



Zero poverty... think again

Impact of climate change on development efforts

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Abstract

This paper reviews what is known about the impacts of climate change on eight development goal areas and shows that it is essential for climate change to be addressed in order not to compromise development efforts.

- Climate change will have wide-ranging consequences, direct and indirect, on development and poverty reduction. It will not only worsen areas directly affected by the climate system, such as food production or the availability of water, but also other areas including gender equality and education provision. In short, it will affect the achievability of any future development goals.
- We should not forget the UN Framework Convention on Climate Change, but the post-2015 process offers an opportunity to be more ambitious and engage a much wider range of stakeholders. It has the potential to play a role in steering global efforts to eradicate poverty and to shift to sustainable, low-emission and climate-resilient development pathways.

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¹ www.jorgemartin.org/

² www.bermer.es/

³ www.odi.org.uk/projects/2730-building-post-2015-sustainable-development-agreement

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Abbreviations

CIA	Central Intelligence Agency
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
HLP	High-Level Panel on post-2015
FAO	Food and Agricultural Organisation of the United Nations
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPCC AR4	Intergovernmental Panel on Climate Change Fourth Assessment Report
IUCN	International Union for Conservation of Nature
LIC	Low Income Country
LMIC	Lower-Middle Income Country
MDG	Millennium Development Goals
MIC	Middle Income Country
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
OWG	Open Working Group on Sustainable Development Goals
PVI	Poverty Vulnerability Index
SDSN	Sustainable Development Solutions Network
UMIC	Upper-Middle Income Country
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund

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1 Executive summary

Poverty eradication will be difficult, if not impossible, if climate change is not tackled. The current efforts to formulate new sustainable development goals post-2015 are unlikely to end in success if climate change and shocks are not confronted in unison.

With the 5th IPCC report recently confirming just how certain we are of climate change, this paper reviews the impacts it may have on global development and eradicating poverty. It uses the lens of climate impacts on potential new development objectives, which will become the building blocks of global development action. In order to do this, we examine literature projecting impacts of climate change on a set of potential goal areas, determined from growing consensus about what the goals should look like and the quality of evidence.

Climate change is a reality, and given that it is so interwoven with both economic performance and sustainable development, the world can achieve much better results by taking climate change explicitly into account in the formulation of some of the development goals and targets.

The exercise shows that climate change will have wide-ranging consequences on development and poverty reduction. Climate change will not only impact areas directly affected by the climate system, such as food production or the availability of water, but will also have broader impacts on issues perhaps considered to be distinct from the climate, such as gender equality and education provision.

The impact of climate change on food, for example, could result in more people at risk of hunger in vulnerable groups and countries. With 2° to 3°C warming, between 30 and 200 million people will be at risk of hunger; with an over 3°C warming, this number rises to 250 to 550 million people (Stern, 2007), mostly in Africa and Southeast Asia. The scale of potential impacts and the interactions between the goal areas can be seen in Table 1.

In 2015, world leaders will have a chance to agree on new goals that will set a path towards sustainable development if climate change is integrated. The international processes dealing with climate, disasters and development – the UN Framework Convention on Climate Change (UNFCCC), the Hyogo Framework for Action (HFA) and the post-2015 debate – are currently taking place separately. So even if climate change is one of the main factors affecting the success of achieving various development goals, it is not yet a given that it needs to be explicitly and fully reflected in the post-2015 agreement. It can be argued that it would be enough to take climate change into account during implementation of efforts to achieve each goal. However, if climate change is not explicitly considered in goals and targets, it is likely that resources will be misdirected; programme action will be inefficient; conflicting and counterproductive actions will be put in place; and finally gains in development could be cancelled, and even reversed.

There is an excessive risk and cost to development if it is not addressed (Stern, 2007). We therefore believe it is imperative to include climate change fully in the formulation and targets of development goals, however complex this may be.

Table 1: Summary⁴ of climate impacts on possible development goals

<p>FOOD SECURITY, NUTRITION & AGRICULTURE</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • Increase in people at risk of hunger by between 30 and 200 million in vulnerable groups and countries, at 2° to 3°C warming (Stern, 2007). • Crop yields decrease by up to 30% in Central and South Asia at 1° to 2°C warming; yields from rain-dependent agriculture in Africa down by 50% before 2020, at 1°C warming (IPCC, 2007). <p>Long –term impacts</p> <ul style="list-style-type: none"> • Additional 250 to 550 million people at risk of hunger, mostly in Africa and Western Asia, at 3°C warming (Stern, 2007). • Reduction of crop yields of more than 90% in sub-Saharan Africa, at 3°C warming (World Bank, 2013). <p>Impacted by: water. Impacts on: health, income poverty, peace, employment</p>	<p>ACCESS TO ENERGY, WATER & SANITATION</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • 1 to 4 billion people to experience growing water shortages in Africa, the Middle East, Southern Europe, and parts of South and Central America, at 2°C warming (Stern, 2007). • Increased drought risk in southern, central, and west Africa (World Bank, 2013); in sub-Saharan Africa, up to 171 million poor people will be exposed to drought hazards in 2030 (Shepherd et al., 2013). <p>Long –term impacts</p> <ul style="list-style-type: none"> • Proportion of land area experiencing extreme droughts will increase from 3% to 30% at 3° to 4°C warming (Stern, 2007). • 350 to 600 million people exposed to increased water stress in Africa by 2050, at 1° to 4°C warming (IPCC, 2007). <p>Impacts on: food, health, peace, education</p>
<p>HEALTH</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • 40 to 60 million more people exposed to malaria in Africa, at 2°C warming (Stern, 2007). • Increase in diarrhoeal diseases in low-income regions by 5% to 11% by 2039, at 1.5°C warming (IPCC, 2007a). <p>Long –term impacts</p> <ul style="list-style-type: none"> • By the 2080s, 1.5 billion to 2 billion more people will be at risk of dengue, at 3°C warming (IPCC, 2007a). • Increase of malaria exposure of 70 million to 80 million people, at 3° to 4°C warming (Stern, 2007). <p>Impacted by: food, water. Impacts on: education, employment</p>	<p>REDUCING POVERTY</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • By 2030, poverty increase of up to one third in Malawi, Uganda and Zambia alone (World Bank, 2013a). <p>Long –term impacts</p> <ul style="list-style-type: none"> • By 2100, in South Asia and sub-Saharan Africa, 145 million to 220 million additional people could fall below the \$2-a-day poverty line, at 3.9° to 4.3°C warming (Stern, 2007). <p>Impacted by: food. Impacts on: education, peace</p>
<p>EDUCATION</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • None directly. <p>Long –term impacts</p> <ul style="list-style-type: none"> • Climate disasters threaten educational infrastructure. <p>Impacted by: health, gender. Impacts on: employment</p>	<p>GENDER EQUALITY</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • None directly, but widespread recognition of additional vulnerability and exposure of women. <p>Long –term impacts</p> <ul style="list-style-type: none"> • None directly, but widespread recognition of additional vulnerability and exposure of women. <p>Impacted by: food, water, health. Impacts on: education, peace</p>
<p>PEACE AND SECURITY</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • None directly, but climate disasters can aggravate conflict, and conflict reduces ability to act on climate. <p>Long –term impacts</p> <ul style="list-style-type: none"> • None directly, but climate disasters can aggravate conflict, and conflict reduces ability to act on climate. <p>Impacted by: food, water, income poverty</p>	<p>SUSTAINABLE JOBS AND ACCESS TO PROSPERITY</p>	<p>Medium-term impacts</p> <ul style="list-style-type: none"> • None directly. <p>Long –term impacts</p> <ul style="list-style-type: none"> • Climate disasters threaten educational infrastructure. <p>Impacted by: food. Impacts on: income poverty</p>

⁴ These data come from the literature review. See annexes for full details including references. Baselines have not been standardised, see each reference for full comparison. ‘Impacted by’ and ‘impacts on’ refer to the linkages and dependencies between different goal areas to illustrate how direct impacts filter through to other goal areas.

2 Introduction – what is at stake?

In the next two years, global agreements will be made that shape the trajectory of global development efforts for decades to come. National governments at the UN are agreeing new objectives on avoiding dangerous climate change, on disaster management, and on sustainable development pathways that will address poverty and the environment concurrently. Getting these deals right is vital due to the political and financial weight that will be mobilised to achieve them.

It is widely accepted that the environment is an intrinsic part of any development effort, since it influences, and in many cases dictates, how people develop. On the other hand, the environmental cost of development and human progress is of critical concern as it raises issues of the ability to sustain progress and intergenerational equity. Over the past decade, there has been a shift in development and climate change discourse towards an understanding that climate change exacerbates existing development challenges, making the poor more vulnerable⁵ and pushing those living on the margins closer to the edge. This shift has been acknowledged by many international agencies and is beginning to feature in planning and practice⁶.

What is not so widely accepted is that a changing environment, especially the dynamic process of climate change and shocks such as extreme weather events, must be integral to the fight against poverty. The cost to development of a changing climate and environmental degradation is full of uncertainties⁷; however, without accounting for how such changes will affect poverty reduction efforts, the global goal of getting to zero poverty is at huge risk.

The first Millennium Development Goal (MDG) target of halving the 1990 poverty rate by 2015 has been reached. The proportion of the world's population living under the 1990 extreme poverty rate, \$1.25 a day (in 2005 prices), was halved in 2010, according to estimates of the World Bank (World Bank, 2013b). A few other goals of the original MDGs, such as the one on access to drinking water, have also been attained.

In spite of these advances, there is an extra urgency now to get climate change and development right together. Given the negative impacts that climate change is already having on human progress, development goals could be designed to be climate-smart, i.e. include targets that deliver a triple win of ending poverty, shifting to low carbon development, and enabling adaptation, disaster risk management and resilience to environmental shocks and stresses. Where decisions that are climate-smart while also fostering development are not possible, trade-offs will need to be carefully managed.

⁵ Vulnerability to poverty is an outcome of various development dimensions; faulty development drives vulnerability. Vulnerability is also not a permanent state: it is dynamic and also related to specific hazards.

⁶ For example, UNEP, 2011

⁷ Over the ten years from 2000 to 2009, more than 2.2 billion people worldwide were affected by 4,484 natural disasters. These disasters killed close to 840,000 people and cost at least \$891 billion in economic damage (Kellest and Sparks, 2012). Munich Re (2014) estimated the economic damage from 880 disasters in 2013 to be \$125 billion. These estimations do not include hidden costs, which are difficult to determine (Kellest, 2014).

What is needed is a coherent understanding of how climate change impacts on the different dimensions of poverty. As things stand, even those with little concern for climate change will find that the things they are worried about, such as health, education, food, water and jobs, are affected by the changing climate. Successfully meeting objectives in these areas is reliant on incorporating efforts to limit climate change in development planning. This means that, while many people may not consider climate change of high priority in comparison to other development objectives (Melamed and Ladd, 2013), efforts in the areas that do matter to them depend on tackling climate change.

Note on scenarios and likelihoods in this report

To compile this report we have drawn on recently published data from a range of reputable sources that have used different models of emissions scenarios to develop their predictions. The combination of possible future scenarios of global atmospheric greenhouse gas concentrations with models of how these specific scenarios affect the earth's climate leads to a wide range of likelihood estimates of impacts due to climate change.

We have chosen to omit discussion of climate scenarios⁸ in order to present the possible impacts of climate change in the most accessible format. Where we do refer to scenarios, we use the global average temperature change or a likely future date, or both, as a short-hand for the scale of change that this scenario represents and a way to standardise descriptions of them.

The World Bank's *Turn Down the Heat* report (2013a) maps 2°C warming to the 2040s and 4°C to the 2080s, citing 'years indicate the decade during which warming levels are exceeded in a business as usual scenario'. We have therefore standardised as closely as possible predictions about the impacts of climate change in line with such accepted models of how emissions scenarios affect the global climate over the 21st century.

We recognise that global average temperature changes hide a bigger range of regional variations and are not in and of themselves a reliable indicator of the scale of impact at any given location. For example, a scenario of 2°C average global warming may result in greater or lesser changes at particular locations.

A further complication is the baseline years used under each scenario. The IPCC 5th assessment (2013a) uses a 'pre-industrial' baseline of 1850-1900 to compare future changes in temperature. Stern (2007) builds scenarios from the ones provided in IPCC's 3rd assessment and uses a 1990 baseline date. The World Bank's *Turn Down the Heat* report (2013) mostly uses a 1951-1980 baseline. We have not sought to standardise baselines and instead refer the reader to each source for further information on the periods being compared.

We have thoroughly referenced all sources of information with the expectation that if the policy community wishes to further explore a particular statement then the scenarios and models underlying it can be easily identified.

⁸ 'A scenario is a coherent, internally consistent and plausible description of a possible future state of the world. It is not a forecast; rather, each scenario is one alternative image of how the future can unfold. A projection may serve as the raw material for a scenario, but scenarios often require additional information (e.g., about baseline conditions). A set of scenarios is often adopted to reflect, as well as possible, the range of uncertainty in projections. Other terms that have been used as synonyms for scenario are "characterisation", "storyline" and "construction"' (IPCC, 2013b).

3 Climate change and development

3.1 Scenarios and evidence for climate change

According to the Intergovernmental Panel on Climate Change's (IPCC) recently released first part of the Fifth Assessment Report (AR5), it is unequivocal that most of the recent climate change is caused by human activity. The world has warmed by approximately 0.8°C between 1901 and 2010, and will almost certainly warm at approximately 0.2°C per decade over the next few decades, after which further temperature rises start to depend on the specific emissions scenarios (World Bank, 2013a; IPCC, 2013a).

The most recent climate models used by the IPCC (2013a) show that we are already committed to a warming of around 1.5° to 2°C, in comparison with pre-industrial levels, by the end of the century, no matter what we do⁹. As climate change is already a reality and bound to continue for several decades, we can attempt to adapt to those changes, including building greater resilience against shocks. These unavoidable changes must be incorporated into plans and programmes in order to achieve maximum effectiveness in our development efforts.

What happens towards the second half of the century depends on the emissions path taken in the next few years and decades. Mitigation efforts are in fact aimed at keeping the global rise in temperature to 2°C (World Bank, 2013a) and even relatively ambitious action would still 'more likely than not' result in rises above this target (IPCC, 2013a). Meanwhile, the current rate of warming, coupled with present global emissions trends and pledges, sets us on a path to reach global temperature increases in the range of 3°C to 5°C on average by 2100 (World Bank, 2013a; IEA, 2013; IPCC, 2013a; Global Carbon Project, 2013; UNEP, 2012). Limiting climate change to 2°C will be a huge task, and a large effort must be undertaken before 2020 in order to keep it there, because 'business as usual' scenarios of global emissions put us on a pathway to greater temperature changes this century.

This potential for greater temperature changes means that development planning needs to consider the likely rise of 2°C in most scenarios, and potential rise of 4°C during the course of this century depending on the success of climate action in the next decades. The choice between these scenarios obviously has massive implications for future global development.

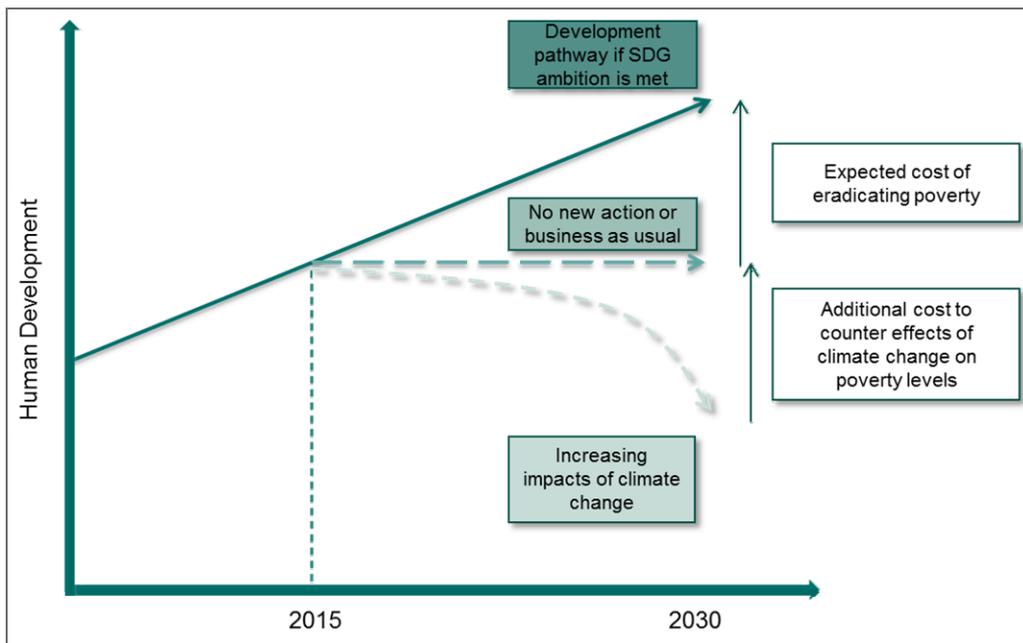
⁹ Under the most ambitious scenario used in the IPCC 2013 report, it is 'unlikely' that temperature increases will exceed 2°C by the end of the 21st century. Under all other scenarios it is 'likely' that the temperature will exceed 1.5°C.

3.2 Scenarios of poverty reduction

It is clear that if we do not do anything about it, poverty is not going to disappear by itself, and a certain amount of international effort is required and expected to continue the progress made under the MDGs. However, even if the international community manages to eradicate poverty, it also needs to tackle the effects of climate change in order to make these poverty reductions sustainable in the long term. Within two or three decades, the effects of climate change will become more pronounced and we are likely to see significant impacts. As these exacerbate existing development challenges, the gap between current levels of human development and the target of abolishing poverty will grow (Figure 1).

As the climate changes, and negatively impacts upon poverty, additional effort could be required to reduce poverty in comparison with a scenario where the climate is not accounted for (Figure 1). While the development community understands the gap between current levels of human development and our ambition, and has a feeling for the effort and investment needed in order to overcome this, there is a significant disconnect between our level of ambition and what could be required if climate change erodes the gains made in reducing poverty¹⁰.

Figure 1: Impact of climate on poverty reduction pathways



¹⁰ Other ways to explore the gap between poverty reduction ambitions and climatic projections have been attempted. One example linking projections in income poverty and weather-related hazards by Shepherd et al. (2013) examines whether there is an income threshold beyond which the risk of falling into poverty as a result of a disaster is reduced.

3.3 The key argument: impacts on the economy

'Climate change is a fundamental threat to economic development and the fight against poverty.' Dr. Jim Yong Kim, World Bank Group President (World Bank, 2013a)

'Climate change is found to have already set back global development by close to 1% of world GDP.' DARA and the Climate Vulnerable Forum (2012)

In his 2007 report, the economist Nicholas Stern described the full global economic implications of climate change in different scenarios. With a temperature increase of 2° to 3°C, Stern predicts that the cost of climate change 'could be equivalent to a permanent loss of around 0 to 3% in global world output' (Stern, 2007, p.9). He also points out that the developing nations will be those who 'shoulder the heaviest weight', and that less optimistic predictions of temperature increase have much greater consequences.

Since this report, the understanding of the potential for huge economic impact due to climate change has received increased attention. In its Fourth Assessment Synthesis Report in 2007, the IPCC found it 'very probable' that the net economic costs of climate change would increase over time as global temperatures increase. According to CDKN (2012, p.12), 'there is high confidence that economic losses from weather and climate related disasters are increasing, albeit with large inter-annual variability.' The annual accumulated estimates have ranged from a few billion to about \$200 billion (in 2010 dollars), with the highest value for 2005 (the year of Hurricane Katrina). While measured economic losses from disasters are largest in developed countries, there is high confidence that both fatality rates and economic losses as a proportion of GDP are higher in developing countries, up to 8% higher in extreme cases (CDKN, 2012).

The Stern Review states also that there is a strong cost-benefit case for early action on climate change, since the costs of inaction will far outweigh investment in mitigation and adaptation. The report estimated that it would be necessary to spend 2% of GDP yearly to mitigate the effects of climate change. Fankhauser et al. (2009) cite global adaptation cost estimates ranging from \$25 billion a year to well over \$100 billion a year, noting that adaptation is part of the response to climate change, and therefore just a portion of the overall costs, which include mitigation costs and other 'residual' impacts. Meanwhile, the World Bank (2011a) quotes estimates of measures to adapt to climate change from \$4 billion to \$109 billion a year. But according to the International Monetary Fund (IMF), existing studies tend to underestimate economic damages from climate change, and in particular undervalue the risk of 'worse-than-expected' outcomes (IMF, 2008).

The issue of the economic impacts of climate change is particularly relevant in the development context as growth is considered one of the pillars of sustainable development. Economic growth increases a nation's capacity to reduce poverty; when this is coupled with social development and environmental protection, a level of sustainable development can be achieved (Soubbotina and Sheram, 2000; Hull, 2009). However, the incorporation of climate change into development planning has not been achieved in a meaningful manner either. For example, UNEP's Mainstreaming Climate Change Adaptation into Development Planning report (2011a, p.11) notes that efforts to incorporate climate change adaptation into national development planning 'are still at a relatively early stage in many countries'.

This failure results in contradictions. For instance, the international community dedicates \$200 billion to aid for developing countries each year and \$7 billion in

response to disasters. Meanwhile, the international funding specifically devoted to disaster prevention and preparedness is a small fraction: about \$1 billion is spent every year globally (Kellett and Caravani, 2013).

While this focuses on the principle that climate change will negatively impact upon growth, it can be complemented by the understanding that increased growth results in greater climate action too. In fact, as economies grow, they tend to decarbonise, contributing to climate change mitigation (Nordhaus, 2013, p.22), since ‘for most products, we use less energy per unit of output’. An example is the US, where good data is available for over a century. Since 1930, the ratio of CO₂ to GDP has fallen at an average of 1.8% yearly. The problem is that this decarbonisation process does not happen quickly enough to avoid the worst effects of climate change. So the crux of the development question is how to help countries and regions to leapfrog over this stage and adapt to unavoidable change.

3.4 Indirect and direct impacts on development areas



Photo: IDPs arrive at Zamzam Camp, © United Nations Photo

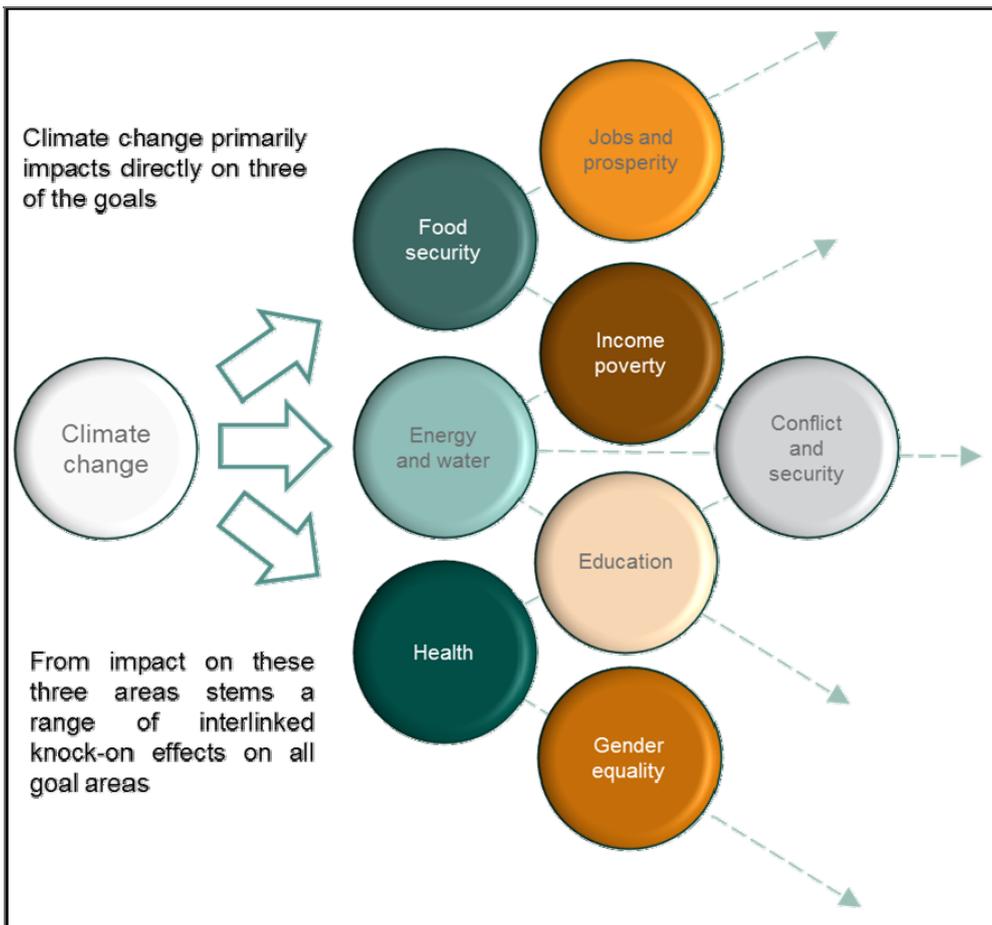
The impacts that climate change will have on development can broadly be classified into two groups: direct and indirect (see Figure 2). Direct impacts can be seen clearly in the development areas of food security, water and health. In these areas, changes in climate have direct influences on rainfall and temperature that affect aspects such as crops and water availability. This direct relationship is particularly important in the water and agricultural sector which is expected to be primarily where climate change impacts will be transmitted to the poor, affecting both food security and human development (Eriksen and Næss, 2003; Hertel and Rosch, 2010; UNDP, 2012; WWAP, 2012).

Changes to water, health and other direct impacts will in turn create other, indirect, changes. Social issues, such as gender equality, education and human rights, are affected indirectly if environmental impacts including drought, extreme weather and shorter growing seasons affect livelihoods and increase living costs (Mearns and Norton, 2010; Eriksen and Næss, 2003). Bates et al. (2008) also support this view noting that the adverse effects of climate change on freshwater systems go on to aggravate the impacts

of other stresses, such as population growth, changing economic activity, land-use change, access to energy and urbanisation. These indirect links to climate change can even be extended to conflict and security because the combinations of these stressors can create situations ripe for conflict (Buhaug et al., 2009). However, because the interaction is complex and there is no direct link, these effects are harder to predict.

The 'billiard ball model' (Figure 2) shows how climate change's links to sustainable development issues can be seen through its direct impact on food security, water and health. Impacts on these areas then have indirect and sometimes cascading effects on the success of other goal areas.

Figure 2: The Billiard Ball model¹¹



3.5 International platforms and finding a common direction

In 2015, the Millennium Development Goals (MDGs) will formally end. However, despite successes, progress against many of the goals and targets remains incomplete, including more than 1 billion people who continue to live in extreme poverty (UN, 2013a). So, what next?

There are a number of processes in play simultaneously: the post-2015 agenda, the United Nations Framework Convention on Climate Change (UNFCCC) and the Hyogo

¹¹ The Billiard Ball model is not intended to be an accurate representation of what happens. In fact, some impacts move in both directions. It is just a way to visualise the impacts, direct and indirect, triggered by climate change.

Framework for Action (HFA). The central challenges as these proceed in parallel are meeting the level of ambition needed between all the processes, and identifying whether linkages can strengthen outcomes or improve effectiveness.

The **post-2015** process is underway, reviewing progress and identifying next steps, culminating with a high-level summit in September 2015. In 2012 at the Rio +20 summit, governments agreed to create a set of universal Sustainable Development Goals (SDGs), which the UN General Assembly Open Working Group (OWG) has been tasked with developing proposals for. The High-Level Panel (HLP) on post-2015, established to advise on the next steps on a global development agreement beyond 2015, recently recommended that sustainable development should be at the core of the framework, and stated: ‘we must act now to halt the alarming pace of climate change and environmental degradation, which pose unprecedented threats to humanity’ (HLP, 2013b). However, tangible and substantial proposals on how to accomplish this have not materialised so far, and it is still unclear how and when this will happen (Stakeholder Forum, 2013).

The primary decision-making body for climate action is the **UNFCCC**, launched at the Earth Summit in 1992, aiming to ‘stabilise greenhouse gas (GHG) concentrations in the atmosphere’. In 1997, the Kyoto Protocol established legally binding requirements for developed countries to cut GHG emissions, and the 2010 Cancun agreements determined that future global warming should be limited to below 2°C (UNFCCC, 2010). But progress has been limited, and legally binding targets only apply to a few of the top emitting countries. Current effort is focussed on negotiating a deal in 2015 that will establish emissions targets and mechanisms for financing action on climate change to be in force from 2020. How closely these emissions reductions targets relate to scientific guidelines or are determined by political convenience is another issue.

The **Hyogo Framework for Action (HFA)** is a 10-year plan to make the world safer from hazards, substantially reduce disaster losses by 2015 and build resilience to disasters. It was endorsed by the UN General Assembly following the 2005 World Disaster Reduction Conference and needs to be renewed in 2015 (‘HFA2’).

Despite the HLP (2013, p.55) stating that ‘without tackling climate change, we will not succeed in eradicating extreme poverty’, there are few references to climate change or its significance as a factor in achieving these goals in its May 2013 report. As a legally binding agreement, the UNFCCC remains the principle mechanism to bring about global action on climate change, and the other processes certainly defer to it. In its report, the HLP says: ‘The proper place to forge an international agreement to tackle climate change is the UNFCCC. The Panel wants to underline the importance of holding the increase in global average temperatures below two degrees centigrade above preindustrial levels, in line with international agreements’ (HLP, 2013).

How much climate change will adversely affect the poor is partly a question of mitigation success. But that it will affect the poor is inevitable; thus the need to adapt to climate change too, and ensure that resilience to more frequent extreme disasters is built. This paper shows that, however the agreements are finally reached, the outcomes of all three processes (UNFCCC, post-2015 and HFA) are inter-dependent to a great extent, and the aim should be comprehensive integration of the issues.

4 Framing and methodology of the review

While the precise outline of a new post-2015 agenda is not yet defined, there is convergence on a number of key issues in recent reports, which is the basis of the selection of areas for analysis here¹². We distinguish between development areas where the impacts are more direct, and those where they are indirect, as discussed in section 3.4 and figure 2. Finally, we also take into account the quality and quantity of evidence that was available. Following these three considerations, level of consensus, level of evidence and direct or indirect impacts, we created the following goal areas to analyse (see table 2 for full details):

1. Food security, nutrition and agriculture
2. Access to energy, water and sanitation
3. Health
4. Reducing poverty
5. Education
6. Gender equality; peace and security; and sustainable jobs and access to prosperity.

The uncertainties over the complex interactions that lead to indirect impacts make these effects harder to predict, and the evidence therefore tends to be stronger for direct impacts and weaker for indirect ones. That does not mean the impacts are less real or genuine: it just means that, due to their obliqueness, scientific confirmation of climate change impacts is more difficult to find.

We did not tackle areas such as good governance, transparency, a global alliance for sustainable development, resilient cities or protection against crime¹³. Not because we think they will not be impacted by climate change, but because we found no convincing scientific evidence of climate impact on them. As we explained in chapter 3 and conclude in chapter 6, the further down the billiard ball model (Figure 2) an area is, the harder it is to find useful evidence of the impacts of climate change.

¹² Our framework builds on three contrasting and influential inputs, as well as a review identifying consensus and divergence in the goal areas, to form a set of eight development goal areas where these intersect. We draw on overlaps between the High Level Panel (HLP, 2013) and Sustainable Development Solutions Network (UNSDSN, 2013) goals as well as the top ten global priorities according to the MY World global survey (Melamed and Ladd, 2013). We also take note of the analysis of convergence and divergence conducted by Bergh and Couturier (2013).

¹³ These areas emerge from goals such as: ‘good governance and responsible institutions’, ‘create a global enabling environment and catalyse long-term finance’ (HLP); ‘empower inclusive and resilient cities’, ‘transform governance for sustainable development’ (SDSN); ‘an honest and responsive government’ and ‘protection against crime and violence’ (MY World)

Table 2: Illustrative goal sets used by this report and their origins

Goal area in this report	High Level Panel (HLP)	Sustainable Development Solutions Network (SDSN)	MY World survey	Level of consensus (Bergh and Couturier, 2013)	
Food security, nutrition and agriculture (Chapter 5.1)	Ensure food security and good nutrition	End extreme poverty including hunger; improve agriculture systems; and raise rural prosperity	Affordable and nutritious food	★ ★	Direct impacts and good evidence
Access to energy, water and sanitation (5.2)	Achieve universal access to water and sanitation; secure sustainable energy; manage resources and assets sustainably	Achieve development within planetary boundaries; curb human-induced climate change; ensure sustainable energy; secure ecosystem services and biodiversity; and ensure good management of water and other natural resources	Access to clean water and sanitation; protecting forests, rivers and oceans	★ ★	
Health (5.3)	Ensure healthy lives	Achieve health and wellbeing at all ages	Better health care	★ ★ ★	Indirect impacts and weaker evidence
Reducing poverty (5.4)	End poverty	End extreme poverty including hunger; improve agriculture systems; and raise rural prosperity		★ ★ ★	
Education (5.5)	Provide quality education and lifelong learning	Ensure effective learning for all children and youth for life and livelihood	A good education	★ ★ ★	
Gender equality (5.6)	Empower girls and women and achieve gender equality	Achieve gender equality, social inclusion and human rights for all		★ ★ ★	
Peace and security (5.6)	Ensure stable and peaceful societies			★ ★	
Sustainable jobs and access to prosperity (5.6)	Create jobs, sustainable livelihoods and equitable growth		Better job opportunities	★ ★	
Not included in this report	Ensure good governance and responsive institutions; create a global enabling environment; and catalyse long-term finance	Empower inclusive and resilient cities; transform governance for sustainable development	An honest and responsive government; protection against crime and violence		



Features at goal level in all key institutional proposals; similar approach in most policy areas



Features at goal level in most of the key institutional proposals, and proposals take a similar approach in some areas

In order to keep our conclusions as simple as possible, we also do not consider the implications for development of human responses to climate change. These can be both positive (for example, the creation of jobs in renewable energy sectors) and negative (flood defences diverting water into other areas).

To identify the impact of climate change on the different potential goal areas, this report has drawn on the official reports from the IPCC, International Energy Agency (IEA), World Bank, OECD, other UN agencies and peer-reviewed literature, with the aim of consolidating current knowledge into a concise narrative that will illustrate the degree and scale of linkages between climate change and other development outcomes.

Literature is reviewed against two headings: current status and climate relevance, and future climate change impacts.

- **Current status and climate relevance** covers the existing global status of progress in this area, how many people are affected by these issues, and the ways in which climate change can impact on this area.
- **Future climate change impact** covers what is known and predicted about how climate change will affect this area over the medium and long-term time frames.

The content of chapter 5 is a summary of the full dataset that is contained in the annexes. Here the future climate change impacts are separated to differentiate between medium (2030-2050) and long-term (2050-2100) predictions.¹⁴The three areas with the greatest direct impacts (food security, nutrition and agriculture, access to energy, water and sanitation, and health) each have their own section (5.1-5.3) as does reducing poverty (5.4.). The four other goal areas, linked indirectly to climate change and with weaker levels of evidence, are detailed in section 5.5.

¹⁴ We have grouped the findings in two groups, taking into account where the research has indicated a time horizon that approximates these periods of time.

5 Reviewing the evidence

5.1 Impacts of climate change on food security, nutrition and agriculture

‘One in eight worldwide did not consume enough food on a regular basis to cover their minimum dietary energy requirements over the period 2010 to 2012.’ (UN, 2013a)

Table 3: Highlights of impacts on food security, nutrition and agriculture¹⁵

	Climate impacts at 2030-2050	Climate impacts at 2050-2100
GLOBAL	<ul style="list-style-type: none"> • Increase in people at risk of hunger by 30 million to 200 million in vulnerable groups and countries (at 2° to 3°C warming); • Worldwide cereal production declines by 5% (at 2°C warming); • 15% to 40% of land species could face extinction (at 2°C warming); • Coral reefs are expected to bleach, affecting tens of millions of people that rely on them (at 2°C warming); • Increase in failure rate of primary season in mixed rain-fed arid-semiarid systems by about 60% to 70% compared to 1960-2002 (at 2°C warming); 	<ul style="list-style-type: none"> • Additional 250 million to 550 million people at risk of hunger, mostly in Africa and Western Asia (at 3°C warming); • Decline in global cereal production by 10%, and entire regions too hot and dry to grow crops by 2100 (at 4°C warming); • Agricultural collapse across large areas of the world by 2100 (at 5° to 6°C warming); • Changes in production of particular fish species, with adverse effects (at 3°C warming); • 20% to 50% of land species face extinction and thousands of species lost in biodiversity hotspots (at 3°C warming);
SECTORAL & REGIONAL	<ul style="list-style-type: none"> • Yields from rain-dependent agriculture in Africa down by 50% before 2020 (at 1°C warming); • Reductions in fishing catch potential from 5% to 50% for some African countries by 2050; marine fisheries production to decline up to 50% around the southern Philippines (at 2°C warming); • Crop yields decrease by up to 30% in Central and South Asia (at 1° to 2°C warming); • Loss of 12% of the cropping area of the Mekong Delta Province due to flooding by 2040 (at 30cm sea-level rise). 	<ul style="list-style-type: none"> • Possible reduction of crop yield of more than 90% in sub-Saharan Africa (at 3°C warming); wheat production likely to disappear from Africa by the 2080s; • Crop yield decrease of 10% to 30% in Asia (at 3° to 4.5°C warming); • Number of people at risk of hunger is projected to increase in Latin America (at 3° to 4.5°C warming).

¹⁵ Notes: These data come from the literature review. See Table A1 for full details including references. Baselines have not been standardised; see each reference for full comparison.

5.1.1 Current status and climate relevance



Photo: "Small farmers are the answer" challenge, © Bill and Melissa Gates Foundation

According to the most recent UN estimates, the proportion of undernourished people in developing regions decreased from 23.2% in 1990–1992 to 14.9% in 2010–2012 (UN, 2013a). While these achievements make it feasible to attain the first Millennium Development Goal of halving the percentage of people suffering from hunger by 2015, the same report also notes that 870 million people did not consume enough food, 98% of whom are in developing countries, in 2012 (UN, 2013a).

The importance of the agricultural sector to developing economies was noted by Stern (2007), who found that in 2007 agriculture accounted for 24% of world output, employed 22% of the global population and occupied 40% of the land area. Agriculture is of special relevance to the poorest people, with 75% of them living in rural areas and relying on agriculture for their livelihood (Bruinsma, 2003; Stern, 2007).

Analysis of socioeconomic and environmental indicators shows that hunger and climate risk are interlinked; that the most food insecure countries are also the most vulnerable to climate risk; and that climate change could exacerbate the risk of hunger (Krishnamurthy, et al., 2014). Agriculture is very reliant on the climate for many reasons, not least because 80% of the world's agricultural production is still rain-fed – with 99% of the main cereals in sub-Saharan Africa being rain-fed (Wani et al., 2009). While a changing climate will not be uniformly adverse (Thornton and Cramer, 2012), it would cause yield declines for the most important crops in many areas of the world (Morton, 2007; Thornton and Cramer, 2012) and sub-Saharan Africa and Southeast Asia will be particularly affected (Morton, 2007; Nelson et al., 2009). As a result, climate change is likely to alter the regional distribution of hungry people and result in higher prices for important, basic crops, with the effect of complex localised impacts.

While yield is one aspect of food security, access, stability and utilisation are also important, and will also be negatively affected by climate change (Met Office and WFP, 2012). Climate change exacerbates the risks of hunger and under-nutrition through extreme weather events and long-term and gradual climate risks, such as sea-level rise and accelerated glacial melt. It could affect all dimensions of food security and nutrition in complex ways, altering food production, access and utilisation, as well as nutrition (Met Office and WFP, 2012). One of the findings of Krishnamurthy et al. (2014) is that, at a global level, the socioeconomic data used to build indicators of adaptive capacity and sensitivity is a better predictor of hunger than the environmental datasets used to define hazard exposure.

5.1.2 Future climate change impacts

The varied nature of climate change impacts across regions, crop type, farming techniques and local factors (e.g. lack of infrastructure, local government and vulnerability) adds significant uncertainty as to the nature and timing of the climate impacts on agriculture in the future. We broadly identify three types of impact on agriculture: productivity changes, land availability, and pest and diseases.

Crop productivity is projected to increase slightly at mid-to-high latitudes under local temperature increases of 1° to 3°C (IPCC, 2007b). At lower latitudes, especially seasonally dry and tropical regions, crop productivity is projected to decrease by the 2030s due to climatic changes associated with even only small local temperature increases (1° to 2°C), increasing the risk of hunger (IPCC, 2007b; World Bank, 2013a). Changes in rainfall patterns will have significant impacts on yields in countries reliant on rain-fed agriculture: for example losses of up to 50% in Africa as early as 2020 (IPCC, 2007b). The scale of the potential risk is dramatic: even when accounting for possible adaptive changes in practice, the range of yield reductions for maize, for example, is expected to be 6% to 18%, for soya beans 6% to 12%, and for spring wheat 4% to 10% by 2050 (Deryng et al., 2011), although the threshold where adaptive practices reduce the impact in yield losses could be reached at an increase of 3°C (IPCC, 2007a).

Loss of crop land will also come as sea-level rises reduce the harvest area of a number of countries with low-lying fertile deltas (World Bank, 2013a). Between 1999 and 2009, storm surges led to 25,600 km² of flooding in the Mekong (Viet Nam), Irrawaddy (Myanmar), and Chao Phraya (Thailand) river deltas (Syvitski et al, 2009), 35% of the total area of these deltas.

Pest and disease susceptibility of crops and livestock will certainly be increased in times of stress such as drought or raised temperatures, and changing ranges of both crops and animals, and their pests and diseases, could also be a factor. However, little is currently known about the exact impacts of pests and diseases on crops, livestock and fish, although the multiple stresses could be substantial (Thorton and Cramer, 2012).

5.2 Impacts of climate change on access to energy, water and sanitation

'People will feel the impact of climate change most strongly through changes in the distribution of water around the world and its seasonal and annual variability.' (Stern, 2007)

Table 4: Summary of impacts on access to energy, water and sanitation¹⁶

Climate impacts at 2030-2050	Climate impacts at 2050-2100
<ul style="list-style-type: none"> • 1 to 4 billion people to experience growing water shortages in Africa, the Middle East, Southern Europe, and parts of South and Central America (at 2°C warming). • Increased drought risk in sub-Saharan Africa - up to 171 million poor people will be exposed to drought hazards in 2030. • Likely risk of severe drought in southern and central Africa and increased risk in West Africa (at 2°C warming). • Decrease in water availability per capita of 20% to 30% in Southeast Asia (at 1.8°C warming). • Food water requirements in India are projected to exceed availability of rain-fed water availability by more than 150% (at 2°C warming). 	<ul style="list-style-type: none"> • 350 million to 600 million people are projected to be exposed to increased water stress in Africa by the 2050s (at 1° to 4°C warming). • Proportion of land area experiencing severe droughts at any one time will increase from around 10% today to 40% (at 3° to 4°C warming). The proportion of land area experiencing extreme droughts will increase from 3% to 30% (at 3° to 4°C warming). • Large decrease in water availability per capita in Southeast Asia of 10% to 20% (at 4°C warming). • By 2050, water availability in Pakistan and Nepal is projected to be too low for self-sufficiency in food production (at 2°C warming).

5.2.1 Current status and climate relevance

Progress towards the goals of gaining access to sanitation and water has been significant so far. Recent UN estimates note that over the last 21 years, more than 2.1 billion people gained access to improved drinking water sources, meaning that the MDG drinking water target was met five years ahead of the target date, despite significant population growth (UN, 2013a). In terms of energy access, in 2011-2012 alone an estimated 50 million people gained access to electricity and 40 million to clean cooking facilities (IEA, 2012).

Access to energy has a pivotal role in development. The IEA (2012) has estimated that there are currently 1.3 billion people without access to electricity. Demand for energy and associated services, to meet social and economic development and improve human welfare and health, is increasing. Given the unmistakable links between the energy sector and climate change, sustainably meeting the energy, food and water needs of 9 billion people by 2050 is a key challenge for the future (OECD, 2013). This could be further compounded by changing scale and geographic distribution of potential renewable energy sources, although there is little certainty about these effects (IPCC, 2011).

The implications of climate change on water and sanitation are strong. In spite of the progress, the challenge is large. In 2011, 768 million people still drew water

¹⁶ See table A2 for full details including references. Baselines have not been standardised; see each reference for full comparison.

from an unimproved source, with the number of people without access to safe drinking water possibly two to three times higher than official estimates due to unclean water sources (UN, 2013a). The challenge of meeting these needs is complicated by the expected changes in water quantity and quality due to climate change. This affects the operation of existing water management practices and infrastructure, such as hydropower, structural flood defences, drainage and irrigation systems (Bates et al., 2008), and poses a challenge to development plans. Freshwater availability is a major limiting factor to food production and economic prosperity in many regions of the world and large changes in irrigation water demand are expected to occur as a result of climate change (Morton, 2007; Bates et al., 2008, Wadi et al., 2013), with increases of 20% to 25% expected by the 2080s in some parts of the world at 3° to 4°C warming (Wadi et al., 2013).



Photo: *Safe water for all*, © Gates Foundation

5.2.2 Future climate change impacts

Climate projections and observations provide considerable evidence that freshwater resources are vulnerable and have the potential to be impacted by climate change, with wide-ranging consequences for human societies and ecosystems (Bates et al., 2008). Each country and each river basin faces a unique set of climate change-related water challenges. While some sources (IPCC, 2007c; IPCC, 2013a) note that there are significant differences in the estimates of potential changes to water quality and quantity among studies, the IPCC AR4 finds there is high confidence that by mid-century, annual river runoff and water availability is projected to increase at high latitudes (and in some tropical wet areas) and decrease in some dry regions in the mid-latitudes and tropics (IPCC, 2007c). There is also high confidence that many semi-arid areas (e.g. Mediterranean Basin, western United States, southern Africa and north-eastern Brazil) will suffer a decrease in water resources due to climate change (IPCC, 2007a).

The variability in timing and reliability of rainfall, and not just the overall volume of precipitation, is also a key concern, as the way that water is sourced and used may have to change if availability does. An increase in the frequency, intensity and amount of heavy precipitation is very likely over mid-latitude land masses and wet tropical regions (IPCC, 2013a) while, simultaneously, increases in the duration and the intensity of drought are also likely on a global scale (IPCC, 2013). Such

changes would affect rain-fed and irrigation-based agriculture, as well as hydropower potential. With high reliance on hydropower in many developing countries (Tanzania for example derives 52% of the power on its national grid from hydroelectricity), water supply shortages have already caused significant power outages and load shedding issues (Malley, 2011). Adapting existing energy systems to changing water availability will be critical to mitigate electricity shortages as places that currently have enough water for hydropower may not in the future (Mukheibir, 2007).

5.3 Impacts of climate change on health

'Despite likely future improvements in global health status from economic development, climate change is likely to be an additional burden that will undermine current global health strategies.' (Kovats and Butler, 2012)

Table 5: Summary of impacts on health¹⁷

Climate impacts at 2030-2050	Climate impacts at 2050-2100
<ul style="list-style-type: none"> • There will be 40 million to 60 million more people exposed to malaria in Africa, a 9% to 14% increase on present-day (at 2°C warming). • Increase in diarrhoeal diseases in low-income regions by approximately 2% to 5% by 2020; risk of diarrhoea expected to increase between 5% and 11% from 2010 to 2039 (at 1.5°C warming). • 62% increase in severe childhood stunting and 29% increase in moderate stunting in South Asia by 2050 (at 2°C warming); 24 million (21%) increase in the number of malnourished children in 2050 (at 2°C warming). 	<ul style="list-style-type: none"> • Increase of malaria exposure of between 70 million and 80 million, or 16% to 19% (at 3° to 4°C warming). • Risk of diarrhoea expected to increase by 13% to 31% by 2070 to 2099 in Southeast Asia (at 4°C warming). • By 2080s, between 1.5 and 2 billion additional people will be at risk of dengue (at 3°C warming).

5.3.1 Current status and current relevance

Health has been a key target area of development under the MDGs, with targets across different goal areas including reducing child mortality, improving maternal health and combating HIV/AIDS, malaria and other diseases. Remarkable gains have been made worldwide in these goals since 1990, including: a drop in mortality rate for children under five from 87 deaths per 1,000 live births to 51 in 2011; an estimated 1.1 million deaths from malaria were averted over this period; and a likely halving of death rates from tuberculosis at the global level by 2015, compared to 1990 levels (UN, 2013a). Despite this progress, however, the health targets of the MDGs are unlikely to be met (WHO, 2013b).

Climate change already contributes to the global burden of disease and premature deaths (IPCC, 2007b). There is medium confidence that climate change has altered the distribution of infectious disease vectors and increased heat wave-related deaths (IPCC, 2007b). Climate change has also already affected the severity of some extreme weather and climate events, and these events have direct and indirect negative impacts on health. Floods, drought, heat stress and other events cause

¹⁷ See Table A3 for full details including references. Baselines have not been standardised; see each reference for full comparison.

death, injury, infectious diseases, malnutrition due to crop damage and interruption of food supply, water insecurity, morbidity, and even mental health problems (CDKN, 2012). It is estimated that 66.5 million children are already affected annually by disasters (CDKN, 2012). Extreme climate and weather events can also negatively impact the critical infrastructure needed to protect human health.

5.3.2 Future climate change impacts

There are two ways in which climate change will directly impact health in the future. Firstly, the physical impact of extreme events causes deaths, injuries and disability. This can then be followed by infectious diseases and malnutrition due to crop damage and disruption of food supply in the wake of such events (CDKN, 2012). Temperature-related mortality, linked to increased occurrence of extremely cold and hot days, can lead to increases in mortality directly or by exacerbating existing conditions (Hales et al., 2003). Other health impacts of extreme events may be indirect but long-lasting, and are often associated with mental health impacts such as stress, anxiety and depression. Secondly, there are causal links between climate change and the prevalence of some vector-borne diseases (for example malaria and dengue fever), and vulnerability to water, food, or person-to-person borne diseases (for example cholera and dysentery), although the potential impact is still very much uncertain (IPCC, 2007b).

The health impacts of climate change are closely linked to impacts on other goal areas, and the main impacts of climate change on human health are likely to occur from changes in water and food security (Kovats and Butler, 2012). Climate change will likely result in declining quantity and quality of drinking water, a prerequisite for good health, and, by threatening food security, exacerbate malnutrition (AfDB et al., 2003). There is high confidence of a large negative impact on health through increased malnutrition (IPCC, 2007b). Adverse health impacts will be greatest in low-income countries, and those at greater risk in all countries include the urban poor, the elderly and children, traditional societies, subsistence farmers and coastal populations (IPCC, 2007b). Furthermore, the global economic value of loss of life due to climate change impacts is expected to range between \$6 billion and \$88 billion, in 1990 dollar prices (IPCC, 2007b).



Photo: Solar panels in Thailand, © Asian development bank.

5.4 Impacts of climate change on reducing poverty

'The impacts of climate change will exacerbate poverty.' (Stern, 2007).

'A changing climate has had and will continue to have a significant impact on human life and natural systems.' (IPCC 2007b)

Table 6: Summary of impacts on reducing poverty¹⁸

Climate impacts at 2030-2050	Climate impacts at 2050-2100
<ul style="list-style-type: none"> By 2030, poverty increase of up to one third in Malawi, Uganda, and Zambia, due to climate-induced food security shocks. Countries prone to the greatest frequency of hazards in 2030 are likely to see high levels of extreme poverty in 2030. 	<ul style="list-style-type: none"> By 2100, in South Asia and sub-Saharan Africa, 145 million to 220 million additional people could fall below the \$2-a-day poverty line (at 3.9° to 4.3°C warming);. Every year an additional 165,000 to 250,000 children could die compared with a world without climate change by 2100 (at 3.9° to 4.3°C warming).

5.4.1 Current status and climate relevance

In recent years, the effort to end poverty has made substantial progress. According to UN estimates (2013a) the proportion of people living in extreme poverty globally has been halved. In developing regions, the proportion of people living on less than \$1.25 a day fell from 47% in 1990 to 22% in 2010. About 700 million fewer people lived in conditions of extreme poverty in 2010 than in 1990. The MDG poverty reduction target was reached five years ahead of schedule (UN, 2013a).

However, there is large regional variability hidden within these numbers, and 1.2 billion people still live in extreme poverty worldwide. A large amount of the progress occurred in China, while poverty remains widespread in sub-Saharan Africa and Southern Asia (UN, 2013a). In Southern Asia poverty rates have fallen by 21%, from 51% in 1990 to 30% two decades later. In contrast, the poverty rate in sub-Saharan Africa fell only 8% over the same period, and almost half the population live on less than \$1.25 a day. Due to population growth, the number of people living in extreme poverty actually rose (despite percentage reductions), from 290 million in 1990 to 414 million in 2010.

While the direct links between climate and income poverty are hardly studied, the preceding sections covering agriculture, nutrition, water, energy and health demonstrate the indirect links between climate change and income through, for example, reduced agricultural productivity. We also know that poverty subsequently influences other areas of development and is a key determinant of access to many other services: for example, unequal income distribution can weaken the educational performance of substantial numbers of students (Dickson et al., 2010). These chains of indirect impacts are typical of the billiard ball model in Figure 2.

A number of studies have associated losses from extreme and severe weather with a series of development indicators, finding significant correlations with education,

¹⁸ See table A3 for full details including references. Baselines have not been standardised; see each reference for full comparison.

socioeconomic development, income inequality, the availability of resources, population density, access to drinking water, female fertility, and some indicators of governance and public corruption (Striessnig et al., 2013; Patt et al., 2010; Yohe and Tol, 2002; Smit and Pilifosova, 2000; Brooks et al., 2005; Kellenberg and Mobarak, 2008). Completing a vicious circle, the magnitude of the expected impacts of climate change will increase the vulnerability of the more marginalised, poorer households in developing countries too (Mearns and Norton, 2010). According to UNICEF, the significance of these impacts highlights the urgency of adopting coping measures to increase people's resilience to climate change (UNICEF, 2012).

5.4.2 Future climate change impacts

Poverty is indirectly affected by climate change, which will have effects on health, income, assets, access to water and future growth prospects, which in turn exacerbate poverty further (IPCC, 2007b; Stern, 2007; AfDB, et al., 2003). Equally, poverty increases the vulnerability of developing nations to the impacts of climate change (Stern, 2007). This is supported by the findings of Nicholls (2004) and Nicholls and Tol (2006), who found that the level of development and population growth are important factors affecting vulnerability to sea-level rise.

Furthermore, within a developing country, the specific vulnerabilities of communities with climate-related risks, such as the elderly and the poor or indigenous communities, are typically much higher than for the population as a whole (IPCC, 2007b). The need for policy makers to understand the distinction not only between variations of vulnerability, but also between poverty and vulnerability (as well as where these two areas overlap and where they do not), is essential. This is emphasised by Brown (2011), who notes people experience vulnerability to climate change whether they are poor or not. Furthermore, among the poor there may be varying levels and patterns of vulnerability (Brown, 2011).

A good disaster risk management (DRM) system can be effective in reducing the impact of disasters on poor people (Shepherd et al., 2013). An example of this is Cyclone Nargis. In 2008, it killed 138,000 people in Burma, whereas Hurricane Gustav, a similar strength storm, killed 153 in the Caribbean and US. The majority of hazard-prone countries with large populations living in poverty also have relatively weak systems to manage disaster risk (Shepherd et al., 2013). Consequently, maintaining the status quo will see millions of poor people inadequately protected in the face of growing disaster threats.

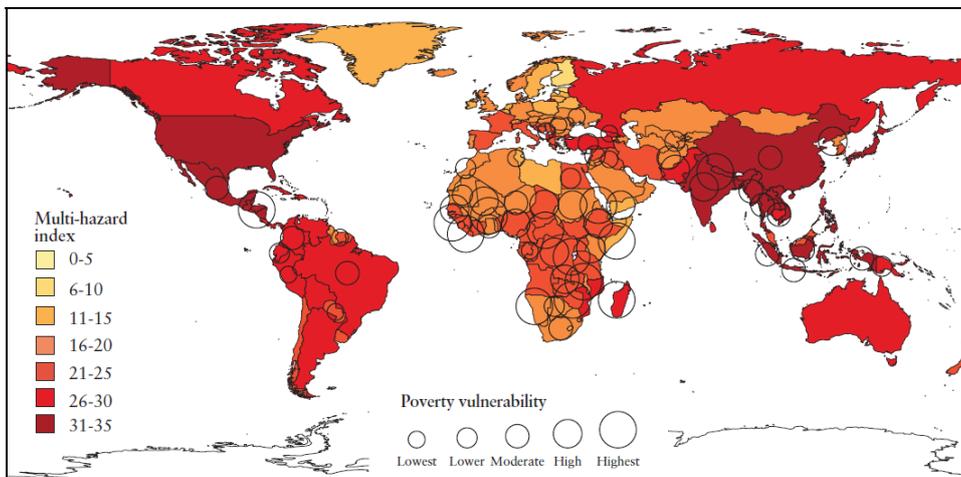
There is consensus that a changing climate has had a significant impact on human life and natural systems (IPCC, 2007b; UNICEF, 2012; UNSDSN, 2013; World Bank, 2013a; Stern, 2007). In their 2012 Special Report on Extreme Events, the IPCC stated that climate change will have substantial impacts on the severity and magnitude of climate extremes in the future and that as climate change becomes more dramatic, its effect on a range of climate extremes will become increasingly important and will play a more significant role in disaster impacts (CDKN, 2012). The impact of climate extremes will be determined by vulnerability and exposure, and increases in exposure and vulnerability will intensify the impact on people and assets (IPCC, 2012).

Aside from these extremes, climate projections suggest that some developing countries are likely to experience great loss in annual rainfall and –although variability is not well understood— increases in its variability, with dire implications for agricultural production and livelihoods (UNDP, 2013). Developing countries are most affected by changes in rainfall patterns and greater weather

extremes already due to lower resilience to shocks and livelihoods more dependent on natural resources such as water and agriculture.

Additionally, projections of income poverty and disasters further indicate that, by 2030, many poor people will be living in climatic hotspots. Shepherd et al. (2013) note that, combining dynamic climate, disaster and poverty projections, and in a 'business as usual' scenario, the world will still see high levels of poverty in 2030. Shepherd et al. (2013) conclude 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 hazards and climate extremes in 2030.

Figure 3: Hazards and vulnerability to poverty in 2030 – overlaying the Multi-Hazard Index and the Poverty Vulnerability Index



Source: Shepherd et al., 2013

Analysis of the overlaps between exposure of countries to multiple hazards¹⁹ and the Poverty Vulnerability Index reveals fragile, conflict-affected or post-conflict countries at the top of the list of the most vulnerable (Figure 3). Peters et al. (2013) further explore the overlaps of 'natural' hazards, conflict and fragility, finding that there is strong evidence that 'conflict and fragility increase the impact of natural disasters, notably by increasing vulnerability to natural hazards.'

However, there are also concerns that many adaptive actions may increase vulnerability or reduce welfare in the long term. According to a study by Eriksen and Brown (2011), there is emerging evidence that many of the responses to climate change run counter to principles of sustainable development. This is also supported by Barnett and O'Neil (2010), who note that adaptation policies and interventions that focus on reducing specific climate sensitivities, such as predicted changes in precipitation or hydrological regimes, can adversely affect vulnerable groups and create social inequality as well as unintentionally undermine environmental integrity. These findings highlight the often parallel and separate nature of climate change and development practices and programming and worryingly underline the evidence that few plans for promoting sustainability have explicitly included either adapting to climate change impacts or promoting adaptive capacity (IPCC, 2007b).

¹⁹ As measured by the Multi-Hazard Index, created by Shepherd et al (2013). The indicators represent heat, drought, flood, earthquake and tropical cyclone hazards.

5.5 Impacts of climate change on education

'Climate change has the serious potential to cause serious disruption to children's schooling [and] education is a vital tool in tackling climate change.' (UNICEF, 2013)

5.5.1 Current status and climate relevance



Photo: El Renacimiento School in Villanueva, Guatemala, © World Bank Photo Collection

Although progress has been made in developing regions, with the number of children out of school declining by almost half, from 102 million to 57 million between 2000 and 2011, the rate of progress has stalled. Achieving the MDG of universal primary education by 2015 is proving to be a difficult task, and if the current trends continue the world will not meet the education MDGs (UN, 2013a).

Children and adolescents from the poorest households are at least three times more likely to be out of school than children from the richest households (UN, 2013a), and household poverty is the single most important factor keeping children out of school (UNICEF, 2012). Girls are more likely to be out of school than boys among both primary and lower secondary age groups; this holds true even for girls in the richest households. The next steps in the provision of education will be further complicated due to the changing climate and the overlaps in areas of climate vulnerability and poor education. For example, sub-Saharan Africa is home to more than half the world's out-of-school children and also faces acute vulnerability to direct climate impacts.

There are 72 million children out of school worldwide and more than half of them (37 million) live in conflict-affected fragile states. 750,000 more children have their education disrupted, or miss out entirely on education, owing to humanitarian disasters (including climate-related) each year (Save the Children, 2008).

5.5.2 Future climate change impacts

The link between climate and education is primarily indirect: climate change has the potential to impact education through worsening health, poverty and peace

issues. Extreme events could cause higher mortality and morbidity rates among children, according to most literature. And this is especially severe in developing countries, where climate-sensitive health outcomes, such as malnutrition, diarrhoea, and malaria, are already common and coping capacities are lowest. Schooling and access to education for children will be indirectly affected through health impacts such as these (CDKN, 2012). An increase in occurrence and intensity of drought and disasters will reduce children's available time (which may be diverted to household tasks), while displacement and migration can reduce access to education opportunities as well (AfDB, et al., 2003). General impacts on security, poverty and livelihoods can lead to education becoming less affordable and inaccessible, and children may have to take paid work instead of finishing education (Stern, 2007).

Of course, climate change has the potential to threaten and damage educational infrastructure directly, making it physically impossible for children to attend school. As an example, in 2008 flooding in Bangladesh damaged 700 schools causing severe disruption in access to education for 50,000 children (Das, 2010). Overall these impacts not only affect education but combine to make children and communities more vulnerable to climate change.

5.6 Impacts of climate change on gender equality, peace and security and sustainable jobs and prosperity

'Climate change can exacerbate existing inequalities between and among women and men and intensify gendered experiences of poverty.'
(Demetriades and Esplen, 2008)

'Improved scientific understanding of the risks of climate change has pushed it to the top of the list of environmental threats to human security.' (Brown and McLeman, 2009)

'Climate change will increase outdoor and indoor heat loads, and may impair health and productivity for millions of working people.' (Kjellstrom et al. 2009)

5.6.1 Current status and climate relevance

Gender equality

Gender is a cross-cutting issue that can determine levels of access to food, education, health care, political status, domestic financial control and employment. It is generally recognised that widespread gender inequalities give rise to higher rates of poverty among women (Demetriades and Esplen, 2008; Plan, 2011). Vulnerability is not experienced equally by all women, since a range of factors influence this, including age, culture, geographies and income (Plan, 2011), with the World Bank identifying that the greatest gender gaps are found in the poorest families (World Bank, 2001).

The third MDG directly relates to promoting gender equality, and particularly focuses on empowering women. Globally, there have been improvements in closing the gap (UN, 2013A; UN, 2013a; World Economic Forum, 2013). The Global Gender Gap 2013 report, which benchmarks national gender gaps on economic, political, education and health-based criteria, concludes that, on average,

over 96% of the gap in health outcomes, 93% of the gap in educational attainment, 60% of the gap in economic participation and 21% of the gap in political empowerment has been closed (World Economic Forum, 2013). It does, however, acknowledge that no country in the world has achieved gender equality: out of the 110 countries covered by the report since 2006, 86% have improved their performance, while 14% have widening gaps. In developing regions, employment for women is generally less secure for women than for men, with fewer social benefits, and progress in promoting gender equality and the empowerment of women is expected to become more difficult in the face of climate change (Stern, 2007).

A vast amount of anecdotal evidence highlights how, on a household level, adolescent girls and women are more exposed to climatic shocks due to the need to take up additional household roles, such as cooking, looking after children and the elderly, collecting water or selling produce. For example, in 38 of the 48 countries examined by the UN (2010), ‘the percentage of households where an adult woman (15 years or over) is the person responsible for water collection is much larger than the percentage of households where an adult man is the person responsible,’ both in rural and urban contexts. An adult woman is ‘the person usually carrying home the water in 63% of rural households and 29% of urban households in sub-Saharan Africa,’ while men only gather water in 11% and 10% of the cases, respectively.

There is widespread acknowledgement among academics and NGOs of the potential of climate change to undo progress in closing the gender gap as the two concepts are highly interdependent, with climate change currently exacerbating existing inequalities across areas such as education, health care and food security (Dankelman, 2010). Constrained rights, restricted mobility and a muted voice in influencing decisions make women particularly vulnerable to climate change (UNDP, 2011).

UNDP (2013) indicates that among the factors that ‘account for the discrepancy between women’s and men’s differentiated exposure and vulnerability to climate change risks’ are the ‘gender-based differences in time use, access to assets and credit, and treatment by markets and formal institutions (including the legal and regulatory framework) [that] constrain women’s opportunities.’ UNDP (2013) also cites the global gender gap in earnings and productivity (‘women make between 30 and 80% of what men earn annually’), and legal differences on the basis of gender. A World Bank (2011b) survey in 141 countries showed that in 103 countries there are still legal differences on the basis of gender that may hamper women’s economic opportunities.

Peace and security

Meanwhile, the number of conflicts in the world increased steadily from the mid-1950s until peaking in the early 1990s (Buhaug et al., 2009). A decline in the number of conflicts since 1992 is attributed to a considerable increase in successful terminations of conflicts combined with a steady but small decline in the frequency of new conflicts (Buhaug et al., 2007). Throughout the 1990s the countries plagued by conflict were increasingly those with the lowest levels of human development, which meant that development efforts required that conflict be addressed (Denney, 2013). There is a distinct geographical grouping of conflict today, with most conflicts being fought in Asia or Africa. This geographical distribution is particularly relevant when considering the impact of climate change because where there is conflict there tends to be underdevelopment (Denney, 2013), although of course peace does not guarantee development and vice versa.

Perhaps the first prominent public mention of climate change in relation with security and peace was in September 2007, when German Chancellor Angela Merkel, while addressing the United Nations General Assembly, said that climate change was 'a threat to global stability', which could cause 'global conflict' if unimpeded (DW, 2007). The CIA has also been reported to have interests in geo-engineering because the US intelligence community sees climate change as a potential threat to global stability, and thus wants a thorough analysis of the mitigation options (Aldhous, 2013).

Sustainable jobs and prosperity



Photo: © Andres Martinez Casares, UNDP Photo collection

Job creation, sustainable livelihoods and equitable growth are key areas of the post-2015 development goals. The High Level Panel listed 'transforming economies for jobs and inclusive growth' as one of five global priority areas (UN, 2013b). Five years after the global economic crisis broke out, 197 million people worldwide were without a job in 2012 and a gap of 67 million jobs had opened up since 2007 (ILO, 2013).

The links between climate and employment exist primarily due to the connection between climate and the many sectors that provide employment opportunities. Agriculture is the second largest source of employment, with over one billion people employed worldwide (Olsen, 2009), and it is also where a lot of new jobs are to be made. Any impact upon the agriculture sector will affect employment opportunities. On top of this, there is the employment creation opportunity of nascent green sectors.

A move to a greener and climate resilient society will require a shift in employment that creates at least as many jobs as business as usual, although there is a period of job loss in the short term (UNEP, 2011; World Bank 2012). While green jobs are not a panacea for employment problems, International Labour Organisation studies illustrate that greening certain sectors of the economy can lead to an increase in direct and indirect employment (ILO, 2009) and green investments tend to be more employment intensive in the short to medium term (UNEP, 2011), an attractive proposition for policy makers. The

transition does require reskilling the workforce, and this goal is therefore closely linked with education.

Renewable energy, compared with fossil fuels energy, shows higher job creation rates, in the context of a sector – energy — which is a ‘relatively small direct employer and source of value added to the economy’ (Fankhauser et al., 2008, p.422).

5.6.2 Future climate change impacts

Gender equality

As said before, anecdotal evidence indicates that gender inequality will be impacted by climate change. Increased rainfall and flooding may force women to walk longer distances to collect clean drinking water. Likewise, droughts may also have the same consequence, with collection times interfering with education and increasing the chance of illness (Plan, 2011). Such impacts may affect physical and mental health, education drop-out rates, and, particularly in combination with finance discrimination, lack of political input and legal inferiority, and can leave women negatively impacted by climate (Demetriades and Esplen, 2008).

Adolescent girls tend to be particularly vulnerable to climate shocks as they fall between development and humanitarian communities due to lack of a voice (Plan, 2013). And with raised levels of vulnerability, as a result of unequal access to resources such as transportation and credit, women’s capacity to adapt will be lower. This is coupled with the existing vulnerability of women to the effects of disasters: women and children account for more than 75% of displaced persons following disasters (AfDB, et al., 2003; Stern, 2007). These factors, combined with social inequity and environmental integrity, make achieving gender equality a complex and politically driven process (Eriksen and Brown, 2011).

It is critical to point out that climate change and gender inequality could leave men powerless too. Arora-Jonsson (2011) indicates that the threat of food insecurity in India has driven up suicide rates among men. Terry (2009) also notes that gender-specific vulnerability and climate stress on rural livelihoods led to the death of hundreds of young West African men attempting to reach Europe.

However, in general, testimonies of the linkages between gender and climate change are only weakly supported by quantitative analysis - a critical space that needs to be filled with evidence-based research as much uncertainty still exists around the interaction of gender and climate change.

Peace and security

Climate disasters have the ability to ignite or exacerbate conflict by deepening existing grievances (Barnett and Adger, 2007; Brown and McLeman, 2009; Harris et al., 2013). Poverty, inequality and exclusion, and access to economic opportunities are among the factors that determine economic and social capital, and in turn capacity to adapt to climate change (Barnett and Adger, 2007). Climate change therefore has a number of impacts that in turn have substantial indirect implications for peace and security: increased scarcity and variability in the yields of renewable natural resources; sea-level rises triggering population displacement; and the escalation of disasters that would affect societies’ resource base, infrastructure, and settlement patterns (Buhaug et al., 2007; Mearns and Norton, 2010). It is in countries where there is already poor governance, social inequalities and other conflict-promoting features that climate change may exacerbate or induce conflict.

Nevertheless, it is difficult to find forecasts regarding the exact impacts of climate change on security and peace due to the indirect nature of the relationship. What we do know is that conflict and environmental issues are often linked: there is evidence of the link between migrants fleeing El Nino floods in 1997 with conflict ensuing in Lower Juba, Somalia (Keen, 1994; Narbeth and McLean, 2003). Reuveny (2007) found evidence that environmental pressures contributed to conflict in 'most' of the cases examined across Asia, Africa and Latin America.

As well as being aggravated by the impacts of climate change, conflict can also be an amplifier of the impact of climate change, as it increases vulnerability. The majority of countries most at risk from climate change are fragile, conflict-affected or post-conflict (Shepherd et al., 2013). Furthermore, increased attention to the links between disaster resilience and conflict prevention reveals that, despite a concurrence of hazards, conflict and fragility, there is a dearth of action on how to effectively support disaster risk reduction and climate actions in such difficult contexts (Peters et al., 2013).

An area of climate change that does directly affect the labour sphere is higher temperatures in developing countries. According to Kjellstrom et al. (2009), in many regions, climate change will decrease labour productivity unless specific adaptations are made. The report concludes that increased occupational heat exposure due to climate change may significantly impact on labour productivity and costs unless preventive measures are implemented. The consequences imply that longer hours or more workers may be required to achieve the same output, and that lost production and occupational health interventions will carry an economic cost.

Sustainable jobs and prosperity

In terms of indirect impacts on employment, the effect of climate change on key employment sectors such as agriculture and tourism will have a knock-on effect for job security and income. Agriculture is a critical sector for employment throughout the developing world, and the scale of economic losses due to reductions in crop productivity described in section 5.1 would severely affect employment. Tourism is another sector where climate change has the potential to disrupt employment: with the wider tourism and travel industry accounting for 10% of global GDP, losses here due to extreme events, sea-level changes or environmental damage (such as coral bleaching) could have large negative impacts.

Efforts to guard against climate change may bring to bear positive changes in employment patterns. The primary gains to be had in terms of employment generation are through green investments in agriculture, buildings, forestry and transport. For example investments in improved energy efficiency in buildings could generate an additional 2 million to 3.5 million jobs in Europe and the US alone (UNEP, 2011). A stimulus package in sustainable management to restore forest natural capital would provide an additional 10 million to 16 million jobs globally at an estimated cost of \$36 billion, mostly in developing countries (Nair and Rutt, 2009).

6 Conclusion and recommendations

The evidence reviewed in this report demonstrates the complexity, interconnectedness and scale of the expected impacts of climate change on poverty and implications for poverty reduction efforts.

For some issues, specifically food, agriculture, water, energy and health, there is evidence from multiple sources of the direct negative impacts of projected climate change on poverty and development. There is also a widely held expectation, rooted in our understanding of social and economic science, that climate change will indirectly impact on many other areas through complex knock-on causalities and dependencies. While the evidence is weaker in some areas than others, and improving quantitative analysis of the indirect relationships would support policy making and catalyse action, overall **the evidence strongly suggests that climate change will make poverty reduction and development increasingly difficult to achieve.**

In spite of this, there seems to be a considerable gap between the science and the concrete proposals as to how to incorporate climate change into a post-2015 agenda. Some consider that including the changing climate in the post-2015 debate could hinder the negotiations, and even derail the process. Environmental regulation is often seen as a handbrake to growth and at conflict with the route out of poverty, and the additional costs of meeting such targets could have effects on developing country competitiveness. The inclusion of climate change in a sustainable development agenda then produces questions about who pays what. Developing countries have repeatedly called developed countries to task for not delivering the promised finance, capacity-building and technology transfer for sustainable development. Without additional funds to finance actions to realise climate goals with the SDGs agenda, many developing countries could be unwilling to sign up to more targets.

With an eighteen-month period ahead in which poverty, climate change, and their inter-linkages will be explored in depth at high political levels, our key recommendations are:

1. In 2015 we must start a journey that credibly leads to successful climate action by 2030

The 2015 agreements need to be a foundation for raising ambition over time, in both climate action and poverty reduction. With the 2015 UNFCCC negotiations expected to establish new binding commitments only from 2020 until 2030, it is vital that the level of ambition is of the scale actually needed to tackle climate change in the timeframes required.

Even if enormous achievements in reducing existing levels of poverty were made over the immediate decades, climate change could reverse many of these gains, if not increase poverty above existing levels. To this end, **the UNFCCC has to succeed with an ambitious global agreement** resulting in a set of emissions cuts that meets the levels required by science, and mechanisms for finance and support that ensure global mitigation and adaptation responses are delivered to developing countries.

After the completion of the 2015 framework, the world must be credibly on the journey that leads to success in 2030, reducing poverty and keeping the planet under the 2°C target that is so vital for the future protection of human health and life. If we continue to emit at the same rate as in 2011, by 2040 the cumulative carbon emissions in the atmosphere will already have exceeded the total amount needed to ‘likely’ remain under 2°C warming²⁰. It is the cumulative emissions that are vital in determining the speed and extent of climate change. Therefore, **the emissions reduction pathway is important: the sooner action is implemented, the more cumulative emissions are reduced.** UNEP (2010) found that emissions pathways consistent with a likely chance of keeping global warming under 2°C peak before 2020 and have a steep emissions reduction curve immediately afterwards. Good action from 2015 onwards is therefore critical to overall success.

2. The achievement of any set of SDGs is dependent on the ability to adapt to climate change

Climate change, visible as both stresses and shocks, will affect any future human development in direct and indirect ways. For some areas of development, there are already relatively detailed impact estimates with high degrees of confidence. For others, the precise impacts remain more uncertain, although the pathways through which impact may occur are clearer.

The need for adaptation is driven home by the knowledge that we are likely committed to at least a 1.5°C rise in global average temperatures by the end of the century already, except under the most ambitious climate mitigation scenarios (IPCC, 2013a). Due to different metrics, levels of confidence and scenarios used to drive analysis, and the complex ways that climate impacts on society, it is not yet possible to create an estimate of the overall number of people that will be affected by climate change. Instead, what we can pull together from the research is that **impacts of climate change are likely to combine and magnify the negative effects in certain geographical locations rather than act in isolation**, dispersed across the world. For example, in Southeast Asia, at 2°C warming, we could see a decrease in water availability per capita of 20% to 30% (World Bank, 2013a) and a 24 million (21%) increase in the number of malnourished children (Parry et al., 2009).

From household to economy-wide scales, the direct impacts of climate change could exacerbate underlying societal problems and create a broad range of factors that further create or entrench poverty. Starting with declining agricultural yields and water availability, and changing disease patterns, for example, households and countries could also face growth in unemployment, increasing gender gaps and an exacerbation of existing tensions. Such population upheaval could result in collapse of the education and health systems, accentuate existing unemployment and

²⁰ IPCC (2013) reported global emissions of 9.5 GtC in 2011 and cumulative C emissions 2012-2100 of 270 (mean, a range of 140-410).

discrimination issues, and make poverty reduction a much bigger task. **Adaptation in a wide range of sectors and areas will be simultaneously needed, otherwise massive setbacks in development and poverty reduction will occur.**

One of the implications of this exercise for policy is that **conventional development policy will not necessarily lead to sustainable adaptation to climate change.** It is important for policy makers to understand that climate adaptation and development on their own are aimed at achieving different things. For example, Eriksen and Silva (2009) show how conventional rural development associated with shifts to land privatisation, commercial agriculture and market integration can weaken the ability of smallholder farmers to respond to drought. As described in section 5.4, it is the most fragile, or post-conflict, states where vulnerability and exposure to hazards most overlap. Developing countries are especially affected by changes in rainfall patterns and greater weather extremes already due to lower resilience to shocks and livelihoods more dependent on natural resources such as water and agriculture.

Stern (2007) argues that the key to adapting to climate change is development itself. This understanding can be noted in the number of development agencies that have established new mechanisms to support adaptation. However, Brown (2011) warns that the process of adaptation itself can exacerbate and reinforce inequalities, or further impoverish those who are already worse off. Furthermore, conventional development policies that address certain aspects of poverty are shown to have detrimental effects on the ability of poor people to adapt to climate change.

This means that it is not simply recognition of the need to adapt that is needed but an understanding of where adaptation and development overlap and where they do not. Therefore, it is important to ensure climate change and development are not held as externalities in the development and adaptation networks, as progress in either sphere may hinder efforts in the other over the next century.

3. There are different ways to integrate climate action and adaptation into the post-2015 goals and international processes, but the final result must add up to coordinated and sufficient action

This report has explored and revealed the strong linkages between climate change and development priorities, both direct and indirect. The issue is not only whether the linkages exist, but how to reflect them in a manner that drives sufficient action, accounting for the strengths and limitations of each policy framework. Will explicitly recognising climate in the post-2015 framework help get better results?

Experience shows that development cannot ignore risks such as changes, shocks and stresses. It also demonstrates that it cannot be taken for granted that these issues will automatically be considered during the post-2015 process, even if evidence shows that development can be more effective by taking these changes into account both: i) earlier rather than later; and ii) at the highest levels of planning, as argued by the World Bank in their 2014 World Development Report (2013c) and by Bettencourt et al. (2006). While there a number of options for linking climate and development, through the post-2015 and UNFCCC processes, and other key processes such as HFA2, **it is vital that the impacts of climate and shocks are integral to future plans to reduce poverty, and that the final policy outcomes incentivise this.**

Whatever the final goal areas, a group of them will see direct impacts from climate change, and there is a large body of evidence that supports this. In our study, these include ‘food security, nutrition and agriculture’, ‘access to energy, water and sanitation’ and ‘health’, but in practice these would include any goal areas that incorporate these sectors.

There will of course be goal areas where there is no real evidence to suggest a direct impact as a result of climate change. This however does not reduce the importance of recognising climate change, because these goal areas will likely be affected by crises in other goal areas. A good example of this is education, which is affected, among other things, by poverty levels and health. Given the reliance of many rural people on agriculture for their livelihoods and the documented health effects of hunger, there is an impact pathway from direct climate impacts on agriculture to an indirect one on education. Appreciating the linkages between the goal areas, and therefore the series of knock-on effects that climate change can have, could build momentum to ensure that climate change is adequately represented in sectors or goal areas where it otherwise might not be. Failing to do so risks a result where action in these vital areas is left uncoordinated, and ultimately insufficient when added together.

Concern over integration of climate action in a post-2015 framework centres on the visibility that goal status brings, compared with the more technical level of action required to meet specific indicators and targets. However, we believe that the primary risk is that climate is incorporated in a non-ambitious way, and that **the chief concern should be that a politically acceptable agreement is made that is effective**, whatever level it sits at within the post-2015 agreement. There are merits and disadvantages of integrating climate and poverty at all levels.

Whether mainstreaming climate using climate-smart targets embedded across all relevant goal areas, including climate within a goal on energy or DRR for example, or having a stand-alone climate change goal, the first point is that recognising climate change somehow is key. This is primarily because action on climate change and development efforts do not necessarily lead to each other without close coordination of the two agendas and policy coherence (Fischler et al., 2013). **The post-2015 agenda, at the very least, has a role to play guiding global efforts on climate change and signalling the international commitment to transition to a sustainable development pathway.**

Fischler et al. (2013) explore several approaches to integrating climate change into the SDGs²¹, including:

1. A ‘light touch’ or narrative-only approach where the importance of climate is reinforced in the narrative and framing, but not in the goals or targets.
2. Mainstreaming climate change targets to make all relevant goals ‘climate-smart’.
3. Different versions of a ‘stand-alone’ climate goal in addition to mainstreaming.

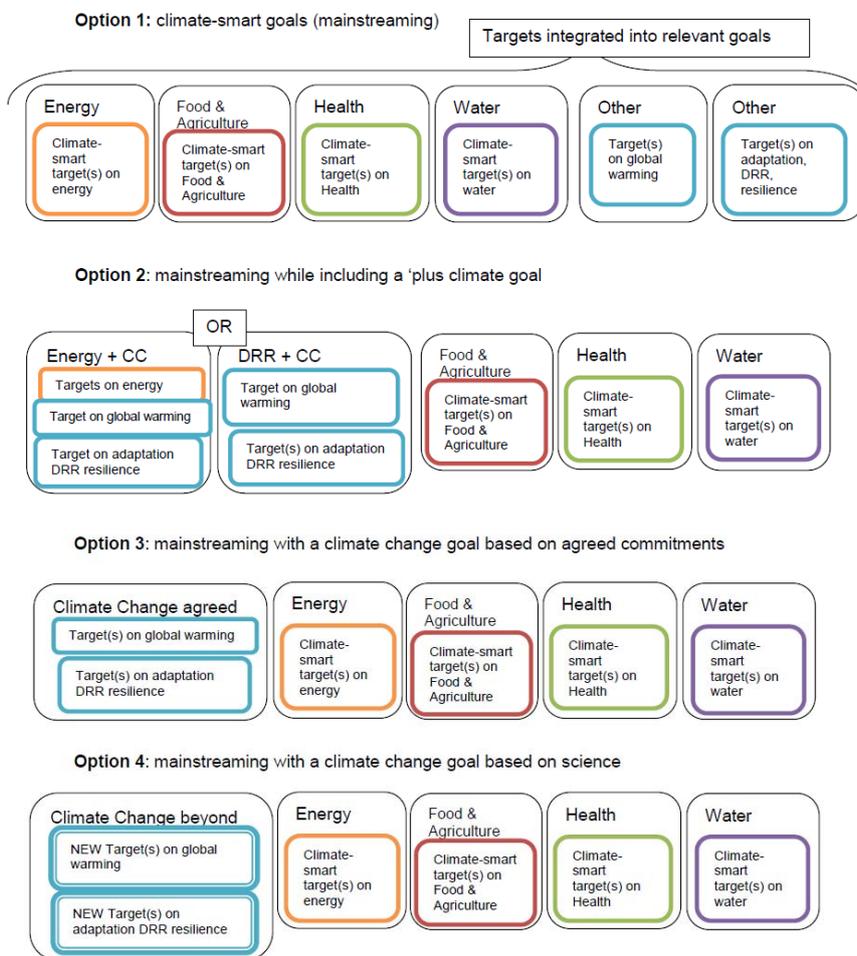
The options Fischler et al. (2013) contemplate are depicted in Figure 4²², but these authors recommend combining mainstreaming and a stand-alone goal as the best

²¹ Their paper is the result of the discussions on how to integrate climate change in international development efforts by a platform of non-governmental organisations called Beyond 2015 - www.beyond2015.org.

²² NB. Fischler et al. (2013) dismiss the narrative-only approach as insufficient.

way forward. With the underlying assumption that only concrete targets and indicators deliver concrete action, these authors recommend mainstreaming. That is why option 1 (including ‘climate-smart’ goals with targets that deliver ‘a triple win of ending poverty, shifting to low/zero carbon development, and enabling adaptation, disaster risk management and resilience to environmental shocks and stresses’) is deemed vital. However, it is not enough: ‘the risk of only using a mainstreaming approach (option 1) is that targets are dotted across the framework, meaning important aspects of climate action may be inadvertently missed or given low prioritisation. More importantly, mainstreaming reduces the political and public profile of climate change by not acknowledging it as a major sustainable development issue in its own right.’ So a stand-alone goal ‘based on actions deemed necessary by current science’ should be incorporated too, even if it would be ‘the politically most controversial option’ (Fischler et al., 2013).

Figure 4: Overview of the different options to integrate climate change in development goals



With the level of irreversible climate change we are committed to, the post-2015 framework provides a key moment in time to ensure that our development efforts prepare the world in such a way that poverty reduction does not take a step backwards as climate impacts on vital areas of human development. We also know that unless improvements in human development can be achieved with significant emissions reductions and alongside action on climate change, then poverty reduction and human progress in the long term will be impossible, and the effects will largely be felt by those living in poverty.

The post-2015 development goals are seen as a universal framework that guides action in all countries to end poverty and realise sustainable development. They are also meant to tackle the key global challenges hindering achievement of these goals. And climate change is a serious challenge that affects all countries. When all impacts are considered jointly, there is no doubt that addressing climate change must be pivotal to any development effort. Tackling climate change is development.

'We have much work to do...the Millennium Development Goals have shown the value of ambition and concrete targets. The Goals expire in 2015. After that we need new goals - sustainable development goals - and a clear post-2015 agenda that will take care of unfinished business, apply to all countries, and end extreme poverty once and for all.' UN Secretary-General Ban Ki-moon (Ki-moon, 2013).

Annexes

These tables contain the full body of research that was identified during the course of this study. We have found information relating to:

- Current status of goal or target area
- Medium-term impacts of climate change on the goal or target area (roughly the period between 2030 and 2050, but varies depending on source of information)
- Long-term impacts of climate change on the goal or target area (roughly the period between 2050 and 2100, but varies depending on source of information)

The tables are set out in relation to the sections of chapter 6 and our ‘indicative goal areas’. Within each goal area we have separated the information into global and regional components depending on the volume and relevance of the information.

Table A1: Food security, nutrition and agriculture

Global			
	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Hunger	From 2010 to 2012, 870 million people (852 million in developing countries), or one in eight worldwide, did not consume enough food on a regular basis to cover their minimum dietary energy requirements (UN, 2013a).	Climate change is not expected to reduce global food availability until after 2030, but it may increase the dependence of developing countries on food imports and accentuate food insecurity for vulnerable groups and countries (FAO, 2002). In these areas, there would be an increase in the people at risk of hunger, by between 30 million to 200 million if the carbon fertilisation effect is small (at 2° to 3°C warming) (Stern, 2007).	An additional 250 million to 550 million people may be at risk of hunger, the majority in Africa and Western Asia (at 3°C warming) (Stern, 2007). Overall, the number of people at risk of hunger is also projected to increase in Latin America (at 2° to 4°C warming) (IPCC, 2007b).

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Agriculture</p>	<p>A 55% increase in global crop production would be required by 2030 to meet global population demand, with an 80% increase by 2050. To facilitate this growth in output, another 185 million ha. of rain-fed crop land (19%) and another 60 million ha. of irrigated land (30%) will have to be created (FAO, 2013).</p> <p>Clear risks emerge as yield-reducing temperature thresholds for important crops have been observed, and crop yield improvements appear to have been offset or limited by existing observed warming (0.8°C) in many regions (World Bank, 2013a).</p>	<p>Yields from rain-dependent agriculture in Africa could be down by 50% by 2020 (at 1°C warming) (IPCC, 2007b). In tropical regions, even small amounts of warming will lead to declines in yield. In higher latitudes, crop yields may increase initially for moderate increases in temperature but then fall.</p> <p>Higher temperatures will lead to substantial declines in cereal production around the world, particularly if the carbon fertilisation effect is smaller than previously thought (Stern, 2007). Worldwide cereal production declines 5% for a 2°C rise.</p>	<p>By 2100, worldwide cereal production could decline by 10% (when a weak carbon fertilisation effect is used), with entire regions becoming too hot and dry to grow crops, including parts of Australia (at 4°C warming).</p> <p>Agricultural collapse across large areas of the world is possible at even higher temperatures (at 5°C to 6°C warming) (Stern, 2007).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Fisheries</p>	<p>Globally, fish provide about 17% of the population's average per capita intake of animal protein (FAO, 2013). About one billion people worldwide (one-sixth of the world's population) rely on fish as their primary source of animal protein (Stern, 2007).</p>	<p>By 2030, the world will require at least another 23 million tonnes of aquatic animal food, which aquaculture will have to provide (FAO, 2012).</p>	<p>Regional changes in the distribution and production of particular fish species are expected due to continued warming, with adverse effects projected for aquaculture and fisheries (IPCC, 2007b).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Agrobiodiversity</p>		<p>Around 15% to 40% of land species could be facing extinction, with most major species groups affected, including 25% to 60% of mammals in South Africa and 15% to 25% of butterflies in Australia. Coral reefs are expected to bleach annually in many areas, with most never recovering, affecting tens of millions of people that rely on coral reefs for their livelihood or food supply (at 2°C warming) (Stern, 2007).</p>	<p>Around 20% to 50% of land species could be facing extinction (at 3°C warming). Thousands of species may be lost in biodiversity hotspots around the world, e.g. over 40% of endemic species in some biodiversity hotspots, such as African national parks and Queensland rainforest in Australia. Large areas of coastal wetlands will be permanently lost because of sea-level rise (up to one-quarter according to some estimates), with acute risks in the Mediterranean, the USA and Southeast Asia. Mangroves and coral reefs are at particular risk from rapid sea-level rise. Strong drying over the Amazon, according to some climate models, would result in dieback of forest with the highest biodiversity on the planet (Stern, 2007).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Harvest area</p>			<p>Mean sea level is projected to rise by 50cm by 2100, leading to the loss of low-lying land in a number of regions. Heavily populated deltas used for agriculture such as in Bangladesh, China, Egypt, India and mainland Southeast Asia will be affected the most. In India alone, land losses could range from 1,000 km² to 2,000 km² by 2030, destroying between 70,000 and 150,000 livelihoods. In Guinea, between 17% and 30% of the existing rice field area could be lost as a result of permanent flooding (IPCC, 2007b).</p>

Sub-Saharan Africa

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Area	Expansion of harvested area (approximately 200 million ha. are cultivated) has led to increases in cereal production in sub-Saharan Africa from 1961-1963 to 2008-2010 (FAO, 2013).	The 2030s to 2040s could see about 40% to 80% reductions in present maize, millet, and sorghum cropping areas for current cultivars (at 1.5° to 2°C warming (World Bank, 2013a).	Significant production shocks are likely for major cereals like wheat, maize, and rice (at 2° and 4°C warming) (IPCC, 2007b).
Crop yield and production	<p>Crop yields have been stagnant for decades at less than 1.5 tonnes per ha. (UNDP, 2012).</p> <p>Sub-Saharan Africa has seen a trend of falling per capita cereal production with stalled per capita production in livestock (UNDP, 2012).</p>	<p>Projected reductions in yield in some countries could be as much as 50% by 2020 due to reduction in the length of growing season, as well as the loss of large regions of marginal agriculture as areas of hyper-arid and arid regions grow by 3% (IPCC, 2007b; World Bank, 2013a).</p> <p>At 1.5°C warming an increase in failure rate of primary season in mixed rain-fed arid-semiarid systems of 35% to 40%, compared to conditions in the period from 1960 to 2002, resulting in a failure rate of one in four years (World Bank, 2013a), up from one in five at present. At 2°C warming an increase in failure rate by about 60% to 70%, resulting in a failure rate of one in three years.</p>	<p>This reduction could grow to more than 90% (at 3°C warming) (World Bank, 2013a). With significant risks of yield reductions in Africa, with the mean changes at 17% for wheat, 5% for maize, 15% for sorghum, and 10% for millet (Knox et al., 2012).</p> <p>It is estimated that, by 2100, parts of the Sahara are likely to emerge as the most vulnerable, showing likely agricultural losses of between 2% and 7% of GDP. West and central Africa are also vulnerable, with impacts ranging from 2% to 4%. North and southern Africa, however, are expected to have losses of 0.4% to 1.3% (IPCC, 2007b).</p> <p>Wheat production is likely to disappear from Africa by the 2080s (IPCC, 2007b).</p>
Fish production	Fish production per capita is projected to remain stagnant in sub-Saharan Africa up to 2020 from 1973 levels (UNDP, 2012).	<p>Potential fish catches off the coast of West Africa, where fish account for as much as 50% of the animal protein consumed, are likely to be reduced by as much as 50% (compared to 2000 levels) by the 2050s (a 2°C warming scenario) (World Bank, 2013a).</p> <p>Significant changes in maximum catch potential for West African coast of 5% to 16% losses for Namibia, 15% gain to 31% losses for Cameroon and Gabon, and up to 50% losses off the coast of Côte d'Ivoire, Ghana, Liberia, Togo, Nigeria, and Sierra Leone by 2050 compared to 2000 levels (at 2°C warming) (World Bank, 2013a).</p> <p>There is potential for offshore catch increases along the eastern and south-eastern coast of sub-Saharan Africa of 16% (Madagascar, Mozambique, Tanzania, and Kenya). With closer proximity to the coast, yield reductions of 16% to 5% are projected. However, potential catch increases of up to 100% at the coast of</p>	

Somalia and South Africa could be experienced (World Bank, 2013a).

Asia

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Crop yields and productivity	<p>Crop production without climate change is projected to increase significantly (by 60%) in the region and to be under increased price pressure and a trend factor expressing technological improvements, research and development, extension of markets, and infrastructure (World Bank, 2013a).</p> <p>The Mekong River and its tributaries are home to some 17 million people, of whom 80% are engaged in rice cultivation. The delta produces around 50% of the country's total production and contributes significantly to Viet Nam's rice exports. Any shortfall in rice production in this area because of climate change would not only affect the economy and food security of Viet Nam but would also have repercussions for the international rice market (World Bank, 2013a).</p>	<p>It is projected that crop yields could increase up to 20% in East and Southeast Asia, while they could decrease up to 30% in Central and South Asia by the mid-21st century (at 1° to 2°C warming). Taken together and considering the influence of rapid population growth and urbanisation, the risk of hunger is projected to remain very high in several developing countries (IPCC, 2007b).</p> <p>For South Asia, mean production will be reduced by 16% for maize and 11% for sorghum by 2050, but there is no average change forecast for rice (Knox et al., 2012). However, analysis by Masutomi et al. (2009) points to average reductions of Asian rice yields of between 5% and 9% in the 2050s without accounting for the CO₂ fertilisation effect, although this decrease is predicted to be counteracted if a CO₂ fertilisation effect occurs.</p>	<p>Crop yields are projected to decrease around 10% to 30% with the largest reductions in the cases where the CO₂ fertilisation effect is weak (at 3° to 4.5°C warming) (World Bank, 2013a).</p> <p>By the 2050s, the BAU crop increase may be reduced by at least 12%, requiring more than twice the imports to meet per capita demand than is required without climate change (at 2°C warming). As a result, per capita calorie availability is projected to decrease significantly (World Bank, 2013a).</p>
Fisheries	<p>In 2004, fishery exports in Viet Nam amounted to \$2.36 billion and 90% of commercial landings came from offshore fisheries. Exports of overall fish and fishery products in the Philippines amounted to \$525.4 million (World Bank, 2013a).</p>	<p>The projected changes in maximum catch potential ranges from a 16% decrease in the waters of Viet Nam to a 6% to 16% increase around the northern Philippines. Additionally, marine capture fisheries production (not directly associated with coral systems) is projected to decline by 50% around the southern Philippines (at 2°C warming) (World Bank, 2013a).</p>	
Harvest area	<p>2.6 million ha. in the Mekong Delta are used for agriculture, which is one fourth of Viet Nam's total (General Statistics Office, 2012).</p>	<p>A sea-level rise of 30cm, which could occur as early as 2040, is projected to result in the loss of about 12% of the cropping area of the Mekong Delta Province of Viet Nam due to flooding (5% loss) and salinity intrusion (7% loss) (World Bank, 2013a).</p>	

Table A2: Access to energy, water and sanitation

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Water stress	<p>Around one-third of today's global population live in countries experiencing moderate to high water stress, and 1.1 billion people lack access to safe water (Stern, 2007).</p>	<p>1 billion to 4 billion people will experience growing water shortages, predominantly in Africa, the Middle East, Southern Europe, and parts of South and Central America (at 2°C warming) (Stern, 2007).</p> <p>In Africa, between 75 million and 250 million people are projected to be exposed to increased water stress due to climate change by 2020 (at 1°C warming). If coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems (IPCC, 2007b).</p>	<p>In Africa, 350 million to 600 million people are projected to be exposed to increased water stress by the 2050s (at 1° to 2°C warming) (IPCC, 2007b).</p> <p>Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits (high confidence). By the 2050s, the area of land subject to increasing water stress due to climate change is projected to be more than double that with decreasing water stress (at 1° to 2°C warming) (Bates et al., 2008).</p>
Drought	<p>Drought, as measured by the Palmer Drought Severity Index, increased in the 20th century, although some areas became wetter (IPCC, 2007b).</p>	<p>Increasing drought risk (at 1.5°C warming) in southern, central, and West Africa and at 2°C warming, likely risk of severe drought in southern and central Africa (World Bank 2013a) and increased risk in West Africa. In both scenarios a decreased risk in East Africa, but West and East African projections are uncertain (World Bank, 2013a).</p> <p>Assessments of drought, extreme temperature and flood hazards alone reveal that between 176 million 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 (Shepherd et al., 2013).</p> <p>The countries prone to the greatest range and frequency of hazards in 2030 are also likely to see high levels of extreme poverty in 2030. Just assessing drought hazards brings in many sub-Saharan Africa countries, where up to 171 million poor people will be exposed to drought hazards in 2030, depending on the poverty models used: Benin (5 to 6 million); Burkina Faso (8 to 11 million); DRC (20 to 30 million); Ethiopia (12 to 22 million); Kenya (6 to 11 million); Mali (6 to 9 million); Niger (4 to 8 million); Nigeria (14 to 22 million); Senegal (5 to 8 million); Sudan (12 to 18 million); Uganda (3 to 7 million) (Shepherd et al., 2013).</p>	<p>At 3°C warming and above, likely risk of extreme drought in southern Africa and severe drought in central Africa, increased risk in West Africa, and decrease in East Africa. West and East African projections are uncertain (World Bank, 2013a).</p> <p>The proportion of land area experiencing severe droughts at any one time will increase from around 10% today to 40% and the proportion of land area experiencing extreme droughts will increase from 3% to 30% (at 3° to 4°C warming). (Stern, 2007). In Southern Europe, serious droughts may occur every 10 years (at 3°C warming) (Stern, 2007).</p>

Water availability	<p>In Southeast Asia, with the projected population increase factored in, a large decrease in water availability per capita in the order of 20% to 30% is estimated by 2069 to 2099 (at 1.8°C warming) (World Bank, 2013a).</p> <p>In contrast, South Asia and parts of Northern Europe and Russia are likely to experience increases in water availability (runoff), for example a 10% to 20% increase (at 2°C warming) (Stern, 2007).</p>	<p>The Mediterranean basin and parts of southern Africa and South America are likely to experience further decreases in water availability by up to 40% to 50% (at 4°C warming) (Stern, 2007).</p> <p>Approximately 10% increase in summer (wet season) rainfall is predicted (at 4°C warming). Intra-seasonal variability of monsoon rainfall increased by about 15% (World Bank, 2013a).</p> <p>In contrast, South Asia and parts of Northern Europe and Russia are likely to experience increases in water availability (runoff), for example slightly greater than 10% to 20% increases (at 4°C warming) (Stern, 2007).</p> <p>In Southeast Asia, there will be a large decrease in water availability per capita in the order of 10% to 20% (at 4°C warming) (World Bank, 2013a).</p> <p>Water supplies stored in glaciers and snow cover are projected to decline in the course of the century (Bates, 2008).</p>
Flooding	<p>1 billion to 5 billion people, mostly in South and East Asia, may receive more water. However, much of the extra water will come during the wet season and will only be useful for alleviating shortages in the dry season if storage could be created (at a cost). The additional water could also give rise to more serious flooding during the wet season (Stern, 2007).</p>	<p>Between 7 million to 70 million and 20 million to 300 million additional people will be flooded each year due to 20cm to 80cm of sea-level rise (at 3° to 4°C warming) (low and high population growth assumptions respectively) (Stern, 2007).</p> <p>By 2050, rising populations in flood-prone lands, climate change, deforestation, loss of wetlands and rising sea levels are expected to increase the number of people vulnerable to flood disaster to 2 billion (WWAP, 2012).</p>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">South Asian water availability</p>	<p>South Asia's average per capita water availability is less than 2,500m³ annually, compared to a worldwide average of almost 7,000m³ per capita per year (World Bank, 2013a).</p> <p>In rural areas of India, Bangladesh, Pakistan, Nepal, and Sri Lanka, 10% or more of the population still remain without access to an adequate amount of water. In the year 2010 in India, only 34% of the population had access to sanitation; in Pakistan that proportion is 48% and in Bangladesh it is 54% (World Bank, 2013a).</p>	<p>Food water requirements in India are projected to exceed the water available for rain-fed agriculture by more than 150% (at 2°C warming), indicating the country will be highly dependent on irrigation water for agricultural production (World Bank, 2013a).</p> <p>Freshwater availability in Central, South, East and Southeast Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s (IPCC, 2007b).</p> <p>By 2050, water availability in Pakistan and Nepal is projected to be too low for self-sufficiency in food production (at 2°C warming) (World Bank, 2013a). Without adequate water storage facilities, the increase of peak monsoon river flow would not be usable for agricultural productivity; increased peak flow may also cause damage to farms due to river flooding (World Bank, 2013a).</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Irrigation water</p>	<p>Global irrigation water demand (ensemble of all RCPs) increases by 10% by mid-century. Projected global irrigation water demand exhibits the largest increase under RCP 8.5: 12% increase by 2050s. Even under RCP 2.6 global irrigation water demand increases by 9% by 2050s, although the increase subsides by 2080s (Wada et al., 2013).</p>	<p>Global irrigation water demand (ensemble of all RCPs) increases by 14% by the 2080s. Projected global irrigation water demand exhibits the largest increase under RCP 8.5 - 21% by the 2080s. For RCP 6.0 the increase in irrigation water demand is substantial (>20%) for China, Europe and southern Africa, and becomes even larger for RP8.5, under which scenario the change in irrigation water demand exceeds 35% in many heavily irrigated regions in the USA, Europe, Asia and Africa (Wada et al., 2013).</p> <p>Reductions in water availability in the Indus, Ganges, and Brahmaputra Rivers, due in part to loss of glacial melt water from the Himalayas, may impact food security. More than 63 million fewer people could be fed by the river basins due to reduced water availability (World Bank, 2013a).</p>

Table A3: Health

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Vector borne diseases	<p>The incidence of dengue has grown dramatically around the world in recent decades. More than 2.5 billion people – over 40% of the world's population – are now at risk from dengue. WHO currently estimates there may be 50 million to 100 million dengue infections worldwide every year (WHO, 2013a).</p> <p>450 million people are exposed to malaria today, of which around 1 million die each year (Stern, 2007).</p> <p>A range of vector-borne illnesses have been linked to climate, including malaria, dengue, Hantavirus, Bluetongue, Ross River Virus, and cholera. Cholera, for example, has seasonal variability that may be directly affected by climate change. Vector-borne illnesses have been projected to increase in geographic reach and severity as temperatures rise, though such shifts depend on a variety of human interventions like deforestation and land use (CDKN, 2012).</p>	<p>There will be 40 million to 60 million more people exposed to malaria in Africa, a 9% to 14% increase on present-day (at 2°C warming) (Stern, 2007).</p> <p>Previously malaria-free highland areas in Ethiopia, Kenya, Rwanda and Burundi could experience modest changes to stable malaria by the 2050s, with conditions for transmission becoming highly suitable by the 2080s (IPCC, 2007b).</p>	<p>Increase in malaria exposure of 70 million to 80 million people (16% to 19%), assuming no change to malaria control efforts (at 3° to 4°C warming) (Stern, 2007)</p> <p>It is estimated that by the 2080s, 5 billion to 6 billion people will be at risk of dengue as a result of climate change and population increase, compared with 3.5 billion people if the climate remained unchanged (at 3°C, low confidence) (IPCC, 2007b).</p>
Child health	<p>101 million children (16% of children, or one in six) under age five were underweight in 2011. The number of underweight children in 2011 fell by 36% from an estimated 159 million children in 1990. Still, this rate of progress is insufficient to meet the MDG target of halving the proportion of people who suffer from hunger by 2015 (UN, 2013a).</p> <p>Globally, more than one quarter (26%) of children under age five were stunted in 2011. Though still unacceptably high, the proportion represents a 35% decline from 1990 to 2011 (from 253 million to 165 million children) (UN, 2013a).</p>	<p>24 million (21%) increase in the number of malnourished children in 2050 as a result of climate change (Parry et al., 2009).</p> <p>A 62% increase in severe childhood stunting and a 29% increase in moderate stunting in South Asia by 2050 (at 2°C warming) (World Bank, 2013a).</p>	
Diarrhoea	<p>Diarrhoeal disease is the major cause of child mortality in Asia and the Pacific, accounting for 13.1% of all deaths under age five (World Bank, 2013a).</p> <p>South Asia has a declining trend in the incidence of the disease. In the absence of climate change, cases of diarrhoeal disease in South Asia (including Afghanistan) would decrease earlier, as the expected rise in income would allow South Asian countries to invest in their health services (World Bank, 2013a).</p>	<p>Climate change is projected to increase the burden of diarrhoeal diseases in low-income regions by approximately 2% to 5% in 2020 (a 1°C warming, medium confidence) (IPCC, 2007b).</p> <p>In Southeast Asia, an increase of 6%, compared to an average increase across the world of 3%, by 2030 in the relative risk of diarrhoeal disease under climate change scenarios, by 2030 (at 1.5°C warming) (World</p>	<p>The relative risk of diarrhoea is expected to increase 5% to 11% for the period 2010 to 2039 (at 1.5°C warming) and 13% to 31% for the period 2070 to 2099 in South East Asia relative to 1961 to 1990 (at 4°C warming) (World Bank, 2013a).</p>

Bank, 2013a).

Table A4: Reduction of income poverty

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Poverty	<p>1.2 billion people are still living in extreme poverty worldwide. In sub-Saharan Africa, almost half the population live on less than \$1.25 a day. It is the only region that saw the number of people living in extreme poverty rise steadily, from 290 million in 1990 to 414 million in 2010, accounting for more than a third of people worldwide who are destitute (UN, 2013a).</p>	<p>By 2030, poverty implications because of food price rises in response to productivity shocks have the strongest adverse effects on non-agricultural, self-employed households and urban households, with poverty increases by up to one third in Malawi, Uganda, and Zambia (Hertel, T., Burke, M., and Lobell, D., 2010).</p> <p>Following a ‘business as usual’ strategy will see high levels of poverty remain in 2030. Disasters have the potential to entrench existing poverty and cause high numbers of people to drop into poverty as their assets are depleted and means of generating income are restricted. Risk of impoverishment is associated with lack of access to markets, capital and insurance mechanisms that can help people to cope and rebuild. The combination of exposure to climate vulnerability and limited access to social safety nets, to land and to work, together with living in a rural location, is an additional risk indicator (Shepherd et al., 2013).</p>	<p>By 2100, in South Asia and sub-Saharan Africa, up to 145 million to 220 million additional people could fall below the \$2-a-day poverty line, and every year an additional 165,000 to 250,000 children could die compared with a world without climate change (at 3.9° to 4.3°C warming) (Stern, 2007).</p>

Table A5: Climate change impacts on education

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Education	<p>Considerable progress has been made in South Asia, where the adjusted net enrolment rate of children of primary school age increased from 78% to 93% between 2000 and 2011. Almost half the reduction in the global number of children out of school can be attributed to this region, where the number of such children fell from a high of 38 million in 2000 to 12 million in 2011 (UN, 2013a).</p> <p>In 2008 approximately 49 schools were washed away</p>	<p>Climate change could exacerbate the existing development challenge of ensuring that the educational needs of all children are met. Several factors that are expected to worsen with climate change, including undernourishment, childhood stunting, malaria and other diseases, can undermine childhood educational performance. The projected increase in extreme monthly temperatures within the next few decades may also have an adverse effect on learning conditions (World Bank, 2013a).</p>	<p>Climatic disasters can threaten educational infrastructure making it physically impossible for children to attend school. Education levels may also decline through climate-induced changes in income and health conditions. Schooling will become less affordable and accessible, especially for girls, as income, assets and employment opportunities are affected by climate change. Children will need to help more with household tasks or prematurely engage in paid employment leaving less time for</p>

<p>and 700 schools were seriously damaged causing severe disruption in access to education for around 50,000 children. The total rehabilitation cost for the damage was approximately \$8 million (Das, 2009)</p>	<p>schooling. Deteriorating health conditions will also affect both a child's learning abilities and school attendance, and the supply of teachers. Children will be deprived of the long-term benefits of education and will be more vulnerable to the effects of climate change (Stern, 2007).</p>
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Table A6: Climate change impacts on sustainable jobs and access to prosperity

	Current development status	Climate impacts at 2030-2050	Climate impacts at 2050-2100
Agriculture	<p>Over 1 billion people are employed in the agriculture sector. It is the second greatest source of employment worldwide after services. As agriculture is affected by extreme weather events, salinisation of irrigation water and degradation of marginal lands, workers in the sector will be adversely affected and will have to look for new ways to grow their crops and find new pastures (Olsen, 2009).</p>	<p>By 2030, strong adverse effects on non-agricultural, self-employed households and urban households are possible, with poverty increases by up to one third in Malawi, Uganda, and Zambia. On the contrary, in some exporting regions and countries (for example, Australia, New Zealand and Brazil) aggregate trade gains would outweigh the negative effect of direct crop losses (World Bank, 2013a; Hertel et al., 2010). Indeed, the rise in price more than offsets the adverse impact of lower agricultural productivity in some cases (Hertel et al., 2010).</p>	<p>In economic terms, losses for three crops in Kenya (mangoes, cashew nuts and coconuts) could amount to almost \$500 million with a 1m sea-level rise (IPCC, 2007b).</p>
Tourism	<p>One job in the direct tourism industry creates roughly one and a half additional (indirect) jobs in the wider related economy (Olsen, 2009). The industry creates more than 230 million direct and indirect jobs (60% to 70% are women), representing approximately 8% of the entire global workforce (Olsen, 2009).</p> <p>At the end of 2007 the wider travel and tourism industry accounted for 10.3% of global gross domestic product (Olsen, 2009).</p> <p>Coral reef loss and degradation would have severe impacts for marine fisheries and tourism. Increasing sea surface temperatures have already led to major, damaging coral bleaching events in the last few decades (World Bank, 2013a).</p>	<p>The tourism sector is highly affected by climate change. As a result of rising sea levels, many coastal areas and small islands will have to address changes in relation to jobs (Olsen, 2009).</p> <p>There is a 50% probability risk of annual coral bleaching events occurring in the Southeast Asia region as early as 2030 (at 1.2°C warming) (World Bank, 2013a).</p>	<p>Projections indicate that all coral reefs in the Southeast Asia region are very likely to experience severe thermal stress by the year 2050, as well as chemical stress due to ocean acidification. The likelihood for coral bleaching is 100% by 2100 (at 4°C warming). There are strong indications that this could have devastating impacts on tourism revenue (World Bank, 2013a).</p>

Infrastructure	<p>Storms and associated flooding are already the most costly disaster today, making up almost 90% of the total losses from climate catastrophes in 2005 (\$184 billion from windstorms alone, particularly hurricanes and typhoons). A large proportion of the financial losses fall in the developed world, because of the high value and large amount of infrastructure at risk (Stern, 2007).</p>	<p>Damage to infrastructure from storms will increase substantially with only small increases in event intensity. Changes in soil conditions (from droughts or permafrost melting) will influence the stability of buildings (Stern, 2007).</p>
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