional variation of multi-hazard indicator for West Africa

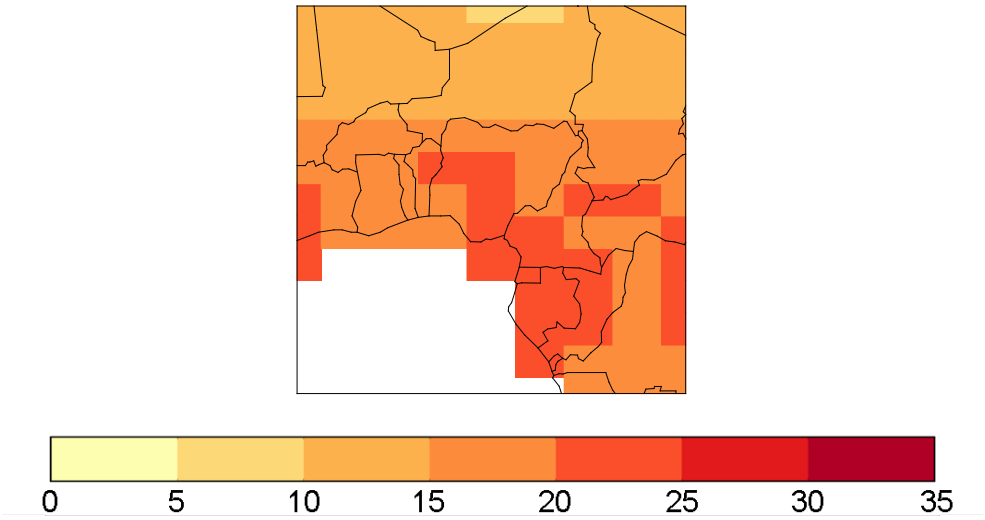
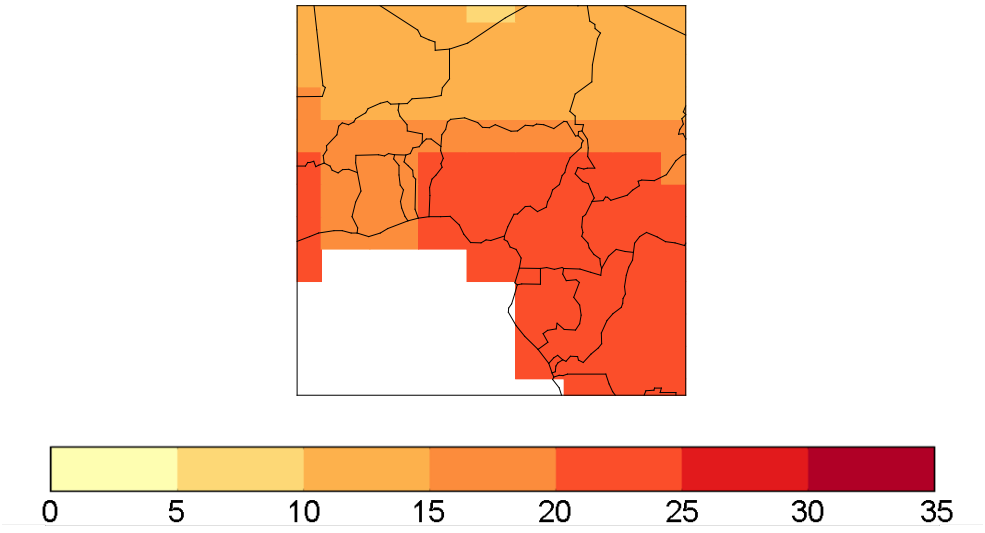


Figure A31: Regional variation of multi-hazard indicator for West Africa for 2030s



South Asia

The South Asia region has the largest regional variability in hazard, in terms of low and high hazard regions. The highest hazard exposure occurs around the Bay of Bengal region, where tropical cyclones, floods and droughts all contribute to the region's high hazard levels. This continues in the future projection of hazard, at least in part because the changes in tropical cyclone frequency and intensity have not been accounted for in the future hazard indicator, so these remain unchanged.

Figure A32: Present-day regional variation of multi-hazard indicator for South Asia

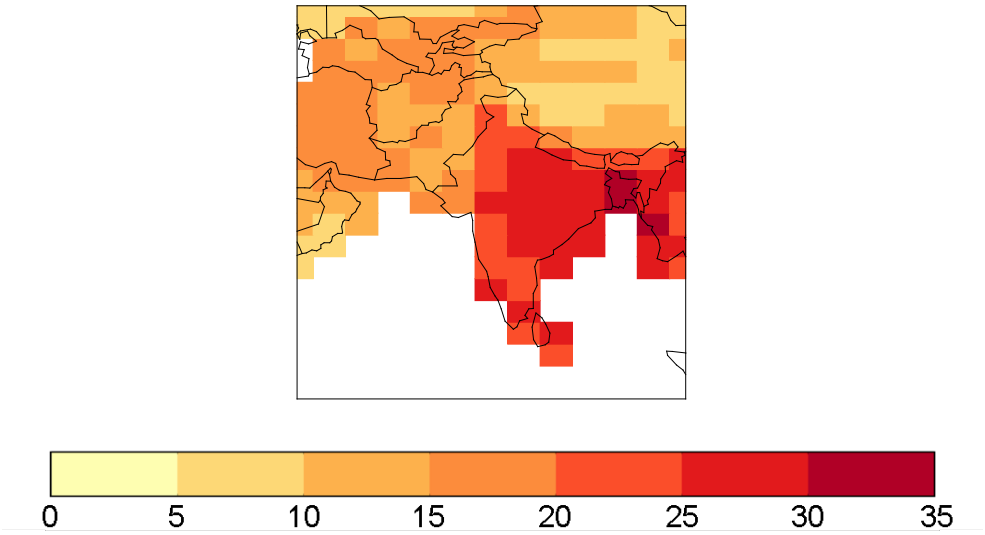
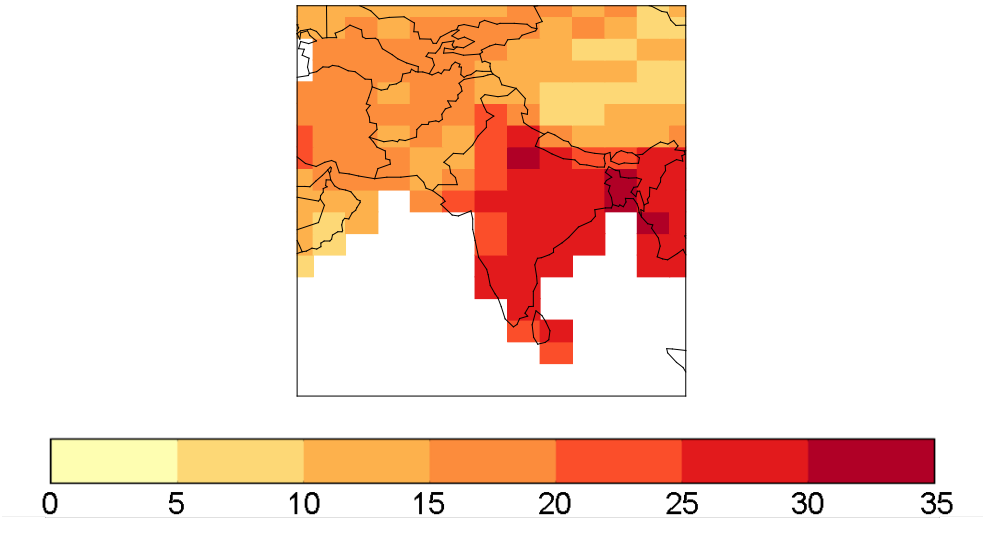


Figure A33: Regional variation of multi-hazard indicator for South Asia for 2030s



4 Technical annex D: Regional drought hazard (Chapter 3)

East Africa

The drought hazard level in East Africa is relatively low, but larger across the highlands of Ethiopia than elsewhere in the region. The drought indicator shows periods of dryness relative to the climatology of the region during the year, so highland areas, which receive more rainfall overall than dry, coastal Somalia, can be more 'drought-prone'. The model projection indicates a reduction in drought in this part of Africa by the 2030s. This result should be treated with caution, as there is high uncertainty about precipitation projections, particularly in tropical areas.

Figure A34: Historic drought-hazard indicator for 1971-2000 for East Africa

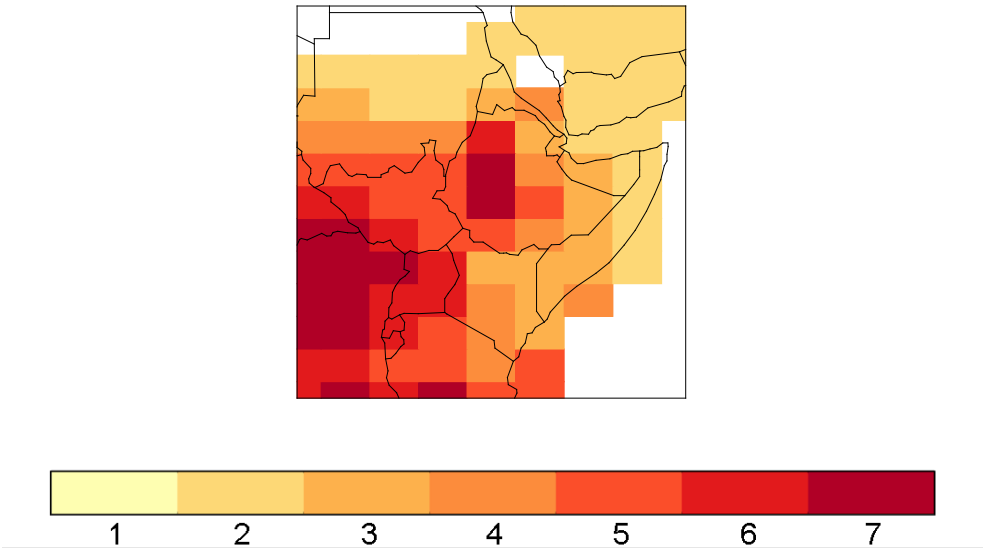
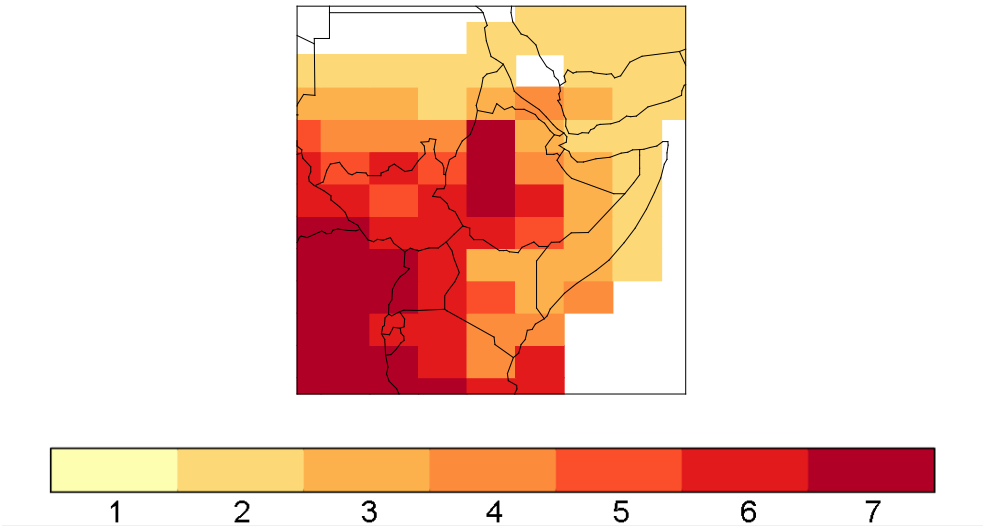


Figure A35: Future drought-hazard indicator for the 2030s for East Africa



Madagascar

Madagascar has relatively high levels of drought, and climate-model projections suggest that the risk of drought will increase by the 2030s. In a country with high poverty levels this could have a large negative impact locally.

Figure A36: Historic drought-hazard indicator for 1971-2000 for Madagascar

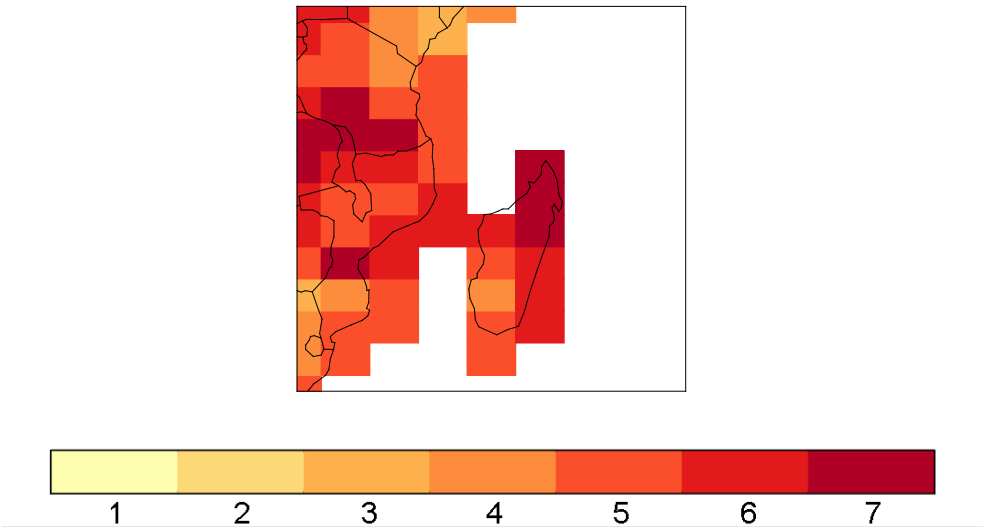
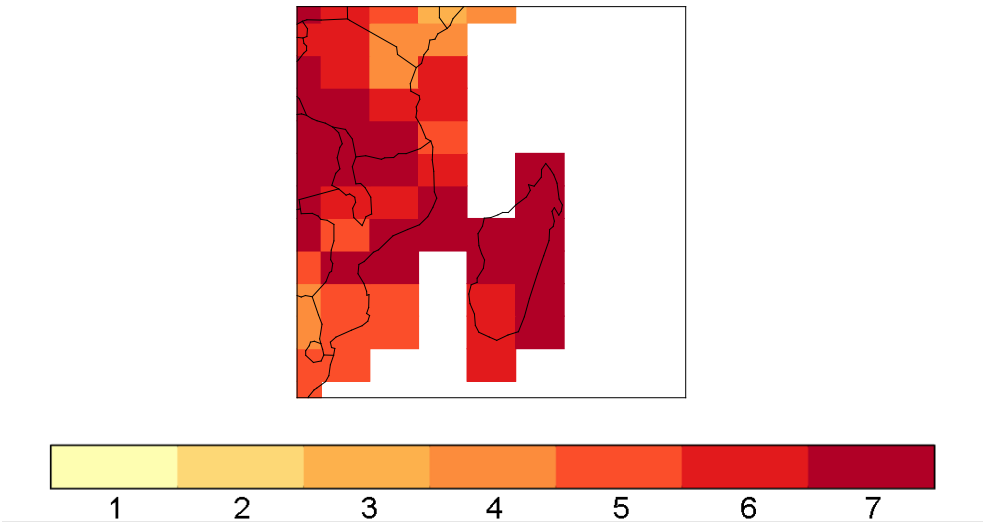


Figure A37: Future drought-hazard indicator for the 2030s for Madagascar



West Africa

West Africa is also drought-prone, with climate projections suggesting an increase in drought by the 2030s. It is possible that drought hazard is under-estimated in this region of the world, but the indicator used here shows drought relative to recently climatology, which in West Africa coincides with a very dry period. This means that drought needs to be more severe to increase the indicator than would otherwise be the case.

Figure A38: Historic drought-hazard indicator for 1971-2000 for West Africa

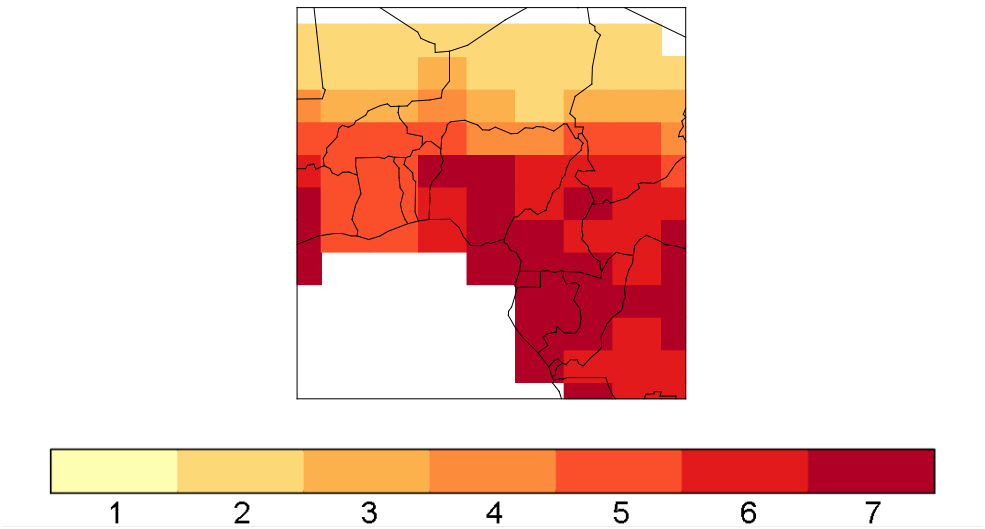
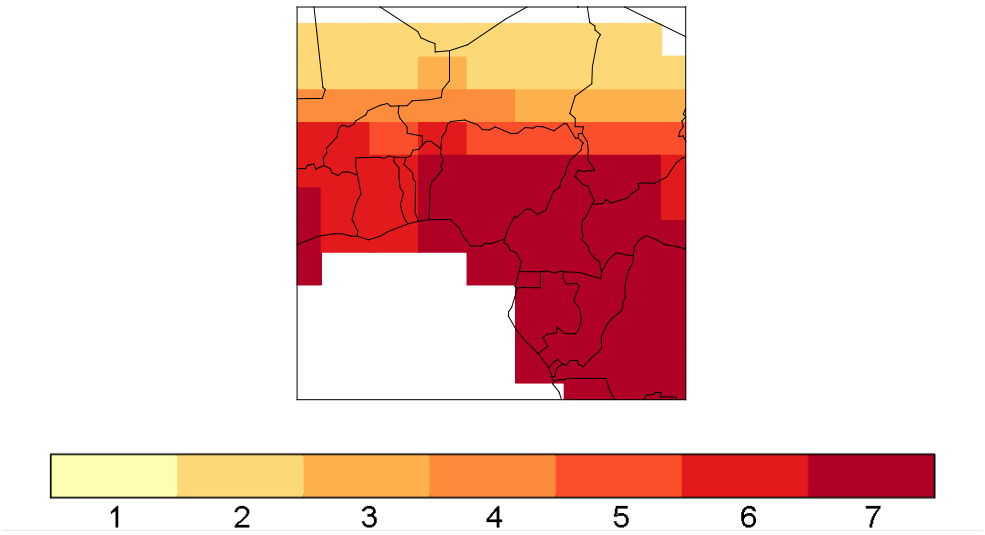


Figure A39: Future drought-hazard indicator for the 2030s for West Africa



South Asia

Much of South Asia, including nearly all of India and Bangladesh has high levels of drought hazard. The climate-model projections have a weak signal for change in drought, with low levels of agreement between the models. This is not surprising, as the Indian monsoon plays an important role in water availability in the region, and is not well represented by climate models.

Figure A40: Historic drought-hazard indicator for 1971-2000 for South Asia

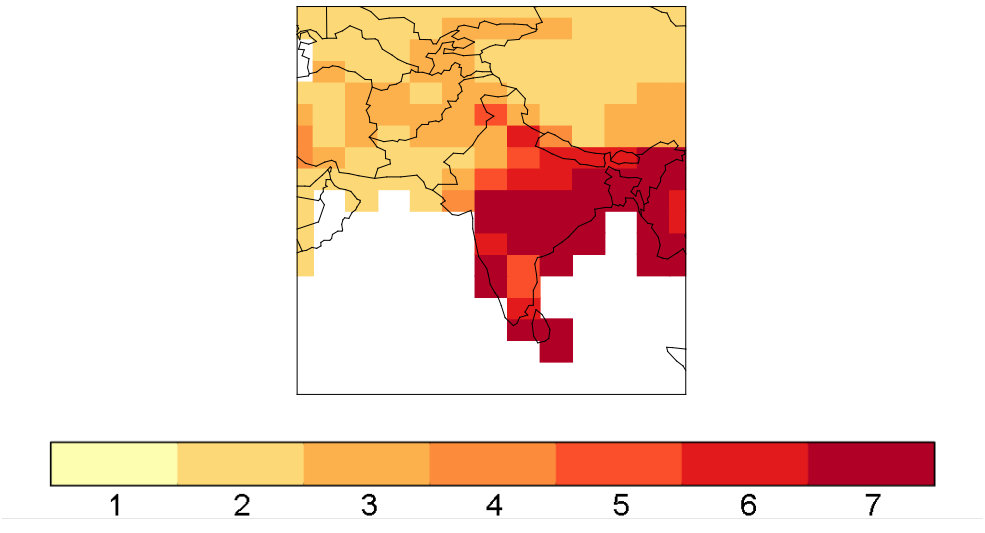
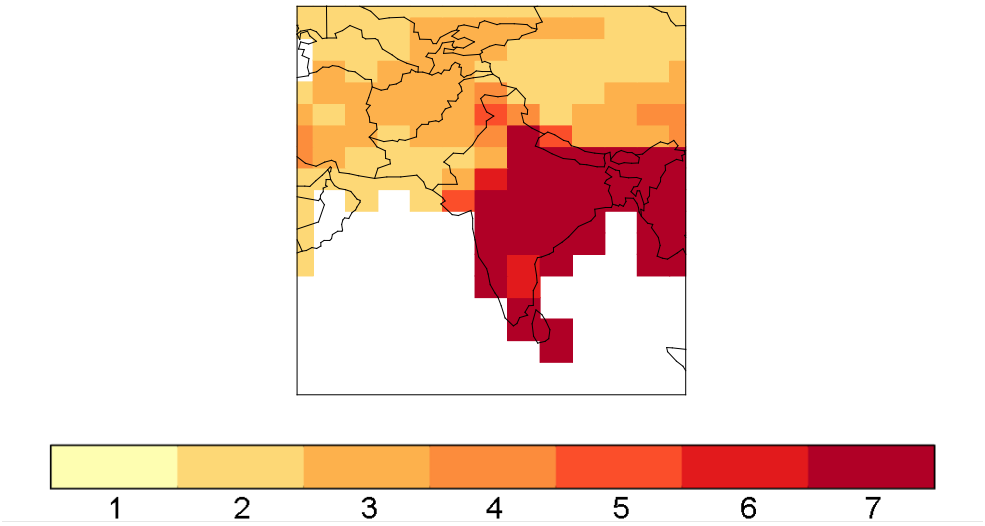


Figure A41: Future drought-hazard indicator for the 2030s for South Asia



5 Technical annex E: Description of the data indices used to inform risk management capacity (Chapter 4)

The WorldRiskIndex is a tool to assess the disaster risk to which a society or country is exposed by external and internal factors.

The WorldRiskIndex is based on the core understanding that a society's disaster risk is influenced by its structure, processes and framework conditions, which may, in turn, be affected by natural events and the effects of climate change

The concept of the Index stresses that it is not only the magnitude of frequency of a natural event but also the social, economic and ecological factors characterizing a country that essentially determine whether a natural hazard can turn into a disaster. One advantage of the Index is its modular structure based on four components:

- exposure to natural hazards
- susceptibility
- coping capacities
- adaptive capacities.

The Index examines the abilities and capacities of people or systems to cope with and adapt to negative impacts of natural hazards. Vulnerability comprises the components of susceptibility, coping capacities and future adaptive capacities.

Susceptibility

- Indicator A: Share of population without access to improved sanitation
- Indicator B: Share of population without access to clean water
- Indicator C: Share of population undernourished
- Indicator D: Share of under 15- and over 65-year-olds in the working population
- Indicator F: Gross domestic product per capita (purchasing power parity)
- Indicator G: Gini index.

Coping capacities

Coping capacities encompass measures and abilities that are immediately available to reduce harm and damages in the occurrence of an event.

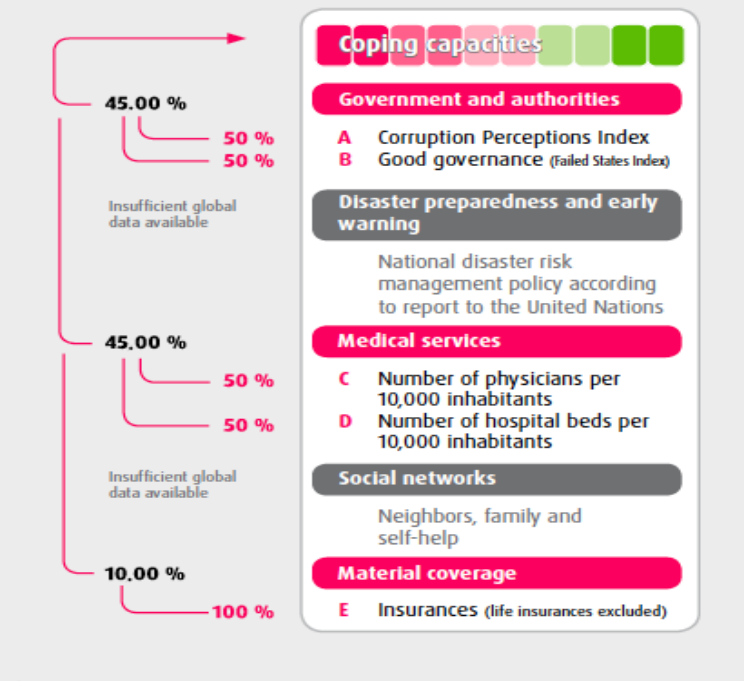
There are five sub-categories of coping capacities:

- government and authorities
- disaster preparedness and early warning
- medical services
- social networks
- material coverage.

All the indicators of the component coping capacities have been updated:

- Indicator A: Perception of corruption (Corruption Perceptions Index)
- Indicator B: Good governance (Failed States Index)
- Indicator C: Number of physicians per 10,000 inhabitants
- Indicator D: Number of hospital beds per 10,000 inhabitants
- Indicator E: Insurances.

Figure A42: Coping capacities



Future adaptive capacities

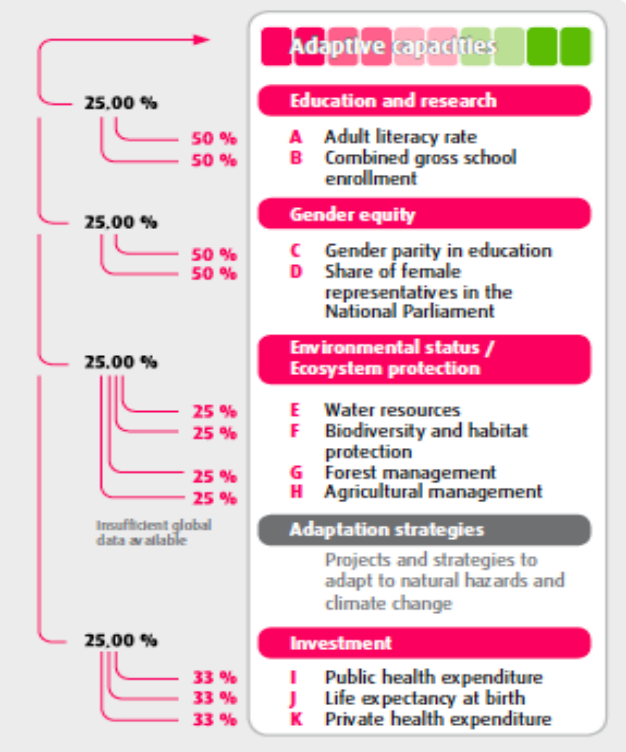
In contrast to coping, adaptation is understood as a long-term process that also includes structural changes. In addition, adaptation encompasses measures and strategies dealing with and attempting to address the negative impacts of natural hazards and climate change in the future

Indicators:

- Indicator A: Adult literacy rate
- Indicator B: Combined gross school enrolment

- Indicator C: Gender parity in education
- Indicator D: Share of female representatives in the national parliament
- Indicator E: Water resources
- Indicator F: Biodiversity and habitat protection
- Indicator G: Forest management
- Indicator H: Agricultural management
- Indicator I: Public health expenditure
- Indicator J: Life expectancy
- Indicator K: Private health expenditure.

Figure A43: Adaptive capacities



6 Technical annex F: Global Adaptation Index (GAIN) readiness index, governance (Chapter 4)

The Global Adaptation Index (GAIN) (http://gain.globalai.org/) is an open data browser that provides national level scores (and access to the underlying data) of current vulnerability to climate change and readiness to adapt for 192 countries. It aims to help businesses and the public sector better prioritise adaptation investments for a more efficient response to the immediate global challenges ahead. GAIN offers information on a country's vulnerability in four sectors (water, food, health and infrastructure), and on its readiness to undertake adaptive actions supported by these much-needed investments.

Figure A44: The Global Adaptation Index (GAIN)

Figure A45: Indicators in the GAIN readiness axis

Components	Indicator
Economic	Business freedom
	Trade freedom
	Fiscal Freedom
	Government Spending
	Monetary Freedom
	Investment Freedom
	Financial Freedom
Governance	Voice & Accountability
	Political Stability & Non-Violence
	Control of Corruption
Social	Mobiles per 100 persons
	Labor Freedom
	Tertiary Education
	Rule of Law

Figure A46: Indicators in the GAIN vulnerability axis

Sectors			Exposure	Sensitivity	Capacity
	Water	Quantity	Projected change in precipitation	Internal and external freshwater extracted for all uses	Population with access to improved water supply
		Quality	Projected change in temperature	Mortality among under 5 yr.-olds due to water-born diseases	Population with access to improved sanitation
	Food	Quantity	Projected change in agricultural (cereal) yield	Population living in rural areas	Agricultural capacity
		Quality	Coefficient of variation in cereal crop yields	Food import dependency	Children under 5 suffering from malnutrition
	Health	Quantity	Estimated impact of future climate change on deaths from disease	Health workers per capita	Longevity
		Quality	Mortality due to communicable (infectious) diseases	Health expenditure derived from external resources	Maternal mortality
Infrastructure	Coast	Quantity	Land less than 10 m above sea-level	Population living less than 10 m above sea-level	Measured on the Readiness Axis
	Energy	Quantity	Population with access to reliable electricity	Energy at risk	
	Transport	Quantity	Frequency of floods per unit area	Roads paved	

7 Technical annex G: Hyogo Framework for Action (HFA) Monitor Indicator Framework (Chapter 4)

Table A2: Hyogo Framework for Action Core Indicators

Priority for Action 1
Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation Core Indicator 1: National policy and legal framework for DRR exists with decentralised responsibilities and capacities at all levels. Core Indicator 2: Dedicated and adequate resources are available to implement DRR plans and activities at all administrative levels. Core Indicator 3: Community participation and decentralisation are ensured through the delegation of authority and resources to local levels. Core Indicator 4: A national multi-sectoral platform for DRR is functioning.
Priority for Action 2
Identify, assess and monitor disaster risks and enhance early warning Core Indicator 1: National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors. Core Indicator 2: Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities. Core Indicator 3: Early warning systems are in place for all major hazards, with outreach to communities. Core Indicator 4: National and local risk assessments take account of regional / transboundary risks, with a view to regional cooperation on risk reduction.
Priority for Action 3
Use knoweldge, innovation and education to build a culture of safety and resilience at all levels Core Indicator 1: Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems, etc.). Core Indicator 2: School curricula, education material and relevant trainings include DRR and recovery concepts and practices. Core Indicator 3: Research methods and tools for multi-risk assessments and cost benefit analysis are developed and strengthened. Core Indicator 4: Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.
Priority for Action 4
Reduce the underlying risk factors Core Indicator 1: DRR is an integral objective of environment related policies and plans, including for land use, natural resource management and adaptation to climate change. Core Indicator 2: Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk. Core Indicator 3: Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities Core Indicator 4: Planning and management of human settlements incorporate DRR elements, including enforcement of building codes. Core Indicator 5: DRR measures are integrated into post-disaster recovery and rehabilitation processes.

Core Indicator 6: Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

Priority for Action 5

Strengthen disaster preparedness for effective response at all levels

Core Indicator 1: Strong policy, technical and institutional capacities and mechanisms for DRM, with a DRR perspective are in place.

Core Indicator 2: Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programmes.

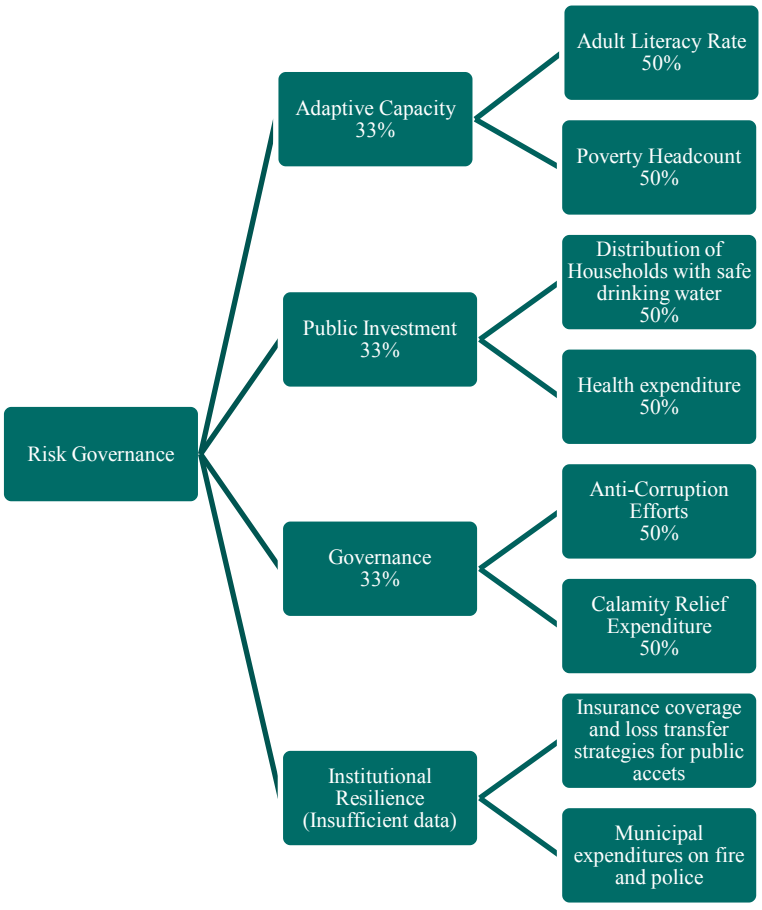
Core Indicator 3: Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.

Core Indicator 4: Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

8 Technical annex H: Sub-national risk governance index (Chapter 4)

The sub-national risk management index was based on a core understanding that an actor's ability to respond effectively to disaster is very much influenced by the country's socioeconomic structure and existing service delivery capacity. Unpacking disaster governance in developing countries requires examining how the society in question deals with an array of risks that would be augmented in times of disaster, such as health and safety risks, as well as taking into account the existing infrastructure and level of government accountability. Due to lack of a lack of comparable data for use in the full WRI index, an alternative is proposed, lending itself heavily to previous composite indictors, and available datasets. This index draws on four indicators – adaptive capacity, public investment, governance, and institutional resilience – to create a composite picture of a DRR regime. Creating a modular structure to differentiate drivers of risk is somewhat arbitrary – all of these themes are linked and causality can run either way (i.e. better risk governance exists because a society has higher adaptive capacity, or vice versa). A breakdown of the index's core components is depicted in Figure A48.

Figure A47: Components of sub-national risk governance



Adaptive capacity (based on WRI)

Although this can be taken as its own indicator (and many indices do measure adaptive capacity as a stand-alone), adaptive capacity feeds into disaster governance because tackling risk effectively is tied to the baseline composition of a society. This index adaptive capacity is understood as the population's ability to cope with and adapt to shocks. States that have already reduced structural inequalities by addressing poverty and adult literacy are more likely to rebound economically and socially after a disaster event. Meanwhile, states with very high poverty and low adult literacy will face larger governance challenges and will most likely have a higher reliance on outside humanitarian aid in a disaster, ultimately creating parallel structures of service delivery.

Public investment

This is recognised as a component of disaster risk in the WRI and the UNOCHA Global Focus Model. Public investment is often measured as a component of adaptive capacity, but here public investment is seen as a standalone. This is primarily because this index narrows the definition of adaptive capacity to measure the resilience of people, allowing public investment to be targeted specifically to measure the effectiveness of the states' service delivery. According to the 2012 Asia-Pacific Disaster Report 'Reducing Vulnerability and Exposure to Disasters', the majority of economic losses and disaster incidence are related to water, or the lack thereof. The capacity of a society to adapt to disaster risk requires specific investment and institutional support. For these reasons, infrastructure around water and health expenditure were both seen as proxies for the type of service delivery needed for effective risk governance.

Governance

This indicator is based on the GAIN Readiness Index, which seeks to measure the ability of a country's public sector to absorb additional investment resources and apply them towards climate change. General principles of good governance apply to this indicator, such as public accountability (measured by efforts to combat corruption). This indicator also measures public budgeting and expenditure for disaster response.

Institutional resilience (Included in OCHA GFM, WRI 'Coping Capacities')

Data to compile a comprehensive idea of institutional resilience at the state level are lacking. The proposed indicators are based on the Cutter et al. Disaster Resilience Indicators for Benchmarking Baseline Conditions.[56]

Though the subnational governance index provides a useful indication of differences at a local scale, the limitations of the approach must be noted. Most importantly, a lack of reliable and consistent data means that approximations have to be made. Any interpretation of index outputs needs to take strong account of these weaknesses.

56 Cited in S.L., Burton, C.G. and Emrich, C.T. (2010) 'Disaster Resilience Indicators for Benchmarking Baseline Conditions'. Journal of Homeland Security and Emergency Management: Vol. 7 : Iss. 1, Article 51. DOI: 10.2202/1547-7355.1732. Available at: http://www.bepress.com/jhsem/vol7/iss1/51

9 Technical annex I: (Chapter 5)

Table A3: Vulnerability index with hazard indicators

Highest vulnerability >10% $0.75/day	MHI	High vulnerability >1,000,000 $0.75/day	MHI	Moderate vulnerability either >10% $1.25/day or >1,000,000 $1.25/day	MHI	Lower vulnerability either >10% $2.00/day or >1,000,000 $2.00/day	MHI	Lowest vulnerability either >10% $4.00/day or >1,000,000 $4.00/day	MHI	Not vulnerable <10% $4.00/day and <1,000,000 $4.00/day	
Madagascar	27	India	35	Sao Tome and Principe	-	Kyrgyzstan	18	Lebanon	23	Maldives	Malta
Burundi	23	Pakistan	30	Nicaragua	33	Moldova	18	Romania	21	Panama	Trinidad
Swaziland	18	Nigeria	23	Vanuatu	-	Sierra Leone	22	Timor-Leste	25	Barbados	France
Rwanda	-	Ethiopia	22	St. Lucia	-	Syria	21	Serbia	24	Slovak Republic	Singapore
Haiti	31	Bangladesh	34	Solomon Islands	-	Cape Verde	-	Mauritius	-	Equatorial Guinea	Hong Kong
Malawi	22	Philippines	33	Micronesia; Federal States.	-	Mauritania	16	Congo, Republic of	22	Malaysia	United Kingdom
Central African Republic	22	Kenya	20	Djibouti	16	Montenegro	-	Bulgaria	20	Oman	Russia
Guinea Bissau	23	Yemen	16	Fiji	-	Armenia	19	Puerto Rico	-	Latvia	Belgium
Somalia	15	Mozambique	27	Guinea	23	El Salvador	30	Bhutan	-	Belarus	Australia
Comoros		Uganda	22	St. Vincent and the Grenadines	-	Egypt	22	Suriname	21	Argentina	Bahrain
Nepal	34	Niger	17	Grenada	-	Paraguay	24	Jamaica	-	Algeria	Netherlands
Lesotho	16	Korea North	20	Botswana	17	Laos	34	Lithuania	12	Chile	Korea South
Eritrea	16	Zambia	21	Samoa	-	Belize	33	Gabon	22	Estonia	Canada
Zimbabwe	22	South Africa	18	Tajikistan	18	Guyana	22	Dominican Republic	29	Portugal	Czech Republic

Benin	21	Guatemala	33	Papua New Guinea	29	Macedonia, Former Yugoslav Republic of	26	Tunisia	13	Bosnia and Herzegovina	Switzerland
Honduras	33	Thailand	34	Cote d'Ivoire	22	Georgia	26	Mongolia	17	Hungary	Austria
Liberia	22	Colombia	28					Costa Rica	28	Croatia	Denmark
Burkina Faso	19	China	33	Viet Nam	34	Morocco	20	Bolivia	29	Greece	Germany
Senegal	21	Ghana	19	Afghanistan	20	Uzbekistan	18	Jordan	21	Uruguay	Brunei
Tanzania	21	Mexico	35	Indonesia	31	Turkey	28	Albania	26	Poland	Finland
Namibia	17			Myanmar	34	Sri Lanka	28			New Zealand	Iceland
Palestine	21			Brazil	29	Ecuador	28	Iraq	21	Bahamas	Ireland
Chad	22			Cameroon	23	Peru	28	Angola	22	Azerbaijan	Japan
Mali	21			Cambodia	30	Cuba	31	Ukraine	18	Israel	Kazakhstan
Gambia	21							Venezuela	26	Spain	Kuwait
Togo	18							Iran	21	Italy	Luxembourg
Congo; Democratic Republic of	22									Slovenia	Norway
Tonga										Saudi Arabia	Qatar
Sudan	20									Cyprus	Sweden
South Sudan	22									USA	Taiwan
% of group MHI >= 20	71%	% of group MHI >= 20	80%	% of group MHI >= 20	79%	% of group MHI >= 20	76%	% of group MHI >= 20	81%	Libya	Turkmenistan
											UAE

Table A4: Multi-hazard – baseline (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	1 32	61

Table A5: Multi-hazard – optimistic (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

Table A6: $1.25 poverty Projections to 2030 in top multi-hazard countries (baseline and optimistic)

	$1.25/day poverty baseline (millions)	$1.25/day poverty optimistic (millions)
Asia		
Bangladesh	20.93	14.12
Cambodia	1.501	1.082
China	7.127	3.719
India	126.5	50.6
Indonesia	3.43	1.281
Japan	0	0
Lao pdr	0.295	0.184
Malaysia	0.004	0.001
Myanmar	3.075	2.079
Nepal	18.45	15.48
Pakistan	57.56	28.5
Papua new guinea	1.085	0.579
Philippines	13.18	7.821
Sri lanka	0.292	0.147
Taiwan	0	0
Thailand	4.797	2.889
Timor-leste	0.007	0.002
Turkey	0.215	0.061
Viet Nam	4.908	3.304
Asia total	**263.356**	**131.849**
Europe		
Albania	0.001	0.0004
Georgia	0.118	0.067
Macedonia (former Yugoslav Republic of)	0.059	0.038
Europe total	**0.178**	**0.1054**
Latin America & Caribbean		
Argentina	0.009	0.004
Belize	0.027	0.014
Bolivia	0.175	0.088
Brazil	2.1	1.233
Chile	0.001	0
Colombia	3.845	2.561
Costa rica	0.008	0.004
Cuba	0.382	0.208
Dominican Republic.	0.073	0.038
Ecuador	0.648	0.379
El Salvador	0.313	0.244

Guatemala	3.733	2.51
Haiti	6.802	6.008
Honduras	3.25	2.542
Mexico	4.048	2.528
Nicaragua	1.436	1.074
Panama	0.018	0.008
Peru	0.262	0.112
Venezuela	0.034	0.007
LAC total	**27.164**	**19.562**
Sub Saharan Africa		
Madagascar	27.24	22.19
Mozambique	7.505	4.303
Sub Saharan Africa total	**34.745**	**26.493**

Table A7: $1.25 poverty projections to 2030 in top drought, heat and flood-prone countries (baseline and optimistic)

	$1.25/day poverty baseline (millions)	$1.25/day poverty optimistic (millions)
Asia		
Bangladesh	20.93	14.12
Cambodia	1.501	1.082
India	126.5	50.6
Indonesia	3.43	1.281
Lao pdr	0.295	0.184
Malaysia	0.004	0.001
Myanmar	3.075	2.079
Nepal	18.45	15.48
Papua new guinea	1.085	0.579
Sri lanka	0.292	0.147
Thailand	4.797	2.889
Turkey	0.215	0.061
Viet Nam	4.908	3.304
Asia total	**185.482**	**91.807**
Latin America & Caribbean		
Argentina	0.009	0.004
Belize	0.027	0.014
Bolivia	0.175	0.088
Brazil	2.1	1.233
Colombia	3.845	2.561
Ecuador	0.648	0.379
Guatemala	3.733	2.51
Guyana	0.037	0.032
Mexico	4.048	2.528
Paraguay	0.498	0.3
Peru	0.262	0.112
Uruguay	0	0
Venezuela	0.034	0.007
LAC total	**15.416**	**9.768**
Sub Saharan Africa		
Angola	0.335	0.115
Cameroon	1.535	0.896
Central African Republic.	3.117	2.596
Chad	5.463	3.689
Congo	0.21	0.109
Côte d'ivoire	3.086	1.855

Democratic Republic of Congo	29.96	19.87
Equatorial Guinea	0	0
Ethiopia	21.76	11.58
Gabon	0.022	0.012
Guinea	2.038	1.227
Guinea-bissau	1.204	0.949
Liberia	2.333	1.791
Nigeria	21.75	13.9
South sudan (Sudan pov)	18.24	12.34
Sierra leone	0.884	0.363
Uganda	6.568	3.254
Sub Saharan Africa total	**118.505**	**74.546**

10 Technical annex J: (Chapter 6)

A meeting in New York on 18-19 July 2013 of agencies, UN Member States, campaign organisations and experts, proposed a suite of suggested targets and indicators, some as potential alternatives to the High-level Panel (HLP) suggestion (see Table A8). The first of which, 'reduce by x% the impact of disasters on economic growth and reduce by x% the number of deaths from disasters' broadens the scope of the HLP's suggestion and recognises the economic impacts that disasters can have on growth and development. The second, 'reduce by x% the impact of disasters on economic growth and end disaster-induced poverty' takes this one step further and ties disasters directly to issues of impoverishment.

Table A8: Potential alternative disaster target formulations for the post-2015 development goals

Proposed target: Reduce by x% the impact of disasters on economic growth and reduce by x% the number of deaths from disasters	**Proposed target: Reduce by x% the impact of disasters on economic growth and end disaster-induced poverty**
Potential indicators include:	**Potential indicators include:**
% of investment decisions informed by disaster risk assessments	% of investment decisions informed by disaster risk assessments
% of overall assets/GDP at risk from disaster damages	% of overall assets at risk from disaster damages
	% of school days lost as a result of disasters
% of people at risk of disasters who are covered by functioning early warning systems and evaluation plans	% of people covered by social protection systems that can be up-scaled when triggered by disaster threats
% of earthquake resistant buildings in earthquake prone zones	# of people displaced and made unemployed by disasters
% of population in high hazard zones, killed and displaced by disasters annually	% of annual government spending allocated to DRR and preparedness activities
% of annual government spending allocated to DRR and preparedness activities	% of people living below the 'resilience' [to poverty] threshold'
The advantages of this blended target and indicator set are:	The advantages of this blended target and indicator set are:
Ability to highlight the important relationship between economic assets and mortality.	A broad appeal to richer countries (on the economic growth side) and to poorer countries (on the impoverishment side)
Broad appeal across wide geographies	

Simple messages and concepts to convey **Appeal with powerful ministries of finance**	Appeal with powerful ministries of finance More direct link to a goal on 'ending poverty' Ability for countries to appropriate it with national poverty lines Ability to capture many livelihood and asset-based aspects in the impoverishment target, supporting a more inclusive target.

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