Impacts on people

Heat-related health

What do hotter temperatures mean for everyday life?

For most people, climate change means higher temperatures. While there may be some health benefits – fewer cold-related deaths in the winter – mostly the prognosis is poor.

Quoted temperature increases are an average and pose perhaps less threat than periods of extreme high temperature – heat waves – which are occurring more often and can be deadly. Elderly and sick people are the more vulnerable, as are those living in isolation and in poorer and hotter parts of cities. There is evidence from the US that black and minority ethnic groups are more likely to be living in the hottest parts.

The European heat-wave of 2003 saw sweltering conditions across much of the continent during June, July and August of that year. Brogdale in the UK recorded 38.5ºC. Over a decade later, in 2016, researchers used modelling to calculate the extra deaths that occurred due to climate change worsening the heat wave, concluding that approximately 64 more people died in London (20% extra) and 506 more in Paris (70% extra). At the time, media reported that temporary mortuaries were being set up in France to cope with high death toll. The researchers did note that following the event, emergency responses improved and as a result other heat waves have not resulted in so many deaths.

During the coming century, climate change will continue to make heat waves more severe and more frequent. They will also be longer, due to interference with the air currents that move weather around. In one study, scientists estimate that there will be around an extra 47,000 heat-related deaths in Europe in the last three decades of this century – assuming that greenhouse gas emissions reach their peak by 2040. If climate change goes unchecked and emissions continue to rise, there will be more than 117,000 extra deaths attributable to climate change. It is worth noting that models used to calculate these figures do not account for an ageing population, which would mean more elderly and vulnerable people in the future than there are today.

As well as these direct effects, there will be indirect effects due to greater exposure to ultraviolet radiation and higher quantities of pollen and pollution, triggering respiratory conditions such as asthma. Higher temperatures also promote food-borne diseases. The link between high ambient temperatures and increased incidence of *Salmonella* food poisoning, for example, is well-established – the bacterium replicates faster in warmer conditions. One Australian study suggested that when the temperature rises by 5ºC, *Salmonella* cases rise by 45%. There are already 12,900 reported cases of *Salmonella* food poisoning each year just in Australia and possibly another six times this number that go unreported.

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Agricultural impacts of climate change

Agriculture: good news for some, bad news for most

One of the few benefits of climate change may be increased crop growth in temperate climates, thanks to warmer temperatures and higher carbon dioxide levels.

The most recent Intergovernmental Panel on Climate Change (IPCC) report notes that higher carbon dioxide levels could improve yields by raising photosynthesis rates, though it still notes the "big uncertainty in the magnitude of the CO_2 effect and [its] interactions with other factors". Even if crop yields increase, nutritional quality may be impacted – for example, via increased sugar content of fruits and reduced protein content of grains.

A 2019 study looked at the impact that climate change has already had on the ten most important food crops – barley, cassava, maize, oil palm, rapeseed, rice, sorghum, soybean, sugarcane and wheat – between 1974-2008. The researchers calculated that climate change reduced yields by about 1% across the board, but that while wheat and soybean yields improved, most other crops suffered, with oil palm yields decreasing by over 13%. Some countries saw worse effects than others. For example, in sub-Saharan Africa, Ghana lost about 8% across all ten crops whilst Tanzania saw gains of around 2%.

Low and middle-income countries are likely to be hardest hit. According to a UN analysis published in 2018, by 2050, West Africa and India will be experiencing the worst of climate change's effects on agriculture, seeing yield decreases in the region of 3%. Meanwhile, Canada will benefit from yield increases of just under 3% and parts of Scandinavia may become warm enough for growing cereals.

Coastal areas are suffering more from storm surges, erosion and rising sea levels. Seawater is contaminating low-lying agricultural land, as in coastal parts of Carolina, where sea levels are rising by nearly half a centimetre per year. In 2019, one North Carolina farmer estimated that saltwater incursion and flooding had cost him $2 million in lost crops over five years. Meanwhile, in Vietnam, saltwater intrusion exacerbated by climate change is expected to have a major impact on rice farming. Growers will have to adapt their farming practices, switch to more salt-tolerant crops or lose their livelihoods.

Falls in agricultural productivity may lead to widespread malnutrition and hence social upheaval – such as migration to cities and civil unrest. Climate change has also been implicated in droughts that have led to humanitarian crises and conflict. In Somalia, for example, a drought in 2016-2017 forced a million people from their homes in search of food and water. Ongoing conflict within the country puts these people at further risk. The IPCC's 2014 report predicts increased conflict over critical resources in future.

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Sea level rise

Rising sea levels are already threatening low-lying countries, as well as coastal regions

Loss of ice sheets, combined with the thermal expansion of water – the small increase in water volume caused by the rising global temperature – is leading to a global rise in sea levels.

Low-lying countries are at particular risk. At the extreme, countries may disappear entirely. Inhabitants of the Carteret Islands, part of Papua New Guinea, were some of the first people to have to relocate due to sea level rise. In August 2018, the Pacific islands were only 1.5 metres above sea level at their highest point. Their land is being inundated, crops are failing and the population of less than 2,000 is dwindling.

Another nation at severe risk is the Kiribati, a collection of small islands in the South Pacific. Built on coral atolls, it has an average elevation of less than 2 metres above sea level and a total population of 100,000. Wells that residents use for drawing water are being contaminated by sea water and storms can engulf entire islands.

All coastal regions will suffer more regular sea incursions, storm damage and salt-water seepage. For many, the result is likely to be a loss of life or livelihood, or displacement. Countries such as the Netherlands, Germany, France, Belgium, Denmark – even Spain and Italy – are advised to strengthen their coastal defences. Belgium, for example, has a coastline of just 67 kilometres, but it is mostly less than 5 metres above sea level and densely populated. It is well-used by the tourist, fishing, shipping and offshore wind industries. Therefore, coastal defences such as sea walls, breakwaters, brushwood and marram grasses have been put in place.

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Algal blooms

Large populations of toxic algae in lakes and oceans pose a risk to people

Algal blooms, which may make the water look green-blue or red, are often seen in polluted waters contaminated with nitrogen and phosphorus. However, they also seem to be becoming more frequent under climate change. Their greatest impact is likely to be in marine environments, but they may also affect inland reservoirs and water supplies.

Combined with other changes such as acidification and increases in water temperature, the blooms could lead to very challenging conditions for marine life as well as fisheries. They also damage the environment by consuming dissolved oxygen, creating oceanic 'dead zones'. Most concerning for people are harmful algal blooms that produce toxins, creating concern over contaminated shellfish.

In the US, the Environmental Protection Agency says that algal blooms are a problem in all states and advises people to keep themselves and pets away from strange-coloured, scummy or bad-smelling water.

In lakes, increased rainfall may help to wash out the algae. However, blooms of toxic cyanobacteria, which are known to grow faster in warmer waters, have led to drinking water issues in Lake Erie, where 400,000 people had their water supply turned off in 2014. Although the causes are complex, and include pollution, scientists are currently trying to gain a better understanding of how climate change may impact algal blooms.

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Mosquitoes and malaria

Will climate change promote the spread of malaria?

By transmitting a wide variety of diseases, including malaria, yellow fever, dengue fever and various forms of encephalitis, mosquitoes may have been responsible for more human deaths than any other single organism.

Mosquitoes have evolved to fill a particular environmental niche and form part of a complex web of interactions with other organisms – an ecosystem. What's more, the mosquito has several distinct stages in its life cycle – egg, larva, pupa and adult – each of which has its own environmental niche.

Several climate factors could affect these stages, such as:

- temperature
- rainfall
- humidity
- timing of seasons.

Yet the climate-related causes of mosquito-borne illnesses, such as increased temperature and increased rainfall, are so complex and so interrelated with other factors that it is very challenging to pinpoint their precise effects.

The World Health Organization estimates that malaria kills around 435,000 people a year. It exists only where particular species of mosquito live, so if climate change alters the distribution of mosquitoes, malaria will move too. Some models suggest that the 'malaria belt' around Europe – currently sitting around Mediterranean regions – may move northwards. One 2015 study suggested that by 2030 the UK could see transmission of malaria by *Plasmodium vivax* mosquitoes for two months of the year. This transmission window could expand to four months well before the end of the century. The disease may also recur in European countries where it was previously eradicated.

Malaria in the highlands

One controversy has centred on the possible role of climate change in the recent resurgence of malaria in the highlands of Kenya. Its role has not been proven. However, malaria depends on a certain air temperature for the mosquitoes that carry it to thrive. Historically, highland areas have remained relatively

protected by their cooler temperatures. The higher altitudes of Ethiopia, too, have been considered safe zones. It is clear, though, that as climate change progresses, higher altitudes will begin to exceed the threshold temperature. This has, in fact, been happening since the 1980s in Ethiopia, meaning people at higher and higher elevations are now within zones that where mosquitoes could survive to transmit the disease. Currently, altitude is a major factor in the Ethiopian health ministry's decision-making practices about malaria control. In the future, it may have to include many more people in its decision-making.

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Cholera

What is cholera, and how is it affected by climate change?

Cholera is a bacterial infection most commonly caused by food and water contaminated with the *Vibrio cholerae* bacterium. It is common in the aftermath of extreme weather, but its spread also depends on the persistence of cholera-causing bacteria in ocean ecosystems.

Data recorded from seawater samples going back to 1958 shows that cholera cases go up when sea surface temperatures increase. As a result of climate change, northern regions are expected to suffer more cases of cholera. For example, there have already been outbreaks in Alaska.

One small ray of hope is that this knowledge will improve our ability to predict future cholera epidemics. Remote sensing, for example, can be used to measure sea surface temperatures and sea levels, and thereby identify areas of risk.

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Social impacts

How will communities or countries cope with climate change?

The greatest effects of climate change will be on low- and middle-income countries. High-income countries have the infrastructure and resources to cope with climate challenges; others are not so fortunate.

Widespread crop failure and loss of aquaculture (fish and sea-life farming), as well as less tourism, are likely to lead to considerable hardship and mass migration. An underappreciated consequence is the amount of mental distress this is likely to cause.

Farmers in the worst-affected areas will feel the stress. It is already reported that climate change led to 59,000 suicides among Indian farmers in the past 30 years. According to one study, there are 70 farmer suicides for every degree rise above 20ºC during the crop-growing season in India.

The most recent Intergovernmental Panel on Climate Change report suggests that climate change could further increase the migration rate from rural to urban environments, though it recognises that there are many reasons for migration. Estimates of total 'environmental migration' range from 25 million to 1 billion by 2050.

Conflict

There are also real fears that a lack of resources – particularly water – will fuel social strife. This could amount to local conflicts, or escalate to ethnic or even national wars.

In 2018, the President of the UN Security Council raised the issue of climate change in a speech about instability in West Africa and Sahel: "The Security Council expresses concern over the overall humanitarian situation in the region, characterized by the impact of armed conflict and terrorism, extreme poverty, food insecurity, forced displacement, adverse effects of climate change and epidemics, which contribute to the high levels of structural, chronic and acute vulnerability in the region and continue to affect populations, and call for significant humanitarian and development action."

An Austrian study published in 2019 found that climate-related factors such as drought played a significant role in asylum-seeking linked to conflict between 2011-2015. A three-year drought in Syria prior to this period has been blamed for crop failures, food shortages, mass migrations and the political unrest and uprising that followed. However, it is difficult to make direct associations between climate change and conflict, as there are many other factors involved.

Even the mitigation strategies that we put in place to help deal with climate change may lead to conflict. In a 2018 study, researchers found that actions to tackle climate change are leading to local conflicts in Cambodia, largely over land and what it is used for. Homes and forests have been bulldozed to make way for cassava plantations to support biofuel production in other countries, whilst local communities clashed with military police.

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Diet changes

Could going vegetarian or eating insects help?

There has been much talk in recent years of changing our diets to reduce our impact on the environment and as a climate change mitigation strategy. Plant-based diets, in particular, have been touted as a way to save the planet.

One of the reasons that meat is given a raw deal by environmentalists is that it is linked to methane emissions. About 44 per cent of global methane emissions come from livestock. Because methane is a more potent (though shorter-lived) greenhouse gas than carbon dioxide, reducing the amount of methane in the atmosphere could have an important impact on mitigating climate change.

However, this is not the only reason. Eating plants is simply a more efficient way of getting your calories than eating meat, because raising animals requires more resources. By some estimates, getting the same number of calories from beef as from wheat, potatoes and rice would use up about 163 times more land, 18 times more water and 19 times more nitrogen, whilst producing 11 times more greenhouse gases (in carbon dioxide equivalent). In total, animal products are thought to be responsible for over three-quarters of all greenhouse gas emissions from agriculture.

This does not necessarily mean that reducing the amount of meat you eat is always more beneficial for the environment. It also depends where you live and how far different foods have to travel to get to you. One 2019 study advised that recommendations for environmentally friendly eating should be tailored to the country. However, across France, Finland and Germany, they did find that targeting a reduction in meat consumption as opposed to all animal products generally would be more likely to produce a good result in terms of reducing greenhouse gas emissions.

Meanwhile, the food industry is looking at ways to make the consumption of insects (entomophagy) – a highly sustainable source of lean protein – more palatable to the average western consumer. Two billion people globally already include insects in the diet. In 2018, some Sainsbury's stores in the UK started selling roasted crickets and companies in the US, Australia and Germany are now making foods containing insects. They can also be ground and incorporated into flours and burgers. The advantage of these edible bugs is that they require a lot less water, land and feed per kilogram of protein produced compared to traditional livestock. Currently the price to the consumer is high due to the short supply, but that could change as the competition stacks up.

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