
Unless we act now
The impact of climate change on children
unite for children
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Note on maps: All maps included in this publication are stylized and not to scale. They do not reflect a position by UNICEF on the legal status of any country or area or the delimitation of any frontiers. The dotted line represents approximately the Line of Control agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the Parties. The final boundary between the Republic of the Sudan and the Republic of South Sudan has not yet been determined. The final status of the Abyei area has not yet been determined.

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Unless we act **now**

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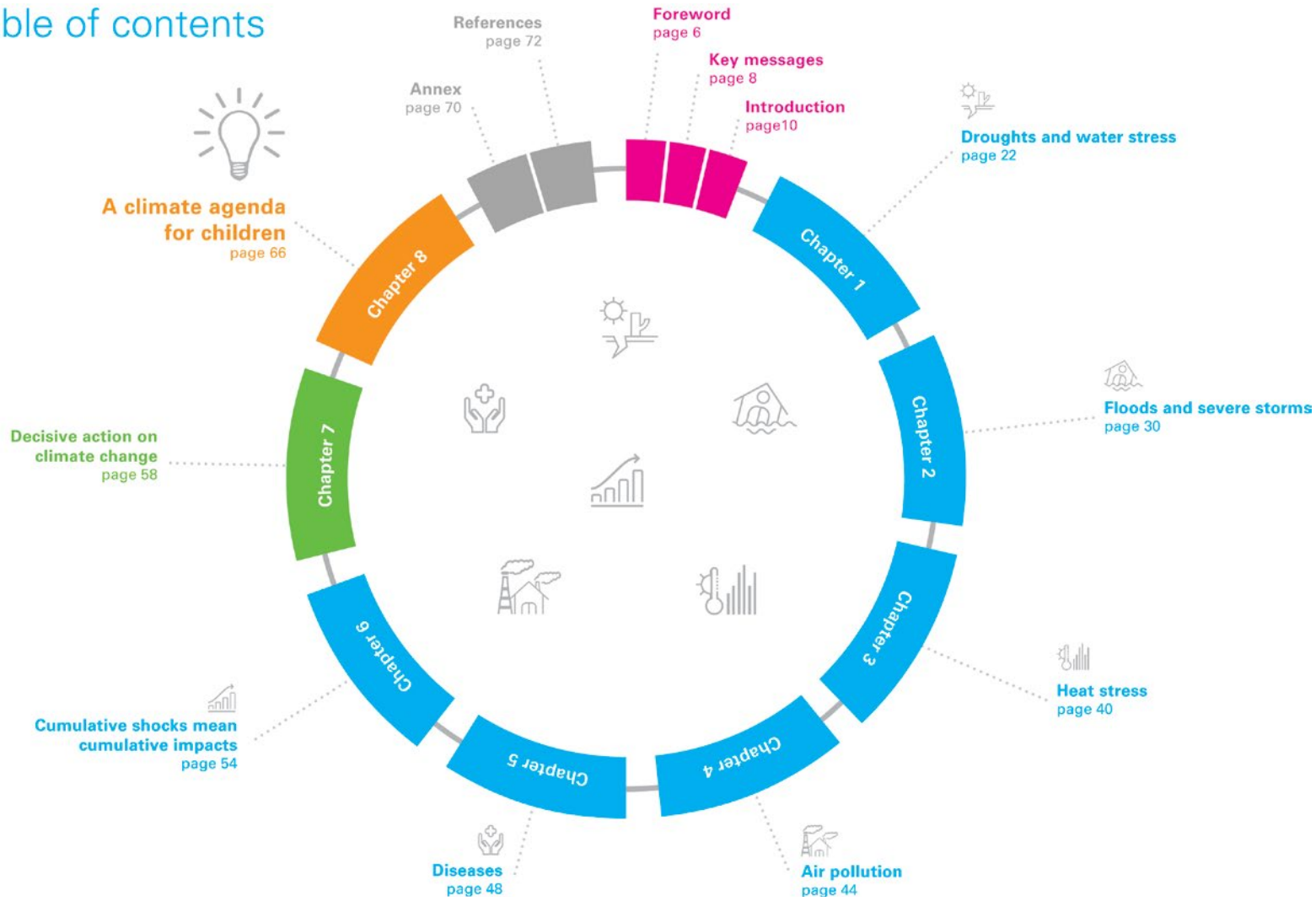

Foreword

There may be no greater, growing threat facing the world's children – and their children – than climate change. This mounting global crisis has the potential to undermine many of the gains we have made in child survival and development – and poses even greater dangers ahead.

In every crisis, children are the most vulnerable. Climate change is no exception. As escalating droughts and flooding degrade food production, children will bear the greatest burden of hunger and malnutrition. As temperatures increase, together with water scarcity and air pollution, children will feel the deadliest impact of water-borne diseases and dangerous respiratory conditions. As more extreme weather events expand the number of emergencies and humanitarian crises, children will pay the highest price. As the world experiences a steady rise in climate-driven migration, children's lives and futures will be the most disrupted.

These are the threats that children face today. Unless we act forcefully to stem the climate crisis now, the danger will only escalate. It is a prospect so painful to imagine that many people would rather not think about it.

But action must begin with knowledge and understanding of the costs of inaction. By combining state-of-the-art demographic data on the world's child population with scientific projections on the likely impacts of climate change in the decades ahead, this report offers a unique look at the climate-related risks that children face. It also outlines the likely scenarios for children if the world continues on its current course.

We have an opportunity to tackle this crisis before it's too late. That means taking decisive action to cut greenhouse gas emissions in order to slow, and ultimately stop, the advance of climate change. It means protecting children whose families are displaced as a result of climate change, and giving children's needs the highest priority in our efforts to mitigate environmental impacts. It means educating children to adapt to the immediate challenges of climate change – and to understand the role that they will be called on to play. Finally, it means listening to the voices of children and young people who, for better or worse, will inherit the planet we share.

No human responsibility runs deeper than the charge of every generation to care for the generation that follows it. For current and future generations of children, and for us all, the stakes could not be higher.

Anthony Lake
UNICEF Executive Director

There may be no greater, growing threat facing the world's children – and their children – than climate change.

Key Messages

Children will bear the brunt of climate change

Today, over half a billion children live in extremely high flood occurrence zones; nearly 160 million live in high or extremely high drought severity zones. While climate change will ultimately impact every child, these children are already in harm's way and face some of the most immediate risks.

There is a clear scientific consensus that climate change will increase the frequency of droughts, floods and severe weather events. These threats will pose grave risks for children over the coming decades. Severe weather events can destroy or disrupt infrastructure critical to children's well-being, including schools, health facilities and transport. Droughts and flooding can destroy crops, disrupt water systems and contaminate water reserves.

Although not as abrupt, slow-onset climate change impacts can also undermine development gains and livelihood options. Climate change will contribute to rising temperatures and changing rainfall patterns which, in turn, are likely to exacerbate the spread of vector-borne diseases such as malaria and dengue. Over time, dwindling water supplies and resource scarcity can increase migratory pressures on vulnerable families, disrupting livelihoods and increasing the risk of family displacement. Shifting agro-ecological zones and rainfall patterns can exacerbate rural poverty and food insecurity.

The dangers of climate change are more pronounced for children than for adults. Children are more vulnerable to vector-borne diseases than adults. They face greater dangers from undernutrition and diarrhoeal diseases. The physical dangers of extreme weather events – flooding, building collapse, and more – pose unique threats to young bodies and minds. If, as expected, climate change worsens each of these risks, it is children who will suffer most. Children will also feel these effects longer than adults, making them vital in today's decisions about climate change responses.

Climate change will make existing inequities even worse

Climate change will not affect all equally. Because of the risk associated with them, flood and drought zones often overlap with areas of high poverty and low access to essential services such as water and sanitation. This means that children and families who are already disadvantaged by poverty – those with the fewest resources for coping – are likely to face some of the most immediate dangers of climate change.

This can create a vicious cycle: a child living in poverty or deprived of adequate water and sanitation before a crisis will be more affected by a flood, drought or storm, less likely to recover quickly and at even greater risk in a subsequent crisis. While climate change poses universal threats, tackling it is also an imperative for equity. Unaddressed, climate change will harm the poorest and most vulnerable children first, hardest and longest.

The trajectory of climate change can – and must – be interrupted

Climate change science indicates that because of past and ongoing greenhouse gas emissions, the world's climate is already changing. It is imperative that we prepare for the impacts that are inevitable. There is, nevertheless, an opportunity for action that can stave off some of the worst effects of climate change. What the world does now to cut greenhouse gas emissions can dramatically reduce the number of children threatened by the most severe impacts of climate change in the coming decades.The path that the world chooses now will indelibly mark our children's futures.

Now is the time for action

The world must embark on low carbon development to reduce greenhouse gas emissions, and needs to adapt to the impacts of climate change that cannot be halted. We can take steps now to safeguard our children's future, notably:

- Cutting greenhouse gas emissions so that the average rise in the global temperature is limited to a maximum of 2° Celsius, and ideally to 1.5°C.
- Prioritizing the needs of the most vulnerable in climate change adaptation efforts, particularly children – who will bear the brunt of climate change far longer than adults.
- Reducing inequities among children now to promote their future resilience to climate change and other disasters or crises.
- Listening to and acting on children's perspectives on climate change.
- Providing children and youth with climate change education, awareness raising and training.
- Aligning and coordinating work on climate change adaptation, preparedness and disaster risk reduction at national and sub-national levels.
- Protecting children and their families who are forced to move as a result of climate change.
- Investing in children as part of national climate plans on mitigation and adaptation.
- Scale-up proven approaches to address the changing needs of children.

Children deserve to live in a world free from the life-threatening effects of climate change. Given the overwhelming scientific evidence on the dangers of climate change, and the clear opportunities we have for altering its course, there is no excuse for not acting ambitiously.

Introduction

Climate change has begun to change our world in unprecedented ways. We are already witnessing increasingly frequent and severe floods, droughts and changes in precipitation as well as heat and water stress. These phenomena are having, and will continue to have, a devastating impact on living conditions in many parts of the world, particularly where many of the world's poorest and most vulnerable children live.

Children will suffer disproportionately from climate change and growing environmental risks:

- The youngest will have to contend with the immediate and life-threatening dangers of climate-related disasters, food insecurity, rising air pollution, increased risk of vector-borne diseases, acute respiratory infections, diarrhoeal diseases and malnutrition.[1,2] Evidence is increasingly showing that these risks can have a markedly detrimental impact on a child's early development.[3,4]

- Children, especially young children, live their lives at a faster pace than adults. Consequently, anything harmful in the environment is bound to have a relatively greater impact on them. For example, young children breathe at twice the rate of adults. In polluted environments, their risk of respiratory infections, such as pneumonia, or conditions such as asthma, is likely to be far higher than for adults.[5, 6, 7]

- Children's vulnerability to vector-borne diseases such as dengue, malaria, and diseases associated with poor water quality, inadequate sanitation and poor hygiene practices, such as diarrhoeal diseases, is also far higher than adults. In 2015, malaria is estimated to lead to 438,000 deaths, of which more than two-thirds are children under 5 years of age.[8] Children are also more susceptible to undernutrition. Diarrhoeal diseases are a major cause of under-five mortality, and are estimated to result in 530,000 deaths in 2015 alone.[9]

- Some of the most dense child population areas in the world are likely to suffer significantly from flooding, drought and water and heat stress. These include parts of South Asia, particularly coastal South Asia and south of the Himalayas; the Mekong Delta; the Nile river basin; the Pacific Islands and other Small Island Developing States (SIDS) across the world; Equatorial Africa; and the Pacific coast of Latin America. Due to several major global trends, including demographic and migration trends, more and more people are living in disaster-prone areas and exposed to weather extremes.[10] Those with the highest exposure to climate risks are also likely to experience repetitive crises, which also makes it more difficult for poor families and children to recover. Even without climate change, the challenges ahead would stand to be enormous; climate change will significantly compound these challenges.

- Children, particularly young children are reliant on adults for their survival and development: whatever happens to adults often has a devastating impact on children too. Besides the direct risks of climate change, children are also affected when climate change hits their parents and other caregivers, such as loss of livelihoods and crop productivity. Moreover, when climate change sparks conflict over dwindling resources, children again pay the price for adults' actions.

- Today's children will live longer than most of the people who read this report. The impacts of climate change are only just beginning, and will likely continue to worsen over the lifetime of todays children, and future generations. The decisions made now will have greatest impact on our children.

The number of children potentially exposed to climate risks and their effects is alarming. Currently, over half a billion children are living in areas with extremely high levels of flood occurrence, and nearly 160 million live in areas of high or extremely high drought severity. Most of them live in some of the world's poorest countries with the least capacity to manage these environmental risks.

Strengthening the resilience of the poorest children and families to not only absorb these changes, but also adapt and transform, will be critical. It will also require, as part of these efforts, that we address the profound social and economic inequities that drive the ways in which many children will be so deeply impacted by the climate crisis.

Climate change and development are inextricably linked. Action on climate change is essential to achieving the Sustainable Development Goals (SDGs), and requires integrated action across social, economic and environmental spheres.

Climate change threatens children's survival, development, nutrition, education, and access to health care – all of which are children's rights and shrined in the Convention on the Rights of the Child (CRC).* In addition, Article 24 of the CRC makes explicit mention of considering "the dangers and risks of environmental pollution". The Inter-governmental Panel on Climate Change (IPCC) has confirmed that CO2, a major greenhouse gas, has increased since the industrial revolution from approximately 280 ppm to over 400 ppm by March 2015. The IPPC also confirmed that it is 'extremely likely [probability > 95%] that human influence has been the dominant cause of the observed warming since the mid-20th century'.[11,12] Knowing this, and knowing how climate change can affect children, makes it morally wrong not to act promptly and decisively.

* See Convention on the Rights of the Child, Articles 6, 24, 27, 28, 29.

ABOUT THE REPORT

This report aims to build the evidence base on children and climate change by focusing on the major climate-related risks; children's current and future exposure to these risks; and the policies required to protect children from these risks. The report has three sections. The first section explores the major climate-related risks and their potential impacts on children – how climate change might influence the burden of disease for children – and examines the cumulative impact of repetitive crises on children and families. The second section examines how children may be affected under various scenarios of action - from business-as-usual to ambitious action in addressing climate change. The final section outlines a series of broad policy recommendations to prevent further global warming, decrease children's exposure and increase their resilience to climate change and environmental risks.

Building on UNICEF's child demographic projection series, Generation 2030, the authors aimed to estimate how many children live in climate-affected areas, and how many will live in future climate-affected areas. Severe weather, such as droughts and floods, varies considerably within countries, requiring more detailed information about where children live within countries and how they are impacted.

Using Geographic Information System (GIS) population density data from best available administrative boundaries and supplied by CIESIN, and applying the proportion of children to total population at the most localized available level (in some cases this was national data from the United Nations population division, and in others this was subnational from ICF International / USAID DHS Program), the authors were able to create a child population map that estimates the number of children in every square kilometre on earth.

With this map as a foundation, the authors then overlaid GIS maps that estimate flood and drought zones provided by WRI, and several other climate related impacts to estimate the number of children who live in those zones.

The authors are immensely grateful for the support and guidance throughout the process of key international organizations, particularly UNEP and the OECD, WRI, ICF International / USAID DHS Program, CIESIN, as well as UNICEF's own Data and Analytics Section.


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BUILDING A HIGH RESOLUTION CHILD POPULATION MAP

The preliminary release Gridded Population of the World version 4 (GPWv4)‡ data set used for this analysis was derived from best available administrative boundary population counts for 2010 by the Center for International Earth Science Information Network (CIESIN) at Columbia University. The final data set will eventually be distributed via the NASA Socioeconomic Data and Applications Center (SEDAC), and will go through a more formal alpha and beta review process as part of that release. GPWv4 is constructed from national or subnational input areal units of varying resolutions, which will show differences in the visual display of information depending on the resolution of the input boundaries, but represents the best available global population data.

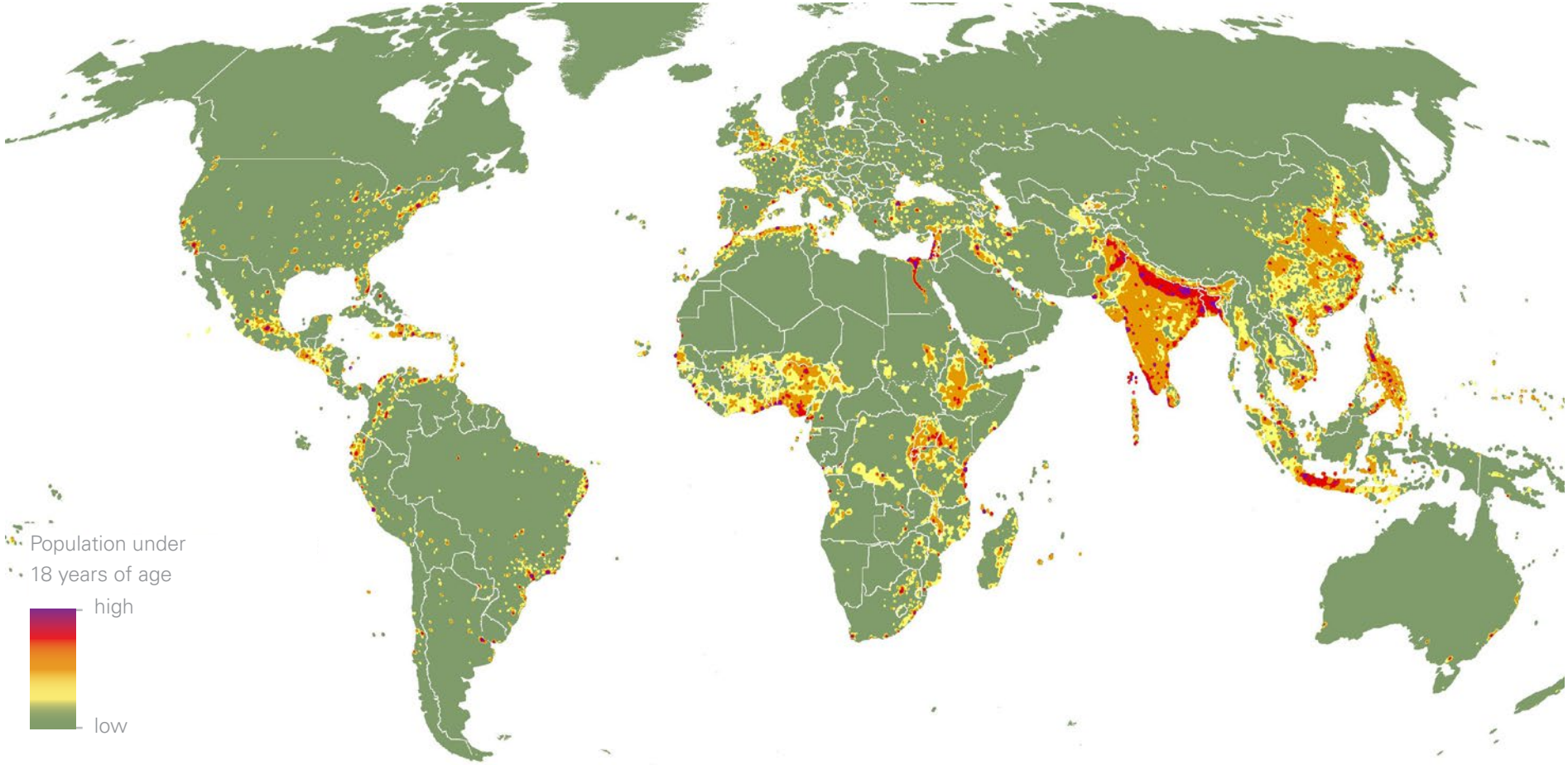
The GPWv4 data was augmented by UN World Population Prospects projections for 2015, so that the national population totals equaled those from the UN. The percentage of the population under 18 years of age was then calculated on a national level, and enhanced with sub-national boundaries and percentages for 58 countries provided by ICF International through the DHS Program. The percentages were then used to estimate the number and location of children under 18 years of age in 2015 around the world. Aggregated child population estimates are within 5% of the UN global child population estimates.

For future populations, GPWv4 data was augmented by UN population projection data for the year 2050, showing the total number of people per nation, as well as the percentage of children under 18 years of age. Those projections were used as a multiplier to derive the number and location of children under 18 years of age in 2050 globally based on GPWv4 data.

‡ Center for International Earth Science Information Network - CIESIN - Columbia University. 2014. Gridded Population of the World, Version 4 (GPWv4), Preliminary Release 2 (2010). Palisades, NY. http://www.ciesin.columbia.edu/data/gpw-v4. Accessed 01/11/2015

The distribution of the world's 2.3 billion children has important implications for assessing the impacts of climate change

Fig. 1: Population under 18 years of age per sq km (2015)



2.3 BILLION

CHILDREN LIVE THROUGHOUT THE WORLD

Source: UNICEF analysis, 2015, based on GPWv4 by the Center for International Earth Science Information Network (CIESIN) at Columbia University, and sub-national demographic distribution surveys from the ICF International /USAID DHS Program

This map does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area has not yet been determined.

This map is for illustrative purposes only. Due to different methodologies in collecting the census data, extreme high density areas are difficult to visualize. The map has been augmented to make visualization easier. A full and detailed map is forthcoming and will be available online.

Climate change disproportionately impacts the poorest, deepening existing inequities.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Key climate risks by region

Fig. 2 Key climate risks by region extracted from *IPCC Climate Change 2014, Impacts, Adaptation, and Vulnerability. Summary for Policymakers*

NORTH AMERICA

Wildfire-induced loss of ecosystem integrity, property loss, human morbidity, and mortality as a result of increased drying trend and temperatures ●●●●○

Heat-related human mortality ●●●●○

Urban floods in riverine and coastal areas, inducing property and infrastructure damage; supply chain, ecosystem, and social system disruption; public health impacts; and water quality impairment, due to sea level rise, extreme precipitation, and cyclones ●●●●○

THE OCEAN

Distributional shift in fish and invertebrate species, and decrease in fisheries catch potential at low latitudes, e.g., in equatorial upwelling and coastal boundary systems and sub-tropical gyres ●●●●○

Reduced biodiversity, fisheries abundance, and coastal protection by coral reefs due to heat-induced mass coral bleaching and mortality increases, exacerbated by ocean acidification, e.g., in coastal boundary systems and sub-tropical gyres ●●●●○

Coastal inundation and habitat loss due to sea level rise, extreme events, changes in precipitation, and reduced ecological resilience, e.g., in coastal boundary systems and sub-tropical gyres ●●●◐○

SMALL ISLANDS

Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability ●●●●○

The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas ●●●●○

CENTRAL AND SOUTH AMERICA

Water availability in semi-arid and glacier-melt-dependent regions and Central America; flooding and landslides in urban and rural areas due to extreme precipitation ●●●●○

Decreased food production and food quality ●●●○○

Spread of vector-borne diseases in altitude and latitude ●●●○○

POLAR REGIONS

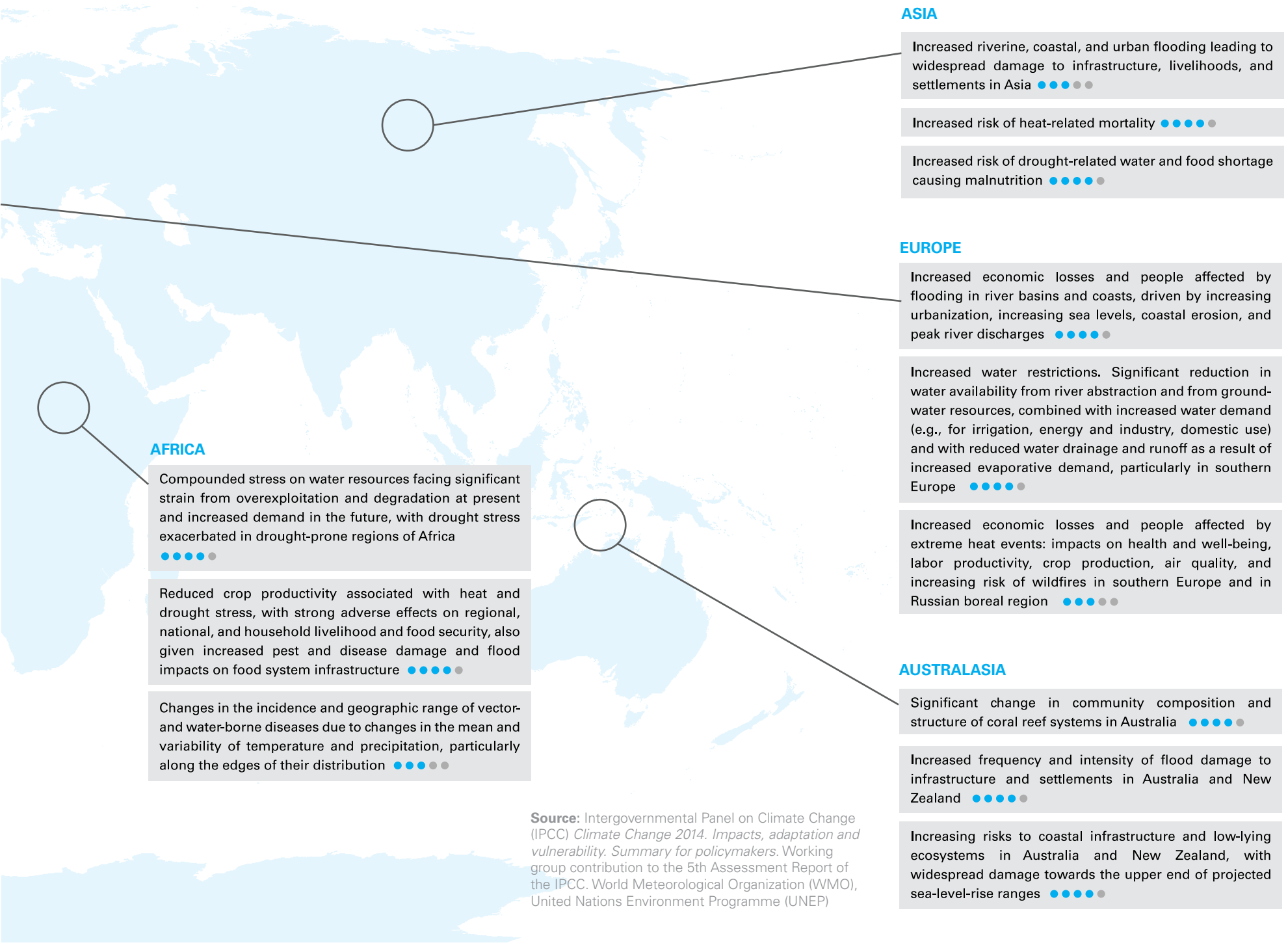
Risks for freshwater and terrestrial ecosystems (●●●●○) and marine ecosystems (●●●○○), due to changes in ice, snow cover, permafrost, and freshwater/-ocean conditions, affecting species´ habitat quality, ranges, phenology, and productivity, as well as dependent economies

Risks for the health and well-being of Arctic residents, resulting from injuries and illness from the changing physical environment, food insecurity, lack of reliable and safe drinking water, and damage to infrastructure, including infrastructure in permafrost regions ●●●●○

Unprecedented challenges for northern communities due to complex inter-linkages between climate-related hazards and societal factors, particularly if rate of change is faster than social systems can adapt ●●●●○

Confidence in the validity of a finding synthesizes the evaluation of evidence and agreement. Levels of confidence include five qualifiers:

- ●○○○○ very low confidence
- ●●○○○ low confidence
- ●●●○○ medium confidence
- ●●●●○ high confidence
- ●●●●● very high confidence



ASIA

Increased riverine, coastal, and urban flooding leading to widespread damage to infrastructure, livelihoods, and settlements in Asia ●●●○○

Increased risk of heat-related mortality ●●●●○

Increased risk of drought-related water and food shortage causing malnutrition ●●●●○

EUROPE

Increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanization, increasing sea levels, coastal erosion, and peak river discharges ●●●●○

Increased water restrictions. Significant reduction in water availability from river abstraction and from groundwater resources, combined with increased water demand (e.g., for irrigation, energy and industry, domestic use) and with reduced water drainage and runoff as a result of increased evaporative demand, particularly in southern Europe ●●●●○

Increased economic losses and people affected by extreme heat events: impacts on health and well-being, labor productivity, crop production, air quality, and increasing risk of wildfires in southern Europe and in Russian boreal region ●●●○○

AFRICA

Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future, with drought stress exacerbated in drought-prone regions of Africa ●●●●○

Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure ●●●●○

Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution ●●●○○

AUSTRALASIA

Significant change in community composition and structure of coral reef systems in Australia ●●●●○

Increased frequency and intensity of flood damage to infrastructure and settlements in Australia and New Zealand ●●●●○

Increasing risks to coastal infrastructure and low-lying ecosystems in Australia and New Zealand, with widespread damage towards the upper end of projected sea-level-rise ranges ●●●●○

Source: Intergovernmental Panel on Climate Change (IPCC) *Climate Change 2014. Impacts, adaptation and vulnerability. Summary for policymakers.* Working group contribution to the 5th Assessment Report of the IPCC. World Meteorological Organization (WMO), United Nations Environment Programme (UNEP)

Nearly 160 million children live in areas of high or extremely high drought severity.






1. Droughts and water stress

Nearly 160 million children are currently living in aeras of high or extremely high drought severity, most of whom live in Africa and Asia.

Drought is caused by an intense and persistent shortage of precipitation resulting in a water shortage.[1,2] Most droughts are slow-onset, but they can be more acute if they occur in arid zones or in combination with heatwaves.[3] The water stress associated with droughts can be aggravated by water consumption for agriculture, industry, power generation and domestic purposes, as well as environmental degradation and disruption of water supply systems. As temperatures rise due to global climate change, more moisture evaporates from land and water, leaving less water behind. Consequently, water demand is expected to increase in the coming years as plants, animals and humans will require more water to compensate for increased evaporation.[4,5]

Droughts can have multiple effects on poor families and communities. Crops fail, livestock dies and income drops, leading to food insecurity for the poor as well as rising food prices. Water becomes scarce and the lack of food and water, as well as inequitable access to these necessities, can result in social disorder.[6,7]

Children are among the most vulnerable to these effects.[8] Income loss and food supply shortages caused by droughts can lead to nutritional deprivations that can have both immediate and lifelong impacts. As children need to consume more food and water per unit of body weight than adults, they are more vulnerable to any deprivation of food and water. Undernutrition contributes to the severity of a range of diseases, and is responsible for nearly half of all under-five deaths.[9] A study in India has shown that a woman's exposure to drought in the year before she gives birth has a negative and statistically significant effect on her child's weight for age.[10,11] Moreover, untreated undernutrition during the first two years of life can lead to irreversible stunting. This affects both physical and cognitive development, which has implications for the rest of a child's life – including his or her schooling, health and livelihood.[12]

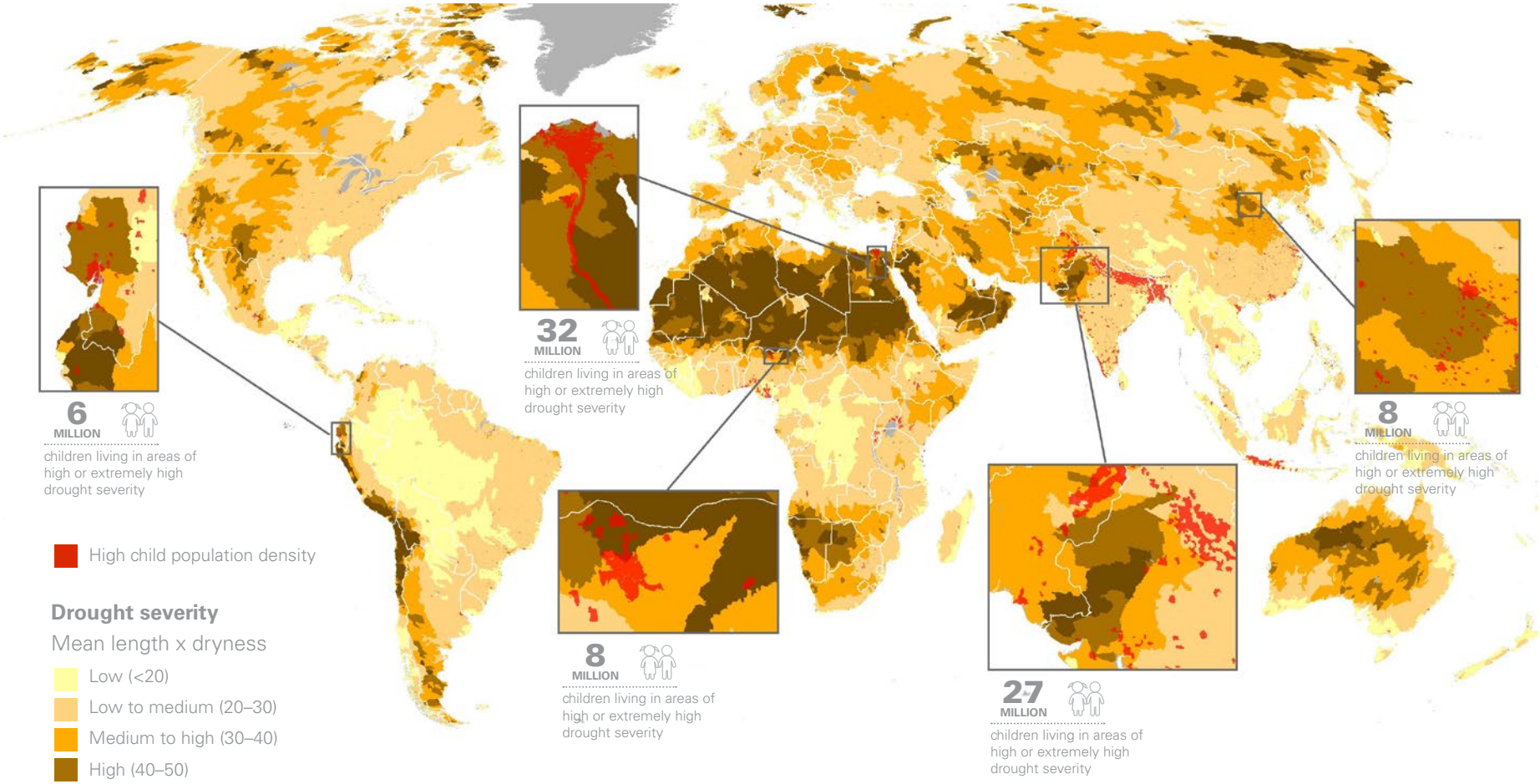
In Eastern Africa, the 2011 drought contributed to a food crisis that brought many threats to children. The loss of livelihoods forced children to beg for food and take hazardous jobs to support their families. Families often had to split up in search of food, leaving children alone, unprotected and exposed to violence, abuse and exploitation. School attendance also dropped sharply.[13]

In the same year, one in five children in rural Indonesia said that weather events, like droughts and failing harvests, meant they had to leave school and find work to help support their family.[14] Children in Kenya said that the weather impacts the ability of their families to put food on the table.[15] Experts suggest that the record drought in Syria may have contributed to the strife behind the current conflict.[16]

Droughts can also increase the incidence of communicable diseases. Because water is scarce, poor drought-affected families and children without parental care often resort to using unsafe water. Health services can also become disrupted if healthcare workers are forced to leave local areas due to the drought.

Nearly 160 million children live in areas of high or extremely high drought severity

Fig. 3: Children living in areas of high or extremely high drought severity



160 MILLION

CHILDREN LIVE IN AREAS OF HIGH OR EXTREMELY HIGH DROUGHT SEVERITY

Source: UNICEF analysis, 2015. Original drought maps from World Resources Institute (WRI) Aqueduct.

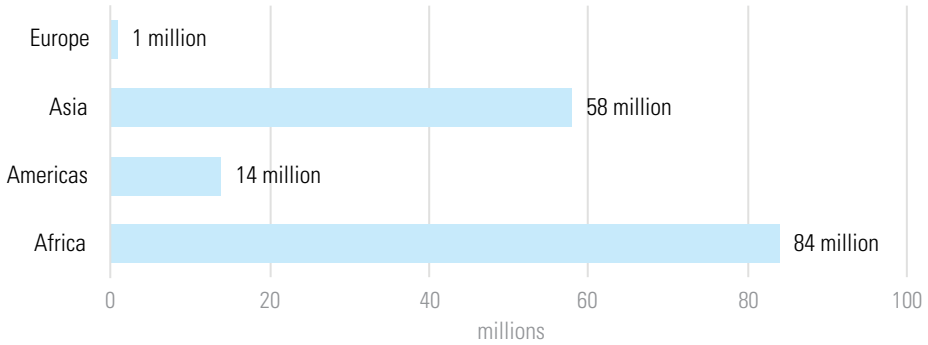
Note: Drought severity estimates the average of the length times the dryness of droughts from 1901 to 2008. Drought is defined as a continuous period where soil moisture remains below the 20th percentile. Length is measured in months, and dryness is the number of percentage points below the 20th percentile (Sheffield and Wood 2007, provided by WRI). For a full description of droughts, see Annex A.

This map does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area has not yet been determined.

Additionally, overcrowding, resulting from displacement of populations, can also affect water consumption and sanitation conditions.[17]

The risks to children from drought go well beyond threats to their physical well-being and protection. Children also experience emotional distress, including fear of being separated from their families, mounting tensions and pressures within households, a lack of emotional support at family level, and increased workloads.[18]

Drought can also lead to other conditions that are potentially dangerous, such as forest and peat fires.[19] They can result in death or displacement, as well as the destruction of essential services, shelter and food. Furthermore, smoke from wildfires is harmful to health, even across long distances – and has been estimated to cause 260,000 to 600,000 global deaths annually.[20] On average, children under the age of 12 breathe twice as frequently as adults and so the impact of smoke on their health is particularly severe.[21,22,23] In Indonesia and neighbouring countries, wildfires exacerbated by El Niño in 1997 caused a serious episode of smoke and haze, and a spike in greenhouse gas emissions.[24] More than 12 million people in Indonesia were exposed to the haze, and in Singapore there was a 30 per cent increase in hospital cases associated with haze-related conditions. The ongoing 2015–2016 El Niño weather phenomenon is again aggravating wildfires in Indonesia and elsewhere, causing significant health, social, economic and environmental damage.[26]

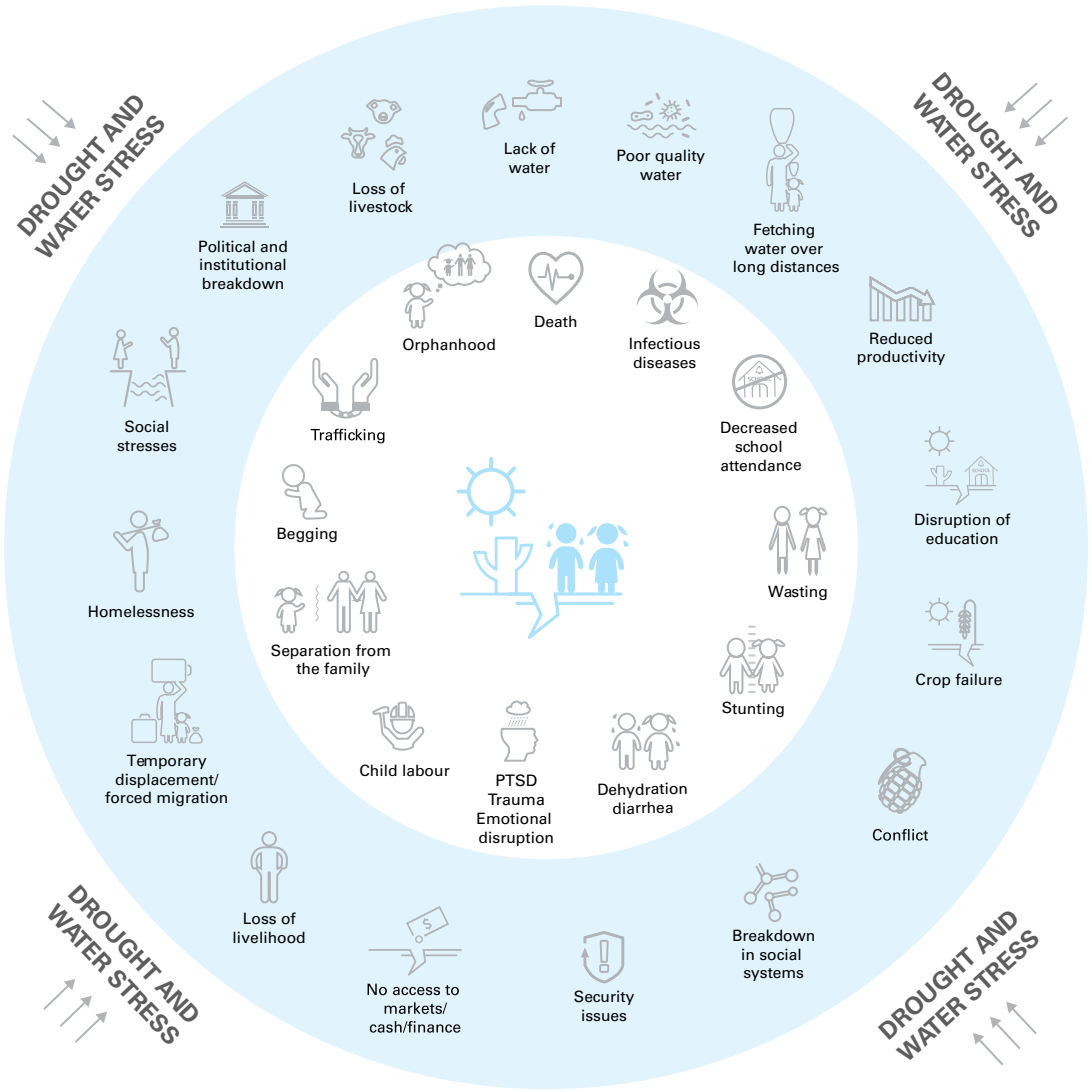


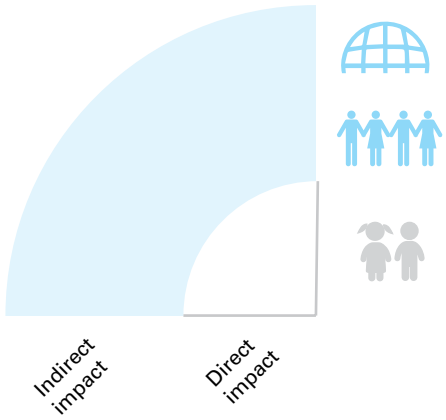
Africa has the highest number of children living in areas of high or extremely high drought severity.

Fig. 4: Number of children living in areas of high or extremely high drought severity by region

Potential impacts of droughts and water stress on children

Fig. 5.





Note: These infographics are meant to be illustrative only. Floods, droughts, severe weather, and extreme heat events vary considerably depending on the context in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality. The impacts of these events have much to do with the strength of disaster-risk reduction, resilience, adaptation and recovery programmes and policies.

Double disadvantage

Fig. 6.

NEARLY
160
MILLION

children live in areas of high and extremely high drought severity.

NEARLY
70
MILLION

children live in areas of high and extremely high drought severity in countries **with low access to improved sanitation.**[a]

NEARLY
60
MILLION

children live in areas of high and extremely high drought severity in countries **with low access to safe water.**[b]

OVER
50
MILLION

children live in areas that face both high drought severity and where half or more of the population **lives on less than $3.10 per day.**[c]

OVER
20
MILLION

children living in areas of high and extremely high drought severity also live in **fragile contexts**.[d]

a - Countries where less than half of the population has access to improved sanitation facilities. Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation (WHO/UNICEF JMP)

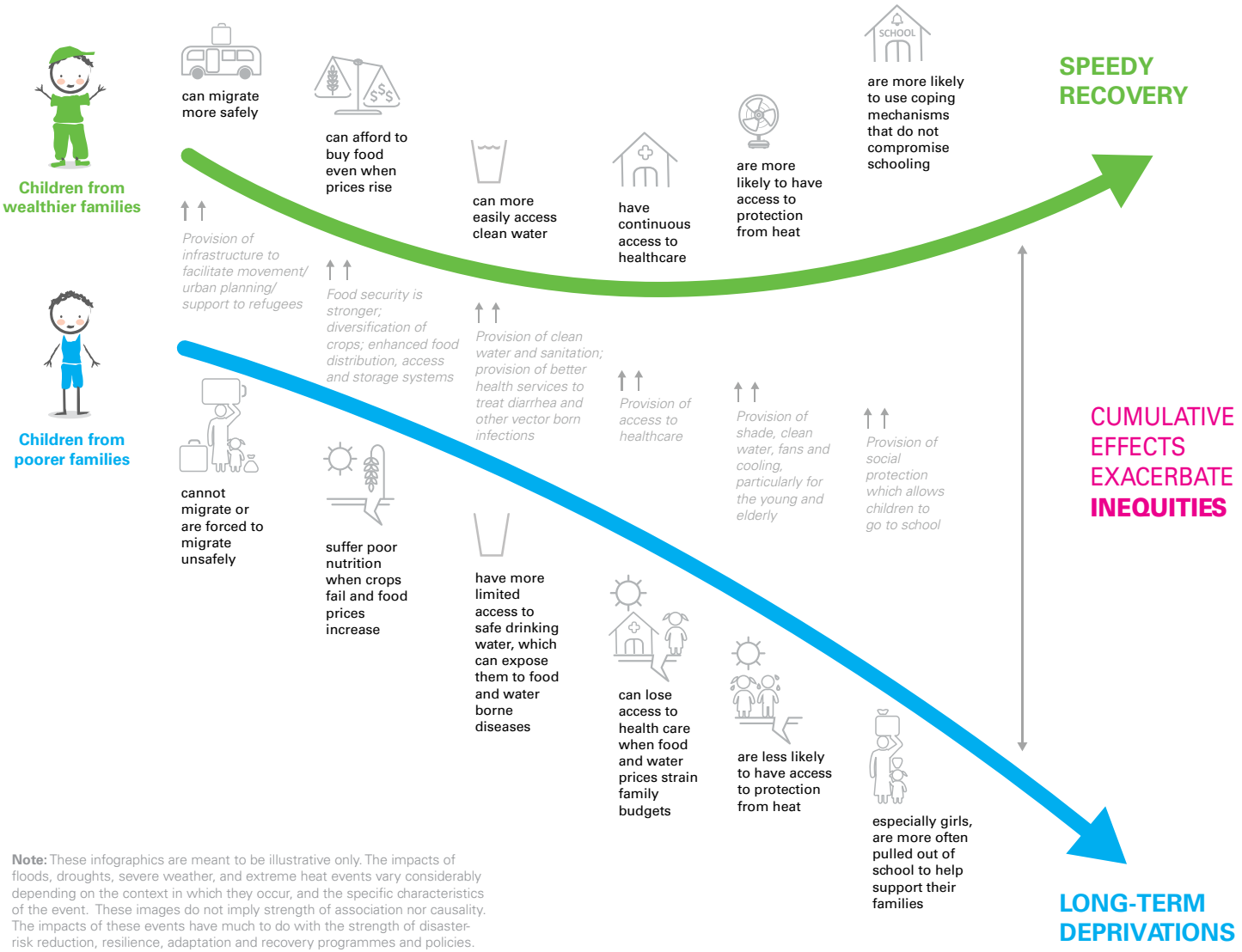
b - Countries where 10 per cent or more of the population lacks access to improved drinking-water sources. Source: WHO/UNICEF/JMP

c - Countries where half or more of the population lives on less than $3.10 per day, as per recent updates on poverty thresholds by World Bank.

d - Countries defined by World Bank - Harmonized List of Fragile Situations FY16.

Droughts can exacerbate inequities

Fig. 7.



Note: These infographics are meant to be illustrative only. The impacts of floods, droughts, severe weather, and extreme heat events vary considerably depending on the context in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality. The impacts of these events have much to do with the strength of disaster-risk reduction, resilience, adaptation and recovery programmes and policies.

Over half a billion children live in extremely high flood occurrence zones.






2. Floods and severe storms

More than half a billion children live in extremely high flood occurrence zones, the vast majority of them live in Asia.

Floods threaten children's survival and development. Direct impacts include injuries and death by drowning. Many children lack sufficient strength to stay on their feet when currents are fast, including in shallow water. Even when they know how to swim, strong currents and debris in the water put them at high risk of injuries and drowning.

Beyond the immediate risks of death and injury, floods pose a grave risk to children's health. Floods compromise safe water supplies, increasing the risk of diarrhoea outbreaks. They also damage sanitation facilities, contributing to water contamination and undermining the sustainability of sanitation behaviours.[1] Additionally damage to housing endangers children's well-being, particularly if emergency shelter is either scarce or inadequate.

Flooding also affects children due to its impact on both family livelihoods and food security. Coastal flooding salinates arable land, diminishing agricultural areas and productivity: both of these can decrease food availability and income, and increase malnutrition, particularly among young children.[2,3]

Storm surges lead to the salt water intrusion into coastal freshwater aquifers on which millions of people depend for drinking water.[4] In such emergency situations, breastfeeding becomes vital: not only is breastfeeding the best source of nutrition for the baby, it contains antibodies that protect the child against illness. In emergency situations it becomes almost impossible to prepare and feed breastmilk substitutes safely.[5]

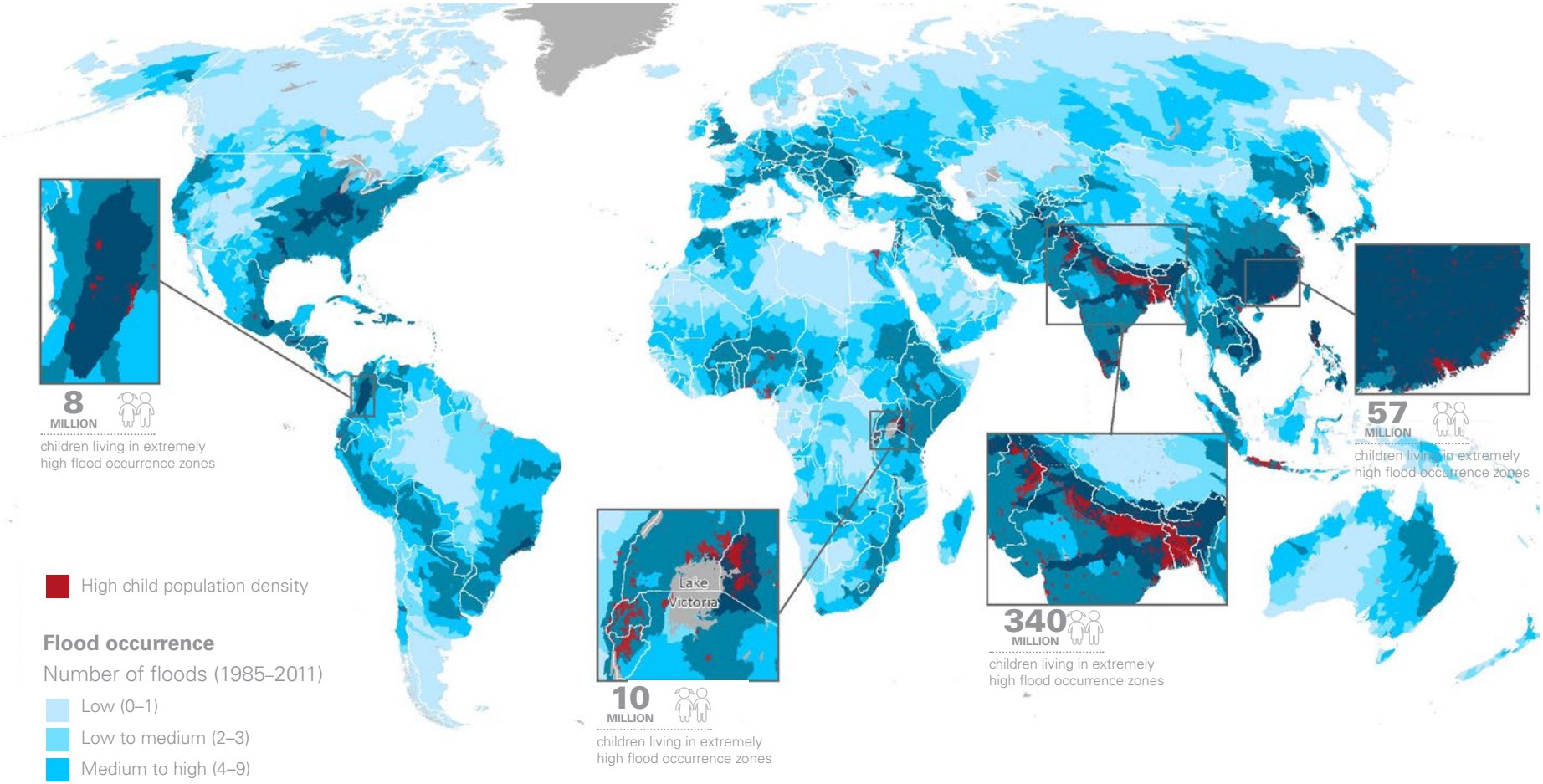
Floods can displace thousands of people, temporarily or for extended periods before houses and infrastructure, such as roads, power and communication links are rebuilt. Children, in particular, are highly vulnerable during population displacements. When a catastrophe occurs, parents or relatives can die and child protection systems become disrupted, increasing children's susceptibility to abuse, child labour, trafficking and exploitation. Since 2008, climate-related displacement has affected an estimated 22.5 million people per year on average - equivalent to 62,000 people every day.[6]

These pernicious impacts on children are not just theoretical; they have occurred in recent floods around the world. The 2010 floods in Pakistan affected more than 2.8 million children under 5 years of age, many severely. Rates of under-five mortality were notably higher in flood-affected areas than the national average. Furthermore, access to quality medical facilities dropped as the floods damaged or destroyed around 15 per cent of clinics and hospitals, and wiped out stocks of essential drugs.[7]

The long-term effects of flooding on children can be substantial. Evidence shows that the 1997-1998 El Niño reduced families' income and led to stressful conditions for many poor children and families. About five years later, children exposed to the direct effects of the El Niño during their early childhood posted test scores in language development, memory and visual spatial thinking 11-21 per cent lower than children of similar age unaffected by the shock. Negative physical effects were also found, including lower height (1-1.8 cm), higher propensity to stunting and lower weight for age (0.38kg) compared to the control group.[8]

More than half a billion children live in extremely high flood occurrence zones

Fig. 8: Children living in flood occurrence zones



530 MILLION

CHILDREN LIVE IN EXTREMELY HIGH FLOOD OCCURRENCE ZONES

Source: UNICEF analysis, 2015. Original flood maps from World Resources Institute (WRI) Aqueduct.

Note: Flood occurrence is a count of the number of floods recorded from 1985 to 2011. Extremely high flood occurrence make up areas with >27 floods between this period (see Brakenridge, Dartmouth Flood Observatory 2011, provided by WRI). For a full description, see Annex A.

This map does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area has not yet been determined.






The impacts go beyond the physical and cognitive. Studies of post-traumatic stress disorder following Hurricane Andrew in the south-east of the United States found that children are two to three times more likely than adults to suffer the symptoms of post-traumatic stress disorder and that these symptoms endure longer in children than in adults.[9] A study in southwestern Poland showed similar results: 28 months after the 1997 flood, 18 per cent of the study participants (age 11-21) were diagnosed with post-traumatic stress disorder.[10,11]

Overlapping crises, such as floods combined with conflict and/or poverty, can be particularly detrimental. More than 6 million children live in fragile contexts that are also extremely high flood occurrence zones; and over 300 million children who live in extremely high flood occurrence zones also live in countries where half or more of the population lives on less than US$3.10 per day.‡

The Intergovernmental Panel on Climate Change (IPCC) has established that sea level rise contributes to coastal flooding and erosion. This is due to the thermal expansion of water when temperature increases, and in particular because of melting land-based ice. Compared to the global mean between 1986 and 2005, a likely range of sea level rise would be 40 cm (between 26 cm and 55 cm) in the highly ambitious action scenario (RCP 2.6), 47 cm (32cm - 63 cm) under a 'moderately ambitious action' scenario (RCP 4.5), and 63 cm (45cm - 82 cm) under a 'business-as-usual' scenario (RCP 8.5).* These impacts will happen gradually, but will nevertheless have major socio-economic implications.[12,13] The impact of rising sea levels will be even more acute when combined with extreme weather events, such as tropical cyclones. Coastal structures, early warning systems, and evacuation plans that were previously adequate will require strengthening and adjustments.

Oceans themselves are also under pressure as a result of climate change. For example, the increase in water temperature and acidification caused by climate change is affecting marine life in terms of health, reproduction and migration of species, compounded by stresses such as overfishing and pollution. Marine ecosystems and biodiversity are at risk, and so are livelihoods, especially of coastal communities dependent on subsistence fishing for their livelihoods and protein intake.[14,15,16]

‡ Note: In October 2015, The World Bank updated its International Poverty Lines from $2.00 a day to $3.10, and for extreme poverty from $1.25 to $1.90 a day.
* Please see page 60 for further description on scenarios

Double disadvantage

Fig. 9.

NEARLY
530
MILLION

children live in extremely high flood occurrence zones.

OVER
270
MILLION

children live in extremely high flood occurrence zones in countries **with low access to improved sanitation.** [a]

NEARLY
100
MILLION

children live in extremely high flood occurrence zones in countries **with low access to safe water.** [b]

OVER
6
MILLION

children living in extremely high flood occurence zones also live in **fragile contexts.** [c]

OVER
300
MILLION

children living in extremely high flood occurrence zones are also in countries where half or more of the population **lives on less than $3.10 per day.** [d]

OVER
400
MILLION

children live in extremely high flood occurrence zones in countries with **high proportions of diarrhoeal deaths.** [e]

10
MILLION

children face the double danger of living in extremely high flood occurrence zones and in countries **with high proportions of malaria deaths.** [f]

a - Countries where less than half of the population has access to improved sanitation facilities. **Source:** WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation (WHO/UNICEF JMP)

b - Countries where 10 per cent or more of the population lacks access to improved drinking-water sources. **Source:** WHO/UNICEF/JMP

c - Countries defined by World Bank - Harmonized List of Fragile Situations FY16. [17]

d - Countries where half or more of the population lives on less than $3.10 per day, as per recent updates on poverty thresholds by World Bank. [18]

e - Countries where more than 5% of deaths under 5 years of age are due to diarrhoea. **Source:** WHO-MCEE estimates of child cause of death, 2000-2015/UNICEF

f - Countries where more than 5% of deaths under 5 years of age are due to malaria. **Source:** WHO-MCEE estimates of child cause of death, 2000-2015/UNICEF

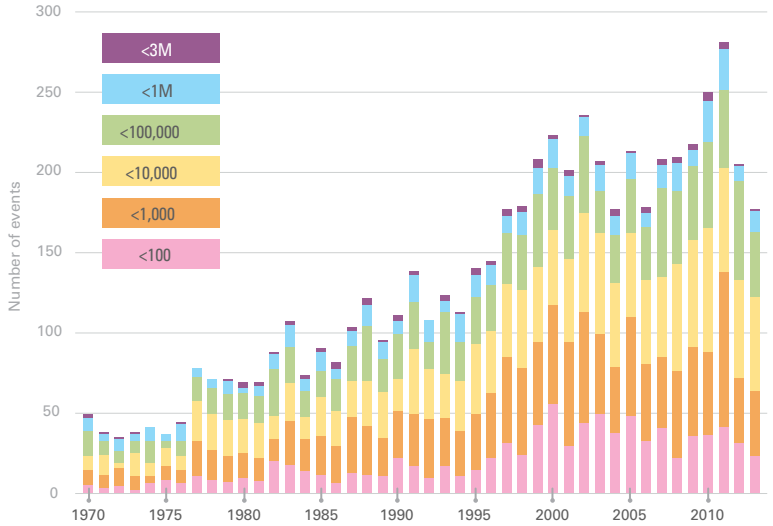
Floods are often caused by storms, but storms also have an impact on children in specific ways. Approximately 115 million children globally live in high or extremely high tropical cyclone risk zones.† The most vulnerable continent by far is Asia, where more than 100 million children live in high or extremely high tropical cyclone risk zones. Tropical cyclones (known as typhoons, hurricanes and cyclones depending on their location) pose grave and immediate risks to children including serious injuries and death, the breakdown of essential services such as health, water and sanitation, and widespread population displacement.[19]

Severe storms often result in extensive damage to infrastructure (roads, railways, bridges, power lines, communication and coastal protection), buildings (homes, schools and health clinics), agriculture, forestry and coastline erosion; this can affect economic development, social stability and the rule of law.

Strengthening health systems will be crucial to managing and improving resilience to severe storms. Strong child protection systems will also be necessary to prevent abuse, neglect, trafficking and other related harms that children face as a result of droughts, floods and the associated impacts such as migration and displacement.

Over the past four decades, the annual number of disaster-related displacements has grown steadily

Fig. 10: Annual disaster-related displacement events by magnitude of displacement

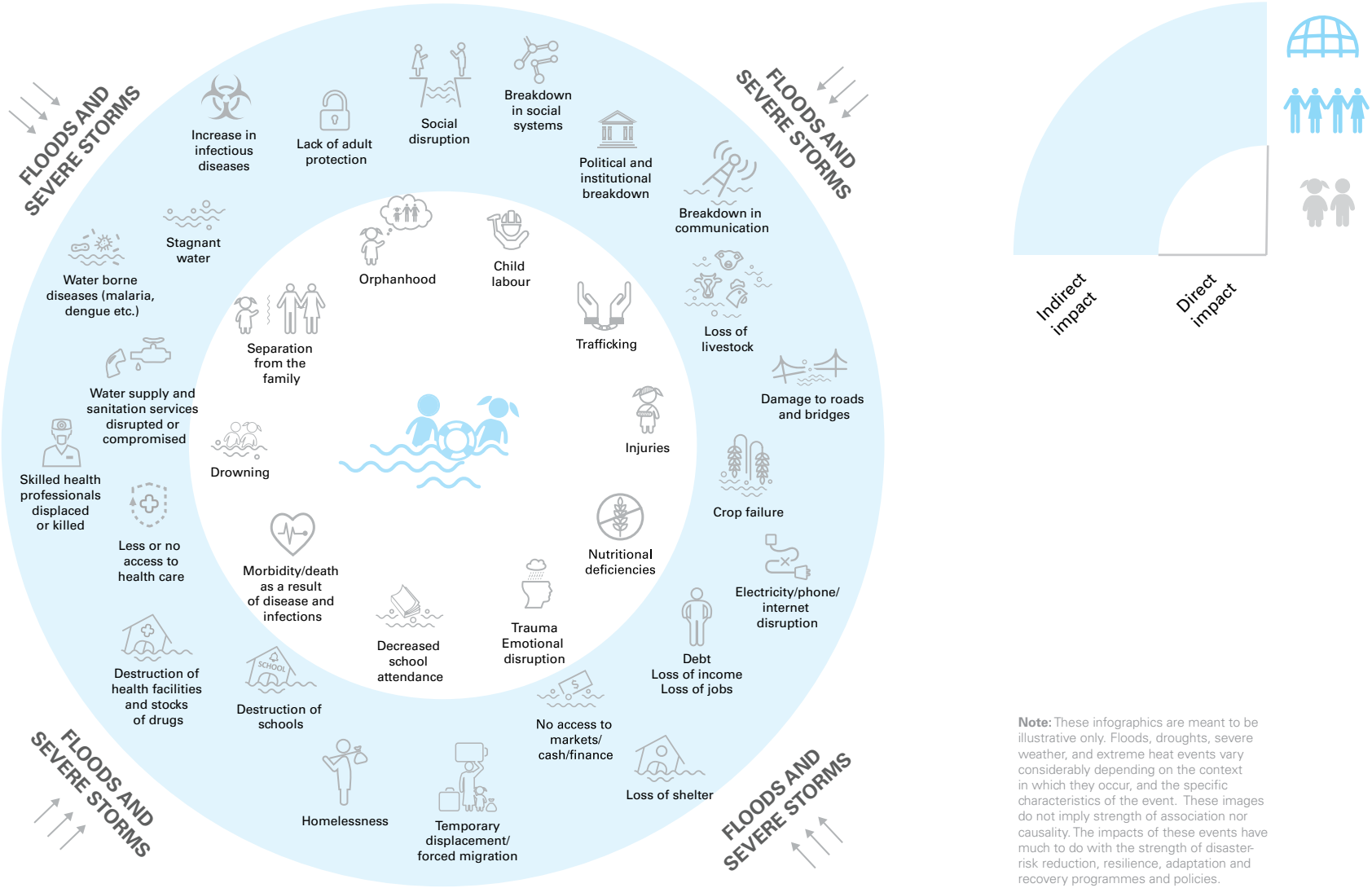


Source: The Internal Displacement Monitoring Centre (IDMC), Disaster-related displacement risk: measuring the risk and addressing its drivers, 2015

† Child population that lives in 'high' and 'extremely high' cyclone risk zones. Cyclone risk is defined by UNEP. Unit is estimated risk index from 1 (low) to 5 (extreme). This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR). It was modeled using global data. Credit: UNEP/GRID-Europe.

Potential impacts of floods and severe storms on children

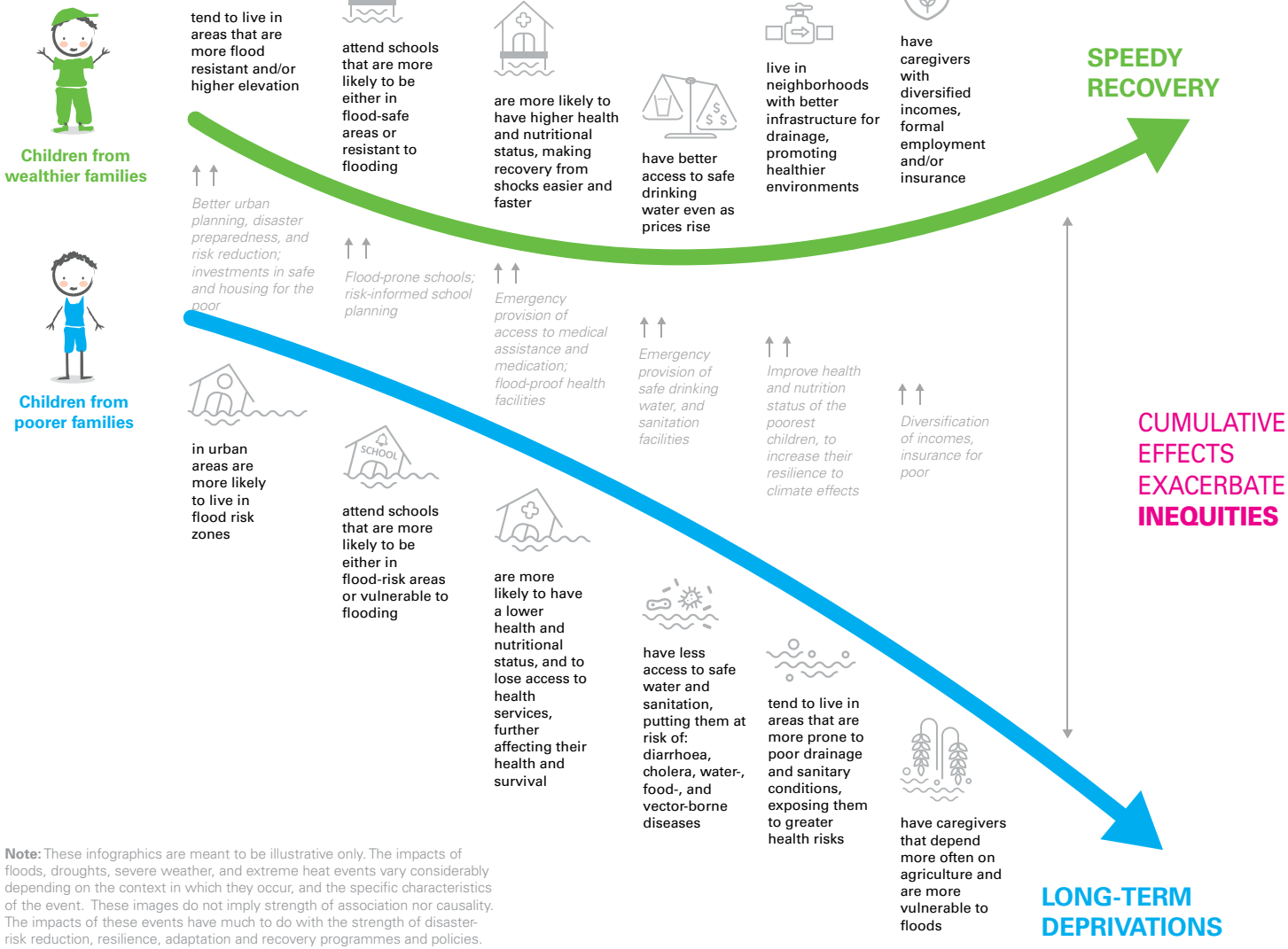
Fig. 11.



Note: These infographics are meant to be illustrative only. Floods, droughts, severe weather, and extreme heat events vary considerably depending on the context in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality. The impacts of these events have much to do with the strength of disaster-risk reduction, resilience, adaptation and recovery programmes and policies.

Floods and severe storms can exacerbate inequities

Fig. 12.



Note: These infographics are meant to be illustrative only. The impacts of floods, droughts, severe weather, and extreme heat events vary considerably depending on the context in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality. The impacts of these events have much to do with the strength of disaster-risk reduction, resilience, adaptation and recovery programmes and policies.

Extreme heat will become a growing and a regular problem in many parts of the world. Public education on how to manage it will be vital.


أوكي






3. Heat stress

Numerous studies have documented that human-induced climate change has increased the frequency and severity of heatwaves across the globe. Children stand to suffer greatly from this as they adjust more slowly than adults to changes in environmental heat, and are more vulnerable to heat-related health risks.[1, 2, 3, 4, 5]

During heatwaves, studies have shown that children under 12 months old are particularly vulnerable.[6, 7, 8] Infants and small children are more likely to die or suffer from heatstroke because they are unable or lack agency to regulate their body temperature and control their surrounding environment.[9] In addition, heat stress can be especially challenging in cold chain management, as certain microbes multiply faster and more efficiently under higher temperatures.

Exposure to abnormal or prolonged amounts of heat and humidity without relief or adequate fluids can cause various types of heat-related illnesses. The health effects of heatwaves include heat rash, which are prevalent in young children, as well as heat-related cramps, exhaustion and stroke.[10] Children and adolescents with chronic health conditions, such as respiratory conditions and those who take certain medications, may be even more susceptible to heat-related illnesses.[11] Other risk factors include whether a child is poor, has access to adequate nutrition, water and sanitation, or is orphaned and/or homeless.

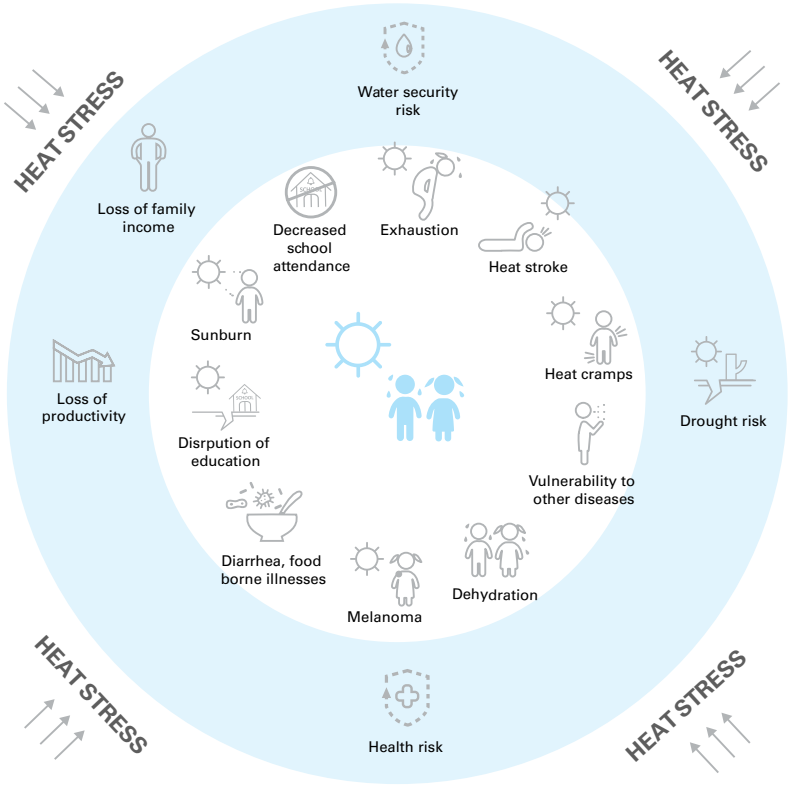
Extreme heat stress can result in dehydration, which slows the sweating rate. This is a common cause of hyperthermia and death in infants, young children and the elderly, Factors that promote excessive fluid loss, such as diarrhoea, may increase the risk of heat-related injury and death.[12]

A number of studies point to the links between increased temperature and the health of children. During El Niño in the late 1990s when temperatures were 5ºC above normal in Lima, Peru, one study found that there was a 200 per cent increase in the hospitalization of children compared to the normal rate.[13]

Extreme heat is a real threat to children's well-being, not just in countries around the equator but also in many temperate climates. Extreme heat does not only affect children directly, but also affects them through a variety of heat-related illnesses.[14] Protecting children requires the right clothing, shelter and access to drinking water so they can stay hydrated. Extreme heat will become a growing and a regular problem in many parts of the world. Public education on how to manage it will be vital.

Potential impacts of heat stress on children

Fig. 13.



Note: These infographics are meant to be illustrative only. The impacts of floods, droughts, severe weather, and extreme heat events vary considerably depending on the context in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality. The impacts of these events have much to do with the strength of disaster-risk reduction, resilience, adaptation and recovery programmes and policies.

Extreme heat does not only affect children directly, but also affects them through a variety of heat-related illnesses. Protecting children requires the right clothing, shelter and access to clean drinking water so they can stay hydrated.

Household air pollution leads to 4.3 million deaths annually, and 13 per cent (534,000) of these are deaths of children under 5.






4. Air pollution

Household (or indoor) air pollution contributes to 4.3 million deaths each year, and 13 per cent (534,000) of these are deaths of children under 5. [1] More than 50 per cent of deaths among children in this age group are due to pneumonia caused by particulate matter (soot) inhaled from household air pollution.[2] Exposure to household air pollution also has fatal consequences on pre-natal health leading to increased risk of stillbirth and low birthweight.[3] Promoting clean cooking technologies and fuels as well as cleaner sources of light can support substantial health benefits for children.

Ambient (or outdoor) air pollution, which is predominantly a cause of climate change rather than an effect, also has major ramifications for child health. In 2012, an estimated 3.7 million deaths worldwide were attributable to ambient air pollution; 3 per cent (127,000) of these deaths were children under the age of 5.[4,5] Ambient air pollution tends to be worst in urban centres. As more children live in urban centres, this poses a growing threat. Currently, more than 50 per cent of the world's population live in urban areas; by 2050 this share is expected to reach 70 per cent.[6]

Exposure to air pollutants through inhalation is particularly harsh for children because their lungs are small and still developing until around the age of 18. Their mean breathing rate up until age 12 is still about twice as rapid as adults, meaning that they will inhale proportionately more polluted air – particularly since, in general, they spend more time outdoors engaging in vigorous physical activity.[7, 8, 9, 10, 11]

Increasing temperatures compound the direct toxicity of fossil-fuel pollutants such as ozone, an important trigger of childhood asthma, as well as breathing troubles for adults with chronic lung diseases.[12,13,14] Ozone can exacerbate asthma symptoms in children who already suffer from the disease[15]; long-term exposure can also cause asthma in healthy children.[16] Children are also more likely to suffer from asthma than adults, and they may be exposed to higher levels of ozone because they are more likely to be outside during peak ozone times.[17]

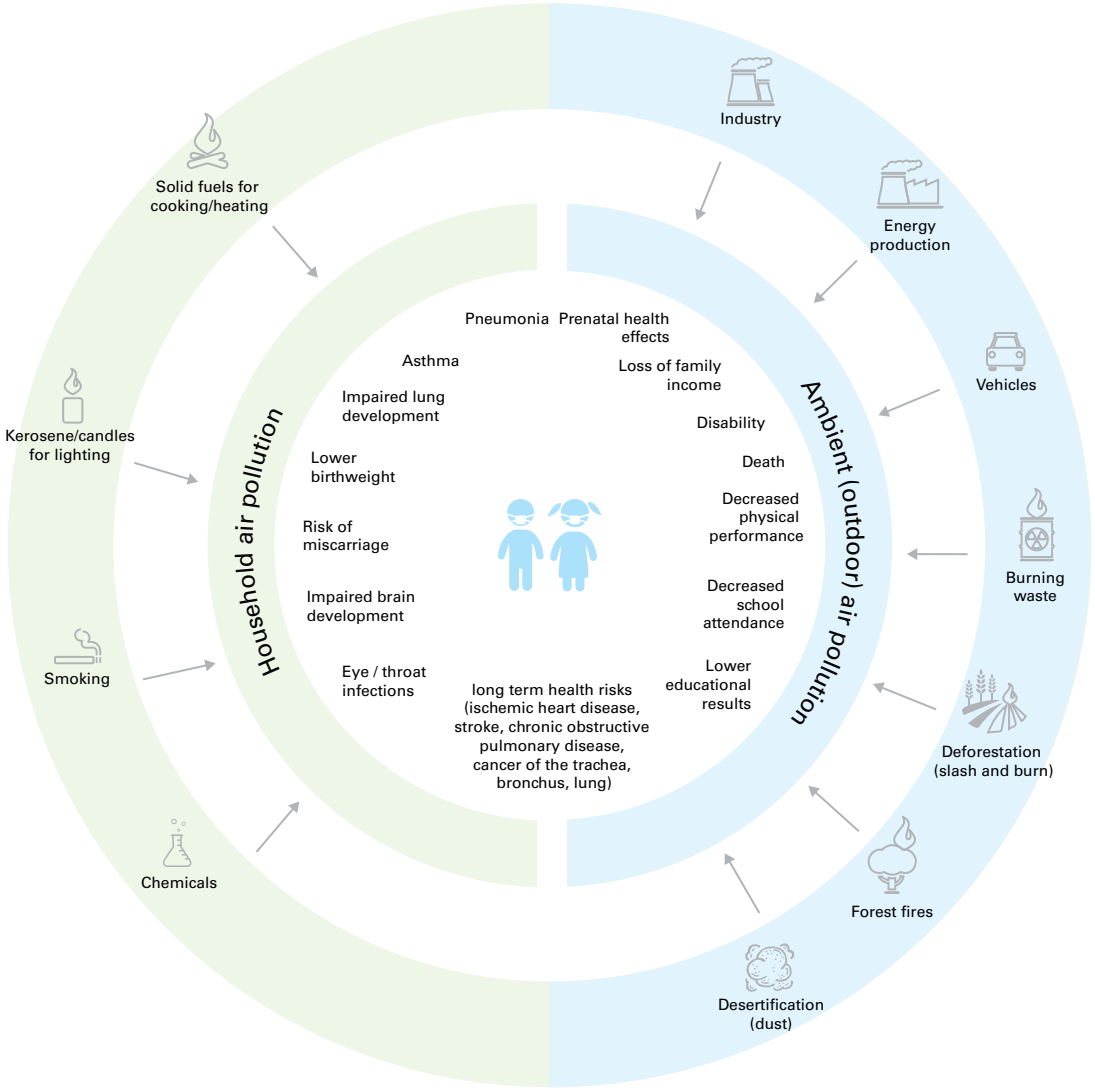
A further consequence of a warmer climate is an increase in plant growth and pollen production, resulting in higher levels of natural allergens, and consequently an increase in the incidence and severity of asthma and other respiratory conditions in children.[18]

Studies have shown that climate change can result in droughts which have been associated with an increasing number of wildfires. These wildfires can lead to particularly problematic levels of air pollution. In 1997, wildfires were responsible for considerable health issues in Indonesia and Singapore.[19,20] Currently, wildfires are again also posing significant threats to these and other countries in Asia.[21]

Reducing so-called short-lived climate pollutants such as soot, tropospheric ozone or methane as recently recommended by the World Health Organization and the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants, represent an opportunity with particularly rewarding benefits for child and maternal health outcomes. In addition, decisive action on these climate pollutants would bring positive effects to food security, physical activity and could potentially save 3.5 million lives each year by 2030.[22]

Potential impacts of air pollution on children

Fig. 14.



Household (indoor) air pollution

Ambient (outdoor) air pollution

Note: These infographics are meant to be illustrative only. The impact of air pollution varies considerably depending on the context. These images do not imply strength of association nor causality. The impacts have much to do with children's underlying health, as well as the strength of programmes and policies to limit air pollution and protect children from it.

Outdoor air pollution tends to be worse in urban centres. As more and more children live in urban centres, this poses a growing threat to their health and well-being.

Lethal and debilitating diseases including malaria and dengue fever are highly susceptible to changes in the climate.

5. Diseases

Lethal and debilitating diseases, including malaria and dengue fever, are highly susceptible to changes in the climate. Changes in temperature, precipitation and humidity have a direct effect on the reproduction and survival of the mosquitoes that transmit these diseases. Similarly, stagnant water from increased rainfall, floods or extreme weather events that disrupt and contaminate water systems can influence the spread of cholera and meningococcal meningitis and other food-borne dieseases, including diarrhoea. Warm temperatures alter parasitic development rates, and increase bite rates and transmission. Overcrowded urban areas that have standing water and poor access to sanitation are at particular risk.[1]

The World Health Organization (WHO) has estimated that 88 per cent of the existing burden of disease as a result of climate change occurs in children under 5 years of age.[2] This is due to their particular vulnerability in the early stages of life. When it comes to the spread of disease influenced by climate change, the risk falls squarely on children.

Malaria

Malaria is one of the world's most threatening killers, especially of children under the age of 5. This age cohort still represents over two thirds of global malaria deaths – or over 800 children under 5 per day.[3] With increasing temperatures and shifting agro-ecological zones, the geographic prevalence of malaria is changing and spreading into higher altitudes. For example, tropical highland zones are increasingly likely to see higher rates of malaria transmission as temperatures rise. This makes population groups who may have not yet adopted the practices to adequately protect themselves and their children from malaria particularly vulnerable.[4]

In addition, there is the risk of reintroduction of malaria to areas where the disease has been eradicated. The same applies to other temperature-sensitive vector-borne diseases and their carriers, such as Lyme disease, which is transmitted by ticks.

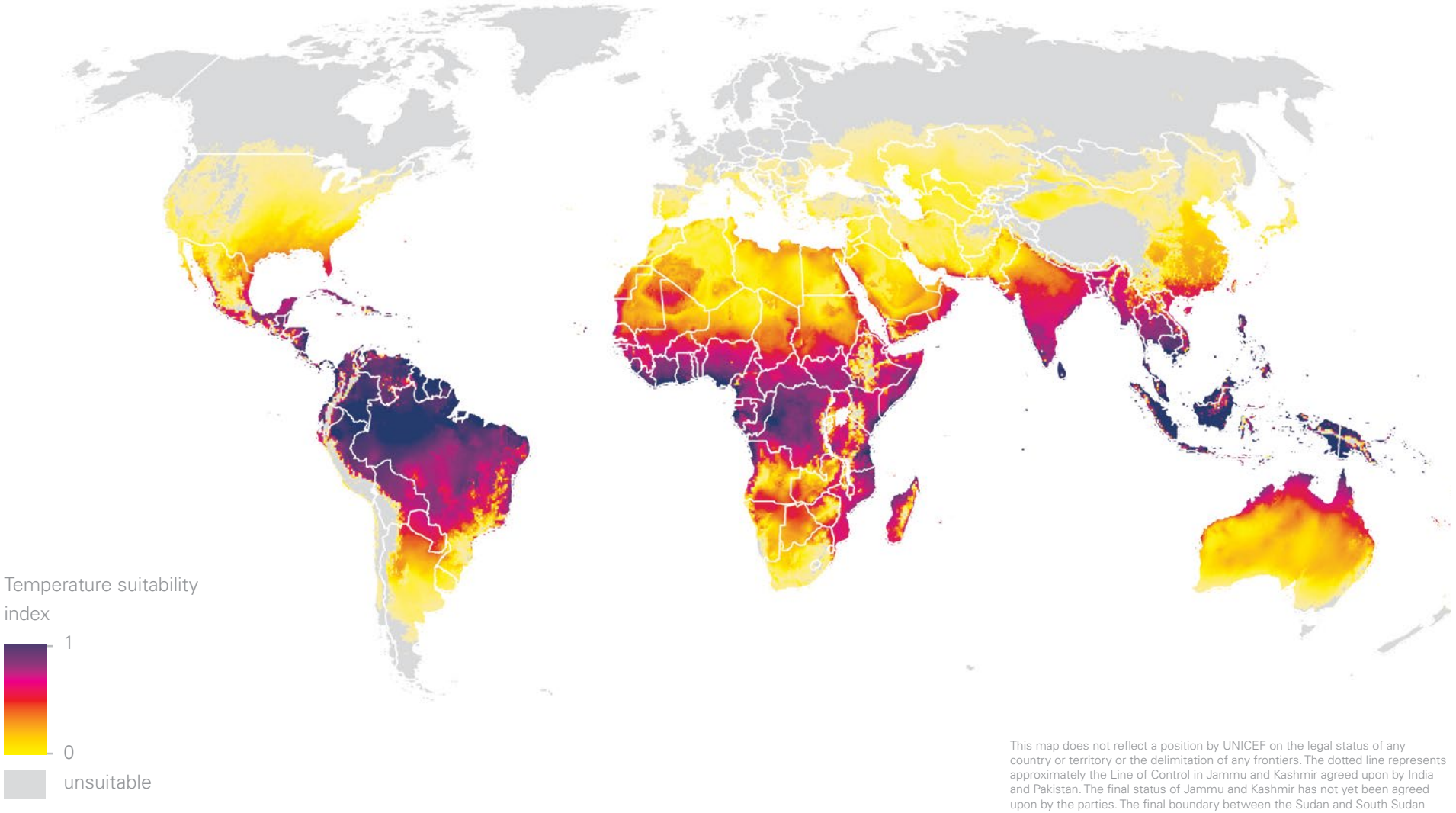
Incidences of malaria are greatest in Africa, where an estimated 90 per cent of all malaria deaths occur. Low- and lower-middle income countries are primarily affected and typically have limited access to effective health care services for prevention, diagnosis, and treatment.[5] Therefore, reductions in the incidences of malaria are directly associated with health system strengthening, infrastructure and poverty reduction.

The geographic range and incidence of malaria is dependent on weather and climate.[6] Future projections of precipitation patterns, temperature variability, and temperature of the water at breeding sites will likely alter disease susceptibility.[7] The transmission of malaria typically peaks at 25ºC and decreases above 28ºC.[8] Climatic events may also contribute to malaria epidemics, including El Niño events and the Indian Ocean Dipole (IOD).[9] El Niño events have been associated with malaria outbreaks in Colombia, Ecuador, Peru, French Guiana, Amazonia, and Venezuela.[10]

Climatic conditions could affect the movement of parasites into new regions and alter ecosystems, which could in turn affect the transmission of malaria.[11] Highland areas above 2,000 metres – where temperatures are currently too low for transmission to occur – especially in East Africa, are expected to experience increased malaria epidemics as climate change persists.[12] Malaria transmission in the Bolivian Andes has reached 2,300 metres, and

Rising global temperatures have made many regions suitable for transmission of malaria, one of the world's leading killers of children under the age of 5

Fig. 15: Temperature suitability for the transmission of malaria



This map does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. The final boundary between the Sudan and South Sudan has not yet been determined. The final status of the Abyei area has not yet been determined.

Source: WHO/WMO Atlas of Health and Climate, 2012.

even higher altitudes in Venezuela and Bolivia.[13] In China, the re-emergence of malaria has been linked to increases in rainfall and temperature.[14]

However, while in most cases higher temperatures will expand suitable climates for malaria, the relationship between climate change and the spread of vector born disease is complex. Malaria incidences will also depend considerably on public health interventions, as well as factors influencing the reproductive potential of parasites, land use change and drug resistance.[15]

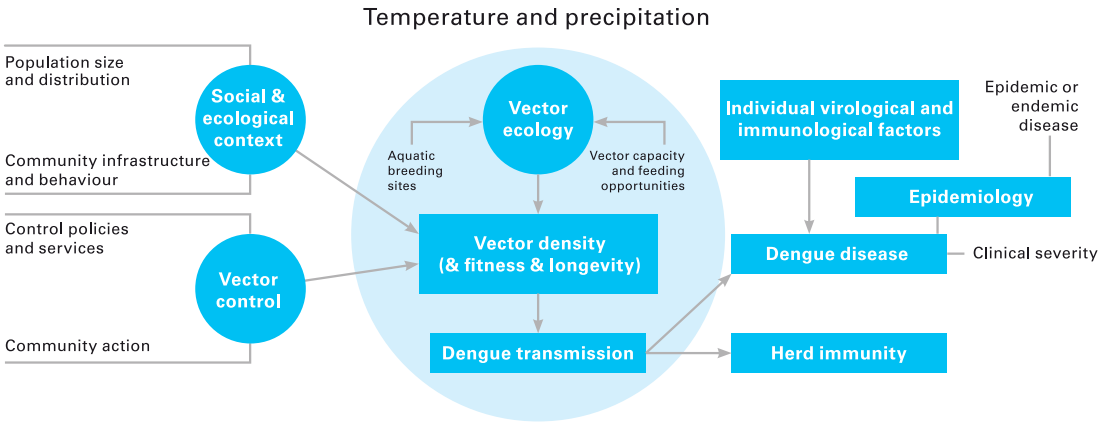
Dengue fever

Dengue fever affects approximately 50 million people, and is responsible for 15,000 deaths per year.[16] It is the most rapidly spreading mosquito-borne viral disease in the world, facilitated by increasing globalization and migration, climate change and mixing of strains. No effective vaccine exists for the disease; it can only be dealt with by environmental and chemical control of the vectors, rapid case detection and case management in hospitals.

The disease is endemic in over 100 countries in Africa, the Americas, Eastern Mediterranean, South-East Asia, and Western Pacific.[17] Variations in endemics are associated with rainfall, temperature, and unplanned rapid urbanization.[18] Climatic events have influenced the prevalence of dengue fever in Venezuela during La Niña events.[19] Furthermore, environmental and climate variability have major impacts on the incidence of dengue fever in Central America, Colombia, and French Guiana.[20]

Diarrhoea

Worldwide, diarrhoea ranks among the top five causes of death for children under 5. Acute cases of diarrhoea can last several days

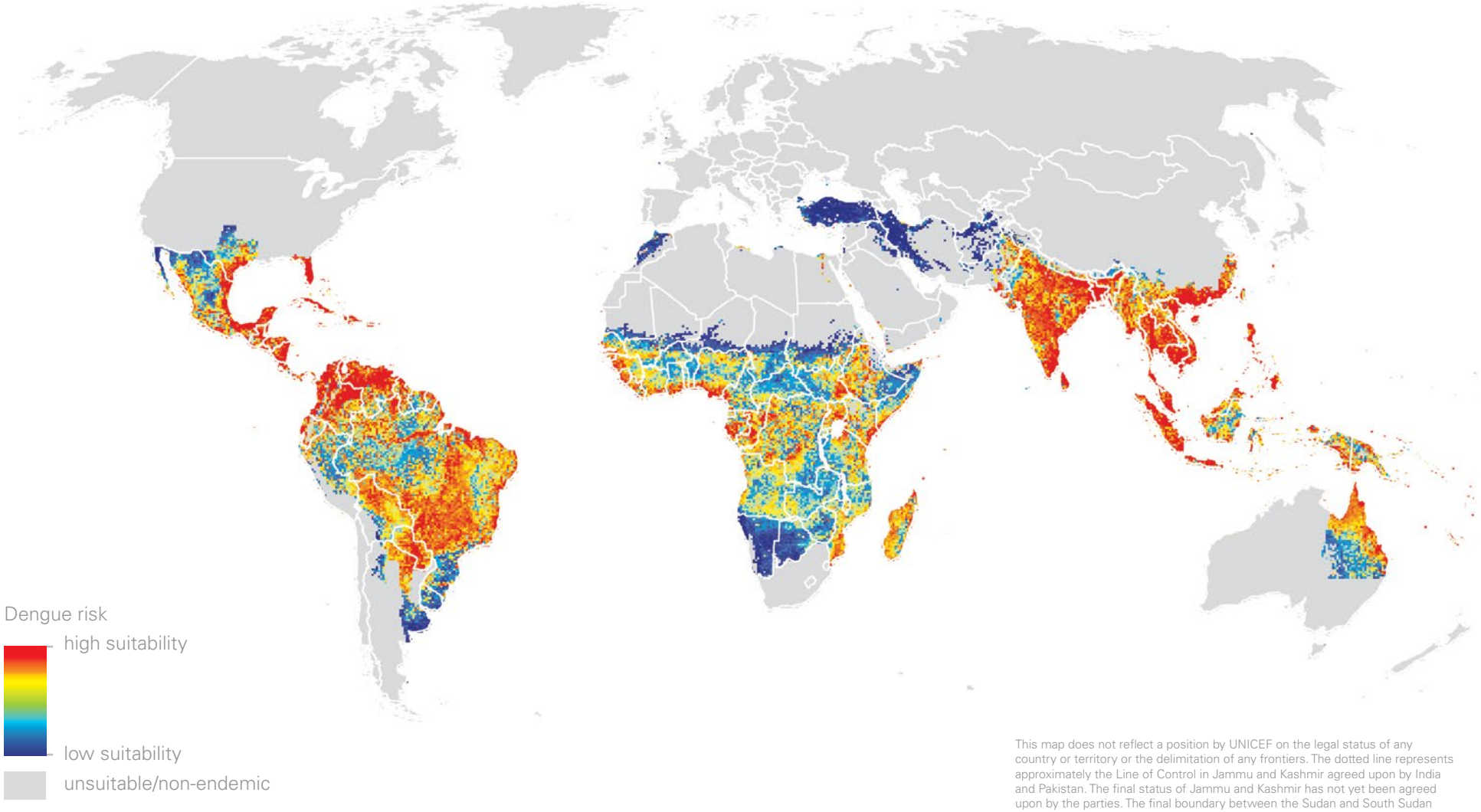


Source: WHO/WMO Atlas of Health and Climate, 2012

Fig. 16: Climate exerts a strong influence on dengue transmission - in interaction with many other non-climate factors

Conditions that increase suitability for dengue fever are likely to intensify due to climate change

Fig. 17: Estimated suitability for dengue based on a combination of disease surveillance data, and prediction based on climate and other environmental factors



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Source: WHO/WMO Atlas of Health and Climate, 2012






and cause dehydration through significant fluid and nutrient loss, which can result in death.[21] Children who are already malnourished or have impaired immunity, for example, if living with HIV, are at a high-risk level of life-threatening diarrhoea.[22]

Intense weather events such as severe storms, which can cause floods and landslides and which are increasing in frequency and intensity due to climate change, disrupt access to safe water and sanitation, and lead to inaccessibility and contamination of water sources. Consequently, water-borne diseases such as diarrhoea, as well as cholera - one of the severest diarrhoeal diseases - can spread more easily. Paradoxically, droughts have a similar effect on the incidence of diarrhoea and cholera. As water becomes scarce and competition for it increases, the poorest people tend to resort to unsafe water sources, thereby becoming disproportionally exposed to these two diseases.

Diarrhoea is a major cause of death during natural disasters and other complex emergencies.[23] In these situations, populations are displaced into temporary, overcrowded shelters where the drinking water and food are often contaminated, and sanitation is inadequate.[24] These factors may all lead to an increased transmission of diarrhoea and malnutrition. Limited health services and transport reduces the potential for prompt treatment of diarrhoea cases.[25]

Cholera

Cholera is an acute diarrhoeal infection causing an estimated 3 to 5 million cases and 100,000-120,000 deaths each year.[26] The infection can be extremely severe in both children and adults.[27] However, people who have compromised immune systems are at a higher risk of infection, such as malnourished individuals or people living with HIV and other diseases.[28]

The transmission of cholera is associated with a lack of access to safe water resources, and outbreaks are most common in areas with inadequate sanitation, poor governance, and poverty.[29] Areas that are most at risk include peri-urban slums and camps for displaced people or refugees, where safe water sources and sanitation levels are limited.[30]

Recent studies have indicated that climate change creates favourable environments for cholera growth.[31] Currently, the frequency and duration of cholera outbreaks are associated with heavy rainfall in Ghana, Senegal, other coastal West African countries, and South Africa.[32] Importantly this association may be elevated during El Niño /La Niña events.[33] The number of cholera cases in Tanzania and in Zambia has also been associated with increases in temperature or rainfall.[34] The IPCC projects that increases in precipitation in many areas of Africa, especially West Africa where cholera is already endemic, are likely to occur.[35] This could lead to an increase in cholera outbreaks in these areas.[36] Cholera outbreaks have also been noted in coastal populations of South Asia.[37] These outbreaks are linked with increasing water temperature and algal blooms.[38] Disasters can also increase the risk of transmission as a result of disrupted water and sanitation systems or displacement of populations into unsanitary, overcrowded camps.[39]

Fig. 18: African Meningitis Belt: Loosely defined as areas that experience frequent epidemics during the dry season

Source: WHO/WMO Atlas of Health and Climate, 2012

Meningococcal meningitis

Meningococcal meningitis (MM), a climate-sensitive disease caused by a bacterial infection, favours hot, dry and dusty conditions. The meninges, the three membranes that envelop the brain and spinal cord, become infected which can lead to severe brain damage. [40] Untreated, the disease is fatal in 50 per cent of cases, and its long-term side effects include brain damage, blindness and deafness. [41] It kills thousands of people every year and is estimated to be responsible for 2 per cent of under-five mortality.[42] It also hampers the health, productivity and well-being of many more.

A strong relationship exists between the location of MM epidemics and climate. The highest rates of meningitis occur within the 'meningitis belt' of sub-Saharan Africa, stretching across 26 countries between Senegal and Ethiopia, home to over 300 million people.[43] There is an increased risk of becoming infected with the disease during the dry season between December and June.[44] This season is characterized by dust winds, colder nights, and periods of very low humidity that can cause upper respiratory tract infections.[45]

Research has indicated that exposure to elevated concentrations of air pollutants, such as carbon monoxide (CO) or particulate matter, may be linked to meningitis.[46] For instance, exposure to smoke from cooking fires has been associated with an increased risk of contracting MM in the northern region of Ghana.[47] Risk of transmission may also be higher in overcrowded housing and when large population displacements occur.[48] Meningococcal meningitis poses a major public health problem and is yet another example of climate change disproportionately affecting already disadvantaged groups: those living in overcrowded housing, dependent on solid fuel for cooking and those with limited access to protective vaccines, health infrastructure and resources.[49]






6. Cumulative shocks mean cumulative impacts

Extreme climate events – including floods, droughts, storms or heatwaves – will have negative consequences for children, even if they just occur once. However, experiencing more than one shock is more difficult to recover from, especially if events occur in quick succession. Climate change will increase the frequency of extreme climate events. Globally, natural disasters are occurring almost five times as frequently as 40 years ago.[1]

Families hit by one crisis may be able to absorb the shock provided the crisis is not too severe. However, when families are hit by two, three or four shocks consecutively, their coping mechanisms can become exhausted after one or two shocks. Cumulative shocks make it difficult not only to recover, but also to survive, as documented in recent studies. In Malawi, in response to continuous erratic weather, poor households grappling with multiple stressors such as poverty, HIV/AIDS or the loss of a family member, frequently resorted to unsustainable coping mechanisms. They often liquidated productive assets or slaughtered or sold livestock to overcome the immediate food insecurity, thereby jeopardizing their food security in the long-term.[2]

In fact, many unsustainable coping mechanisms compromise children's long-term prospects. In 2008/2009, examples of Nigerian families coping with the triple F crisis (food, finance and fuel) paint a particularly grim picture of what life with recurring disasters means for the poorest children. Families' coping strategies led to devastating short and long-term consequences for children: school withdrawal, a significant rise in malnutrition rates, and a heightened risk of being subjected to exploitative forms of labour, trafficking and transactional sex among children.[3]

If shocks are going to become more frequent in the future, it is imperative to build resilience and improve equitable outcomes for children today. The resilience of children and families is influenced by their access to adequate nutrition, health, education, water and sanitation, and all forms of protection required now – before crises hit.

Climate change stands to increase the frequency and magnitude of disasters. Every additional shock can push people deeper into a cycle of poverty that is harder to escape.


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Ambitious action to cut greenhouse gases will benefit the lives of hundreds of millions of children.

7. Decisive action on climate change can impact millions of children

The reality is that a major tipping point has already past. IPCC scientists consider that we are already feeling the impacts of climate change, and to some degree they will continue to get worse even if we manage to dramatically decrease greenhouse gas emissions. Nonetheless, action taken now to reduce emissions and adapt to climate change will benefit children at risk from its potentially deadly effects.[1]

Climate projections are difficult to make, as the predictability and magnitude of risk events are susceptible to change. However, given the latest UN demographic projections and climate projections[2], our analysis indicates that a very large number of children will be living in zones where temperature and precipitation stands to change.

Consider three scenarios (for full description, see box on page 60) – under scenario one, the global community takes limited action to reduce emissions and the earth warms around 4°C by 2100, compared to pre-industrial levels. This would be the 'business-as-usual' scenario. Under scenario two, the global community actively pursues policies and actions to curb emissions, holding the increase in global temperatures to around 2°C: a 'moderately ambitious' scenario. Under scenario three, the global community acts very ambitiously (a 'highly ambitious scenario) to keep the temperature rise to less than 2°C, ideally around 1.5°C.

Based on projection models for temperature, the authors looked at how many children would live in areas where temperatures change from the 0-2°C degree bracket to the 2-4°C degree bracket. For example, consider the maximum Temperature at Surface (TAS) change projections for January 2050, just short of half-way between now and the end of the 21st century: the projections indicate temperature changes across much of South America, Africa, Australia and the Middle East. Temperature changes are likely to be more significant in colder climates – such as northern Russia, and Canada. Any melting of snow, glaciers or ice caps can have an exponential effect on warming, as less light is reflected out of the earth's atmosphere, accelerating the warming process.[3,4]

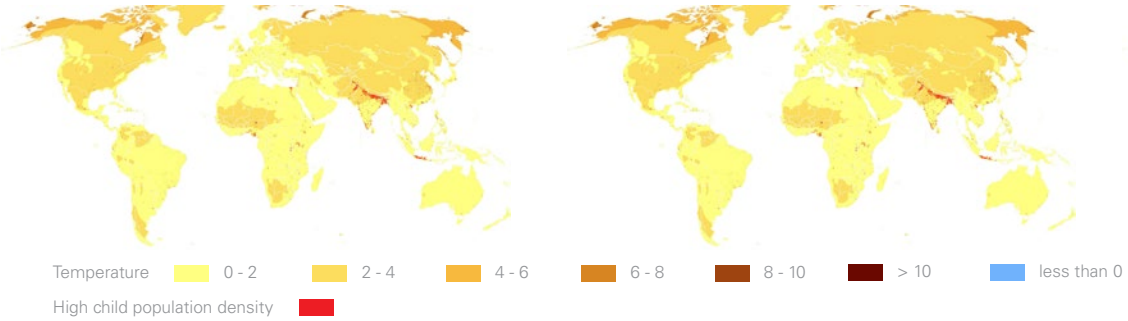
Without ambitious action on curbing emissions, more children will live in areas that will experience temperature change

Overlaying maps of projected temperature changes with projected child population data, indicates the following: under a business-as-usual scenario, by 2050 1.45 billion children are projected to live in zones where the maximum average surface temperature will change by greater than 2°C. Under a moderately ambitious action scenario, this number is projected to drop to around 750 million children. Under a highly ambitious action scenario, the number would drop to 150 million children.

It is important to realize these temperature changes are projected for 2050, not 2100, and that due to the uncertainties in the models, there still is significant overlap between the three scenarios by 2050. Nevertheless, although this means that the projected number of children at risk has a high level of uncertainty, the data start to tell the story of the potential consequences of the policy decisions we make today on the number of children at risk in the future.

How much we cut emissions will determine how many children will live in areas where temperatures change the most

Fig. 19: Temperature change under a 'business-as-usual' scenario, 2050



Temperature at Surface (TAS) change in degrees C, RCP 8.5, January 2050

Under a 'business-as-usual' scenario (RCP 8.5) approximately **1.45 billion children** will be living in zones where average temperature at surface has changed from 0-2°C to 2-4°C

Fig. 20: Temperature change under a 'moderately ambitious' scenario, 2050

Temperature at Surface (TAS) change in degrees C, RCP 4.5, January 2050

Under a 'moderately ambitious' scenario (RCP 4.5) approximately **750 million children** will be living in zones where average temperature at surface has changed from 0-2°C to 2-4°C

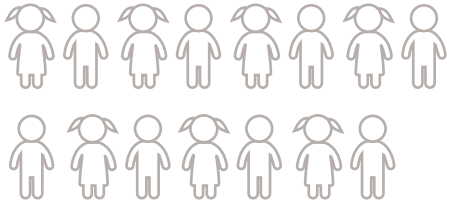
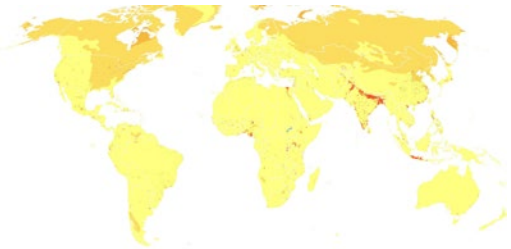


Fig. 21: Temperature change under a 'highly ambitious' scenario, 2050



Temperature at Surface (TAS) change in degrees C, RCP 2.6, January 2050

Under a 'highly ambitious' scenario (RCP 2.6) approximately **150 million children** will be living in zones where average temperature at surface has changed from 0-2°C to 2-4°C

Legend

= 50 million children

Ecosystems are susceptible to even the slightest changes in temperature and rainfall

Even a relatively small change in average temperature can have a major impact on the biodiversity and ecosystems that we depend on. The slightest change can affect the survival of a species, which tends to have ripple effects for many other species. If one species is unable to survive as a result of a temperature or precipitation change, all of the species that depend on it (such as for food) are threatened. Some species are also more vulnerable than others to temperature change destroying their habitat, such as ones that live around Arctic sea ice and coral reef systems. One study found that 20-30 per cent of plant and animal species are at high risk of extinction as a result of a 2-3ºC increase in global mean temperatures.[7] Reduced biodiversity can have a significant impact on humans, including in terms of food security, the development of medicines, as well as the transmission of certain diseases.[8] Biodiversity loss also undermines the ability of ecosystems to provide clean water.[9]

Averages hide the extremes

Small changes in average temperature can mask much larger variations in extreme temperatures. Minimum and maximum temperatures capture some of the variations in temperature, but even those are averages. Sudden cold and heat events are likely to be exacerbated by climate change, and the risk of heatwaves, for example, will rise progressively with further warming.[10] Since 1950, the increase in extreme weather events attributable to climate change has risen and the IPCC projects that with an additional 1ºC temperature rise, this risk is likely to become severe and widespread. Large-scale singular events also have the potential to create irreversible changes. Floods and extreme weather that are particularly devastating, for example, can wipe out localized ecosystems in a single event, making it impossible to fully recover.[11]

Box 1: Scenarios (Representative Emission Pathways)

*For the 5th Assessment Report of the IPCC (Intergovernmental Panel for Climate Change) four scenarios– so-called Representative Emission Pathways (RCPs) – were developed using fixed levels of radiative forcing (global energy imbalances) and greenhouse gas (GHG) concentrations by the end of the twenty-first century as a starting point. For this report, we are zooming in on the three scenarios most often referred to in the policy discourse as a way of highlighting trends to expect under the varying emission projections and the corresponding impacts and adaptation measures necessary to address those impacts.

The first scenario (scenario RCP 8.5) is consistent with a likely average mean surface temperature increase of 4.3 degrees Celsius (the projection ranges from 3.2 to 5.4 degrees compared to 1880).

The second scenario (RCP 4.5) is a medium one projecting a likely average increase of 2.4 degrees Celsius, ranging from 1.7 to 3.2 degrees by the end of the century.

The third scenario (RCP 2.6) projects a mean temperature rise of 1.6 degrees Celsius, likely increase ranging between 0.9 and 2.3 degrees Celsius vis a vis pre-industrial levels (SBC, 2015; IPCC, 2013).[5,6]

The RCP 8.5 is the pessimistic scenario assuming no mitigation policies which we label here as the 'business-as-usual' scenario. The second one, RCP 4.5, we label as a 'moderately ambitious scenario'. Lastly, we label the RCP 2.6 as our 'highly ambitious scenario'.

While the different scenarios illustrate the consequences of different levels of concentration of greenhouse gases in the atmosphere, this type of modelling is based on a considerable amount of uncertainties, both regarding climate change impacts as well as its socio-economic assumptions (e.g. assumptions regarding economic activity, energy use, population size, and climate policies, to name a few).

Whether ice sheets melt, or riverbeds become dry, can depend on a two-degree change

In cold regions, 2ºC might be enough to melt glaciers and snowcaps and let spring start earlier in the year; in hot regions, it might be enough to evaporate rivers and lakes and stop plant seeds from germinating. In some regions it might have a limited impact.[12] 2ºC might not seem like a lot but it is, and its effects can be widespread.

Slight changes in temperature can trigger feedback loops leading to irreversible changes. For example, the thawing frozen soil in the Arctic and Antarctic regions can release additional greenhouse gases which, in turn, would accelerate climate change. Melting of ice sheets can reduce the amount of solar heat that is reflected back into space, and hence accelerate global warming and add to sea level rise.[13]

Children not living in the zones outlined in the maps will still be affected by climate change

Small changes in temperatures over oceans, for example, can affect the formation and severity of hurricanes, typhoons and cyclones. These extreme storms travel hundreds of miles, well beyond the confines of where they formed. Likewise, ecosystems are not delinked from wider regions. Birds and fish, for example, travel great distances, and their survival can affect ecosystems and the survival of other species in other zones.

There are very similar human dimensions, too. For example, given the highly integrated global economy and food distribution systems, food security that is compromised in one area also affects food security in other parts of the world.

Many of the direct effects of climate change are hard to predict and it is difficult to attribute specific extreme events to climate change. But since 1880 the global average temperature has increased an estimated 0.85ºC[14], and we have already witnessed an increase in severe weather events, storms, floods and droughts.[15] Relatively small changes in temperature can have major effects on ecosystems, agriculture, water resources, diseases, and human health.[16]

One thing is clear: the scale of climate related crises has already been witnessed, especially when combined with growing urban populations, informal settlements, and mass migration. And while it might be hard to predict exactly where and exactly how it will get worse, we know we are on a path of irreversible damage, unless we act now.

INDIGENOUS CHILDREN AND CLIMATE CHANGE

Climate change has adverse implications for the full enjoyment of human rights and has a disproportionate impact on marginalized and excluded individuals and groups, including those whose ways of life are inextricably linked to the natural environment.[17, 18]

Despite having contributed little to greenhouse gas emissions, the estimated 370 million indigenous adults and children in some 90 countries around the world are at particular risk of facing the direct consequences of climate change.[19, 20] Due to their close, dependent relationship with the environment and its resources, climate change is posing an existential threat to today's indigenous children and future generations. Indigenous peoples' vulnerability to the impacts of climate change is further exacerbated by the fact that they are estimated to constitute 15 per cent of the world's poor, and one third of the 900 million people living in extreme poverty in rural areas.[21]

The global distribution of indigenous peoples demonstrates a marked correlation with areas of high biological diversity. In addition to the invaluable human resource that the vibrant diversity and rich culture indigenous people represent, indigenous peoples' knowledge of sustainable practices and stewardship is a key element in maintaining the world's ecological richness.

The United Nations system stresses that indigenous peoples' rights, unique worldviews, traditional knowledge and sustainable resource management strategies must be built into climate change-related responses at local, national and global levels, including in climate change mitigation initiatives.[22] This must also include the meaningful and effective participation of indigenous young people, particularly in climate change adaptation, protection of ecosystems including but not limited to tropical rainforests, advocacy as well as policy processes.

Children deserve to live in a world free from the life-threatening effects of climate change. Given the overwhelming scientific evidence on the dangers and causes of climate change, failing to take action is an injustice to all children. But there are concrete steps that can and must be taken to safeguard our children's rights and future - if we act now.

A climate agenda for children

The worst impacts of climate change are not inevitable. There are concrete steps that the world can take now to safeguard our children's future and their rights:

1 **Cut greenhouse gas emissions so that global temperature increases are limited to a maximum of 2ºC, and ideally to 1.5ºC.** Failing to curb emissions will put hard-won development gains at risk. Governments must increase their emissions pledges, in line with science, to meet the scale of the climate change challenge, with high-income countries taking the lead. Cutting emissions will require prioritizing low carbon development, adopting a robust legal framework with clear rules, and expanding sustainable energy solutions. Development is not possible without energy and sustainable development is not possible without sustainable energy.

2 **Make the needs of the most vulnerable, including children, central to climate change adaptation.** Children are particularly vulnerable to climate change for many reasons, including their susceptibility to the diseases and environmental stresses that will be worsened by a shifting climate. While all people deserve protection from the effects of climate change, those who have contributed the least to climate change will suffer its effects longest. Therefore, the youngest and most disadvantaged should receive the strongest protections from its effects. This task should not be relegated only to departments or ministries of environment, but should also be handled by agencies and actors across the public, private and civil society sectors.

3 **Reduce inequity among children now to promote their future resilience to climate change.** As with all disasters, the poorest children and families will be the hardest hit by climate change. Fewer social and financial resources mean that families have a more difficult time coping with shocks. As climate change makes crises more common, these repeated shocks will make it harder and harder to recover. Without action now, the transmission of poverty and disadvantage across generations will worsen. Reducing these inequities now – providing the poorest children with access to safe water, adequate sanitation and good hygiene; good nutrition and food security; strong and accessible health systems; and well-functioning child and social protection systems – will give disadvantaged children a better basis for coping with the effects of climate change in the future. It will also make it less likely that today's inequities are exacerbated by climate change.

4 **Listen to and act on children's perspectives on climate change.** Children have unique perspectives on environmental issues and a greater stake in the impacts of climate change. They are important actors in enhancing community capacity, taking action to address climate-related risks and promoting environmentally sustainable lifestyles. 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 are to be safeguarded.

5 **Provide children and youth with climate change education, awareness raising and training.** Climate change education increases the adaptive capacity of children and their communities, helps to foster environmental stewardship, and develops children's capacity to be agents of change and active citizens. The global community must reaffirm the role of climate change education. Children should be supported in strengthening their awareness, knowledge, skills and engagement to promote environmental sustainability among their peers and in their community. If climate change education is built into the curriculum of primary and secondary schools, and becomes part of higher, alternative and vocational education, children and young people will develop an early understanding and appreciation of all aspects of environmental sustainability including climate change adaptation and mitigation.

6 **Scale-up proven approaches to address the changing needs of children.** For example, in areas where malaria, dengue and cholera are likely to increase, programmatic adjustments will be needed and preparations should begin now. Scaling up vaccinations now, such as for meningitis, in regions poised to experience outbreaks will also help lessen the severity of impact. High quality data, accurate surveillance and monitoring of disease through primary care information systems, as well as improved climate modelling will be necessary.

7 **Align and coordinate work on climate change adaptation, preparedness and disaster risk reduction.** Planning and policies on climate change preparedness, response, and recovery must take into account the full spectrum of children's needs before, during, and after severe climate events. Schools must be safe and education must not be interrupted; community infrastructure must be safe and relief and reconstruction interventions must help reduce future and current risk. Furthermore, by investing now and pre-positioning emergency supplies, we can reduce the costs of emergency response by more than $US2 for every US$1 invested, as well as reducing emissions from international delivery of emergency supplies.

8 **Put in place measures to protect children who have been displaced, migrate or are refugees as a result of climate change or climate-related impacts.** The frequency and magnitude of climate-related disasters is likely to increase. Already, climate related events and their impacts are causing tremendous population movements around the globe. These trends are likely to become more common, and measures need to be put in place both nationally and internationally so that children are protected and their rights are upheld whether they move internally or across borders.

9 **Invest in children when implementing national climate plans on mitigation and adaptation.** Taking the needs of children into account in investments in sustainable energy and on climate change adaptation can benefit society, resulting in reduced child mortality, better early childhood development, improved maternal health, and better education. Children will be among the most important direct beneficiaries of universal access to modern energy services because of the benefits they provide for health, education and economic opportunities for their families.

With US$90 trillion set to be invested over the next 15 years in infrastructure and energy, there is tremendous potential. Accountability and transparency are key: the global community needs to make sure that children, whose future is most at risk, will indeed benefit from the investments made.

10 **Everyone should get involved.** Protecting the planet for our children is everyone's responsibility. It will take courage, determination and substantial effort. Governments need to take bold and ambitious decisions to reach an agreement which reduces greenhouse gas emissions and enables the protection of future generations from the impacts of climate change. But others must also do their part, including business and civil society. We will need a different approach to how we produce and consume, how we take action at the grassroots level, and how we hold each other to account. Protecting the planet and protecting our children go hand-in-hand – and both can be achieved if **we all act now.**

Annex

Calculation of Drought Severity

Extracted from WRI (2015) Aqueduct Global Maps 2.1: Constructing Decision-Relevant Global Water Risk Indicators. Francis Gassert, Matt Luck, Matt Landis, Paul Reig, and Tien Shiao

Drought severity (DRO) measures the mean severity of drought events from 1901 to 2008 as recorded in a modeled 1° × 1° gridded data set by Sheffield and Wood (Justin Sheffield and Eric F Wood, "Projected Changes in Drought Occurrence Under Future Global Warming from Multi-Model, Multi-Scenario, IPCC AR4 Simulations," Climate Dynamics 31 (2008): 79–105, http://link.springer.com/article/10.1007/s00382-007-0340-z). To produce this dataset, they generated a monthly soil moisture hydrograph for each grid cell, and defined drought runs as continuous periods in which soil moisture falls under the 20th percentile of the monthly hydrograph (q(Θ)<20%). Severity (S) of a drought run beginning at time, ti, is the length (D) times the intensity (I) of the drought, with the length measured in months and intensity equal to the average number of points by which soil moisture falls beneath the 20th percentile.

$$S=\sum_{t=t_i}^{t+D-1} 20\% - q(\Theta)_t \qquad i.e.\ S=I\,x\,D$$

We resampled the gridded mean severity dataset and averaged it across our hydrological catchments.

$$r_{DRO,j}=\sum_{p<j} \mathrm{mean}(S)_p$$

By definition, all regions of the world experience some form of drought 20 percent of the time. The drought severity indicator emphasizes those regions where soil moisture deficits are longer and drier, thereby making them harder to adapt to and mitigate. Regions that experience decadal or multidecadal variations in precipitation are more likely to fall into this category.

Calculation of Flood Occurrence

Extracted from WRI (2015) Aqueduct Global Maps 2.1: Constructing Decision-Relevant Global Water Risk Indicators. Francis Gassert, Matt Luck, Matt Landis, Paul Reig, and Tien Shiao

Flood occurrence (FO) measures the number of floods recorded in each catchment between 1985 and 2011. Reported flood extent polygons were taken from the Global Flood Observatory (G.R. Brakenridge, "Global Active Archive of Large Flood Events", Dartmouth Flood Observatory, University of Colorado, http://floodobservatory.colorado.edu/Archives/index.html.) Polygons are estimated from remote sensing, governmental, and media reports of affected regions. Extent polygons (E) are then spatially joined to catchments (j) to count the total number of floods that may have affected each catchment over the recorded period.

$$r_{FO,j} = \text{count}\left(\{E | E \cap j \neq \emptyset\}\right)$$

The flood occurrence indicator differs from the preceding hydrological indicators in several ways. First, floods are extreme events that are not captured in our long-term measurements. Second, this indicator counts actual observations rather than modeled occurrence, reflecting the influence of flood control infrastructure as well as events such as flash floods and coastal flooding, which are not easily captured by current hydrological models. Finally, this dataset's method of flood extent estimation ignores local typography and may substantially overestimate the extent of flood impact.

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Protecting the planet and protecting our children go hand-in-hand – and both can be achieved if we all act now.

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