

The Challenges of Climate Change

Children on the front line



The UNICEF Office of Research

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In late 2012, the UNICEF Office of Research produced an edition of its online debate Research Watch on Climate Change and Children: www.unicef-irc.org/research-watch/Climate-change-and-children/

The response received from the public, partners and UNICEF colleagues was extremely positive. So much so that the Office decided to expand the project into an e-book, bringing together the thoughts and arguments of experts and advocates on different aspects of climate change, with the aim of broadening debate around the issue with a special focus on the implications for and interests of children.

The original outline was discussed and prepared with the support of Joy Guillemot, who helped to translate our many ideas into a concrete project. The final publication has benefited greatly from her clear insights. Chris Brazier also provided wise guidance and sensitive editing.

Patrizia Faustini coordinated and managed the overall project under the supervision of James Elder.

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Abbreviations and Acronyms

| | |
|--------------------|--|
| ACCCRN | Asian Cities Climate Change Resilience Network |
| ADB | Asian Development Bank |
| APMEN | Asia Pacific Migration and Environment Network |
| AR (AR3, AR4, AR5) | Assessment Report (of the Intergovernmental Panel on Climate Change) |
| CCDare | Climate Change and Development – Adapting by REducing vulnerability |
| CO ₂ | carbon dioxide gas |
| COP | Conference of Parties |
| CRC | Convention on the Rights of the Child |
| DNPI | Dewan Nasional Perubahan Iklim (National Council on Climate Change, Indonesia) |
| DRR | disaster risk reduction |
| EBA | ecosystem-based adaptation |
| ECS | equilibrium climate sensitivity |
| FAO | Food and Agriculture Organization of the United Nations |
| GAC | Global Action Classroom |
| GHGs | greenhouse gases |
| IAASTD | International Assessment of Agricultural Knowledge, Science and Technology for Development |
| IIIEE | International Institute of Industrial Environment Economics |
| IOM | International Organization for Migration |
| IPCC | Intergovernmental Panel on Climate Change |
| ISA | injection of stratospheric aerosols |
| KfW | Kreditanstalt für Wiederaufbau (German government-owned development bank) |
| MDGs | Millennium Development Goals |
| MEA | Millennium Ecosystem Assessment |
| NGO | non-governmental organization |
| OHCHR | Office of the High Commissioner for Human Rights |
| PDSI | Palmer Drought Severity Index |
| RCP | representative concentration pathways |
| RYTF | Rockaway Youth Task Force |
| SMC | Surat Municipal Corporation |
| TCR | transient climate response |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNHCR | United Nations High Commission for Refugees |
| WHO | World Health Organization |
| YMP | Young Masters Programme (on sustainable development) |
| YOUNGO | Youth non-governmental organizations |
| YUNGA | Youth and United Nations Global Alliance |

Foreword

In November 2013, delegates assembled in Warsaw, Poland, for the latest in a series of conferences within the United Nations Framework Convention on Climate Change. The aim was to reach an agreement on a new binding protocol to limit greenhouse-gas emissions by 2015. Progress was slower than anticipated and far slower than is needed. The consequences of this affect all of us. They especially affect children and young people who will, in the future, shoulder the burden of climate change but whose needs and views, until recently, have not been considered adequately in the debates surrounding it. Increasingly, though, children and young people are raising their voices and contributing to the conversation through their resourcefulness, imagination, and ethical as well as practical concerns. When UNICEF UK carried out an Ipsos MORI poll in 2013, it found that not only were 74 per cent of British children aged 11–16 worried about how climate change would affect their future, 63 per cent were also concerned about how children and families in developing countries would be affected. *“Unless we take action,”* said 14-year-old Eshita, *“I fear that, by the time I reach 30, the problems we are faced with now will seem minute in comparison.”* Similar polling in the United States showed that nearly three out of four young voters would be less likely to vote for a candidate who opposed the government’s current plan to tackle climate change.

As the effects of climate change become more visible and extreme, they are likely to affect adversely the lives of children and adolescents all over the world. For example, families that lose their livelihoods to drought will be less able to afford the costs of schooling or health care. Over 99 per cent of deaths already attributable to climate-related changes occur in developing countries – and children make up over 80 per cent of those deaths. Diseases may spread – especially diseases that threaten children more than adults, such as malaria and diarrhoea. Hard-won development progress may be reversed.

In fact, one of the key messages of this e-book is that climate change both feeds on and accentuates inequality. The inequality, for example, between the inhabitants of the present and those of the future whose legacy is being squandered; between the countries that have emitted the most carbon and those that are paying the price of those emissions; and, within nations, between the fortunate and the have-nots who are already undernourished or living in unsanitary conditions.

Inequality undermines the world’s capacity to care for its most vulnerable, youngest citizens, those who should be protected by the Convention on the Rights of the Child (CRC). This e-book emphasizes the importance of upholding children’s rights in the post-2015 development agenda and the climate negotiations.

A commitment to reduce greenhouse gas emissions will benefit all of us – but especially children. Improving the lives of marginalized communities in developing countries means embarking on and funding low carbon development. We must also recognize the interconnectedness of climate change with other sectors. Investments in health, education, nutrition, sanitation, and access to sustainable energy are beneficial in and of themselves.

They also make children and their families more resilient and better able to adapt to climate change and its hazards.

The challenge of climate change is huge; it requires an urgent response from all generations – and the children who will inherit the earth are the last people who should be excluded. 14-year-old Khadidiatou from Senegal summed it up well when she said: *“I want governments to establish an agreement between the rich and the poor, to make adaptation better in African countries. You need to listen to the voice of the children!”*



Anthony Lake, Executive Director, UNICEF

Preface

Children and young people represent 30 per cent of the world's population. Not only do they represent the largest group of people currently affected by climate change, but they are also more vulnerable than adults to its harmful effects. Children and young people also constitute the generation that will be required to deal with the future impacts of climate change and that will have to deliver the very deep cuts in greenhouse gas emissions that will be essential in the coming decades. Yet they are a constituency that has traditionally been ignored when it comes to high-level climate negotiations.

This book is an attempt to redress the balance. It aims to insert children's perspectives into the global debate on how we should mitigate climate change and adapt to its impacts. It brings together the knowledge and opinions of 40 contributors – scientists, development workers, and experts in health, nutrition and children's rights – in an attempt to build up a clear picture of what climate change means for the children of today and tomorrow.

The authors aver that climate change is not a distant prospect, the causes and effects of which can be debated in abstract terms; it is happening now. Extreme weather events are both happening more frequently and are increasing in force and intensity. Rising sea levels are already depriving people of their homes and of the environments on which they depend. Climate change is already decreasing biodiversity and causing the acidification of the oceans.

The brunt of the impact of climate change is borne by children. The World Health Organization (2012) has estimated that children suffer more than 80 per cent of the morbidity and mortality produced by climate change – with those in poorer areas inevitably being the worst affected. As rising temperatures produce a spread of malaria into previously unaffected areas, for example, it is the lives of children that are most endangered. When people's sources of livelihood are disrupted, whether through flooding or extreme weather events, it is the youngest members of the community who will suffer most from undernutrition and diarrhoeal disease.

These impacts of climate change are already being felt – and yet the prospects for the future, as projected by scientific experts, are more alarming. In 2013, scientists reported that concentrations of carbon dioxide in the atmosphere had exceeded 400 parts per million for the first time in human history. Atmospheric levels of the main greenhouse gases – carbon dioxide, methane and nitrous oxide – are now higher than they have been for at least 800,000 years. These high concentrations will already profoundly alter the world's climatic conditions for decades to come, even if emissions are successfully curbed over the next few years – and if emissions continue to grow, the consequences will be disastrous. According to the IPCC Chair, Rajendra Pachauri, who contributes to the concluding section of this book, "Climatologists are increasingly certain that humans are dramatically altering the Earth's climate – and that, in the absence of strong collective action, we face catastrophic warming of 4°C (7°F) or more by 2100."

Save the Children estimated in 2009 that, over the next decade, around 175 million children will be hit by climate-related disasters every year, and that climate change could ultimately lead to an additional 250,000 child deaths a year in South Asia and sub-Saharan Africa alone. In the light of projections such as these, the book explores the issue of intergenerational justice. It questions the ethics of maintaining our current lifestyle and intensive resource exploitation in the full knowledge that living conditions on the planet will be worsened in the second half of the twenty-first century and beyond. Unless much more urgent action is taken than at present, future generations will reap a bitter harvest. Our children and grandchildren are our primary point of contact with those future generations and, if we understand how they will be affected, we are more likely to be persuaded of the necessity of humanity changing its course.

Children, then, are the first victims of climate change in the present and will pay a disproportionate price for its more extreme consequences in decades to come. They also serve as symbolic representatives of future generations – reminders that we who currently live and work on this planet have a duty of stewardship, holding it in trust for them. These are, in a sense, passive roles that children play in the current global debate. Yet children are already taking an active part in making a difference on climate change. This book contains positive examples from all over the world of young people who are making a difference and offering their special perspective. They are raising awareness in their own communities, organizing conservation projects, promoting renewable energy and taking political action in support of sustainability and climate justice. They are not only developing their own potential as future leaders but also demonstrating their leadership on the issue of climate change in the here and now. Involving children and young people in the process can help to unblock the logjam that currently exists in climate negotiations. The participation of young people is no longer something to which international organizations can simply pay lip service – it is a necessity if the interests of future generations of humanity are to be safeguarded.

This book has been commissioned and published by the UNICEF Office of Research at Innocenti in Florence, Italy. Key areas of the Office's work include: equity; poverty and well-being; child protection and child rights. Climate change is, by its very nature, an issue that cuts across all those areas. The hope is that, by gathering together the views of some of the world's leading experts in a range of fields, this book will raise awareness of the ways in which climate change is affecting children now and will impact upon them in the future. And, by offering a child-rights perspective, the book aims to inject fresh urgency into the international debate on how to mitigate climate change and how to adapt to its effects.

This is a vital task that the UNICEF Office of Research pursues. All its work in examining how children's rights can be protected and promoted will be made infinitely more difficult as the effects of human-induced climate change take hold over the next few decades. For this reason, the greater the success in coming years in concluding a binding deal to limit and reduce greenhouse gas emissions, the greater will be the likelihood of children's rights being fulfilled for generations to come.

Marie-Claude Martin



Director, UNICEF Office of Research - Innocenti

Executive Summary

Introduction

Children are among the greatest victims of a warming world, but they are also the most powerful protagonists for change. In the midst of global debates, differing opinions, scientific facts and climatic uncertainties, this book seeks to apply children's perspectives, viewing the future from their position, and weighing the possibilities for changing lifestyles and mitigating the now inevitable effects and impacts.

The rights of children, intergenerational justice and inequality are the central issues emerging from these contributions by 40 experts – scientists, development workers, and specialists in health, nutrition and children's rights. Together they present the best knowledge from the climate change debate, and firmly place the accent on future generations and humanity's responsibilities today.

The reality of climate change – and why children bear the brunt of its impacts

In 2013, scientists reported that atmospheric concentrations of carbon dioxide (the key greenhouse gas) exceeded 400 parts per million for the first time in human history – and emissions of other key greenhouse gases, such as methane and nitrous oxide, have also been rising fast. The scientific debate over whether human-induced climate change is 'real' is effectively over. In September 2013, the Intergovernmental Panel on Climate Change (IPCC), whose chairperson Rajendra Pachauri contributes his perspective to this collection, came out with its Fifth Assessment Report, a comprehensive review of the scientific literature on climate change by the world's leading climatologists. It concludes that the Earth has warmed by some 0.85°C (1.5°F) since 1880, and by about 0.7°C (1.3°F) since 1950. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished and sea levels have risen.

The IPCC now says, moreover, that it is as evident that humans are dramatically changing the planet's climate as it is that smoking causes cancer. The emissions already stored in the atmosphere will produce further warming even if we now manage to rein in atmospheric pollution by carbon dioxide and the other greenhouse gases. But if we do not take urgent, concerted action to restrain the growth in those emissions, there is likely to be warming of 4°C (7°F) or more by 2100, the consequences of which will be catastrophic for human civilization.

The damaging effects of climate change are already in evidence in every corner of the planet – and children are already suffering most from its myriad impacts. Not only do children make up almost half of the population in developing countries, but they are also especially vulnerable to its impacts.

Even in the next decade, it is estimated that extreme weather events – which are becoming more frequent and more intense as a consequence of climate change – are likely to affect 175 million children a year. When disaster strikes, those children who survive the initial impacts may be deprived of schooling and may face an increased incidence of disease and disruptions to clean water and adequate sanitation. Even leaving aside natural disasters, children are already suffering most from the adverse health consequences of a warmer world, accounting for up to four in five of all illnesses, injuries and deaths attributable to climate change. As the contributions from both Frederica Perera and Kristie Ebi make clear, climate change is, in many areas, increasing the range and incidence of major health hazards for children – for example, by enabling malarial mosquitoes to move into hillier areas that have previously been too cool for them. In addition, heatwaves, which are becoming more frequent, put babies and infants at particular risk because they cannot regulate their own body heat.

All of these impacts will be magnified and exacerbated as temperatures continue to rise over the coming decades, and as many millions of people are displaced by sea-level rise, drought or

other climate change-related conditions. As Joseph Romm underlines, food insecurity is also bound to increase in a world likely to contain 9 billion people by the middle of the century, and as changes in average temperature and rainfall have an adverse effect on food quantity and quality. In conditions of food scarcity, children are more likely than adults to be afflicted by undernutrition – and to suffer lifelong damage as a consequence. Hans Herren argues here that climate change will necessitate fundamental changes to food production systems so as to render them more sustainable.

Climate adaptation and children

Faced with the reality of a warming world, humanity is now beginning to wrestle not only with the need to mitigate climate change by limiting and reducing its greenhouse gas emissions, but also to consider how to adapt by putting in place measures that protect people from the most catastrophic impacts.

One clear conclusion of this book is that the priority must be disaster risk reduction rather than simply disaster relief, a point emphasized by Catherine Cameron. Instead of responding to extreme events when they happen, on an emergency basis, the world needs to make a major investment in reducing the likelihood of disasters happening in the first place.

This will entail changing the policies and practices of the last three decades which, as Thea Dickinson and Ian Burton report, have seen settlement in flood-prone areas increasing by almost 115 per cent – and by 192 per cent on coastlines threatened by cyclones. Large numbers of people are located in or near areas of high risk: on seismic fault lines; at the foot of active volcanoes; or in areas where vegetation has been removed, creating a danger of landslides.

All these kinds of settlement increase the likelihood of disaster misfortune – especially when the exposed communities are also impoverished. Poverty not only makes people more prone to disaster – makeshift housing in shanty towns or slums is more at the mercy of the elements, and may be squeezed on to more marginal land, next to water or above ravines – but also makes recovery from climatic misfortune much more difficult.

Many cities in the developing world are growing fast. Much of that growth is unplanned, but huge amounts of public and private money are also being invested in new urban infrastructure. This affords the opportunity to apply lessons already learned about climate change and its impacts. Ashvin Dayal and Anna Brown explain that it would mean avoiding building on low-lying flood plains or across the natural surface run-off contours of a city. It would entail designing drainage systems that can cope with greater volumes of rainfall. And it would involve constructing new housing for low-income families capable of withstanding floods, extreme storms and heat pressures.

Because children are highly vulnerable to extreme events and bear a disproportionate share of the impact, both in the immediate and the longer term, investment in disaster risk reduction is certainly in their best interests. But adaptation to climate change is not just about reducing the incidence and impact of disasters – it involves putting in place measures that will protect humanity, and children in particular, from the everyday effects of the climatic changes that we know are going to occur.

As Courtenay Cabot Venton makes clear, child-centred adaptation measures can be easily justified in economic terms – and not just because many of the programmes associated with them cost relatively small amounts of money, such as treating diarrhoea and cholera with antibiotics and oral rehydration therapy. Since children are one of the largest groups threatened by climate change, interventions that target them may well benefit from economies of scale – and will certainly forestall the costs of dealing with the health problems, missed education and protection issues that would ensue if such investments are not made.

Climate change and child rights

Because children are recognized as being in the front line, more vulnerable to the impacts of climate change than any other population group, their rights and interests should loom large in climate change policy, advocacy and research – yet this has manifestly not been the case up to now. As things stand, climate-impact assessments and policies are generally developed without paying any attention to child-rights issues – and the unique risks to children and the specific responses that they require remain overlooked.

Yet all states have obligations under human rights law to abate the effects of climate change on the human rights of those within their jurisdiction. In particular, the provisions of the Convention on the Rights of the Child (CRC), although they do not mention climate change specifically, clearly require governments to protect children from the most harmful consequences of environmental pollution. States should be investigating the full impacts of climate change on the human rights of the child by, for example, gathering data measuring increases in mortality and disease owing to changing climate patterns, or monitoring the impacts on education of an increased incidence of natural disasters.

Moreover, while the global community is in uncharted territory as it struggles to come up with a meaningful, practical legislative framework that will constrain carbon emissions, Joy Guillemot and Jazmin Burgess argue that the CRC is an accepted structure that could help to guide national governments and international bodies on to a more sustainable path. If the international community works on a triple track over the next two years – to follow the guidance of the CRC; to agree on the post-2015 international development agenda that will succeed the Millennium Development Goals; and to pursue a binding climate agreement in 2015 – it could make its path and priorities much clearer.

Child participation and leadership on climate change

Under the CRC, children have the right to participate in matters that relate to them. They also represent the future generations, as yet unborn, whose lives may be blighted by the present world's irresponsible environmental practices. National governments tend to be influenced by electoral cycles that run to no more than four or five years, and this means that they are often peculiarly ill equipped to take action that involves short-term hardship or sacrifice for the long-term good. In the exceptional circumstances of climate change, where the benefits of people in the present seem to stand in conflict with the rights of people in the future, the concept of intergenerational justice is therefore key – an issue explored here by Fabian Schuppert.

Hitherto, the participation of children and young people in high-level climate discussions has been limited. Nevertheless, their presence at recent Conferences of the Parties to the United Nations Framework Convention on Climate Change has developed the awareness, confidence and leadership qualities of the individual young people attending – as Adeline Tiffanie Suwana's account of working as a youth delegate from Indonesia makes clear. Not only that, but young people's presence has had a considerable collective impact in terms of presenting the issues afresh.

Since 2008, the United Nations Joint Framework Initiative on Children, Youth and Climate Change has been coordinating efforts to empower young people to take adaptation and mitigation actions as well as to enhance their effective participation in decision-making processes.

Young people have, however, not been waiting for the invitation from those in power and have for many years been raising awareness in their own communities, organizing conservation projects, promoting renewable energy and taking political action in support of sustainability and climate justice. Though these projects have been invaluable, they have generally been short-term efforts to address particular issues. In the uncertain world that climate change is producing, it is vital that children have the chance to engage in community-based approaches to sustainable development and adaptation on a more long-term basis, as the essay by Roger Hart, Scott Fisher and Bijan

Kimiagar suggests. Children not only have the right to such involvement, they have the capacity – and involving them in community governance will enhance their flexibility and competence to deal with the challenges of climate change.

Interviews conducted by Bronwyn Hayward and Elin Selboe with young people who are taking action on climate change locally, nationally and even internationally demonstrate their personal qualities of resilience and leadership but also suggest that these have been nurtured and supported by family and community networks. Faced with the significant challenges of a changing climate, all young citizens need environmental education that links them to the lives and experiences of people on the other side of the globe and are more likely to thrive in communities (and countries) where decision-making is inclusive and transparent. As Ivana Savić argues, children should not be seen as victims but as rights holders who, when suitably empowered, are capable of partnering on an equal footing with individuals and groups of all kinds to mitigate climate change and contribute to adaptation.

International cooperation and a global youth movement to protect the climate are now much more possible in today's online, interconnected world, and could enable young people to realize their potential as leaders on the issue of climate change. The participation of young people is no longer something to which governments and international organizations can simply pay lip service – it is a necessity if the interests of future generations of humanity are to be safeguarded.

2015 – a vital year

The lives and livelihoods of children and their families around the world are already being affected by climate change. Although no particular outcome can be predicted with certainty, it is clear that, unless there is a significant reduction in emissions over the next decade, by 2050 there will be major climatic changes that will make human life on the planet much more difficult. In 2015, representatives from around 200 countries are scheduled to agree on the final structure of a new global climate agreement. The outcome of these talks will largely determine whether the world is two, three or four degrees warmer (or more) by the end of this century.

In addition to being critical for the climate negotiations, 2015 is also an important year for human development: the successes and failures of the Millennium Development Goals will be reviewed, and a new framework of action for sustainable development agreed. Whatever shape this new framework takes, poverty eradication will remain central.

In the book's concluding essay, Rachel Garthwaite and Paul Mitchell argue that looking at both climate change and poverty through the lens of inequality could help to bring these two agendas closer together. Of the 2.4 billion people living on less than \$2 a day, some are more vulnerable to climate change than others. Inequalities shape vulnerability to climate change, while climate change magnifies and exacerbates inequalities. Furthermore, viewing these issues in this way highlights the particular vulnerability of children to climate change, poverty and inequality, and emphasizes the importance of ensuring that their specific needs are addressed by policy-makers. Development and climate policies that are child focused, as well as targeted towards meeting the needs of those who are marginalized and disadvantaged, would go a long way towards meeting the specific needs of children and ending poverty and inequality.

2015 is a year of opportunity. It could be the year in which the world embarks on an ambitious agenda to end poverty, halt climate change and promote the rights of children. To have any chance of achieving this, greater cooperation and collaboration between the child rights, development and climate change communities is needed. Putting young people front and centre could help to unlock the climate change impasse – and safeguard the future of generations of children to come.

Present and future climate realities for children

JOSEPH J. ROMM



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Climatologists are increasingly certain that humans are altering the Earth's climate dramatically – and that, in the absence of strong collective action, we face catastrophic warming of 4°C (7°F) or more by 2100.¹ The greatest challenge for our children and their children will be feeding the 9 billion people projected for the middle of the twenty-first century in a world ravaged by hotter temperatures, more extreme weather and sea level rise. Young children in particular are most at risk from the high temperatures, malnutrition and climate-induced migration.

The greenhouse effect has made the life we know possible. Our sun

emits vast amounts of electromagnetic radiation, including visible light. Some of the incoming solar energy is reflected back into space, but more is absorbed by the Earth. This process heats up the planet. The Earth reradiates the energy it absorbs mostly as heat – as infrared radiation.

Some atmospheric gases let visible light escape through into space while trapping certain types of infrared radiation. Because these greenhouse gases (GHGs), including water and carbon dioxide (CO₂), trap some of the reradiated heat, they act as a partial blanket that helps keep the planet about 33°C (60°F) warmer than it otherwise would be, making the climate habitable for humans.

For more than 11,000 years since the end of the last ice age, the temperature of the planet has been

remarkably steady. That stable climate enabled the development of modern civilization, global agriculture, and a world that could sustain a large population.

Since the dawn of the Industrial Revolution 250 years ago, however, humankind has been spewing vast quantities of extra GHGs into the atmosphere – particularly CO₂ from burning fossil fuels (coal, oil and natural gas). That has caused more and more heat to be trapped, slowly raising temperatures. For most of this time, few worried about the consequences.

But thanks to the work of thousands of scientists – many of whom contribute to the United Nations Intergovernmental Panel on Climate Change (IPCC) – the risks are now clear. We are engaging in a dangerous, planet-wide, uncontrolled experiment as these

¹ For more detailed discussion of the science of climate impacts, see ClimateProgress.org (especially <http://thinkprogress.org/climate/2012/10/14/1009121/science-of-global-warming-impacts-guide>) as well as the Intergovernmental Panel on Climate Change's Fifth Assessment Report at www.ipcc.ch

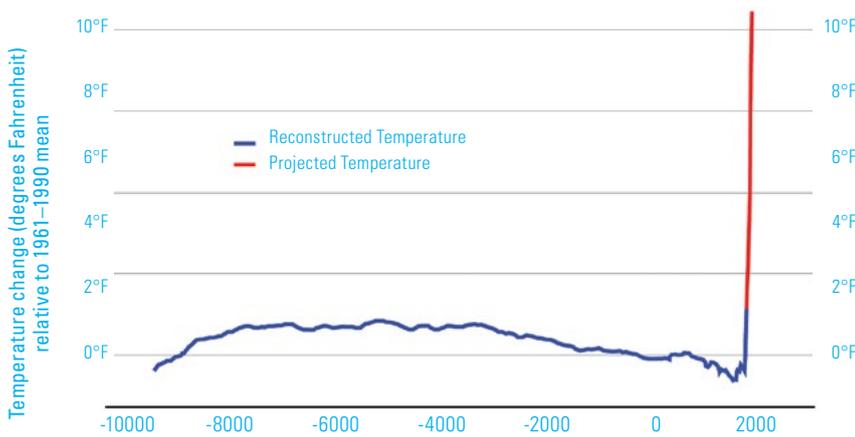


Figure 1: Temperature change over the past 11,300 years (in blue, via Marcott, S.A., Shakun, J.D., Clark, P.U. Mix, A.C. (2013). A Reconstruction of Regional and Global Temperature for the Past 11,300 Years, *Science*, 339: 1198) plus projected warming this century on humanity's current emissions path (in red, via recent literature).

emissions push our climate system into a different and far less hospitable state than human civilization has ever known (see Figure 1).

In September 2013, the IPCC presented its Fifth Assessment Report, a comprehensive review of the scientific literature on climate change by the world's leading climatologists. It concludes that the Earth has warmed some 0.85°C (1.5°F) since 1880, and about 0.7°C (1.3°F) since 1950.

The IPCC now says we are as certain that humans are changing dramatically the planet's climate as we are that smoking causes cancer. The IPCC scientists are more certain of the human role in climate change than they were in their previous report, in 2007.² Furthermore, for warming since 1950, they explain: "The best estimate of the human-induced contribution to warming is similar to the observed warming over this period". In other words, the

best estimate is that humans are responsible for all of the warming we have experienced since 1950. And the scientific literature makes clear that we are already seeing the effects of this warming in more extreme heatwaves, stronger droughts, more intense deluges and accelerated sea level rise.

Given that we are already seeing dangerous climate impacts, what should our children expect in the coming decades as the planet continues to warm up?

The IPCC finds that, on average, total warming from pre-industrial levels is headed beyond 4°C (7°F) by 2100. Warming over the land in the mid-latitudes – where much of the world's population lives – is projected to be considerably higher than the average planetary warming (see Figure 2).

Note that Figure 2 shows the average temperature change under two different scenarios: from 1986–2005 and 2081–2100. You can add about 1°F to arrive at total warming from pre-industrial levels.

In November 2012, the World Bank issued a blunt report, *Turn down the heat: Why a 4°C warmer world must be avoided*.³ This warned: "we're on track for a 4°C

warmer world marked by extreme heat waves, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea-level rise". Bank President Jim Yong Kim said that the "latest predictions on climate change should shock us into action".

Children will suffer the most in a 4°C world ravaged by climate change. That's because growing bodies and developing minds are extremely sensitive to the effects of malnutrition. In addition, young children are especially at risk to the effects of high temperatures, since they can't as easily regulate their body heat. And of the tens (and eventually hundreds) of millions of people who become displaced by climate change, extreme weather and sea level rise, it is children who will suffer the greatest since they are most susceptible to disease and least able to fend for themselves.

According to Professor Kevin Anderson, Director of the Tyndall Centre for Climate Change Research in the United Kingdom, 4°C warming is "incompatible with an organized global community, is likely to be beyond 'adaptation', is devastating to the majority of ecosystems and has a high probability of not being stable (i.e. 4°C [7°F] would be an interim temperature on the way to a much higher equilibrium level)".⁴

This point about 4°C warming not being stable is important. The latest IPCC report explains: "It is virtually certain that near-surface permafrost extent at high northern latitudes will be reduced as global mean surface temperature increases. By the end of the 21st century, the area of permafrost

² IPCC (Intergovernmental Panel on Climate Change) (2007). Climate Change 2007, Fourth Assessment Report, Geneva: IPCC.

³ World Bank (2012). Turn down the heat: climate extremes, regional impacts, and the case for resilience – full report. *Working Paper*, Washington: World Bank.

⁴ Reported at 'Works in Progress', *Climate crisis is more imminent and more severe than predicted*. Available at: <http://www.olywip.org/content/climate-crisis-more-imminent-and-more-severe-predicted>

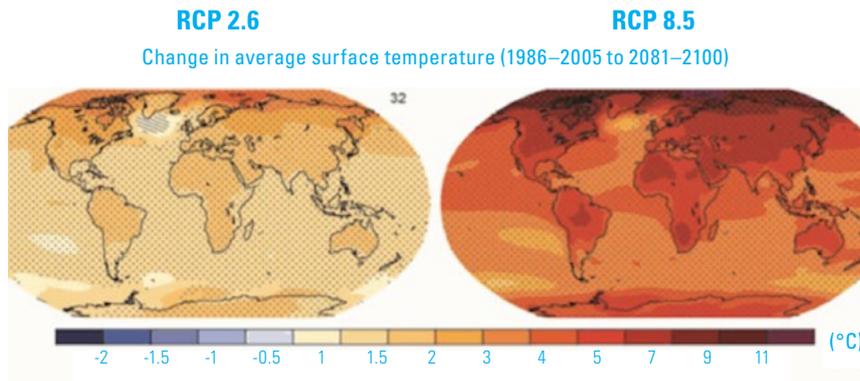


Figure 2: Humanity's choice (via IPCC): Aggressive climate action starting now (left figure, Scenario RCP 2.6) minimizes future warming. Continued inaction (right figure, Scenario RCP 8.5) results in catastrophic levels of warming, 4°–7°C [7°–12°F] over much of Earth's inhabited landmass.*

near the surface (upper 3.5 m) is projected to decrease by between 37% (RCP 2.6) to 81% (RCP 8.5) for the model average.”

In the no-action case (RCP 8.5), the top 10 feet (3 metres) of permafrost will thaw out. Given that the permafrost contains twice as much carbon as the atmosphere does today, this is quite alarming – especially since no IPCC model actually factors in carbon from defrosting permafrost into its temperature projections. In 2011, a major study found that the carbon feedback from thawing permafrost is likely to add up to 1.5°F to total global warming by 2100.⁵

This is one more reason why aggressive climate action is so urgent – to avoid crossing carbon-cycle tipping points that will further accelerate global warming.

Here are other key impacts from such a temperature rise:

- Permanent Dust Bowl conditions over many regions around the globe that are heavily populated and/or heavily farmed

- Sea level rise of around 1 foot (30.48cm.) by 2050, then 3 to 6 feet (0.91cm.-1.82m) by 2100, rising 6 or more inches (15cm.) each decade thereafter
- Massive species loss on land and sea – perhaps 50 per cent or more of all biodiversity
- More extreme weather, particularly intense heatwaves, droughts, superstorms and floods
- Myriad direct health impacts.

Remember, these will all be happening simultaneously around the world and getting worse decade after decade. Today, when disaster strikes, the world rallies to help the victims, especially the children who are most at risk. But in the future, every country in the world will be dealing with the above problems at the same time. Countries will largely have to fend for themselves when super-droughts and superstorms strike. Just as alarmingly, a 2009 study led by the US National Oceanic and Atmospheric Administration found the worst impacts would be “largely irreversible for 1,000 years”.⁶

Let's look at the synergistic effect of these impacts on food security – the increasing difficulty

of feeding 7 billion, then 8 billion, and then 9 billion people in a world with an ever-worsening climate. This is likely to be the climate impact that affects most people in the coming decades – especially children, hundreds of millions of whom already suffer from food insecurity and malnutrition.

In over two decades of tracking world food prices, the FAO (Food and Agriculture Organization of the United Nations) Food Price Index has never stayed so high for so long. This represents true suffering for hundreds of millions of people who live on the edge, for whom food is a large fraction of their income, as in, for example, North Africa.

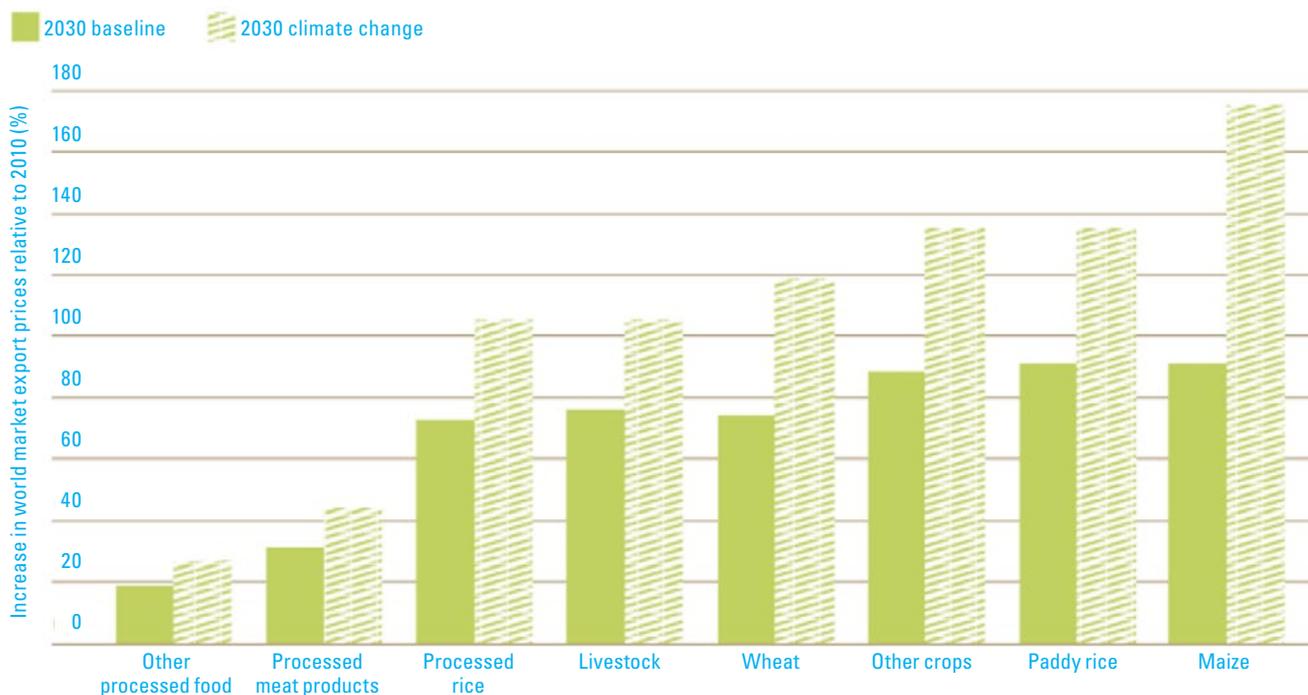
Population growth, dietary shifts, growing use of crops for biofuels, peaking conventional oil production and increases in extreme weather have all played a part. For instance, in 2010, Russia experienced a once-in-a-thousand-year heatwave that devastated crops and led the government to ban wheat exports for more than a year, a key trigger for the jump in food prices. Yet one study found that global warming will make this kind of heatwave a once-in-a-decade event for Russia by the 2060s.⁷

Some of the carbon pollution emitted by humans gets absorbed in the ocean where it acidifies the water. This acidification threatens a marine biological meltdown by the end of the twenty-first century. That threat to seafood is further amplified by warming waters, other forms of pollution and overfishing. At the same time, sea level rise and the accompanying

5 MacDougall, A., C. Avis and A. Weaver (2012). 'Significant contribution to climate warming from the permafrost carbon feedback.' *Nature Geoscience*, 5: 719–721, doi:10.1038/ngeo1573.

6 Solomon, S. G-K Plattner, R. Knutti, and P. Friedlingstein (2008). Irreversible climate change due to carbon dioxide emissions, Proceedings of the National Academy of Sciences of the United States of America, Washington: PNAS. Available at: <http://www.pnas.org/content/early/2009/01/28/0812721106.full.pdf+html>

7 Dole, R., M. Hoerling, J. Perlwitz, J. Eischeid, P. Pegion, T. Zhang, X.-W. Quan, T. Xu and D. Murray (2011). 'Was there a basis for anticipating the 2010 Russian heat wave?' National Oceanic and Atmospheric Administration.



Source: D. Willenbockel (2011) 'Exploring Food Price Scenarios towards 2030', Oxfam and IDS

Figure 3: Real food price changes predicted over the next 20 years

saltwater infiltration are threatening some of the richest agricultural deltas in the world, such as the Nile and Ganges.

One analysis just of the impact of temperature rise on food finds, "Half of [the] world's population could face climate-driven food crisis by 2100."⁸ This analysis, moreover, focuses on the direct temperature impact and does not consider other well-understood climate impacts, such as that of soil drying up.

Finally, prolonged drought and 'dustbowlification' – and its impact on food security – may well be the impact that harms the greatest number of people over the next few decades.

As far back as 1990, scientists at the NASA Goddard Institute of Space Studies projected that severe to extreme drought in the United States, then happening every

20 years, could become an every-other-year phenomenon by the middle of the twenty-first century.⁹

A number of major recent studies have confirmed those early findings.¹⁰ These studies warn that the US Southwest, parts of the US Midwest, and many other highly populated parts of the globe (including large parts of Mexico and Brazil, countries bordering the Mediterranean, large sections of Southwest Asia, and western and southern Africa) are probably headed towards sustained – or even near-permanent – drought and Dust Bowl-like conditions if we stay anywhere near our current emissions path. The Palmer Drought Severity Index (PDSI) is one of the most common measures of drought severity. A PDSI of -4 or below is considered extreme drought. The PDSI in the US

Great Plains during the Dust Bowl period of the 1930s spiked very briefly to -6 , but otherwise rarely exceeded -3 for the decade.

The US National Center for Atmospheric Research concluded in a major review and analysis that "By the end of the century, many populated areas, including parts of the United States and much of the Mediterranean and Africa, could face readings in the range of -4 to -10 . Such decadal averages would be almost unprecedented."¹¹ It is hard to see how the world could feed 9 billion people under such circumstances without a dramatic change in diet and food practices.

Two major Oxfam studies show the impact that global warming could have on food prices.^{12,13}

8 Battisti, D. S. and R. L. Naylor (2009). 'Historical warnings of future food insecurity with unprecedented seasonal heat'. *Science*, 32(5911): 240–244.

9 Rind, D., R. Goldberg, J. Hansen, C. Rosenzweig and R. Ruedy (1990). 'Potential evapotranspiration and the likelihood of future drought'. *Journal of Geophysical Research*, 95(D7): 9983–10004. Available at: http://pubs.giss.nasa.gov/docs/1990/1990_Rind_et_al_1.pdf

10 Romm, J. (2011). 'Desertification: The next dust bowl'. *Nature*, 478: 450–451, doi: 10.1038/478450a. Available at: www.nature.com/nature/journal/v478/n7370/full/478450a.html

11 US National Center for Atmospheric Research (2010). 'Climate change: Drought may threaten much of globe within decades'. *NCAR/UCAR AtmosNews*, 18 October. Available at: <https://www2.ucar.edu/atmosnews/news/2904/climate-change-drought-may-threaten-much-globe-within-decades>

12 Oxfam (2011). *Growing a better future*. Available at: www.oxfam.org/sites/www.oxfam.org/files/growing-a-better-future-010611-en.pdf

13 Oxfam (2011). *Extreme weather endangers food security*. Available at: www.oxfam.org/sites/www.oxfam.org/files/extreme-weather-media-brief-111128-final.pdf

A 2011 study, *Growing a Better Future*, projected that several major grains would double in price over the next two decades (see *Figure 3*).

Further modelling of the impact of warming-driven extreme weather shocks leads Oxfam to conclude that corn prices could increase by a staggering 500 per cent by 2030.

To sum up the latest research, failure to reduce global carbon pollution risks myriad catastrophic impacts for future generations. Young children are most at risk from high temperatures

and climate-induced migration. Especially worrisome is the threat posed to our ability to feed the world's growing population and, again, children are at the greatest risk from any increase in malnutrition. Strong action starting now, on the other hand, holds the real prospect of minimizing the most severe consequences of climate change. Considering that future generations of young children have done nothing whatsoever to contribute to the climate problem they will be forced to suffer through – and that we may be approaching a tipping point beyond which

catastrophic impacts are irreversible – I believe that basic human morality demands that those of us responsible for the problem take strong steps now to curtail carbon pollution.

**IPCC 2012: Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, adapted from Figure SPM.8: Cambridge University Press.*

What is happening to the climate?

RICHARD MILLAR, DUNCAN CLARK AND MYLES ALLEN



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What is the climate?

The Earth's climate is a complex system. It arises from the interactions and feedbacks between the planet's atmosphere and its oceans, ecosystems and ice caps. The climate also sets the stage for plant, animal and human life to exist and flourish on the Earth.

Humanity lives in the lowest part of the atmosphere, called the troposphere. The local conditions of this part of the atmosphere, such as the surface air temperatures, the amount of rainfall and the chemical composition, allow us to lead the lives we do around the world. These atmospheric conditions depend on other parts of the climate system that might seem to be distinct. For instance, the

amount of rainfall over Europe is strongly dependent on the patterns of sea-surface temperatures in the North Atlantic.¹

Human populations and human industrial activities have expanded so significantly since the beginning of the Industrial Revolution that humanity now has the potential to be a major driver of change in the climate system. We are already fulfilling that potential with carbon dioxide emissions from the burning of fossil fuels and changes in land use across the globe.

The last three decades were the warmest at the Earth's surface since the instrumental record

began,² and the global scientific community is now 95 per cent certain that human influence is responsible for over half of the warming experienced in the second half of the twentieth century. In addition, other parts of the climate system are undergoing changes. The summer Arctic sea-ice extent has decreased by between 9.4 per cent and 13.6 per cent each decade, with its size in the summer of 2012 being the lowest ever recorded.

Climate scientists are working to understand these changes to Planet Earth and how the climate that humanity has evolved to live in will be affected.

¹ Woollings, T. (2010). "Dynamical influences on European climate: An uncertain future". *Philosophical Transactions, Series A, Mathematical, Physical, and Engineering Sciences*, 368 (1924): 3733–3756. Available at: www.ncbi.nlm.nih.gov/pubmed/20603379

² IPCC (Intergovernmental Panel on Climate Change) (2013). Fifth Assessment Report: The physical science basis, Cambridge University Press.

The physics of global warming

The greenhouse effect

Carbon dioxide gas (CO₂) is essential for life on Earth in several ways. First, carbon dioxide is required for plants and primary producers to photosynthesize, and hence underpins the global food and ecological webs. Second, the ‘greenhouse effect’ of the atmosphere, in which carbon dioxide plays a major role, has a warming effect without which the temperature of the Earth’s surface would be more than 30°C colder.³ This would make life on Earth very different from the world we know today.

Carbon dioxide warms the climate system through the greenhouse effect. The physical properties of carbon dioxide molecules allow them to absorb the frequency of radiation emitted upwards by the Earth (this heat causes the slightly warmer feeling on the underside of your hand when you hold it out horizontally near the ground on a clear night). Most energy escaping to space is radiated not from the surface, but from high altitudes above this ‘greenhouse blanket’. Because temperatures decrease with height through the troposphere, and colder molecules radiate energy more slowly, this means that energy escapes at a slower rate than it would do if the surface were to radiate to space directly. So the entire surface and troposphere are much warmer than they would be otherwise to maintain the balance between incoming and outgoing energy.

However, by releasing large amounts of carbon dioxide into

³ For a historical overview of climate change science, see: Le Treut, H. et al. (2007). *Climate change 2007: The physical science basis. A report of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.*

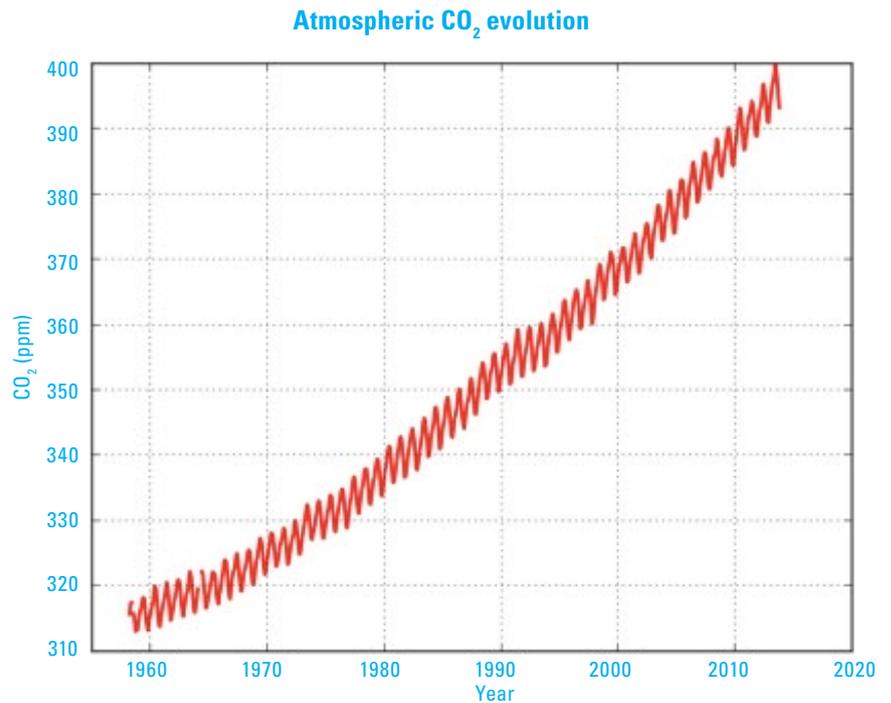


Figure 1: The Keeling curve, showing the monthly evolution of the atmospheric carbon dioxide concentrations from the Mauna Loa Observatory, Hawaii.

the atmosphere on short climatic timescales, we are enhancing the Earth’s natural greenhouse effect beyond its equilibrium state and causing the planet to warm quickly in response.

The Keeling curve charts the rise of carbon dioxide concentrations in the atmosphere since the late 1950s (see Figure 1).⁴ This additional carbon dioxide (caused mainly by increased anthropogenic or human-created emissions) creates the enhanced greenhouse effect driving modern climate change.

Climate feedbacks

While the enhanced greenhouse effect is the main driver of global climate change, mechanisms in the climate system can be triggered that act either to amplify or to

⁴ Keeling, C. D., A. F. Bollenbacher and T. P. Whorf (2005). “Monthly atmospheric 13C/12C isotopic ratios for 10 SIO stations”. *Trends: a compendium of data on global change.*

reduce warming. A well-known example of this is the ice-albedo feedback. As the surface temperature of the planet warms, ice and snow in the Polar Regions can start to melt. Ice and snow have a high reflectivity (albedo) and so reflect a high fraction of incoming solar energy back out of the climate system. As ice and snow cover recede, the planet on average reflects less sunlight away and absorbs more of the solar energy. This in turn causes temperatures to rise further, melting more ice and snow and amplifying the initial climatic change. Understanding and quantifying climate feedbacks is one of the major challenges of climate science.

Understanding and predicting climate change

Climate modelling

In order to predict what might happen under future climatic scenarios, we need to understand exactly how the climate system works. This enables us to quantify the energetic forcing and the

feedback loops driving the changes in the climate that govern its complex response.

Climate scientists use a range of models of varying complexity to understand the behaviour of the climate system and to predict future changes under particular emissions scenarios. The most sophisticated of these are known as Earth-system general circulation models, which represent climatic fields on grids over the sphere of the Earth and solve the fundamental physical equations that govern their evolution. These state-of-the-art models represent important climate processes such as atmospheric chemistry and the carbon cycle. These physics-based models are validated against the historical climate observations and then used to make the detailed projections of future climate change in the reports of the Intergovernmental Panel on Climate Change (IPCC) and elsewhere.

A simple model of the climate

In contrast to the state-of-the-art Earth-system models, which are very computationally expensive and require large super-computers to run, we can create simple models of the climate that capture the essential behaviour of the climate system in a globally averaged sense.

In this article, we use a simple climate model of the impulse-response type. The model used here is based on that of Boucher and Reddy.⁵ In this framework we represent the climate response to a forcing agent, such as carbon dioxide emissions or solar insolation changes, with two characteristic timescales of adjustment to the energetic forcing. The first one

represents the faster adjustment of the atmosphere, land surface and upper ocean, while the second represents the much longer adjustment required for the deep ocean to come to equilibrium. The response model is coupled with a carbon-cycle model that describes the rate at which carbon dioxide is removed from the air due to natural processes and stored in the biosphere and the ocean.

The details of this model can be found in the Appendix on page 14.

Future climate scenarios

The Earth's future climate depends on actions we take as a global society. Future paths of economic development; population growth; decisions that the world makes about curbing emissions of carbon dioxide and other climate forcing agents: all of these elements can lead to an infinite number of possible emissions scenarios. Climate science accounts for this uncertainty by making projections based on several representative pathways drawn from the range of alternatives.

In this section we present results from four representative concentration pathways (RCP) scenarios.⁶ RCP 8.5 is a high-emissions scenario with economic activity continuing as usual into the future with greenhouse gas emissions uncurbed. RCP 6.0 is a scenario where the radiative forcing on the climate is stabilized after 2100 without overshoot. RCP 4.5 stabilizes the radiative forcing on the climate before 2100. RCP 2.6 is a 'peak and decline' scenario where radiative forcing peaks mid-century and then declines towards 2100. This last scenario

involves substantial reductions in emissions and even the need for technologies that will remove carbon dioxide from the atmosphere.

The response of the climate system to these forcing scenarios is set by the climate sensitivity – the amount the surface air temperatures of the climate warm in response to an applied radiative forcing. This sensitivity is often captured by climate scientists in two quantities: the *transient climate response* (TCR), the amount of warming experienced at the point where atmospheric carbon dioxide concentrations reach double pre-industrial values when increased at 1 per cent every year; and the *equilibrium climate sensitivity* (ECS), the total warming experienced by the climate after atmospheric carbon dioxide concentrations are instantaneously doubled and then held there.

One of the headline results in the recent Fifth Assessment Report (AR5) by the IPCC on the physical science behind climate change was a slight change in the uncertainty bounds of ECS to 1.5°–4.5°C (from 2.0°–4.5°C) and TCR to 1.0°–2.5°C (from 1.0°–3.0°C).⁷ These adjustments are in large part due to recent estimates of climate sensitivity based on observational studies.

It can be difficult to envisage how this adjustment of the climate-sensitivity bounds translates into changes in the future scenarios. Earth-system models set their own climate sensitivity organically via the interactions among the many processes that they represent in their simulations, and hence the impacts of these changes in sensitivity estimates cannot be tested directly in Earth-system

5 Boucher, O. and M. S. Reddy (2008). "Climate trade-off between black carbon and carbon dioxide emissions". *Energy Policy*, 36(1): 193–200. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0301421507003709>

6 Moss, R.H. et al. (2010). "The next generation of scenarios for climate change research and assessment". *Nature*, 463(7282): 747–756. Available at: www.ncbi.nlm.nih.gov/pubmed/20148028

7 IPCC (2013). op. cit.

Global temperature projections under the RCP future emissions scenarios

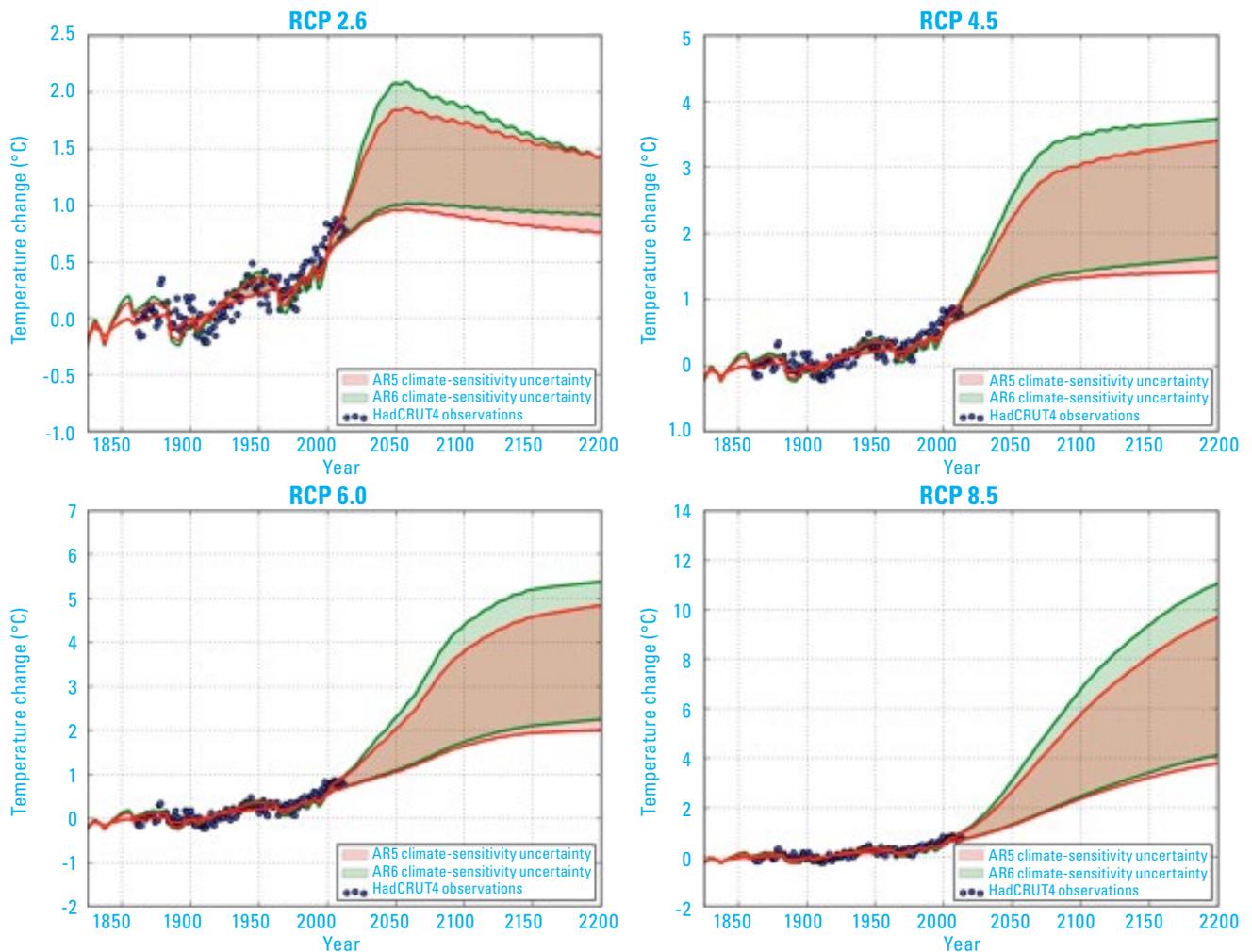


Figure 2: Climate projections under the four different RCP scenarios incorporating the climate-uncertainty estimates from the IPCC AR5 and AR4. The future temperatures are computed using the simple impulse-response model of the climate described above. The observations come from the HadCRUT4 global surface temperature dataset.

models. However, using the simple impulse-response model described above, the ECS and TCR estimates can be explicitly implemented in the model.

This simple climate model has a range of responses under the IPCC AR4 and AR5 climate sensitivities, when forced by the four different future RCP emissions scenarios (see Figure 2). In these climate scenarios, we can see that the changes in climate-sensitivity uncertainty have little impact on the prospects for long-term

climate change. They also do not alter the policy-relevant conclusions that were drawn from the previous Assessment Report.

The new IPCC figures reduce the likelihood of the top warming extremes but do not really change the lower estimates of the minimum warming that we might expect under the emissions scenarios.

Even in the most optimistic scenario considered, RCP 2.6, we will have to adapt to a peak warming that is likely to exceed 1°C.

A carbon budget for all time

The differences between the various RCP scenarios demonstrate the important part that uncertainty over future emissions plays in predicting climatic outcomes. The

assumptions made about society that lie behind the RCP scenarios are detailed and complex. In making climate policy it is useful to identify emergent constraints on the climate response that are common to all of the RCP scenarios.

When the cumulative emissions are plotted against the surface air temperature rise, each scenario lies roughly along the same straight line (see Figure 3). This shows that the warming experienced at any point is a roughly linear function of the cumulative global greenhouse gas emissions since the Industrial Revolution – which is to be expected due to the long lifetime of carbon dioxide in the atmosphere once emitted. The IPCC (2013) concluded that, to have a two-thirds chance of limiting global average warming caused by carbon dioxide

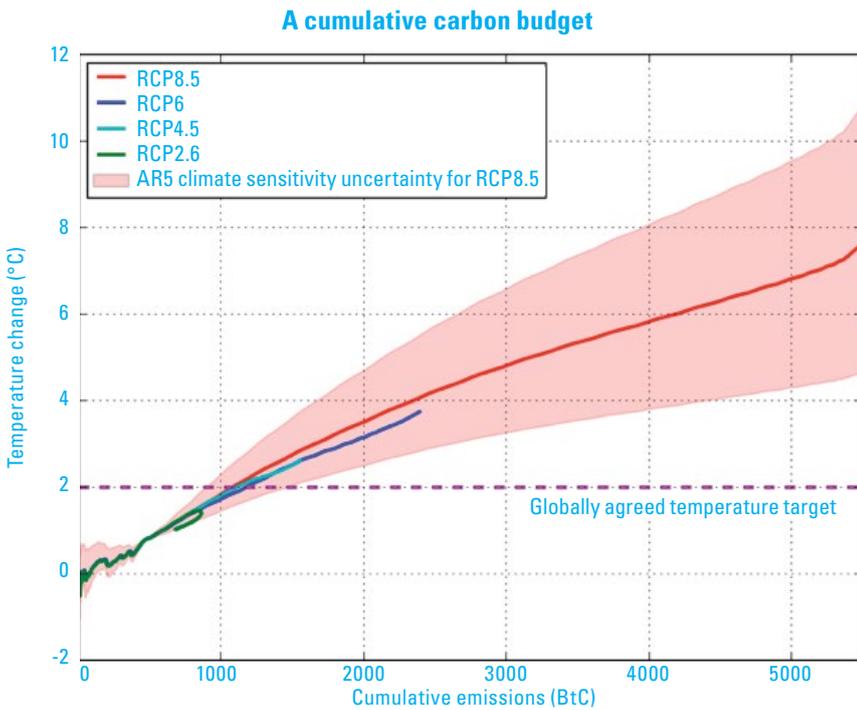


Figure 3: The induced warming as a function of the cumulative carbon emissions for each of the RCP emissions scenarios. The shading represents the uncertainty in the RCP 8.5 line associated with climate-sensitivity uncertainty.

emissions to less than 2°C, human society needs to find a way to limit its total all-time cumulative emissions to less than 1 trillion tonnes of carbon. Since other human activities also contribute to warming, achieving the globally agreed goal of limiting total warming to less than 2°C might mean an even smaller budget.

Conclusions

The science underlying climate change is clear. Human emissions of greenhouse gases are causing the average temperature of the climate to rise. Humanity is currently emitting greenhouse gases at a rate in excess of the highest future emissions scenario considered in the IPCC Assessment

Reports. If emissions continue to rise unabated at the current rate, children born today are likely to face a world at least 2.5°C degrees (and possibly as much as 6°C) warmer by the end of their lives.

To avoid this, a global climate solution that limits cumulative carbon emissions to below a certain threshold is required. Even in the most optimistic future emissions scenarios, society will have to adjust to the myriad impacts associated with a warmer world than we live in now.

Even the very simple models used here are enough to demonstrate how climate change is an intergenerational issue. Every tonne of carbon that is released into the atmosphere by the current generation is a tonne of carbon that future generations will not have available for their use if a given level of climate change is to be avoided. They may even find it necessary to scrub carbon dioxide back out of the atmosphere, a very expensive option, to halt the temperature rise.

APPENDIX: The simple climate model

This section details the model used to analyse the climate-sensitivity changes between the current and the previous IPCC Assessment Reports. The simple impulse-response model is based on the model detailed in Boucher and Reddy (2008 - see note 5).

The temperature response of the climate to a unit of radiative forcing is represented by the following equation, with the coefficients c_i representing the strength associated with each response and d_i the time constant associated with each response.

$$\delta T(t) = \sum_i \frac{c_i}{d_i} \exp\left(-\frac{t}{d_i}\right)$$

This version of the model includes two exponential terms. One term is associated with the time response of the upper ocean (and atmosphere and land surface) to a unit of radiative forcing with a decay constant of about ten years. The other term represents the much longer response of the deep ocean to a unit of radiative forcing with a time constant of about four hundred years.

This model can be inverted to calculate the two c_i coefficients from the transient climate sensitivity and the equilibrium climate sensitivity. In this way the correct coefficients associated with particular estimates of TCR and ECS can be derived. For instance, the equilibrium climate response is given by the sum of the coefficients multiplying the exponentials in the infinite time response:

$$ECS = c_1 + c_2$$

Children suffer most from climate change and burning of fossil fuels

FREDERICA PERERA



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Introduction

Climate change and its major human source, the burning of fossil fuels, have already inflicted disproportionate suffering on children and are seriously endangering their future health and well-being. The predicted trajectories for climate change and fossil fuel-related emissions of carbon dioxide (CO₂) and its toxic co-pollutants are alarming in terms of their future cumulative impacts on children. Until recently, the effects of climate change and fossil fuel emissions have not been jointly considered, resulting in a piecemeal and fractured accounting of the risks to children, and therefore an underestimate of both the urgency and the benefits of taking action.

This commentary builds on several excellent recent reviews of the direct and indirect effects of climate change^{1,2,3} and a prior commentary⁴ to present the case for an integrated assessment and a sharper focus on children as the lever for policy change. A fuller accounting is needed of the mounting public health, social, environmental and economic costs of climate change as they

relate to children now and in the future so as to spur the “large and concerted global mitigation efforts” required.⁵ This accounting must address the major issues of inequity: the disproportionate burden on the young; growing regional and socio-economic disparities in climate-change impacts; and the escalating threat to future generations.

Unfortunately, there have not been comprehensive estimates of the economic costs of climate change and fossil fuel burning and the corresponding benefits of concerted action – either overall or with respect to children. However, the limited estimates

- 1 Xu, Z., P. E. Sheffield, W. Hu, H. Su, W. Yu, X. Qi and S. Tong (2012). ‘Climate change and children’s health – A call for research on what works to protect children’. *Int. J. Environ. Res. Public Health*, 9(9): 3298–3316.
- 2 Sheffield, P. E. and P. J. Landrigan (2011). ‘Global climate change and children’s health: Threats and strategies for prevention’. *Environ Health Perspect*, 119(3): 291–298.
- 3 Patz, J.A., D. Campbell-Lendrum, T. Holloway and J. A. Foley (2005). ‘Impact of regional climate change on human health’. *Nature*, 438(7066): 310–317.
- 4 Perera, F. P. (2008). ‘Children are likely to suffer most from our fossil fuel addiction’. *Environ Health Perspect*, 116(8): 987–990.

- 5 Peters, G. P., R. M. Andrew, T. Boden, J. G. Canadell, P. Ciais, C. Le Quéré et al. (2012). ‘The challenge to keep global warming below 2°C’. *Nature Climate Change*, 3: 4–6.

that do exist indicate that such a concerted policy would have very large and escalating benefits: the estimated health-related costs of just six climate change-related events in the United States between 2002 and 2009 were about \$14 billion and annual health-care costs were \$740 million.⁶ By 2020, an estimated \$100 billion per year will be transferred from developed to developing countries for mitigation of greenhouse gas emissions and adaptation to climate change.⁷ The avoided health costs (benefits) attributed to amendments to the US Clean Air Act are estimated to reach almost \$2 trillion for the year 2020; this amount “dwarfs the direct costs of implementation (\$65 billion)”.⁸

Focusing on children is essential because the developing foetus and child are more biologically and psychologically vulnerable to the myriad direct and indirect effects of climate change and fossil fuel combustion. The foetus and child are especially susceptible to physical and psychological trauma, nutritional deprivation, infectious agents and environmental contaminants because of their dynamic developmental physiology and immature defence systems. They may therefore be affected by environmental exposures that have no apparent effects in adults.^{2,4} In addition, the foetal period represents a window of susceptibility both to

genetic damage⁹ and epigenetic dysregulation from exposure to xenobiotics and stress.¹⁰

Considering both their inherent biologic susceptibility and their long future lifetimes over which early insults can be manifested as chronic disease or cognitive impairment, the foetus and child are considered especially vulnerable and at risk for the multiple, cumulative and long-term health impacts of climate change and fossil fuel-related air pollution.^{1,2,4} These effects include increased incidence of malnutrition and infectious disease, physical and psychological trauma from extreme weather-related disasters, heat stress, respiratory disease, reproductive and developmental disorders, and cancer associated with various air pollutants (ozone, particulate matter, black carbon, polycyclic aromatic hydrocarbons, mercury, nitrogen and sulphur dioxides). Early impairment and disease can affect the physical and psychological health and well-being of children over their entire future life course. In addition, epigenetic effects of *in utero* and post-natal exposure to both toxic and psychological stressors may be inherited trans-generationally, thereby affecting the health of future generations.^{10,11}

Because of their developmental susceptibility, children now bear a disproportionate share of the global

disease burden. The World Health Organization (WHO) estimates that a third of the global burden of disease is caused by environmental factors and that children under 5 years of age bear more than 40 per cent of that burden, even though they represent only 10 per cent of the world’s population.¹² According to WHO estimates based on the disability-adjusted life years metric, more than 88 per cent of the existing global burden of disease due to climate change occurs in children under 5 years of age.¹³ Most of that burden is felt in developing countries and populations of low socio-economic status, which squarely raises the issue of environmental justice. These disparities related to age, region and socio-economic status will continue to grow under the projected trajectory of climate change.² In addition, the internationally recognized right of current and future children to a healthy, sustainable life^{14,15} is violated by our failure to address climate change and its root cause, our dependence on fossil fuel.

Human-induced climate change is a real and escalating threat

There is no longer legitimate scientific debate over whether human-induced climate change is ‘real’. Since 2009, it has been recognized as the biggest global health threat of the twenty-first

6 Knowlton, K., M. Rotkin-Ellman, L. Geballe, W. Max and G. M. Solomon (2011). ‘Six climate change-related events in the United States accounted for about \$14 billion in lost lives and health costs’. *Health Aff (Millwood)*, 30(11): 2167–2176.

7 OECD (2011). *Development perspectives for a post-2012 climate financing architecture*. Paris: OECD Publishing.

8 US Environmental Protection Agency (2011). *The benefits and costs of the Clean Air Act from 1990 to 2020*.

9 Perera, F. P., D. Tang, R. M. Whyatt, S. A. Lederman and W. Jedrychowski (2004). Comparison of PAH-DNA adducts in four populations of mothers and newborns in the US, Poland, and China. In *Proceedings of the 95th AACR Annual Meeting*, 27–31 March 2004. Orlando, FL: American Association for Cancer Research. 454.

10 Dolinoy, D. C., J. R. Weidman and R. L. Jirtle (2007). ‘Epigenetic gene regulation: Linking early developmental environment to adult disease’. *Reprod Toxicol.*, 23:297–307.

11 Perera, F. and J. Herbstman (2011). ‘Prenatal environmental exposures, epigenetics, and disease’. *Reprod Toxicol.*, 31(3): 363–373.

12 Prüss-Ustün, A. and C. Corvalán (2006). *Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease*. Geneva, Switzerland: World Health Organization.

13 Zhang, Y., P. Bi and J. E. Hiller (2007). ‘Climate change and disability-adjusted life years’. *J Environ Health*, 70(3): 32–36.

14 World Commission on Environment and Development (1987). *Our common future* (Brundtland Report). Oxford, UK: Oxford University Press.

15 General Assembly of the United Nations (1989). ‘Convention on the Rights of the Child’. *United Nations, Treaty Series*, 1577: 3.

century.¹⁶ We have seen its face in the increased frequency and intensity of weather-related disasters such as Hurricanes Katrina and Sandy in the United States in 2005 and 2012, an epidemic of forest fires in the United States and Australia in 2012, flooding in Pakistan and Australia in 2010 and 2011, drought in East Africa in 2011, and a deadly heatwave in Europe in 2003.

Lending urgency to the issue is the latest report on the trajectory of CO₂ emissions from the Global Climate Project, which shows that emissions of CO₂ from fossil fuel burning reached a historical high of 9.7+0.5PgC (35.6 billion tonnes) in 2012.⁵ The observed growth rates are at the top end of all previous emissions scenarios. As a result, CO₂ atmospheric concentrations are approaching (some say have already exceeded) the point where the ultimate increase in the Earth's temperature will exceed the international goal of limiting the increase to 2° Celsius (3.6° Fahrenheit) above pre-industrial levels so as to avoid catastrophic consequences.⁵

A shift to a pathway that would meet that goal is still possible but requires “high levels of technological, social and political innovations and an increasing need to rely on net negative CO₂ emissions in the future ... Unless large and concerted mitigation efforts are initiated soon, the goal of remaining below two degrees Celsius will very soon be unachievable”.⁵ The present climate change models do not account for feedback loops such as the release of vast amounts of methane, a much more potent

greenhouse gas than CO₂, which result from the melting of permafrost at higher temperatures.¹⁷

China, the United States, the European Union (EU) and India are the major CO₂ emitters, largely from burning of coal, liquid fuel (diesel, gasoline and oil) and natural gas. Emissions reductions in the developed countries have been offset by rapid growth in developing countries such as China and India. By 2035, China is expected to emit 55 per cent and the United States 12 per cent of the world's total carbon emissions from coal.¹⁸ Motor vehicle emissions currently contribute 22 per cent of CO₂ globally and are playing an increasing role in developing countries.¹⁹ In addition, black carbon from diesel engines, primitive cook stoves and forest fires is the second most important contributor to long-term climate change.²⁰

As reviewed here, the scientific basis for action to protect children is in place; what is needed is the political will to take that action. A full reckoning of the predicted effects on current and future children of continued global warming and its proximal cause, fossil fuel burning, would be a powerful driver of such action, since protection of children and future generations is the most widely shared value among all

peoples, capable of trumping self-interest.^{14,21}

Climate change and children's health

Human-induced climate change has already significantly harmed children's health and well-being and has placed current and future children on a predicted trajectory of increasing ill health and an unsustainable future.

While there are few quantitative estimates of the proportion of childhood morbidity and mortality due to human-induced climate change, there is scientific agreement that both direct and indirect effects of climate change have already taken a significant toll on children and are predicted to increase dramatically unless action is taken. The following summary is based on prior reviews of the known and potential effects of climate change and fossil fuel emissions and the mechanisms of vulnerability with respect to each.^{1,2,3,4}

WHO²² estimated that climate change from the mid-1970s onwards contributed to more than 150,000 deaths and about 5 million lost disability-adjusted life years worldwide in 2000 alone through increases in diseases such as diarrhoea, malnutrition and malaria, mainly in developing countries.³ This estimate was conservative since it considered only a partial list of health outcomes. WHO estimated that the climate change-induced excess risk of this limited number of outcomes would more than double by 2030.

16 Costello, A., M. Abbas, A. Allen, S. Ball, S. Bell, R. Bellamy et al. (2009). 'Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet*, 373(9676):1693–1733.

17 Anthony, K. M. W., P. Anthony, G. Grosse and J. Chanton (2012). 'Geologic methane seeps along boundaries of Arctic permafrost thaw and melting glaciers'. *Nature Geoscience*, 5(6): 419–426.

18 Kirkland, J. (ClimateWire) (2011). 'China's booming economy may produce the majority of world coal emissions by 2035 – EIA', *New York Times*, 4 February.

19 International Energy Agency (2012). *CO₂ emissions from fuel combustion 2012 – Highlights*. Paris: IEA.

20 Bond, T. C., S. J. Doherty, D. W. Fahey, P. M. Forster, T. Berntsen, B. J. DeAngelo et al. (2013). 'Bounding the role of black carbon in the climate system: A scientific assessment'. *Journal of Geophysical Research: Atmospheres*, 118(11): 5380–5552.

21 Schene, P. A. (1998). 'Past, present, and future roles of child protective services'. *Future Child*, 8(1): 23–38.

22 WHO (2002). *The world health report 2002: Reducing risks, promoting healthy life*. Geneva: WHO.

The regions bearing the greatest burden of climate-sensitive diseases are those with the lowest capacity to adapt to risks, yet they have contributed the least in global emissions of greenhouse gases.

Malnutrition and infectious disease represent the largest share of the burden of childhood morbidity and mortality attributed to climate change.² Children are more vulnerable than adults to famine and nutritional deprivation since they require three to four times the amount of food on a body weight basis than adults. Children represent the majority of the global population afflicted by hunger.¹ Dysfunction from inadequate nutrition during early development can last a lifetime. Children's immature immune systems make them more susceptible to infectious disease pathogens (e.g., cholera and other diarrhoeal diseases) from crop and water contamination due to storms and floods, as well as to vector-borne diseases (e.g., malaria and dengue fever) which have increased in certain regions due to climate change.³ Cholera and other diarrhoeal diseases claim the lives of almost 2 million children each year in the developing world.²³ Salmonella, a food-borne infectious disease, has also been affected by higher temperatures across much of continental Europe.³ Malnutrition places children at higher risk of infectious disease.

Climate change has increased the frequency and intensity of weather-related disasters (floods, droughts, cyclones and hurricanes), which directly affected an estimated 66.5 million children worldwide, 600,000 of whom died, every year from 1990 to

2000.²⁴ The number affected is predicted to rise to 175 million a year.²⁵ Children are highly vulnerable both to physical trauma from such disasters and to stress experienced by their mothers during pregnancy or that they experience in childhood directly or through their caretakers.^{1,2} Drowning and displacement due to floods and famines associated with drought are major causes of fatality and malnutrition of children in developing countries. According to a recent study, rates of sea level rise between 1993 and 2011 exceeded by 60 per cent the highest projections made by the International Panel on Climate Change (IPCC) in 2007,²⁶ making coastal storms more dangerous for coastal infrastructure and inhabitants.²⁷

Another direct effect of climate change is an increase in the frequency of deadly heatwaves, like the one that resulted in 22,000–40,000 heat-related deaths in Europe in 2003.³ Heatwaves are predicted to become more frequent and severe in cities such as Chicago and Paris, with large increases predicted for the western and southern United States and the Mediterranean region. The direct effects of heatwaves on children include hyperthermia, heat stress, renal disease and respiratory illness,²⁸ to which

infants and children are especially vulnerable due to their immature regulatory systems.

Air pollution levels have significantly increased as a result of climate change and fossil fuel burning, with direct impacts on children's health.^{4,29} Both ambient and indoor air quality are affected by these increases due to the penetration of pollutants into the indoor environment.³⁰ Children are more vulnerable to air pollutants because they have a higher respiratory rate and take in more air on a body weight basis than adults. Their immature metabolic/detoxification, DNA repair and immune systems place them at greater risk from inhaled toxicants (including ozone, particulate matter, polycyclic aromatic hydrocarbons, mercury, sulphur and nitrogen oxides) and toxins (such as aeroallergens).

Direct toxic effects of fossil fuel combustion pollutants include increased infant mortality, lower birth weight, deficits in lung function, respiratory symptoms, childhood asthma, bronchitis, developmental disorders, and increased risk of cancer.⁴ The many observed adverse effects are not surprising, given the diversity of fossil fuel combustion products.³¹ What is more, the same pollutant can exert multiple toxic effects. Exposure to air pollution

24 Pronczuk, J. and S. Surdu (2008). 'Children's environmental health in the twenty-first century'. *Ann N Y Acad Sci*, 1140:143–154.

25 Save the Children UK (2007). *Legacy of disasters: The impact of climate change on children*.

26 Rahmstorf, S., G. Foster and A. Cazenave (2012). 'Comparing climate projections to observations up to 2011'. *Environmental Research Letters*, 7(4): 044035.

27 Columbia Climate and Health Program (2012). 'Sea level rising faster than expected'. *Emerging Climate Findings Archive*, November.

28 Knowlton, K., M. Rotkin-Ellman, G. King, H. G. Margolis, D. Smith, G. Solomon et al. (2009). 'The 2006 California heat wave: Impacts on hospitalizations and emergency department visits'. *Environ Health Perspect*, 117(1): 61–67.

29 Intergovernmental Panel on Climate Change (IPCC) (2007). 'Human health'. In *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC*. Geneva, Switzerland.

30 Zhao, Z., Z. Zhang, Z. Wang, M. Ferm, Y. Liang and D. Norback (2008). 'Asthmatic symptoms among pupils in relation to winter indoor and outdoor air pollution in schools in Taiyuan, China'. *Environ Health Perspect*, 116(1): 90–97.

31 Bernard, S. M., J. M. Samet, A. Grambsch, K. L. Ebi and I. Romieu (2001). 'The potential impacts of climate variability and change on air pollution-related health effects in the United States'. *Environ Health Perspect*, 109(Suppl 2): 199–209.

23 WHO (2013). *Facts and figures: Water, sanitation and hygiene links to health*.

in childhood may result in a reduction in lung function and ultimately in increased risk of chronic respiratory illness^{32,33} and greater susceptibility to cardiovascular disease in adulthood.³³

With respect to climate-related changes in air pollution levels, higher temperatures due to climate change accelerate the formation of ozone from its precursors (volatile organic chemicals, carbon monoxide and nitrogen dioxide). Under the high-emission IPCC scenario, daily average ozone levels could rise by 3.7 ppb across the eastern United States, with projected ozone-related deaths from climate change increasing by 4.5 per cent in the mid-2050s, compared with the levels of the 1990s.^{3,34} The seemingly small relative risk translates into a substantial attributable risk because so many millions of adults and children are exposed. In addition to increased mortality, ozone is associated with decreased lung growth and function, and exacerbation of asthma and respiratory tract infection in children. A median increase of 7.3 per cent in summer ozone-related emergency department visits for asthma in children is projected for the New York City metropolitan region by the 2020s.³⁵

32 Gauderman, W. J., R. McConnell, F. Gilliland, S. London, D. Thomas, E. Avol et al. (2000). 'Association between air pollution and lung function growth in southern California children'. *Am J Respir Crit Care Med*, 162(4 Pt 1): 1383–1390.

33 Shea, K. M. (2003). 'Global environmental change and children's health: Understanding the challenges and finding solutions'. *J Pediatr*, 143(2): 149–154.

34 Knowlton, K., J. E. Rosenthal, C. Hogrefe, B. Lynn, S. Gaffin, R. Goldberg et al. (2004). 'Assessing ozone-related health impacts under a changing climate'. *Environ Health Perspect*, 112(15): 1557–1563.

35 Sheffield, P. E., K. Knowlton, J. L. Carr and P. L. Kinney (2011). 'Modeling of regional climate change effects on ground-level ozone and childhood asthma'. *Am J Prev Med*, 41(3): 251–257; quiz A3.

Higher temperatures and greater CO₂ concentrations also promote the growth of aeroallergens (such as pollens and mould), leading to more allergic disease and asthma in children.³⁶ Given their developing immune and respiratory systems, children are particularly sensitive to these exposures.

Another source of air pollution exacerbated by climate change is forest fires that are increased by higher temperatures and lower soil moisture, releasing large amounts of particulate matter, including black carbon. These pollutants are associated with respiratory symptoms, decreased lung growth and function, and exacerbation of asthma and chronic bronchitis in children.¹ Increased temperatures in areas of decreased precipitation are also resulting in the volatilization of persistent organic pollutants and pesticides, to which children's developing nervous systems are particularly vulnerable.

The current effects of climate change and fossil fuel emissions may currently be dwarfed by the burden from lack of sanitation and hygiene, urban air pollution, indoor smoke from solid fuels, and lead exposure, but the burden of climate- and pollutant-sensitive disease is expected to grow substantially in future years and decades.² This brief review has highlighted the many elements of susceptibility of the developing foetus and child resulting from their rapid development, immature defence mechanisms, and vulnerability to genotoxic and epigenetic damage from environmental and psychosocial stressors. Another element of children's susceptibility

36 Beggs, P. J. and H. J. Bambrick (2005). 'Is the global rise of asthma an early impact of anthropogenic climate change?' *Environ Health Perspect*, 113(8): 915–919.

is that they have more future years of life during which exposures are ongoing and during which latent effects of early undernutrition, neurodevelopmental, reproductive and respiratory effects can manifest in disease or impairment.

Mitigation and adaptation strategies

To be effective, prevention and adaptation strategies to climate change must be centred around the needs of children.^{1,2,4} In 2007, the IPCC concluded that significant progress towards stabilizing or reducing global warming emissions can be achieved at relatively low cost using known technologies and practices currently available.³⁷ A concurrent McKinsey report concluded that the United States could reduce greenhouse gas emissions in 2030 by 3.0–4.5 gigatons of CO₂ equivalents by using tested approaches and high-potential emerging technologies, and that the net cost of achieving these levels of emissions abatement could be quite low on a societal basis.³⁸ More recently, Jacobson and Delucchi evaluated the feasibility of providing all energy for all purposes (electric power, transportation and heating/cooling), everywhere in the world, from wind, water and the sun. They concluded that the barriers to a 100 per cent conversion to wind, water and solar power worldwide are primarily social and political, not technological or

37 IPCC (2007). *Fourth Assessment Report*. Geneva, Switzerland: IPCC and World Meteorological Organization.

38 McKinsey & Co. (2007). *Reducing US greenhouse gas emissions: How much at what cost?*

even economic.^{39,40} These reports indicate that the cost of acting now to make power generation, transport, buildings and appliances more efficient and to invest in alternative fuels and technologies is modest compared with the benefits attached to reducing global warming and pollution from fossil fuels.

Environmental justice and intergenerational equity

Poverty increases the susceptibility of the foetus and child to the toxic exposures and stress that result from climate change and fossil fuel pollution. Poor and minority group children, especially those in urban areas and developing countries, are most at risk, because the effects of toxic exposures are magnified by the inadequate nutrition and psychosocial stress produced by poverty or racism.⁴¹ The striking socio-economic inequalities that now exist in children's health within and between countries^{42, 43} are exacerbated by global climate change.⁴⁴

In addition to potentially heritable biological damage from

climate change and fossil fuel emissions, other current and future impacts on children include social and political instability from forced migration and population displacement. This perpetuates poverty and civil unrest in low-income developing countries that already bear most of the global burden of poverty and childhood disease and where people aged under 18 years represent 50 per cent of the population.²

Finally, unless action is taken now, children and their progeny will inherit an unsustainable world, lacking the necessary ecological resources and services to support them. Climate change is a serious environmental challenge that could undermine the drive for sustainable development.⁴⁵ Climate change has already affected natural ecosystems that provide a range of services, often not recognized in national economic accounts but vital to human welfare: regulating water flows, flood control, pollination, decontamination, carbon sequestration, biodiversity conservation, and nutrient and hydrological cycling. These impacts include decreased biodiversity, inundation of large coastal areas and acidification of the oceans.

The right of children and future generations to a sustainable future has been internationally recognized. In 1987, the World Commission on Environment and Development, known as the Brundtland Commission of

the United Nations, published a report, *Our common future*.¹⁴ The report contained prescriptions for long-term environmental strategies to achieve sustainable development that met the essential needs of the world's poorest people while ensuring intergenerational equity. The rights of current and future children were subsequently reaffirmed by a United Nations convention.¹⁵

Growing concern over deteriorating environmental conditions has increasingly prompted legal systems around the world to recognize the interests of future generations and the corresponding responsibilities of present generations to protect them.^{46,47,48} Intragenerational equity is not new, having been embodied in the constitution of the Confederacy of the Six Nations of the Iroquois, which required leaders to make decisions bearing in mind the 'seventh generation to come'. The failure to address climate change through concerted international action would clearly violate the principle of intergenerational equity that no significant environmental burden should be inherited by future generations.¹⁴ The American Academy of Pediatrics concluded in 2007 that "Any solutions that address climate change must be developed within the context of overall sustainability (the use of resources by the current generation to meet current needs while ensuring that

39 Delucchi, M. A. and M. Z. Jacobson (2011). 'Providing all global energy with wind, water, and solar power, Part II: Reliability, system and transmission costs, and policies'. *Energy Policy*, 39(3): 1170–1190.

40 Jacobson, M. Z. and M. A. Delucchi (2011). 'Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials'. *Energy Policy*, 39(3): 1154–1169.

41 Wood, D. (2003). 'Effect of child and family poverty on child health in the United States'. *Pediatrics*, 112(Suppl 3): 707–711.

42 Marmot, M. (2006). 'Harveian Oration: Health in an unequal world'. *Lancet*, 368(9552): 2081–2094.

43 Waterston, T. and S. Lenton (2000). 'Sustainable development, human induced global climate change, and the health of children'. *Arch Dis Child*, 82(2): 95–97.

44 UNICEF (2008). *Climate change and children: A human security challenge*. Florence: UNICEF Innocenti Research Centre.

45 Yohe, G. W., R. D. Lasco, Q. K. Ahmad, N. W. Arnell, S. J. Cohen, C. Hope et al. (2007). 'Perspectives on climate change and sustainability'. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, eds. *Climate change 2007: Impacts, adaptation and vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press. 811–841.

46 Raffensperger, C., T. Giannini and B. Docherty (2008). *Models for protecting the environment for future generations*. Science and Environmental Health Network and The International Human Rights Clinic at Harvard Law School.

47 Atapattu, S. (2002). 'The right to a healthy life or the right to die polluted: The emergence of a human right to a healthy environment under international law'. *Tul. Env'tl. L.J.*, 16: 65.

48 Hill, B. E., S. Wolfson and N. Targ (2004). 'Human rights and the environment: A synopsis and some predictions'. *Geo. Int'l Env'tl. L. Rev.*, 16: 359.

future generations will be able to meet their needs)".⁴⁹

Conclusion

Several factors now provide the impetus for the paradigm shift that is necessary: the large body of scientific knowledge concerning

the biological vulnerability of the young to physical and psychosocial stressors resulting from climate change and fossil fuel pollution; the significant harm already inflicted on this vulnerable group; the awareness of striking disparities in those risks; and the politically powerful value shared by all cultures and communities of protecting the health and well-being of present and future children.^{14,21}

The benefits of a child-centred policy on climate change and energy include the individual and societal benefits of millions fewer cases of deaths and disease in children, including those from malnutrition, diarrhoeal disease, infectious disease, heat stroke, asthma and allergies, developmental disorders and cancer. They also include the benefits of extending health and security to all the generations of children to come.

⁴⁹ Shea, K. M. (2007). 'Global climate change and children's health'. *Pediatrics*, 120(5):1359-1367.

Childhood health risks of climate change

KRISTIE L. EBI



Children are already bearing the brunt of the health impacts of climate change. The World Health Organization estimates that over 80 per cent of the illnesses, injuries and deaths occurring due to climate change are in children, particularly those living in poor and under-served areas.¹ Climate change is altering weather patterns in ways that can affect the geographic range, seasonality and incidence of health outcomes that are among the major killers of children, particularly under-nutrition, diarrhoeal diseases

and vector-borne diseases such as malaria.² Between the period 1961–1990 and the year 2000, climate change was estimated to have increased the numbers of cases of these diseases by between 3 and 10 per cent.¹ Future impacts on children are projected to increase based only on the influence of weather and climate on health risks, assuming no change in other drivers of climate-sensitive health outcomes and no additional interventions to avoid, prepare for, respond to or recover from

the impacts of climate variability and change.

Current trends and projections in childhood climate-sensitive health outcomes

Even with considerable progress over the last few decades, the burden of childhood diseases on which climate change is operating is unacceptably large. The Global Burden of Disease Study 2010 estimated that 64 per cent (4.9 million) of the 7.6 million deaths in children younger than 5 years were attributable to infectious causes, with pneumonia (14.1 per cent; 1.1 million), diarrhoea (9.9 per cent; 0.8 million) and malaria (7.4 per cent; 0.6 million) claiming the most lives of children who

1 McMichael, A. J., D. Campbell-Lendrum, S. Kovats, S. Edwards, P. Wilkinson, T. Wilson, R. Nicholls, S. Hales, F. Tanser, D. LeSueur, M. Schlesinger and N. Andronova (2004). 'Global climate change'. In M. Ezzati, A. Lopez, A. Rodgers and C. Murray, eds. *Comparative quantification of health risks: Global and regional burden of disease due to selected major risk factors*. Geneva: World Health Organization. 1543–1649.

2 Confalonieri, U., B. Menne, R. Akhtar, K. L. Ebi, M. Hauengue, R. S. Kovats, B. Revich and A. Woodward (2007). 'Human health'. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, eds. *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press. 391–431.

survived the neonatal period.³ Africa remains the continent with the highest risks. Of the 3.6 million annual childhood deaths in Africa, 11 per cent are due to diarrhoeal diseases.³ Contaminated water and inadequate sanitation and hygiene are the leading reasons for the high rates. Rising temperatures that facilitate the replication of some pathogens, and more flooding events that damage water treatment facilities and/or spread pathogens, could increase the burden of disease, depending on the effectiveness of control programmes.

Annually, there are between 451,000 and 813,000 deaths from malaria in Africa, a number that has been declining slowly since approximately 2004.⁴ Weather and climate are among the environmental, social and economic determinants of malaria, which also include lack of human and financial resources, inadequate public health and health-care systems, limited access to health-care facilities offering effective diagnostic testing and treatment, insufficient access to water and sanitation, and poor governance. Climate change is expected to affect the geographic range, seasonality and incidence of malaria, particularly along the current edges of its distribution, with contractions in a few areas and expansions in many others.² Movement of the parasite into new regions is associated with epidemics with

high morbidity and mortality. Consensus is growing that highland areas, especially in East Africa, will experience increased malaria epidemics, with areas above 2,000 metres particularly affected, where temperatures are currently too low to support malaria transmission.⁵

Between 2011 and 2013, 842 million people suffered from chronic hunger, approximately 12 per cent of the global population.⁶ Sub-Saharan Africa and parts of Asia remain the regions with the highest prevalence and they are also making the slowest progress. Hunger and undernutrition remain major contributors to global ill health, and are responsible for a third of the burden of disease in children under 5.⁷ Beyond immediate mortality and morbidity impacts, childhood undernutrition is associated with reductions in educational achievement and earning capacity that affect individual lives and societal development.⁸ Although the proportion of the world's

undernourished population has been reduced, progress has slowed since 2007,⁹ probably due in part to warmer temperatures decreasing production of cereal crops in regions susceptible to food insecurity.¹⁰

An example of how weather and climate events can affect food security is the prolonged drought in Syria that affected 1.3 million people in 2008 and 2009, with up to 800,000 severely affected.¹¹ There were significant losses of rain-fed and irrigated winter grain crops. Wheat production decreased by almost 50 per cent, with most farmers dependent on rain-fed production suffering complete or near-total loss of crops. Herders lost around 80 per cent of their livestock due to barren grasslands. Combined with an increase in the price of food and basic resources, many affected households could not afford basic supplies or food, thus increasing the rate of undernutrition, particularly among pregnant women and children under 5. Inadequate consumption of micronutrients and macronutrients in the most affected households meant that the average diet contained less than 15 per cent of the recommended daily fat intake and 50 per cent of the advised energy

3 Liu, L., H. L. Johnson, S. Cousens, J. Perin, S. Scott, J. E. Lawn et al. (2012). 'Global, regional, and national causes of child mortality: An updated systematic analysis for 2010 with time trends since 2000'. *Lancet*, 379: 2151–2161.

4 World Health Organization (updated February 2013). *MDG 6: Combat HIV/AIDS, malaria and other diseases*. Available at: www.who.int/topics/millennium_development_goals/diseases/en

5 For example, Pascual, M., J. A. Ahumada, L. F. Chaves, X. Rodo and M. Bouma (2006). 'Malaria resurgence in the East African highlands: Temperature trends revisited'. *Proceedings of the National Academy of Sciences*, 103(15): 5829–5834; Gething, P. W., D. L. Smith, A. P. Patil, A. J. Tatem, R. W. Snow and S. L. Hay (2010). 'Climate change and the global malaria recession'. *Nature*, 465(7296): 342–345; Lou, Y. and X. Zhao (2010). 'A climate-based malaria transmission model with structured vector population'. *SIAM Journal on Applied Mathematics*, 70(6): 2023–2044; Erment, V., A. H. Fink, A. P. Morse and H. Paeth (2012). 'The impact of regional climate change on malaria risk due to greenhouse forcing and land-use changes in tropical Africa'. *Environmental Health Perspectives*, 120: 77–84.

6 Food and Agriculture Organization of the United Nations, World Food Programme and International Fund for Agricultural Development (2013). *The state of food insecurity in the world 2013. The multiple dimensions of food security*. Rome: FAO.

7 Black, R. E., C. G. Victora, S. P. Walker, Z. A. Bhutta, P. Christian, M. de Onis et al. (2013). 'Maternal and child undernutrition and overweight in low-income and middle-income countries'. *Lancet*, 382: 427–551.

8 Victora, C. G., L. Adair, C. Fall, P. C. Hallal, R. Martorell, L. Richter et al. (2008). 'Maternal and child undernutrition: Consequences for adult health and human capital'. *Lancet*, 371: 340–357.

9 Wheeler, T. and J. von Braun (2013). 'Climate change impacts on global food security'. *Science*, 341: 508–513.

10 For example, Lobell, D. B., W. Schlenker and J. Costa-Roberts (2011). 'Climate trends and global crop production since 1980'. *Science*, 333: 616–620.

11 Murray, V., G. McBean, M. Bhatt, S. Borsch, T. S. Cheong, W. F. Erian, S. Llosa, F. Nadim, M. Nunez, R. Oyun and A. G. Suarez (2012). 'Case studies'. In C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and P. M. Midgley, eds. *Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*. Cambridge University Press, Cambridge, UK, and New York: 487–542.

and protein requirements. One of the most visible effects of the drought was the migration of 40,000 to 60,000 families from the affected areas, with its own attendant risks.

Projections of the impacts of climate change on food security, through changing crop yields under new temperature and precipitation patterns, increase concerns about future childhood under-nutrition. A robust and growing literature base indicates that major cereal cropping systems will be affected by additional climate change, with tropical areas projected to fare worse than temperate areas for small amounts of warming, and with all areas projected to have negative yield impacts.⁹ Expected increases in the world population to 9.6 billion by the middle of the twenty-first century¹² and climate change are projected to increase the numbers at risk of hunger and undernutrition, particularly in Africa and South Asia.¹³

Using a process-driven approach, Lloyd et al.¹³ projected future child undernutrition (as measured by severe stunting) in 2050 in sub-Saharan Africa and South Asia, taking into consideration food and non-food (socio-economic) causes, and using regional data based on the A2 emissions scenario of the Intergovernmental Panel on Climate Change (IPCC).¹⁴ Current baseline prevalence rates of severe stunting were 12–20 per cent in sub-Saharan Africa

and 19 per cent in South Asia. Considering only future socio-economic change, the prevalence of severe stunting in 2050 in Africa would be 7–17 per cent (i.e., a net decline). However, when climate change is taken into account, the prevalence of severe stunting would be 9–22 per cent, or an increase of between 31 and 55 per cent in the proportion of children severely stunted. In South Asia, severe stunting is projected to be 2.9 per cent without climate change (i.e., a large decline) and 4.6–4.7 per cent with climate change taken into account – a significantly smaller improvement.

Many other risks for children's health and well-being are expected to occur with ongoing and future climate change, with additional data and understanding needed to quantify the adverse consequences. For example, climate change is contributing to increases in pollen in some regions, which may be exacerbating allergies and asthma.¹⁴ However, there is too incomplete an understanding of the degree to which aeroallergens are contributing to the global increase in paediatric allergic disease to make it possible to estimate the contribution of climate change.

Providing more comprehensive estimates of current and projected impacts is complex because of the nature of climate change itself and because of the many factors that can increase or decrease the rates of climate-sensitive health outcomes. However, the science is clear on many aspects of climate change.

Climate change

Climate change is caused by natural and human-made activities, particularly the burning

of fossil fuels and deforestation that are adding significant quantities of greenhouse gases to the atmosphere. The IPCC has concluded the evidence that humans are changing the climate to be unequivocal, based on observed increases in average air temperatures and other geophysical factors.² Each of the last three decades has been successively warmer than any preceding decade since 1850.¹⁵

The greenhouse gases currently in the atmosphere will continue to drive temperatures up for at least 30 to 40 years (often called the climate change commitment), with about as much climate change occurring over that period as has already occurred since the Industrial Revolution.¹⁶ The rate of climate change is greater than it has been for at least 10,000 years.

Continued emissions of greenhouse gases will cause further warming and changes in precipitation and other weather patterns, sea level rise, and additional ocean acidification. By the end of the twenty-first century, the increase in global mean surface temperature is likely to exceed 1.5°C for all but the most aggressive scenario for reducing greenhouse gas emissions and may be as high as 4°C.¹⁶ Warming will show broad geographic diversity, with more warming in many places that currently have the highest burdens of climate-sensitive health outcomes.

12 United Nations Department of Economic and Social Affairs (2013). *World population prospects: The 2012 revision*, Working Paper No. ESA/P/WP.228.

13 Lloyd, S. J., R. S. Kovats and Z. Chalabi (2011). 'Climate change, crop yields, and undernutrition: Development of a model to quantify the impact of climate scenarios on child undernutrition'. *Environmental Health Perspectives*, 119: 1817–1823.

14 Bielory, L., K. Lyons and R. Goldberg (2012). 'Climate change and allergic disease'. *Curr Allergy Asthma Rep*, 12: 485–494.

15 Intergovernmental Panel on Climate Change (2013). *Climate change 2013: The physical science basis. Summary for policymakers*. Geneva, Switzerland: IPCC.

16 IPCC (2012). Field, C. B., V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and P.M. Midgley, eds. *Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press, and New York.

In addition to shifts in the mean values of weather variables, there are changes in the frequency and intensity of extreme weather and climate events.¹⁶ Daily temperature extremes and heavy precipitation events in some regions are now different from how they were before 1950, in part due to climate change, resulting in increasingly large economic losses and risks for more individuals and communities.

Projections of future climate change and its impacts are, of course, inherently uncertain because it is not possible to fully predict: future emissions of greenhouse gases; how the climate system will respond to additional greenhouse gas emissions; what climate policies will be implemented (and how rapidly); how societies will develop in terms of demographics, economics and technology; and the effectiveness and timeliness of public health actions to address the health risks of climate change.

These uncertainties are not a reason to delay action, however. This is because much is understood about the magnitude and pattern of climate change over coming decades; because it is certain that children will be among those most affected; and because societies are under-prepared for effectively managing current and future risks.

Managing the risks

Climate change can exacerbate the current challenges faced in seeking to improve children's health and well-being and can create new risks. Quantifying when, where and by how much risks will increase is difficult, not least because of incomplete data about and understanding of how the key drivers of health outcomes interact to create impacts under different socio-economic and climate scenarios. When local data are insufficient (which is common in the most vulnerable places), narratives of possible futures based on expert judgement and local expertise can increase understanding of how various risk factors can interact to affect children's health in a particular region, including whether tipping points could be reached. This can inform the development of robust policies and measures to address the risks. Such narratives and projections can highlight where there are knowledge gaps and where more research is needed, with a view to better managing risks.

What can be done? Current policies and measures to prevent climate-sensitive health outcomes can and should be modified, and new policies and measures developed, not only to address the current risks of climate

variability and change, but also to consider the implications of continuing changes in climate and development pathways. The design, implementation, monitoring and evaluation of policies and measures should be robust to a range of possible futures and should be flexible enough to be adjusted as more information is gained. Incorporating elements of adaptive management – a structured and iterative process of decision-making in the face of imperfect information – into public health practice will increase its effectiveness in addressing the health risks of climate change.¹⁷ Key changes will include: putting a stronger emphasis on stakeholder engagement; taking a systems-based approach when considering whether to modify current interventions or implement new ones; developing interventions based on models of future vulnerabilities and impacts; and ensuring a strong and explicit focus on managing risks.

Without urgent action, climate change is expected to lead to negative consequences for child growth and development, needlessly affecting current and future generations.

¹⁷ Ebi, K. L. (011) 'Resilience to the health risks of extreme weather events in a changing climate in the United States.' *Int J Environ Res Public Health*, 8(11): 4582–4594.

Why the agriculture and food system must change

HANS R. HERREN



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Climate change, and its direct impact on food production in particular, will affect children more than adults, and the poor more than the well-off, not least because of the wrong-headed policies still being promoted by the governments of many developing countries and their development partners. Developed countries are not spared either from such policies, which promote increased production of the main commodities, instead of concentrating on more diverse food production – and targeting smallholder farmers, where the nexus between hunger and poverty is clearest. Given that there is a close correlation between access to food and income level, it is paramount that poverty is tackled with new and strong vigour, especially in

rural areas, which would slow the migration to urban slums.

Climate change and its consequences will be felt across all the main dimensions of food insecurity and also in all geographical zones, as few places in the world will be spared. The prevailing approaches offered by the main development partners and the private sector are a continuation of the Green Revolution. These are strongly dependent on fertilizers and new crop varieties, and are generally more demanding in terms of water, while having less resilience towards weather extremes, pest and disease attacks. They also tend to have lower nutritional content. As a result, we can expect the following outcomes, all with a high impact on children and vulnerable people.

Availability

Extreme weather, as well as average temperature and rainfall changes, will have a major impact on food quantity and quality. The systems currently proposed have little resilience both in terms of contributing to climate change and of being able to cope with the expected altered conditions. This applies to most geographical areas given that the anticipated changes are spread across the globe, albeit with different levels of impact.

Access (physical and economic)

Food insecurity will increase all over the world, as more and more people are pushed to the point

where they cannot afford to buy the food they need, even if they are not in the poorest segment of the population. The fact that there are about 42 million hungry people in the USA and Europe, and that the numbers are growing, shows how serious the access problem is even in countries with lots of cheap food. It is also well known that undernutrition in developing nations is mostly a matter of access, as the example of India shows very well. Clearly, climate change, with its potential impact on food prices, will exacerbate the access problem.

Utilization

Climate change, and the more humid conditions it will bring, will make it much harder to keep food clean and free of toxins. There may also be a need to store food for longer periods, which will cause it to lose nutritional value. Fresh produce will suffer more disease and insect problems as a result of climate change. Food that has been more ‘stressed’ from cultivation all the way to consumption will affect health in many ways, and will harm children more than adults, with lasting effects that will range from stunting to internal organ damage.

Stability (vulnerability and shocks)

“Ultimately, political stability, effective governance and, most importantly, uninterrupted long-term commitments to mainstreaming food security and nutrition in policies and programmes are key to the reduction

of hunger and malnutrition.”¹

This statement from the Food and Agriculture Organization of the United Nations sums up what is needed. It is important that development partners work closely with the governments of developing countries to improve governance and political stability. The best way to achieve this is by empowering local governments to make their own assessments of the situation, draw their own conclusions and formulate their own policies – local ownership of the decision-making process and the policies that issue from it is vital. This is also the case in terms of being prepared for natural disasters and external shocks. The key is to make sure that national governments have the know-how, human resources and tools to make informed decisions and policies – and also that they have involved multiple stakeholders so as to assure the cooperation of all levels of society. One area that is open to debate is the assumption that economic growth is needed to assure food supply and stability. Although many developing countries have experienced strong growth in recent years, in Asia in particular, the results have been mixed in terms of food security. There is a need to define more clearly what kind of growth is needed to make a dent in the poverty/hunger nexus. More attention needs to be paid to indicators other than gross domestic product, or even the Human Development Index. The best way to improve stability and to reduce countries’ vulnerability to shocks is to pursue inclusive green growth, with an emphasis on equity as well as environmental and social sustainability.

The way forward

Do we have the solutions for the problems identified above? Based on the fund of global experience, farmers’ knowledge and the available evidence in scientific publications, the answer is a guarded ‘yes’. We can start with *Agriculture at a Crossroads*, the 2009 report of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD).² The report clearly indicated the necessity for a change in paradigm – for a move from Green Revolution agriculture to agro-ecology and sustainable production practices. “Business as usual is not an option” was the tag line of the report. Given the challenges that agriculture is and will be facing, recommendations were made to transform the present systems, based on high inputs of external energy and subsidies – which are not only out of reach for most governments but also waste food and contribute to environmental and soil degradation, loss of biodiversity and climate change. The report recommended a shift towards systems that are multifunctional and mindful of the planetary boundaries as well as the three dimensions of sustainable development: environmental, economic and social.

The solutions proposed have been researched and tested in many parts of the world and are available to farmers, free from company patents. They do, however, require renewed efforts in extension, communication and general farmer support, ranging

1 Food and Agriculture Organization of the United Nations (2013). *State of food insecurity in the world 2013*. Rome: FAO. Available at: www.fao.org/docrep/018/i3434e/i3434e00.pdf

2 International Assessment of Agricultural Knowledge, Science and Technology for Development (2009). *Agriculture at a Crossroads*. Available at: www.unep.org/dewa/Assessments/Ecosystems/IAASTD/tabid/105853/Default.aspx

from access to land, credit, insurance, education and other enabling investments, especially for women and smallholder or family farms. Among the examples of new agronomic practices that farmers could implement immediately, and double or treble yields almost overnight, are the Push-Pull and System of Rice Intensification technologies. These have been widely tested and adopted but would need major support to be scaled up and reach the poor and hungry. In addition to

producing more and better crops, these practices also improve soil fertility in the medium and long term, increase the resilience of the production system and create quality jobs along the production-to-marketing value chain.

It is time for development partners and governments in both the developed and the developing world to take seriously the recommendations made in the IAASTD Report and its 'Global summary for decision makers', which were elaborated by its 400 authors following six

years of very detailed research and analysis.

We cannot afford to carry on with major initiatives in the food and agriculture system that are often led by the private sector and that ignore the reality of climate change and our planet's boundaries. It is our duty to make the basic and simple changes necessary now, even if these are costly and go against vested interests – because the alternative would be even more costly and more disastrous. We cannot afford to fail the next generation, the children of today.

Mitigating the negative impacts of environmentally driven migration on children and other vulnerable people

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Extreme environmental events are increasingly recognized as a key driver of migration across Asia and the Pacific. More than 20 million children and adults in the region were displaced by such events during 2012, with many fleeing areas struck by monsoon floods and typhoons. In November 2013, more than 4 million people were displaced in the Philippines alone by Typhoon Haiyan. Most of those affected by these events eventually returned to their communities when conditions improved, but an undetermined number became migrants, usually within their own country.¹

1 Internal Displacement Monitoring Centre (2013). *Global estimates 2012: People displaced by disasters*. Geneva: IDMC.

Asia and the Pacific is the global region most prone to natural disasters, both in terms of the absolute number of disasters and of the number of people affected. It is extremely exposed to climate impacts and is home to highly vulnerable population groups, who are disproportionately poor and marginalized. Continued population growth in locations at high risk of climate-related natural disasters means that more and more people are likely to be displaced by extreme environmental events over the coming years.

When confronting the prospect of growing environmental threats, the poorest populations may be unable to relocate to a safe location due to a lack of resources and opportunities. Their plight

may grow in severity as climate change reduces their resources (for example, weather-damaged crops reducing farmers' income). This is why policy interventions aimed at addressing environmentally driven migration should pay attention not only to those who migrate, but also to those who do not have the means to move elsewhere.

Poor people often live in vulnerable and highly exposed areas – on marginal land, along river banks subject to flooding, in drought-afflicted rural areas, and along coastlines battered by storms and storm surges. They typically live in poorly constructed dwellings and, in the case of urban dwellers, in densely populated neighbourhoods with poor drainage. Poor people are more likely

to be forced out of their homes by extreme environmental events, but may have nowhere to go and few means with which to escape hazardous conditions.

Children are generally more at risk than adults when environmental threats gradually grow, or when natural disaster suddenly strikes. They are more likely to suffer damage to their health (diarrhoea, drowning, vector-borne diseases and lack of adequate nutrition). They may also lack the assets, physical strength and decision-making options that can make the difference between life and death. A World Health Organization study of mortality linked to climatic events globally over three decades found that environmental factors accounted for a quarter of the deaths in the general population but for more than a third of deaths among children under 14.²

When extreme environmental events displace people, children are often pulled from school, led away from accessible health-care facilities, and compelled to work in order to survive and help their families get through the crisis. They can also end up in dangerous situations at risk of emotional, physical and sexual violence, particularly if they have lost the company of parents or other trusted adult guardians along the way.

To reduce migration driven by worsening environmental conditions, and to enhance the resilience of at-risk communities, governments should strengthen social protection systems, basic urban infrastructure and disaster preparedness. They should also

adopt measures recognizing that migration can be a useful way for people to cope with environmental changes. If humanely managed with proper planning and arrangements, migration can provide substantial benefits to both origin and destination areas, as well as to migrants and their families.

Research supported by the Asian Development Bank (ADB) has found that, although migration can impose significant costs on migrants, it can also improve their lives in the right circumstances, especially if there is time to plan and assistance is available for resettlement.³ The communities from which migrants depart may experience reduced environmental stress and less competition for resources. They may also receive remittances that can be used to build adaptive capacity. In the long run, migration can be instrumental in fostering resilience at the household level, and can improve access to information and social networks.

Recognizing the particular vulnerability of minors to climate change, the Children in a Changing Climate coalition has advocated for adaptation planning and implementation to incorporate features to protect children's rights, including disaggregated analysis of climate vulnerability and capacity by age, gender and urban/rural status; participatory spaces created by, with and for children; child-centred resilience projects and programmes with dedicated support and resources; and indicators for monitoring and evaluation that are based on children's rights.⁴

Other steps that can be taken to protect children from natural hazards include ensuring that strategic plans on climate change protect and involve children; that a proportion of adaptation financing is explicitly targeted to build children's capacity to adapt; and that climate change adaptation and disaster risk reduction are included in school curricula.⁵

More generally, decision-makers need more targeted, policy-relevant research on the interaction between the environment and migration. Many uncertainties remain about how populations in particular locations react to environmental changes, both sudden and of a slow-onset variety. Recognizing this 'data gap', ADB and the International Organization for Migration launched the Asia Pacific Migration and Environment Network (APMEN) in 2012.⁶ APMEN promotes research on the migration and environment nexus in Asia and the Pacific, and offers a platform for sharing analysis and insights on environmentally driven migration.

Across Asia and the Pacific, actual and anticipated extreme environmental events are forcing people, both old and young, to relocate temporarily or for long periods. By taking action today, governments can mitigate future humanitarian crises and improve the prospects of people remaining in their communities. Alternatively, should conditions make that impractical or dangerous, they can provide them with options to settle in a place that is safe for their children, and offers them livelihood opportunities to support their families. Migration has long been recognized as an effective

2 Prüss-Ustün, A. and C. Corvalán (2006). *Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease*. Geneva: World Health Organization.

3 Asian Development Bank (2012). *Addressing climate change and migration in Asia and the Pacific*. Manila, Philippines: ADB.

4 Polack, E. (2010). *Child rights and climate change adaptation: Voices from Kenya and Cambodia*. IDS, Brighton, UK, and Plan International, Surrey, UK.

5 Ibid.

6 www.apmen.iom.int/en

tool for development, and can also serve as a tool for climate change adaptation, including for children living in environmentally threatened areas.

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expressed in this article are those of the author and do not necessarily reflect the views and policies of ADB or its Board of Governors or the governments they represent.

Why we need a child-centred approach to adaptation

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Chronic crises and sudden disasters related to climate change disproportionately affect children. Not only do children make up almost half of the population in developing countries, hence forming one of the largest groups affected by climate change, but they are also especially vulnerable to its impacts. For example, due to their physical immaturity, threats such as malaria and diarrhoea, hunger and malnutrition often result in much higher levels of illness and death among children, particularly those under the age of 5, than among adults.

Every year in the next decade, the kinds of natural disasters brought about by climate change are likely to affect up to 175 million children.¹ The impacts are diverse.

Children are often unable to attend school in times of disaster and even beyond, as their families send them out to work. Children are at greater risk of injury and suffer disproportionately from disease as water, sanitation and food security are threatened; and the psychological and social implications are high as they may be separated from parents, lose family members, be forced into early marriage, or suffer from violence and displacement because of disaster.

According to the World Health Organization (WHO), “Climate change was estimated to be responsible in 2000 for approximately 2.4 per cent of worldwide diarrhoea, 6 per cent of malaria in some middle-income countries and 7 per cent of dengue fever in

some industrialized countries.”² The Stern Review further estimates that climate change could lead to an additional 250,000 child deaths per year.³ Each year, more than 800,000 people die of malaria, of whom 85 per cent are children under the age of 5.⁴ Health impacts affect all other aspects of life; for example, UNICEF estimates that children lose 272 million school days due to diarrhoea alone.⁵

In 2009, around 2.7 million children under the age of 5 died

1 Save the Children (2007). *Legacy of disasters: The impact of climate change on children.*

2 World Health Organization (2002). *The world health report 2002: Reducing risks, promoting healthy life.*

3 Stern, N. (2006). *Stern Review on the economics of climate change.* London: HM Treasury.

4 United Nations Inter-agency Group for Child Mortality Estimation (2010). *Levels and trends in child mortality: Report 2010.*

5 UNICEF (2010). *Raising clean hands: Advancing learning, health and participation through WASH in schools.*

from the effects of malnutrition,⁶ accounting for 35 per cent of children's deaths.⁷ The long-term implications of chronic malnutrition, or stunting, have a profound effect on children's mental and physical development and these impacts are irreversible after the first two years of a child's life.⁸ A study of early childhood development in developing countries estimated that stunting caused by chronic malnutrition resulted in a reduction of 20 per cent in average annual earnings.⁹ It is estimated that by 2050 there will be 25 million more malnourished children because of climate change.¹⁰

Diarrhoea, despite being easily preventable, accounted for the death of 1.2 million children under 5 years old in 2009.¹¹ An estimated 85,000 deaths due to diarrhoea are attributed to climate change.¹² Estimates suggest that, due primarily to the effects of climate change, cases of diarrhoea are predicted to increase by between 2 per cent and 5 per cent by 2020 in countries with a per capita income of under \$6,000.¹³ In some parts of Africa, cases of diarrhoea could increase by as much as 10 per cent.

A child-centred approach to adaptation

A child-centred approach to adaptation targets activities that help to reduce the vulnerability of children to climate change. Child-focused or child-centred approaches to adaptation fall into two categories: programmes that focus specifically on children's needs, referred to here as 'child-targeted' policy and programming; and programmes that involve children in the design and delivery, referred to as 'child-led' adaptation (*see Table 1*).

A proper response to the threat of climate change demands greater investment in a child-centred approach to adaptation. The focus here is on adaptation (rather than mitigation of emissions) because children are on the front line of vulnerability to climate change, and hence adaptation is key to protecting their lives and livelihoods.

Many of the potential solutions for reducing vulnerability of children are largely low cost and already well known. For example, if all children in high-risk countries were to sleep under an insecticide-treated net, the threat of vector-borne diseases would be substantially reduced.¹⁴ Diarrhoea and cholera are easily treatable with antibiotics and low-cost oral rehydration therapy, yet millions of children lack access to these life-saving interventions.

There are three key economic arguments for investing in a child-centred approach:

1. Children are one of the largest groups at risk from climate change. Therefore, measures that specifically target this group have

the potential to reduce the impacts of climate change across a large proportion of the population, and may realize economies of scale. Importantly, child-centred measures lead to skill development across a large segment of the population and over a longer time period.

Save the Children estimates that children make up approximately 50 per cent of people affected by disasters.¹⁵ Hence, any measures that target children as a group have the ability to foster resilience in a large portion of the population, and may realize economies of scale. Similarly, those measures that are built around child participation are drawing on a large population for effecting change.

2. Children are also one of the groups most vulnerable to the effects of climate change. Therefore, the losses associated with degradation of health, education and protection caused by climate change are high. In turn, adaptation measures to protect children have the potential to offset these losses, and realize significant economic gains.

Populations are most at risk to the effects of climate change where exposed groups have the least resilience to these changes. Children are clearly one of the groups most vulnerable to the effects of climate change. A UNICEF report highlights that children are particularly vulnerable because their physical characteristics, childhood activities and natural curiosity put them at greater risk from environmental hazards.¹⁶ They are more susceptible to disease, and are more likely to die from climate-related disease. If they

6 United Nations Inter-agency Group for Child Mortality Estimation (2010). Op. cit.

7 Save the Children (2009). *Hungry for change: An eight-step, costed plan of action to tackle global child hunger*.

8 Save the Children (2008). *In the face of disaster: Children and climate change*.

9 Grantham-McGregor, S. et al. (2007). 'Developmental potential in the first 5 years for children in developing countries'. *Lancet*, 369(9555): 60–70.

10 Nelson, G. C. et al. (2009). *Climate change: Impact on agriculture and costs of adaptation*. International Food Policy Research Institute.

11 United Nations Inter-agency Group for Child Mortality Estimation (2010). Op. cit.

12 Save the Children (2009). *Feeling the heat: Child survival in a changing climate*. London: Save the Children UK.

13 Intergovernmental Panel on Climate Change (2007). *Fourth Assessment Report: Climate change 2007: Impacts, adaptation and vulnerability*.

14 See, for example: WHO (World Health Organization) n.d. 'Insecticide-treated Mosquito Nets: A WHO Position Statement'. <http://www.who.int/malaria/publications/atoz/itnspaperfinal.pdf>

15 Save the Children (2007). Op. cit.

16 UNICEF (2008). *Climate change and children: A human security challenge*.

Table 1: Child-centred Adaptation: Inputs and potential outcomes

| INPUT: | POTENTIAL OUTCOMES: |
|---|---|
| Child-focused and child-led activities that aim to ensure access to education, health, protection and well-being for children | <p>Survival:</p> <ul style="list-style-type: none"> • Prevention of disease among children before, during and after disasters • Reduction in injury and loss of life among children during disasters • Nutrition and infant health care addressed in regard to chronic extensive risks <p>Development:</p> <ul style="list-style-type: none"> • Increased confidence and skills • Increased ability to express themselves • Leadership skills • Improved school attendance and achievement • Able to resume schooling more quickly after disasters • Ensure children's ability to play as part of social development <p>Protection:</p> <ul style="list-style-type: none"> • More positive view of life • Take better care of themselves • Less likely to join gangs • Increased protection of children before, during and after disasters (including risks of exploitation, abduction, recruitment into fighting forces, sexual violence, labour migration) • Opportunity to express their emotions following traumatic events <p>Participation:</p> <ul style="list-style-type: none"> • Increased credibility with adults • Improved status of children within the community • An increased sense of belonging and doing something good for the community • Children who have participated elected as youth leaders • Children initiate their own disaster risk reduction, adaptation and broader development activities • Increased participation of children in community risk reduction and adaptation activities |

Adapted from Plan International, "A children-centred adaptation of the characteristics of a disaster resilient community."¹⁸

survive, the impacts of disease can be irreversible and have economic impacts that continue throughout life. Research findings increasingly point to the critical imprints that childhood health, nutrition and education leave on long-term adult mental and physical health and the ability to contribute to a sustainable society.¹⁷

As a result of children being highly vulnerable, the potential losses associated with climate change and disaster impacts are high. It stands to reason that where climate change losses are high, measures that avoid those losses result in significant economic gains. In addition, these gains are likely to be realized over a longer

time frame: where children are proactively involved in adaptation and disaster risk reduction activities, they carry that knowledge and learning with them for life and, because they are young, will benefit from this over more years than an older counterpart.

3. Many of the interventions that can reduce the vulnerability of children to climate change are some of the lowest-cost options and are already well established, such

¹⁷ Children in a Changing Climate (CCC) coalition (2011). *Children and disasters: Understanding impact and enabling agency*.

¹⁸ UNICEF & Plan International (2011). *Benefits of a Child Centred Approach to Climate Change Adaptation 2011*. UNICEF UK and Plan International.

as insecticide-treated mosquito nets, and water, sanitation and hygiene training.

Clearly, there is a wide array of adaptation options available to protect populations from the effects of climate change (see Table 2). In some cases, the options required are very costly, as in the case of structural measures such as building dykes and dams to protect shorelines from sea level rise and other extreme events. However, in the case of children, many of the actions required are simple and low cost, such as mosquito nets, water and sanitation interventions, and treatment of diarrhoea.

The way forward

There is clear evidence that investment in climate change adaptation and disaster risk reduction will build resilience, and that in the vast majority of cases the investments can represent value for money. Furthermore, in child-centred initiatives the benefits may be significantly amplified, for the reasons mentioned above.

However, it is increasingly clear that many initiatives that represent value for money in principle are not yielding their intended benefits in practice. Interventions are all too often implemented in isolation from each other, with a strong sectoral focus and a short-term investment horizon. Community involvement and ownership can be lacking, and the overall effect is that well-intentioned interventions can fail to deliver their intended benefits even in the short term.

Further to this, despite the significant implications of climate change for children, assistance has not targeted them on a scale that matches the problem. For example, a Save the Children publication

School-based water testing in Tajikistan

Providing clean water to schools is a big challenge in Tajikistan. Diarrhoea and typhoid are prevalent because of the lack of clean water and basic sanitation. For instance, children often drink water from ditches because there is no clean drinking water. Cases of diarrhoea and typhoid are likely to increase because of climate change, and any measures that reduce their impact on the population will help to improve resilience.

In order to improve the situation, it was important to have a full picture of the conditions and quality of water in schools and communities. This was not easy, since the lack of clean water and basic sanitation is widespread, especially in rural areas. A UNICEF-initiated, school-based hygiene and sanitation project accomplished extensive, reliable water testing, led by children as researchers who sought to assess the quality of water at their schools and communities on a weekly basis.

The results were interesting and useful. Within a short time, it was possible to generate a comprehensive map of the quality of water and sanitation in hundreds of schools and communities, an achievement that would have required considerable time and money if done through surveyors.

These results surprised many communities, as tests found contamination in wells thought to be safe. The child researchers became community hygiene promoters, raising awareness of the danger of drinking untreated water, introducing the practice of boiling contaminated water before use, and advocating for better sanitation facilities in and around water sources. The information was also coordinated with district health officials and became useful in making decisions on where the priorities were in bringing safe water and sanitary facilities to schools and communities.

Source: Goodman, D. (2005). 'Water, sanitation and hygiene education: Children and adolescents leading the way in Tajikistan'. Case Study. New York/Tajikistan: UNICEF. Available at: www.unicef.org/voy/media/Tajikistan.pdf. In UNICEF (2008). *Climate change and children: A human security challenge*.

highlighted the lack of funding in relation to disasters and children:

“Despite the significant impact of disasters on children’s health, nutrition, protection and education, these sectors have, to date, been consistently under-funded by donors when providing emergency assistance. For example, in the 2007 UN Consolidated Appeals, the education sector received funds to meet only 38 per cent of needs and the protection sector received just 36 per cent of requirements;

these figures contrast with an average of 72 per cent funding across all sectors.”¹⁹

Global development efforts are striving to define and develop community ‘resilience’ – in other words, to enhance a community’s capacity to cope and manage change on its own in the face of shock or stress. This demands a holistic and coordinated approach to development, which can have

19 Save the Children (2008). Op. cit.

Table 2: Examples of child-centred adaptation and disaster risk reduction interventions

| Category | Examples of child-centred interventions |
|---------------------------|---|
| Education | <ul style="list-style-type: none"> • Structural measures, for example retrofitting of schools to withstand impacts of disasters and to improve access to schools (for example, routes to school raised above flood levels) • Community funds targeted at school fees • Integration of disaster risk reduction/adaptation activities and environmental education into school curriculum • Youth-led community risk mapping • School-based programmes such as early warning systems, gardening |
| Health | <ul style="list-style-type: none"> • Community-based water management programmes, such as rainwater harvesting, chlorination • Improved access to health services • Access to anti-malarial treatment and insecticide-treated mosquito nets • Household water treatment • Training on first aid, water, sanitation and hygiene • Draining stagnant water • Improved sanitation options • Mapping of water sources |
| Protection and well-being | <ul style="list-style-type: none"> • Community projects such as clearing drains to reduce waterlogging, raising of embankments • Teaching children to swim, evacuation techniques • Tree planting • Advocacy training, programmes to give children and youth a voice • Social protection, psychological and social support • Safety net interventions to help prevent dislocation and exploitation of children • Engaging children in raising awareness through multimedia |

Taken from: UNICEF UK and Plan International (2011), *The benefits of a child-centred approach to climate change adaptation*. Available at: www.unicef.org.uk/Latest/Publications/Climate-adaptation

a transformational effect. Recent evidence in Ethiopia suggests, for instance, that a holistic approach to mobilizing women can yield significant benefits for the entire family. The ‘Self Help Group’ approach facilitates the coming together of groups of between 15 and 20 women to support each other, identify needs in their community, save, and start small

businesses. The economic impact is substantial, with benefits upwards of \$100 for every \$1 spent. The impact on children’s rights is also significant – family members of these groups eat three nutritious meals a day, all their children are sent to school, and the women band together to prevent early childhood marriage and other harmful traditional practices.²⁰

There is certainly a strong economic argument for scaling up investment in child-focused measures as an effective and long-term response to climate change. And holistic approaches, such as the one described above, should be pursued more widely and on a larger scale so as to ensure that children are at the heart of climate change adaptation.

20 Tearfund (2013). *Partnerships for change: A cost benefit analysis of Self Help Groups in Ethiopia*. http://tilz.tearfund.org/en/resources/policy_and_research/food_security/#sthash.s0QcgY6M.dpufhttp://tilz.tearfund.org/-/media/files/tilz/research/partnerships%20for%20change%20full%20report%20final%20oct%202013.pdf

Hot, flooded and crowded: Coping with climate change in cities today

ASHVIN DAYAL AND
ANNA BROWN



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Cities of the developing world provide a critical route out of poverty for millions of rural poor, but these massive concentrations of human activity also face unprecedented new risks and vulnerabilities that we are only beginning to understand. In cities already ill-equipped to meet existing needs, the effects of climate change on rapid urban expansion add a new layer of challenges and complexity. How can cities continue to grow physically and thrive economically in the face of the monumental challenges resulting from changes in our climate?

This is precisely the problem that catalysed the launch of the Asian Cities Climate Change Resilience Network (ACCCRN), which is supported by the Rockefeller Foundation.

ACCCRN is a network of 10 core cities in Asia, implementing a range of activities that collectively will improve the ability of these cities to withstand, prepare for and recover from the projected impacts of climate change and climate variability. The approaches taken are determined by the local needs and priorities of each city. ACCCRN focuses particularly on improving the resilience of poor and vulnerable populations to climate change impacts. These tend to be the socio-economic groups that feel climate change impacts the most and are the least equipped to deal with them. The Network is also regional and global in its outlook and outreach. A key objective is to share its success stories and encourage cities around the world to replicate its most effective

activities – demonstrating, for example, how land use and infrastructure planning in a town can incorporate climate data to ensure that investments will stay safe well into the future. This requires engagement from diverse sectors and actors, including national and municipal government decision-makers, civil-society leaders, international donor agencies and private firms.

While global climate change models have become increasingly sophisticated, the ability to extrapolate with precision and certainty how changes in temperature and precipitation will affect local communities and economies remains elusive. Scientific progress in downscaling climate data to smaller geographic units, including cities, still has a long way to go.

More work is required to generate the scenarios and models for cities that will give town planners, engineers and communities the kind of detailed information they need to ensure that the infrastructure in which they are investing, along with other efforts to build urban climate change resilience, will stand the test of time.

However, even without perfect information, the scientific data we have today can map how climate change is already affecting cities – their infrastructure, community development and business operations. Indeed, it is not so much precision that we need but the capability to plan in a dynamic manner, given the new, unfolding uncertainties. Warmer temperatures; rising incidence of heatwaves and drought; longer periods of water shortages; increased and increasingly concentrated rainfall levels, causing more severe and prolonged flooding of urban drainage systems; outbreaks of disease: these are the climate change realities that city managers are struggling with today. Addressing these issues can, at first, appear overwhelming. Through ACCCRN, we have found that connecting the pressures of today with the challenges of the future creates an entry point for city stakeholders to undertake measures that build resilience. In this sense, engaging governments, as well as local community and business leaders, in building an urban resilience strategy can be an extremely productive process.

Consider this example from the Indian ACCCRN city, Surat. The devastating 2006 floods are estimated to have caused \$4 billion worth of damage.

Mobilized by this catastrophe, the Surat Municipal Corporation (SMC), along with local businesses, the non-governmental organization community and the ACCCRN India national partner, TARU Leading Edge, have comprehensively mapped the climate-related impacts and vulnerabilities facing the city so as to improve, among other things, how water from the upstream Ukai Reservoir is managed. By strengthening coordination between the SMC, the Narmada Water Resources Management Authority and the Gujarat State Disaster Management Agency, and by conducting more sophisticated rainfall and hydrological modelling, Surat aims to create an entirely new system to manage water releases prior to reaching peak levels. This could have a profound effect, mitigating the need for a sudden release due to extreme and intense rainfall events, which are likely to increase in frequency and severity as a result of climate change. This will be a carefully calibrated effort, balancing the needs of power generation, irrigation and flood prevention, all of which impose conflicting pressures on the way the reservoir is managed. The resulting improvements in water release management will give the city an extra two to three days of respite time to prepare for floods, enabling vulnerable communities to be relocated and valuable assets to be repositioned. This will not necessarily stop the floods, but it will give the city and its inhabitants a new and dynamic capability to manage the situation, especially

as conditions change over time. This is what building climate change resilience is all about.

With an urban infrastructure boom across much of the developing world still in a nascent stage, even in the larger metropolises, we know that hundreds of billions of dollars of public and private spending will be invested over the decades ahead in housing, transport, drainage and other infrastructures. Decisions made today will shape our cities for the next 50 to 100 years – a time horizon in which we know climate change impacts will grow in severity. We have the opportunity to incorporate what we already know about climate change – for example, not allowing infrastructure to be built in low-lying flood plains or across the natural surface run-off contours in a city. We have the knowledge to design drainage systems that incorporate a range of future rainfall projections. And there are enormous opportunities for innovation, with new forms of construction and design ensuring that housing for low-income families can withstand floods, extreme storms and heat pressures, all of which we know will worsen in the future.

Perhaps by acknowledging how critical it is to incorporate a long-term view in our urban planning – one that accounts for climate change – and by recognizing the key role that local governments play on the ground in aligning community needs with civil society and business solutions, building more climate-resilient cities can also be a catalyst for the wider transformation in urban development that is clearly needed across much of the developing world.

Palliative climate change planning and its consequences for youth

THEA DICKINSON AND
IAN BURTON



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We live in an atmosphere of heightened disaster risk. Once it was acceptable to discount or discredit small risks in decision analysis matrices. Now, however, we have learned that the results of discounting small risks are catastrophic. Unaddressed risks and vulnerabilities are leading to an increase in human-made disasters. There are several reasons why this occurs. To begin with, rational decision analysis discounts very small risks. Using a matrix risk analysis, the likelihood that a tsunami wave in Japan would breach the coastal defences and flood nuclear power stations is very low and would therefore be discounted. Decision-makers often have full knowledge of a potentially calamitous event and yet move forward with the construction of

buildings and infrastructure in hazard-prone areas.

Poverty is another driver of construction in high-risk locations. Not only is the infrastructure located in an exposed area, but it is also not built to codes and standards that can withstand frequent natural hazards such as earthquakes and cyclones. In the wake of a disaster, during the rebuilding and reconstruction process when there is an opportunity to put things right, the results fall short of being climate resilient. Recovery after a disaster is frequently rushed, often intensifying previously existing vulnerabilities.

Developers often choose short-term profits that discount the risks associated with building, say, an expensive sea-front home on a hurricane-exposed coast.

Prospective buyers are aware of the liability, but it is a price they are prepared to pay for a piece of paradise – often the most marvellous locations are on vulnerable mountain tops and coastlines. Development fixates on short-term gain and many management strategies and policies seem to disregard or omit long-term planning requirements. However, we can no longer discount long-term risks. Future climate change must be a part of the disaster risk reduction equation and a core element of the land development discussion.

The final theme common to heightened disaster risk is the abdication of responsibility. Catastrophes are acts of God or the government's responsibility. Individuals and communities perceive these hazards to be so far

beyond their control and understanding that they must be from some unearthly realm.

Yet if human beings are in fact contributing to the disasters around them, then there must surely be some accountability. If our actions and choices bring calamity, don't we have a duty to resolve these choices and recognize that these commonalities – discounting small risks, inequality and poverty, short-sighted decision-making and profit-driven development – all cost human lives?

Short-term and ineffective strategies result in deficient disaster preparedness, while reducing risk requires political and economic backing, partnered with sources of core funding. When political and economic priorities change to, for example, international military action or debt repayment as a result of faulty economic management, a nation's vulnerability to disasters will increase.

The emergence of climate change into the international arena launched the United Nations Framework Convention on Climate Change. At the time, 1992, the threats were considered to be long term. With a noticeable lack of urgency, the policy community (comprising concerned scientists, civil-society organizations and non-governmental organizations) focused on the risks posed to 'our children' and our 'children's children'. More recently the debates have switched so as to give greater emphasis to immediate and short-term impacts. However, there is also danger in focusing on the near term, because that may distort the design and choice of adaptation strategies and policies.

Vulnerability often originates in a country or region's main topographic features and is exacerbated

by the quest to populate the most risk-exposed parts of the land, whether for reasons of seaport access or of beauty. In the past 30 years, settlements in flood-prone areas have increased almost 115 per cent – and 192 per cent on coastlines threatened by cyclones.¹ Unparalleled population growth and increasing urbanization have also contributed to this exposure. Much of the world's population is located on or near areas of high risk: neighbourhoods are built on seismic fault lines; villages are assembled at the foot of active volcanoes; vegetation is removed, promoting landslides; cityscapes are overdeveloped, encouraging urban heat islands; and dams are erected, allowing for huge populations to inhabit areas that were once uninhabitable.

All of these examples increase the likelihood of disaster misfortune. When these exposed communities are also impoverished, with fragile economies, the probability of disaster increases dramatically. Poverty affects the ability of a community or region to recover from disaster, and increases the likelihood of that community suffering cascading effects – making it more susceptible, for instance, to widespread waterborne disease following a flood.² As the number of risk factors increases, the more likely a society is to become defenceless and have a diminished capacity to adapt.

1 Development initiatives: Global Humanitarian Assistance (2012). *GHA Report 2012*. Available at: www.globalhumanitarianassistance.org/wp-content/uploads/2012/07/GHA_Report_2012-Websingle.pdf; United Nations Office for Disaster Risk Reduction (UNISDR) (2012). *Towards a post-2015 framework for disaster risk reduction*. Available at: www.unisdr.org/files/25129_towardsapost2015frameworkfordisaste.pdf

2 ActionAid International (2005). *People-centered governance: Reducing disaster for poor and excluded people*. Johannesburg, South Africa.

Palliative adaptation

The Asian Development Bank recently announced funding for the Coastal Climate-Resilient Infrastructure Project in Bangladesh.³ There is good short-term rationale for this project and, to the extent that it is successful, it may serve temporarily to improve the local economy, as well as to reduce current risks from tropical cyclones and sea level rise. However, extreme events in Bangladesh are predicted to increase in frequency and severity during the implementation and lifetime of this project. And by 2050 it is those extreme events that are expected to "dislocate 35 million" Bangladeshis and their children.⁴

What is more, this is a multi-million-dollar project. The Asian Development Bank provided a loan of \$20 million, with co-financing of \$68 million from the International Fund for Agricultural Development and KfW Development Bank, in addition to \$30 million from the Strategic Climate Fund and \$31 million from the Government of Bangladesh.⁵ The project aims to fund "upgrades to around 540 kilometres of roads, bridges, culverts, as well as improvements to

3 Asian Development Bank (2012). Press release: 'ADB, partners to help protect rural Bangladesh from climate impacts'. Available at: www.adb.org/news/bangladesh/adb-partners-help-protect-rural-bangladesh-climate-impacts; Asian Development Bank (2013). Project Data Sheet: 'Coastal Climate-Resilient Infrastructure Project'. Available at: www.adb.org/printpdf/projects/45084-002/main

4 Asian Development Bank (2012). Op. cit.; Asian Development Bank (2013). Op. cit.; Intergovernmental Panel on Climate Change (2012). Field, C. B., V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and P.M. Midgley, eds. *Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press, and New York.

5 Asian Development Bank (2012). Op. cit.

rural markets”. It will also “build and improve cyclone shelters and animal shelters”.⁶

It needs to be recognized that within a few short decades these well-intentioned investments will be under water. The temperature increase that has already occurred, and the further increases to which the planet is already and unavoidably committed, make it almost certain that large parts or all of the project area will eventually be flooded.

Over \$80 million are expected to be spent on this one project to protect and reduce risk in a highly vulnerable area. However, the risk reduction is only short term and eventually evacuation and permanent migration will need to take place. This is, therefore, palliative adaptation: it attempts to make the vulnerable populations of this generation safer, but at the cost of creating major problems and catastrophic circumstances for future generations. This is not sustainable development. It is unsustainable.

Does this mean that such palliative short-term adaptation projects and investments should not be made? No, not at all. There should be short-term, temporary staging, until large population moves can take place to climate-resilient locations. In the case of Bangladesh there are additional options. These do not include the ‘Dutch response’ of dykes, polders and dams, not only because Bangladesh is a

poor country but also because an engineering solution is technically difficult. This is due to the physical nature of the delta, which has extremely unstable river channels, seasonal flow that is highly variable, and strong tropical cyclones.

So, how do we transform the lives of the most vulnerable people in the midst of increased disaster risk? Are there more effective ways to spend the millions of dollars of earmarked adaptation funding? Can we prevent this devastating outcome from being the legacy of this generation? We believe that there are many options.

Investing in youth

Investing in child and youth development in health and education would give the next generations in Bangladesh the capacity to follow different occupations beyond the currently dominant livelihoods of farming and fishing. Equipped with other skills, younger people would be able voluntarily to migrate away from the coastal lands to safer and higher inland locations in search of other livelihoods and sources of income.

But this by itself would not be enough. It would probably lead to migration to Dhaka and other overcrowded cities, where the housing and infrastructure are inadequate even for their present populations. Policies need to identify new sites for migrants. These could be entirely

new towns and/or smaller communities that could be chosen to be growth poles. At minimum, these new locations would require investments in housing and infrastructure built in a structurally sound manner and in climate-resilient locations. In addition, steps would need to be taken to attract public and private investments in the green economy (developing innovative renewable and clean energy technologies, sustainable agricultural practices, and efficient water management and waste management strategies). Such activities can produce goods and services for export, and for local and regional markets. Economic incentives or concessions would be required to kick-start the process.

Granted, this could not be done all at once. Nor should it be. It is a longer-term strategy to complement the current short-term investment in coastal areas. It would allow younger people to migrate voluntarily out of the region and to find not just better employment with higher incomes but also greater security from climate risks.

This would be a resilient strategy that in the long run would be transformational. If such a policy shift occurred, resilient and transformational adaptation would be directed specifically to the benefit of today’s children as well as of the children and youth of tomorrow.

6 Asian Development Bank (2013). Op. cit.

Helping children survive and thrive through disaster risk reduction

CATHERINE CAMERON



Our world is increasingly affected by extreme weather events. Recent decades have seen significant growth in the number of reported disasters such as droughts, floods and cyclones. More people are being adversely impacted by these events. The information from the Intergovernmental Panel on Climate Change report *Managing the risks of extreme events and disasters to advance climate change adaptation* illustrates this clearly.¹ The projections for the coming decades are worse. Policymakers can take advantage of short summary reports for Africa, Asia and Latin America/Caribbean, as well as four thematic summaries for Agriculture, Ecosystems,

Health and Water.² There will be increased exposure to floods in 2030 and 2070, assuming constant exposure to hazards (see Figure 1).

Children are highly vulnerable to extreme events and bear a disproportionate share of the impact, both in the immediate and longer term. It is both good government and economic sense to invest in disaster risk reduction (DRR) to support children and their families. The short-term ‘Superman’ of disaster response needs to be supplanted by the quiet competence of Clark Kent in reducing such impacts through more and better DRR.³

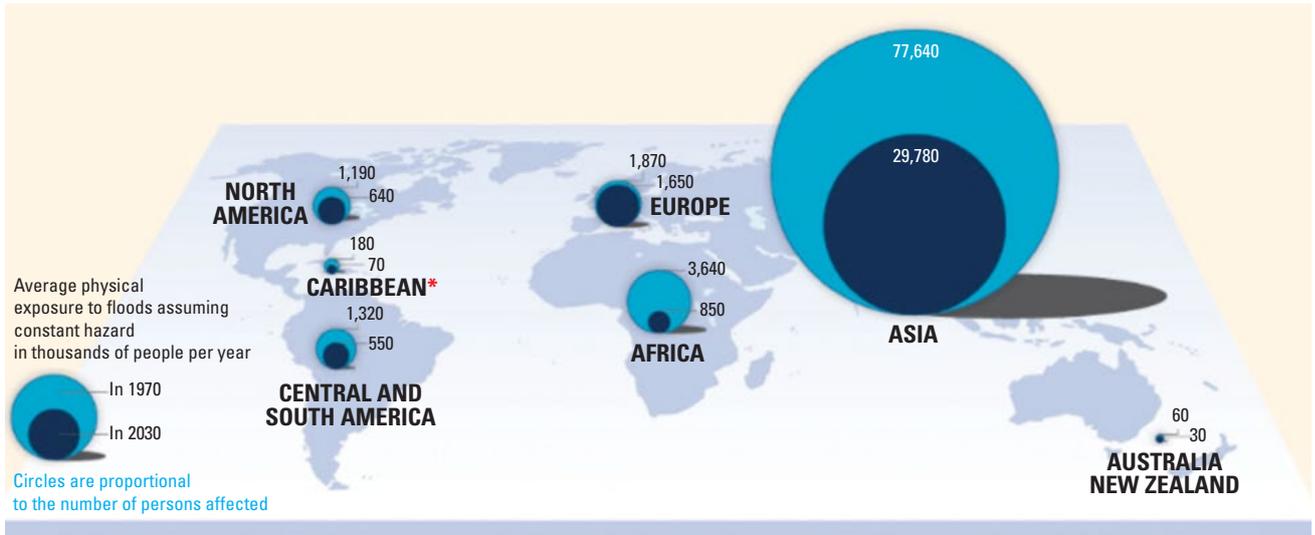
Smarter DRR efforts account for children’s needs. Specific attention can be paid to them during the design and implementation of any intervention. Such DRR is ‘child-centred’ or ‘child-focused’. Engaging children directly in the design and delivery of DRR activities can have many benefits. This work is referred to as ‘child-led’ DRR and covers a broad spectrum of actions.

DRR interventions involving children can be characterized along a continuum from expanding knowledge through enhancing voice to taking action. This is further delineated as action to protect, to influence and finally to transform. To date, effort and success have been concentrated more on the earlier part of this continuum, with many initiatives

1 Intergovernmental Panel on Climate Change (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation (SREX)*. Available at: <http://ipcc-wg2.gov/SREX>

2 Agulhas Applied Knowledge, www.agulhas.co.uk/Publications_Climate_Change.html

3 This suggestion originates from a blog by Simon Maxwell and Sam Bickersteth. Available at: www.oxfamblogs.org/fp2p/?p=12027



*Only catchments bigger than 1,000 km² were included in this analysis. Therefore, only the largest islands in the Caribbean are covered.

Source: IPCC 2012: Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Figure 4.2: Cambridge University Press.

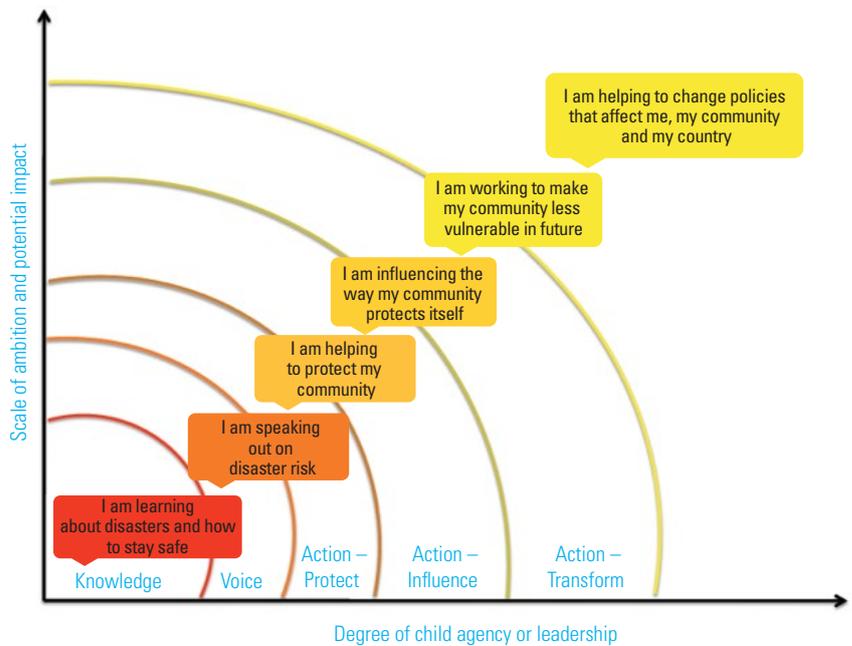
Figure 1: Average physical exposure to floods 1970 and 2030 (projection)

to expand and transfer knowledge and enhance voice and fewer on taking action to protect. The balance of effort could now shift, to focus more on supporting children engaged in action to influence and to transform (see Figure 2).

To achieve change, more work at this level is required. If more DRR is focused on action, then greater engagement with international processes and private-sector co-benefits will yield results. This approach to DRR is less well understood and articulated and represents a significant opportunity.

There is good evidence to show that DRR can be one of the more cost-effective development interventions. It saves lives and protects other valuable and scarce resources such as food, livestock and property. It promotes early responses to climate risks. We know that development assistance is increasingly being diverted into emergency and disaster response.⁴

4 Up from 4.8 per cent 1990–1994 to 7.8 per cent in 2003.



Source: Back, E., C. Cameron and T. Tanner (2009). Children and disaster risk reduction: Taking stock and moving forward. Children in a Changing Climate coalition, Brighton: Institute of Development Studies.

Figure 2: Child agency and potential impact

It is, however, much more cost-effective to invest in more and better DRR on a much larger scale all over the world.

The U.S. Geological Survey and the World Bank estimated that an investment in DRR of \$40 billion would have prevented losses

of \$280 billion in the 1990s.⁵ In India, DRR programmes yielded a cost-benefit ratio of 13.38, meaning that for every dollar invested there were \$13.38 worth of benefits (or averted costs).⁶ In Nepal, a study by the Red Cross found that

5 Environmental Resources Management (2006). *Natural disaster and DRR measures: A desk review of costs and benefits*. London: Department for International Development.

6 Ibid.

DRR initiatives yielded a cost-benefit ratio of 15.⁷

It would be helpful to emphasize the additional economic benefits that flow from DRR work with children, where the costs may well be lower and the benefits greater (using a lifetime

analysis and taking into account intergenerational benefits). This would require a shift in the way such interventions are assessed, and so is an important issue for DRR practitioners. More evidence on the outcomes of DRR projects framed in this way would be beneficial – for example, confirming the improvements that are anticipated

in child survival, educational attainment, health and well-being.

Child-led and child-focused DRR is both cost-effective and efficient. Given the considerable benefits that derive from it, the smart approach would be to invest in it much more significantly – in terms both of attention and of expenditure.

7 Krishna Kumar K.C. and D. Kull (June 2009). *Global Platform for Disaster Risk Reduction*. Nepal Red Cross.

Ecosystem-based approaches to adaptation and African children

MUSONDA MUMBA



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The consequences of degraded ecosystems – particularly fresh-water ecosystems – are numerous and include health risks for children. Such health risks have resulted in millions of deaths across the world and in Africa in particular. There is also a resurgence of old diseases owing to ecological imbalance. Global climate change has inflicted additional stress on ecosystems, altering them even further, with more complex and detrimental consequences.

At the turn of the century a number of events led by the United Nations took place. In 2000, following the so-called Millennium Summit, 193 United Nations Member States adopted the eight goals to be achieved by 2015, called the Millennium Development Goals (MDGs). In

the same year, the then United Nations Secretary-General Kofi Annan called for the Millennium Ecosystem Assessment (MEA). The objective was “to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being.”¹ There were clear linkages between the two processes. In addition, there was agreement that economic development, human well-being and functional ecosystems were intertwined. So, in simple terms, everything is connected. The basic fact remains that people worldwide depend on intact ecosystems and the services that they provide,

such as clean water and food. This is even more visible in the developing regions of the world, particularly Africa.

The findings of the MEA (2005) clearly showed that, over the previous 50 years, humans had altered ecosystems fundamentally, more rapidly than ever before, and that this was largely owing to demands for food, fresh water, timber and other resources. At this juncture in human history, there is no doubt that humans have modified the planet to meet the demands of a rapidly growing global population and thus rising consumption. This has also complicated the delivery of the MDGs as it was envisaged in 2000. But even more daunting is the fact that climate change is seen as one of the major causes of change in

1 Millennium Ecosystem Assessment (MA). <http://www.millenniumassessment.org/en/index.html>

and deterioration of ecosystem services, and the impacts are likely to increase in the future.²

Africa has been identified as one of the most vulnerable regions to climate change in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007).³ The most vulnerable sector is water. It is projected that the population at risk of increased water scarcity in Africa will be 75–250 million in the 2020s and 350–600 million in the 2050s. The extreme water stress and related risk of conflict are likely to affect the most vulnerable, particularly women and children.

Nearly 90 per cent of deaths of children under the age of 5 across Africa have been attributed to water-borne diseases, particularly diarrhoea and malaria. This is going to be compounded further by changes in climate and will certainly pose further challenges for the delivery of MDG4, for example, which focuses on the reduction of child mortality. The impact of climate change on water resources is an unprecedented and increasing global threat to life, livelihoods and life-supporting systems. Even if the most stringent mitigation measures were put in place today,

these impacts would continue beyond this century.

In this case, therefore, adaptation to climate change has been seen as the most viable option for Africa. There is an urgent need to take adequate adaptation actions before the impacts become unmanageable, as well as to prepare for the long-term effects.

Healthy ecosystems provide valuable services such as food, clean water, protection from disease, and flood and erosion control, while at the same time building resilience against climate change impacts. This has been recognized by the United Nations Framework Convention on Climate Change in its decision 1/CP.16, which invites parties to enhance action on adaptation by “building resilience of socio-ecological systems, including through economic diversification and sustainable management of natural resources.”⁴

As a global leader in science-based environmental policy-setting and implementation, the United Nations Environment Programme has taken the step of pursuing Ecosystem-based Adaptation (EBA) as one of its key programmes on climate change. EBA is defined by the Convention on Biological Diversity as “the use of biodiversity and ecosystem services to help people adapt

to the adverse effects of climate change.”⁵ As further elaborated by Decision X/33 on Climate Change and Biodiversity, this definition also includes the “sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities.”

EBA focuses on restoration, protection and management of ecosystems in order to help vulnerable human communities to cope with the impacts of climate change. The value of EBA interventions has already been proven in several countries and across numerous sectors. Evidence is emerging of its success in helping people, particularly women and children, to adapt to climate variability and to reduce their vulnerability to climate impacts. With these impacts increasingly being felt across the world, there is an urgent need to increase resilience to climate change while fostering sustainable economic development at the local, national and regional levels. Otherwise, all the achievements of development so far will be completely undone.

2 *Ecosystems and human well-being: Our human planet. Summary for decision-makers* (2005). Millennium Ecosystem Assessment Vol. 5. Washington DC: Island Press.

3 Alley, R., et al. 'IPCC 2007: Summary for policymakers.' *Climate Change* (2007): 1–18.

4 Dec. 1/CP.16, para 14 d); FCCC/CP/2010/7/Add.1. Available at: <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2>

5 Secretariat of the Convention on Biological Diversity (2009). *Connecting biodiversity and climate change mitigation and adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*. Technical Series No. 41. Montreal: Secretariat of the CBD. Available at: www.cbd.int/doc/publications/cbd-ts-41-en.pdf

Child rights at risk

JOY GUILLEMOT AND
JAZMIN BURGESS



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Today, 2.2 billion children are growing up facing the impacts of climate change. Representing over 30 per cent of the world's population, children have the absolute right to live in a decent environment with all that this implies: attending school; having nutritious food; enjoying good health; and living and growing up in safety. This is not simply a moral assertion. It is a legal commitment through the United Nations Convention on the Rights of the Child (CRC) – the world's most widely ratified human rights treaty and the foundation for the work of UNICEF with and for children.¹ These essential rights

of children are directly threatened by climate change, and generations of children now and in the future may be denied their rights to survival, development, protection and participation in society.

The CRC, child rights and climate change

Climate change is an urgent challenge for the world's children. It is estimated that, over the next decade, approximately 175 million children a year will be affected by climate-related disasters;² in the next two decades, 37.5–125 million additional African children

will be subjected to water scarcity;³ and by 2050 an estimated 25 million more children will be undernourished as a result of climate change.⁴ Children are recognized as the most vulnerable to its impacts and should therefore be in the forefront of climate change policy, advocacy and research – and yet they still are not. Furthermore, it is their right to participate in all matters that affect them – and yet this rarely happens. Children are the least responsible for the causes of

1 UN General Assembly (1989). *Convention on the Rights of the Child*. United Nations, Treaty Series, vol. 1577, 3. Available at: www.unhcr.org/refworld/docid/3ae6b38f0.html

2 Save the Children (2007). *Legacy of disasters: The impact of climate change on children*. London: Save the Children. Available at: www.savethechildren.org.uk/sites/default/files/docs/legacy-of-disasters_1.pdf

3 Calculated as the 50 per cent proportion of the total population under age 18, from figures reported in: IPCC (2007). *Climate change 2007: Impacts, adaptation and vulnerability*. Contribution to Working Group II to the Fourth Assessment Report to the Intergovernmental Panel on Climate Change.

4 Nelson, G. C., M. W. Rosegrant, J. Koo et al. (2009). *Climate change: Impact on agriculture and costs of adaptation*. Washington DC: International Food Policy Research Institute.

Table 1: Climate risks to child rights under the CRC

| Child rights at risk | Climate risk and interface with climate change |
|---|--|
| Article 2 Right to non-discrimination | <p>The impacts of climate change on vulnerable communities discriminate against children; for example, because of their physiology they are more susceptible to certain impacts. Climate change exacerbates inequity because its impacts often hit children the hardest. To ensure that this right is upheld, priority attention needs to be paid to children in climate change responses and policy.</p> <p>Moreover, poorly implemented climate change responses can continue to put this right at risk. For example, opportunities to discriminate and infringe equal rights arise with regard to adaptation investments and cases of displacement owing to climate change. This right can be threatened if decisions do not recognize the special needs of children; the different needs of girls and boys; or do not give equal rights to refugee children, children of foreign origin, or children of indigenous or minority groups.</p> |
| Article 3 Best interests of the child must be a top priority | Climate change can be seen to work in opposition to the best interests of children in vulnerable countries. For example, through the increased risk of disease or the growing risk of natural hazards disrupting education and impacting child protection. |
| Article 4 Protection of rights | The multiple impacts of climate change affect child rights. Action to tackle climate change is therefore essential to fulfil the rights of all children; inadequately responding to climate risks infringes this principle. |
| Article 6 Right to survival and development | A child's right to survival is directly challenged by increasing climate-related disasters, and by the increased risk of disease and hunger as a result of climate change. |
| Article 12 Right to a voice | Decisions on climate change at the local, national and international level will impact on children now and continue to do so in the future. Children will also in the future bear the social, economic and environmental impacts of inadequate and unambitious climate change decision-making today. Limiting their opportunities to voice opinions and provide solutions inhibits this right. |
| Article 22 Right to protection as refugees | Climate change is leading to increased migration from areas that it renders dangerous or uninhabitable. Children are negatively affected when they are displaced, meaning that climate change makes their right to refugee protection increasingly necessary. |
| Article 24 Right to health | A child's right to health is directly and indirectly threatened by climate change. Some 85 per cent of the burden of disease from climate change affects children, ⁵ while the risks of water-borne diseases, vector-borne diseases and the complications of malnutrition all increase owing to climate change. |
| Article 24, 2c Right to health-sustaining conditions | Children's right to health is infringed when health-sustaining conditions such as clean water and nutritious food are compromised by climate change. Increasing greenhouse gas emissions, including CO ₂ , contribute directly to air pollution, which in turn drives climate change. Air pollution also directly contributes to increased respiratory diseases amongst children and therefore challenges the fulfilment of a child's right to health. |
| Article 26 Right to social protection | Owing to climate change, developing countries have additional need of resources dedicated to ensuring that children are able to cope. This right is increasingly at risk owing to developed countries' slow progress in providing the additional funds that would help vulnerable countries to adapt to climate change. |
| Article 27 Right to an adequate standard of living | Climate-induced sea-level rise, flooding and extreme weather events destroy housing and create unsafe living conditions for children. |
| Article 28 Right to education | Every child has the right to an education. Children are kept from attending school when family livelihoods and financial resources are negatively affected by climate change. In addition, children's access to education can be disrupted when schools are damaged or destroyed by climate-related disasters. |

5 World Health Organization (2009). Global health risks: Mortality and burden of disease attributable to selected major risks. Geneva: World Health Organization.

| Child rights at risk | Climate risk and interface with climate change |
|---|--|
| Article 30 Right to indigenous culture and language | Indigenous populations are often marginalized, live in highly climate-sensitive ecosystems (such as the Arctic) and are often among those most vulnerable to climate-related impacts. Loss of traditional species and land, and induced migration owing to climate change, can impact on the right of a child from an indigenous minority to identity (including language and culture). |
| Articles 34, 35 and 36 Right to protection from exploitation | Climate change will induce stress on livelihoods and communities that will potentially result in children being at risk of exploitation and violence – for example, through increased child labour, abduction, recruitment into fighting forces, sexual violence and labour migration. The greater frequency and ferocity of climate-related disasters is likely to increase the protection risks to children before, during and after those events. |

climate change and yet they will unfairly inherit a legacy that they did not choose. The estimated impacts of climate change on children are substantial, work against development objectives, can set back progress on child rights, and yet remain critically missing from the climate-policy dialogues and responses. However, a critical opportunity has not yet been fully explored which may be able to elevate attention to children's issues related to climate change.

Children's vulnerability to climate change fundamentally threatens the realization of many, if not all, of their rights as stated in the CRC. The Convention, which was unanimously adopted by the United Nations General Assembly in 1990, recognizes the human rights of children, defined as any person under the age of 18, and sets out in detail what every child needs to have for a safe, happy and fulfilled childhood. The CRC is the most widely ratified international human rights treaty in history – in total, 193 governments have ratified it. It enshrines specific child rights in legally binding international law and defines universal principles and standards for the status and treatment of children

worldwide.⁶ However, child rights are exposed to climate risks and it will become harder for developing countries in particular to maintain their commitments to the CRC. Although all child rights may be affected, 15 rights are particularly at risk from climate change-related setbacks, and these are described in Table 1.

Why the CRC can be a powerful framework for climate action

The interconnectedness between climate change and key child-rights issues elevates the CRC as a vital framework and mechanism for protecting child rights in a changing climate. The reasons that an integrated approach can be useful include:

Governments have ratified and have obligations under the CRC

The 193 countries which have ratified the CRC are consequently obliged to uphold each individual article protecting child rights. This means that governments are legally bound to take action on climate

change in order to ensure that it does not infringe on child rights in national terms.

The CRC places obligations on governments to ensure that the rights of the children in their country are being upheld. In addition, Article 24 and General Comment 5 oblige developed countries to take action to uphold child rights in developing countries. In the context of climate change, this could include developed countries mobilizing resources to help vulnerable communities to adapt to the impact of climate change, and to ensure that emissions reductions do not lead to climate change impacts that negatively affect children in developing countries. In the absence of a post-Kyoto climate regime that makes it clear where the responsibility for action lies, the CRC is already agreed by all governments and presents a potential framework for action on climate change that can directly complement progress at the level of the United Nations Framework Convention on Climate Change (UNFCCC).

⁶ UNICEF (2009). *State of the world's children: Celebrating 20 years of the Convention on the Rights of the Child*. New York: UNICEF.

Monitoring and accountability mechanisms exist

The requirement of States parties to report to the CRC Treaty Body (the Committee on the Rights of the Child) and civil-society engagement with members of the Committee provide a unique platform for advocacy and accountability on children and climate change-related issues. This provides a powerful opportunity to hold governments accountable for protecting child rights in the face of climate change.

Child-rights policy that reduces children's vulnerability helps to meet climate challenges

Governments that pursue child rights-oriented policies promoting child survival, development, protection and participation in the face of climate change will be contributing to action on climate change as well as delivering on their CRC obligations.⁷

The CRC presents a different angle for climate action

Climate change is increasingly understood to be more than an environmental issue. By articulating climate impacts using the CRC, the focus can be shifted to prioritizing children as the most vulnerable population, engendering a rights-based approach, and advocating for child survival, development and protection worldwide.

Opportunities to integrate child rights and climate change action

Today, most existing climate-impact assessments and policies are developed without attention to child-rights issues. The unique risks to children and the specific responses that they require remain overlooked by the broader statements on climate change. Joined-up action on the implementation of the CRC and the UNFCCC can shift the focus to protecting child rights from climate change setbacks, while also maximizing opportunities to promote child rights through climate policy. The following are ways in which these two sets of commitments might be brought together at the national level.

Measure and report on child rights in climate risk assessments

Population vulnerability is often described in aggregate terms. However, the populations most affected by, for example, food insecurity and disease transmission are most commonly children and there will also be gender-specific impacts. Disaggregated data identifying the risks for children under 5, children under 18, and boys and girls should be explicitly enumerated in national vulnerability and adaptation assessments, so that policies can appropriately respond to the risks to children.⁸

Link child rights and climate change in development planning

UNFCCC Article 3.4 urges States parties to incorporate climate change into national development planning.⁹ Most governments have done so, with both adaptation and mitigation policies. They either have National Action Plans on Climate Change or 'Climate Change Roadmaps' that often bridge specific climate plans into 5- or 10-year development planning cycles. Implementation of the CRC has a number of co-benefits for these processes, and vice versa. Opportunities exist to incorporate climate concerns into mechanisms for CRC implementation and monitoring.

Incorporate climate risks to child rights into donor strategies

Donors can hold recipient countries accountable for identifying and reporting child-rights infringements owing to climate change. Donor countries should review their development cooperation programmes in the light of their CRC and UNFCCC commitments, requesting that co-benefits and risks are identified. It is particularly critical to monitor governments' institutional capacity to protect child rights as their society is impacted and stressed by climate change.

7 UNICEF and Plan International (2011). *The benefits of a child-centred approach to climate adaptation*. Available at: www.unicef.org.uk/Documents/Publications/ClimateChange_child_centred2011.pdf

8 UNICEF (2011). *Children's vulnerabilities to climate change and disaster impacts in East Asia and the Pacific*. Bangkok: UNICEF. Available at: www.unicef.org/media/files/Climate_Change_Regional_Report_14_Nov_final.pdf

9 Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (1992). *United Nations Framework Convention on Climate Change*. A/AC.237/18. Available at: www.un-documents.net/unfccc.htm

CRC reporting should explicitly identify climate risks

In 2011, at least 12 countries noted environmental degradation and climate change as a barrier to CRC implementation.¹⁰ This number is likely to increase. The CRC reporting mechanisms are a primary place for identifying and reporting risks to child rights. If challenges to the CRC are monitored, the evidence can be strengthened and used to inform UNFCCC mechanisms.

Promote the right of children to participate (Article 12) in climate policy

Children and adolescents are an untapped resource for adaptation

and mitigation measures, and have the legal right to engage in issues that affect them. Children have gained recognition as ‘major parties and stakeholders’ to the UNFCCC, with associated mechanisms for participation.¹¹ Child, adolescent and youth engagement should be encouraged and supported at national and local levels.

Conclusion

While the rhetoric and case for action on the increasing threats of climate change for vulnerable populations have gained significance and traction in recent years, often the

impacts of climate change on children, and specifically their rights both now and in the future, are still overlooked. New opportunities are available for countries to fulfil their CRC commitments by concretely linking CRC implementation to other government processes for mitigating and adapting to climate change. The CRC serves as a core framework for protecting child rights in climate change-related policies, and for monitoring how commitments to the CRC are challenged by a changing climate. By taking action on climate change in line with the CRC, we have the opportunity to address the unfair challenges presented to the world’s most vulnerable children.

¹⁰ Source: UNICEF-UK Informal Review of 2011 CRC Reports: Bangladesh, Cameroon, Grenada, Guatemala, Jordan, Kiribati, Mozambique, Pakistan, Philippines, Slovak Republic, Thailand, Uzbekistan.

¹¹ The CRC defines a child as a person between the ages of 0 to 18. The United Nations definition includes youth and extends to age 25.

Human rights principles, climate change and the rights of the child

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As other chapters in this volume make clear, climate change will have – and indeed, is already having – a disproportionate impact on children. In 2009, the Office of the High Commissioner for Human Rights (OHCHR) issued a report on climate change and human rights which emphasized the threats that climate change poses to the human rights of children, including to their right to health.¹ The 2013 UNICEF report on climate change and children similarly found that “children bear the brunt of the impact of climate change” and that more frequent natural disasters, food crises and changing rainfall patterns threaten

a wide spectrum of children’s rights, including their basic rights to education, health and clean water, and the right to food.²

In this contribution we place the effects of climate change on children’s rights in a broader context. We begin by briefly describing how international human rights institutions, as well as states, have increasingly recognized the links between human rights and environmental protection. We then review how human rights norms apply to environmental harm, including the harmful effects of climate change. Finally, we discuss specific human rights principles relevant to the protection

of children from the impacts of climate change.

The relationship between human rights, environmental harm and climate change

It is well established that environmental harm, including harm caused by climate change, can interfere with the enjoyment of human rights that are protected by international law. No United Nations human rights treaty explicitly includes a right to a healthy environment, although some regional treaties do. But it is clear that environmental harm can interfere with other human rights as well. For example, the Convention on the Rights of the Child provides that environmental

1 OHCHR (2009). *Report on the relationship between climate change and human rights*. UN Doc. A/HRC/10/61, 48–50.

2 UNICEF United Kingdom (2013). *Climate change: Children’s challenge*. London: UNICEF UK. Available at www.unicef.org.uk/Documents/Publication-pdfs/unicef-climate-change-report-2013.pdf

pollution poses “dangers and risks” to nutritious food and clean drinking water, both of which are elements of guaranteeing a child’s right to health.³ Human rights expert committees and regional tribunals have explained how environmental harm can infringe not only the right to health, but also the rights to life, property, and privacy.⁴

The effects of climate change, in particular, on human rights have been described by special rapporteurs appointed by the Human Rights Council, the principal United Nations human rights body,⁵ and the Council itself has recognized the grave implications that climate change has for human rights.⁶ The most detailed examination by a human rights body of the effect of climate change on human rights is a 2009 report prepared by the OHCHR at the request of the Human Rights Council.⁷ That report detailed the adverse impacts of climate change on a spectrum of human rights, including the rights to life, food, water, the highest attainable

standard of health, housing and self-determination.⁸

In short, there can no longer be serious doubt that climate change, as well as other environmental harms, can and does interfere with the enjoyment of human rights recognized and protected by international law. The question then arises: what *duties* does human rights law place on states with respect to climate change?

The application of human rights law to climate change

Because climate change is a type of environmental harm, the human rights obligations that apply in the context of environmental harm generally should also apply to climate change. These obligations, although still developing, are becoming clearer.

At the outset, it is important to note that interference with the enjoyment of a human right does not necessarily equate to a violation of a legal obligation pertaining to that right. For example, if a hurricane destroys my home, resulting in injury or even death, it interferes with the enjoyment of my human rights to property, health, and perhaps even life, but it does not violate human rights law because it had no legal obligation that it could violate.

States, of course, are different. They do have duties under human rights law. Although the application of those duties to environmental problems is not always completely clear, states do seem to have some specific obligations. These include a duty to ensure that decisions that may cause environmental harm to the enjoyment of

human rights are made through a process that includes examination and dissemination of information about environmental impacts, informed participation by those affected, and access to legal remedies if the state fails to meet its obligations. The implementation of these duties should result in policies and decisions that better reflect the values and concerns of individuals and communities who are potentially affected by environmental harm.⁹

If states follow these procedural requirements, they appear to have wide discretion in deciding how to strike a balance between environmental protection and other interests, such as economic and social development. However, this discretion has limits. At a minimum, a state cannot legitimately decide to allow environmental degradation that would prevent the enjoyment of even minimal levels of a right or that might interfere with human rights on a massive scale.¹⁰

In principle, this framework applies to threats from climate change, but the application to climate change faces some obstacles. The size of these obstacles depends in part on whether the framework is being applied to action (or inaction) by a state that relates to the effects of climate change on the enjoyment of human rights *within that state’s jurisdiction*, which may be referred to as *internal obligations*, as compared with whether it is being applied to *extraterritorial obligations* relating to the harm from climate change outside the state’s territorial jurisdiction.

3 Convention on the Rights of the Child (1989), Art. 24(2) (c), UN Doc. A/RES/44/25.

4 See, for example, Committee on Economic, Social and Cultural Rights, General Comment No. 14, *The Right to the Highest Attainable Standard of Health*, 15, UN Doc. E/C.12/2000/4 (2000); Önerilidiz v. Turkey, 2004-XII Eur. Ct. H.R. 1, 115; Marangopoulos Found. for Human Rights v. Greece, Complaint No. 30/2005, 195, Eur. Comm. of Social Rights (2006); Soc. & Econ. Rights Action Ctr. v. Nigeria, Comm. No. 155/96, 58, Afr. Comm’n on Human & People’s Rights (2001) (*Ogoniland Case*); López Ostra v. Spain, 20 Eur. H.R. Rep. 277, 295 (1994); Fadeyeva v. Russia, 2005-IV Eur. Ct. H.R. 255, 281; and Ta:kin v. Turkey, 2004-X Eur. Ct. H.R. 179, 205.

5 *Report of the Special Rapporteur on adequate housing as a component of the Right to an Adequate Standard of Living, and on the Right to Non-discrimination in this context*, UN Doc. A/64/255 (2009); and *Climate change and the Human Rights to Water and Sanitation: Position Paper*. Available at: www.ohchr.org/Documents/Issues/Water/Climate_Change_Right_Water_Sanitation.pdf

6 See, for example, UN Human Rights Council res. 10/4, 3 (March 25 2009), UN Doc. A/HRC/10/4.

7 OHCHR (2009). *Report on the relationship between climate change and human rights*. UN Doc. A/HRC/10/61.

8 Ibid.

9 See, for example, Woods, K. (2010). *Human rights and environmental sustainability*. Cheltenham: Edward Elgar, 130.

10 See, for example, *Saramaka People v. Suriname*, 2007 Inter-Am. Ct. H.R. (Ser. C), No. 172.

Each state has obligations under human rights law to abate the effects of climate change on the human rights of those within its jurisdiction. At a very minimum, the state would have obligations imposed by human rights law to take adaptation measures to help people to bear the effects of climate change, even if a state's contribution to global greenhouse gas concentrations is minimal. Using the framework discussed in the previous section, the state should carefully assess the likely impacts of climate change within its jurisdiction, disseminate information about those effects, allow full participation of all those affected in the process of deciding how to address the problem, and provide legal remedies to ensure that their rights are not being violated owing to climate change.

When it comes to extraterritorial obligations, human rights obligations on states to reduce emissions confront several challenges.¹¹ One obstacle has to do with the difficulty of tracing clear causal links between anthropogenic contributions to climate change and the effects of climate change on human rights, including linking emissions from a particular source to a particular effect.¹² Another problem is that many human rights norms were developed primarily to address the behaviour of states toward those within their own jurisdiction, an approach that does not translate easily to trans-boundary problems such as climate change.

Although these and other issues present challenges, strong arguments can be made that human

rights law requires states to take into account the extraterritorial effects of their contributions to climate change. In particular, the duty of international cooperation, which stems from the Charter of the United Nations, could require states to work together to address climate change, including through negotiating and implementing international climate accords that meet human rights minimum standards.¹³

Additional considerations for the human rights of the child

In keeping with the above analysis, while extraterritorial obligations of states certainly may be relevant to protecting the rights of the child from trans-boundary harm caused by climate change, the clearest duties are probably the internal duties of states to protect children within their own jurisdiction from the harmful effects of climate change.

The most comprehensive statement of the human rights of the child is of course the Convention on the Rights of the Child (CRC), which sets out a full spectrum of human rights, including civil, cultural, economic, political and social rights.¹⁴ The Committee on the Rights of the Child, the body of independent experts that oversees implementation of the CRC, has specifically identified the duty of states to protect the child's right to health from climate change impacts. The Committee

has explained that “[e]nvironmental interventions should, *inter alia*, address climate change, as this is one of the biggest threats to children's health and exacerbates health disparities. States should, therefore, put children's health concerns at the centre of their climate change adaptation and mitigation strategies.”¹⁵

In addition, the Committee has identified four general principles that represent fundamental values of the Convention. These are the right of all children to be heard and taken seriously, the right to non-discrimination, the right to life and development, and the primary consideration of the child's best interests.¹⁶ Although there are other duties stemming from the CRC relevant to climate change, these principles provide a good starting point for discussion and action on the impacts of climate change on children.

The Committee has explained that the “best interest of the child” principle requires the state systematically to consider how children's rights and interests are or will be affected by its decisions and actions.¹⁷ In principle, this consideration should apply equally to decisions and actions related to climate change adaptation, so that any decision related to climate change should include an evaluation of the possible impacts of the

11 Knox, J. H. (2009). 'Climate change and human rights law'. 50 *Va. J. Int'l L.*, 163.

12 OHCHR (2009). Op. cit.

13 *Ibid.*, 99 (“International human rights law complements the United Nations Framework Convention on Climate Change by underlying that international cooperation is not only expedient but also a human rights obligation and that its central objective is the realization of human rights”).

14 Convention on the Rights of the Child (1989). Op. cit.

15 Committee on the Rights of the Child (2013). General Comment No. 15, *The right of the child to the enjoyment of the highest attainable standard of health* (Art. 24) 50, UN Doc. CRC/C/GC/15.

16 Committee on the Rights of the Child (2003). General Comment No. 5, *General measures of implementation of the Convention on the Rights of the Child* (Arts. 4, 42 and 44, para. 6), 12, UN Doc. CRC/GC/2003/5 (discussing these principles); Committee on the Rights of the Child (2009). General Comment No. 12, *The right of the child to be heard*, 2, UN Doc. CRC/C/GC/12.

17 Committee on the Rights of the Child, General Comment No. 5, *ibid.*, 12.

decision on the children affected.¹⁸ The Committee has stated that the justification of decisions affecting children should show that this principle has been explicitly taken into account, including through explaining what was considered to be in the children's best interests and how the children's interests have been weighed against other considerations.¹⁹ Moreover, the Committee has made clear that the state should ensure that the child's best interests are explicitly spelled out in establishing, monitoring and evaluating data collection and, where required, supporting research on children's rights issues.²⁰

With respect to climate change, this should require the state to investigate the full impacts of climate change on the human rights of the child, including through, for example, the gathering of appropriate data, such as increases in mortality and disease owing to changing climate

patterns, or the impacts on education of an increased incidence of natural disasters.

The right of all children to be heard and taken seriously also supplements duties related to examination and dissemination of information and informed participation by those affected by climate change. As the Committee has explained, the views expressed by children may add relevant perspectives and experience and should be considered in decision-making, policy-making and the preparation of laws and/or measures as well as their evaluation.²¹ The Committee further elaborates that the concept of participation emphasizes that including children "should not only be a momentary act, but the starting point for an intense exchange between children and adults on the development of policies, programmes and measures in all relevant contexts of children's lives."²² Children also need access to information in formats that are appropriate to their age and

capacities on all issues of concern to them, including on the impacts of climate change on their rights.²³ The long-term threats posed by climate change mean that the views of children are of particular importance, since they are likely to be those most affected.

It is encouraging that the Committee has specifically highlighted climate change in the context of the child's right to health. However, civil society, states, the Committee and other bodies could do much more to discuss the impacts of climate change on the rights of the child in all appropriate forums, including the review process before the Committee, and the Universal Periodic Review procedure of the Human Rights Council. This could include the sharing of examples of good practices to fulfil states' obligations related to the rights of the child. By learning more about what other states are doing, each state will be better able to fulfil its own duties to protect the rights of children from the effects of climate change.

18 Committee on the Rights of the Child (2013). General Comment No. 14, *The right of the child to have his or her best interests taken as a primary consideration* (Art. 3, para. 1), 6, UN Doc. CRC/C/GC/14.

19 Ibid.

20 Ibid., para 15(f).

21 Committee on the Rights of the Child (2009). General Comment No. 12, *The right of the child to be heard*, 12, UN Doc. CRC/C/GC/12.

22 Ibid., 13.

23 Ibid., 82.

Climate change and intergenerational justice

FABIAN SCHUPPERT



The effects of human-made climate change are a major issue for scientists, researchers and policy-makers alike. While there exists rather broad consensus that climate change is indeed happening, significant controversy persists over the extent of the consequences of climate change and adequate policy responses.

Within the field of climate ethics and philosophy, researchers analyse the normative implications of climate change, with a particular focus on the issue of global and intergenerational justice. This research aims to provide a moral compass for policy-makers in the rather exceptional circumstances of climate change and massive environmental degradation, in which

the benefits for present generations seem to stand in conflict with the rights of future generations. Moreover, despite the fact that climate change is a global phenomenon, the consequences will differ across regions, which means that those who contributed most to the problem will in many cases not be as seriously affected as more vulnerable parties who contributed much less. Thus, climate change is indeed a global problem of intra- and intergenerational justice.

Since the publication of the first Intergovernmental Panel on Climate Change (IPCC) report in 1990, climate change and its socio-economic effects have become a major focus for policy-makers; however, both the

process and its consequences are extremely complex, giving rise to a host of questions. From an ethical perspective, some of the most pressing questions concern the balance of mitigation versus adaptation efforts, as well as the ascription of responsibility for past and current greenhouse gas emissions.

The issue of intergenerational justice

With respect to intergenerational justice, which is the idea that present generations have certain duties towards future generations, climate change raises particularly pressing issues. These

include which risks people who are currently living are allowed to impose on future generations, and in what way available natural resources can be used without threatening the sustainable functioning of the planet's ecosystems. Furthermore, when one talks about the rights of future generations, this inevitably seems to raise the issue of how to balance the rights claims of people who are currently living against the rights claims of future people.

The main focus of our research is on the moral problems of intergenerational risk imposition and the ethical requirements of just and sustainable governance of natural resources. Both these issues affect the world in which our children, grandchildren and future generations will live.

Risk imposition

In the field of climate ethics, the issue of morally permissible risk imposition is a particularly complex problem. While all political and economic decisions with regard to climate change are made under conditions of uncertainty, there seems to exist a normatively significant difference between actions that impose a major life-threatening risk on others (no matter whether these others are currently living or future people) and actions that impose limited minor risks.

In other words, one needs a set of criteria that allows one to distinguish between morally permissible and morally impermissible risk impositions, and one needs threshold levels, so as to provide decision-makers with clear guidelines. However, as the workings

Climate engineering: cure or curse?

Climate engineering, or geo-engineering, refers to the intentional manipulation of the Earth's climate to counteract anthropogenic climate change and its potential warming effects. Climate engineering covers a broad range of activities and policies, ranging from carbon capture and storage through cloud whitening to the injection of stratospheric aerosols (ISA).

The key issue with most of the climate-engineering proposals that are currently being widely discussed is that both their effectiveness and the risk of potential negative side-effects are virtually unknown variables. Proponents of climate engineering argue that the risks involved are limited and thus climate engineering would offer a quick solution to the issue of global warming through effective adaptation. However, the issue with technologies such as ISA is that they only mask the problem of climate change, since they actually do not address the root of the problem but simply offer (if they work at all) temporary protection against some of the negative effects associated with the phenomenon.

Critics of climate engineering thus question its overall effectiveness, suggesting that many engineering policies only treat some symptoms of climate change but neglect others, while leaving the root of the problem intact. These critics argue that the risks involved, such as the irreversibility of many climate-engineering measures, are too high to take.

The aim of research in climate ethics is critically to assess the risks involved and to offer normative criteria for making ethically sound and responsible decisions.

of the so-called precautionary principle (familiar from the Rio Declaration and European Union policy-making) show, defining objective criteria for distinguishing acceptable and unacceptable risks is extremely difficult.

The aim of my research on climate change and intergenerational justice is to formulate normative principles for (un)acceptable risk imposition, by taking into consideration not only the likelihood of the occurrence of a risky event, but also the scope of its potential costs/consequences and its effects on people's basic rights and interests, as well as its

breadth. Doing so allows us to tackle such complex questions as the ethical status of different forms of climate engineering (see box), or the (im)permissibility of trade-offs between future well-being and present economic gains.

Resource governance

The issue of just and sustainable resource governance calls for a range of institutions and policies at several levels, since natural resources come in very different shapes and forms. Hence, the first step for any

theory should be as clear as possible about the resources in question. Part of my own research entails carefully distinguishing between various resources and critically assessing existing claims to resource ownership, use and consumption.

Not all resources can be managed locally, regionally or nationally. In order to safeguard resource governance that does not jeopardize sustainable ecosystem functioning and biodiversity, and that protects the rights of future generations, one needs to explore the limits to resource use, the availability of ecological space and the possible (un)availability of

alternative resources. Since environmental sustainability should be considered an underlying meta-capability for the protection of all other basic rights, resource governance must be subjected to strict norms and principles. Without binding standards and international multi-level governance, existing resource-use practices, as well as the effects of climate change, threaten both environmental sustainability and the basic rights of current and future people.

Relevance

Ethical research on climate change and intergenerational justice

attempts to answer some of the most pressing questions we face today, such as how we should manage the planet's natural resources so as to give our children, our grandchildren and future generations a planet worth living on. However, since climate change and our natural environment are complex phenomena, there are no simple one-size-fits-all solutions. By acknowledging the complexity of the issue and critically assessing the morals of risk imposition, analysing the ethical hazards of climate engineering and providing normative guidelines for sustainable resource management, research in climate ethics offers practice-oriented advice for policy-makers.

Good girls and bad boys? Some critical thoughts on casting a gender lens on children in climate change

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Once dubbed the ‘latecomer’ on the climate change agenda¹ – an arena where it seemed hard, initially, to see any links at all between the science of greenhouse gases and the human social fabric – gender equality was for a long time fended off as irrelevant. Today, the social dimension of climate change is better understood, from the lopsided climatic impacts on people living in poverty, to the links between wealth and carbon emissions, and calls for inclusive and fair climate talks and funding. In the wake of that, the case for addressing gender inequalities – which is a lot to do with poverty reduction, inclusiveness

and fairness – has become a lot more tangible.

But as the issue has gained visibility and recognition, it has often been talked about and acted on in ways that seem more likely to maintain things as they are than to lead to more fairness. Critical thoughts on gender and climate work to date are probably harder to come by than useful advice from a quickly growing body of relevant recommendations and good-practice principles. This is why my three recommendations for considering gender issues in taking action on children and climate change are perhaps primarily a call to evaluate things critically rather than automatically adopting what is already there.

First, do not let men and boys drop out of the picture. Most people think ‘gender’ and translate that directly into ‘women’ – or ‘girls’. It is easy to see why: women and girls have indeed been the main focus when a policy brief, public statement, research report or project design on climate change adaptation or mitigation has addressed gender inequalities.² And they have done so to highlight and redress the disadvantages and discrimination that women and girls still face all over the world.³

1 Denton, F. (2004). Gender and climate change: Giving the ‘latecomer’ a head start. *IDS Bulletin* 35, no. 3, 42–49.

2 Okali, C. and L. Naess (2013). *Making sense of gender, climate change and agriculture in sub-Saharan Africa*. Future Agricultures Consortium. Available at: www.eldis.org/go/home&id=65144&type=Document#_UoEIsI3lf8; and Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change* 21, no. 2, 774–751.

3 www.weforum.org/issues/global-gender-gap

But there is a problem, as visualized by a group of researchers that I recently worked with: they called a vision of a more equitable, sustainable and climate-resilient world that only brings women and girls into the picture “a bird with just one wing”. It cannot fly. It encourages solutions that are as lopsided as such a vision of the problem. Don’t get me wrong. This is not to diminish, for example, the hardships, lost chances and often violence that women and girls frequently face where climatic shifts are making the lives of people living in poverty more difficult. Nor is it to belittle the immense gender gaps that still exist right across the world. But it is to say that, without having men and boys playing their crucial role in creating fairer future societies, while recognizing that they themselves face situations where expectations about their boy- or manhood limit their options, we are setting ourselves up for a crash landing. We are all beings whose identities, opportunities and life chances, throughout our lives, are strongly linked with the gender roles that society projects on us, for better or for worse. Thus, the ‘gender story’ about children and the climate cannot be a story about girls alone.

Second, and speaking of stories, be critically aware of which stories are told and retold. The same two stories have been told over and over again in the gender and climate debate.⁴ On the one hand, we have heard plenty about the ‘vulnerable woman’ in a changing climate. We are all familiar, for example, with the iconic woman walking across an arid landscape

carrying water or firewood.⁵ She has perhaps become more famous than ever in the context of climate change policy and programming. And, of late, the picture of a young woman climbing up a pole and fixing a solar panel in Orissa, India, has been featured on not just one but at least three covers of gender and climate change reports to date, including my own.⁶ She is a symbol of the second, more recent story – the story of the heroic, sensible, ‘eco-friendly’ and selfless woman who, if only we invest enough in her, will go on to save her family, her community and our planet.

Many of us, myself included in the past, have made extensive use of these stories and images, with good intentions and often under pressure to ‘illustrate’ our case for stronger attention to gender issues with catchy examples.

But we need to recognize the side-effects of this oversimplification. The focus on ‘investing in women and girls’ that has dominated discussions on gender equality and climate has opened the doors to victim-blaming – a way of limiting the vision to the symptoms of a problem while diverting attention from its root causes. A recent report on the general state of funding for the advancement of women’s rights has likened this to “watering the leaves” while “starving the roots” of

justice and gender equality.⁷ In the climate arena where – in the name of empowerment and smart adaptation and mitigation investments – women and girls are being glorified, instrumentalized and overburdened with new roles and expectations for a better world,⁸ the power imbalances at the root of poverty and climate injustice are more often than not left untouched.

And what about the unspoken messages that these stories have implied about men and boys? Have they not somehow implied that men and boys are *not* suffering the impacts of climate change, and that they are less capable of leading the world towards sustainability, less worth the investment, less likely to make responsible decisions? Has this created a sufficiently open and engaging invitation to *all* members of society to take responsibility and leadership for equality and climate justice?

Finally, be cautious about the possible consequences of collective labelling, and about killing too many birds with one stone. In bringing attention to groups who have struggled to be noticed in climate change adaptation and mitigation, ‘women and other marginalized groups’ (read: children, people with disabilities and indigenous groups) are frequently lumped together under one big heading of marginalization and powerlessness. While this has again been

4 Arora-Jonsson, S. (2011). ‘Virtue and vulnerability: Discourses on women, gender and climate change’. *Global Environmental Change* 21, no. 2, 774–751.

5 Leach, M. (2007). ‘Earth mother myths and other ecofeminist fables. How a strategic notion rose and fell’. *Development and Change* 28, no. 1, 67–85.

6 Otzelberger, A. (2011). Gender-responsive strategies on climate change. Progress and ways forward for donors. Brighton: Institute of Development Studies. Available at: www.bridge.ids.ac.uk/vfile/upload/4/document/1107/Gender%20responsive%20strategies%20on%20climate%20change_progress%20and%20ways%20forward%20for%20donors.pdf

7 Arutyunova, A. and C. Clark (2013). *Watering the leaves, starving the roots. The status of financing for women’s rights organizing and gender equality*. Toronto, Mexico City, Cape Town: Association of Women’s Rights in Development. Available at: www.awid.org/Library/Watering-the-Leaves-Starving-the-Roots

8 Okali, C. and L. Naess (2013). *Making sense of gender, climate change and agriculture in sub-Saharan Africa*. Future Agricultures Consortium. Available at: www.eldis.org/go/home&id=65144&type=Document#UoEIsI3fif8

driven by a desire for fairness, it probably has not done enough justice to the diversity of strategic interests within and between these groups. And while it might have brought some attention to people who might otherwise be ignored altogether, I suspect it might also have accidentally served those who are not very interested in any real changes in power relations. Throwing the apples and pears

of social inequality all together in one big bucket – or paragraph, or bullet point – of ‘the marginalized’ makes it easier to take that entire bucket and push it into a dark, forgotten corner, especially when it comes to making ‘the big decisions’.

There are many gender myths to bust and assumptions to challenge. Both those working on gender equality and those working

to tackle climate change know that unlearning something is much harder than learning something new. Young people have less unlearning to do than adults. So, overall, the one thing at the top of my wishlist is to let young people in particular make their mark on fresh visions and new strategies that will drive what is said and done about gender in the climate arena.

Partnering with and catalysing young innovators

IVANA SAVIĆ



Broad public participation is a prerequisite for achieving sustainable development, and thus combating climate change.¹ Climate change is everyone's concern and everyone's responsibility, including children and youth, and combating it thus requires the engagement of young people.

The right to the participation of the child is one of the basic principles of the Convention on the Rights of the Child (CRC). The notion of children's participation has two components. The first is the right of the child to be heard, as enshrined by Article 12, which imposes an obligation on the state to hear children in all decisions concerning them

– including climate change law, policies and activities at all levels. The second component is the right to participate, which corresponds to the idea of the child as an active actor in his/her life, family and community. The participation of children “should not only be a momentary act, but the starting point for an intense exchange between children and adults on the development of policies, programmes and measures in all relevant contexts of children's lives.”²

Children are recognized as those with the strongest interest in environmental matters, and hence their participation in mitigating climate change and adaptation

must be ensured.³ This claim is further strengthened by Principle 10 of the Rio Declaration on Environment and Development, where it is recognized that “environmental issues are best handled with the participation of all concerned citizens, at the relevant levels” while stressing the importance of youth to “forge a global partnership in order to achieve sustainable development and ensure a better future for all.”⁴ In addition to the obligation to ensure the participation of children in climate change deliberations, their best interests should be a primary consideration in designing laws,

1 Agenda 21: Programme of Action for Sustainable Development, UN GAOR, 46th Sess., Agenda Item 21, UN Doc A/Conf. 151/26 (1992), para. 23.2.

2 UN Committee on the Rights of the Child (CRC), General Comment No. 12 (2009): The right of the child to be heard, 20 July 2009, CRC/C/GC/12, para. 13.

3 Savić, I. (2012). ‘Youth participation in environmental activities’. In *Climate change: Impacts on children and their rights*. Sion: Institut International des Droits de l'Enfant, 167.

4 Rio Declaration on Environment and Development. UN Doc. A/CONF.151/26 (vol. I); 31 ILM 874 (1992).

policies, activities and solutions related to climate change.⁵

In the last two decades, there have been significant achievements with regard to the participation of children in action on climate change. In the follow-up to the Earth Summit in 1993, their participation was institutionalized for the first time in history, when children and youth were included as one of the nine ‘Major Groups’ through which all citizens could participate in United Nations activities in relation to sustainable development.⁶ This represented a benchmark for the participation of children and youth in development and environmental governance. Furthermore, the concept served as a model for the United Nations Environmental Programme⁷ in creating its TUNZA programme for engaging young people in environmental activities.⁸ It also influenced the establishment in 2009 of YOUNGO as one of the functional groups representing stakeholders within negotiations on the United Nations Framework Convention on Climate Change.⁹

Despite this progress, children still face numerous challenges that prevent them from being recognized as relevant partners in combating climate change and building climate change resilience.

First, children are still perceived as victims of climate change,

rather than researchers, leaders, innovators and agents of change. Children are certainly one of the groups most affected by climate change, but this does not mean that they are helpless. On the contrary, children whose rights are violated or denied owing to the consequences of climate change could partner with their peers, human-rights defenders and climate change groups in order to initiate strategic litigation aimed at delivering broad social change in the interests of climate change mitigation and adaptation, as well as prevention and redress of environmental degradation. Nonetheless, the myth of children as victims is still dominant and greatly influenced by the traditional perception of children as objects of protection rather than as rights holders. We need to shift this perception and to start seeing children as holders of rights who are capable of partnering on an equal footing with all relevant stakeholders to mitigate climate change and contribute to adaptation. This will be particularly important to address within the post-2015 development agenda, where the participation of children in combating climate change should be one of the cross-cutting issues.¹⁰

Second, the participation of children in issues around climate change is in the best interests of the child. The institutional mechanisms for the participation of children must therefore be ensured at all levels – local, national, regional and international – and at all stages of decision-making on climate change issues, from law and policy development through to implementation, monitoring and evaluation. Children should

have access to both climate change information and opportunities for participation that are child-friendly and age-appropriate. Furthermore, children – especially those most affected by climate change – should not be debarred from participation and voicing their concerns by lack of financial resources.

Third, it is imperative to ensure the empowerment of children and to build their resilience through capacity development. This would include, but not be limited to, developing the leadership skills of children and young innovators in combating climate change and ensuring that they understand the scientific, technological, economic and social aspects of the changing climate.

Last but not least, it is necessary to build communities of children and youth, both online and in situ, that enable the sharing of knowledge and experience, networking and partnerships and create space for the development of integrated innovation programmes. These communities should be child and youth-led, and should receive broad support from both the public and private sectors.

Conclusion

Partnering with children and young innovators is an aim towards which all governments and international organizations, together with private-sector and civil-society groups, should strive. Not only could such partnerships contribute to children’s individual development and well-being but they could also promote community-building and ensure the sustainability of initiatives on climate change. Such an approach builds legitimacy, improves the quality of decision-making,

5 UN Committee on the Rights of the Child (CRC), CRC General Comment No. 7 (2005): Implementing child rights in early childhood, 20 September 2006, CRC/C/GC/7/Rev.1, para. 13.

6 For more information on the United Nations Major Group for Children and Youth please see: <http://sustainabledevelopment.un.org/index.php?menu=158> and <http://childreneyouth.org/> Other groups are: Business and Industry, Farmers, Indigenous Peoples, Local Authorities, NGOs, Scientific and Technological Community, Women, Workers and Trade Unions.

7 www.unep.org/civil-society/MajorGroups/tabid/52184/Default.aspx

8 www.unep.org/tunza/

9 <http://youthclimate.org/>

10 For more information see: www.worldwewant2015.org/sustainability

and enhances the ownership, responsibility and accountability of climate change implementation.

In addition, it serves to protect children's and other stakeholders' interests, reducing conflicts of interest and contributing

to the effectiveness of climate change governance.

Catalysing young innovators is a long-term investment not only in climate change solutions, but also in human capital and a better future for all. Climate change is

one the biggest challenges facing humankind but it also represents an opportunity to change the way in which we treat our environment and our children in order to bring about a just, fair and sustainable future for all.

Engaging youth in participatory games for learning about climate risks

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Climate change is increasing the risk of extreme events and disasters, which hit the world's poorest and most vulnerable first and hardest – especially children.¹ Many of these hazards occur cyclically and are to a certain extent predictable. The extreme events will continue to occur, yet communities, and the institutions and organizations supporting them, can greatly reduce their impacts by making use of available climate information – from early warnings in the short term through to changes that will reduce risk in the long term.²

1 Intergovernmental Panel on Climate Change (2012). *Special report on managing the risks of extreme events and disasters to advance climate change adaptation*, Geneva: IPCC. Available at: www.ipcc-wg2.gov/srex

2 Van Aalst, M. K. (2009). In *World Disasters Report 2009*. Geneva: International Federation of Red Cross and Red Crescent Societies. Ch. 3.

We know from experience that building the capacity of communities and vulnerable groups – including children – to use such information pays off. For instance, in Cuba, children conveyed early-warning messages to help to spread the word about impending hurricanes. In Brazil, Save the Children taught children to measure rainfall to give early warning of floods or landslides.³ Yet all too often the tools and resources developed by climate scientists to help to predict disasters do not reach those who are most vulnerable and in the greatest need of the information. Higher-income countries are able to produce and

3 Save the Children (2011). *Reducing risks, saving lives: Save the Children's approach to disaster risk reduction and climate change adaptation*. London: Save the Children.

disseminate more complete climate information, while poorer countries with fewer resources to invest in weather and climate information sorely lack access to the relevant science. But even if the information does exist, it often does not get to the right people – those who could use it to make better decisions.⁴ So what can be done to bridge the divide between complex climate science and practical action on the ground?

An innovative and widely applicable approach for bridging the gap between science and practice at the local level in a more meaningful way is the use of *participatory games*. Such games can provide a compelling, memorable and fun

4 For example, World Climate Conference 3 (2009). The focus was on climate predictions and information for decision making.

way of learning about climate science and other topics related to climate risk management. Players can move from ‘Huh?’ moments of confusion to ‘A-ha!’ moments of discovery and understanding. The games have the ability to reflect complex systems with a range of plausible futures and, during game play, players discover the likely trade-offs, feedbacks, delays and thresholds involved in the myriad effects of disaster events. This type of experiential learning can drive meaningful dialogue on what appropriate planning in climate change and disaster risk reduction programmes might look like and on the role that accessing and understanding expert information plays in this planning process. Importantly, participatory games create a fruitful atmosphere of collaboration and mutual understanding among a range of stakeholders who may speak different languages, have different perspectives and pursue different priorities.

The Red Cross Red Crescent Climate Centre has been designing, testing and using games for learning and dialogue processes addressing diverse topics, including forecast-based decision-making, dengue prevention strategies, gender inequity and diversifying smallholder cropping systems. The ‘scaleability’ of games as learning tools in climate risk management has led to more than 80 game events taking place in four continents, with stakeholders ranging from Red Cross youth learning about the links between climate risks and health, through national finance ministry staff involved in an Africa-wide regional insurance pool, to subsistence farmers developing village-level flood contingency plans. Each of these groups has been able to explore

and discuss a variety of practical and policy options through the use of games.

The groundbreaking use of games for learning continues to gain momentum: in December 2012, youth joined the Climate Centre at the United Nations Framework Convention on Climate Change Conference of the Parties in Doha to play games on climate risk management including ‘Humans versus Mosquitoes’. This game was developed by a team of graduate students and faculty at Yale University and Parsons The New School for Design, with the deliberate intention of creating a game that could be played by schoolchildren in vulnerable communities.⁵ The game raises awareness about dengue fever, which may be aggravated by climate change due to increasingly favourable environments for the mosquito that carries it. Because there is no treatment or cure, to reduce dengue risk it is important to motivate people to take preventive action and clean up mosquito breeding sites. To make the game accessible to youth, a simple game mechanism was adapted, similar to ‘Rock, Paper, Scissors’. Game sessions in over 10 countries have raised dengue awareness by motivating students, Red Cross youth and other stakeholders to learn more about and address this underestimated risk factor.⁶

‘Before the Storm’ is another participatory game designed to promote meaningful dialogue among diverse stakeholders about the need to collaborate on turning

science-based predictions into concrete decisions.⁷ This game mimics the information divide in reality, where potential users of forecasts often cannot understand the language and meaning of experts’ statements about likely future conditions, and scientists cannot understand why their forecasts are not used. These stakeholders may not be accustomed to examining jointly whether action is or is not advisable based on a given forecast expressed in terms of probabilities. Lively game play engages producers, communicators and users of forecast information with very different backgrounds and skills in discussing how to select among multiple plausible forecast-based actions, and considering their merits and risks – including what can go wrong, whether in terms of ‘acting in vain’ or ‘failing to act’. Differences of opinion lead to rich conversations about the links between what science can say and what people are willing and able to do given vulnerabilities, capacities, cultural norms and other factors affecting whether early warnings trigger early action.⁸

As a result of such games, humanitarian workers and community members learn about the potential and limits of science-based forecasts. Scientists confront the irrefutable reality that their technical language is not universal and requires translation into thresholds for action. They also learn that, when presented with scientific information, many

5 See <http://humansvsmosquitoes.com> for complete rules and other materials.

6 Mendler de Suarez, J., P. Suarez, C. Bachofen et al. (2012). *Games for a new climate: Inhabiting the complexity of future risks*. Frederick S. Pardee Center Task Force Report. Boston: The Frederick S. Pardee Center for the Study of the Longer-Range Future, Boston University.

7 See a four-minute video of ‘Before the Storm’ gameplay in Senegal with humanitarian workers, forecast producers and vulnerable farmers and fishermen at www.youtube.com/watch?v=Mpj_EbKdwEo. ‘Before the Storm’ was designed by the Red Cross/Red Crescent Climate Centre in partnership with Parsons The New School for Design.

8 Suarez, P. and A. Tall (2010). *Towards forecast-based humanitarian decisions: Climate science to get from early warning to early action*. Humanitarian Futures Programme. London: King’s College London.

people will always choose to act on received forecasts, regardless of probabilities. Generating locally appropriate options for forecast-based disaster preparedness at the community level is part of this exercise.⁹

⁹ Mendler de Suarez, J., P. Suarez, C. Bachofen et al. (2012). *Games for a new climate: Inhabiting the complexity of future risks*. Frederick S. Pardee Center Task Force Report. Boston: The Frederick S. Pardee Center for the Study of the Longer-Range Future, Boston University.

The impacts of climate change on the lives and livelihoods of the most vulnerable are real. Yet we vastly underutilize the tools and resources developed by climate scientists to help to predict disaster. Games can help to spur innovation and the development of new policies and practices that incorporate the use

of seemingly incomprehensible science. Anticipatory, inclusive and participatory approaches can help to transform traditional thinking. Ensuring that the most vulnerable, including children, can access, understand and act on climate information will increase their resilience in an increasingly uncertain climate.

Opportunities for child empowerment through participation at United Nations climate conferences

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Indonesia established the National Council on Climate Change or *Dewan Nasional Perubahan Iklim* (DNPI) in July 2008 through a Presidential Decree. The Council, chaired by the President of the Republic of Indonesia, was designed to serve as a policy coordinating body among government ministries and institutions on matters related to climate change. It also acts as the focal point of the United Nations Framework Convention on Climate Change (UNFCCC) in Indonesia.

DNPI started taking part in children and climate change activities when Plan International asked its representative to judge poster and writing competitions. Winners were awarded a trip to the UNFCCC 15th Conference of Parties (COP 15) in Copenhagen

at the end of 2009 as Plan International youth delegates.

Three Indonesian children participated in the conference as observers from a non-governmental organization. Meanwhile, Plan youth delegates from Indonesia, Kenya, the United Kingdom, the Netherlands and Sweden took part in the conference as young reporters. These children interviewed delegates from all over the world and exchanged views with them on climate change.

Seeing how exposure to international events could empower children and prepare them to be future leaders on climate issues, DNPI began to develop a programme called Children and Youth Delegation to involve children and youth in its international activities with the following objectives:

- To advance the involvement of children and youth in climate change issues so that they can play a part in international outreach activities.
- To promote the participation of children and youth at a global level in addressing the climate change crisis.
- To maintain gender balance in providing opportunities for climate change education and campaigning.
- To improve coordination between sectors by empowering the children and youth of Indonesia to act as key mediators in communicating climate change issues in the international sphere.

Subsequent to COP 15, DNPI regularly sent children as part of

the Indonesian delegation, with pink badges.*

The importance of children's participation in international policy processes is stated in Article 6 of the UNFCCC and the Doha Work Programme related to it, and in the United Nations Convention on the Rights of the Child.

Article 6 of the UNFCCC encourages action in developing and implementing educational and training programmes on climate change.

The Doha Work Programme encourages states' parties to develop tools and methodologies to support climate change training and skills development through collaborative efforts. It also encourages the provision of training programmes for groups with a key role in climate change communication and education, including journalists, teachers, youth, children and community leaders.

The United Nations Convention on the Rights of the Child spells out the basic human rights that children everywhere have: the right to survival; to develop to the fullest; to protection from harmful influences, abuse and exploitation; and to participate fully in family, cultural and social life.

In the national arena, the Republic of Indonesia's 2002 law on child protection respects a child's right to participate and to state his/her opinion in decision-making processes, especially when these will affect the child's life.

The active participation of children in climate change discussions can be expanded through outreach activities, journalistic coverage and public campaigns.

The concrete results of such participation can serve as resources to mobilize support for national and global activities.

To enhance the role of children in addressing climate change it has been necessary to pool resources from various stakeholders. The Indonesian Children and Youth Delegation programme has been supported by various entities, including the Open Society Institute, the Indonesia Partnership for Governance Reform, the British Council, Pertamina Geothermal, the United Nations Development Programme, the Ministry of Environment, the Ministry of Youth and Sports Affairs, and the National Council on Climate Change.

Another supporter has been The Climate Reality Project Indonesia, a branch of the non-profit organization founded and chaired by Nobel Laureate and former US Vice President Al Gore. All around the world, 5,000 members of the Climate Reality Leadership Corps are standing up and making a difference on the climate crisis, including 250 climate leaders in Indonesia, 10 per cent of whom are children. Participants learn the latest on the science of climate change and are trained in public speaking, social media and leadership skills, communication strategies, community outreach and organizational skills.

Climate leaders speak to their communities about how climate change affects their daily lives – and about what we can do to combat it. They are appearing in the media, activating social networks, and inspiring people everywhere to join us in confronting the defining issue of our time.

The Inconvenient Youth, managed by The Climate Reality

Project, is a place where teenagers aged 13 to 18 can share their ideas on solving the climate crisis and leading our society to a sustainable future.

In cooperation with DNPI, The Climate Reality Project Indonesia sent children and youth, including those who are part of the Inconvenient Youth Group, with their chaperones/mentors to attend the last week of COP and participate as speakers at suitable events.

At COP 16 in Cancún, the event was 'Bearers of Future Responsibility: Engaging Children and Youth in Building Climate-Change Resilience'. Organized by UNICEF, Save the Children and Plan International, speakers included Yvo De Boer, the former Secretary of UNFCCC, and Mary Robinson, former Irish President and head of UNHCR.

At COP 17 in Durban, South African and Indonesian child and youth delegates gave cultural performances, interacted with delegates and exhibitors, and were interviewed by Climate Change TV. A special session was also arranged at the Indonesia Pavilion for the children to speak.

Unfortunately, however, at COP 18 in Doha last year children were not accredited to attend the talks apart from in exceptional cases or on the dedicated Young and Future Generations Day. Ironically, one side-event that the children could not attend owing to the age restriction was 'A Child-centred Approach to Climate-change Adaptation: Opportunities and Challenges'. This was organized by the Children in a Changing Climate Coalition comprising Plan International, Save the Children, World Vision and UNICEF.

Members of the Indonesian delegation who were under 18 did,

* Identification as a member of a government delegation.

however, eventually network with their peers from countries such as Japan, Saudi Arabia, India and China during the Indonesia Climate Day outside the United Nations compound.

Over the last three years, the DNPI Children and Youth Delegation programme has worked in the following way:

- A number of organizations and government agencies nominate children and young people as participants in the UNFCCC Conference of Parties. They are selected on the basis of their interest in climate change issues, their English language ability and their previous extra-curricular activities. A gender-balanced group of between 10 and 15 is chosen for each COP.
- A few weeks before departure, a three-day workshop is conducted in Jakarta, which includes sessions on Indonesian culture, diplomacy, journalism, climate science, climate change mitigation and adaptation. It also contains a model UNFCCC.
- While at the COP, the young delegates attend special youth sessions, interact with negotiators on the Indonesian delegation, observe the international negotiation process, conduct daily debriefings and work on their own journalistic coverage.
- After the COP, the young delegates write articles, post information on social media and engage in national and international events on climate change.

Members of the Indonesian children and youth delegation have become role models for their peers, have initiated community events

and have participated in numerous international events.

Among them is Adeline Tiffanie Suwana, who started attending UNFCCC COPs when she was 13 and wrote the following account in 2012.

The warm atmosphere of mid-July 2008 was breezing across my neighbourhood as it was time for the change of season in Indonesia. It was supposedly only an ordinary transition from sunny to rainy season, but the changing season four years ago turned out to be unforgettable.

I still vividly remember that it was a hot summer day and I was only 11 years old. My parents were about to drive my friends and I to the local pool, but then it started to drizzle. They decided to wait until the rain settled down, but it never did; little did I know that the pouring rain would not stop for the entire week. Soon, the water sewers started to overflow and a massive flood submerged my entire neighbourhood, reaching its peak of more than three metres. Other districts suffered worse – floods were as high as their roofs and lives were lost. As I sat down in an evacuation jeep, the weather anomaly piqued my curiosity.

It led me to seek out knowledge on what was happening. I asked several adults who answered that a significant amount of garbage dumps in my city were the key problem for the flooding; some said that it was God's will. I was quite confused until my science teacher in school answered my question with a new term that I had never heard before: climate change.

From the massive floods, through the risk of rising sea levels to the climate refugees, the impact of climate change triggered me

to actively participate in taking care of our environment, starting with myself. After adopting an eco-friendly lifestyle, I decided that it was time to trigger actions, spreading the cause of volunteerism to anyone I knew.

The reaction was amazing. The first action was planting mangroves in a nearby swamp with more than 100 kids from three different schools who had all voluntarily come to take action. My project was then called 'SahabatAlam', meaning 'nature's best friend'.

Years later, SahabatAlam has become a well-established non-governmental organization transcending places beyond Jakarta. In my journey, I have interacted with more than 25,000 youths, teachers and activists. Now I have organized more than 100 different activities, ranging from simple actions such as biking to school and planting trees to nationwide-scale projects such as a water turbine programme that uses hydropower energy from waterfalls to generate electricity in villages.

I created a website, www.sahabat-alam.com/en and worked together with the media to reach youth nationwide. Continuously seeking improvements, I am currently trying to establish more branches in other areas and creating new young pioneers that can motivate others to get involved in this massive call for action against the climate crisis.

I believe that it is of the utmost importance that young people are aware and initiate actions against climate change. I therefore started a project in SahabatAlam called 'Save the Planet School Seminar', which aims to educate the young generation in elementary

and junior high school about climate change and the world's biodiversity. Its purpose is also to inspire and to empower youth in starting actions in their own school and districts.

Equipped with cutting-edge communication tools, powerful images and verified data from The Climate Reality Project Indonesia, I was able to raise these children's awareness. They tend to learn more from images, not words, and will be more participative in discussions when they are with their own peers. More importantly, these children become attracted to and concerned with the climate issue, and are eager to start an action.

After every seminar session, I gather these children into focus groups to plan actions that they could do in their own school and district. They then try to promote their plans and collectively decide

on a monthly plan that they will implement in their schools.

Afterwards, these children and I would do these actions, which they would do in the future independently and would be monitored. Some of the past actions have included planting trees in their schools, recycling waste collected from the students, tending pot gardens in their classrooms and much more. These children have also participated in regional projects together with Sahabat Alam in various places – for example, releasing endangered sea turtles and planting coral reefs in Indonesia's Thousand Islands.

Over the years, I have visited more than 20 schools in the outskirts of Jakarta. When I was spreading awareness of climate change in schools, I was extremely surprised that the vast majority of children did not have a clue what climate change is. Most students could learn about it by listening to

the news or browsing the internet, but most elementary students or even junior high school students, especially in the outskirts districts, do not have access to both, resulting in their not knowing the term climate change, let alone what it means. This situation has to be changed now – and fast.

I believe that youth have opinions on how they could help the environment. I have some, and so do millions of youth out there who have interesting points of view, but are unable to voice them. Millions more do not know the crisis that we are facing and have to deal with in the future. However, with more youth starting to voice their opinions, to spread awareness and to create communities of young people that care about our Mother Earth, we could urge sustainable policies, demand action from our leaders, and even be the leaders for the future.

Engaging children in the African climate change discourse

MOUNKAILA
GOUMANDAKOYE AND
RICHARD MUNANG



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Climate change poses significant dangers to human well-being and development pathways in sub-Saharan Africa, where the resources and capacity to respond are limited. This is going to get worse, as warming in Africa is projected to be greater than the global annual mean, with an average increase of 3–4°C over the next century. This poses a serious challenge to social and economic development, particularly because the economies of most African countries depend on climate-sensitive sectors such as agriculture, water, fisheries, energy and tourism. About 70 million people and up to 30 per cent of African coastal areas could face the risk of flooding by the end of the twenty-first century owing to climate change-induced sea-level

rise; yields from rain-fed agriculture could be reduced by up to 50 per cent; 25 to 40 per cent of mammal species could become endangered or extinct by 2080; while 5,000 African plant species will be faced with substantial reductions by 2085. Between 75 and 250 million people in Africa are projected to face increased water stress. This is likely to constrict economic growth and hamper measures for the timely delivery of the Millennium Development Goals.

Children are critically exposed to these impacts of climate change on the continent. The effects of longer and more intense droughts, repeated floods and shifting seasons are severely hampering their education and creating community pressures that result in children

being more at risk from economic exploitation. For example, many of the main threats to child survival, such as malaria, diarrhoea and undernutrition, are highly sensitive to climatic conditions and these are expected to worsen as a result of climate change.¹ Breaks in the regular water supply, for example, are costing a family of six in rural Africa an average of three hours a day that now has to be spent on the collection of water.² Given that this is an activity predominantly carried out by children, the long-distance search for water is depriving them of time that could be spent on other activities,

1 UNICEF (2008). *Climate change and children: A human security challenge*. Florence: UNICEF Innocenti Research Centre.

2 Pan Africa Chemistry Network (2010). *Africa's water quality: A chemical science perspective*. Cambridge: Royal Society of Chemistry.

including school attendance. The incidence of cholera has also been shown to increase the farther away families live from water points, because the distance reduces their access to both safe water and sanitation.

Children have considerable strengths that are a significant resource; they are also effective communicators of risk and drivers of change in their communities. Yet, to date, climate change decision-making and responses have paid little attention to how adaptation measures can be child-led, with the result that there is little institutional knowledge of initiatives taken by children to reduce their communities' vulnerability to climate change. There is an urgent need now to involve children in climate change adaptation – and to recognize their capacity to participate in decision-making.

Turning the climate crisis into an opportunity in Africa: children's place and space

The current climate change crisis plaguing children may offer a window of opportunity if appropriate action is taken to build their social and physical resilience. If children's local knowledge of changes, impacts and priorities could be linked with the work of climate change experts in relevant sectors, there would be more chance that development and adaptation approaches, strategies and assistance would meet their needs. Their active participation in adaptation solutions can be a powerful force for change but can also enhance their resilience to climate shocks and stresses.

Using education programmes to put climate change adaptation on the national agenda

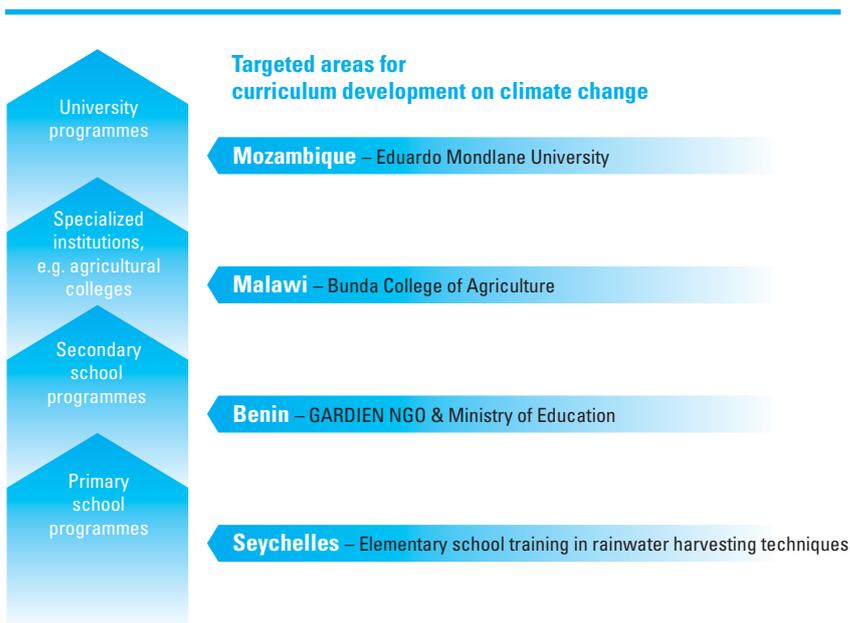
Actions that involve children and keep the climate change agenda in the eye of the nation are crucial. Targeting programmes and training, especially those that integrate climate change into the school curriculum, is especially fertile ground. CCDare, a joint initiative of the United Nations Environment Programme and the United Nations Development Programme, has developed an educational curriculum on climate change adaptation. This has been introduced in four countries at different school levels, along with pedagogic training of teachers which prepared them for using the materials. The flexibility of the Programme was such that it was able to target primary, secondary and tertiary levels of education, and to address both general and specialized educational training. There is a huge opportunity to replicate this in other countries, though it is

important that climate change is coherently integrated into the curriculum, developing appropriately between the primary, secondary and tertiary levels (*Figure 1*).

Strengthening child-led adaptation

In Togo, working with children within their communities led to the rehabilitation of small dams for harvesting rainwater. This has resulted in improved access to water for local communities, for both domestic and agro-pastoral consumption, while also helping to expand rural livelihood activities such as market gardening, brick construction and fisheries. The co-benefits of the project, which provides a year-round supply of water to the surrounding ecosystem, include the natural regeneration and restoration of biodiversity, serving as medicinal products for the household and dietary supplements for local communities. The lessons developed children's capacities and proved

Figure 1: Climate change curriculum development



that, if they are meaningfully engaged, they can be empowered – and that what they learn can catalyse the formulation of policy at local, sub-national and even national levels.

Way forward and policy recommendations

Attempts to formulate and implement climate change policy that enable children to make a positive contribution to the process of risk reduction and climate-resilient development are hampered by two factors: the lack of child participation in decision-making and the complexity of issues related to climate change adaptation. Knowledge of the issues and meaningful participation from an early age can lead to an informed and skilled generation of decision-makers and greater potential for regional

solidarity. The successful execution of practical projects, such as those mentioned above, has shown that young people are more likely to be empowered if activities start with what they know about the climate risks that they face and recognize the activities that they are already engaged in to reduce those risks. It is therefore imperative to ensure that:

- there is long-term support for including climate change adaptation and disaster risk reduction in school curricula in ways that empower children as active citizens, and equip them with the relevant skills and knowledge to manage their environment and adapt to a changing climate
- governments and other policy-makers acknowledge children as stakeholders, providing formal mechanisms that allow children to contribute to decision-making on climate change
- local, national, regional and strategic plans on climate change – including National Adaptation Programmes of Action and National Adaptation Plans – protect and involve children
- all adaptation interventions build on lessons from community-based adaptation approaches that value local knowledge, and in which children are able to participate
- a proportion of adaptation financing is explicitly targeted to build child participation and capacity to adapt
- local governments are equipped to play a key role in delivering child-sensitive adaptation in the long term.

Engaging children in the climate change discourse can provide a guiding vision so that, with proper planning, the climate crisis in Africa can be turned into an opportunity.

Partnering with young people in climate change action

UNITED NATIONS JOINT
FRAMEWORK INITIATIVE
ON CHILDREN, YOUTH
AND CLIMATE CHANGE



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The largest generation of young people the world has ever known is the main driving force that needs to be mobilized to reverse global environmental degradation and address the consequences of climate change. Popular conservation arguments draw attention to the legacy we mean to leave for our children: if not for love of nature itself, then surely for love of our children we must wish to leave this planet in a liveable state! Valid as this argument is, it should not be allowed to cast young people in a passive role in the face of climate change: they should be recognized as active and inspiring agents of global change towards a sustainable future for all of us.

Partnering with and for young people is therefore key to tackling climate change. Countless

examples from around the world show children and youth to be resourceful, innovative and passionate thinkers, advocates and leaders on climate change action.¹ Young people are actively engaged at local, national and international levels in raising awareness, running educational programmes, conserving our nature, promoting the use of renewable energy and adopting environmentally friendly practices. It is therefore the responsibility of policy-makers and implementers to enter into effective partnerships with and support actions by this key constituency.

The arguments are obvious: young people constitute the

generation which, upon maturing, will have to face the consequences of climate change much more immediately than the current generation of adults. A socio-political system which does not equip its future citizens and leaders for the future that they are expected to meet and does not involve them in its decision-making process is unsustainable.

Moreover, partnering with youth motivates young people to address the complex challenges that our world is facing today. In school, young people often learn about climate change, but not necessarily about what they can do about it. Effective partnerships with youth also allow young people to do something about climate change. Instead of taking on a

¹ United Nations Joint Framework Initiative on Children, Youth and Climate Change, 2013. Fact sheet available at: <http://www.un.org/esa/socdev/documents/youth/fact-sheets/youth-climatechange.pdf>

fatalistic approach, they contribute to shaping a better future.

When better to nurture sustainable habits than at a young age? Research shows that childhood experiences in nature lead to more environmentally conscious behaviour in adults.² Similarly, cultivating sustainable thinking from a young age onwards is more likely to have a lasting effect than trying to modify already ingrained habits later in life. In an ideal scenario, a new, 'green' generation will not follow the unsustainable example set by its elders, but will instead make climate-conscious decisions as a matter of habit.

The United Nations Joint Framework Initiative on Children, Youth and Climate Change

The United Nations System recognizes the key role that young people play in tackling climate change and works closely with youth-led and youth-focused organizations around the world through the United Nations Joint Framework Initiative on Children, Youth and Climate Change (Joint Framework Initiative).³ Since 2008, the Joint Framework Initiative has been co-ordinating efforts by 16 intergovernmental entities and many children's and youth organizations to empower young people to take adaptation and mitigation actions and enhance their effective participation in climate change

policy decision-making processes.⁴ Exciting examples of how members of the Joint Framework Initiative partner with children and youth organizations to address climate change and promote sustainable lifestyles include:

- The Food and Agriculture Organization of the United Nations (FAO) supports the development of food security and climate change educational programmes and resources for rural farmer field and life schools. FAO also co-ordinates the Youth and United Nations Global Alliance (YUNGA), a partnership between United Nations agencies, civil-society organizations and other entities founded in 2009.⁵ YUNGA collaboratively develops and implements resources and initiatives that foster sustainable behaviour from an early age and provide a gateway for thousands of young people worldwide to participate in the activities of the United Nations. Over 10,000 youth have already completed the YUNGA Food Security and Climate Change Challenge Badge.⁶
- Through the YouthXchange initiative, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP) support youth projects on sustainable lifestyles in 45 countries around the world.⁷
- UNEP adopted a long-term Tunza Youth Strategy for engaging youth in environmental activities in the areas of capacity-building, environmental awareness and information exchange, with a vision to foster a generation of environmentally conscious citizens, capable of positive action.⁸ Since 2004, over 4,500 children and young people have participated in annual UNEP Tunza International Conferences, representing over 100 countries, and covering a number of issues ranging from climate change to the green economy and green jobs. The Tunza website receives over 1 million visits a year. Between 1991 and 2012 the Tunza International Painting Competition received more than 3 million entries from over 100 countries.
- Children, youth and adults from more than 50 countries participate in the Sandwatch programme, which aims at developing awareness on the vulnerability of marine ecosystems and the need to use them wisely.⁹ The programme seeks to change lifestyles and habits on a community-wide basis. Sandwatch students undertake field studies at their local beach and regularly collect data. They share their findings with the wider community and then take action to address issues, enhance their beach environment and build resilience to climate change. Initiated by UNESCO more than 10 years ago, Sandwatch is co-ordinated by the non-profit Sandwatch Foundation with support from UNESCO and many other partners.

2 Rickinson, M., J. Dillon, K. Teamey et al. (2004). *A review of research on outdoor learning*. National Foundation for Educational Research and King's College London; Larson, L. R., Green, G. T., & Castleberry, S. B. (2011). Construction and validations of an instrument to measure environmental orientations in a diverse group of children. *Environment and Behavior*, 43: 72-89.

3 http://unfccc.int/cc_inet/cc_inet/youth_portal/items/6519.php

4 United Nations Joint Framework Initiative on Children, Youth and Climate Change, 2009, 2010 and 2013.

5 <http://yunga-youth.weebly.com/>

6 www.fao.org/climatechange/18820-04f5d6f7e9296cb1b2ced188e8824cb52.pdf

7 www.youthxchange.net/main/home.asp

8 www.unep.org/tunza/children/Default.aspx

9 www.unesco.org/new/en/natural-sciences/priority-areas/sids/sandwatch/

- The free web-based education and learning network Young Masters Programme on Sustainable Development (YMP), created by the Swedish International Institute of Industrial Environment Economics (IIIEE) at Lund University, puts social, environmental and economic awareness on high-school timetables all over the world.¹⁰ More than 20,000 youth, aged 16 to 18, from over 100 countries have already taken part in the YMP programme since its start in 1999. With the UNESCO Chair on Education for Sustainable Development at Lund University, UNESCO co-operates on the Young Masters Programme on Sustainable Development.
- The Global Action Classroom (GAC) programme, which is held through the Earth Child Institute, seeks to connect youth globally so they may learn and inspire the children in their communities to take action to improve their local environments through the positive use of technology.¹¹ With nearly 400 students having already participated from six countries, including Nigeria, Brazil and Ghana, students connect through blogging and share media, stories, and comments to gain a stronger understanding of environmental issues both locally and globally, and thus to make greater impact within their communities. Students observe their local environment, and then share their findings with participants in other parts of the globe and blog about the environmental action that they take. Many of the initiatives the students undertake include writing to local policy-makers to request land to provide habitats for wildlife, conducting water testing and planting trees.
- The growing engagement of the International Youth Climate Movement in the intergovernmental climate change process led to the creation of the rapidly expanding United Nations Framework Convention on Climate Change (UNFCCC) observer constituency of youth non-governmental organizations (YOUNGO).¹² In only four years, YOUNGO has become a vibrant network of young climate activists and advocates, who make official statements at UNFCCC conferences, provide technical and policy inputs to negotiation groups, engage directly with decision-makers and organize a variety of awareness-raising activities. Youth participation has brought moral, intergenerational and equity-based values as well as constructive technical and policy inputs to the UNFCCC negotiations.
- The UNFCCC secretariat coordinates the work of the Joint Framework Initiative and works closely with YOUNGO to support the substantive engagement of youth in the intergovernmental climate change process through the organization of high-level briefings with decision-makers, capacity-building events for youth organizations, the facilitation of youth participation from developing countries and virtual participation of youth around the world who cannot attend UNFCCC conferences.¹³
- Youth organizations have also featured prominently within the UN process on sustainable development since 1992, officially engaging with the intergovernmental process through the major groups sector for Children and Youth. As it pertains to the implementation of Agenda 21, young representatives advocate systematically around the climate change agenda, and across some 40 thematic and cross-cutting sustainable development issues emerging from major conferences and summits, as well as from the work of the Commission on Sustainable Development. The role of young people as critical stakeholders in sustainable development was duly affirmed by the Rio+20 Conference, which calls on governments and the UN system to further enhance the participation and consultation of youth in the process to accelerate implementation of existing commitments.

The way forward

Looking ahead, the work that remains to be done is clear. The adaptive capacities of youth in developing countries need further strengthening – in particular, rural youth represent one of the world's groups that is most vulnerable to climate change. In developed countries, the scaling up of behaviour change initiatives should continue to be a priority.

10 www.goymp.org

11 www.earthchildinstitute.org/global-action-classroom/

12 <http://youthclimate.org/>

13 http://unfccc.int/cc_inet/cc_inet/youth_portal/items/6578.php

More efforts must be made to ensure that youth are ready to take advantage of new environment-oriented employment opportunities. Growing attention to climate change and sustainable development offers a chance for green economic growth around the world. Green jobs not only provide much-needed employment opportunities for youth, but they also give youth an outlet to contribute directly to

the fight against climate change by adopting green behaviours in the workplace as well as in their private lives.

Tackling climate change requires concerted and co-ordinated government action as well as conscious and informed efforts by individuals. It is therefore essential to strengthen both formal and informal education on climate change and viable lifestyles. In addition, sustainable production

and consumption patterns must be promoted and youth supported as environmental champions in their local communities. Partnerships should be developed between governments and intergovernmental, non-governmental and youth organizations to create joint environmental initiatives aimed at building the capacity of youth as future leaders – and as driving forces behind a new climate change regime.

Supporting resilient global citizenship in a changing climate: Lessons from Norway, Samoa and New Zealand

BRONWYN HAYWARD AND
ELIN SELBOE



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The alarming trajectory of climate impacts raises specific challenges for children and young adolescents. The authors of this chapter report on interviews with four young leaders from Norway, New Zealand and Samoa. These small nations have significantly different greenhouse gas emission profiles and face differing climate change impacts. Discussion in this chapter reflects on the conditions which enhance the resilience of youthful leadership. We highlight the importance of social and economic support for young people as they learn to engage and participate as citizens. The chapter then highlights ways in which non-governmental organizations (NGOs) and governments can support young people to enhance their

capacity to cope as resilient global citizens in a changing climate.

Youth and citizenship in a changing climate

A picture of a child carrying water through an arid landscape adorned the cover of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report on climate change, vividly reminding readers that young citizens are growing up in a world very different from that of their parents and grandparents. It is a world in which half the population are under the age of 25 and many are already disproportionately exposed to the risks associated

with a changing climate.¹ As noted elsewhere in this volume, climate change threatens to undermine children's well-being, particularly the 9 in 10 of the world's young people growing up in 'developing economies' where a changing climate is already disrupting education, and impacting on health, food security and family livelihoods. In some cases even children's cultural heritage is at risk in a changing climate.² The Hyogo Framework for Action, signed by 168 governments, agreed to enhance community

1 Plan International (2010). *Weathering the storm: Adolescent girls and climate change*. Woking, UK: Plan International. Available at: <http://plan-international.org/aboutplan/resources/publications/emergencies/weathering-the-storm-adolescent-girls-and-climate-change/>

2 Ingold, T. and T. Kurttila, 'Perceiving the environment in Finnish Lapland'. *Body and Society*, 6(3–4), 2000, 183–196.

resilience and reduce the vulnerability of citizens in the face of dangerous environmental change.³ Subsequently, the UNICEF Children's Charter of Disaster Risk Reduction has stressed that children's resilience is enhanced under conditions that minimize disruption to schooling, improve child protection, and prioritize access to information and infrastructure that will meet the needs of young people.⁴

Understanding youth resilience

Resilience is a term that is used widely and often uncritically. What do we mean by resilience and how can we better support young citizens' resilience in a changing climate? The Latin root for the term resilience is *salire* – to jump or spring. This idea of resilience as a cross-cultural capacity to bounce back from adversities is reflected in discussion in psychology where, for example, resilient children are described as being "... better equipped to resist stress and adversity, cope with change and uncertainty, and to recover faster and more completely from traumatic events or episodes."⁵

These dominant ideas about resilience have also been influenced by the ecological literature of the 1960s and 1970s, particularly work by Holling,⁶ which implied that "... uncertainty and surprise

is part of the game and you need to be prepared for it and learn to live with it."⁷ This insight from ecological sciences resonates with those who argue that youthful resilience is less about the ability to control life conditions, and more about helping young people as they learn to cope, adapt and manage over time in an unpredictable, dynamic environment.⁸

A focus on resilience can be helpful if it reminds us that young people are not simply victims or dependants. Young citizens can sometimes also exercise very significant 'agency', or the ability to imagine and effect desired change.⁹ For example, informed, educated, well-resourced youth networks can inspire effective resistance to powerful or entrenched interests. However, critical theorists also remind us that we need to attend to the circumstances in which children grow up. Too often, discussions of resilience are silent about the unreasonable risks and threats that young people are exposed to, or the way that policy actions (or inactions) can exacerbate dangerous environmental change, by undermining the conditions and resources that are vital to supporting youthful resilience.¹⁰

Reflections on youth resilience too frequently focus on cultivating personal qualities such as an individual's perseverance and

confidence as sources of strength in challenging circumstances. While individuals can make a significant impact, addressing climate change requires more than personal qualities such as confidence. Successful resilience also requires access to social resources and skills needed to challenge formidable vested interests including, for example, mining companies and financial agencies that benefit from carbon emissions.¹¹ To be effective in these situations, resilient citizens will also need the opportunity of an education and community support as they learn to reason about and resist everyday injustice, or respond to needs in their community or in distant places. This perspective of resilience is much wider than understanding an individual's capacity to cope.¹² It reminds us that effective resilience is forged in the social relationships and economic and cultural conditions that enable young citizens to make a difference, provided that they have the appropriate support and resources to develop their skills and capacity for citizenship.

Learning from resilient global youth leaders

To illustrate the range of resources and support needed for resilient global citizenship, we report on interviews with

3 United Nations Office for Disaster Risk Reduction (2005): *Hyogo Framework for Action*. Geneva: UNISDR. Available at: www.unisdr.org/we/coordinate/hfa

4 UNICEF (2011). *Children's Charter of Disaster Risk Reduction*. New York: UNICEF.

5 Newman, T., and S. Blackburn (2002). *Transitions in the lives of children and young people: Resilience factors*. Interchange 78. Edinburgh: The Scottish Government Education Department.

6 Holling, C.S. 'Resilience and stability of ecological systems'. *Annual Review of Ecology and Systematics*, 4(1), 1973, 1–23.

7 Folke, C. 'Resilience: The emergence of a perspective for social-ecological systems analysis'. *Global Environmental Change*, 16(3), 2006, 253–267.

8 Costanza, R., B. S. Low, E. Ostrom and J. Wilson (eds.) (2001). *Institutions, ecosystems, and sustainability*. Boca Raton: Lewis Publishers; Adger, N. 'Social and ecological resilience: Are they related?' *Progress in Human Geography*, 24(3), 2000, 347–364; Goldstein, S. and R. Brooks (2012). *Handbook of resilience in children*. Salt Lake City: Springer.

9 Hayward, B. (2012). *Children, citizenship and environment*. London: Earthscan/Routledge.

10 O'Brien, K., B. Hayward and F. Berkes (2009). 'Rethinking social contracts: Building resilience in a changing climate'. *Ecology and Society*, 14(2): 12. Available at: www.ecologyandsociety.org/vol14/iss2/art12/

11 Barry, J. (2012). *The politics of actually existing unsustainability: Human flourishing in a climate-changed, carbon constrained world*. Oxford: Oxford University Press.

12 Ungar, M., L. Liebenberg, R. Boothroyd et al (2008). 'The study of youth resilience across cultures: Lessons from a pilot study of measurement development'. *Research in Human Development* 5(3): 166–180; Panter-Brick, C. and J. Leckman (2013). 'Editorial commentary: Resilience in child development – interconnected pathways to wellbeing'. *Journal of Child Psychology and Psychiatry*, 54(4): 333–336.

four young community leaders from three small countries, each with contrasting greenhouse gas emission profiles.

In the first case, Norway, young people under 25 make up 31 per cent of the population of 5 million. Norway's greenhouse gas emission profile is estimated at 11.1 kilotonnes (kt) of carbon dioxide equivalent (CO₂ e) per capita, owing largely to contributions from oil and gas extraction, manufacturing industry, mining and transport.¹³ The IPCC suggests that young Norwegians will face variable effects, rising annual temperatures, and milder, more unstable winters.

In the second case, New Zealand's youth make up 36 per cent of the 4.4 million total population. The country's greenhouse gas emission profile is estimated at 17.9 CO₂ e kt per capita, mainly derived from agricultural emissions and transport.¹⁴ New Zealand's young people will experience, amongst other changes, a drier east coast of the South Island, the spread of new diseases and greater coastal erosion associated with more severe storm impacts.¹⁵

By contrast, Samoa, which became independent from New Zealand in 1962, has a population of 194,000, of whom 56 per cent are under the age of 25. Samoa's greenhouse gas emission profile is low, at an estimated 1.96 CO₂ kt per capita, yet its young people will

still face very significant challenges in a changing climate, including rising sea levels, the potential of increasing severity of cyclones, and new diseases.¹⁶

Discussion now turns to the interviews with four young leaders aged between 14 and 27 years. Each has a significant track record in youth organization combating climate or environmental change at local, national and international level and each was asked to reflect briefly on his or her achievements and experience, and the support that they identified which has enabled their resilient, global youth leadership.

Lan Marie Nguyen Berg, 24, Norway. Former leader of the NGO Spire's climate change policy group and co-founder of Klima-Tuvalu information exchange

What is your biggest achievement?

It has been talking to around one thousand Norwegian pupils about climate change and what I experienced working as a youth reporting, blogging from the small island state of Tuvalu. One of my favourite things is to visit schools to engage youth and spark an interest in climate change and the well-being of people elsewhere. If just two pupils in each class get inspired and engage one or two others, who engage others – that's how we create change.

What change or action do you want to see?

I would like to see a mass mobilization of people that can connect

and engage with how we live our lives, more in a pact with nature, recognizing our Earth's limits, and creating a sense of community, so that we can create a safe world for everybody.

How did you get involved in this issue and what sparked your interest?

I learnt a bit through my studies and the media, but it was while I had the opportunity to work as a journalist writing about climate-induced displacement that I became really interested in climate change issues and decided to become a member of the organization Spire. As a representative of Spire in Copenhagen in 2009, I came to understand the depth of the injustice in climate change issues, the implications it will have for development in poor countries, and how our lifestyle and lack of political will influences all this.

What enables young people to achieve change?

They have to believe that they can achieve change. We have to focus on building people up and try to create spaces where young people can find out what they are good at and how they can use that for a cause that they care about. We also need spaces where young people can discuss different views on how to create a better society and a just world.

What barriers make it difficult for young people to engage and make change?

I think the barriers are mostly psychological; most people can effect some change if they really want to. Also, we need to become more inclusive, broadening our view of how we should act for

13 New Zealand Ministry of Business, Innovation and Employment (2011). Greenhouse Gas Inventory. Wellington: Ministry of Business, Innovation and Employment. Available at: <http://www.med.govt.nz/sectors-industries/energy/energy-modelling/data/greenhouse-gas-emissions>

14 Ibid.

15 IPCC (Intergovernmental Panel on Climate Change) (2013). Climate change 2013: The Physical Science Basis. Cambridge: Cambridge University Press. http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

16 Government of Samoa, Ministry of Natural Resources and Environment (2008). *Second National Greenhouse Gas Inventory*. Apia: Government of Samoa. Available at: <http://unfccc.int/resource/docs/natc/samnc2nir.pdf>

making change. If we are more open minded about whom to ally with and what to include in the movement, we will be able to involve more people in various ways.

Eivind Trædal, 27, Norway.

Founder of the journal *Tvergastein*, former local leader in the organization Nature and Youth, editor of the environmental lifestyle magazine *Putsj* and author of the *Activist Handbook*.

What is your biggest achievement?

Taking part in a summer camp with Nature and Youth (N&Y) in Lofoten in 2009 was very important and a lot of fun. It was a great experience and, shortly after, the Norwegian parliament resolved that Lofoten would not be opened for oil extraction during that parliamentary period, which was a huge victory. I also wrote the *Activist Handbook* for N&Y, as I think educational material is very important, and this book turned out to be fun and informative.

What change or action do you want to see?

I would love to see the environmental movement manage to downscale climate change to local, tangible and understandable issues that are visible for youth.

How did you get involved in this issue and what sparked your interest?

The environmental bug in the early 1990s 'bit' me and my friends, as we learnt about it in school and created our own small club picking

up rubbish and drawing how we wanted the future to include flying hot-air balloons and fewer cars. It really started when I joined N&Y's summer camp at the age of 14. My parents spoke about it and encouraged me, and I went there with some friends. It was fun, social and political.

In your view, what enables young people to achieve change?

Participation in local branches of organizations like N&Y, working with concrete issues that are exciting and engaging. Climate problems are massive and intangible, so people need to see that it is possible to work with these issues in your local community.

What barriers make it difficult for young people to engage and make effective changes?

There is the classic barrier of not being taken seriously due to your status as youth. Also, it is quite challenging to have your own opinion and to stand up for what you believe in. The class gap in the environmental movement might be another barrier: it is mostly youth from homes with books and 'active' parents that feel confident to join in; those with high cultural capital.

Sam Johnston, 24, New Zealand.

Initiator of the New Zealand Student Volunteer Army and named Young New Zealander of the Year 2012

What is your biggest achievement?

Following the devastating Christchurch earthquakes of 2010 and 2011, I started a Facebook

page with some friends to mobilize my local student community to help clean up the city. Named the Student Volunteer Army, we were able to mobilize, organize and coordinate over 11,000 students in Christchurch to support local residents, clearing silt from their yards and homes, and delivering food, water and information in partnership with central government and local residents. The response has changed the view of students in New Zealand, and gave many people confidence in young people's ability to self-organize for the good of the community, and join together following a disaster. Our team developed this concept into a charitable trust that now focuses on disaster preparedness in a changing world, youth engagement and volunteer service.

What change or action do you want to see?

Our work focuses on three areas. We are establishing a series of student service clubs throughout New Zealand universities and schools to help integrate service learning as a core part of education. We also want to see young people able to play a greater role in disaster preparedness, being agents of change and building resilience in their communities in collaboration with international humanitarian aid organizations. Finally, we want to help young people rethink the value of their time as volunteers. Working with RockCorps, for example, we have organized events where you 'earn' a ticket to a concert through volunteering help in your community, not by paying money.

How did you get involved in this issue and what sparked your interest?

As a young Kiwi I see a world full of opportunity. I find people are always willing to help bring positive change and genuinely want to be involved in the social projects I work on. My particular interest is in disaster preparedness. My interest in how we build communities that have the resilience to recover from a disaster came from the earthquakes in Christchurch and from seeing that young people have an incredible ability to build resilience and create magic in their communities. I love being able to share and help people recreate the magic that I have seen in my home town in other places, including Japan, where we worked after their disasters.

What enables young people to achieve change?

Giving us space to think and build confidence in our thinking. I excel when surrounded by mentors who continually challenge and stretch my thinking, when not being overwhelmed with activities and demands on my time, and when I am able to easily work and spend unstructured time with like-minded people.

What barriers make it difficult for young people to engage and make change?

Low self-confidence and a risk-averse society that does not encourage mistake-based learning make it hard for some to take the first step and put their ideas on the table.

Brianna Fruean, 14, Samoa.
Youth climate activist and Samoan Youth Ambassador

What would you say is your biggest achievement?

I have been raising awareness about environmental issues in Samoa and, in 2011, I organized a Moving Planet Samoa walk for more than 100 people that had a wide effect in spreading awareness on climate change in my community. Afterwards I got a special recognition award at the Samoan youth awards. I was very humbled to have been seen as a Samoan Youth Ambassador. This recognition really summed up all I've overcome and achieved over the past years.

What change or action do you want to see?

A new generation of passionate young people who know their worth, as well as our older generation seeing us as assets, not liabilities. I want to see a movement of youth who show interest in the issues their countries are facing.

How did you get involved in this issue and what sparked your interest?

When I first heard about climate change, through my family and teacher, I was very young, and as a little girl I couldn't understand why we as humans were doing this to our own planet. I decided I was going to do whatever I could to help out, so I started a school environmental group and it grew.

What enables young people to achieve change?

I think seeing other people their own age already achieving change. Sometimes your best teachers are your peers because it's easier to listen to people whom you can relate to. I have also worked with groups like Powershift and spoken in other countries.

What barriers make it difficult for young people to engage and make change?

I think it's the box we tend to put ourselves in, thinking "we are too young to do this", "we are too inexperienced to do that" or "it's not my job to think about that yet". Young people need to know how important their role and voice are in the world today. I think once all young people can get out of their own boxes, it will make it much easier for them to start a movement and make the changes they want to see.

Reflecting on the insights of youth leaders

The perspectives of these four highly effective global youth leaders raise some important issues about how we can support resilient youth citizenship. Each of them has remarkable personal qualities, including charisma, organization, excellent communication skills and the ability to inspire others to take action. These personal qualities were augmented by education and access to media, including social media. Globally, many young people have access to smartphones, for example, but it is these tools – combined with resources and conditions of education, some

financial support and personal networks – that help to empower youthful citizens. Moreover, as each young leader reminds us here, social conditions also matter. These leaders each mention significant supportive adults in their formative years as well as organizations that offered additional peer support and mentoring. In addition, the work of these young leaders was magnified by other structural conditions, such as governmental initiatives and policies enabling youth participation and access to decision-making spaces, including delegations sent to global networking meetings.

Supporting youth resilience in a changing climate is challenging. Many young people feel the responsibility to act to improve the lot of others. Yet not every citizen has equal access to resources and social conditions which enable their voices to be heard effectively. Citizens in wealthy societies are often able to define ‘the problem’ and propose solutions. This is both encouraging and problematic, particularly if it displaces the concerns and priorities of local communities in other countries. In this context, the reflections of the young citizens here remind us that in developed economies effective leaders need more than empathy – they need opportunities to learn to address systemic injustice. For example, both Lan Marie Nguyen Berg and Brianna Fruean commented that their engagement with NGOs and larger forums of young citizens provided important opportunities to interact and better understand the views of other global citizens who were more distant.

However, there are important limits to youthful resilience. Global conditions of high youth

unemployment and precarious work bring additional stress which has the potential to undermine the skills and capacity of many young citizens who are already struggling with the problems of a changing climate. To cope effectively with ongoing or chronic stressors associated with climate change, young citizens will also need access to quality education and secure employment. In challenging local conditions, social ties within and beyond the local community to which young people can turn for emotional support also matter.¹⁷

Summary: skills and capabilities of resilient citizenship in a changing climate

Reflecting on the interviews above and our wider research,¹⁸ we argue that the capacity for youthful resilience in a changing climate is most effectively supported when adults supporting young people think about adolescent resilience as the outcome of positive interactions and enabling social conditions experienced in everyday life. While each of the individuals interviewed here had personal qualities which made them exceptional and highly efficacious leaders, the skills required for effective resilience are also enhanced when these qualities are nurtured and given wider support by family, community and

organizations through access to education and employment. The impact of youth engagement and leadership is further magnified when their voices are connected, and heard in national and inter-governmental forums, as well as in the media.

Faced with the significant challenges of a changing climate, all young citizens will benefit from being mentored by competent, experienced peers or adults. They need opportunities to share ideas, make mistakes, and communicate with others to build social networks of trusting relationships in communities where decision-making is inclusive and transparent. Governments can further assist this by ensuring that there are multiple opportunities for youth representation and inclusion in a variety of decision-making ‘spaces’ from the local to the international level.

The experience of the young leaders interviewed here also resonates with a SEEDS model of citizenship which we advocate, where young people learn effective citizenship through opportunities to experience *social agency* – imagining and effecting desired change through collective action in school and wider communities.¹⁹ Furthermore, each young leader commented on the importance of opportunities for formal and informal *environmental education* and learning about *embedded justice*. For example, these young leaders independently commented on the value of NGOs contributing to their own awareness-raising and deeper understanding of everyday injustice or ways to put right a

17 Bagshaw, S. (2011). *Improving the transition: Reducing social and psychological morbidity during adolescence*. Report from the Prime Minister's Chief Science Advisor. Wellington: Office of the Prime Minister's Science Advisory Committee, 79–87. Available at: www.pmcsa.org.nz/wp-content/uploads/Improving-the-Transition-report.pdf

18 Selboe, E. (2010). ‘Youth and social change in Dakar, Senegal: Intergenerational differences and power battles in local mosques’. *Forum for Development Studies*, 37(3), s 365–383; Hayward, op. cit.

19 Hayward (2012), op. cit.

wrong. In addition, each of these remarkable young leaders appears to have consciously *decentred* their *deliberation*: by this, we mean that each one was able to connect their stories and experiences to the lives and experiences of others in other places. Finally, the young citizens learned global

awareness through opportunities for *self-transcendence* – the chance to identify with the needs of others, and to contribute to events and issues that are ‘bigger than self’, but improved because of their contribution.

In summary, while these four young citizens demonstrate

remarkable personal leadership qualities, their reflections and experience also remind us that to create a more just and sustainable future, we must invest in and maintain the wider social, political and economic conditions that enable the resilience of each new generation.

Climate change activism and youth

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Both internationally and in the United States, a small youth climate movement has growing momentum and is engaged in wide-ranging activities. A group of teenagers in Alaska presents a climate trust initiative to the Alaskan Supreme Court for hundreds of other teenagers to hear. A quarter of a million high-school students across the United States *do one thing* to mitigate climate change following a climate science presentation. Youth from over 50 countries attend United Nations-sponsored climate conferences, bring a youth voice to the meetings, and return home to create programmes to reduce and adapt to climate change.

There are many more examples of young people speaking out about climate change. They

advocate for immediate aggressive action to reduce the threat, and express their desire to be heard. To date, however, these voices have not been coordinated into a global chorus, and a great many young voices are missing – young people who will be affected by climate change, but are either unaware of its threat or feel helpless to do something about it. Here we outline a systematic approach to supporting the development of youth climate-activism efforts in a community, region or nation – using the United States as our example – and describe how these efforts can be linked across geographic boundaries as a strategy for building a global youth movement. The approach involves a combination of interventions and adult-mentored programmes to

educate young people, and build their skills and opinion leadership.

We begin this discussion with the recognition that global climate change is no longer a distant threat: close to a thousand children are estimated to die each day owing, in part, to its effects on food production and communicable diseases, and annual costs to the global economy have been estimated at \$1.2 trillion.¹ Extreme weather events in 2012 touched every part of the globe; 2012 was the hottest year in recorded United States history and the wettest in the United Kingdom.² Unmitigated,

1 DARA (2013). *Climate vulnerability monitor: A guide to the cold calculus of a hot planet*. Madrid: DARA. Available at: <http://daraint.org/wp-content/uploads/2012/09/CVM2ndEd-FrontMatter.pdf>

2 World Resources Institute (2013). *Timeline: Extreme weather events in 2012*. Available at: <http://insights.wri.org/news/2012/09/timeline-extreme-weather-events-2012>

Table 1: Teenage climate change publics, 2010

| | Alarmed | Concerned | Cautious | Disengaged | Doubtful | Dismissive | Population |
|-----------|---------|-----------|----------|------------|----------|------------|------------|
| Teenagers | 6.7% | 32.3% | 26.1% | 12.8% | 12.7% | 9.6% | 1,004 |

Source: Yale, 2010; Yale/George Mason, 2010

climate change impacts will multiply, and the burden will fall most heavily on the poorest nations and the most vulnerable individuals, most often children. Of the 2.2 billion children and youth in the world, 85 per cent live in developing countries.³

Although young people cannot vote, they are stakeholders who could provide a powerful moral voice, arguing for immediate action to reduce emissions, and awakening their parents' generation to the threats that high-consuming lifestyles and fossil fuel use represent to the lives of their children.

Below, we use data from the United States to illustrate a strategy for increasing youth issue engagement, and fostering the skills that they will need to become effective advocates; we then present a selected set of current youth programmes – as exemplars – that appear well positioned to engage young people more deeply depending on their current level of involvement in the issue.

Climate change issue engagement among youth in the United States

National surveys have found that adolescents' beliefs and attitudes about climate change range across the same continuum identified in

research with American adults: both may be classified into one of six distinct publics within *Global Warming's Six Americas*.⁴ Individuals within each of these six groups share similar beliefs about climate change, are similarly concerned or unconcerned about the threat, and support or oppose national and international action to reduce it.

In 2010, nationally representative surveys found that 6.7 per cent of teens in the United States belonged to the *Alarmed* segment; this group are highly concerned about climate change, and view it as harmful, human-caused and solvable (see Table 1). Another 9.6 per cent are *Dismissive* – convinced that climate change is not real or a cause for concern, and likely to believe it is a scientific hoax.

Between these two extremes lie four groups that are less engaged with the issue and uncertain about the reality, dangers and causes of climate change. More than 80 per cent of United States teenagers belong to these four groups:

- The *Concerned* (32.3 per cent) hold views similar to the *Alarmed*, but do not view the threat as imminent, and are

somewhat less engaged or motivated to take effortful forms of action.

- The *Cautious* (26.1 per cent) are inclined to believe that climate change is real, but do not view it as threatening or personally relevant, and are uncertain about its causes or potential for reduction.
- The *Disengaged* (12.8 per cent) have given the issue no thought whatsoever. They know little to nothing about climate change, and many come from families with lower socio-economic status – hence, they are likely to face other threats that are more immediate than climate change.
- The *Doubtful* (12.7 per cent) are uncertain about the reality of climate change, but believe that if it is happening, it has natural causes; they are pessimistic about its potential for reduction.⁵

Characteristics of the six groups of teenagers are shown in Table 2. The data show that teenagers in the more engaged segments – the *Alarmed* and *Concerned* – are much more likely to understand the reality and

3 Food and Agriculture Organization of the United Nations: Available at: www.fao.org/climatechange/youth/en/

4 Maibach, E., A. Leiserowitz, C. Roser-Renouf, and C. K. Mertz (2011). Identifying like-minded audiences for climate change public engagement campaigns: An audience segmentation analysis and tool development. *PLoS ONE*, 6(3): e17571. doi:10.1371/journal.pone.0017571; Leiserowitz, A., N. Smith and J. R. Marlon (2011) *American teens' knowledge of climate change*. Yale University. New Haven, CT: Yale Project on Climate Change Communication. Available at: <http://environment.yale.edu/climate-communication/article/american-teens-knowledge-of-climate-change>

5 The segments identified in the United States are not necessarily transferable to other countries – particularly to developing nations. A segmentation of adults in India, which used similar questions to those used in the United States segmentation, identified very different groups, including the *Experienced* (24%), a group that is not well informed about climate change, but is convinced that it is happening, in part because they have personally experienced its impacts; this is the largest audience segment in India (see Leiserowitz, A., J. Thaker, G. Feinberg and D. Cooper (2013). *Global Warming's Six Indias*. Yale University, New Haven, CT: Yale Project on Climate Change Communication).

Table 2: American teenagers' climate-related beliefs, feelings and actions, by 'Six Americas' segment

| | | Alarmed (percentage) | Concerned (percentage) | Cautious (percentage) | Disengaged (percentage) | Doubtful (percentage) | Dismissive (percentage) | Population (percentage) |
|-------------------|--|-------------------------|---------------------------|--------------------------|----------------------------|--------------------------|----------------------------|----------------------------|
| Beliefs | Global warming is happening | 96 | 82 | 59 | 19 | 13 | 9 | 52 |
| | Humans cause global warming | 75 | 79 | 60 | 39 | 13 | 5 | 53 |
| | US is being harmed now | 50 | 46 | 15 | 18 | 0 | 0 | 24 |
| | Very/extremely important to me | 88 | 23 | 1 | 1 | 4 | 25 | 13 |
| Emotions | Very afraid | 54 | 19 | 5 | 8 | 4 | 0 | 12 |
| | Very hopeful | 39 | 16 | 14 | 16 | 4 | 4 | 14 |
| | Very angry | 38 | 18 | 8 | 9 | 0 | 9 | 12 |
| | Very helpless | 28 | 12 | 14 | 4 | 6 | 0 | 10 |
| Behaviours | Recycle everything ^a | 58 | 37 | 12 | 23 | 10 | 18 | 24 |
| | Turn off electronics not in use ^a | 44 | 30 | 14 | 19 | 11 | 25 | 22 |
| | Walk or bike, instead of drive ^a | 36 | 21 | 23 | 22 | 10 | 29 | 22 |
| | Boycott companies ^b | 79 | 17 | 15 | 4 | 2 | 6 | 15 |

^a Teenager reports 'always' performing this action.

^b Punished companies that are opposing steps to reduce global warming by *not* buying their products one or more times.

danger of climate change, and to have stronger feelings about it – worry, fear, anger and helplessness, but also hope. They are more likely to engage in a number of conservation behaviours and in consumer activism, although they do not differ from the less engaged segments on a number of behaviours not shown here, including use of public transportation, water conservation and trash reduction.

Comparisons of United States adolescents with adults find lower issue engagement among adolescents, in spite of the fact that, as the climate continues to change, the threats that they face will be greater. At the time

of these surveys, smaller proportions of teenagers than adults were *Alarmed* and *Dismissive*, and a larger proportion were *Disengaged*; in other words, teenagers were less likely than adults to have recognized the importance of the issue, but they were also less likely to have formed a firm opinion that climate change is not real. They did not see themselves as more vulnerable to harm from climate change than their parents believed themselves to be, and thought that the impacts of climate change on the United States will begin further in the future than their parents did. We conclude from this that concern and issue

engagement among United States teenagers is not as high as the severity of the threat merits (this is true of adults as well, but even more true of teenagers).

Engaging adolescents in the issue could occur in any of multiple arenas – online, at school, with peers, via the mass media, through targeted interventions, or within their families. We know that family influence is strong on this issue: parents' and children's beliefs are similar, both parents and teenagers engage in more climate-friendly behaviours if they talk more frequently about global warming and energy conservation; and parental influence on their children's

conservation behaviours has been demonstrated in multiple studies.⁶

In just over a quarter of United States families (28 per cent), both the parent and adolescent belong to the two most pro-action segments – the *Alarmed* and *Concerned*. Teenagers in these families are likely to be responsive to programmes aimed at increasing their activism, and interventions aimed at either parents or teenagers may well reach both. We don't know, however, how many of these families are already engaging in climate activism: data on climate-related political activities of United States teenagers are scarce, but surveys of adults show that about 8 per cent of American adults advocate for mitigation policies with their elected representatives (the vast majority of them belong to the *Alarmed* segment), and about 15 per cent support environmental groups with donations or by volunteering. Undoubtedly the proportion of youth activists is small, but could be increased.

Translating 'Six Americas' segments into youth climate change activism

To build a youth climate movement, we provide different roles for different teenage segments (see Figure 1). Many of the *Alarmed* are ready to act as leaders on the issue, generating projects, influencing their peers through opinion leadership and modelling climate-friendly behaviours for others. The *Concerned* may not be ready to lead, but they are eager

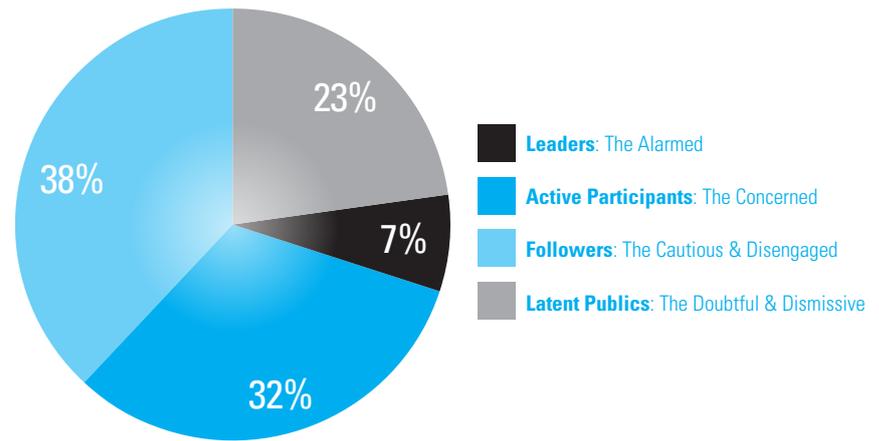


Figure 1: United States teenagers' projected engagement in climate change activities

to participate, and will take action if shown what they can do that will make a difference. Youth in these two segments with parents in similar segments have the highest potential to act as climate leaders, and many are probably already doing so. Those with parents who are less concerned are still likely candidates for becoming involved, given appropriate opportunities to engage, but they may require more mentorship and adult support.

The *Cautious* and *Disengaged* are not yet ready to take action, but with education on the issue and attractive peer models to follow, they could be enticed to become involved. If their parents are *Alarmed* or *Concerned*, encouragement at home could help them to become more actively engaged, but those with parents in the other four segments will need more support from peers and adult mentorship. Programmes for these groups should offer easy access with low entry barriers, for example school initiatives or youth-serving organizations such as 4-H programmes.⁷

With time, education, and increases in both skills and opinion leadership, many of the *Concerned* could move to the *Alarmed* segment and become Leaders, and many of the Followers in the *Cautious* and *Disengaged* groups could become Active Participants. Some in the Latent Public (the group that doesn't recognize the problem, in other words the *Doubtful* and *Dismissive*) might move towards becoming Followers, but the more likely path for this group is that their behaviours will become more sustainable as social norms change, and that this will occur regardless of changes in their beliefs and attitudes.

We believe that youth can be moved towards the more concerned segments by creating or expanding interventions and programmes that vary in their commitment of time and energy, their opportunities for collaboration or independent action, and their level of mentorship by adults. Taking this population approach to youth engagement – that is, providing programmes that meet differing needs and skill-sets – has the potential to yield large shifts in whole populations.

Although this framework is largely speculative, we know that engagement and participation can be increased through educational

6 E.g. Gronhoj, A. and J. Thogerson (2012). 'Actions speak louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviors'. *Journal of Economic Psychology*, 33, 292–302.

7 4-H United States youth organization: the 4-H name stands for four personal development areas: head, heart, hands, and health.

interventions. An evaluation of an entertainment-education programme in 49 high schools found that, following a one-hour presentation on climate change, 38 per cent of youth shifted to more engaged segments, and students in just over half the schools created 'action teams' to initiate and execute mitigation projects.⁸

Below we describe a select sample of climate-action programmes that vary in the extent to which they have the potential to engage the differing segments of youth.

Programmes well positioned to engage potential leaders

- *Our Children's Trust* (www.ourchildrenstrust.org). In October 2013, a group of Alaskan youth brought their case for science-based climate protection before the Alaskan Supreme Court at an Alaskan high school as part of the Court's educational outreach. This unique programme is part of the Atmosphere as Public Trust Initiative, which is initiating legal action in all 50 US states, the federal government and three other countries. In addition, the Trust films documentaries of youth testimonials (produced by partners WITNESS and iMatter campaign), has sponsored letter-writing contests, and is supported by multiple online social media venues.
- *350.org*. Working in 188 countries, the organization has multiple campaigns with adults and youth to promote the move

to renewable energy sources and away from fossil fuels. It has organized over 20,000 climate demonstrations in over 182 countries. Of relevance here is the organization's youth movement on college campuses in the United States to press their universities and communities to divest from fossil fuels; to date, the campaign has spread to more than 300 colleges and over 100 cities, states and religious institutions. Fifteen cities and six colleges have agreed to divest, and the movement continues to grow.

- *United Nations Joint Framework on Children, Youth and Climate Change (UNFCCC), Youth Non-Governmental Organization (YOUNGO)* (www.youthclimate.org). In 2009 the UNFCCC Secretariat extended constituency status to youth non-governmental organizations (NGOs) allowing them to receive official information, participate in meetings, request speaking slots and receive official logistical support at conferences. Titled YOUNGO, there are now over 2,000 individual and youth organization members around the world. NGO members work with youth to generate a wide array of adaptation and mitigation programmes such as Sandwatch, a network of children, youth and adults in 50 countries to monitor changes in their beach environment (www.unesco.org/new/en/natural-sciences/priority-areas/sids/sandwatch/).
- *The Young Masters Programme on Sustainable Development (YMP)* (www.goymp.org) developed by the Swedish International Institute of

Industrial Environment Economics at Lund University, is a free, web-based education and learning programme, with more than 25,000 teenagers from over 100 countries having participated since 1999. These web-based classrooms have students from different countries read and carry out assignments and discuss their results.

Programme well positioned to engage willing participants

- *Alliance for Climate Education (ACE)* (www.acespace.org). ACE, a multi-faceted programme allowing multiple levels of youth engagement, has reached over 1.5 million high-school students since 2008 with an entertainment-education assembly. It has motivated over a quarter of a million youth to *do one thing* about climate change; over half of the schools served have active 'green teams' and there are now more than 1,000 of these, with 40,000 student members, participating in the completion of one or more climate change projects. ACE has also trained almost 3,000 high-school students to be climate change leaders since 2009, and moved over a third of its audience to a more concerned audience segment.

Programme well positioned to engage potential followers

- *4-H* (www.4-h.org). 4-H reaches 7 million young people and is found in more than 70 countries. 4-H is uniquely situated to bridge communities, regions and

⁸ Flora, J., M. Saphir, C. Roser-Renouf et al. (under review). *Evaluation of a national high school entertainment education programme: The Alliance for Climate Education*. September 2013, communication with Alliance for Climate Education staff.

countries with a 100-year history of agricultural and economic development. 4-H membership offers engagement opportunities in climate and related science projects. Supported by adult leaders and with the structure of a large organization, 4-H projects develop youth responsibility in science such as California 4-Hers teaching restaurant owners how they can ‘take a bite out of plastic pollution’, or Michigan youth turning their schools’ used cooking oil into bio-diesel fuel for school buses and farm equipment.

Studies find that participation in extracurricular activities such as the above programmes builds political engagement that carries on into adulthood.⁹ And if communities provided a range of programmes such as these, young people from different segments could find activities that fit their current skills and interests, and that would offer opportunities for growth in engagement.

The final step in building a global youth movement would require cross-community and cross-national coordination among organizations. Online civic engagement would be key: crowd-sourced fundraising, social media communications, online petitions, massive online learning courses, video posts, and discussion forums devoted to climate issues. These types of activities already exist, are expanding, and are associated with the same motivational factors as offline activities: a recent study of German youth and young adults found that online civic engagement occurred at rates similar to offline engagement and was related to personal motivation and collective efficacy.¹⁰

Not every community, region or country will have ready access to the types of programmes described above. Further, interventions to engage youth in other nations will face different challenges in building a youth movement – resources, awareness and perceived threat

can be expected to vary widely. Nonetheless, the basic framework we have outlined here – education, leading to group participation, which builds issue engagement, skills and opinion leadership, thereby fostering more committed action – is likely to be effective in many contexts.

Ultimately, cross-national cooperation and a global youth movement to protect the climate could have synergistic effects. On a national scale, we have a successful example of this type of bridging: environmental organizations in the United States have coordinated their activist activities in opposition to the building of the Keystone XL pipeline, which would bring tar-sands oil from Alberta, Canada to the Gulf Coast. To date, the pipeline has not been approved, and its rejection now seems possible – a dramatic change from the situation just a year ago.

In today’s online, interconnected world, a global movement of youth is both possible and achievable. We need their voices, speaking together with a common message: *Protect my Future.*

9 Glanville, J. (1999). Political socialization or selection? Adolescent extracurricular activity and political engagement in early adulthood. *Journal of Social Issues*, 80(2), 279–290.

10 Jugert, P., K. Eckstein, P. Noack et al. (2013). ‘Offline and online civic engagement among adolescents and young adults from three ethnic groups’. *Journal of Youth and Adolescence*, 42, 123–145. Doi 10.1007/s10964.

Beyond projects: Involving children in community governance as a fundamental strategy for facing climate change

ROGER HART, SCOTT FISHER
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Since the emergence of an international environmental movement in the 1970s, millions of children all over the world have been involved in projects to protect or improve the environment. These projects have been invaluable in giving children opportunities to play a role in caring for the environment and their communities. But these opportunities have typically involved children in short-term projects to address particular issues. This chapter argues that we now need to go beyond this idea and to find ways to enable children to have a deeper and more long-term engagement with their community and local environment as a means of preparing them, and their communities, to respond flexibly to a changing and uncertain world.

Climate change is expected to bring dramatic changes to the environment and to be the cause of an increased rate of natural disasters to human communities in the coming decades. Community-based approaches to sustainable development, which create healthy and resilient ecosystems, are essential; so too are adaptation to and mitigation of climate change. Children have both the rights and the capacities to play meaningful roles in these efforts. We argue in this chapter that involving children broadly in community governance – including caring for, improving, monitoring and making decisions about their local environment and community – will better prepare them to act with flexibility and competence in the face of change.

The fundamental importance of community governance

We agree with the original UN Agenda 21 proposal, that planning by local governments is an essential part of sustainable development. Likewise, it is a fundamental component of preparation for, protection from and adaptation to climate change. But the most realistic opportunity for the broad-based involvement of citizens is not in local government decision-making, but in the activities of community governance – the most participatory level of engagement.

All over the world, people come together to manage their lives in groups with different types of structures and processes. Groups of women transforming housing

and sanitation in the slum communities of Mumbai; residents of the barangays of the Philippines regularly monitoring the environment and health of their communities; women in neighbourhood housing clusters in Tokyo working to create open space for play opportunities for their children: these are all examples of the kinds of informal community-based groups that carry out community *governance* below the level of local *government*. Community governance involves all the processes by which a community manages itself, including reflecting, assessing, planning, deciding, acting and monitoring. In many parts of the world where there is little or no local government planning or provision of services, governance by community-based organizations is essential because it is often the only strategy available to poor and marginalized communities that lack public services. We have learned from recent research on comparisons of approaches to urban poverty in the Global South that community-based approaches have been the most effective in helping to reduce urban poverty, but these need to be supported by, and coordinated with, local governments.¹ In wealthier parts of the world, strong communication between local government and civil society should also be basic to establishing sustainable development and for planning and adapting to climate change, but unfortunately it is rare for local governments to have good systems of liaison and coordination with institutions of community governance.

One key argument for community-based approaches to

sustainable development and planning for climate change is the importance of local knowledge of the environment and community uses of the environment. Public participation at the community level allows for this knowledge to be incorporated into the planning of protective ecosystems and social institutions in preparation for disasters and mitigation efforts. This is extremely valuable for strengthening the capacities of communities to be prepared for change, but it is also important for this local knowledge to contribute to municipal, regional and national scales of analysis, planning and action.

Why children should be involved

Our primary argument in this chapter is that building the capacities of children to be involved in the governance of the everyday settings of their lives is the deepest and most effective strategy for preparing them, and society, to face the challenges of the increasing rate of change in the world. We use the term ‘children’ in this chapter following its usage in the UN Convention on the Rights of the Child (CRC), referring to all young people up to 18 years of age, even though we recognize that this overlaps with those who are commonly called ‘youth’. Children as young as 3 years of age begin to learn to manage their activities cooperatively when supported to do so.² Such opportunities for building the capacities of citizenship and governance should extend through all of the institutional settings of children’s lives.

Many will argue that our focus should be on protecting children from the challenges and disasters of climate change rather than involving them in dealing with a problem that they did not create. But protecting children and enabling them to take action are not entirely separate. In recent years, the international development community has learned from a great many examples of children living in settings with high levels of violence, or experiencing natural disasters. Being able to take action through playing a meaningful role in the face of adversity can often offer a kind of *psychological protection* by helping children to feel more in control, more hopeful and more resilient.³

In addition to the benefits of community participation for an individual child’s resilience in the face of disaster, children can play a valuable role in creating more *resilient communities*.⁴ We agree with those who call for children to be educated about issues of sustainable development and climate change, but building the capacities of children to act with one another in cooperative, creative and flexible ways to face adversity and uncertainty is also important for the creation of community resilience.

Fundamentally, the CRC recognizes children as citizens with the right to be heard regarding matters that affect them. This has influenced how some nations involve children in community issues. On a practical level, children can play valuable roles by participating in community preparation for climate change – in community-based mitigation efforts, community disaster

1 Mitlin, D. and D. Satterthwaite (2013). *Urban poverty in the Global South: Scale and nature*. London: Routledge.

2 Hart, R., C. Daiute, S. Iltus et al. (1997). Developmental theory and children’s participation in community organizations. *Social Justice*, 24(69), 33–63.

3 UNICEF (2007). *The participation of children and young people in emergencies: A guide for relief agencies*. Bangkok: UNICEF.

4 Plan International (2010). *Child-centred Disaster Risk Reduction*. London: Plan International.

risk reduction and community rebuilding. We should also recognize the intergenerational learning benefits of children's participation in community governance. The increased rate of change in environmental conditions should lead us to rethink our perspectives on how knowledge is reproduced, and transformed, from one generation to the next. With an increasing rate of change in the landscape of environmental and social conditions in the world, we can no longer afford to wait until children are in their mature adult years before they are involved in finding solutions and taking action. We need to release children's creativity at an early age to join with older generations in order to face the new challenges around them with new kinds of solutions.

How children should be involved

We have had calls for fostering global kinds of citizenship in childhood before, usually devoted to the pursuit of peace between nations, but this is the first time in human history that a global threat has been shared by all of the world's population. It calls for a vision of citizenship that is truly both local and global. The famous environmental dictum of the 1970s was for citizens to 'think globally, act locally', but if we are to have an effective strategy for public engagement in environmental and community management and resilience, we should enable children to 'think and act, both locally and globally'. With greater possibilities for connections between children in communities of different cultures and environments, there are also more opportunities for children to think and act globally through the sharing of work

done in their communities, and through coordinated international actions. Networking among groups of children can encourage their sense of agency by making them feel a part of a larger movement of children for change.⁵ It also has the potential to foster critical thinking about the relationship of their community with other communities and national, regional and international institutions. Children's participation in community governance is a key way for them collectively to 'think and act, both locally and globally'.

In recent years there have also been many experiments around the world with children participating on local government councils. Some of these initiatives have been very large, involving hundreds of municipal children's councils, such as those in the Dominican Republic, Italy and the UK.⁶ There have been few evaluations of the impacts of these councils on community decisions, but in most cases they seem to have had relatively little impact on municipal decisions.⁷ They commonly involve very small numbers of children as representatives, often presenting their own personal perspectives, and it is not surprising that they are not taken very seriously. In order for such councils to be an authentic route for children's participation, they need to be clearly connected to broadly inclusive forms of direct

participation by their peers in the community.

There are multiple examples from around the world of children critically engaged in the full process of community action research on the environmental conditions in their communities, including planning, action, evaluation and advocacy.⁸ However, the more common model of children's participation in community governance is including children in taking action on problems in their daily environment that have been identified by separate adult structures of community governance. We argue that more sustained engagement in all aspects of community governance should be the more fundamental strategy. By allowing children's ongoing critical engagement as observers of their local environment and community, we place them in a stronger, more sustained position to cooperate with each other and with adult members of their community, including those in positions of power. We know that, when children are enabled to investigate the qualities of their physical environment, they become deeply involved. Furthermore, they typically identify the same issues that are important in reducing the risks from disasters that we can expect with climate change, such as poor drainage and sanitation, and contamination from solid waste.⁹ The resulting greater health of the ecosystem and the increased resilience of their community to face dramatic changes are natural

5 Seballos, F. and T. Tanner (2011). *Enabling child-centred agency in disaster risk reduction*. London: Institute of Development Studies.

6 Examples include the Dominican Republic and Italy: www.unicef.org/republicadominicana/english/advocacy_partnerships_12453.htm; UNICEF (2005). *Cities with children: Child friendly cities in Italy*. Florence: UNICEF Innocenti Research Centre.

7 See: 'Children and governance', *Children, Youth and Environments*, 15(2), 2005; Bartlett, S. (2005). 'Integrating children's rights into municipal action: A review of progress and lessons learned'. *Children, Youth and Environments*, 15(2) 18–40; Matthews, H. (2001). 'Citizenship, youth councils and young people's participation'. *Journal of Youth Studies*, 4(3), 2001, 299–318.

8 Hart, R. (1997). *Children's participation: Theory and practice of involving young citizens in community development and environmental care*. London: Earthscan; Hayward, B. (2012). *Children, citizenship and environment*. New York: Earthscan/Routledge.

9 Chawla, L. (2002). *Growing up in an urbanizing world*. London: Earthscan; Bartlett, S. (2008). 'Climate change and urban children: Impacts and implications for adaptation in low- and middle-income countries'. *Environment and Urbanization*, 20, 501–519; Seballos, F. and T. Tanner, op. cit.

outcomes of this sustained active engagement with their local ecosystem and community.

Sadly, in many communities there is little environmental planning and decision-making by local government agencies, and it is rare for officials to coordinate with children's efforts in a serious manner. There are, however, a few inspirational examples of this in different parts of the world that show what is possible.¹⁰ In the Philippines, a nation at great risk from natural disasters, children have been participating in risk assessment and planning.¹¹ Barangays, the most community-based level of governance, commonly involve children in the regular community monitoring of health and environmental conditions. They also often include children representing the perspectives of their peers at municipal council meetings.¹²

In addition to involving children in these specific kinds of community and local environmental issues, it is also important to envision how different initiatives may lend themselves to addressing climate change issues as they arise. The Rockaway Youth Task Force (RYTF), a youth-organized community group in New York City, provides an example of the benefits of flexible community-based governance and responsiveness. When Hurricane Sandy devastated their community, the group quickly reoriented towards providing relief efforts to over 4,000 homes in

their community. Although RYTF had never previously engaged in disaster-response efforts, its existing decision-making structure and community knowledge allowed it nimbly to change itself and to provide an important relief effort in a timely and community-responsive manner.

Schools as sites for involving children

UNESCO declared 2005 to 2014 to be 'The Decade of Education for Sustainable Development', but there is no indication of widespread recognition that involving children in community-based sustainable development has become a central feature of the global 'Education for All' movement which aims to meet the learning needs of all by 2015.¹³ Schools are typically trapped in the traditional pedagogical roles and hence not ideal sites for providing authentic opportunities for engagement with the community and the local environment. Time constraints are often given as the reason for not incorporating an environmental or community focus into a school curriculum, but education for sustained development should not be viewed as one more competing 'subject'. Rather, it should be recognized as a highly motivating and fundamental content domain of learning that cuts across all the subjects of a school's curriculum. Furthermore, the active engagement of children with their community has long been known to be an effective strategy for school learning, especially in the primary school years.

The *escuelas nuevas*, or 'new schools', in Colombia offer an

excellent model of how all children can be active participants in the management of their school and local environment. In the best of these schools, children carry out assessments, monitoring, decision-making and action on the physical environment and are actively involved in managing a wide range of programmes, including organic farming, aquaculture and recycling, while also performing extremely well on traditional measures of learning.¹⁴ Furthermore, this highly participatory school model has been found to promote social capital, knowledge of the democratic process, and overall cooperation between children and adults in the community beyond the school.¹⁵

In areas of the world where local governance structures are not yet strong enough to support sustained opportunities for children to participate, schools may offer the best opportunity. The wildlife club movement in Kenya is an example of how school-based environmental engagement can compensate for fewer community-based opportunities. The wildlife club movement started when secondary school students self-organized funding directly from the Ministry of Wildlife for field trips to experience the country's national parks – some of the most biodiverse regions of the world. These trips became the reason for institutionalizing the clubs and led to strengthening regional environmental education and training initiatives. The children in the clubs also played key roles in national conservation efforts,

10 Hart, op. cit.; Hayward, op. cit.

11 Molina, J. G. (2011). 'The Center for Disaster Preparedness develops a tool for children to participate in risk assessment and planning'. *TAO Shelter*. Quezon City, The Philippines: TAO-Pilipinas. Available at: www.taoshelter.tao-pilipinas.org/disaster-risk-management/involving-children/

12 Council for the Welfare of Children, The Republic of the Philippines (2004). *National Framework for Children's Participation*. Available at: www.unicef.org/philippines/downloads/framework.pdf

13 DESD (Decade of Education for Sustainable Development): www.desd.org

14 Hart, op. cit.; Schiefelbein, E. (1991). *In search of the school of the XXI century: Is the Colombian Escuela Nueva the right pathfinder?* Santiago: UNESCO/UNICEF.

15 Forero-Pineda, C., D. Escobar-Rodríguez and D. Molina (2006) 'Escuela Nueva's impact on the peaceful social interaction of children in Colombia'. In A.W. Little (ed.), *Education for all and multigrade teaching: Challenges and opportunities*. Netherlands: Springer, 265–300.

especially in the anti-poaching demonstrations of the 1970s.¹⁶

The potential of highly participatory children's organizations

Community settings offer better opportunities for children's participation in intergenerational governance than schools. In community settings, children and adults can work together more cooperatively outside of pedagogical or educational concerns. Unfortunately, it is relatively rare for community-based organizations to involve children as partners in assessing, planning or decision-making regarding community initiatives. More typically, children are involved only in the manual labour phase of an environmental project, such as community clean-up work, digging drainage ditches or tree planting. In changing this state of affairs, we believe that the most promising course to consider is the involvement of children's own membership organizations.

For many years, children's membership organizations have engaged in valuable environmental action projects. But typically these projects have been mobilizations of children to take action in ways that have been designed by adults. Such projects therefore do not fulfil the goal of engendering a critical perspective on the quality of the environment or encourage children to believe that they have the potential to initiate their own projects and to carry them out competently. But, in recent years, new kinds of children's groups have been formed in many countries that are more

participatory than the traditional, adult-led children's membership organizations. These relatively self-governed groups have been a gradual response to the visionary challenge set by the CRC for children to be able to participate in decisions that affect them according to their evolving capacities. They reflect a vision of a new kind of active citizenship based on participatory democratic principles. In our work with children's groups, we have found that the most democratic and participatory of these groups are committed to principles of inclusiveness, transparency and equity both in mission and in practice.¹⁷ They attempt to be inclusive of all children in their communities, to be transparent about organizational structures and power relations, and to be equitable in their decision-making processes and allocation of group resources and opportunities. But, while there are an increasing number of these types of groups in many countries, they still tend to organize around short-term projects and are rarely authentically connected to adult decision-making structures and actions in their communities.

We believe that the expansion of participatory children's organizations offers great potential for fostering a culture of participatory governance where it is weak or non-existent. The history of the Sarvodaya Movement in Sri Lanka offers support to this idea. This is a large self-governance movement involving thousands of villages and people of all ages.¹⁸ Here, some village development initiatives begin with bringing young

children together in groups to learn community health information that they can share with others. From this modest beginning, the youngest citizens gradually expand their capacities in community self-organizing, and older members gradually join larger and more ambitious local projects. With such a strong programme of community self-governance already in place, the Sarvodaya Movement played a vital role in the reconstruction of the island following the tsunami in 2004.

Conclusions: what can be done now to involve children

We have argued that children need to be offered opportunities to go beyond their participation in short-term projects and instead need to be enabled to play a central role in the ongoing climate change mitigation and adaptation efforts of their communities. We have also argued that participation by children in the management and governance of the local environment of their communities would be a sustained way for them to play a central role and that they have both the motivation and the capacity for this. Below, we outline a few principles to move project-based work in the direction of sustained engagement in community governance.

Encourage schools to be more participatory and embedded in their communities as a basic component of 'Education for All'

Schools are rarely good models of democratic governance and offer few opportunities for intergenerational collaboration. Nevertheless, they are the most universal opportunity in most parts of the world for children to participate to some

16 McDuff, M. (2000). 'Thirty years of environmental education in Africa: The role of the Wildlife Clubs of Kenya'. *Environmental Education Research*, 6(4), 383–396.

17 <http://crc15.org/>

18 www.sarvodaya.org/about/development-model; Hart, R. (1992). *Children's participation: From tokenism to citizenship*. Florence: UNICEF International Child Development Centre. Available at: www.unicef-irc.org/publications

degree in the sustainable development of their communities. In recognition of the universal importance of climate change for all communities and schools, the global movement for the education of all children should expand its focus to make active engagement in the sustainable development of the local environment a central, cross-disciplinary focus of the curriculum of every school.

Encourage the development of highly participatory and democratic children's membership groups

Where adult community governance structures do not exist or are completely closed to the voices of children, highly participatory and democratic children's groups can act as the incipient local structures of governance for sustainable development. There are now examples in many countries where children, even with little or no education, can effectively govern their own groups. We need to find ways to foster a global movement to encourage these new kinds of children's membership groups, where active citizenship by children in their communities replaces the old model of education and preparation of children for future citizenship in adulthood. By enabling children in groups to learn together how to collaborate, to make decisions,

to deal with issues of power and to monitor themselves, they will become more effective and flexible community actors and be better prepared to build and manage their communities.¹⁹

Encourage networking and collaboration of children's organizations within and between communities

We have learned from our work with participatory child and youth membership organizations that they are extremely enthusiastic about collaborating with other groups across local and even international boundaries. This offers great potential for the energies of local groups to build regional and global understanding of sustainable development and preparation for climate change. Invitations for collaboration within and between communities should be shared among children's organizations and between children and adult groups. Through networking with others, young people learn new practices for organizing themselves democratically and how to become more effective in achieving their community and local environmental goals – while simultaneously developing their understanding of the global and systemic nature of

the environmental issues associated with climate change.

Experiment and comparatively evaluate new forms of authentic participation of children and youth in local government decision-making

Opportunities for young people to participate in local government have grown in number over recent decades. We know this from the increase in child and youth councils linked with local government agencies, such as schools and planning departments. But the uncertainty of climate change requires that we think critically about engaging children in decision-making for sustainable development in more flexible and spontaneous ways. We must move past models of participation that only support a few children to take part in governance and toward opportunities that engage all children in meaningful ways – especially the most marginalized. A valuable step in expanding this movement would be to make a comprehensive international comparison of the many different models of child and youth involvement in local government and what the impacts of young people's inputs have been on decision-making in the communities using these different models of participation.

¹⁹ The Article 15 Project supports children's rights and capacities to self-organize through critical self-reflection and in partnership with adults. See <http://crc15.org/> for a full description of the project and access to the *Article 15 Resource Kit*.

The latest scientific verdict on climate change

RAJENDRA K. PACHAURI



Much has changed since the United Nations Framework Convention on Climate Change (UNFCCC) was agreed on in 1992. Some changes have been positive in respect of dealing with the challenge of climate change, but others undoubtedly show a lack of progress. Perhaps the biggest disappointment that observers have on this subject is the fact that emissions of greenhouse gases continue to grow and, while in many parts of the world there has been significant success in dealing with this challenge, globally the results have fallen below the expectations that were raised when the UNFCCC came into existence. Most glaring has been the fact that carbon dioxide emissions have crossed 400 parts per million this year, as was reported in May 2013 by

the establishment at Mauna Loa, Hawaii, which has been recording measurements of carbon dioxide content in the atmosphere over the last six decades. The increase in other greenhouse gas emissions has also defied expectations inherent in the provisions of the UNFCCC.

In the past three years the Intergovernmental Panel on Climate Change (IPCC) has brought out three reports. These provide valuable information and scientific assessments to enable decision-makers and negotiators to arrive at agreements and actions to deal with the challenges of both adaptation and mitigation. The Special Report on *Renewable energy sources and climate change mitigation* provided a comprehensive assessment of the development of renewable-energy

solutions and prospects for the future. An important finding of this report was that, even with existing technologies, there are today several applications in which renewable-energy solutions compete economically with conventional fossil fuel-based energy systems. This report also examined 164 different scenarios of future renewable-energy development and found a wide range in the projections of the share that renewable energy will have of all energy produced in the year 2050. The highest projection put renewable energy's share of the total at 77 per cent in 2050 and the lowest at almost one-seventh of that. The main implication of this range of scenarios was that mitigation through the development of renewable energy will be

heavily dependent on policy measures and initiatives that are put in place in the immediate future. The Fourth Assessment Report (AR4) of the IPCC had clearly stated: “Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes.”

The IPCC also brought out in 2011 a Special Report on *Managing the risks of extreme events and disasters to advance climate change adaptation*. This report highlighted the impacts of climate change in the form of specific extremes and disasters. Two major findings of this report highlighted that it is *virtually certain* that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur in the twenty-first century on a global scale. It was also found *very likely* that the length, frequency and/or intensity of warm spells or heatwaves will increase over most land areas. In fact, based on specific emissions scenarios, it was projected that a 1-in-20-year hottest day is *likely* to become a 1-in-2-year event by the end of the twenty-first century in most regions, except in the high latitudes of the Northern Hemisphere, where it is *likely* to become a 1-in-5-year event. This report also found it *likely* that the frequency of heavy precipitation or the proportion of total rainfall that is heavy will increase in the twenty-first century over many areas of the globe. These findings are of extreme relevance to the global community as it seeks to adopt a set of actions to adapt to the impacts of climate change, while at the same time mitigating the emissions of greenhouse gases.

AR4 has clearly stated that many impacts can be avoided, reduced or delayed by mitigation. It has also stated that neither adaptation nor mitigation alone can avoid all climate change impacts. Adaptation and mitigation, it was found, can complement each other, and together can significantly reduce the risks of climate change.

The IPCC is currently in the final stages of its Fifth Assessment cycle. As part of this, the Working Group I report, which deals with the physical-science basis of climate change, has been completed and was released in September 2013. This report has come up with a large number of significant findings, some of which are provided below:

- Warming of the climate system is unequivocal and, since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea levels have risen and the concentrations of greenhouse gases have increased.
- Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was *likely* to have been the warmest 30-year period of the last 1,400 years.
- Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 per cent of the energy accumulated between 1971 and 2010 (*high confidence*). It is *virtually certain* that the upper ocean (0–700 metres) warmed from 1971 to 2010,

and it is *likely* that it warmed between the 1870s and 1971.

- The rate of sea-level rise since the mid-nineteenth century has been larger than the mean rate during the previous two millennia (*high confidence*). Over the period 1901–2010, global mean sea levels rose by 0.19 (0.17 to 0.21) metres.
- The atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40 per cent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land-use-change emissions. The ocean has absorbed about 30 per cent of the emitted anthropogenic carbon dioxide, causing ocean acidification.
- Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea-level rise and in changes in some climate extremes. This evidence for human influence has grown since AR4. It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-twentieth century.
- Global surface temperature change for the end of the twenty-first century is *likely* to exceed 1.5°C relative to 1850 to 1900 for all Representative Concentration Pathway (RCP) scenarios¹ except RCP2.6. It is *likely* to exceed 2°C for RCP6.0

¹ Four greenhouse gas concentration trajectories adopted by the IPCC for its Fifth Assessment Report and used for climate modeling and research.

and RCP8.5, and *more likely than not* to exceed 2°C for RCP4.5. Warming will continue beyond 2100 under all RCP scenarios except RCP2.6. Warming will continue to exhibit interannual-to-decadal variability and will not be regionally uniform.

- Changes in the global water cycle in response to the warming over the twenty-first century will not be uniform. The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions.
- The global ocean will continue to warm during the twenty-first century. Heat will penetrate from the surface to the deep ocean and affect ocean circulation.
- Global mean sea level will continue to rise during the

twenty-first century. Under all RCP scenarios the rate of sea-level rise will be *very likely* to exceed that observed during 1971–2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets.

The major advance that has taken place globally in respect of actions to implement the provisions of the UNFCCC is the heightened awareness of the reality of climate change. The work of the IPCC has been of great significance in assessing, on an open, transparent and objective basis, all aspects of climate change, including the scientific and socio-economic dimensions of the problem. As a result, the world is better equipped today with knowledge on the subject than was possible in the past, and it is expected that this knowledge will translate into

action across the globe to deal effectively with the challenge of climate change. The impacts of climate change have been found to be serious, particularly for the poorest communities in the world, which are vulnerable to these impacts largely because their adaptive capacity is limited. There are, therefore, equity issues that need to be taken into account as countries and societies decide to mount efforts to deal with climate change in the future.

The formulation of plans and actions will be supported considerably by knowledge and the scientific assessment of past climate change and projections for the future. AR5, once it is completed, will provide a substantial updating of knowledge to help human society come up with plans and actions that will make a difference in dealing with the problem.

Inequality, climate change and children's development

RACHEL GARTHWAITE AND
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Recently (2012–13), scientists have reported that atmospheric concentrations of carbon dioxide (the key greenhouse gas) have exceeded 400 parts per million¹ at a number of sites in the Northern Hemisphere for the first time in human history.² Passing this point will not result in immediate drastic changes to our planet's climate, but it is a symbolic milestone in our seemingly relentless march towards the threshold for dangerous climate change.^{3,4}

1 The daily average CO₂ concentration.

2 <http://scrippsnews.ucsd.edu/Releases/?releaselD=1358>

3 The broad scientific consensus is that an increase of the globally averaged temperature of more than 2°C above pre-industrial levels will have serious implications for much of the world's population. (See: Parry M. L., O. F. Canziani, J. P. Palutikof et al. (2007) *Climate Change 2007: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 2007*. Cambridge: Cambridge University Press.) The IPCC estimated in 2007 that to stay below 2°C requires atmospheric CO₂ concentrations to stabilise at 350–400 ppm. (See Figure 5.1, IPCC 2007 Synthesis Report.)

That we have reached this milestone is not a surprise but it should be a major wake-up call. While countries quibble over who is most to blame and who should pay, emissions continue to increase, reaching an all-time high in 2012,⁵ and to follow pathways that are likely to lead to the highest temperature increases (up to 6°C by 2100).⁶ When the Intergovernmental Panel on Climate Change (IPCC) publishes the fifth in

4 IPCC (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Core Writing Team: Pachauri, R. K. and Reisinger, A. (eds.)). Geneva: IPCC, 104.

5 Olivier, J. G. J., G. Janssens-Maenhout, M. Muntean and J. A. H. W. Peters (2012). *Trends in global CO₂ emissions: 2012 report*. The Hague/Bilthoven: PBL Netherlands Environmental Assessment Agency.

6 Peters, G. P., R. M. Andrew, T. Boden et al. (2013). 'The challenge to keep global warming below 2°C'. *Nature Climate Change*, 2(1): 4–6.

its series of reports on global climate change during 2014, it will paint a sorry picture of many changes, including increasing temperatures, melting glaciers and ice-sheets, accelerating sea-level rise, more frequent and intense extreme events, and ocean acidification. Impacts on food production,⁷ human health,⁸ infrastructure⁹ and ecological resources¹⁰ are already being observed, but still the climate negotiations falter.

7 Lobell, D. B., W. Schlenker and J. Costa-Roberts (2011). 'Climate trends and global crop production since 1980'. *Science*, 333(6042): 616–20.

8 Costello, A., M. Abbas, A. Allen et al. (2009). 'Managing the health effects of climate change.' *The Lancet*, 373: 1693–1733.

9 See Chapter 7: 'Industry, settlement and society' in Parry et al. (2007), op. cit.

10 Fischlin, A. and G. Midgley. 'Ecosystems: their properties, goods and services'. Chapter 4 in Parry et al (2007), op. cit.

2015 – an important year

While the climate negotiations struggle on, the lives and livelihoods of people around the world are already being affected by climate change.¹¹ Climate change was at least partially responsible for the 2011 East African drought which killed at least 50,000 people¹² and the 2003 European heatwave which killed more than 35,000 people.¹³ While it is difficult to predict with certainty what the impacts will be in the future, it is safe to say that, unless we see a dramatic reduction in emissions within the next decade,¹⁴ by 2050 we are likely to see major changes in food production, water availability, disease prevalence and many of the other factors that are important determinants for people's health and well-being.¹⁵ There is a lot riding on the climate change negotiations over the next two to three years. In 2015, representatives from over 200 countries are scheduled to agree on the final structure of a new global climate agreement. The outcome of these talks will largely determine whether the world is two, three or four degrees warmer (or more) by the end of this century.

How vulnerable people are to climate change is, of course, a key factor in determining how much of an impact it has, and not all people are equally vulnerable. Social and economic

conditions are crucial factors in determining a person's exposure to risk and their adaptive capacity.¹⁶ Consequently, it is the poor and disadvantaged who are most vulnerable. How significant the impacts of future climate change are will, therefore, also depend on how much progress is made in reducing poverty over the next couple of decades. In addition to being critical for the climate negotiations, 2015 is also an important year for human development: the successes and failures of the Millennium Development Goals (MDGs) will be reviewed, and a new framework of action for sustainable development agreed.¹⁷ Whatever shape this new framework takes, poverty eradication will remain central. It should therefore have a defining influence on the pace (and carbon intensity) of development in all countries, as well as the management of the critical resources required to satisfy the health and well-being needs of the world's poor.

The key challenge is bringing these two intergovernmental processes into alignment to ensure that, between them, they can deliver the scale of ambition needed to eradicate poverty across all its dimensions, prevent dangerous climate change, and strengthen the resilience of vulnerable communities to the climatic

changes that are now unavoidable. During the first year of the post-2015 discussions there has been intense debate and resistance from many quarters to including climate change mitigation in any substantive way in the next framework. However, unless closer links are made between the climate change and human development communities (and policy agendas), it is unlikely that the scale of ambition needed to address climate change will be realized. This failure will become a major barrier to achieving our global human development goals, if not by 2030, certainly by 2050.

While debate continues about whether climate change should be included within the post-2015 agenda, inequality has emerged as one of the priority issues for both the development and the climate agendas.¹⁸ Analysis undertaken as part of the MDG review process shows that, while progress has been made in reducing absolute poverty levels globally, the benefits have not been felt by all, with the poorest households being left behind. These people are the most vulnerable to climate change. In many countries income inequality – and inequality in access to essential services such as safe drinking water and sanitation – has actually increased during the MDG period.¹⁹ In China, for example, income inequality has increased and inequalities in access to health care and education remain high,²⁰ while in India huge disparities exist between rural and

11 See Parry et al. (2007), op. cit.

12 Marshall, M. (2013). 'Humanitarian disaster blamed on climate change'. *New Scientist*, 1 March 2013.

13 Confalonieri, U., B. Menne, R. Akhrar et al. 'Human health'. Chapter 8 in Parry et al. (2007), op. cit.

14 See United Nations Environment Programme (2012). *The Emissions Gap Report 2012. A UNEP Synthesis Report*. Nairobi: UNEP.

15 World Bank (2012). *Turn down the heat: Why a 4°C warmer world must be avoided*. Washington DC: World Bank.

16 The IPCC defines adaptive capacity as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" *IPCC Fourth Assessment Report: Climate Change 2007 (AR4): 21*.

17 Post-2015 refers to the work under way to agree a successor framework to the Millennium Development Goals. During the first phase of these discussions (the High Level Panel phase) this was originally human-development focused. However, with the advent of the Open Working Group on Sustainable Development Goals, it has now been broadened out to a discussion aimed at agreeing a global sustainable development goals framework by 2015.

18 See: www.worldwewant2015.org/node/299198 and www.undp.org/content/dam/undp/library/MDG/english/global-conversation-begins-web.pdf

19 Save the Children (2012). *Born equal: How reducing inequality could give our children a better future*. London: Save the Children.

20 Save the Children (2012). 'China Case Study' in *Born equal: How reducing inequality could give our children a better future*. London: Save the Children.

urban areas in terms of access to water and sanitation, with 69 per cent of rural areas lacking access to sanitation facilities compared with 19 per cent of urban households.²¹ Inequality is a major barrier to development; it hinders economic growth and progress in human well-being.²² Inequalities, to a significant degree, shape the vulnerability of people and communities to climate change.

Inequality and climate change

Of the 2.4 billion people living on less than two dollars a day, some are more vulnerable to climate change than others because of their age, gender, health status, geographic location, livelihood, or relative access to social protection.²³ Inequalities – if they result in people having low incomes, living on marginal land, in exposed areas or in unsafe housing, being malnourished or having poor health – can determine whether a person, household, community or even state experiences just another climate event or whether they become a victim of a climate disaster.

However, this is not a one-way relationship. Climate change *magnifies* inequality – it hurts the poor first and worst, and so accentuates the differences between the rich and poor, the advantaged and disadvantaged. It also *exacerbates* inequality.

The impacts of climate change can make it even more difficult for people to lift themselves out of poverty either because their livelihoods have been destroyed or undermined, or because new vulnerabilities have been created (for example, through ill health or loss of assets).²⁴ Climate change and inequality are, therefore, closely related and these interlinkages are perhaps most pronounced for children.²⁵

Childhood is a critical time for physical, cognitive and social development, so the impacts of climate change on children – whether direct or indirect – can have lifelong consequences (on, for example, life expectancy, general health or employment potential). Children are already more vulnerable to the impacts of climate change than other groups,²⁶ by virtue of their physiology, metabolism, physical size and strength, and dependence on others for resources and protection.²⁷

If they are also subjected to social or economic inequalities, their vulnerability to weather-related events is further heightened. Inequalities in income, location and gender have been shown to have a dramatic impact on children's chances of survival, their health, nutritional status and education.²⁸

In the event of weather-related disasters, these impacts can mean the difference between life and death. Children who are malnourished or otherwise unwell may be less able to escape physically (from a flood, for example). Children who have not been immunized may be more likely to succumb to the diseases that often immediately follow disasters (for example, diarrhoea or measles). These existing inequalities will be reinforced as the impacts of climate change intensify in coming decades – increasing children's vulnerability to shocks and pressures.

Addressing inequalities through countries' development policies is one way of reducing the vulnerability of children and disadvantaged groups to the impacts of climate change. Ensuring that climate-adaptation strategies are child-focused and targeted towards the most vulnerable in society is another. A third is to focus on building resilience to climate change (and the other shocks that may lead to or deepen poverty).

Building resilience – a point of convergence?

Building resilience is a concept that is increasingly gaining attention in discussions relating to climate change and poverty reduction. Broadly defined, resilience “enables not only coping with added shocks and stresses, but also addressing the myriad challenges that constrain lives and livelihoods and facilitating more general improvements to the quality of human lives.”²⁹ Resilience is a useful concept because it captures the

21 Save the Children (2012). 'India Case Study' in *Born equal: How reducing inequality could give our children a better future*. London: Save the Children.

22 Save the Children (2013). *Ending poverty in our generation: Save the Children's vision for a post-2015 framework*. London: Save the Children.

23 The World Bank Poverty Overview: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA0,,contentMDK:20040961~menuPK:435040~pagePK:148956~piPK:216618~theSitePK:430367~isCURL:Y,00.html>

24 www1.uneca.org/Portals/adfvii/documents/PreADF/RCM-SHD-PreADFConceptNote.pdf

25 See United Nations Development Programme (2008). *Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world*. New York: UNDP.

26 Save the Children (2010). *Right to a future: Climate change negotiations must be accountable to children*. London: Save the Children.

27 Lawler, J. and M. Patel (2012). 'Exploring children's vulnerability to climate change and their role in advancing climate change adaptation in East Asia and the Pacific'. *Environmental Development*, 3(2012): 123–126.

28 Save the Children (2012). *Born equal: How reducing inequality could give our children a better future*. London: Save the Children.

29 Dodman, D., J. Ayers and S. Huq. 'Building resilience' in The Worldwatch Institute (2009). *State of the World 2009: Into a warming world*. Washington DC: W. W. Norton and Company.

idea that vulnerability is not static. It should not be understood as a fixed state or an outcome, but should rather be seen as “a process that constantly evolves to meet changing demands”. Certainly, building children’s resilience to the unavoidable impacts of climate change should be considered an urgent task for both the climate change and human development communities. However, in the same way that vulnerability is shaped by social and economic inequalities, so too is the potential of individuals, families or communities to be resilient. Understanding the impact that inequalities are having on the capacity of an individual (household or community) to plan for, respond to or adapt to climate change over time should be a central part of the process of designing interventions to build resilience. At the same time, actions focused on building resilience must address the non-climate drivers of vulnerability and reduce existing inequalities. We must tackle both the climate and non-climate drivers of vulnerability if resilience is to be built sustainably.

Conclusion

That the world is heading towards a future with a much harsher climate is certain, and that today’s children (and their children) will bear the brunt of it is also certain. 2015 is a year of opportunity. It could be the year in which the world embarks on an ambitious agenda to end poverty, halt climate change and address the other global-scale issues that are currently threatening human health and prosperity. To have any chance of achieving this, greater cooperation and collaboration between the development and climate change communities is needed – and soon, before the outcomes of the parallel negotiation tracks become *faits accomplis*.

Analysing poverty and climate change through an inequality lens is one possible way of bringing the two communities closer together. Inequalities shape vulnerability to climate change, while climate change magnifies and exacerbates inequalities. Furthermore,

viewing these issues in this way highlights the particular vulnerability of children to climate change, poverty and inequality, and emphasizes the importance of ensuring that their specific needs are addressed by policy-makers. Development and climate policies that are child-focused, as well as targeted towards meeting the needs of those who are marginalized and disadvantaged, would go a long way towards meeting the specific needs of children and ending poverty and inequality. If they were also focused on building resilience, children (and their communities) would be healthier, wealthier, better educated and therefore less vulnerable to the impacts of climate change.

The human development and climate change agendas are mutually reinforcing. A failure to integrate and align these two agendas better in the lead-up to 2015 and beyond will create barriers to sustainable development and risk depriving poor children of their future lives and livelihoods. We either tackle both or we will achieve neither.

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United Nations Framework Convention on Climate Change

The United Nations Joint Framework Initiative on Children, Youth and Climate Change brings together 16 United Nations and intergovernmental entities, as well as many youth organizations, to empower young people to take adaptation and mitigation actions and enhance the effectiveness of their participation in climate change policy decision-making. Members of the Joint Framework Initiative who contributed to the article in this publication are:

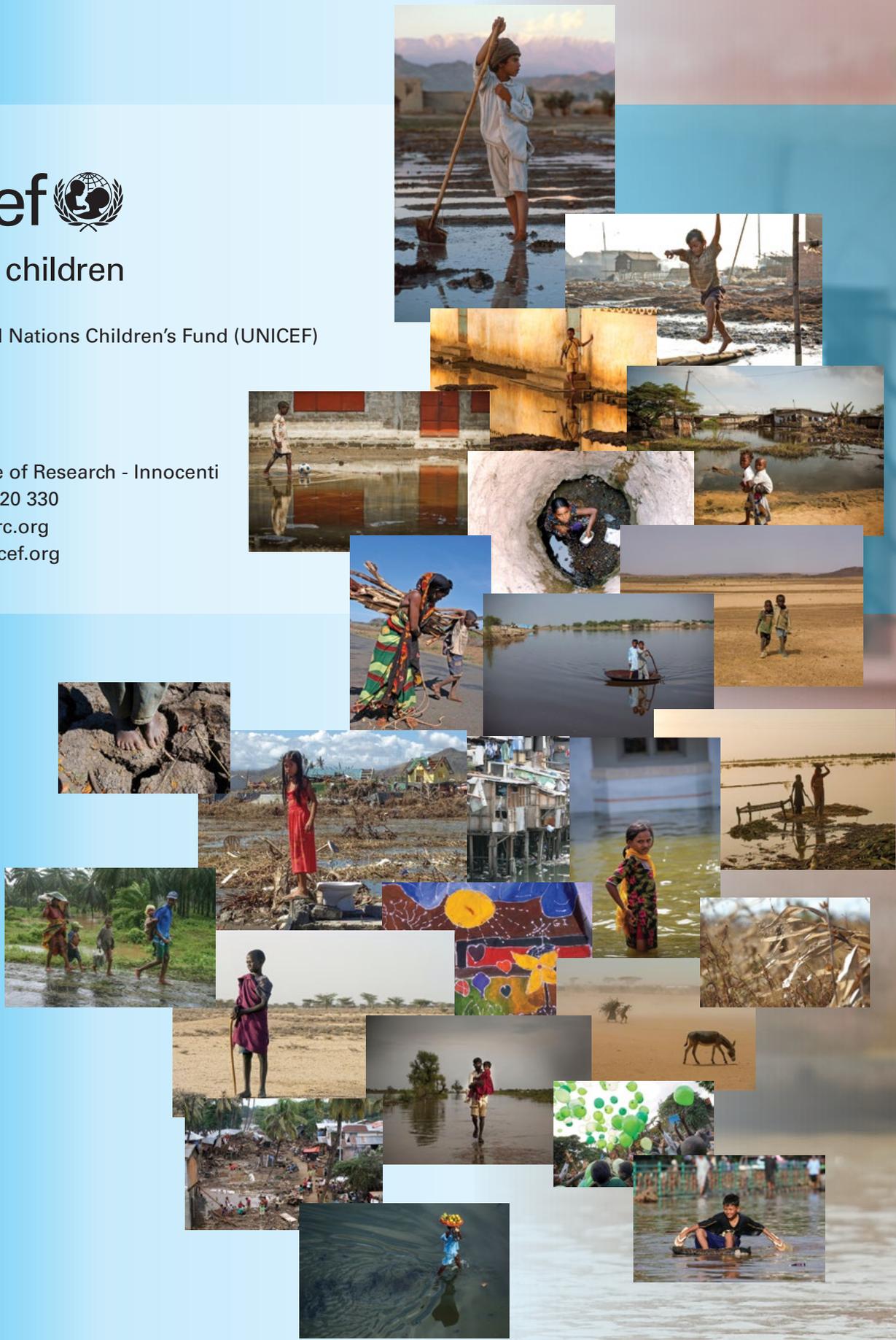
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