1

The Doomsday Clock

Climate Change and the Global Developmental Crisis

Nearly 20 years after the landmark earth summit at Rio de Janeiro in Brazil, how does the global balance-sheet on the climate issue look? Have societies, governments and international bodies like the UNFCCC grasped the gravity of anthropogenic climate change (change induced by human activity) and the urgent need for remedial action? Has the world done enough to ensure that it can pull back from the precipice of catastrophe by drastically reducing emissions of greenhouse gases, which are heating up the earth and dangerously destabilising the climate?

The honest answer is, not quite. The past two decades' history is best captured by the famous Doomsday Clock image of the *Bulletin of the Atomic Scientists*, in which the closer the minute-hand is to midnight, the nearer the world is to extinction.[1] Just before Rio, the world was probably only five minutes away from midnight, but racing towards it as GHG emissions rose relentlessly. The Rio summit and the debate which followed showed that the world is living dangerously beyond its means and over-consuming natural resources. The raised international awareness and progressive policy changes after Rio put the minute-hand back by two minutes.

As climate science developed, there was progress in assigning responsibility for climate change and combating it. Major agreements negotiated under UNFCCC auspices such as the Kyoto Protocol, despite flaws, goaded the world to apply its collective will to undertaking deep emissions cuts which, climate science told us, were imperative.[2] A consensus emerged that the developed countries, which account for three-fourths of the GHGs accumulated in the atmosphere, must accept the primary responsibility for combating climate change. Quantitative targets were set for reductions in their emissions. So, by the time the Bali Action Plan was agreed

in 1997, the minute-hand was probably set at 8 minutes before midnight. This is the furthest it has been from Doomsday Hour for some decades.

Since then, some of the gains in the climate talks, and actual climate actions, have been rolled back or threatened. The Doomsday Clock has raced forward at an alarming speed. The Copenhagen climate conference in 2009 was a colossal failure. In one fell swoop, it advanced the minute-hand to 4 minutes before midnight. With the Cancun summit, which followed a year later, it became clear that the world was moving away from a science-based approach to setting emissions reduction targets for different countries in keeping with their responsibility for causing climate change, to a system of voluntary pledges of mitigation, as and when governments offer to make them on an arbitrary basis. Cancun moved the minute-hand forward, to 3 minutes before midnight.

Just before the Durban climate conference, when this book is being written, the global scenario remains dismal, and the prospect of another summit failure very real. There have been setbacks in the intersessional talks too. *The Doomsday Clock now stands at 2 minutes before midnight.*

The world is closer than ever before to catastrophic and irreversible climate change. The earth's climate system is in deep trouble because most governments, factories, transporters, energy producers, retailers, shopkeepers, offices and ordinary consumers have got locked into fossil-fuel dependence. Burning coal/gas to produce electricity, using petrol or diesel to move from one place to another, and building homes with cement, steel and bricks which consume a lot of energy, have long been the default option in many societies. They are not doing enough to overcome their fossil-fuel addiction and cut GHG emissions to the extent necessary and possible.

GHG emissions heat up the atmosphere through a process known as 'radiative forcing', which alters the planet's heat balance.[3] Emissions are now rising by 2 billion tonnes of carbon dioxide (CO_2)-equivalent a month, or by 800 tonnes a second.[4] This increase exceeds many of the worst-case projections of the 2007 Fourth Assessment Report of the IPCC, to which more than 450 lead authors, 800 contributing authors, and an additional 2,500 reviewing experts from more than 130 countries contributed. The Fourth Assessment Report (FAR) forecast a likely temperature rise of 1.8 to 4 ^{0}C by the end of the twenty-first century.

But the present global emissions trajectory, based on the pledges and commitments made by different countries, threatens to warm the earth in this century well beyond the 1.5° to 2° C rise (over pre-industrial temperatures), considered the highest tolerable by climatologists. Average global temperatures are now on course to rise by 3 to 4° C, even a mind-boggling 5° C. Eminent scientists have issued the dire warning that billions of people will die if global warming increases to 4° C. According to Kevin Anderson, director of the Tyndall Centre for Climate Change

Research in the UK, *only around 10 per cent of the planet's population will survive at 4° C warming.*[5] This is of course speculative guesswork based on extrapolation. But the staggering magnitude of the possible havoc should cause alarm—and trigger urgent remedial action.

There is growing scientific consensus in favour of treating 1.5° C as the uppermost tolerable limit for global warming. More than 100 countries and a large number of NGOs endorse this. So does the UNFCCC Secretariat, headed by Christiana Figueres.[6] But such levels are not 'safe'. Nor are the carbon dioxide concentrations in the atmosphere associated with them—such as 450 ppm for 2° C.

The 2° C limit would pose unacceptable risks to some of the world's vital ecosystems and is compatible with large-scale disasters such as melting ice-sheets and a high sea-level rise. For all intents and purposes, it must be ruled out. The chances of 2° C being exceeded at a CO_2 atmospheric concentration of 450 ppm are 25 per cent. Even a 1.5° C warming is liable to cause more frequent droughts, heat-waves, wildfires and floods, with increased water stress for 1.7 billion people.[7]

Each year, the world burns fossil fuels which represent the equivalent of the earth's entire production of plant and animal life for 400 years![8] On current trends, the world could soon cross not one, but perhaps many, of the 'tipping points' identified by science, such as rapid loss of Arctic summer sea-ice, decay of the Greenland ice-sheet, dieback of the Amazon rainforest, and great instability in the Indian summer monsoon.[9] Once one or some of these are crossed—which may happen even at a global warming level of 3^0 C or less—, the climate system's behaviour changes qualitatively and remedial action can become futile.

The global effort at reducing emissions is falling woefully short of the critical minimum. Many climate change processes have accelerated. And the natural sinks of greenhouse gases are losing their absorptive capacity.

By 2009, the world already exhausted one-third of its carbon dioxide budget (1,000 billion tonnes, or gigatonnes) for the first half of this century, compatible with a 2° C rise in temperature. The world has spent nearly half (precisely 44 per cent) of the stricter budget (750 Gt) demanded by CO_2 stabilisation at 350 ppm, corresponding to a likely 1.5° C global warming level.[10] There are few signs that the globe's principal emitters will urgently act to cut their GHG emissions aggressively so as to remain within this budget. They have failed so far even to pledge to make the requisite emissions reductions.

A huge 'gigatonne gap' stares the world in the face today. This is the difference between the likely global emissions total after the cuts pledged by various governments, and what is necessary to cap atmospheric GHG concentrations and global warming at relatively safe levels. The major nations lack the political will to get out of their fossil fuel addiction and make a bold departure towards low-carbon development.

As of mid-2011, the globe's nations made voluntary emissions reduction pledges that together add up to only about 60 per cent of the cuts needed by 2020 to limit global warming over the twenty-first century to 2° C. Even these pledges are ambivalent, or hedged in with all manner of conditions and varying degrees of leniency in the application of accounting rules. Since the pledges are voluntary, there is no assurance that they will be translated into action. The past record in this respect is dismal, even where, as in the case of the Kyoto Protocol, legally binding commitments were involved.

Even assuming that all the pledges made after the Copenhagen summit by various nations are implemented, there will still be a substantial deficit in relation to the critical threshold, according to the UN Environment Programme's *Emissions Gap Report* 2010.[11] This estimates that under a BAU scenario, itself unacceptable, the world's annual GHG emissions would reach about 56 Gt of CO_2-equivalent by 2020, up from about 48 Gt in 2009. But emissions must fall to 44 Gt by 2020 for a fair chance of pegging temperatures to 2° C or below.

However, even in the best-case scenario, fully implementing the pledges would only cut emissions to around 49 Gt by 2020. This would leave a gap of about 5 Gt. In the worst-case scenario—where countries follow their lowest ambitions, and accounting rules are lax—emissions would be as high as 53 Gt in 2020, only slightly lower than BAU projections. And the gigatonne gap would rise to 9 Gt of CO_2-eq. In the extreme case, the pledges could even permit emissions to *exceed* the BAU projection, with frightful consequences.

Estimates by Climate Action Tracker (CAT), a science-based assessment indicator developed by experts based in Europe[12], are even more dismal. Basing itself on the latest (post-Cancun) pledges and clarifications offered by different nations, CAT estimates the emissions gap at 10–14 Gt. This is the difference between the likely total emissions by 2020 (54 Gt) if the pledged reductions are implemented, and the 40–44 Gt necessary to limit global warming to 2° C or 1.5° C, as the Cancun Agreements aim to do. Even if governments implement the most ambitious reductions in the range they have pledged, and follow the most stringent accounting rules, especially for land use and land-use change and forestry (LULUCF), the emissions gap would at best decrease to 8–12 Gt, a huge quantity by any reckoning.[13]

Yet, powerful governments are deluding themselves that future climate summits will make up for past failures by reaching a worthy agreement after which low-carbon technologies would somehow emerge which miraculously save the planet. The unembellished truth is that with each failure to pledge and make deep emissions cuts, yet more GHGs accumulate in the atmosphere, and the world locks itself into a trajectory of high and rising temperatures. 'In other words', says climatologist Kevin Anderson, 'next year's negotiations cannot compensate for this and previous years' failures.'[14]

Climate change impacts unfold over decades, even centuries. Yet, 'to avoid what is commonly considered dangerous levels of [climate] impacts, emissions need to begin reducing rapidly now.... In the meantime, every molecule of carbon dioxide emitted simply adds to all those emitted over the past century, inexorably increasing the level of warming and consequently the scope and scale of the impacts.'[15] Contrary to what the science tells us, the international negotiations have proceeded on the assumption that the climate problem will be the same next year as this year. But 'next year, the problem will have become worse—as it has done each and every day that we have failed to reduce emissions since the Earth Summit in Rio in 1992.'[16]

No amount of low-carbon technology can remove and replace the emissions which are already embedded in the atmosphere. There is simply no substitute for making deep and early emissions cuts. The longer these are delayed, the greater the future burden on the world. Worse, the wider the gigatonne gap, the greater the likelihood of one or more tipping points being crossed, with consequences too horrifying to imagine.

Major developments in climate science indicate that the effects of climate change are far greater and occurring much faster than forecast by the model used by the IPCC's Fourth Assessment Report (2007). Greenhouse emissions cause a rise in temperature in the atmosphere, the oceans and on land, leading to changes in hydrology, the carbon cycle, wind patterns and ocean currents, and thus affecting different ecosystems, from the arctic to the tropical.

Some of the extreme or erratic recent weather events—such as the prolonged drought in 2011 in western Europe following one of the coldest winters ever; the terrible and violent floods in Pakistan of 2010; severe droughts and heat-waves in Asia, Africa and Latin America; fires scorching millions of square kilometres of forests in eastern Europe; terrifying tornadoes in North America; and cyclones and floods in Asia and Australia—are probably part of the process through which climate change manifests itself. The precise causation of such 'global weirding' is hard to establish.[17] But it has become the 'new normal'.

Scientists have been reluctant for 20 years to link climate change with extreme weather. But they are now set to end their reluctance. Climate researchers from different countries have formed 'a new international alliance that aims to investigate exceptional weather events to see whether they can be attributable to global warming caused by greenhouse gas emissions.'[18]

Some scientists from the National Centre for Atmospheric Research and National Oceanic and Atmospheric Administration in the US, and the British Meteorological Office, have joined hands to 'form a coalition called the Attribution of Climate-Related Events which is preparing a report on the subject.... They hope in future to assess each extreme weather phenomenon in terms of its probability of being linked with global warming and then to post the result on the internet.'[19]

Many researchers believe that while it is not possible to link single weather events such as storms with climate change, it is evident that 'the environment in which all of these storms are developing has changed'. Senior scientist Kevin Trenberth of NCAR has been quoted as saying: 'It's not so much the instantaneous result of the greenhouse effect, it's the memory of the system and the main memory is in the oceans and the oceans have warmed up substantially, at depth, and we can measure that.'[20] Similarly, in the changed climate, there is more moisture in the atmosphere and hence a higher potential for stronger storms and heavier rainfall. Many weather events are now taking place outside the realms of natural variability.

Some of the short-term effects of climate change are already apparent. Among them are changes in the timing of the seasonal freezing and thawing of lakes, the timing of plant flowering and animal migration—thus leading to the disappearance or blurring of distinctions between seasons—and hydrological cycles. This last is altering river flows and increasing total atmospheric moisture content over the oceans. Human activities now account for a high proportion of the observed increase in the sea-surface temperature, which contributes to more intense hurricanes.[21]

Increasingly evident are the *second-order effects* of the climate change process (ironically called 'positive feedback' in the value-neutral terminology of science), under which warming accelerates in a non-linear way. For instance, warming leads to faster melting of the Arctic ice-sheet, polar ice-caps and glaciers, which reflect back 80 per cent of sunlight. The dark water or rock thus exposed only reflects back 5 per cent of sunlight. The rest of the heat further speeds up melting. This, along with thermal expansion of water or rock, leads to yet more heating and yet more melting.

The second-order effects have resulted in unprecedented thinning of the Arctic ice-sheet and a huge decrease in the summer sea-ice area, with loss of the oldest and thickest ice. In 2007, the sea-ice area was the lowest recorded since satellite observations began. But even this record may be shattered in 2011. In July 2011, the area shrank 2.6 per cent below its previous record low for July, in 2007.[22]

So comprehensive and compelling is the evidence of the impact of human activity on the planet, believes an influential group of geologists, that 'we are entering a new phase of geological time: the Anthropocene. Millions of years from now, they say, alien geologists will be able to make out a human-influenced level in the accumulated layers of rock, in the same way that we can see the imprint of dinosaurs in the Jurassic or the explosion of life that marks the Cambrian.'[23]

A working group of the International Commission on Stratigraphy, charged with setting global standards for the fundamental scale to express the history of the earth, recently met to 'discuss evidence for the planet having crossed into a new geological epoch'. The last time the planet passed a geological boundary (the

Holocene) was 12,000 years ago. Then, humans were 'an insignificant species, just one of a couple of hominids struggling to survive in a world where so many of our cousins, such as *Homo erectus*, had failed to make it.'[24]

In the last analysis, climate change contains the possibility of extinction of the human species. This has led historians[25] and philosophers to ask how we might comprehend our present and future when there is no continuity of human experience which connects the past, present and future—an assumption on which the entire discipline of history is based. What happens when the wall between human and natural history is breached? How do we understand the unintended consequences of our actions as a species, which lead to epochal self-destruction?

This raises a crucial ethical question. Human beings have radically reshaped the physical world through agricultural and industrial activities, mining, and by damming rivers—causing a massive loss of plant and animal species, changing the composition of the earth's crust, and spreading human-produced chemicals and radioactive fallout from nuclear tests the world over. But will humans take responsibility for ushering in the Anthropocene and causing the injury they have heaped upon the planet? If so, who assigns the responsibility? How will this be enforced? Are human societies capable of the high degree of cooperation and collective action this demands?

One just cannot be sure that good sense will somehow prevail and humanity will be eventually saved from a climate catastrophe. It is entirely possible, and on present reckoning likely, that national governments will continue to follow the dread logic of the 'social dilemma' in game theory and individually remain obsessed with promoting their short-term interests such as economic competitiveness, while collectively undermining the natural life-support systems vital to their societies' very survival.

The situation is similar to that caused by the furious nuclear arms race during the Cold War, driven by a search for security through terror and by doctrines such as mutually assured destruction (MAD). This led to the amassing of enough firepower in the world's nuclear arsenals to incinerate it 50 times over, and brought civilisation to the brink of the abyss of destruction on several occasions.

The melting of the Arctic ice-sheet has acquired iconic significance in the popular imagination with the image of a forlorn polar bear. Recent evidence shows that periods of rapid Arctic sea-ice loss lead to faster warming over land in the polar region. Increased ocean heat dissipates towards the end of summer to the atmosphere as the region enters winter and the ocean freezes again into sea-ice. This warmer air extends over land and allows bacteria more time to decompose thawing plant and other organic matter that had been long frozen. This releases CO_2 and methane into the atmosphere, amplifying global warming. Antarctic ice-shelves are also collapsing more rapidly than expected. When ice-shelves collapse, the glaciers behind them

begin to flow into the ocean more rapidly, accelerating sea-level rise. The West Antarctic ice-sheet continues to exhibit accelerated melting, with 10 major ice-shelf collapses in the last decade.[26]

Simultaneously, permanently frozen soil (permafrost) in the Arctic region is thawing at an accelerated rate. Most of the Arctic landmass sits on permafrost which contains large amounts of carbon—significantly more than currently exists in the earth's atmosphere. If these soils thaw, they will release large amounts of CO_2 and methane (CH_4), the two most important greenhouse gases. This is already happening. With further warming, methane emissions would increase further, perhaps nonlinearly, increasing global warming. Many permafrost soils have warmed rapidly in recent decades, and the large amount of carbon in these soils would release approximately 10 times the current atmospheric CH_4 burden.

No less significant is the rapid melting of glaciers in the Greater Himalayas, or the Hindu Kush-Himalaya-Tibetan Plateau mountain range, the world's third largest reservoir of ice, snow and water, discussed later in the book. This has enormous consequences for some of the greatest river systems of the world's most populous continent, Asia.

As for the world's oceans, a 'deadly trio' of carbon-related impacts—including warming, acidification, and oxygen depletion—may lead to a loss of marine species and entire marine ecosystems such as coral reefs within a single generation, in addition to the continuing loss of several species and marine habitat types (e.g. mangroves and seagrass meadows). An experts' panel led by the International Programme on the State of the Ocean (IPSO), in partnership with the International Union for Conservation of Nature (IUCN), recently concluded: 'Unless action is taken now, the consequences of our activities are at a high risk of causing, through the combined effects of climate change, overexploitation, pollution and habitat loss, the next globally significant extinction event in the ocean. It is notable that the occurrence of multiple high-intensity stressors has been a pre-requisite for all the five global extinction events of the past 600 million years.'[27]

The oceans are undergoing what scientists call 'carbon perturbation' caused by human activity. As a result, 'acidification is occurring faster than in the past 55 million years'. Many of the negative impacts are far greater than the worst-case scenarios of the IPCC's Fourth Assessment Report. New stressors are emerging even as current stressors' impact increases.[28]

Nothing sums up the state of the oceans as lucidly as the following description of the Arctic Ocean by NASA climate scientist Jay Zwally, who as a teenager had hauled coal: 'The Arctic is often cited as the canary in the coal mine for climate warming. Now as a sign of climate warming, the canary has died. It is time to start getting out of the coal mines.'[29]

Increased contributions of water from melting glaciers and ice-sheets on land, as well as thermal expansion from continued ocean warming, are causing a rise in sea levels. The FAR estimated global average sea-level rise for the end of this century (2090–2099) compared with the end of the last century (1980–1999) at between 0.2 and 0.6 metres. This was based primarily on projections of thermal expansion due to ocean warming with only modest contributions from mountain glaciers.

'Because understanding of ice sheet behavior is still evolving, future ice sheet disintegration was not included in models used by the IPCC at that time. Researchers have since examined plausible contributions from ice sheets given current understanding of accelerating ice sheet melt and other factors. New analysis indicates that meltwater from ice on land could lead to a sea-level rise increase of ~2.6 feet (0.8 metre) by the end of the century; and although ~6.6 feet (2.0 metres) is less likely, it is still physically possible.'[30] Other estimates put the maximum possible rise even higher, at a mind-boggling 6 to 7 metres.[31]

THE SINKS AREN'T WORKING WELL

Human activity has pumped so much CO_2 into the atmosphere in recent years that the natural processes which absorb the gas simply cannot keep pace with the increase. The two great natural sinks of GHGs, the oceans and the forests, are working less and less efficiently. As the oceans absorb CO_2, they become more acidic. This, combined with increasing ocean temperatures, diminishes their ability to continue absorbing CO_2. Acidification seriously threatens the world's marine ecosystems, especially coral reefs and shellfish. The past 50 years have also seen reduced absorption of CO_2 by forests, including tropical rainforests, the other great natural GHG sink.[32] The overall efficiency of absorption of CO_2 in forests has declined. And continuing deforestation has aggravated matters.

The new science also undermines the conventional assumption of the quantitative equivalence of carbon dioxide emissions regardless of their vintage. Thanks to ocean acidification, more CO_2 stays on in the atmosphere. In 1960, a tonne of CO_2 emissions resulted in around 400 kilogrammes of CO_2 remaining in the atmosphere than earlier. In 2006, a tonne of CO_2 emissions results in about 450 kg remaining in the atmosphere. Thus, the same quantity of CO_2 emitted today results in more heat-trapping capacity than it did a few decades ago. The fraction of CO_2 that stays in the atmosphere is growing over time. Because of this, and accelerating emissions, atmospheric CO_2 concentrations from 2000 to 2007 annually increased 33 per cent faster than in the 1990s.

Climate studies based on new models show that high atmospheric CO_2 concentrations will persist much longer than believed earlier—1,000 years or longer

even after emissions stop completely. Some of the effects of climate change, including warmer temperatures, may be practically irreversible. About a quarter of the CO_2 emitted may remain in the atmosphere for 5,000 years. And the rate of heat transfer between the atmosphere and the oceans will slow down as the oceans' ability to absorb heat decreases, especially at CO_2 concentrations above 450 ppm.[33]

This highlights the urgency of early emissions cuts and sets a pretty severe limit on the levels at which emissions may peak before they are made to decrease sharply and stabilise. At least 40–45 per cent of the emissions cuts of the developed countries must take place by 2020. The longer these are delayed, the more onerous and less realisable will the future burden become. How sharply the world cuts its emissions by 2015 and 2020 will have a far greater bearing on the climate by the end of the century than even deeper cuts undertaken later, say, between 2020 and 2040.

Estimates of the likely social or human impact of climate change vary. But the forecasts continue to get bleaker. Changes in the climate system are probably exacerbating some of the events routinely described as 'natural disasters' and magnifying their effects. Science is as certain as it can be of this. It is society that is now called upon to act to limit the harm and alleviate the human suffering.

Researchers estimate that climate change is annually displacing 25–30 million people globally. About 375 million people may be affected by climate-related disasters by 2015. As many as 200 million may be on the move each year by 2050 because of hunger, environmental degradation and loss of land. And several major cities that are dependent on water from mountain ranges could face collapse.[34]

LAST TO POLLUTE, FIRST TO SUFFER THE CONSEQUENCES

Climate change confronts our polarised world with another great challenge. The causes of climate change lie primarily in the historical GHG emissions of the developed countries. But its effects are concentrated and at their severest in the Global South, where four-fifths of the world's peoples live. The South is far more vulnerable because of geographic factors and because of its poverty, undeveloped infrastructure, lack of early warning systems and emergency preparedness, low capacity for adaptation, and poor availability of resources for relief and rehabilitation. These factors are compounded by the indifference or apathy of bureaucracies towards underprivileged people, and not least, relatively low public awareness of climate issues.

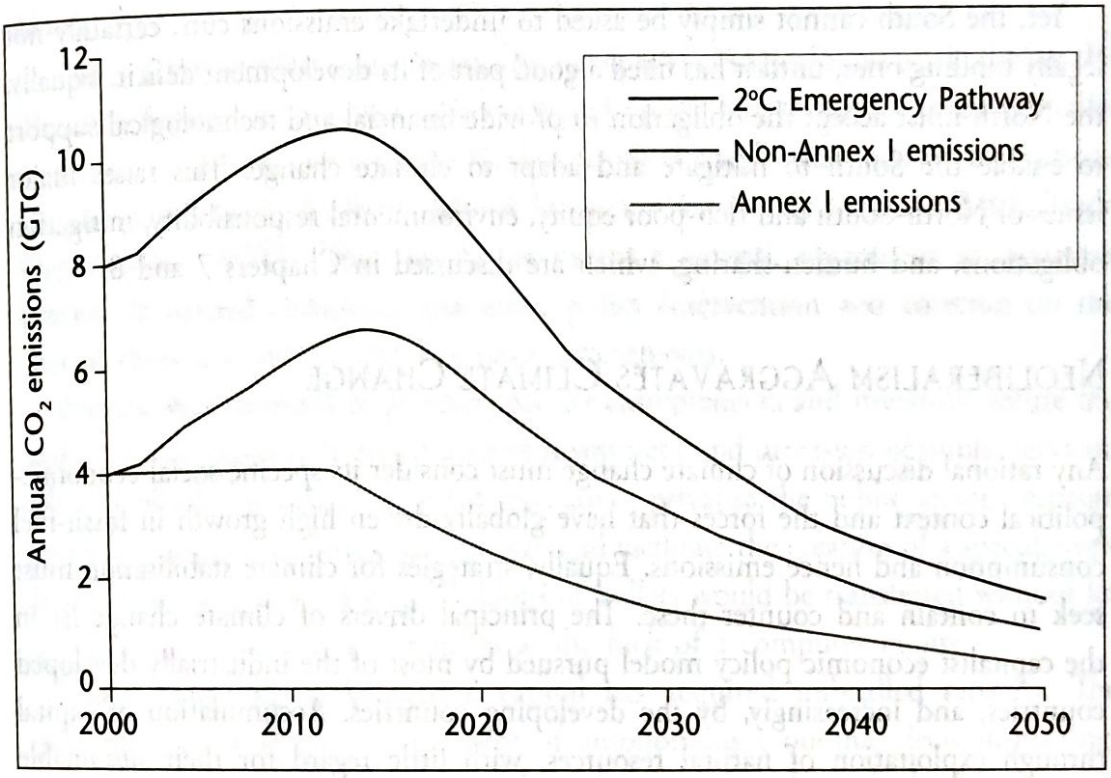
The climate crisis is a double whammy for the South. And it is especially harsh on its poor. This was recently underlined by the *Least Developed Countries (LDCs) Report 2010* (UNCTAD, Geneva, 2010). The LDCs account for less than 1 per cent of the world's total GHG emissions, but the frequency and intensity of extreme weather events in them are five times higher now (519 events in 2000–2010) than

during the 1970s (116). In the last decade, about 40 per cent of all casualties related to natural disasters were found in the poorest countries of the world.

The North owes a climate debt to the South. And it is rising. The North's high historical emissions, coupled with its continuing failure to reduce GHG emissions substantially, have only left a limited, indeed minuscule, carbon budget on which the Southern countries must pursue their developmental objectives—providing to their poor people a modicum of food and water security, primary healthcare, literacy, elementary education, access to energy, and employment security.

The small and shrinking size of the South's carbon budget is lucidly depicted in *The Greenhouse Development Rights Framework* produced by the Stockholm Environment Institute (SEI) and EcoEquity. The longer the North delays making emissions cuts, the smaller the development space left for the South. In effect, the North is squatting in the global climate space, and depriving the South of access to it. The North must vacate that space, or be made to vacate it (see Figure 1.1 below).

FIGURE 1.1: THE SOUTH'S DILEMMA



Note: The top line shows the 2° C Emergency Pathway, in which global CO_2 emissions peak in 2013 and fall to 80 per cent below 1990 levels in 2050. The lowest line shows Annex I emissions declining to 90 per cent below 1990 levels in 2050. The line in the middle shows, by subtraction, the emissions space that would remain for the developing countries.

Source: Heinrich Böll Stiftung, 2008, *The Greenhouse Development Rights Framework: The Right to Development in a Climate Constrained World*, A Report by Paul Baer and Tom Athanasiou of EcoEquity and Sivan Kartha and Eric Kemp-Benedict of the Stockholm Environment Institute', Berlin: Heinrich Böll Stiftung, Second Edition, November, pp. 14.

The South faces a great dilemma. In the absence of affordable and adequate low-carbon alternatives, much of the South can only pursue its development goals by relying on fossil-fuel burning, which will raise emissions in the short run. As *The Greenhouse Development Rights Framework*'s authors put it: 'From the South's perspective, this pits development squarely against climate protection.... The developing countries are quite manifestly justified in fearing that the larger development crisis, too, will be treated as secondary to the imperatives of climate stabilisation.'[35]

Climate change thus translates not just into an environmental crisis, but also a developmental crisis which threatens the poor. This greatly narrows the South's options, although it does not eliminate them. (There are practical alternatives, which are discussed in Chapters 6 and 11). In both the 1.5° C and 2° C pathways to stabilising global warming, the South is left with remarkably little carbon space even if the North undertakes deeper emissions cuts than currently pledged. The South's emissions must peak only a few years after the North, and thereafter decline continuously till 2050.

Yet, the South cannot simply be asked to undertake emissions cuts, certainly not legally binding ones, until it has filled a good part of its development deficit. Equally, the North must accept the obligation to provide financial and technological support to enable the South to mitigate and adapt to climate change. This raises major issues of North-South and rich-poor equity, environmental responsibility, mitigation obligations, and burden-sharing, which are discussed in Chapters 7 and 8.

NEOLIBERALISM AGGRAVATES CLIMATE CHANGE

Any rational discussion of climate change must consider its specific social-economic-political context and the forces that have globally driven high growth in fossil-fuel consumption and hence emissions. Equally, strategies for climate stabilisation must seek to contain and counter these. The principal drivers of climate change lie in the capitalist economic policy model pursued by most of the industrially developed countries, and increasingly, by the developing countries. Accumulation of capital through exploitation of natural resources, with little regard for their sustainable reproduction and regeneration, has been the motor force of this model for three centuries. The process sharpens class and regional polarities. Accumulation of capital involves putting a low value on natural resources and turning them into commodities, with a view to profit maximisation.

Capitalist production, based on unequal exchange and unfair trade, typically entails rapid depletion of natural resources, environmental pollution, generation of wastes, and their dumping. The pursuit of private gain or parochial self-interest at the expense