Planetary Boundaries: Challenging Environmental Orthodoxies

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Presentations

Professor Johan Rockström is Professor in Natural Resources Management at Stockholm University and executive director of the Stockholm Environment Institute (SEI) and Stockholm Resilience Centre. An internationally recognized scientist on global sustainability issues, he led the recent development of the new Planetary Boundaries framework for human development in the current era of rapid global change. He is lead author of two benchmark scientific publications on planetary boundaries.

Professor Rockström outlined the concept of planetary boundaries developed by an international group of earth scientists and systems analysts. They examined evidence of the complex impacts of growing anthropogenic pressures on the planet, using a merger of earth science and complex systems analysis to attempt to quantify a state which would avoid catastrophic change and to identify resilience, mixing natural change and social science. They propose nine planetary boundaries and argue that each of these, if breached, risks causing a catastrophic failure of earth systems.

There is now growing understanding of non-linear change, which is already evident in the complex interactions between these planetary boundaries. Complex systems are not operating in the incremental or linear fashion expected. Some areas have a 'slow burn' that controls the resilience of the system –making it even more difficult to assess thresholds – for example, nitrogen has local thresholds, as in lake systems – if change happens on a wide scale it aggregates to create concern at a global scale.

The research has quantified seven of the nine boundaries and estimated 'tipping points' to avoid catastrophic change:

- climate change (CO_2 concentration in the atmosphere <350 ppm and/or a maximum change of +1 W m^{-2} in radiative forcing);
- ocean acidification (mean surface seawater saturation state with respect to aragonite ≥ 80% of pre-industrial levels);
- stratospheric ozone (<5% reduction in O_3 concentration from pre-industrial level of 290 Dobson Units);
- biogeochemical nitrogen (N) cycle (limit industrial and agricultural fixation of N_2 to 35 Tg N yr^{-1}) and phosphorus (P) cycle (annual P inflow to oceans not to exceed 10 times the natural background weathering of P);
- global freshwater use (<4000 km^3 yr^{-1} of consumptive use of runoff resources);
- land system change (<15% of the ice-free land surface under cropland);
- the rate at which biological diversity is lost (annual rate of <10 extinctions per million species).

Two additional planetary boundaries for which a boundary level has not yet been determined are chemical pollution and atmospheric aerosol loading.

Biodiversity loss is the most severe of the nine areas. There has been unprecedented loss, particularly as biodiversity can be seen as a toolbox for dealing with shocks. For example, where a number of species are found in the same role, this allows for some losses. Retaining this diversity is therefore not an esoteric matter of 'protection'.

Professor Rockström and his colleagues estimate that humanity has already transgressed three planetary boundaries: for climate change, rate of biodiversity loss, and changes to the global nitrogen cycle. Planetary boundaries are interdependent, because transgressing one may shift the position of other boundaries or cause them to be transgressed. He believes nonetheless that there is still a window of opportunity to remain within 'the safe operating spaces' inside these boundaries.

Mark Lynas, author of the award-winning *'Six Degrees: Our future on a hotter planet',* has written a new book *'The God species: How the planet can survive the age of humans'* introducing the science behind the identification of planetary boundaries.

His presentation examined the implications of trying to remain within that 'safe space' referred to by Professor Rockström. He argued that major technological and social changes are needed if humanity is to keep within them.While the precise nature of planetary boundaries may be challenged, 'either we accept the scale of our impact on the planet or lapse into denial. If we keep in mind all the planetary boundaries, we are less likely to address one while exacerbating another.'

In his view, there are a number of fundamental errors in current environmental orthodoxies, including attitudes to nuclear energy, GM crops, geo-engineering, carbon offsetting, and organic farming. He argued that many of our responses so far, especially those focused on climate change, will be ineffective. The majority of emissions growth is going to come from developing countries, not the old industrial countries, so that the focus of the environmental movement is on the wrong place.

He saw the elimination of poverty as critical to meeting planetary boundaries and staying safe. He challenged the notion that urbanization is a negative development and questioned exaggerated concerns over expanding nuclear power.