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LIMITS TO GROWTH

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B. Synonyms (*if applicable*)

Constrained Growth, Limits to Success, Finite Growth

C. Definitions

Limits to growth is reached when any system faces a set of constraints, either all together or sequential, that it can only overcome temporarily or not overcome at all in order to maintain its own growth. Limits here could be multiple and multi dimensional but are generally understood as being physical in nature. The term became popular after the release of the book Limits to Growth (Meadows et al., 1972) and since then has been widely used in the sustainability and sustainable development discourse. Limits to growth is also a system archetype in the systems thinking discipline.

Introduction

Limits to Growth (LtG) became a subject of debate, research and reflection after the release of the book Limits to Growth (Meadows et al., 1972). LtG became a best seller in several countries, eventually being translated into about 30 languages (Meadows et al., 2004). The fundamental principle of it was that Earth's resources and its ability to absorb pollution are finite and would pose a physical limit on the growth of economy, population and consumption of resources. It received both high praise and high critique and was widely criticized by those who believed that growth cannot have limits in the foreseeable future. This led to marginalization of the main message of the book which stated that efforts need to be put in order to change the way we perceive growth and change our consumption patterns. It argued that a state of Global Equilibrium would be much more desirable instead of a scenario where population and economy has to undergo contraction in future. The book also stated ways and means in which this Global Equilibrium could have been achieved. But this message received much less attention in light of the critics which ridiculed the idea of limits and the methodology that was used to develop these scenarios. However, recent trends have suggested that the scenarios of limits to growth are indeed coming true (Turner, 2008, 2012) and that we have lost precious time by engaging ourselves in debates and arguments instead of focusing on building solutions to avoid reaching those limits (Norgard et al., 2010). Subsequent pieces of work

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to LtG include Dynamics of Growth in a Finite World (Meadows et al., 1974), Beyond Limits to Growth (BTL) (Meadows et al., 1992) and Limits to Growth 30 year Update (Meadows et al., 2004). All these reiterate the key finding that continuous growth on a planet with finite resource and pollution absorption capacity would lead to correction in population and economic growth once those limits are reached, while BTL and the LtG 30 year update (Meadows et al., 1992, 2004) focus more on how to move the world back into sustainable territory. The more recent commentaries also compare the real world trends in key parameters (population, pollution etc.) with the model projections that add merit to the initial findings (Turner, 2008) (Turner, 2012) (Hall and Day, 2009).

Origins

The idea of there being limits to growth, especially for humans and human activity, has been teasing the imagination of thinkers and researchers for a long time. The first popular and notable piece of work dates back to 1798 authored by Thomas Robert Malthus in his work *An Essay On The Principle Of Population* (Malthus, 1798). In his book Malthus argued that any nation either had institutions and customs that were able to save it from the pressures of population, or would find itself forced into declining standards of life and a balance between food and population achieved by pestilence, war and misery (Malthus, 1798). However, human population has grown multifold since Malthus wrote his article with no substantial outbreak of war or worldwide misery being witnessed yet. This could be partially attributed to technology advancement and use which has given us the means to increase efficiency which often lead to lower prices and hence to greater consumption of resources which then can support larger population, enabled to a great extent by our discovery of fossil fuels (Hall and Day, 2009). However, the idea of limits to growth of human population is just not limited to food but also to the larger global environment.

The idea that there could be limits to life and that all living beings are living on a common entity called Biosphere goes back to 1920's when the term was coined by Vladimir I. Vernadsky (Bardi, 2011) (Vernadsky, 1998). Various studies and theories have since been formed with this view in mind where the resources (both renewable and non-renewable) are considered to have finite capacity to accommodate human activities. Some of the most notable forms of early work was carried out in the 1950's by Dr. M. King Hubbert, a geologist with Shell Oil and later with US Geological Survey. He pioneered the theory of Peak Oil which refers to that point in time where the oil production reaches a maximum, which is difficult to achieve again in future due to finite stock of fossil fuels on earth. The theory in general parlance is also known as Hubbert's Peak (Mathur, 2011). At the same time, geologist M. King Hubbert predicted in 1956 and again in 1968 that oil production from the United States would peak in 1970 (Hall and Day, 2009) while the world oil peak would happen when half of the oil reserves are consumed (Hubbert, 1956). Many other proponents of peak oil have since been warning businesses, economies and society of the potential disruption peak oil could bring to the social and economic systems, and how it could affect the global food system, financial markets, reduce economic growth and curtail our ability to maintain cheap supply of daily commodities. Essentially warning us of our limits to growth constrained due to finite supply of affordable energy (Gowdy, 2006) (Leggett 2005) (Hall and Day, 2009) (Mathur, 2011). As an antidote the most popular solution proposed to the depletion of fossil fuel energy has been to develop alternate forms of energy, mainly solar and wind. But research on the finite nature of minerals and rare earths, which are essential elements to build the alternate energy infrastructure, also suggest that alternate forms of energy may not be able to completely replace fossil fuels. This issue has been popularly cited as Peak Minerals (Bardi 2014) (Bardi and Pagani 2007). Peak minerals analyzes the current trend in the extraction of the most common minerals in order to evaluate possible future dates in production peaks of these minerals, some of which are essential for production

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of solar and wind energy infrastructure (Bardi and Pagani 2007). The energy based limits to growth of our global systems has been widely criticized and debated for a very long time with no actionable consensus on what needs to be done. The horizon of research on peaking of resources has since expanded to cover a much larger resource base and evolved into the theory of peak everything (Heinberg 2007). Using the peak theory the assessments now cover the issues of overharvesting of fisheries, wood (timber), freshwater and also touch upon climate change and global warming as evidences of limits.

The Beginnings of Limits to Growth

The Limits to Growth study was initiated by Prof. Jaw W. Forrester and his team at Massachusetts Institute of Technology's (MIT) Sloan School of Management, on the request of Club of Rome, an informal, non-political, multi-national group of scientists, intellectuals, educators, and business leaders. The Club of Rome titled their proposal, "THE PREDICAMENT OF MANKIND: Quest for Structured Responses to Growing World-wide Complexities and Uncertainties", aimed to analyze the "world problematique" (Club of Rome, 1970). The core objective of the proposal was to develop an initial, coarse-grain, "model" or models which can reveal both the systemic components (of the imbalances of the world) that are most critical and those interactions (between continuous critical problems) that are most generally dangerous for the future (Club of Rome, 1970). In 1970 Forrester was invited to travel to Bern to attend a meeting of the Club of Rome and was asked whether system dynamics can be used to increase understanding of the predicament of mankind to which he answered in affirmative (Lane, 2007). The first publication, as a result of this project, that Forrester came out with was called World Dynamics (Forrester, 1971) after which the club of Rome supported a longer term research which lead to the book Limits to Growth (Meadows et al., 1972). The Limits to Growth was compiled by a team of experts from the U.S. lead by Dennis Meadows and his team of Donella Meadows, Jorgen Randers and William Behrens III along with experts from several foreign countries (Meadows et al., N.A.) World dynamics was based on WORLD1 model which was sketched on a piece of paper by Forrester on his journey home from the club of Rome meeting (Lane, 2007). The limits to growth book was written on the basis of the WORLD3 model, which was a more refined version of the World model used in (Forrester, 1971). They key messages of over pollution and population collapse, remained common in both the publications. However, limits to growth book offered a more in depth reading and was written with the general reader in mind (Forrester, 1996).

The World Model

The world model was made using the system dynamics modeling methodology. The method used stocks, flows, internal feedback loops and time delays (MIT, 1997). The methodology was invented by Jaw W. Forrester at MIT Sloan School of Management in the 1950's. It's origin is cited as a serendipitous emergence since it was developed by Forrester when he had been involved in a project with the General Electric Corporation where Forrester used the concept of feedback loops to understand the linkages between inventory levels, managers collecting information on that level, the decision making and its subsequent impact on the inventory levels (Lane 2007). This was the beginning of the first publication called Industrial Dynamics (Forrester 1961). Forrester then chanced upon an urban challenge of economic stagnation as described to him by John Collins, then mayor of Boston. He then created a simulation model, using modeling principles as used in Industrial Dynamics, to simulate urban dynamics. This was the second publication titled Urban Dynamics (Forrester 1969). Forrester drew on the

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experiences acquired by him and his co workers to publish Principles of Systems (Forrester 1968). Towards the end of the decade the more general name "System Dynamics" was adopted (Lane 2007). The methodology used computational capabilities of a computer to run equations and generate graphs over time as model results. The first compiler built for performing such tasks was called SIMPLE (Solving Industrial Management Problems using lots of Equations). The progressive version of similar compiler was called DYNAMO. The WORLD models were created using DYNAMO (Hayes, 2002). Using system dynamics methodology and a computer model called "World3," the limits to growth book presented and analyzed 12 scenarios that showed different possible patterns—and environmental outcomes—of world development over two centuries from 1900 to 2100 (Meadows et al. n.d.). The model was made up of five sectors of the global system namely, population, food production, industrial production, pollution and consumption of non renewable natural resources (Turner 2008). The World3 scenarios showed how population growth and natural resource use interacted to impose limits to industrial growth (Meadows et al., 1972).

Key Messages

The most significant and alarming message of limits to growth was "If the present growth trends in world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both human population and industrial capacity" (Meadows et al., 1972) (Norgard et al., 2010). Although the authors mentioned and reiterated the fact, in the LtG book, that their model was not meant for predictions, but rather is a tool to understand the broad sweeps and the behavioral tendencies of the system, it still received criticism from academia, economists and journalists for projecting misleading futuristic forecasts (Nordhaus, 1973) (Nordhaus et al., 1992) (Meadows, 1995). The main scientific conclusion of the study that "delays in global decision making would cause the human economy to overshoot planetary limits before the growth in the human ecological footprint slowed" did not receive as much popularity and public attention as did the misconstrued notion that "The Limits to Growth (LtG) forecast the end of the world before the year 2000, using a big mathematical model of the world system" (Randers, 2012). Few noticed that the book was not all about doom, but suggested multiple ways of stabilizing the global population and industrial capital at levels which can in the long run be sustained and thereby avoid reaching the limits. This was titled (in the book) as a state of global equilibrium where the birth rates get aligned with the death rates, the capital investment rate are kept same as depreciation, the resource consumption per unit of industrial output is reduced to one-fourth of 1970, economic preferences of society are shifted towards services such as education and health facilities, pollution generation and agriculture output is reduced to one-fourth of 1970 and more capital is diverted to food production (Meadows et al., 1972). The authors acknowledged that implementation of these policies is a socially complex process and since there is no precedent of it, it can only be experimented through models, either mental models or formal written models (Meadows et al., 1972).

Critique of Limits to Growth

Soon after its publication, and over the years since, Limits to Growth (LTG) has been the subject of praise, criticism and debate on its assumptions and results. The criticism has been directed at different aspects of the publication (Bardi, 2011). Much of it has been shown to be unfounded and arising from misreading the text, for

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eg. the notions that LTG predicted certain minerals would run out by a certain year/ predicted collapse before the year 2000/etc. (Turner, 2012; Bardi, 2011). However, no such prediction is found anywhere in the text, with the text explicitly mentioning a number of times that "the values merely indicate the general direction the world system, as it is currently structured, is taking us." (Meadows et al., 1972). A number of publications have pointed out these misreadings, whether they be of tables not intended to be predictive but illustrative of a larger point, or other parts of the text. (Meadows1995;Meadows et al, 2004; Turner 2012, Bardi, 2011;Hall&Day, 2009). As noted in (Meadows, 1995), false statements on LTG may have been strengthened through their repetition and citation over time, giving the false statements a similar air of truism that myths tend to hold. Further, review studies have shown that various other criticisms over the years have been composed more of rhetoric or 'gut-reactions' rather than being founded on a logical refutation of LTG (Bardi, 2011).

Some of the criticism, however, such that of (Cole et al, 1973) and (Nordhaus, 1973) has indeed been far more rigorous and serious in nature, and these are briefly discussed here along with responses they have garnered from other scholars. Some of the main points raised by (Cole et al, 1973) in their long and detailed review were that the authors of LTG had been too pessimistic in their assumptions on parameters input to the model; and that there were fundamental faults in the model used. (Bardi, 2011) shows that the claims are largely untrue, and a bit of his response is included here for illustration. He shows the first point as being unfounded not only as the LTG study took into account a wide range of assumptions in its 12 scenarios, some so optimistic that they can only be described as nonrealistic, but also in light of the largely implausible replacements proposed by the authors (Bardi, 2011). The second point of contention in (Cole et al, 1973) was on the model itself, and arises from a misunderstanding of the (then relatively novel) method of system dynamics. This is seen in their claims such as if the study had chosen different starting years, results would be moved along the time axis accordingly, with collapse occurring proportionately earlier or later. However, they failed to recognize that initial values would need to be re-input for a change in starting year, and that the results would thus not just adjust simplistically, but remain largely the same for the same year of comparison (Bardi, 2011). Another general contention they raised was that of model verifiability, which is answered by (Bardi, 2011), quoting (Sterman, 2002) and showing that all models of complex systems are wrong in a predictive or 'verifiability' sense, but that their utility lay in revealing how they worked.

The second serious critique, (Nordhaus, 1973) was made on (Forester, 1971), a precursor to LTG using a precursor to the World3 model, the World1, and raised some important points of contention, largely regarding the absence of data to support the model (Bardi, 2011). In response, (Forrester et al, 1974) showed that the criticism had largely arisen from an "inappropriate method of analyses used by Nordhaus, not from shortcomings of the World Dynamics book or model". For illustration, the argument refuting (Nordhaus, 1973)' first point is given here, as it also links well with the point on misunderstanding of the method of SD mentioned earlier. (Forrester et al, 1974) showed that (Nordhaus, 1973) had wrongly compared certain 'effect' parameters rather than the final model outputs to real world data, as should be done for any SD model. To quote from the response (Forrester et al, 1974), "real-life data, which have been generated as a consequence of many combined influences, should not be considered functions of only one of the simultaneously active causal mechanisms in the model. A reasonable test of model validity under these circumstances would compare data output from real life with corresponding data output from the model." (Forrester et al, 1974) goes on to show that the data presented by Nordhaus actually correlates well with the model runs. Nordhaus' second and third points of criticism dealt with the role of technology, price and markets. In crux, these critiques say that LTG underestimated the power of technology and that it did not represent adequately the adaptive resilience of the free market (Meadows, 2004). This is in some

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sense, the view of technological optimists (Krier& Gillette, 1985), essentially that "exponential technological growth will allow us to expand resources ahead of exponentially increasing demands has been aired many-a-time" (Krier& Gillette, 1985). It is captured succinctly in one critique of LTG, "The force of rising costs meets the force of advancing technology, which brings down the costs of using existing resources and literally creates new resources by bringing within the bounds of feasibility materials or methods which formerly lay outside it" (Kaysen, 1972).

Some responses to these points have emphasized that LTG explicitly considered a number of scenarios on technological improvements, even considering highly optimistic scenarios such as where initial resources are considered infinite (Bardi, 2011), and still found limits, when not from finishing resources, from rising pollution or falling food availability (Meadows et al, 1972).These points were clarified explicitly by the authors of LTG in their 30-year update: "Technological advance and the market are reflected in the model in many ways. World3 assumes markets function to allocate limited investment capital among competing needs, essentially without delay, adding that "Health care improvements, for example, are automatic in World3. They are generated and increase life expectancy whenever the simulated world's service sector can pay for them" (Meadows et al, 2004). On the point of market resilience being left out, they clarify: "If nonrenewable resources become scarce, the World3 free economy allocates more capital to discovering and exploiting them. We assume that the initial nonrenewable resource base can be used completely, though as resources are depleted it takes more and more capital to find and extract those that remain. We also assume that nonrenewable resources are perfectly substitutable for each other without cost or delay. Therefore, we lump them all together without distinguishing one from another", and "We do not represent prices explicitly, because we assume that prices are intermediary signals in an adjustment mechanism that works instantly and perfectly. That assumption omits many delays and inaccuracies that occur in 'real' market systems." (Meadows, 2004). However, they conclude that, "Exponential growth can rapidly exceed any fixed limit. If one limit is pushed back, exponential growth will soon run into another. Because of delays in the feedback from limits, the global economic system is likely to overshoot its sustainable levels." In conclusion, they say that "Technology and markets operate only on imperfect information and with delay. Thus, they can enhance the economy's tendency to overshoot." And finally, "Technology and markets typically serve the most powerful segments of society. If the primary goal is growth, they produce growth as long as they can. If the primary goals were equity and sustainability, they could also serve those goals."

(Bardi, 2011) also quotes (Hall, 2008) and (Daly, 1977) to argue that the concept of Solow's residual- which is used to prove that the exponentially growing progress curve will continue to grow at the same rate in the future and, therefore, compensate for resource depletion as it has done in the past- remains contested. He bases his statement on the residual failing to both account for growth of energy production and not considering real product and real factor inputs, which when done, almost entirely account for it. (Krier& Gillette, 1985) further show that technology has been seen to be a doubled edged sword, with both benefit and harm, and that market mechanisms would find it hard to internalize some of the limits, such as pollution, due to a lack of clear ownership of the global commons. They also make the point that purely from a political point view, the view of technological optimists is hard to take at face value since there are many layers of politics and governance needed to be surpassed and that "The disservice of technological optimism is its implicit, unexamined claim that engineering can rise above politics."

Although a subject of debate since its publication, LTG died out from the public sphere for many years in between (Bardi, 2011). Over the last decade or so however, the scenarios of the Limits to Growth have regained

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importance, and recent studies and articles have found its results to have been both accurate and prescient. (Simmons, 2000) (Turner, 2008) (Turner, 2012) (Jackson, 2016).

Beyond the Limits to Growth

The authors of LTG have periodically written articles, papers, responses, book sequels and books which relate to or refer to their original work on the limits to growth (Meadows et al., 1974, 1992, 2004, 1995, 2008) (Randers 2012). In the Beyond the Limits the authors studied global developments between 1970 and 1990 and used that information to update their computer model and subsequent findings. One important additional message that came out of the book was that humanity had already overshot the limits of Earth's support capacity and thus they decided to reflect this message straight through the title of the book, Beyond the Limits (Meadows et al., 1992). In the subsequent version of another updated book, Limits to Growth: The 30-Year Update, they presented 14 scenarios from a slightly updated version of World3 model called as World3-03. It had more refined numbers to test different estimates of "real world" parameters and to also account for the development of technology, including generating scenarios to test what happens if the world chooses different policies, ethics, or goals (Meadows et al., 2004). The key message that authors pointed out from their work was that "growth does not necessarily lead to collapse. Collapse follows growth only if the growth has led to overshoot, to an expansion in demands on the planet's sources, and sinks above levels that can be sustained" (Meadows et al., 2004). The authors also responded to an important popular question, "Were the Limits to Growth predictions correct?". The authors stated that they did not try to predict the future but generated scenarios under various "what if, then" conditions. In response to under what conditions a collapse becomes inevitable they state that one needs to understand "the dynamic patterns of behavior that are produced by three obvious, persistent, and common features of the global system: erodable limits, incessant pursuit of growth, and delays in society's responses to approaching limits. Any system dominated by these features is prone to overshoot and collapse" (Meadows et al., 2004). Subsequent analysis of LtG projections and real world trends provide more empirical basis on this question (Turner, 2008, 2012) (Hall and Day, 2009).

In another article the authors give a synopsis of the LtG: 30 year update. In this synopsis the authors suggest few general guidelines for what sustainability would look like, and what steps we should take to get there (Meadows, n.a.):

- "Extend the planning horizon. Base the choice among current options much more on their long-term costs and benefits.
- Improve the signals. Learn more about the real welfare of human population and the real impact on the world ecosystem of human activity.
- Speed up response time. Look actively for signals that indicate when the environment or society is stressed. Decide in advance what to do if problems appear.
- Minimize the use of nonrenewable resources.
- Prevent the erosion of renewable resources.
- Use all resources with maximum efficiency.
- Slow and eventually stop exponential growth of population and physical capital."

The general principle of there being limits to growth has also gained prominence in other literature and disciplines since its release, for eg. planetary boundaries (Rockstrom et al, 2009).

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The Idea of Limits to Growth in Other Disciplines

Modern economic theory

The existing form of traditional economic theory treat the economy as an independent and self-regulating system whose productivity is not constrained or linked to the biophysical limits of the environment. Adherents of this model believe that humankind has achieved mastery over the natural world and technology will be able to compensate for the depletion of important natural resources. The model uses price as an indicator of scarcity and on the feedbacks and flows of the marketplace to respond and relieve it. Rising prices indicate scarcity of resources and under constant purchasing power of consumers, they get constrained from over-utilisation of these resources. An example of this is economist Juilan Simon, "technology exists now to produce in virtually inexhaustible quantities just about all the products made by nature… We have in our hands now … the technology to feed, clothe, and supply energy to an ever-growing population for the next seven billion years" (Bartlett 1996; later corrected to seven million years).

A feature of this theory is if resources deplete below a certain threshold it will lead to technological solutions that will either expand the resource pool, increase efficiency of utilization or produce alternatives. At the centre of this theory is that in an ever-expanding economy the poorest sections of society will eventually be lifted to a state of material security. In other words, expansion of the economy is expected to eliminate poverty (Beckerman, 1974).

The dominant economic model today does not locate the economy in real space-time. There are no concrete flows between the economy and the ecosystems in which the economy is embedded. Due to a lack of environmental constrain on the economic model, there is a significant departure in economic growth trends and health of the biosphere. Average income is accelerating ahead of population growth whereas the ecosphere, by contrast, has much diminished making it clear that the expansion of the economy is accompanied by degradation of the biosphere. The conventional economic theory does not account for the current ecological crisis and thereby lacks explicit acknowledgement of there being Limits to Growth.

- Ecological economics

Ecological economics presents an adjustment to the conventional economic theory where it integrates economic models with the biophysical environment it relies on. The ecologist view of the economy is not an isolated system, but a completely constrained and wholly dependent growing subsystem within a non-growing ecosphere (Daly, 1992). This is an alternative view to the mainstream belief that the economy operates free of significant biophysical constraints. This implies nested relationship between the ecosphere and the economy is typical of complex dynamic self-producing system (Kay *et al.,* 2000). Perhaps the most important implication that flows from this ecological economic formulation is that economic production is secondary production. In other words, the production of economic goods and services are categorized as consumptive processes that rest on primary production of natural resources. This consumptive nature of the economic model is quantified by the ecological footprint concept (Rees, 1996; Wackernagel *et al.,* 1996; WWF, 2000).

- Ecological footprints

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The ecological footprint provides an area-based estimate of the biophysical burden on the environment by a given population. There is a strong positive correlation between per capita eco-footprints and material standard of living (or per capita GDP) which implies larger the ecological footprint, higher the material wealth of a population. This suggests that populations in developed countries live beyond the biophysical capacities of their region. The concept of eco footprints can be used to estimate global ecological limits. Eg. There are 9 billion hectares of productive cropland, pasture and forest on Earth and ~3 billion hectares of shallow ocean, for a total of 12 billion productive hectares (2 per capita). However, with an estimated eco-footprint of 2.8 ha per capita, the present human population already has the eco footprint of almost 17 billion hectares. This suggests the carrying capacity has already been overshot by as much as 40% (Rees, 2002).

- Planetary boundaries

Recently, carrying capacity has been dealt with using the concept of planetary boundaries. According to this, thresholds are defined as non-linear transition in the functioning of coupled human-environmental systems (Schellnhuber 2002, Lenton*et al.,* 2008), such as the recent alarming retreat of Arctic sea ice caused by anthropogenic global warming. Thresholds are intrinsic features of those systems and are often defined by a position along one or more control variables such as temperature. Planetary boundaries framework provides a challenge for earth system science and may have profound impacts on environmental governance from local to global scales. There is significant uncertainty surrounding the duration over which boundaries can be transgressed before causing unacceptable environmental change and before triggering feedbacks that may result in crossing of thresholds that drastically reduce the ability to return within safe levels. Of the nine identified and seven quantified planetary boundaries, anthropogenic activities have already breached three: (i) climate change, (ii) biogeochemical nitrogen cycle, and (iii) the rate of biodiversity loss (Rockström, J. et al, 2009). In the 2015 update of planetary boundaries study it was found that four—climate change, loss of biosphere integrity, land-system change, and altered biogeochemical cycles (phosphorus and nitrogen)—of the nine planetary boundaries have been crossed because of human activity. The complex and dynamical nature of ecological processes tricks the human mind into delayed decision making or behavior corrections which may reduce the pressures excreted due to human activity. The resultant environmental reactions to such extreme pressures on the bio-geophysical capacity of the planet are still highly uncertain, and may result in complex, interconnected, unpredictable extreme events; the frequency, intensity and duration of which are likely to increase with increasing environmental burdens (IPCC, 2012).

Cross-References

Climate Change

Regenerative Economics

Self Sufficiency

Sharing Economy

Poverty and Globalization

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