The 1.5 Health Report

SYNTHESIS ON HEALTH & CLIMATE SCIENCE IN THE IPCC SR1.5

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Foreword

As scientists and public health professionals, we welcome this synthesis of the health content of the IPCC special report on global warming of 1.5C.

Climate change affects health through a range of different pathways: from extreme weather events, to infectious disease, to water and food security. The actions that would be necessary to keep global warming below 1.5C, would themselves have effects on health, for example in reducing the intolerable death rate from air pollution. These diverse connections mean that information on the health implications of restricting global warming are scattered throughout the IPCC report. This synthesis does the valuable service of bringing them together in one place.

The synthesis underlines three important messages. The first is that the greater the warming, the greater the risks to health overall. The IPCC special report makes clear that there are local variations and is frank about the uncertainties in attempting to give precise estimates of the health impacts under each scenario, particularly in specific locations.

However, that is not an excuse for inaction. The report is clear that some of the consequences of global warming, such as the sea level rise that threatens population health, and eventually the existence of small island states and low-lying communities, increase inexorably with temperature. Higher air temperatures eventually pass the thresholds above which it is safe to work or play outside. Increasing energy in the atmosphere, leading to elevated air and water temperatures, increase the potential for extreme weather events and the transmission of certain infectious disease. Uncertainty about the precise magnitude and pattern of these changes should be an argument for caution, not complacency. There is a strong public health case for limiting warming to the greatest extent possible.

The second message is that there can be important health gains from the actions that will be necessary to limit warming. Several important climate pollutants, including black carbon and methane, contribute directly or indirectly to the indoor and outdoor air pollution that causes approximately 7 million deaths a year around the world. Actions that target these pollutants can bring significant near-term health and climate benefits.

Policies that address the upstream drivers of climate pollution, such as cleaner and more sustainable electricity generation systems, and urban design and transport policies that facilitate walking and cycling, promote health in diverse ways while also cutting emissions of carbon dioxide, which is the greatest overall contributor to long-term warming.

The final message is that the speed of reducing emissions will affect the level of adaptation ambition required. The longer it takes to reduce emissions, the greater the adaptation needed to protect population health. No matter the extent of mitigation, there will be residual risks for health that health systems will need to manage.

Not every mitigation actions is beneficial for health, however. Increasing the use of biofuels could for example affect the availability of land for agriculture, thus affecting food security.

This highlights the importance of ensuring health professionals are engaged in decisions regarding specific mitigation actions to ensure that accompanying policies and measures are implemented to protect and promote population health when such actions are necessary.

Ultimately, the report supports a positive vision of a world that safeguards the climate and is a safer and healthier place to live.

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DISCLAIMER:

This Synthesis Report aims to summarise the findings of the IPCC Special Report 1.5 report (IPCC-SR1.5) regarding the relationship between climate change and health. The IPCC-SR1.5 was published in Incheon on October 8 and is publicly available at www.ipcc.ch/report/sr15/. This Synthesis Report represents a near-literal transcription of all elements in the IPCC-SR1.5 that refer to human health, although paragraphs have been shortened. The Synthesis Report tries to stay as close as possible to the original text in the IPCC-SR1.5, and in no way aims to replace, dispute, or reinterpret the findings of the IPCC-SR1.5. Each paragraph in this Synthesis Report has a reference to the Section in the IPCC-SR1.5 where it can be found. In cases of doubt, dispute or unclarity, the authors of this Synthesis Report ask you to refer to the original IPCC-SR1.5 report.

Background on the IPCC 1.5 Report

The **Intergovernmental Panel on Climate Change** (IPCC) **Special Report on 1.5°C** (IPCC SR1.5), released on October 8th in Incheon, Republic of Korea, is the most important scientific report on climate change that will guide climate policymaking in the years to come.

Requested at the United Nations climate summit in Paris in 2015 by the 21st Conference of the Parties (COP21), the Special Report on 1.5°C was tasked to inform global leaders of the impacts of 1.5°C and 2°C of global warming above pre-industrial temperatures and their corresponding pathways.

The IPCC SR1.5 forms an official collection of all known scientific, peer-reviewed, research on the impacts of 1.5°C of global warming on natural and human systems around the world.

The **Summary for Policymakers** of the Special Report on 1.5°C (SPM) - which provides a 30-page synopsis of the 800-page full scientific report - was approved during the first joint session of IPCC Working Group I, II and III and the 48th Session of the IPCC in Incheon, Republic of Korea, from 1 to 5 October 2018.

This Summary for Policymakers serves as a guiding document for policymakers worldwide who seek to design and implement science-based policy measures to mitigate greenhouse gas emissions, strengthen and implement the global response to climate change, as well as advance sustainable development, poverty eradication and the reduction of inequalities.

Taking into account that under current collective efforts under the Paris Agreement, global warming is projected to exceed 3°C above pre-industrial levels, the Special Report on 1.5°C is a comprehensive assessment of the global implications of a 1.5°C and 2°C warmer world.

The Impacts of Global Warming on Human Health

Climate Change is adversely affecting human health by increasing exposure and vulnerability to climate related stresses. Observed and detected climatic changes that affect human health include extreme weather events, a changing distribution of health risks, increased risks of undernutrition, displacement of populations and greater risks of injuries, disease and death. [Section 5.2.1 and 3.4.7]

Any increase in global warming, even an increase by half a degree, could affect human health. Warming of 1.5°C is not considered 'safe' for most nations, communities, ecosystems and sectors and poses significant risks to natural and human systems. [Cross-Chapter Box 12]

Risks to human health and food production systems are projected to be lower at 1.5°C than at 2°C. Risks are projected to be lower at 1.5°C than at 2°C for heat-related morbidity and mortality, ozone-related mortality, and undernutrition. [Section 3.3.1 and 3.4]

The impacts of 1.5°C could disproportionately affect disadvantaged and vulnerable populations through food and water insecurity, higher food prices, income losses, lost livelihood opportunities, adverse health impacts, and population displacements. [Section 5.2.1]

Urban areas are particularly vulnerable to global warming when it comes to human health, because of the heat island effect in urban areas.The extent of risk to human health depends on human vulnerability and the effectiveness of adaptation for regions (coastal and non-coastal), the nature of informal settlements, and the design of infrastructure sectors (energy, water, and transport). [Section 3.4.5 and 3.4.8]

Climate change is projected to be a poverty multiplier. The health risks that come with global warming are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. [Section 3.4.10 and 3.4.11]

Extreme Weather Events

Climate-change-related risks from **extreme events**, such as heatwaves, extreme precipitation, and coastal flooding, are already moderate to high with 1°C additional warming above preindustrial temperatures.. Risks associated with some types of extreme events (e.g., extreme heat) increase further at higher temperatures. [Section 3.5.2.2]

Heat Waves

Climate change has contributed to increased heat-related mortality. There is robust evidence that climate change is affecting the frequency, intensity, and duration of heatwaves and that exposure to high ambient temperatures is associated with excess morbidity and mortality. [Section 3.4.7]

The magnitude of projected heat-related mortality and hazardous heat conditions at +2°C is greater than at +1.5°C, and each additional unit of warming is projected to increase heat related mortality. [Section 3.4.7.1]

Even if climate change is held below 2°C, taking into consideration urban heat island effects, there could be a substantial **increase in the occurrence of deadly heatwaves in cities**, with the projected risks similar at 1.5°C and 2°C, but substantially larger than under the present climate. [Section 3.4.7.1]

At +1.5°C, twice as many megacities as present (such as Lagos, Nigeria, and Shanghai, China) **are likely to become heat stressed**, potentially exposing more than **350 million more people to deadly heat stress by 2050**. [Section 3.4.8 and 3.5.5.8]

At +2°C warming, Karachi (Pakistan) and Kolkata (India) could expect annual conditions equivalent to their deadly 2015 heatwaves. This could imply a tipping point in the extent and scale of heat-wave impacts. However, these projections do not integrate adaptation to projected warming, for instance, cooling that could be achieved with more reflective roofs and urban surfaces overall. [Section 3.5.5.8]

Evidence suggests **recent adaptation reduced the impacts of heatwaves on human health.** Different warming scenarios that assume additional adaptation to heatwaves see a reduction in the projected magnitude of health risks. Heat action plans that provide early alerts and advisories combined with emergency public health measures can reduce heat-related morbidity and mortality. [Section 4.4.3.2]

The extent to which mortality increases with rising temperatures varies by region, presumably because of acclimatisation, population vulnerability, the built environment, access to air conditioning, and other factors. Populations at highest risk include older adults, children, women, those with chronic diseases, and people taking certain medications. [Section 3.4.7.1]

Tipping point for Human Health [Section 3.5.5.8 and Table 3.7]

It is unsure whether tipping points, defined as thresholds for abrupt and irreversible change, exist for human health impacts from climate change.

Increases in temperature are often modelled using a linear relationship with hospitalisations and deaths, making it hard to identify a tipping point for heat-related deaths.

It is plausible that coping strategies will not be in place for many regions, that could result in potentially significant impacts on communities with low adaptive capacity, effectively representing the **occurrence of local or regional tipping point**s.

With a warming of 1.5ºC or less, **more than 350 million more people will be exposed to deadly heat by 2050** under a midrange population growth scenario.

With a warming of 1.5ºC-2°C, annual occurrences of heat-waves similar to the deadly 2015 heatwaves in India and Pakistan are expected.

With a warming of up to 3°C, a substantial increase in potentially deadly heat-waves is very likely.

Flooding & Sea Level Rise

Previous IPCC reports[1] confirmed that **increased storm surges, coastal flooding, and sea level rise** due to global warming is projected to exacerbate the risk of death, injury, ill-health, and the disruption of livelihoods in low-lying coastal zones and small island developing states and other small islands. [Sections 3.4.4 and 3.4.5 and 3.4.6.3]

Coastal communities especially (home to hundreds of millions of people) will suffer from reduced health, reduced income, livelihoods, cultural identity and reduced coastal protection. [Section 3.3.2]

The risks of 1.5°C vs 2°C of global average warming for Small Island Developing States (SIDS) are expected to be severe, but research gaps still persist. [Cross-Chapter Box 9 and Section 3.4.5.3]

Infectious & Vector-borne Diseases

There is strong evidence that changing weather patterns associated with climate change are **shifting the geographic range, seasonality, and intensity of transmission of selected**

[1] The IPCC 5th Assessment Report (AR5), published in 2014

climate-sensitive infectious diseases, with increases and decreases projected with additional warming. [Section 3.4.7]

The health risks increase with greater warming. Projections suggest that climate change will further expand the geographic range of these diseases, with increases and decreases projected depending on the disease (e.g., Malaria, Dengue, West Nile virus, and Lyme disease), the region, and the degree of temperature change. [Section 3.4.7.1]

The magnitude and pattern of future impacts is expected to depend on the extent and effectiveness of additional adaptation and vulnerability reduction, and on mitigation for risks past mid-century. [Section 3.4.7]

Many scientific studies suggested the **negative health impact of malaria could increase with climate change** due to a greater geographic range for the *Anopheles* vector, a longer season, and/or an increase in the number of people at risk, with larger negative health impacts occurring in relation to greater amounts of warming, and complex regional patterns. [Section 3.4.7.1]

Some regions are projected to become too hot and/or dry for the *Anopheles* mosquito, such as in northern China and parts of south and southeast Asia. Vector populations are projected to shift with climate change, with expansions and reductions depending on the degree of local warming, the ecology of the mosquito vector, and other factors. [Section 3.4.7.1]

The mosquitos *Aedes aegypti* and *Aedes albopictus* - t**he principal vectors for Dengue Fever, Chikungunya, Yellow fever, and Zika virus - are projected to increase in number, with a larger geographic range by the 2030s** than at present, which could put more individuals at risk of the diseases they carry, with regional differences. [Section 3.4.7.1]

Warmer global average temperatures are expected to **expand the range of the West Nile Virus** in North America and Europe, particularly along the current edges of its transmission areas, and are expected to extend the transmission season,with the magnitude and pattern of changes varying by location and degree of warming. [Section 3.4.7.1]

Climate change s expected to **expand the geographic range and seasonality of Lyme disease** and other tick-borne diseases in parts of North America and Europe. These changes are larger with greater degrees of warming. Climate change is already worsening the adverse health outcomes associated with Lyme disease in Canada. [Section 3.4.7.1]

Climate change could increase or decrease future negative health impacts of leishmaniasis, Chagas disease, and other vector-borne and zoonotic diseases, with generally **greater negative health impacts at higher degrees of warming**. [Section 3.4.7.1]

Air Quality

Because ozone formation is temperature dependent, projections focusing only on temperature increase generally conclude that **ozone-related mortality could increase with additional warming, with the risks higher at +2°C than at 1.5°C**. [Section 3.4.7.1]

Changes in projected Particulate Matter-related mortality could increase or decrease, depending on climate projections and emissions assumptions. [Section 3.4.7.1]

Food Security

Climate change exacerbates the risk of food insecurity and the breakdown of food systems, particularly for poorer populations in both urban and rural settings. For example, the interaction of climate change with food security can exacerbate **undernutrition**, increasing the vulnerability of individuals to a range of diseases. [Section 3.6 and 3.4.6.1]

Health risks associated with food insecurity are higher and the globally undernourished population larger at 2°C compared to 1.5°C of warming. [Section 3.6]

Climate change-related changes in dietary and weight-related risk factors are projected to increase mortality due to global reductions in food availability. [Cross-Chapter Box 6]

There is increasing evidence that high ambient levels of CO2 concentrations could affect human health by **increasing the production and allergenicity of pollen** and allergenic compounds and by **decreasing the nutritional quality of important food crops**. [Cross-Chapter Box 6]

In experiments, artificially elevated CO2 and 1.5°C of warming caused an increase in the **yield** of maize and potato crops. However, observations of actual crop yield trends indicate that reductions as a result of climate change remain more common than crop yield increases, despite increased atmospheric CO2 concentration. [Section 3.4.6.1]

The rise in tropospheric ozone has already reduced yields of wheat, rice, maize, and soybean ranging from a 3% to a 16% reduction globally. [Section 3.4.6.1]

While climate change is very likely to decrease agricultural yield, the consequences could be reduced substantially at 1.5°C with appropriate investment and adaptation. [Cross-Chapter Box 6]

Elevated CO2 concentration lead to faster growth rates and lower protein values in several important cereal grains (C3-type) although perhaps not always for drought resistant grains such as sorghum (C4-type). [Section 3.4.6.1]

Elevated CO2 concentrations of 568–590 ppm alone (corresponding to **a warming of 2.3 – 3.3°C**) would reduce the protein, micronutrient, and B vitamin content of the 18 rice cultivars grown most widely grown in southeast Asia, where it is a staple food source, by an amount **sufficient to create nutritional-related health risks for 600 million people**. [Section 3.4.6.1]

Furthermore, **climate-change induced species redistribution** could be far reaching and extensive, even if anthropogenic greenhouse gas emissions stopped today. This is projected to have global consequences for food security and human health: key insect crop pollinators will see their range shrink with increasing temperatures, and certain pest and disease species will move into areas which become newly climatically suitable, causing them to become invasive or harmful in certain agricultural areas. [Section 3.4.3.3]

Climate change will negatively affect childhood undernutrition, particularly stunting, through reduced food availability, and will negatively affect undernutrition-related childhood mortality and disability-adjusted lives lost, with the largest risks in Asia and Africa. Climate change is projected to hinder increasing food security, stunting the prevention of childhood deaths. [Cross-Chapter Box 6]

The projected health risks for undernutrition are greater at 2° vs 1.5°C warming. **The projected global undernourished population is 530 to 550 million at 1.5°C and 540 to 590 million at 2ºC**. Furthermore, climate change is reducing the protein and micronutrient content of major cereal crops, which is expected to further affect food security. Socioeconomic conditions are the primary driver of vulnerability. [Cross-Chapter Box 6]

Water Security

Climate change can alter the availability of water and threaten water security. 80% of the world's population already suffers from serious threats to its water security as measured by indicators including water availability, water demand, and pollution. [Section 3.4.2.1]

Limiting global warming to 1.5°C is expected to substantially reduce the probability of drought and risks associated with water availability (i.e. water stress) in some regions. In particular, risks associated with increases in drought frequency and magnitude are substantially larger at 2°C than at 1.5°C in the Mediterranean region and Southern Africa. Higher warming levels may induce strong levels of vulnerability exacerbated by large changes in demography. [Section 3.3.3 and 3.3.4 and Box 3.2]

Sustainable Development & Poverty

Poverty and disadvantage increased with recent warming (about 1°C) and are projected to increase in many populations as average global temperatures increase from 1°C to 1.5°C and beyond. [Section 5.1 and 5.2.1]

By the mid to late of 21st century, **climate change is projected to be a poverty multiplier** that makes poor people poorer and increases the total number of people in poverty. [Section 3.4.10.1]

Climate change could force more than 100 million people into extreme poverty, with the numbers attributed to climate change alone between 3 million and 16 million, mostly through impacts on agriculture and food prices. [Section 3.4.10.1]

Unmitigated warming could reshape the global economy later in the century by reducing average global incomes and **widening global income inequality**. Most severe impacts are projected for urban areas and some rural regions in sub-Saharan Africa and Southeast Asia. [Section 3.4.10.1]

Health risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Risks are currently moderate due to regionally differentiated climate-change impacts on crop production in particular. Based on projected decreases in regional crop yields and water availability, **risks of unevenly distributed health impacts are high for additional warming above 2°C**. [Section 3.5.2.3]

Migration & Displacement

The potential impacts of climate change on migration and displacement are an emerging risk. The social, economic and environmental factors underlying migration are complex and varied, however, and our understanding of the linkages of 1.5ºC and 2ºC of global warming on human migration are limited and represent an important knowledge gap. [Section 3.4.10.2 and 3.7.2]

Temperature had a statistically significant effect on outmigration over recent decades in 163 countries, but only for agricultural-dependent countries. A 1°C increase in temperature was associated with a 1.9% increase in bilateral migration flows from 142 sending countries and 19 receiving countries. [Section 3.4.10.2]

Internal and international migration have always been important for small islands, with numerous factors playing a role. [Section 3.4.10.2]

At 2°C warming, there is a potential for significant population displacement concentrated in the tropics. Tropical populations may have to move at distances greater than 1000 km if global mean temperature rises by 2 °C from the period of 2011–2030 to the end of the century. [Section 3.4.10.2]

Drought significantly increases the likelihood of sustained conflict for particularly vulnerable nations or groups due to their livelihood dependance on agriculture. If the world warms by 2°C–4°C by 2050, then rates of human conflict could increase. [Section 3.4.10.2]

Occupational health

Additional climate change is projected to increasingly compromise safe work activity and worker productivity during the hottest months of the year. Higher ambient temperatures and humidity levels place additional stress on individuals engaging in physical activity. [Section 3.4.7.1]

Global warming of +1.5°C is projected to reduce working hours worldwide by 6% due to heat stress. Environmental heat stress in 2050 is projected to **reduce worldwide labor capacity by 20% in hot months** from a 10% reduction today, assuming no change in worker behavior or workplace conditions. [Section 3.4.7.1]

<u>Human Health Impacts at 1.5°C vs 2°C of Warming</u> [Section 3.4.7.1]
Warming of 2°C poses greater risks to human health than warming of 1.5°C, often with complex regional patterns, with a few exceptions.

A warming of 1.5°C compared to 2°C would lower: (1) the risk of temperature related morbidity and smaller mosquito geographic ranges; (2) the exposure of 3546 to 4508 million people to heatwaves; (3) the exposure of 496 million people exposed and vulnerable to water stress; (4) 110 to 190 million fewer premature deaths [Section 3.4.7 and 5.4.2.1]

If climate change continues as projected, major **changes in ill health** could include: (1) greater risks of injuries, diseases, and death due to more intense heatwaves and fires; (2) increased risk of undernutrition resulting from diminished food production and reduced nutritional quality of some cereal crops in poor regions; (3) lost work capacity and reduced labor productivity and (4) Increased risks of food-, water-, vector borne diseases.

If climate change continues as projected, potentially **limited positive health effects** could include: (1) the reduction of cold-related morbidity and mortality in some areas due to fewer cold extremes; (2) geographic shifts in food production; (3) reduced capacity of disease-carrying vectors due to exceedance of thermal thresholds. However, these positive effects are projected to be increasingly outweighed, worldwide, by the magnitude and severity of the negative health effects of climate change.

Mitigation Pathways & Human Health

In many parts of the world, **limiting warming to 1.5°C can be achieved synergistically with poverty alleviation, improved energy security and public health benefits through improved air quality, preventing millions of premature deaths**. [Chapter 2, Executive Summary]

The public health benefits of stringent mitigation pathways in line with warming of 1.5°C can be sizeable and potentially larger than the initial mitigation costs. For instance, a study examining a more rapid reduction of fossil-fuel usage to achieve 1.5°C relative to 2°C, found that improved air quality would lead to more than 100 million avoided premature deaths over the 21st century. These benefits were assumed to be in addition to those occurring under 2°C pathways. [Section 2.5.3]

Mitigation pathways typically show that there are significant synergies for reducing air pollution, and that the synergies increase with the stringency of the mitigation policies. [Section 5.4.2.1]

Greenhouse gases and air pollutants are typically emitted by the same sources. Hence, **mitigation strategies that reduce GHGs or the use of fossil fuels typically also reduce emissions of pollutants**, such as particulate matter (e.g., PM2.5 and PM10), black carbon (BC), sulphur dioxide (SO2), nitrogen oxides (NOx), and other harmful species, causing adverse health and ecosystem effects at various scales. [Section 5.4.2.1]

Also **mitigating for non-CO2 emissions**, such as methane or HFC's, can carry **large benefits for public health** and sustainable development, particularly through improved air quality. [Section 2.3.3.2 and 4.3.6]

The **reduction of short-lived climate forces** - such as methane, aerosols, black carbon and co-emissions from vehicles - **provides health co-benefits** by reducing air pollution and avoiding premature death. This, in turn, enhances the institutional and socio-cultural feasibility of such actions. Interventions to reduce black carbon, for example, offer tangible local air quality benefits, increasing the likelihood of local public support. Most foreseeable climate policies, however, only slightly limit some sources of SLCFs like traditional biomass, indicating health benefits could be limited. [Section 2.5.3 and 4.3.6]

Mitigation efforts that focus on transforming the food and agriculture system can have positive health co-benefits by promoting healthier and more sustainable diets: limiting the demand for GHG-intensive foods - including healthy diets with low animal-calorie shares and low food waste - is a key factor in reducing emissions from agriculture and could be achieved through shifts to healthier and more sustainable diets. For example, land spared by adopting healthier diets in Western Europe could be afforested, increasing the yearly carbon storage potential from 90 to 700 MtCO2 in 2050. [Section 2.4.4]

Mitigation pathways aiming solely at limiting warming to 1.5°C or 2°C without concurrent measures in the food sector, such as through large-scale land-related measures like afforestation and/or bioenergy supply, **could have negative impacts for global food security**. Impacts on food security from 1.5°C mitigation pathways could be significantly higher than those of 2°C pathways. [Section 5.4.2.2]

Decreasing the share of coal in energy supply in line with 1.5ºC-compatible scenarios reduces air and water pollution, and coal mining accidents, and **enhances health** by reducing air pollution, notably in cities. [Section 5.4.1.2]

Nuclear energy, the share of which increases in most of the 1.5ºC-compatible pathways, can increase the risks of proliferation (SDG 16), have negative environmental effects (e.g., for water use, SDG 6), and have **mixed effects for human health when replacing fossil fuels** (SDGs 7 and 3). [Section 5.4.1.2]

The use of fossil Carbon Capture and Storage (CCS) is likely to exacerbate local air pollution due to the lower efficiency of CCS coal power plants. There is a non negligible health risk of carbon dioxide leakage from geological storage and the carbon dioxide transport infrastructure. [Section 5.4.1.2]

Enhanced Weathering - a form of carbon sequestration that accelerates mineral weathering through the distribution of ground-up rock material over land - **can have impacts on health** when particle sizes are respirable. [Section 4.3.7.4]

Negative impacts of climate change on air quality, public health and sustainable development need to be taken into account as the social costs of carbon. The Social Cost of Carbon (SCC) measures the total net damages of an extra metric ton of CO2 emissions due to the associated climate change. Negative and positive impacts can be monetised, discounted and the net value expressed as an equivalent loss of consumption today. The Social Cost of Carbon can be evaluated for any emissions pathway under policy consideration. There are suggestions that a broader range of polluting activities than only CO2 emissions, such as impacts on air quality, health and sustainable development in general, should be included in social costs. [Cross-Chapter Box 5 and Box 3.6]

Human Health is a sustainable development feature of a 1.5° pathway, and synergies exist between many sustainable development objectives - such as SDG3 and SDG13 - and climate policy targets. In general, limiting climate change can enhance several dimensions of sustainable development, including human health and access to clean air and water, and many countries show greater willingness to support climate policies that can deliver other societal goals such as the Sustainable Development Goals. In that sense, health and quality of life should be seen as ‘intergenerational investments’.

Strengthening and Implementing the Global Response to Climate Change & Human Health

Health is mentioned as an adaptation priority in 54% of all NDCs. The sectoral coverage of adaptation actions identified in NDCs is uneven, with adaptation primarily reported to focus on the water sector (71% of NDCs), agriculture (63%), health (54%), and biodiversity/ecosystems (50%). [Cross-Chapter Box 11]

Investing in health, social safety nets, and insurance for risk management can be considered as overarching adaptation options that enable synergies across systemic transitions and can be implemented across rural and urban landscapes.are cost-effective and have a high potential to be increased in scale. [Section 4.3.5 and 4.5.3]

Health and education are social co-benefits for adaptation and mitigation pathways. Aligning adaptation and mitigation interventions with non-climate benefits can accelerate transitions and reduce risks and costs. These co-benefits can enhance the feasibility of climate responses in specific contexts by removing barriers to climate action. [Section 4.3.5.7 and 4.5.1]

Supporting population health and health systems as an adaptation option, and as part of a system transition, is not hindered by any economic, institutional, societal or environmental factors, making it a highly feasible adaptation option. [Section 4.5.3.1]

The ‘feasibility’ of adaptation and mitigation options or actions to limit warming to 1.5°C within the context of sustainable development is determined by, among others, the implications of these actions for human behaviour and health (known as social/cultural feasibility). [Section 4.5.3.1]

Until mid-century, climate change is expected to primarily exacerbate existing health challenges, with socio-economic factors determining the magnitude and pattern of climate-sensitive health risks. [Section 3.4.7 and 4.3.5.4]

Enhancing current health services includes providing access to safe water and improved sanitation, enhancing access to essential services such as vaccination, and developing or strengthening integrated surveillance systems, with high agreement that - when combined with iterative management - it can facilitate effective adaptation and has moderate evidence of feasibility. [Section 4.3.5.4]

Adaptation in developing cities is spend more on health and agriculture related adaptation options while developed cities spend more on energy and water. Developing cities have limited adaptive capacity due to pressures on investment in health, housing and education. [Cross-Chapter Box 9]

Integrating and promoting green urban infrastructure can have mitigation benefits, by reducing air pollution, and adaptation benefits, by facilitating healthy lifestyles. [Section 4.3.3.7]

Recycling materials and developing a circular economy has advantages in terms of cost, human health, governance and environment, although it can be institutionally challenging as it requires advanced capabilities and organisational changes. [Section 4.3.4.2]

Technological advancements in health and other sectors can be strong enablers of climate action. The widespread use of e-health - which would replace traditional face-to-face medical practice with remote systems using ICTs - combined with technological progress in other sectors could reduce one quarter of global greenhouse gas emissions by 2030, according to one study[2]. [Section 4.3.3.4 and 4.4.4.2]

Dietary choices towards foods with lower emissions and requirements for land, along with reduced food loss and waste, could reduce emissions, increase adaptation options, and have significant co-benefits for food security, human health and sustainable development, but evidence of successful policies to modify dietary choices remains limited. [Section 4.3.2 and 4.4.5] The **sustainable intensification of agriculture** can further increase the efficiency of inputs and enhance health and food security. [Section 4.3.2.1]

[2] According to a study by the Global e-Sustainability Initiative, an industry-run organisation.

Climate Change, Health & Sustainable Development

Limiting global warming to 1.5°C rather than 2°C could make it markedly easier to achieve many aspects of sustainable development, with greater potential to eradicate poverty, reduce inequalities, and prevent health impacts. Impacts avoided with the lower temperature limit could reduce the number of people exposed to climate risks and vulnerable to poverty by 62 to 457 million, and lessen the risks of poor people to experience food and water insecurity, adverse health impacts, and economic losses, particularly in regions that already face development challenges. It would also make it easier to achieve certain SDGs such as health (SDG3). [Section 5.2.2 and 5.2.3]

Compared to current conditions, **1.5°C of global warming is projected to pose heightened risks to eradicating poverty, reducing inequalities and ensuring human and ecosystem well-being**. [Section 5.2.1]

Some of the worst impacts on sustainable development are expected to be felt among agricultural and coastal dependent livelihoods, indigenous people, children and the elderly, poor labourers, poor urban dwellers in African cities, and people and ecosystems in the Arctic and Small Island Developing States (SIDS). [Section 5.2.1]

While recent improvements in several Sustainable Development Goals (SDGs) such as water security, and health may have reduced some aspects of climate vulnerability, increases in incomes were linked to rising greenhouse gas (GHG) emissions and thus to a **trade-off between development and climate change**. [Section 5.1.1]

Climate-Resilient Development Pathways place well-being for all at the core of an ecologically safe and socially just space for humanity, including health and housing to peace and justice, social equity, gender equality, and political voices. [Section 5.5.3.1]

There are strong synergies between adaptation to climate change and the achievement of SDG 3 (healthy lives and well-being) and other SDGs. These synergies are expected to hold true in a 1.5°C warmer world, across sectors and contexts. [Section 5.3.2]

Pursuing place-specific adaptation pathways toward a 1.5°C warmer world has the potential for significant positive outcomes for human well-being, in countries at all levels of development. [Section 5.3.3]

Adaptation can reduce morbidity and mortality. Heat-early-warning systems help lower injuries, illnesses, and deaths, with positive impacts for SDG 3. Institutions better equipped to share information, indicators for detecting climate-sensitive diseases, improved provision of basic health care services, and coordination with other sectors also improve risk management, thus reducing adverse health outcomes. Effective adaptation creates synergies via basic public health measures and health infrastructure protected from extreme weather events. [Section 5.3.2]

Yet, trade-offs can occur when adaptation in one sector leads to negative impacts in another sector. Examples include migration eroding physical and mental well-being, hence adversely affecting SDG 3. Similarly, increased use of air conditioning enhances resilience to heat stress; yet it can result in higher energy consumption, undermining SDG 13. [Section 5.3.2]

In the absence of effective adaptation, achieving the SDGs will be challenging, mainly in poverty, health, water and sanitation, inequality and gender equality. [Section 5.2.3]

Also for mitigation measures there are multiple synergies across a range of sustainable development dimensions such as health (SDG 3), energy (SDG 7), responsible consumption and production (SDG 12) and oceans (SDG 14). [Section 5.4.2]

At the same time, the rapid pace and magnitude of change that would be required to limit warming to 1.5°C, if not carefully managed, could lead to trade-offs with some sustainable development dimensions [Section 5.4.2]

Strategies that advance one SDG may create negative consequences for other SDGs, for instance health (SDG 3) versus energy consumption (SDG 7). [Section 5.3.2]

Climate change is projected to be a poverty multiplier. The health risks that come with global warming are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. [Section 3.4.10 and 3.4.11]

At 1.5°C warming, compared to current conditions, further negative consequences are expected for poor people, and inequality and vulnerability. By 2030 (roughly approximating a 1.5°C warming), 122 million additional people could experience extreme poverty, based on a 'poverty scenario' of limited socio-economic progress, mainly due to higher food prices and declining health, with substantial income losses for the poorest 20% across 92 countries. [Section 5.2.1]

Knowledge Gaps in Climate Change & Health Research

The IPCC SR1.5 report recognises the **existence of knowledge gaps on the health and well-being risks in the context of socio-economic and climate change at 1.5°C**, especially in key areas such as occupational health, air quality and infectious disease. [Section 3.1 and 3.7.2]

The impacts of global and regional climate change at 1.5°C on public health, food distribution, nutrition, poverty, tourism and coastal infrastructure are poorly understood, particularly for developing nations. [Section 3.7.2]

Knowledge gaps also exist on the implications of climate change at 1.5°C on livelihoods and poverty, on rural communities, indigenous groups and marginalised people. [Section 3.4.7.1 and 3.7.2]

Research on the climate impacts on human health have so far focussed on global risks, with limited focus on regional risks and adaptation options at 1.5°C and 2°C. Because of a lack of projections of how risks might change in 1.5°C and 2°C worlds, climate-sensitive health outcomes - such as health impacts of poor air quality, or mental health - were not considered in the IPCC SR1.5. [Section 3.4.7.1]

The difference between the impact of 1.5°C and 2°C on human health is badly understood for a range of climate-sensitive health outcomes, such as diarrheal diseases, mental health and air quality. The implications of climate change at 1.5°C on livelihoods and poverty, on rural communities, indigenous groups and marginalised people are poorly understood. [Section 3.1 and 3.7.2]

Our current understanding of the linkages of 1.5ºC and 2ºC of global warming on human migration are also limited and represent an important knowledge gap. [Section 3.7.2]

There are a limited number of precise, quantitative studies of **projected impacts of sea level rise** at 1.5ºC and 2ºC, which particularly influence the human health, agriculture and water resources of small island nations.

There is still limited understanding of what the **co-benefits and trade-offs are when reducing Short-Lived Climate Forcers** (e.g., better health outcomes, agricultural productivity improvements). [Section 4.3.6]

The scientific literature on climate-SDG interactions is still an emergent field of research and hence there is low to medium confidence in the precise magnitude of the majority of these interactions. Understanding these mitigation-SDG interactions is key for selecting mitigation options that maximise synergies and minimize trade-offs towards the 1.5°C and sustainable development objectives. [Section 2.5.3]