Backgrounder:

Health impacts of climate change at 1.5°C, 2°C, and 3°C

The serious impacts of climate change on health are already being felt throughout the world.

- Climate change impacts human health directly - through extreme weather, the distribution of vector-borne and other infectious diseases and worsening air pollution, and indirectly - by causing undernutrition, harder working conditions, and mental stress.[1]
- The health impacts of climate change at 1.5°C are reduced compared to warming of 2°C, and significantly reduced compared to warming of 3°C.
- Although limiting global warming to 1.5°C will bring substantial benefits to people's health, climate change will still create health problems for many people.

This brief describes the impacts of climate change with 1.5°C, 2°C, and 3°C temperature scenarios, incorporating new research from the Intergovernmental Panel on Climate Change (IPCC) special report due to be released in October 2018.

1. Heat

Extreme heat is one of the key causes of weather-related deaths. Since the middle of the 20th century, the length and number of heatwaves have increased as a result of human-caused climate change. Even if warming is limited to 1.5°C, there will be an increase in hot days and heat-related health issues as a combination of climate change and urbanisation continues to intensify heat extremes globally.[2]

Heat stress affects productivity, and can increase the risk of cardiovascular, respiratory and renal diseases. Even 1°C of warming has the potential to reduce productivity by 1-3% for outdoor workers. Poor populations without access to air conditioning will be more affected, as they will be less able to escape extreme heat.

Heat stress combined with physical exertion and lack of hydration can cause chronic kidney disease (CKD) (also known as chronic renal disease), which decreases kidney function over time. Cases of CKD known as Mesoamerican nephropathy have emerged in Central America - a type of heat stress nephropathy (HSN) that could be linked to heat stress. CKD disproportionately affects poor populations and manual labourers working under hot conditions.

With 1.5°C of warming:

- In 2015 a heatwave in Karachi, Pakistan, killed 1300 people. According to one projection, a 1.5°C temperature rise would mean the region experienced the same temperature about once every 3.6 years.

[1] IPCC, AR5, WGII, Chapter 11, p.716.

[2] Ibid, p. 35.

- In today's climate the average African region experiences one to three heatwaves a year - where temperatures rise into the top 5% of the average for the region for 2-3 days. In a world that is 1.5°C warmer by 2100 this frequency could more than double by the middle of the century.
- Twice as many megacities (e.g. Lagos, Nigeria, and Shanghai, China) could become heat stressed under such warming, exposing an additional 350 million people to heat stress by 2050.[3] (More than the combined population of Mexico and Brazil.)

With 2°C of warming:

- The European summer heatwave of 2003, which killed 70,000 people, was an example of a three sigma heatwave. Most heatwaves of this level result in serious impacts to society, causing deaths, serious forest fires or harvest losses. If temperatures rise 2°C above pre-industrial levels, heat extremes of this level could be experienced in half the summer months in tropical countries, while in Western Europe they will be experienced in a fifth of summer months. In the Middle East and North Africa, temperatures could rise to 46°C on the hottest days. Temperatures of this level pose a serious threat to life and could make some parts of the region uninhabitable.

With 3°C of warming:

- In today's climate the average African region experiences one to three heatwaves per year. Under a scenario where temperatures rise 3°C by the end of the century, heatwaves could increase by a factor of five by the middle of the century.
- Droughts are likely to become increasingly frequent and severe in the Mediterranean area, western Europe, and Northern Scandinavia.

2. Air pollution

Air pollution is a major current health risk, leading to increased mortality, and cardiovascular and pulmonary diseases. It is often caused by the same fossil fuel use that causes climate change, and climate change could make air pollution worse. Air pollution is already a major problem in urban areas, with particularly high levels in cities in central, south, and east Asia.

With 1.5°C of warming:

- Ozone related deaths[4] are expected to increase from 382,000 in 2000 to about 1.7 million globally by 2100 in a wide range of future warming scenarios.

With 2°C of warming:

- The risk of ozone related deaths is projected to increase compared to with a 1.5°C temperature rise.

3. Reduced food availability

Food security is driven by environmental, social, political, and economic factors. Problems with food availability and agriculture will become more pronounced as global temperature increases. For every degree celsius of additional temperature rise,[5] global wheat yields are estimated to drop 6% and global rice yields 10%.

[3] Ibid, p. 35.

[4] Climate Change and Air Pollution: The Impact on Human Health in Developed, (2018), p.16.

[5] The 2017 report of the Lancet Countdown (2017), p.11.

Change in rainfall, rise in average temperature, and soil composition are all determining factors in crop growth and quality. Climate change could reduce the nutritional value of crops, with undernutrition identified by some researchers as the largest potential health impact of climate change this century.

New research suggests that a warmer world will raise insect metabolisms, requiring them to eat more, and increasing insect-driven crop losses.

With 1.5°C of warming:

- Rising temperatures, drought, and unstable weather patterns have serious implications for global food production. Every degree of global temperature rise reduces global yields of wheat by 6.0%, rice by 3.2%, maize by 7.4%, and soybean by 3.1%. Some regions are more affected than others - for example in West Africa, wheat yields could fall by up to 25% if temperatures rise 1.5°C.[6]
- Fishing will also be affected. Every year, about 82 million tonnes of fish are caught in the sea. For every degree of warming, this could decrease by 3 million tonnes. Coral reef collapse, ocean acidification or overfishing could all push this number higher.

With 2°C of warming:

- There would be an average of 25 million more people that are undernourished compared to warming of 1.5°C by the end of the century.[7]
- In Bangladesh, reduced freshwater fish stocks are expected to decrease food security for the poor by the middle of the century, compared to warming of 1.5°C.
- Reduced water availability will bring reduced food security for a small but significant proportion of the population living in Asian river basins by 2050, compared to warming at 1.5°C.[8]
- A 2°C rise in temperature could lead to insect-driven losses of 213 million tonnes of rice, maize, and wheat.

With 3°C of warming:

- Globally, agricultural yields fall rapidly between one and three degrees celsius of warming. Once local temperatures reach three degrees celsius above pre-industrial levels, all crops are negatively affected, wherever they are in the world, including temperate regions.[9] Fish species go locally extinct, with serious impacts on fisheries.[10]

4. Water scarcity

80% of the world's population is already experiencing threats to water security, including water availability, water demand, and pollution. Populations living in low-lying areas are at higher risk of flooding and contamination of freshwater sources[11] from sea level rise and oil salination. Higher water temperatures, increased rainfall, and drought can increase water pollution and damage human health.

Climate change is further threatening water security by changing the hydrological cycle, and as warming of glacier and ice sheets impacts freshwater supplies. The Middle East, India, Antarctica, and Greenland are experiencing the most significant freshwater loss.

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[6] Differential climate impacts for policy-relevant limits to global warming: the case of 1.5C and 2C (Earth System Dynamics, 2016), p.337.

[7] Projected global undernourished population is 530-550 million at 1.5°C and 540-590 million at 2°C .

[8] Ibid, p.15.

[9] IPCC, AR5, WGII, Chapter 7, p.497.

[10] IPCC, AR5, WGII, Chapter 7, p.508.

[11] IPCC, AR5, WGII, Chapter, 11, p.717.

With 2°C of warming:

- Heavy rainfall will increase across Europe in all seasons, except in southern Europe in the summer. The amount of rain falling in central and northern Europe in winter could increase by as much as 20%. But at the same time rain could decrease by 20% in central and southern Europe in the summer. Overall, 8% of the global population would face severe water shortages.

With 3°C of warming:

- The amount of water stored underground is likely to decline. Groundwater supplies about a third of US drinking water, the majority of public water supply in England, and about two-thirds of public water supply in western Australia.
- A 3°C temperature rise would be very likely to reduce groundwater recharge to half of 1990 levels by 2050 in some parts of Australia.[12] The amount of groundwater recharge (where water moves down from the surface to groundwater) in England could fall to 22% below current levels[13] by 2050.
- 43% of glaciers in Asia[14] which currently provide water for 800 million people living in India, Pakistan, Afghanistan, China, Bhutan, and Nepal could be lost.
- The number of people around the world living near freshwater sources prone experiencing new or aggravated water scarcity is expected to increase from 8% at 2°C to 11% at 3.5°C[15] over the course of the century.

5. Vector-borne diseases

Climate change drives changes in temperature, rainfall, and humidity, and as a result, increases the risk of disease transmission. Climate change is expected to shift disease patterns[16] with some regions experiencing increases whilst others experience a decline.

Malaria, dengue fever, Japanese encephalitis, and tick-borne encephalitis are the major mosquito-borne infectious diseases that will be affected by climate change. Deaths caused by vector borne diseases are about 300 times higher in developing countries than in developed countries.

With 3°C of warming:

- The number of people at risk of malaria globally will increase by about 4%,[17] compared to temperatures under 2°C.

6. Limiting temperatures will reduce the risk of these impacts

Through the Paris Agreement, countries around the world agreed to keep temperatures below 2°C above pre-industrial levels, with an aim of limiting temperature rise even further to 1.5°C. The world has already warmed by about 1°C. Although limiting warming to 1.5°C will benefit human health, there is no 'safe limit' of climate change for human health.

[12] IPCC, AR5, WGII, Chapter 3, Table 3-2.

[13] IPCC, AR5, WGII, Chapter 3, p.249.

[14] Himalayas, the Hindu Kush, Karakoram, Pamir Alai, Kunlun Shan, and Tian Shan mountains - Asia's glaciers are a regionally important buffer against drought (2017), Nature, p.169.

[15] IPCC, AR5, WGII, Chapter 3, p.249.

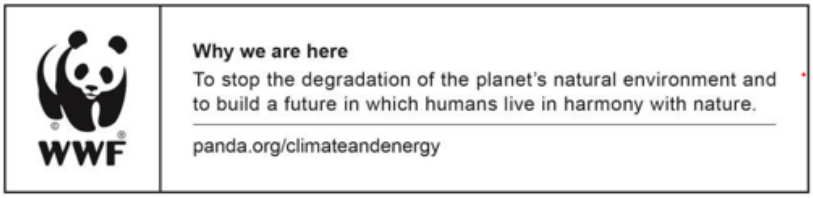
[16] Health risks of warming of 1.5 °C, 2 °C, and higher, above pre-industrial temperatures (2018), Environmental Research Letters, p.5.

[17] Global warming and the possible globalization of vector-borne diseases: a call for increased awareness and action (2016), Tropical Medicine and Health, p.2.

By limiting warming to 1.5°C:

- Limiting warming to 1.5°C will bring bigger benefits for human health than 2°C, and bigger benefits for individuals in developing countries.
- About 3.3 million cases of dengue fever annually in Latin America and the Caribbean could be avoided, compared with a no-policy scenario with warming of 3.7°C. (0.5 million per year less than with 2°C.)
- The number of people at risk of malaria could be at least 150 million lower than the number of people at risk with warming of 2-3°C.
- There will be less local and regional air pollution[18] as greenhouse gas emissions are cut, providing the biggest health co-benefits from limiting climate change. This is such a huge benefit that in economic terms it could conceivably be larger[19] than the entire cost of reducing carbon emissions in most major emitting countries.
- Limiting temperature rise to 1.5°C compared to 2°C could prevent about 153 million premature deaths from air pollution worldwide by 2100, about 40% of those over the next 40 years.

This paper was prepared by GSCC to support understanding of issues arising from the IPCC's Special Report on 1.5°C warming.



For further information contact:

Dr Stephen Cornelius
Chief Advisor-Climate Change, WWF-UK
SCornelius@wwf.org.uk

Dr Fernanda Viana De Carvalho
Global Policy Manager,
WWF Climate & Energy Practice
fcarvalho@wwfint.org

Dr Christopher Weber
Global Climate & Energy Lead Scientist,
WWF Global Science
chris.weber@wwf.org

[18] Multiple benefits from climate change mitigation: Assessing the evidence (2017), Grantham Research Institute. p.1.

[19] Based on a comparison of 2010 data from the World Health Organization's Global Burden of Disease on air pollution and the US government's 2015 estimate of the social cost of carbon - Ibid, p.1.