Essay

The Peril of Crossing Planetary Boundaries

Arvind Gupta

By several accounts, the 26th meeting of the Conference of Parties (COP 26) of the UN Framework Convention on Climate Change (UNFCCC) held in Glasgow in November 2021 was a disappointment. The developed countries failed to keep the promise of providing US dollar 100 billion per year to the developing world to meet the challenge of climate change even as several fresh pledges on coal and methane were announced. Such promises received a lot of headlines but failed to lessen the widespread scepticism about the seriousness of the developed countries to reduce Carbon Dioxide (CO2) emissions. The global mean temperature is on course to cross 1.5 degrees Celsius in the next few years and even 2 degrees Celsius unless serious efforts are made to drastically reduce the total tonnage of carbon emission.

Developing countries have been caught in a bind. They are being told that they have to accept limits to their growth. They have been late starters in their development journey and therefore have a limited carbon budget at their disposal. The developed countries have used up all their carbon budget in the last 150 years. They are now pressing the developing countries to curtail use of fossil fuels and embrace green technologies. The problem is that the cost of the energy transition is going to be huge not only for the developing countries but also for the developed world. While rich countries might be able to afford the costs, the developing countries are not in a position to do so. Green technologies are still underdeveloped. They are available mostly with western companies. They are also expensive. Developing countries risk becoming dependent upon the developed world for green technologies. Further, the developed world is unwilling to provide technology and finance to developing countries for the

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energy transition. In fact, the use of green technologies even in developed countries is still limited.

Covid has set back the developing world by at least a couple of years. Poverty has deepened in many countries. UN sustainable development goals which are aimed at ending poverty and inequality by 2030 are unlikely to be achieved. Even as developing countries struggle to regain the pre-Covid levels in the next few years, the carbon budget will further reduce in the coming 10 years as developed countries continue to emit greenhouse gases at appreciable levels.

Even as politicians argue over emissions and growth, nature follows its own logic. It does not care where the emissions are coming from, who is poor or rich. All that matters is cumulative emissions which show no signs of declining. Extreme weather events are becoming more frequent and more severe. Their destructive power cripples even the developed countries. To build resilience against such destructive events requires massive investments which are difficult to find. It is estimated that humanity is left with a carbon budget of about 400 billion tonnes only. Every year we emit around 40 billion tonnes of carbon into the atmosphere. If emissions are not stopped forthwith, the goal of keeping global warming below 1.5° centigrade, or preferably below 2°C, is not likely to be met.

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It is now well accepted that the global warming underway is mostly due to human activities. The tell-tale signs of climate change and its deleterious impact are visible everywhere in the form of heatwaves, devastating floods, prolonged droughts, accelerated melting of the Arctic Sea ice, the disintegration of the ice sheets, etc. While politicians, economists, businessmen and other stakeholders debate and quarrel about what is wrong and what needs to be done, the state of the planet's health is deteriorating. The Earth system has been disturbed. This is bound to have a serious impact on human well-being.

Limits to Growth?

Way back in 1971, the book *The Limits to Growth* was published. It was based on the knowledge of the planet's health available at that time. It got a huge endorsement from contemporary politicians including Swedish Prime Minister Olaf Palme and Indian

Prime Minister Indira Gandhi. The book has deeply influenced generations of thinkers. The central thesis of the book was that planetary resources are finite. Their finite availability puts limits on growth. The purpose of the book was to give a warning that humanity was overexploiting the resources available. This would lead to multiple crises.

The idea of putting limits to growth was controversial. The developing countries were particularly concerned that the rich Western developed countries were using the argument of the finiteness of resources available to put limits on their growth. Stopping economic growth could never be a solution. That is how the concept of sustainable development was born. It meant maintaining a healthy balance between growth and environmental health. It also meant stopping reckless materialist consumption in developed countries. Sustainable development would require a change of consumption patterns in the western countries, which were using resources in far excess of their genuine needs while the developing countries were starving. Clearly, the economic models based on unbridled capitalism, market, greed and profit were not suitable for sustainable development. The result is that the planetary resources have come under tremendous pressure. Even where the developing countries have these resources, they lack the capabilities – capital, technology, and human resources-- to develop them.

Planetary Boundaries

In 2009, Johan Rockström, a Swedish scientist, came up with the idea of "planetary boundaries" that sought to quantify the safe zone within which humans should pursue development. Transgressing these boundaries, the scientist warned, would trigger "non-linear, abrupt environmental change within continental-scale to planetary-scale systems".[1]

The nine boundaries identified are:[2]

1) Climate Change;

2) Rate of Biodiversity Loss;

3) Interference with the Global Phosphorus and Nitrogen Cycles;

4) Stratospheric Ozone Depletion;

5) Ocean Acidification;

6) Global Freshwater Use;

7) Land-system Change;

8) Atmospheric Aerosol Loading;

9) Chemical Pollution

Here are some numbers indicating how human activities have increased the stress on the planet planetary systems:

- CO2 emissions are at present 412 parts per million, as compared to 350 ppm in pre-industrial times.
- Surface ocean acidity has increased 30 percent since the industrial revolution.
- Since the industrial revolution, the Earth's nitrogen cycle has been disturbed even more than the carbon cycle. Nearly 121 million tonnes of nitrogen is being removed from the atmosphere as compared to 35 million tonnes in pre-industrial times.
- The extinction rate of species is more than 104 million per year as compared to 10 per million per year in preindustrial times.

Scientists estimated in 2015 that planetary boundaries pertaining to climate change, nitrogen and phosphorus cycles, land use and biodiversity loss have already been breached.[3] A pictorial depiction of the planetary boundaries and the safe zone available for pursuing development is given below (See Figure-1).

The Debate

The concept of planetary boundary provides a framework for sustainable development. The key argument is that development should be pursued within the safe operating zone defined by the planetary boundaries. Tipping points should not be crossed. The concept is useful but controversial. It has triggered a debate on how much stress the planet can tolerate due to human activities. There is no agreement as to what should be defined as a boundary and how one should fix the tipping point. There is an inadequate understanding of how one boundary interacts with the other. Thus, there is certain arbitrariness and subjectivity in delimiting the

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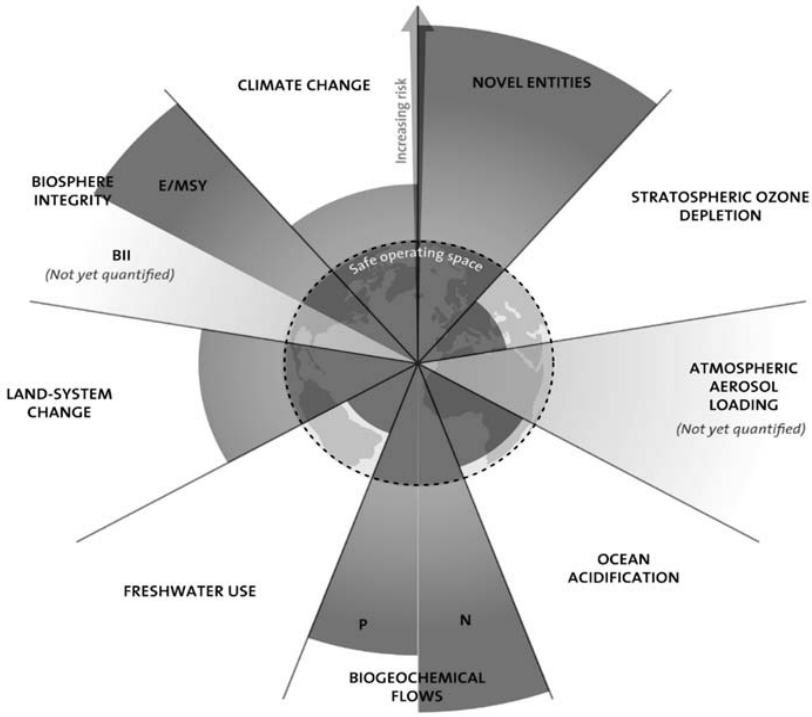

Source: Designed by Azote for Stockholm Resilience Centre, based on analysis in Persson et al. 2022 and Steffen, et al., 2015.[4]

Figure 1

concept of planetary boundaries. Moreover, there is no global mechanism for pursuing development within these boundaries. No one can regulate and control them.

More serious is the objection that by defining the boundaries and tipping points arbitrarily, the human actor would hasten rather than slow down to exploit the limited space available. This will only accelerate the journey to the tipping point. We are seeing this happening in the case of carbon budget. There is a race among the nations to exploit the remaining available carbon space as quickly as possible so that the others don't take advantage of it. China is a good example. Having declared the year 2060 as the date for net-zero emissions, it has accelerated the setting up of thermal power plants to reach peak emissions by 2030 before declining to the net zero emission goal.

In 2012 Kate Raworth from Oxfam suggested that the concept of planetary

boundaries is inadequate. Apart from physical boundaries, it should also include 'social boundaries' such as jobs, education, food, access to water, health services and energy to delineate an environmentally safe space compatible with poverty eradication and "rights for all". This would be an area where there is a "safe and just space for humanity to thrive in".

The concept of planetary boundaries was accepted in 2011 by the former UN Secretary-General Ban Ki-moon and mentioned in some UN reports. Later on, it was dropped because of objections from many quarters. In 2011, at their second meeting, the High-level Panel on Global Sustainability of the United Nations had incorporated the concept of planetary boundaries into their framework, for poverty eradication while combating climate change and respecting the range of other planetary boundaries. The UN sustainable development goals were designed to pursue development keeping in mind the balance between growth and environment. Sustainable development is a laudable goal but difficult to achieve. Since then considerable scientific work has been done to quantify the planetary boundaries. While there may not be a consensus as yet, the work is important as it helps delineate the "planetary playing field" while remaining in the safe zone of development.

Sustainability

Over the years, it has been realised that traditional economic models on which all developmental activities are based are insufficient to promote sustainable development. Human activities are destroying the environment and the ecology at an alarming rate. For example, according to the current research, the 6th mass extinction, also called Anthropocene extinction is already underway. The families of bacteria, fungi, plants and animals are being destroyed at an alarming rate. It is estimated that the rate of destruction of biodiversity is 100 to 1000 times faster than the background extinction rate. The widespread destruction of the coral reef due to acidification of the oceans has contributed to marine biodiversity loss. Plastic pollution is now a global problem. It is estimated that 8.3 billion tonnes of plastics have been produced since the 1950s. Plastic in the oceans impacts nearly 800 species directly. The increased use of Nitrogen and Phosphorus in fertilizers to enhance agricultural production has been the basis of

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the green revolution. But it has had serious side effects too. The leaching away of nitrogen and phosphorus from the land has seriously damaged the environment and perturbed the evolutionary processes by altering the biological processes at the genomic as well as ecosystem levels. The destruction of ecosystems deprives us of the life enhancing natural services provided by nature.

We need fresh thinking on economic models. A new concept of ecological economics has been proposed. Ecological economy emphasises the preservation of natural capital. It rejects the idea that physical capital can substitute natural capital. Ecological economics is different from environmental economics. The latter studies the economic aspects of the environment and is a part of mainstream economics. Ecological economics studies sustainability of growth through preservation of ecology.

The 2015 Paris Agreement on climate change represents a global effort to deal with the existential threat presented by climate change. The success of the Paris agreement is not guaranteed. Earlier, the Montréal protocol on ozone layer depletion had put limits on the production of chlorofluorocarbons. This has contributed to restricting the production of ozone-depleting substances. The Covid-19 pandemic has re-emphasised the need for effective global cooperation to deal with global challenges. A holistic approach to sustainable development needs to be pursued within the operating safe zone defined by the planetary boundary concept.

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Humanity is at a crossroads. A significant proportion of the world's population needs strong and sustained economic growth. Yet, the planet is stressed and cannot bear reckless economic and social activity that destroys ecology and the environment. The answer lies in sustainable development. This is however easier said than done, and is evident in the enormous problem that the international community is facing in dealing with climate change. Effective ways would have to be found to deal not only with climate change but also the other planetary boundaries which are being transgressed. Fair, just, and equitable solutions that take into account the interests of the developing world would have to be found. There is no other option.

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