Global Warming: The Challenge of Preventing Dangerous Climate Change

by Bill Hare

Introduction

Rapid human-induced climate change over the next several decades and beyond presents enormous risks to natural ecosystems, to species, and particularly to the development prospects of the poorest regions of the world. Three international scientific assessments over the past fifteen years by the UN Intergovernmental Panel on Climate Change, the first in 1990 and the most recent in 2001, have shown that the science of global warming is certain enough to justify action to reduce emissions of greenhouse gases. The scientific community is increasingly anxious about the slow rate of policy action. Such concerns have led the UK government's chief scientist to warn recently that, in his view, climate change is the most severe problem that the world is facing today.[1]

The Scope of the Problem

A range of serious climate impacts is projected if greenhouse gas emissions are not reduced. The impacts of climate change are likely to include effects that could undermine development in many poor, developing countries, leading to increased hunger, water scarcity, droughts, and enhanced spread of diseases such as malaria.[2] Rapid human-induced climate change will rarely act alone in impacting vulnerable communities, but as the climate warms to unprecedented levels, its influence is likely to become decisive in a number of regions. In richer countries, with better health care, water supply systems, and greater economic resilience, damages may still be high with only a few degrees global-mean warming.

Some of the largest negative effects of low levels of (disproportional quick) warming (below 2°C compared to baseline pre-industrial) are likely to be on species and ecosystems.[3] Iconic species, such as the polar bear, may be at risk of extinction in the wild over the coming century as a consequence of the loss of sea ice. Coral reefs seem particularly at risk with quite low levels of temperature increase (1.5°C)[4], raising questions as to whether or not many can be saved from rapid climate change.[5] Some scientists express concern that the Amazon forest may be at risk of collapse

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from warming, which could occur within the next few decades.[6] Indeed, the list of species and ecosystems threatened by climate change is a long one.[7]

Sea level rise, another consequence of climatic warming caused by the thermal expansion of warming oceans and the melting of glaciers and ice sheets, threatens the survival of a number of small island countries and, in the longer term, several low-lying deltaic countries or regions. One of the fundamental aspects of the sea level rise is that it is very difficult to stop, evocated by the relative inertia of the climate system. After the climate has stopped warming, sea level rise caused by thermal expansion of seawater would continue for many hundreds and perhaps a few thousand years, irrespective of what happens to the large ice sheets. Over several centuries, it is very clear from the science of this problem that limiting sea level rise to less than one meter is going to require the virtual elimination of anthropogenic carbon dioxide (CO_2) and other greenhouse gas emissions. This means that if there is to be a Bangladesh in 2300, quite aggressive action in the early and middle decades of the twenty-first century is needed.

Risk of Abrupt System Changes

Climate change is unlikely to unfold slowly. There is a danger of rapid, abrupt changes in the climate system that would magnify the risks described above, or create new greater risks.[8] In the past, much of the evidence from the behavior of the climate system points to abrupt changes in response to ecological conditions such as variations in solar energy input. Scientific knowledge is, at present, insufficient to forecast how and when abrupt changes might occur. A few examples suffice to illustrate the risks.

Global warming could set off a slowing or shutdown of the North Atlantic thermohaline circulation. That, in turn, could trigger sudden changes in regional climate around that region,[9] with large and negative consequence for ecosystems and food production globally.[10]

Many scientists have speculated that the West Antarctic ice sheet, which contains sufficient water to raise global sea levels by six to seven meters, is unstable.[11] Human climatic warming could precipitate its collapse over a few hundred to a thousand years.[12] Should this happen, a global catastrophe is likely to ensue the flooding of many of the world's major cities over a number of centuries. Should this risk be real, despite scientific controversy,[13] the processes that would trigger a collapse become more critical with increasing temperature.[14]

Another example is that of potential adverse changes in the climate 'regime.' A number of climate models are projecting that warming could lead to a more permanent and perhaps extreme El Niño state of the climate system.[15] As is now well known, El Niños often bring extreme floods, droughts, and other weather disasters to many parts of the world, affecting millions of people.

As a final example, warming could, itself, lead to more warming, known as a 'positive feedback,' rendering ineffective human efforts to control the problem.

Modellers at the Hadley Centre for Climate Prediction and Research in the United Kingdom have indicated that there is a significant risk, should warming not be limited, of large-scale dieback of the Amazon forest towards the end of the coming century. Releases of carbon from such a catastrophe, along with the much larger releases of soil carbon projected by the same model from northern forests, would release large volumes of CO_2, the main greenhouse gas, into the atmosphere.[16] The releases would be so large that they would overwhelm all presently conceivable means of limiting the CO_2 increase in the atmosphere. Warming oceans could trigger the release of large amounts of methane from under the sea bed, which would amplify the warming.[17]

Large Inertia in the Climate System

A fundamental feature of the climate system is its inertia. Like a huge ship, once in motion, it is very difficult to stop, let alone reverse. This means that to avoid significant and potentially dangerous changes, emissions of greenhouse gases, particularly CO_2, need to be reduced sooner rather than later.

Climate change is often portrayed as a long-term problem, which will indulge a period of experimentation and contemplation by governments, policymakers, and the scientific community, and even reward a delay in acting with lower costs.[18] Unfortunately, climate change is neither likely to be forgiving of delay, nor is it likely to be a problem whose effects are slow to unfold over the next several decades, like a long, late summer's day. It appears much more likely that changes will be rapid, even abrupt, and deep effects will be clear to all within relatively few decades, unless ameliorating action is taken. Nor is it a problem that, once started, can be easily, if at all, reversed. Indeed, for some highly vulnerable regions and ecosystems, it may already be too late to prevent substantial loss of species and area. As oceanographer Wally Broecker has argued, "it is clear that Earth's climate system has proven itself to be an angry beast…when nudged, it is capable of a violent response."[19]

Strong Scientific Consensus on Risks of Climate Change

Obviously one of the main issues in determining whether and how to deal with the threat of climate change is the strength of the scientific basis for concern about climate change and its impacts and effects. In other words, just how strong is the case that climate change poses a major threat to the future of ecosystems, species and human lives, livelihoods, and infrastructure? In short, the answer to this question is that there is a very strong scientific consensus, internationally, that human-induced climate change presents substantial risks to species, ecosystems, agriculture, health, water resources, human livelihoods, and infrastructure in many regions.

Internationally, the assessment of climate change has been vested in a body known as the Intergovernmental Panel on Climate Change (IPCC), which was established by the United Nations Environment Programme and the World

Meteorological Organization in 1988. It draws upon hundreds of scientists from over 120 countries to regularly assess the state of scientific, technical, and economic knowledge on all aspects of the issue. It is a unique institution, relying upon the good will of many scientists who voluntarily contribute their time and energy to the not very rewarding labor of reviewing vast amounts of literature responding to the critical comments of governments and other reviewers of their reports. At the end of the assessment process, the scientists must watch as 120 or more governments negotiate, line by line, the summaries of their years of work, producing a document that, by consensus, reflects the internationally-agreed understanding of the state of knowledge of the science, impacts, and economics of climate change. Given this process, which involves governments, such as that of Saudi Arabia, which are determined to water down any findings that could imply that action is needed to combat climate change, it is perhaps surprising that any meaningful conclusions emerge. Yet, conclusions have emerged, and with great effect.

The IPCC's most recent assessment, Third Assessment Report (TAR), adopted in September 2001, significantly strengthened the already robust conclusions on the science and impacts of climate change, as well as the economics of combating its negative effects, from the two earlier assessments in 1990 and 1995. It is worth emphasizing some of its key findings, one of which is that the effect of human activities can already be seen in the climate changes of the last fifty years, due most likely to the increase in greenhouse gas concentrations.[20] In addition to strengthening the finding of human effects on the climate, the IPCC can attribute "about three-quarters of the anthropogenic emissions of CO_2 to the atmosphere, during the past twenty years, to fossil fuel burning."[21] In the coming century, human activities, principally the combustion of oil, coal, and gas, are projected to result in a much faster rate of global warming than that seen over the twentieth century and very likely faster than at any time in the last 10,000 years.

Apart from the high rate of projected climate change, the scale of the warming, in the absence of emission reductions, is very large and compares with what occurred during the transition from the last glacial maximum to the present interglacial period. The IPCC estimates that the human-caused increase of temperature over the course of the twenty-first century will be in the range of 1.4–5.8°C over the period 1990-2100. When the last glaciation ended around 10,000 years ago, the world warmed by some 4–6°C over a period of 7,000 to 10,000 years. In other words, if the IPCC's mid and upper range temperature estimates come about, this human-induced global warming will be similar to that which brought an end to the last ice age. Short of a major climatic catastrophe, such as that which destroyed an estimated 95 percent of species around 250 million years ago,[22] climatic changes on Earth do not come much bigger.

The distinct impact of global climatic warming over the past several decades is evident in many physical and biological systems, such as species, ecosystems, and glaciers.[23] Indeed, the chance that all of the observed changes in relation to melting glaciers, reduced ice on lakes, reduced snow, and reductions in sea ice would be in

the same direction is less than 1 in 100,000.[24] Reviews published since the TAR have confirmed the findings in relation to observed impacts on species and ecosystems.[25] The evidence was less clear as to the social and economic effects of increased flooding and droughts attributed to climate change.[26]

Further work, after TAR was finished, has added to the conclusion of the harmful effects of global warming, but not fundamentally strengthened it. For example, in relation to the October and November 2000 floods in the UK, it was found that the extreme rainfall patterns that caused these were consistent with global warming, but the association was not statistically significant. Nevertheless, should current trends continue, a significant increase in such events is expected for the coming century.[27] Indeed, in Europe, river flooding is expected to increase over much of the continent, and in coastal areas, the risk of flooding, erosion, and wetland loss will increase substantially.[28]

Combating the threat of climate change requires broad international agreement.

One of the key findings of the TAR is that it is the changes in climatic extremes are likely to have the most immediate and the greatest negative effects. Some of these changes may include increased frequency of heat waves resulting in crop and livestock losses, increased frequency of wildfires exacerbating wildlife mortality, and increased energy demand for cooling necessary to prevent human deaths and illness from heat stress and air pollution. Extreme fluctuations in the weather could increase the frequency of high intensity rainfall leading to flood and flash flood risk, with consequent property damage, soil erosion, flushing of pollutants into streams and waterways, health threats, and deaths. In addition, more frequent drought in mid-latitude continental interiors will increase agricultural losses, threaten terrestrial and aquatic ecosystems, and reduce quality and availability of water with life-threatening consequences. Increased intensity and frequency of tropical cyclones in some regions will threaten property, coastal stability, ecosystems, health, and life. Any rise in intensity and frequency of extreme climate events will increase demands on an already overburdened public and private financial mechanisms to cover weather-related losses, particularly in developing countries.[29]

In a marked strengthening of the earlier 1990 and 1995 assessments, which found developing countries at risk from climate change, the TAR states that the greatest hardships will fall on those least able to protect themselves from these meteorological extremes. Increases in global mean temperatures are expected to produce net economic losses in many developing countries for all magnitudes of warming, and the effect is most extreme among the poorest people in these countries. For example, the relative percentage damages to GDP from climate extremes have been substantially greater in developing countries than in the industrialized world. The projected distribution of economic impacts is such that it would increase the disparity in well-being between nations as the temperature increased. Finally, it is

projected that more people will be harmed, rather than benefit, by climate change—even for global mean temperature increases of less than a few degrees.[30]

While many regions will be impacted negatively, as a continent, Africa stands out.[31] Unfortunately, it seems likely that the impacts of climate change on diminishing food security, agriculture, and malnutrition may threaten the well-being of large populations in parts of Africa already struggling to survive. In a region already facing the effects of AIDS, climate change seems likely to foster the extension of ranges of infectious disease on the continent. An increase in droughts, floods, famine, and other extreme events will create a further stress on water resources, food security, health, and infrastructure, which will constrain development in Africa. As climate change grips Africa and vital ecosystems wither under the pressure of increasing human activity and rapid, adverse climatic change, some of the richest biodiversity on Earth may disappear, with consequent damages to human activities, such as subsistence, tourism, and epidemiological success.

Broad International Agreement Needed

While the projected effects of human-induced climate change are of epoch-making dimensions, the political and economic complexities (scientific uncertainties aside) in managing this issue globally are monumental. By its very nature, combating the threat of climate change requires broad international agreement; no country acting alone can do more than slow its own rate of increase of greenhouse gas concentrations in the atmosphere. If all the damages from human-induced climate change occurred predominantly where the harmful greenhouse gases were emitted, the political complexities would be substantially reduced. The situation, however, is the reverse: much of the severe impact is projected to occur in countries and regions with little responsibility to date for the causes of the problem. As a consequence, this gives rise to profound questions of fairness and equity in deciding who should take action, when, and how. This also, in itself, leads to substantial potential for conflict in deciding what levels of climate change are dangerous; the US, for example, is the largest single emitting country, but retains a higher threshold of danger than many of the potential victims. Compounding this situation is the fact that much of the scientific and technical knowledge of climate change resides in the richer industrialized countries, which have the time and resources devoted to studying the issue. Many of those most affected, however, have neither the resources nor the time to fully devote to an understanding of what is at stake as other issues are much more immediate and demanding.

As if this level of complexity and uncertainty were not enough, the major share of emissions of climate changing greenhouse gases, of which carbon dioxide is the main causative agent, are derived from the burning of fossil fuels, such as oil, coal, and gas. These fuels generate most of the energy that drives the global economy. By far the largest proportion of fossil fuel-related CO_2 emissions comes from the richer industrialized countries. Developing countries, ironically, aspire to develop

and need increasing amounts of energy services to achieve higher living standards and economic developments for their people, which translates into large increases in CO_2 emissions. Greatly reducing emissions of CO_2, which is necessary if the climate system is to be stabilized, will involve decoupling energy services in both the developed and developing worlds from CO_2 emissions. Given this context, it is therefore not surprising that many developing countries fear that efforts to combat climate change could curtail their development.

International Action

In response to the risks identified in the IPCC's First Assessment Report in 1990, the international community negotiated the United Nations Framework Convention on Climate Change (UNFCCC), which was adopted at Rio de Janeiro in June 1992.[32] This has, as its ultimate and legally binding objective, the prevention of dangerous interference with the climate systems. Article 2 of the UNFCCC requires that all parties, essentially the entire world community, including the US, work together to *prevent* dangerous climate change. Stabilization of the most important greenhouse gas, CO_2, requires at least a 60–80 percent reduction in anthropogenic emissions. The UNFCCC contained only broad obligations on the industrialized countries to return emissions to 1990 levels by 2000. These obligations were found to be inadequate at the first Conference of the Parties to the UNFCC in Berlin in 1995. It was decided that the parties would negotiate a protocol, or other legal instrument, "as a matter of urgency" to develop emission controls for the industrialized countries. The Kyoto Protocol, which was the product of intense negotiations that attracted extremely high levels of public attention, was adopted in 1997 at the third Conference of the Parties to the UNFCCC with emissions targets for nearly all of the industrialized nations. Following this success, the ensuing years have been marred by controversy and setbacks, including the rejection of Kyoto by President George W. Bush in early 2001. In spite of this, the final agreements on the implementation of the Kyoto Protocol were made at Marrakesh at the end of that year, and with Russia's ratification in 2004, the Protocol entered into force on February 16, 2005. Only the US and Australia stand outside the Kyoto Protocol from the developed country group.

Arguably, progress to date towards the prevention of dangerous climate change has been slow and, with the unilateral withdrawal of the U.S. from the Kyoto Protocol, at risk. Scientific evidence, however, is pouring into the peer-reviewed literature demonstrating the risks of delay in managing the threat of climate change. In many policy circles, there is a rising level of anxiety at the slowness of action in the face of mounting risks. Already, the first effects of human-induced climate change are being felt; species are migrating, glaciers are receding, the atmosphere and oceans are warming, and weather systems are changing. Predictions of the impacts from future changes by the scientific community are alarming, especially if one considers that the magnitude of change projected over the next century is similar to, but many times faster, than that which occurred at the end of the last ice age.

Does Climate Change Matter?

The rejection of the Kyoto Protocol by President George W. Bush has given new life to the so-called climate sceptics, who in many cases are essentially arguing that even if anthropogenic climate change is happening, it is not a big issue. Are people not starving in Africa today, and why does climate change matter when other causes of starvation are much more significant? Is malaria not prevalent south of the Texas border, but hardly heard of within North America considering both regions have the same climate? Since ecosystems and species are being wiped out anyway, are there not more urgent priorities? Are not population growth and consumption patterns much more significant an influence on water use and demand than climate? And did not people adapt to climatic changes in the past? Analysis of these impacted areas plainly indicates that climate change does present clear risks that are not subsumed by other processes.

Climate change poses a first order risk of increased hunger to poorer regions already experiencing food scarcity or food security problems.

The current scale of species loss has been described as the sixth great extinction event: the other five events had natural causes. In evolutionary terms, this, if unchecked, would be a massive loss of the biological inheritance of the planet. While the ecological consequences are difficult to predict, many scientists believe there will be major repercussions on the functioning of the biosphere, which we depend on for many ecosystem services. Climate change will seriously exacerbate, and in many cases directly cause, the loss of species and ecosystems.[33] In some cases, it may be the main driver behind the risk of this large-scale loss, such as the Cape Floristic Province on the southern tip of South Africa,[34] the moist tropical forests of northeastern Australia,[35] much of the Alpine flora of New Zealand[36] or many coral reefs.[37] In other cases, climate change interacting with human disturbance of the Amazon could lead to the more or less complete collapse of that system.[38] In systems such as these and coral reefs, even if the human disturbance currently threatening these systems stopped, climate change would still pose a main or fundamental risk.[39] Most of the main risks occur by the time global mean warming is in the range of 1.5–2.5°C above pre-industrial temperatures.

Unchecked land degradation will make it more difficult for the world to feed itself and exacerbate regional food shortages, as highly degraded regions are less able to cope with normal climatic fluctuations. Climate change is expected to intensify or even cause land degradation problems in many regions.[40] While measures to reduce the loss are likely to provide resilience to climate variability, it seems unlikely that they would be sufficient to prevent significant negative effects.

Most recent global assessments of the ability of the world to feed a growing human population indicate that this is feasible, if not without significant environmental

costs.[41] While overall levels of food production are generally sufficient, areas of food scarcity are only slowly reduced as overall levels of income rise, under assumed scenarios of economic growth. Factoring climate change into the assessment alters the picture significantly, with many developing countries expected to experience yield reductions at low levels of warming. By and large, developed countries are expected to increase their yields, although after a warming of 2–4°C, they are predicted to decline in many places.[42] Well below this level of warming, the number of people at risk of hunger or suffering from food scarcity in poorer developing countries is increasing rapidly, with the risk not being offset by either general increase in income or adaptation measures.[43] In relation to developed countries, the general assessment of increased yields is by no means certain and is dependent on model projections of how climate may change in the future.[44] In other words, climate change poses a first order risk of increased hunger to poorer regions already experiencing food scarcity or food security problems.

As mentioned above, the TAR has identified that climate change poses a threat to development in a number of regions, arising from a set of pressures, such as increased climate-related disaster risk, increased risk of the spread of diseases such as malaria and dengue fever, reduced agricultural production, and food scarcity. Hence, whatever the uncertainties about future development prospects for regions such as Africa, the effects of climate change cloud the future. It could, in many cases, make it significantly harder for countries to cope with the multiple problems afflicting their regions. In other cases or plausible combinations of circumstances, such as increases in extreme-event frequency and intensity, climate change could be a decisive factor in the future development of countries or regions.[45]

In some cases, climate change presents a threat to both the physical and cultural survival of low-lying island countries and their peoples. Highlighted by this issue of cultural or physical loss, caused by the effects of climate change, is the fact that often the impacts are likely to be, and in some cases are already being felt, by people whose lives are lived far from both the physical centers of metropolitan existence in the wealthier industrialized countries. Such people are remote from the causes of climate change and yet are on the sharp end of the impacts. What weight is to be given to their interests as opposed to those of consumers in, for example, the US? The IPCC estimated it would cost less than US$125 per person per year in 2010 to meet the targets of the Kyoto Protocol in the US.[46] If Kyoto's implementation was the first step towards preventing large climatic damages, would this be a fair price to demand? Or if, as the Bush administration decided, this is too costly for the US, then, as a consequence, the peoples affected by rapid climate change may have to fend for themselves.

Of course, sooner or later, unless far reaching action is taken, the consequences of rapid climate change will be felt deep in the heartlands of Europe, North America, Australia, and Japan and not just visited upon the poor of the larger part of the world. Indeed, at least in the public perception, this may already be so in relation to events such as the severe drought of 2001 and 2002 in Australia,[47] severe wind

storms in France, record coastal floods in the United Kingdom in 2000, the river flood catastrophes in Germany in the summer of 2002, and in the 20,000 deaths attributed to the completely unprecedented summer heat wave of 2003. Apart from the scientific reasoning behind treating climate change as a problem that must be dealt with sooner rather than later, the political ramifications may become much sharper sooner than many politicians expect. Respected voices in the scientific community are becoming more strident as the evidence of danger accumulates.[48]

Conclusion: Preventing Dangerous Climate Change

The impacts and risks outlined above point to the need to limit global mean warming to an increase of 2°C or less above pre-industrial temperatures. Such a limit has been identified in the research and policy community[49] and has also found expression as the stated aim of the European Union for global warming policy.[50] Achievement of such a target requires global emissions to peak within a few decades at the most and for industrialized countries to begin reducing emissions virtually immediately,[51] as is implied in the obligations of the Kyoto Protocol.

The rejection of the Kyoto Protocol by President George W. Bush in early 2001 and his subsequent challenge of the basic science underpinning the global response to the threat of climate has sent intellectual, political, and emotional shockwaves throughout the climate community and indeed into the broader world. For many, the threat to the Kyoto Protocol and the international climate regime at large created by President Bush presents a major risk. Prior to Bush's presidency, although progress was slow and difficult, there was a feeling that the world was slowly beginning to deal with the threats posed by climate change. In one blow, Bush's unilateral rejection of the Kyoto Protocol and its underlying scientific justification has cast into doubt the most fundamental basis of international efforts to deal with the threat—the need for a strong international movement from which no main player was exempted.

While most of the world is pushing ahead with implementing Kyoto and preparing for the next stage of broader action, the role of the U.S. remains negative and recalcitrant, yet the problem cannot be solved ultimately without its active involvement. An overabundant amount has been written in the last two or three years about the modes of "re-engagement" of the US, "new frameworks," "Post-Kyoto" climate actions, and so on. The common denominator of these discourses or alternative proposals is that they would do substantially less in terms of emissions reduction than the Kyoto Protocol, and would, in this way, represent a step backwards. By far the strongest response to this discussion has been the establishment of an emission trading system among the twenty-five member states of the European Union. This is both setting a marker for action in the concrete domain of policy instruments and governance of climate change and maintaining forward momentum at a time of great difficulty. Rather than contributing to this discussion here, I note only that both building on Kyoto and developing a large global program for "greening" the energy system in developing countries is the only realistic and essential way to maintain momentum where it matters: reducing emissions from the industrialized countries

and beginning the process of stabilizing emissions from the developing world.

Instead, I want to conclude with an argument of great force and simplicity put forward by Ambassador Lionel Hurst of Antigua and Barbuda, who has drawn a powerful and eloquent analogy between the slave trade and global warming.[52] Global warming threatens the livelihoods and homes of many who have played little or no role in its causes and who themselves can do nothing to prevent the otherwise inevitable loss of islands and homes due to sea level rise. Put simply, global warming poses a moral question to the most powerful on the planet, who are also the major source of emissions, wealth, and know how. The slave trade, Hurst argues, was not stopped by the slaves themselves persuading their masters of the immorality of slavery. It was solved from within, starting with Great Britain, which resolved after much debate to end slavery over two hundred years ago. Ultimately, it prosecuted this decision with great vigor and fought battles and wars to stamp out the trade. A moral decision was made that slavery was not the right thing to do. When it comes to greenhouse gas emissions and climate change, the rich and powerful have the same kind of moral choice to face—to act or not to act to prevent huge damages to powerless people and to natural ecosystems unable to defend themselves.

The ball, I would say, is now in the US court: what is the choice to be?

Notes

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