

# Review of IPCC Evidence 2022

## climate change, health, and well-being

### Acknowledgements

Written by Elizabeth Willetts and Diarmid Campbell-Lendrum. We thank Carlos Corvalan, Marina Maiero and Tara Neville (World Health Organization), and Kathryn Bowen, Gueladio Cissé and Kristie Ebi (authors on Intergovernmental Panel on Climate Change 6th Assessment Report Working Group II Chapter 7: Health, well-being, and the changing structure of communities), for review of this document.

### Synopsis

This policy brief summarizes and unpacks the state of evidence on health outlined in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6). It includes information from Working Group II (WG II; Adaptation) and WG III (Mitigation). It takes a health perspective on the scope of the climate problem; outlines observations and projections for physical and mental health; summarizes knowledge on climate change impacts to environmental determinants of health (food, water, air); and discusses actioning this evidence in adaptation and mitigation strategies and climate change negotiations. In short, impacts to health are increasing. Climate risks are appearing faster and will become more severe sooner than previously expected, and it will be harder to adapt with increased global heating. AR6 reinforces evidence on climate change and health; strengthens integration of social, environment and economic considerations; and emphasizes climate change equity and justice.



### Purpose

This policy brief is intended as an information tool to enable governments, academia, civil society and the health stakeholder community to access and use IPCC evidence to strengthen governance and implementation on climate change and health.

The World Health Organization (WHO) is one of many observer organizations to the IPCC process. WHO is also one of many organizations contributing scientific input to the production of IPCC assessments, and uses the resulting reports to inform its own work and inform guidance for national governments and the wider health community. This document is written from a health perspective and reflects the WHO summary and interpretation of IPCC evidence.

“The cumulative scientific evidence is **unequivocal**: climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all – IPCC WG II (1).\*\*\*\*

AR6 describes the level of confidence in the key findings, based on the strength and consistency of evidence as follows:

\*\*\*\* very high confidence

\*\*\* high confidence

\*\* medium confidence

\* low confidence

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## IPCC and its progress to address health, 1990–2022

IPCC was established in 1988 as a global science policy body on climate change. It functions as a global repository on climate change knowledge and informs global negotiations on climate change. Its mandate is to **assess the state of published and peer-reviewed scientific literature** and engage countries in a process to **approve and adopt new evidence in an intergovernmental context**. Its periodic assessment reports and special reports are mandated to be policy-relevant but not policy-prescriptive. As of July 2022, IPCC includes 195 member countries and has convened 56 times. Its work has involved contributions from thousands of people and assessment of tens of thousands of scientific papers worldwide.

The three IPCC working groups review the physical science basis for climate change (WG I); impacts, adaptation and vulnerability (WG II); and mitigation (WG III). The IPCC recognizes close linkages between climate change mitigation, adaptation and development pathways. Observed impacts and projected risks to health are primarily reviewed by WG II, whose task is to assess the impacts of climate change on human and natural systems at the global and regional levels, including vulnerability to and capacity for adaptation. It frames risks, including to health, in terms of climate hazards, exposures and vulnerability. WG III assesses the scientific, technological, social, economic and environmental aspects of mitigation of climate change.

The evidence adopted by the IPCC is intended to inform the United Nations Framework Convention on Climate Change (UNFCCC), the global policy-making body on climate change. IPCC assessments also provide input to other intergovernmental processes, including the Convention on Biological Diversity, the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services, the United Nations Environment Assembly, United Nations advisory groups such as the One Health High-Level Expert Panel, and a diverse range of agencies, programmes and strategies under the United Nations system more broadly.

The IPCC **first warned of human health impacts from climate change in its 1990 assessment report** (2). It has been building evidence on this issue ever since. The certainty, range and interconnection of agreed evidence on health have evolved over time under the IPCC. Most notably, agreed language has shifted from “likely” to “unequivocal” impacts on human health. In addition, the IPCC now takes a holistic approach to health and well-being, recognizing the interconnection of human health to that of the natural environment. It values this interconnection both in the framing of impacts and in the systems thinking on societal transformation to address climate change mitigation and adaptation (3).

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## What is new for health: key messages on the scope of the problem

The following draws heavily on AR6.

### Means and extremes are changing

The average temperature is rising, increasing the prevalence of anticipated and existing health conditions such as vector-borne diseases. At the same time, extreme temperature events are becoming more extreme, increasing mortality (e.g. heatwave-related deaths). Extreme events are several times more frequent than previously observed or understood, which means many more shocks, including to the health system, lie ahead.

“We should not just be talking about changes in means but also changes in extremes. Particularly for health, extremes are what kill us – WHO (4).

## Losses and damages are broad

Adverse, observed, unavoidable impacts from climate change – known as loss and damage – may be economic or non-economic. From a public health perspective, economic losses include increasing costs to the health sector and loss of productivity across sectors. Non-economic losses, under which health is primarily considered, are widespread.

Direct non-economic health loss can be categorized as injury, illness and mortality from, for example, climate change-induced natural hazards. Indirect non-economic health losses span a much wider spectrum of environmental determinants of health. They include physical and mental health impacts from losses of territory, cultural heritage, Indigenous or local knowledge, societal or cultural identity, and biodiversity and ecosystem services due to climate change.

“ Policy-makers have an overly short-term view. Some of the outcomes of climate change will have massive health impacts for hundreds of years to come – WHO (4).

## Physical and mental health are impacted

Climate change leads to or exacerbates disease across every physiological system in direct and indirect ways. Climate change is also stressful – acutely for people coping with the trauma of sudden climate events, and chronically as the more we find out about climate change, the more we worry. Inaction on climate change is also distressing to youth and will be a growing concern for future generations.

“ Populations that trust their government and see that their government is trying to take action to address climate change tend to have lower levels of concern about climate change – WHO (4).

## Climate-resilient development means systems thinking

Climate change is a determinant of health and influences a wide range of other social and environmental determinants of health. Addressing the complex, compound and cascading risks<sup>1</sup> resulting from climate change requires transformation across society and systems and multisectoral collaborations.

A climate-resilient development approach recognizes necessary integration of mitigation and adaptation planning to advance sustainable development, and dependence of resilience on several enabling conditions. These conditions must be assessed to determine synergies and trade-offs and avoid maladaptation. An overarching narrative of the IPCC 55th session that deliberated and adopted WG II findings was “there is no climate-resilient development without healthy ecosystems and increased social justice” (6). Enabling factors for climate-resilient development include those that improve considerations of equity, justice, poverty reduction and gender equality, and adoption of a planetary health policy perspective (7).

“ Climate governance arrangements and practices are enabled when they are embedded in societal systems that advance human well-being and planetary health – IPCC WG II (7).\*\*\*\*

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<sup>1</sup> Climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions. Some responses to climate change result in new impacts and risks (5).\*\*\*\*

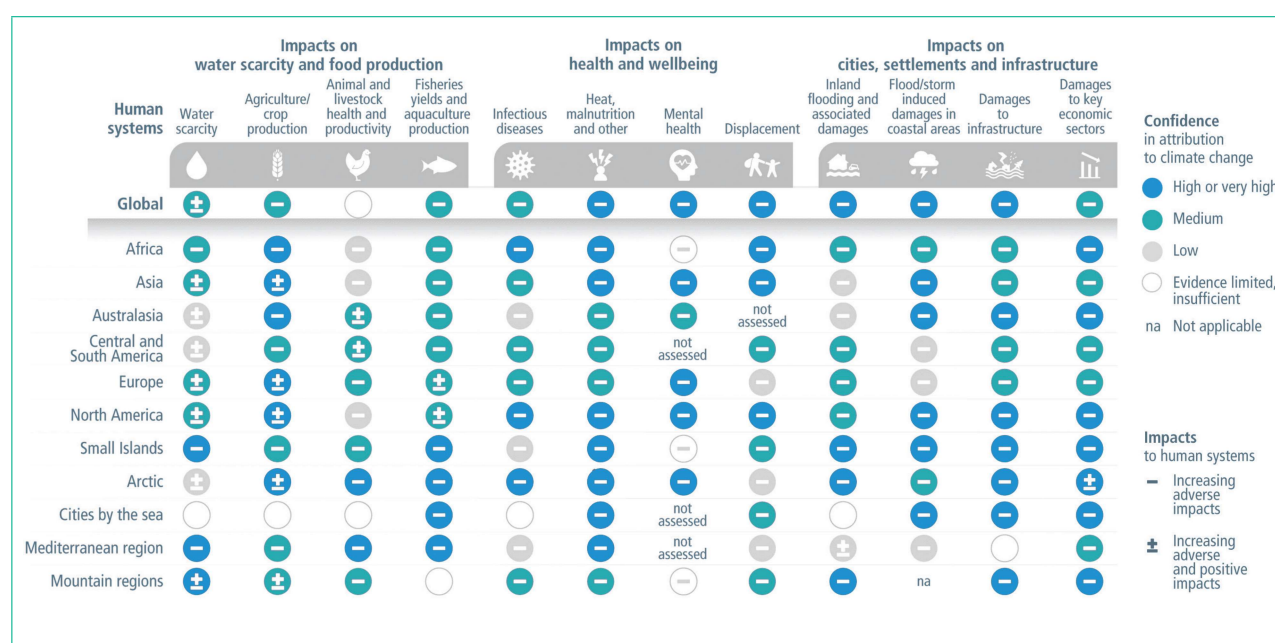
## IPCC observed and projected health impacts

The IPCC reports that climate change already has diverse adverse impacts on population physical and mental health (8) and on human systems, including on water, food, cities, settlements and infrastructure (9); and health services (10).\*\*\* Evidence from AR6 strengthens the confidence in these observations.

Climate change increasingly affects environmental and social determinants of health, especially through compound stressors and events. Diverse and coupled effects occur simultaneously in marine, freshwater and terrestrial ecosystems and across ecosystem services, economies and culture (11). Evidence since AR5 continues to point to how these events adversely affect or cause loss and/or damage to human health, shelter, displacement, incomes and livelihoods, security and inequality (12).\*\*\*

Overall, negative human health outcomes will result from direct climate change-associated events, indirect and compound events, and any limitations in the health sector to address these rising health challenges. According to IPCC, “future global burdens of climate-sensitive diseases and conditions will depend on emissions and adaptation pathways, and the efficacy of public health systems, interventions and sanitation” (13).\*\*\*\*

**Figure 1. The need for a systems approach: observed impacts of climate change on human systems**



Source: Climate change 2022: impacts, adaptation and vulnerability – summary for policymakers. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://report.ipcc.ch/ar6wg2/pdf/IPCC\\_AR6\\_WGII\\_SummaryForPolicymakers.pdf](https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf)).

## Physical health

Climate change and associated extreme events will substantially increase ill health and premature deaths from the near to long term. Climate change influences human health through injury, illness and death, all of which are projected to increase with global heating. Communicable and noncommunicable diseases are climate-sensitive, and both are projected to increase.\*\*\*

Mortality is projected to increase, with mid-range emissions scenarios projecting up to 250 000 additional deaths per year by 2050. Projections using less conservative methods indicate over 9 million deaths per year attributed to climate change by 2100. The mid-century projections of excess deaths are largely based on increased prevalence of climate change-induced heating, childhood undernutrition, diarrhoea and malaria,\*\*\* more than half of which are expected to occur in Africa. Health risks will differ by gender, age, income, social status and region (13).\*\*\*

Table 1 shows the evidence on physical health reviewed and agreed by the IPCC for inclusion in AR6.

**Table 1. Physical health impacts due to climate change, all regions**

Condition	Observed status	Diagnoses cited	IPCC WG II future assessment
Heat stress	Linked to mortality and morbidity (8)****	Heat illness	Increases (13)****
Foodborne and waterborne diseases (8)	Increased occurrence**** Increased regional risks of aquatic pathogens Increased occurrence of diarrhoeal disease linked to extreme temperature events or natural hazards	<i>Vibrio</i> spp.*** Cyanobacteria** Cholera**** Other gastrointestinal infections***	Increases in many regions (13)*** Increases in schistosomiasis (Africa) (13)***
Vector-borne diseases (8)	Increased occurrence** Increased range of expansion or increased reproduction of disease vectors***	Chikungunya (Americas, Asia, Europe)**/** Tickborne encephalitis (Europe)** Lyme disease (North America,*** Europe**) Rift Valley fever (Africa) West Nile fever** (Europe, Asia, North America) Malaria (eastern and southern Africa)*** Dengue (globally)***	Expansion to higher latitudes and altitudes and increased duration of season of transmission*** 2.25 billion people across 4 regions newly at risk for dengue (13)*** Increases in Lyme disease*** Increases in malaria across 3 regions***
Animal and human diseases such as zoonoses	Emerging in new areas (8)***	Anthrax Tularemia (8)****	Increasing emergence of novel zoonoses (14)**
Air pollution (wildfire smoke, atmospheric dust, aeroallergens)	Increased exposure to wildfire smoke**** and pollen (8)***	Cardiovascular and respiratory distress	Increases in respiratory disease from aeroallergens and ozone (13)***

Condition	Observed status	Diagnoses cited	IPCC WG II future assessment
Food insecurity	Increased risks (12)***	Malnutrition (8)***	<p>Increases in food insecurity (15)***</p> <p>Increases in undernutrition and diet-related mortality and risks (13)***</p> <p>10% increase in DALYs by 2050 for undernutrition and micronutrient deficiencies (13)**</p> <p>Increases in malnutrition through reduced nutritional quality, reduced access to balanced food, and inequality (15)***</p> <p>Increases in diet-related risk factors and related noncommunicable diseases globally (13)</p> <p>Increases in undernutrition, stunting and related childhood mortality, particularly in Africa and Asia (13)***</p> <p>8–80 million people at risk of hunger by 2050, concentrated in sub-Saharan Africa, South Asia and Central America (13)***</p> <p>Increases in cardiovascular disease mortality; compared with the 1980s, this increase could be 69–134% by the 2080s (13)***</p>
Food safety	<p>Increased risks in agriculture and fisheries (16)***</p> <p>Increased impacts on food safety (8)***</p>	<p>Increased disease resulting from consumption of toxins or contaminants** (e.g. toxigenic fungi,**** POPs,** methyl mercury**) (16)</p> <p>Increased bacterial infections (<i>Salmonella</i>, <i>Campylobacter</i>, <i>Cryptosporidium</i>),** mycotoxins associated with cancer and stunting in children,*** and seafood contamination with marine toxins and pathogens***</p>	<p>Food safety compromised*** by toxigenic fungi, contamination, algal blooms,*** POPs, methyl mercury (15),** and increases in <i>Campylobacter</i>, <i>Escherichia coli</i> and <i>Salmonella</i> (13)**</p>
Insecure and inadequate WASH	Increased disease risk (8)***	<p>Waterborne and water-related diseases</p> <p>Malnutrition</p>	Increases in water-related risks (17)***

DALYs, disability-adjusted life-years; POPs, persistent organic pollutants; WASH, water, sanitation and hygiene.

This table is organized according to the health categories described and the clinical terms used in the IPCC report.

Source: Climate change 2022: impacts, adaptation and vulnerability – technical summary. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_TechnicalSummary.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_TechnicalSummary.pdf)).

## Mental health

AR6 comprehensively incorporates mental health and well-being for the first time in the IPCC health assessment. The assessment identifies climate-induced extreme temperature events and the losses incurred from environmental degradation, environmental change, and coping responses as mental and emotional stressors.

AR6 WG II further outlines a wide range of expected ongoing climate-induced drivers of stress, including exposure to extreme weather events, displacement, migration, famine, malnutrition, degradation or destruction of health and social care systems, climate-related economic and social losses, and anxiety and distress associated with worry about climate change (13).\*\*\*\* AR6 reports that extreme weather and climate change events have negative outcomes on life satisfaction, happiness, cognitive performance and aggression (12).\*\*\*\*

AR6 emphasizes the mental health impacts on youth (13). From an equity standpoint, some vulnerable communities are more susceptible to negative mental health effects of climate change, including Indigenous Peoples, agricultural communities, emergency responders, women and minority groups (12).\*\*\*

“ Climate change exacerbates many social and environmental risk factors for mental health and psychosocial problems – WHO (18).

Little knowledge exists on many indirect mental health outcomes and health losses due to climate change. For example, more research is needed on characteristics to define solastalgia<sup>2</sup> and other linkages between environmental degradation and human well-being (18). These outcomes are relatively unexplored worldwide, with some regions having insufficient data and evidence. Global statistics point to considerable gaps and the need to explore these issues. For example, since 2008, 20 million people experience internal displacement every year due to weather-related extreme events (largely storms and floods), creating complex distress (12).

Planning for preventive and post-event responses is needed at the community level to reduce mental health risks associated with extreme weather events (19).\*\*\*

Table 2 shows the evidence on mental health reviewed and agreed by the IPCC for inclusion in AR6.

**Table 2. Mental health impacts due to climate change, assessed regions (Arctic, Asia, Australasia, Europe, North America) <sup>a</sup>**

Condition	Observed status	Diagnoses	IPCC WG II future assessment
Adverse impact on well-being and mental health challenges (8): ecological grief**** and anxiety**	Increases with increasing temperatures***	Stress	Risks increase,**** with greater risk to children and adolescents, particularly girls (13)***
	Caused by vicarious or anticipated events**		
	Associated with weather and climate extreme events****	Trauma	
	Associated with loss of livelihoods and culture***		

<sup>a</sup> Africa, mountains and small islands were assessed but considered to have limited evidence.

This table is organized according to the conditions described and the clinical terms used in the IPCC report.

Source: Climate change 2022: impacts, adaptation and vulnerability – technical summary. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_TechnicalSummary.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_TechnicalSummary.pdf)).

<sup>2</sup> Distress produced by environmental change. Also known as ecological grief.

## Health equity

Climate change deepens health inequities. The intersection of gender with race, class, ethnicity, sexuality, Indigenous identity, age, disability, income, migrant status and geographical location often compounds vulnerability to climate change impacts,\*\*\* **exacerbates inequity and creates further injustice** (20).\*\*\* Women, children, elderly people, Indigenous Peoples, low-income households and socially marginalized groups within cities, settlements, regions and countries are the most vulnerable (8).\*\*\* Climate change affects crucial environmental determinants of health (food, water, air), and these impacts are felt disproportionately by people from vulnerable groups.

There is significant room to **expand consideration of health equity, justice and the social determinants of health** into adaptation strategies (20).\*\*\* At the same time, a **just transition to mitigation pathways** is essential to meet the needs of 41% of the global population living in low-emitting countries, many of whom lack comprehensive energy access (21). AR6 WG III reports that eradicating extreme poverty and energy poverty, and providing decent living standards in the near term, can be achieved without significant global emissions growth (22).\*\*\*

AR6 highlights the role of social, distributive and procedural justice, and diverse cultures, perspectives and forms of knowledge (23). This is a starting point for building a comprehensive climate change conversation on equity.

“Inclusive planning initiatives informed by cultural values, Indigenous knowledge, local knowledge and scientific knowledge can help prevent maladaptation – IPCC WG II (24).\*\*\*

## Environmental determinants of health

Protecting food, water and air as fundamental determinants of health is important for climate-resilient development. This section summarizes and frames a discussion of IPCC AR6 WG II key findings in terms of these determinants.

“Strengthening the climate-resilience of health systems and addressing the determinants of health, such as food systems, and water, sanitation and hygiene (WASH), are critically important to making sure we will avoid the worst health impacts of climate change – WHO (4).

### Food



Food environments are a determinant of health. Climate change impacts the food system in multiple ways, including through access, nutrition and security. AR6 WG II reports that the “impacts of climate change on food systems **affect everyone**” (16). Climate change affects both the food system and the supportive ecosystem services that underpin it. These changes **will increase** and become more unpredictable.

“The global food system is failing to address food insecurity and malnutrition in an environmentally sustainable way – IPCC WG II (16).

Climate-related extremes affect **productivity** in agricultural, forestry and fishery sectors.\*\*\* Droughts, floods, wildfires and marine heatwaves reduce food **availability** and increase its **cost** (12). This threatens food security, nutrition and livelihoods for millions of people worldwide (12).\*\*\* The 2015–2016 El Niño event, attributed in part to global heating, resulted in an additional 5.9 million underweight children in 15 countries (8).\*\*\* Global heating will increasingly add pressure to all components of the food system (15).\*\*\*

In the agriculture sector, there have been meaningful alterations in **growing area** distribution, suitability and seasonal events such as **flowering**,\*\*\* resulting in reduced **crop yields**\*\* and changes to **crop quality** and **harvest stability** (16),\*\*\* Agricultural yield disruptions are projected to increasingly result from the negative impact of greenhouse gas emissions on air, soil and water quality and ecological interruptions to pollination,\*\*\* and the inverse relationship between increased atmospheric carbon dioxide (CO<sub>2</sub>) concentration and crop nutrient density (15),\*\*\* AR6 WG II projects that pressure on terrestrial food systems will increase incrementally with temperature (15).\*\*\*

In the fisheries sector, AR6 WG II observes decreases in sustainable **yields of fish** (16).\*\*\* In both agriculture and fisheries, **food safety risks** are observed,\*\*\*\* particularly for Indigenous Peoples and local communities,\*\*\* including from toxigenic fungi (crops),\*\*\*\* algal blooms,\*\*\* bioaccumulation of toxins and contaminants (marine food webs),\*\* and biomagnification of persistent organic pollutants (POPs) and methyl mercury (16).\*\*

“ Climate change has contributed to malnutrition in all its forms in many regions, including undernutrition, overnutrition and obesity, and to disease susceptibility,\*\*\* especially for women, pregnant women, children, low-income households, Indigenous Peoples, minority groups and small-scale producers – IPCC WG II (8).\*\*\*

## Water



Safe drinking water, sanitation and hygiene (WASH) are crucial determinants of human health and well-being and help to create resilient communities (25). Climate change leads to complicated, **unpredictable human relationships with water** sources and the hydrological cycle; has significant **negative effects on WASH**; and has direct negative **impacts on the water-food-energy nexus**. Many changes in water availability and water-related hazards are attributed directly to human-induced climate change (26).\*\*\*

Climate change results in unfamiliar and extreme precipitation patterns \*\*\* and cryospheric changes,\*\*\* which, along with natural hazards, can lead to water insecurity and be exacerbated by poor water governance.\*\*\* Around **half the global population experiences severe water scarcity** for at least 1 month a year due to climatic and other factors (26).\*\*

Observed intensification of the global hydrological cycle has disproportionate social impacts on vulnerable people in low-income countries (26).\*\*\* Over the past decade, mortality from water-related extreme conditions and events was **15 times higher for vulnerable countries** (8).\*\*\* Water-related disasters (tropical storms, hurricanes, heavy rains, floods) are also associated with increased incidence of waterborne diseases (26).\*\*\* Along with drought, these disasters are the most common drivers of climate change-associated **involuntary migration and displacement** (27).\*\*\* Water insecurity can contribute to social unrest, and there is evidence that climate change adds to this (26).\*\*

AR6 WG II projects that **water-related risks will increase** under all warming scenarios (17).\*\*\*

“ Maintaining planetary health is essential for human and societal health and a precondition for climate-resilient development – IPCC WG II (28).\*\*\*\*

## Air



Climate change is not a dominant driver of air pollution, but exposure to climate change-associated events can **increase local exposure to respiratory irritants**. Increased frequency of wildfires increases smoke exposure across regions.\*\*\*\* Changes to the seasonality of pollen seasons increase risks for respiratory disease due to allergens.\*\*\* These can lead to large burdens on health services. For example, the health impacts of the 2019–2020 wildfires in south-eastern Australia resulted in over 3000 hospitalizations due to cardiovascular and respiratory conditions, costing nearly US\$ 2 billion (8).

Climate change and global air pollution are closely interlinked. Burning of fossil fuels, the main source of greenhouse gas emissions, is responsible for **two-thirds of outdoor air pollution exposure** (29). Long-term exposure to one of these pollutants (fine particulate matter, PM<sub>2.5</sub>) **exceeded the WHO 2005 Air Quality Guidelines for over 90% of the global population**, resulting in over 4.2 million deaths a year (30). Under the current WHO 2021 Air Quality Guidelines, over 99% of the global population breathes air that breaches the new standards. The highest exposures are in low- and middle-income countries.

AR6 WG II notes that several chronic **noncommunicable respiratory diseases are climate-sensitive** based on their exposure pathways (e.g. heat, cold, dust, small particulates, ozone, fire smoke, allergens) (8),\*\*\*\* which WG II expects **will increase** with climate change and increasing environmental changes.

“ The economic benefits on human health from air quality improvement arising from mitigation action can be of the same order of magnitude as mitigation costs, and potentially even larger – IPCC WG III (31).

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## Evidence to action

Human health needs to be part of an **integrated mitigation and adaptation agenda** across **all sectors** (32) and governance scales (33). Evidence on health impacts can be used to inform **proactive** adaptation and **synergistic** mitigation, and to steer global decision-making on climate change that promotes positive health outcomes.

The following draws heavily on AR6.

## Adaptation planning

AR6 WG II recognizes that the capacity for the health sector to respond to climate change is “weak”, with limited advancements in health adaptation since AR5. It also recognizes the adaptation benefits to health and well-being from cross-sector approaches and solutions (33). Two other priority enabling conditions for adaptation include substantially scaling up international financial investment in adaptation\*\*\*\* and scaling up perception of risks (19).\*\*

AR6 WG II outlines that **proactive adaptation to minimize health risks** entails (34):

- strengthening **resilience of the health sector**;
- **protecting against exposure** – for example, with heat action plans that include early warning and response systems;
- improving **access to potable water**, reducing exposure of water and sanitation systems to flooding and extreme weather and climate events, and improving early warning systems;
- improving **surveillance and access to mental health care** and monitoring of psychosocial impacts from extreme weather and climate events;
- integrating adaptation approaches that **mainstream health** into food, livelihood, social protection, infrastructure, and water and sanitation policies (i.e. implementing multisectoral health governance).

AR6 emphasizes the importance of **multisectoral approaches to adaptation** to reduce risks associated with environmental determinants of health such as food, water, and air. Specifically, AR6 WG II highlights **integrated approaches to reduce and address risks of malnutrition**\*\*\*\* and, at the household level, that **nutrition-sensitive and integrated agroecological farming systems** offer opportunities to increase dietary diversity and build local resilience to climate-related food insecurity (19).\*\*

Health experts highlight the urgency to accelerate adaptation: “The risk for each climate-sensitive health outcome is projected to increase as global mean surface temperature increases above pre-industrial levels, with the extent and pace of adaptation expected to affect the timing and magnitude of risks” (35).

## Mitigation strategies

Maintaining the necessary conditions to protect human health means aiming for **net zero carbon emissions by 2050** or a 43% emissions reduction by 2030 to stabilize global temperatures. Most emissions arise from **cities**. Deep decarbonization and an aggressive transition to low-emissions energy depend on reducing consumption of fossil fuels and shifting to renewable energy, electrifying transportation, and enhancing carbon intake in cities and ecosystems (36).\*\*\*\*

AR6 WG III discusses climate-resilient development and identifies ways to improve mitigation across systems, sectors and consumer behaviour. It notes significant **synergies between mitigation options and health ambitions under the Sustainable Development Goals (SDGs)**. It reviewed six sectors: industry; transport; buildings; urban systems; agriculture, forestry and other land use; and energy. WG III identifies 11 mitigation activities across 3 sectors with synergies for SDG 2 (zero hunger), and 28 mitigation options across all 6 sectors with synergies for SDG 3 (good health and well-being) (37).

Three significant pathways to **health co-benefits** from mitigation activities reported by AR6 WG III are in the energy, land and urban infrastructure sectors. Cleaner energy improves **air quality**; sustainable food systems produce **healthier, lower-carbon diets**; and sustainable urban planning promotes **active mobility** (38).\*\*\* From the health perspective, these mitigation options are additionally likely to yield significant benefits to mental health and well-being, and impact positively on various social determinants of health, including social cohesion and equity. Mitigation that creates **healthier natural and built environments aligns with WHO strategies to reduce the incidence of communicable and noncommunicable diseases**, such as respiratory and cardiovascular diseases.

The need to reduce consumer demand for unsustainable and high-emissions living featured prominently in the AR6 WG III mitigation discussion. Consumers, mostly in developed countries,<sup>3</sup> can play a role in reducing material and carbon footprint. WG III notes that **reducing demand for high-emissions products and services** is consistent with improving basic well-being for all (Table 3).\*\*\* Policy and information that supports and motivates these consumers towards more sustainable choices could decrease CO<sub>2</sub> and non-CO<sub>2</sub> emissions by 40–70% compared with 2050 projections (39).

A substantial shift in demand patterns depends on what is referred to by AR6 as “choice architecture” – and the impact that architecture has on consumer decision-making. Comprehensive “choice architecture”, including infrastructure and supportive policies and technology options, facilitates mitigation-friendly consumption (39).

In addition to supporting mitigation across high-emitting sectors, WHO also encourages the health sector to adopt strategies to enable a demand shift across the health system to improve its sustainability and resilience and lower its material footprint and carbon emissions.

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<sup>3</sup> Globally, 10% of households with the highest per capita emissions contribute 34–45% of global consumption-based household greenhouse gas emissions; the middle 40% contribute 40–53%; and the bottom 50% contribute 13–15% (20).\*\*\*

**Table 3. Shifting demand for mitigation while enhancing health and well-being**



*Source:* Climate change 2022: mitigation of climate change – summary for policymakers. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC\\_AR6\\_WGIII\\_SPM.pdf](https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf)).

## Health in intergovernmental climate negotiations

This section identifies connections between the IPCC AR6 evidence, the global health agenda, and intergovernmental decisions under the UNFCCC and other forums.

The objective of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system (Article 2). Despite inclusion of human health and welfare in the definition of adverse effects of climate change (Article 1), no UNFCCC decision or outcome document explicitly recognizes in its principles that **stabilization and reduction of greenhouse gases will promote positive health outcomes for people and the planet** (Table 4) (40). Without an identified reference to or role for the health sector in climate negotiations, the health stakeholder community is limited in how it can add value to global policy frameworks on this issue.

**Table 4. Negative impacts to health-related SDGs due to climate change: indicators under WHO custodianship<sup>a</sup>**

IPCC AR6 projections indicate negative impacts of climate change	IPCC AR6 evidence suggests negative impacts of climate change without specific projections	IPCC AR6 evidence indicates negative impacts from processes that drive climate change
<b>2.2.1</b> Stunting under age 5 years (13)	<b>3.8.2</b> Household health expenditure (10)	<b>3.9.1</b> Mortality from indoor and outdoor air pollution
<b>2.2.2</b> Malnutrition under age 5 years (wasting and overweight) (13)	<b>3.9.2</b> Mortality from unsafe WASH (8, 17)	<b>11.6.2</b> Mean levels of fine particulate matter in cities (e.g. PM2.5)
<b>2.2.3</b> Anaemia in women aged 15–49 years (13)	<b>3.d.1</b> Health emergency preparedness (12, 41)	
<b>3.3.3</b> Malaria incidence (8)	<b>5.2.1</b> Ever-partnered women and girls aged ≥15 years subject to physical, sexual or psychological violence by a partner (8, 20)	
<b>3.3.5</b> Interventions needed for neglected tropical diseases (13)	<b>5.2.2</b> Women and girls aged ≥15 years subject to sexual violence by someone other than an intimate partner (8, 20)	
<b>3.4.1</b> Mortality from cardiovascular disease, cancer, diabetes or chronic respiratory disease (13)	<b>6.3.1</b> Domestic and industrial wastewater flows safely treated (13)	
<b>6.1.1</b> Use of safely managed drinking water services (8, 17)	<b>3.8.1</b> Coverage of essential health services	
<b>6.2.1</b> Use of safely managed sanitation (13)		

<sup>a</sup> This table reflects WHO assessment of the implications of evidence presented in the IPCC AR6 for progress in achieving the health-related SDGs. Climate change, and the processes driving it, are expected to undermine progress either globally or in one or more regions. The time horizon for achieving the SDGs (2030) is earlier than for most projections presented in AR6. Negative impacts of climate change broadly scale with temperature increases, however, so even the lower levels of warming that have been experienced, or are expected up to 2030, can be expected to have negative impacts within the SDG timescale and beyond (35).

There is considerable room to **use the IPCC AR6 assessment of health evidence to inform national implementation**. Fulfilment of the UNFCCC and its Paris Agreement depends on national implementation of its decisions. Two essential elements contributing to national implementation are **national adaptation plans** (NAPs) and **nationally determined contributions** (NDCs).

NAPs are voluntary exercises submitted to the UNFCCC. They can, and do, include health components. **The health components of NAPs can be expanded significantly** to encompass and communicate health risks and actions. Explicit links between environmental changes and direct and indirect physical and mental health conditions can be included and made more comprehensive. Roadmaps can be outlined to advance interministerial agreements on cross-sectoral work and to identify preparedness plans for urgent and long-term health risks in the health sector.

NDCs are obligatory reports outlining countries' emissions-reduction ambitions to the UNFCCC. NDCs can include elements that strengthen the argument for ambition, and can include co-benefits such as health gains. NDCs could be strengthened with reference to whether country-level engagement on health is sufficient to address health adaptation needs (19). NDCs should also **demonstrate co-benefits from mitigation activities with synergies to SDGs 2 and 3**; from demand-side shifts in material and emissions footprints; and from other actions that increase community health, well-being and resilience, and support a low-carbon health sector.

Overall, health planning and implementation need to urgently advance beyond development of early warning systems to **more comprehensive climate-health risk management at the national level**. WHO-led **vulnerability and adaptation assessments** and ministry of health-led health national adaptation plans (HNAPs) are **fundamental to multisectoral health governance**, avoiding maladaptation, and incorporating equity considerations, all of which are essential to **building resilience** (42). Vulnerability and adaptation assessments should be done at the national level to assess local climate change impacts on human health, comprehensively scope environmental determinants of health, and identify and assess risks for vulnerable groups. HNAPs are context-specific action plans for addressing environmental health risks and local health-sector needs. **Links between health evidence in IPCC AR6 and actions in HNAPs** need to be strengthened.

Vulnerability and adaptation assessments and HNAPs are health sector **tools that can and should be incorporated into party-driven work<sup>4</sup> to the UNFCCC**. This act connects evidence – the health impacts, vulnerabilities and risks observed and projected by IPCC – and the concrete actions UNFCCC member countries discuss and adopt within negotiations. Moreover, these tools support implementation of UNFCCC party commitments (Article 4.1) to:

(4.1.e) “cooperate in preparing for adaptation to the impacts of climate change” such as to “develop and elaborate appropriate and integrated plans” including for the **water** and **agriculture** sectors;

(4.1.f) take into account in “relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on **public health** and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change”;

(4.1.g) “promote and cooperate in scientific, technological, technical, socio-economic and other **research, systematic observation and development of data** archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies”;

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<sup>4</sup> “Party-driven work” to the UNFCCC includes NDCs (obligatory), enhanced transparency framework and biennial transparency reports, national communications (obligatory), adaptation communications (obligatory) and NAPs (voluntary).

(4.1.h) “promote and cooperate in the full, **open and prompt exchange** of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies”;

(4.1.i) “promote and cooperate in **education, training and public awareness** related to climate change and encourage the widest participation in this process”;

(4.1.j) **communicate to the Conference of the Parties** information related to implementation” (40).

Importantly, health stakeholder efforts to strengthen NAPs, NDCs, vulnerability and adaptation assessments and HNAPs **support the fulfilment of the newly adopted human right to a clean, healthy, sustainable environment**. In Resolution 76/300, the United Nations General Assembly notes that the realization of this right requires full implementation of multilateral environmental agreements (43), such as the UNFCCC.

The health evidence adopted by the IPCC in the AR6 can and should be **used as a baseline for indicators, metrics, assessments, planning and analysis to inform various workstreams under the UNFCCC**. In near-term UNFCCC negotiations, this will be particularly meaningful in discussion on the Global Stocktake and the Global Goal on Adaptation under the Paris Agreement, and on the Warsaw International Mechanism for Loss and Damage.

Across global environmental treaties, uptake of **integrated health and environment data is essential** to reinforce governance, funding streams and information systems for planetary health. Health evidence and projections adopted by the the IPCC can also be used to **inform and advance the integration of the environment into the One Health approach** and to support **realization of global biodiversity targets under the Convention on Biological Diversity**, among other processes.

Systems transformation, as emphasized in AR6, may be more seriously considered if “health” becomes a component to a UNFCCC Conference of the Parties (COP) decision, and part of a common conversation among climate change delegations worldwide.

# References

The following abbreviations are used in the references:

## IPCC AR6 WG II Full Report, Chapter 7 (WG II Ch. 7)

Cissé G, McLeman R, Adams H, et al. Health, wellbeing, and the changing structure of communities. In: Climate change 2022: impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change; 2022 ([https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_FullReport.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FullReport.pdf), accessed 14 September 2022).

## IPCC AR6 WG II Summary for Policymakers (WG II SPM)

Climate change 2022: impacts, adaptation and vulnerability – summary for policymakers. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://report.ipcc.ch/ar6wg2/pdf/IPCC\\_AR6\\_WGII\\_SummaryForPolicymakers.pdf](https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf), accessed 14 September 2022).

## IPCC AR6 WG II Technical Summary (WG II TS)

Climate change 2022: impacts, adaptation and vulnerability – technical summary. Geneva: Intergovernmental Panel on Climate Change Working Group II; 2022 ([https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_TechnicalSummary.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_TechnicalSummary.pdf), accessed 14 September 2022).

## IPCC AR6 WG III Summary for Policymakers (WG III SPM)

Climate change 2022: mitigation of climate change – summary for policymakers. Geneva: Intergovernmental Panel on Climate Change Working Group III; 2022 ([https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC\\_AR6\\_WGIII\\_SPM.pdf](https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf), accessed 14 September 2022).

## IPCC AR6 WG III Technical Summary (WG III TS)

Climate change 2022: mitigation of climate change – technical summary. Geneva: Intergovernmental Panel on Climate Change Working Group III; 2022 ([https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC\\_AR6\\_WGIII\\_TS.pdf](https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TS.pdf), accessed 3 October 2022).

- 1 WG II SPM D.5.
- 2 Human settlement; the energy, transport and industrial sectors; human health; air quality; and changes in ultraviolet-B radiation. In: Impacts assessment of climate change. Geneva: Intergovernmental Panel on Climate Change Working Group II; 1990 ([https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc\\_far\\_wg\\_II\\_chapter\\_05.pdf](https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_II_chapter_05.pdf), accessed 12 September 2022).
- 3 WG II SPM Figure SPM 1.
- 4 Climate change, a health emergency: what the IPCC says about health, and why it is important for COP27. Webinar, Health and Climate Network, World Health Organization, 30 May 2022; based on Hickman C, Marks E, Pihkala P, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health*. 2021;5(12):e863–e873.
- 5 WG II SPM B.5.
- 6 Summary of the 55th session of the Intergovernmental Panel on Climate Change and the 12th session of Working Group II. *Earth Negotiations Bull*. 2022;12:794 (<https://enb.iisd.org/55th-session-intergovernmental-panel-climate-change-ipcc-55-12th-session-working-group-II-summary>, accessed 12 September 2022).
- 7 WG II TS E.5.
- 8 WG II TS B.5.
- 9 WG II TS Figure T.S.3.
- 10 WG II SPM B.1.
- 11 WG II TS B Observed impacts.

- 12 WG II TS B.2.
- 13 WG II TS C.6.
- 14 WG II TS C.2.
- 15 WG II TS C.3.
- 16 WG II TS B.3.
- 17 WG II TS C.4.
- 18 Mental health and climate change: policy brief. Geneva: World Health Organization; 2022 (<https://apps.who.int/iris/handle/10665/354104>, accessed 14 September 2022).
- 19 WG II Ch. 7.
- 20 WG II TS B.7.
- 21 WG III SPM D.3.
- 22 WG III SPM B.3.
- 23 WG II TS A.1.
- 24 WG II SPM C.4.
- 25 Water, sanitation and hygiene (WASH). Geneva: World Health Organization (<https://www.who.int/health-topics/water-sanitation-and-hygiene-wash>, accessed 12 September 2022).
- 26 WG II TS B.4.
- 27 WG II TS B.6.
- 28 WG II TS E.4.
- 29 Lelieveld J, Klingmüller K, Pozzer A. Effects of fossil fuel and total anthropogenic emission removal on public health and climate. *Proc Natl Acad Sci U S A*. 2019;116(15):7192–7197.
- 30 WHO global air quality guidelines. Geneva: World Health Organization; 2021 (<https://apps.who.int/iris/handle/10665/345329>, accessed 12 September 2022).
- 31 WG III TS 4.
- 32 WG II TS E.1.
- 33 WG II TS D.8.
- 34 WG II SPM C.2.
- 35 Ebi KL, Boyer C, Nicholas Ogden N, et al. Burning embers: synthesis of the health risks of climate change. *Environ Res Lett*. 2021;16(4):044042.
- 36 WG III C.6.
- 37 WG III SPM Figure SPM.8.
- 38 WG III SPM D.1.
- 39 WG III SPM C.10.
- 40 United Nations Framework Convention on Climate Change. Bonn: United Nations; 1992 ([https://unfccc.int/files/essential\\_background/background\\_publications\\_htmlpdf/application/pdf/conveng.pdf](https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf), accessed 12 September 2022).
- 41 WG II Ch.8.
- 42 Quality criteria for health national adaptation plans. Geneva: World Health Organization; 2021 (<https://www4.unfccc.int/sites/NAPC/Documents/Supplements/WHO%20Criteria%20for%20quality%20NAPs.pdf>, accessed 12 September 2022).
- 43 A/RES/76/300. The human right to a clean, healthy and sustainable environment: draft resolution. 67th session resolution. New York: United Nations General Assembly; 2022 (<https://digitallibrary.un.org/record/3982508?ln=en>, accessed 12 September 2022).