


# Envisioning a future with climate change

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Climate change research and assessments, including the most recent IPCC report, paint an increasingly dire picture of the future. However, the assumption that the future will be worse than the present may be wrong for many aspects of human well-being.

Large segments of the population in high-income countries believe that climate change could lead to the extinction of humankind or that, at a minimum, the future will be worse than the present. This belief is partly based on projections from climate change research; for example, hundreds of thousands of deaths from heatwaves and other climate-related causes, billions of people at risk of disease, steeply rising damages from floods, millions pushed into poverty, 20% of species going extinct, tipping points about to be bridged and parts of the world already approaching the threshold of a survivable climate<sup>1–3</sup>. Statements in the press have echoed, and in some cases magnified, the theme<sup>4,5</sup>. But the very same studies that underlie this dire outlook anticipate a future where, in most scenarios, humanity is better educated, better fed, longer lived and healthier, also with less poverty and less conflict, continuing trends that have been underway for decades<sup>6</sup>. These improvements apply not just to the global or country average but – where such outcomes have been examined – to more vulnerable populations as well.

This seeming contradiction is fostered by the practice within climate change research and assessment reports of focusing predominantly on the additional risk from climate change to future human well-being, which is mainly negative, without putting it in the context of the total risk from all factors, many of which are unrelated to climate and positive. For example, climate change clearly represents a threat to human health, but better sanitation, improved healthcare systems and biomedical progress are expected to continue to improve it. As a result, even with climate change leading to hundreds of thousands of additional deaths, declines in mortality from other causes are expected to greatly outweigh the climate effect – leading to increases of 10–20 years in life expectancy this century, even in those countries with the shortest life expectancies today. Climate change acts to slow that improvement, not to reverse it.

Early observations of this kind were limited to economic growth<sup>7</sup>, arguing that climate change damages would constitute a small fraction of total economic output. This perspective relied on aggregate economic measures that did not capture diverse dimensions of well-being and ignored distributional issues. A larger research base now allows us to evaluate a range of impacts on their own terms and at smaller scales, and we see expectations of substantial – but rarely recognized – net improvements in well-being.

This is not to say that climate impacts are unimportant; they can become severe under some conditions<sup>8</sup> and need to be addressed, especially those that affect the most vulnerable. Viewing the future

through net changes to well-being raises its own challenges: we cannot blithely trade off higher climate-related mortality against lower mortality from other causes, or millions pushed into poverty by climate change against millions lifted out of it by economic development. There are also exceptions to the outlook for climate change to slow improvements driven by non-climate factors. In some cases, climate change is expected to accelerate worsening trends driven primarily by other factors, as is the case for the risk of species extinction (driven primarily by land use), water scarcity (driven by increased demand) and income inequality (driven by economic factors)<sup>1</sup>. In other cases, climate change itself is the primary driver of expected worsening conditions. Most of the world's coral reefs, for example, are in dire circumstances now and may be lost or degraded within a few decades<sup>1</sup>. Temperature-attributable mortality is expected to increase in warmer regions<sup>9</sup>, and the habitability of some small island states is threatened.

But a mismatch between the climate-centric view of a slide towards potential collapse and the larger picture of slowed improvements remains and has many consequences. Basic misunderstandings of the climate change issue permeate public and some policy discussion; overly pessimistic outlooks may blunt climate action by making it seem hopeless; policy priorities may become distorted by not distinguishing conditions that are truly likely to worsen from those that may only improve less quickly; and we may undermine scientific credibility when outcomes in the near future do not match predominant expectations.

## Additional versus total risk

The IPCC frames its analysis in terms of risk (the potential for adverse consequences to something of value) and notes the difference between additional and total risk in a guidance document<sup>10</sup>. However, it does not generally distinguish between the two measures in its reports, and the Summary for Policymakers on impacts, adaptation and vulnerability that appears within the most recent report does not mention either measure<sup>11</sup>. In the absence of context, it is reasonable to interpret conclusions as referring to total risk, a serious mistake given that most of the reported results turn out to be additional risks.

As one example, the 'burning embers' diagrams used by the IPCC for the past 20 years and more to summarize how five broad categories of climate change risks vary according to the level of global warming<sup>12</sup> probably do more to confuse the outlook than to clarify. As they reflect additional risk, they show a rise in all categories of risk as global warming levels increase, but total risks for several of these categories will likely decline as non-climate factors reduce risk even as the climate warms.

Consider the risk that climate change will drive people into poverty, whether it is through increasing numbers of natural disasters or crop failures, or even high food and energy prices caused by efforts to reduce emissions. Tens of millions of people could be impoverished in this way in the coming decades<sup>2,13</sup>. This outcome reflects the additional risk of poverty due to climate change and is calculated by projecting the number of people in poverty in the future with and without considering climate change, and then subtracting the two results.

What has not been emphasized, however, is the total risk: the total number of people projected to be in poverty due to all factors, including climate change.

Measured in terms of total risk, poverty is clearly expected to improve. In a middle-of-the-road scenario, the number of people in poverty driven by non-climate factors falls from around 600 million in 2020 to 350 million in 2030, and to less than 100 million in 2050, as incomes rise<sup>13</sup>. The net result is that by mid-century, the total number of people at risk of poverty from all causes, even accounting for the tens of millions pushed into poverty by climate change, declines by at least two-thirds relative to today. Today's poorest regions see the largest improvements.

A similar story holds for malnutrition. The IPCC notes that: "Climate change will increasingly put pressure on food production and access, especially in vulnerable regions, undermining food security and nutrition (high confidence). Increases in frequency, intensity and severity of droughts, floods and heatwaves, and continued sea level rise will increase risks to food security (high confidence) in vulnerable regions from moderate to high between 1.5°C and 2°C global warming level."<sup>11</sup> Many would interpret this assessment as anticipating a future with worsening food security as warming reaches 2°C, but this outlook refers only to the additional risk from climate change, implicitly assuming that all other drivers are held fixed.

The picture is different in terms of total risk. Currently, there are about 700–800 million people at risk of hunger globally<sup>14</sup>. By 2050, even including the effects of about 2°C warming, that number is expected to fall to about 250 million in a middle-of-the-road development scenario<sup>15</sup>. Climate change accounts for only about 25 million people within this remaining burden. The improvement is not limited to relatively better-off regions but also occurs in South Asia and sub-Saharan Africa where food insecurity is currently highest. This outcome for hunger is uncertain of course, but the plausible range of the number of people at risk by mid-century (approximately 50–800 million people) is overwhelmingly determined not by climate change but by the other factors driving food security, including income growth, technological development in agriculture, diet and trade regimes.

The outlook of climate slowing down improvements has caveats. Most studies are not refined enough to evaluate whether climate change could prevent some fraction of the least well-off from seeing little or no improvement in well-being. Most scenarios do not yet include recent events, including the effects of the COVID-19 pandemic or the impacts of conflict such as the war in Ukraine on food security, which could influence outcomes in the near term. I use a middle-of-the-road scenario to illustrate results, but there is a wider range of possibilities when assuming more optimistic or pessimistic development pathways. In addition, better accounting for extreme events and cascading risks could increase anticipated impacts.

## Solutions

To address this problem, changes to how we carry out and communicate both research and assessment of climate change are required. A first step is simply to distinguish clearly between the additional risks posed by climate change and total risks, and to be cognizant of the difference when characterizing findings. Further, assessments should be done in the context of historical change and projected future change due to all factors, so that climate change effects can be put into perspective. For instance, the IPCC notes that: "Compared to other socioeconomic factors the influence of climate on conflict is assessed as relatively

weak (high confidence). Along long-term socioeconomic pathways that reduce non-climatic drivers, risk of violent conflict would decline (medium confidence)<sup>11</sup>". Explicit treatment of the role of climate change and its comparison to expected overall trends should be extended to all impacts.

Likewise, it has been suggested that assessment of adaptation options should be based on their effect on total risk, rather than additional risk<sup>16</sup>. At a minimum, accounting for changes in total risk over time will provide a better estimate of the adaptive capacity of populations most in need of adaptation options.

Research and assessments should also more carefully scrutinize outlooks for total risk. Projecting the total risk of hunger, for example, may have different requirements than projecting the additional risk from climate change, especially regarding the most vulnerable populations and the processes that affect them. It must also grapple with the issue of expressing results in net terms that may obscure important trade-offs between climate and non-climate effects.

In addition, our understanding of the impact of extreme events is limited. For instance, initial work suggests that extremes could increase the number of people in hunger in a given year by up to a third<sup>17</sup>, but much more work on this potentially crucial pathway is needed. We also need to make sure that we are capturing not just best-guess outcomes, but the potential for low-probability high-consequence events (such as crossing tipping points) that could fundamentally change the picture of the relative risk of climate change. Finally, we need to account for risks not only from climate change, but also from the unintended consequences of mitigation and adaptation as well.

The IPCC and other assessment bodies should move as far towards distinguishing and assessing both additional and total risk as possible. If assessing total risk is a step too far for such institutions, a separate assessment of the future of well-being may be necessary to avoid viewing it primarily through a climate lens. Climate change risks are important and must be addressed; a more accurate perception of their role in a world where well-being is driven by a multitude of factors can only increase our chances of effective responses.

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## Competing interests

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