
BOOK REVIEW

Breaking Boundaries: The Science Behind our Planet.

Johan Rockström and Owen Gaffney.

London: Dorling Kindersley Limited. 2021. £12.99 (GBP). 240pp.

ISBN 9780241466759

Breaking boundaries but not population taboos

Pernilla Hansson¹

The Overpopulation Project

In *Breaking Boundaries: The Science of Our Planet*, authors Owen Gaffney (analyst and journalist) and Professor Johan Rockström (influential researcher in climate and sustainability science) explore the limits to human exploitation of the Earth's systems, stressing the urgency to act and lamenting the inadequacy of actions so far. It is well-written and through the use of metaphors and personal stories the authors manage to make otherwise rather dry source material into a compelling read.

Even if some parts may be somewhat confusing and jump between topics, the chapters manage to explain technical terms so that anyone can understand them. The book is split into three sections or 'acts', through which Rockström and Gaffney take the reader on a journey exploring the way the biosphere works, important revolutions in human history and their consequences, the current state of the Earth's support systems, all the way through to what needs to be done to live within their identified planetary boundaries. The final section of the book contains references for each chapter; however, it is not always clear where any stated fact comes from.

1 pernilla.top@gmail.com

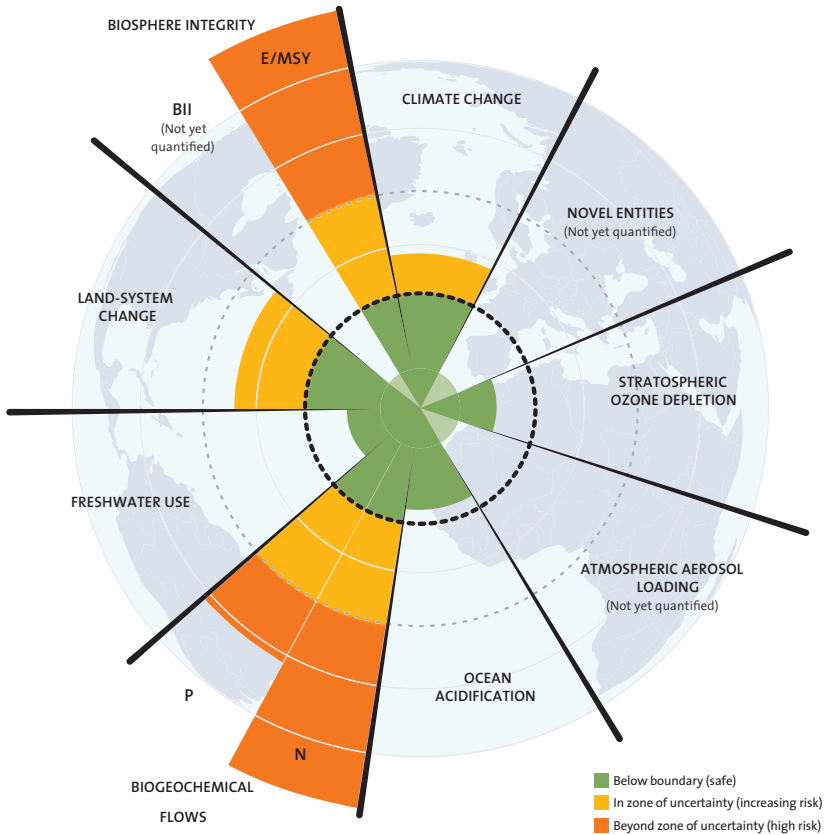
The question for this review is what Rockström and Gaffney have to say about population growth. Reviewing the table of contents, there are two intriguing chapters in Act Three titled 'Feeding 10 billion people within planetary boundaries' and 'The population bomb disarmed'.

But let's not get ahead of ourselves. The first act focuses on Earth sciences, the history of the Earth, with the advent of complex life and several mass extinctions, through to human evolutionary history. It explains the essential basics to understanding Earth science, such as the three stable 'thermostats' of Earth: hothouse, icehouse and snowball. Importantly, the first act introduces the Earth's self-regulation systems, which are discussed throughout the rest of the book. Rockström and Gaffney also highlight the disturbing transition from the Holocene, which had an unusually stable climate that allowed humanity to flourish, to the Anthropocene epoch, whose true self we have yet to see, but which we expect will not have the same stability.

Act Two explores the scientific basis for understanding the health of the planet and how we are changing it. The dangers of passing planetary tipping points for safe use of the biosphere are laid bare, as well as the risk of the domino effect if one tipping point interacts with another. It warns of the difficulties humanity will face in a warmed and destabilised world and asserts that we have already passed four of the nine planetary boundaries (see graph [opposite](#)).

In the final act, which is also the longest, the idea of planetary stewardship is established. Six system transformations are needed, according to the authors: energy, food, inequality, cities, population and health, and technology. A specific chapter is dedicated to each system transformation, exploring different aspects of what needs to be done and how we are doing. This section also explores the role of the economy. Rockström and Gaffney focus on the need to change the economic model into one that no longer promotes endless growth but rather supports societal goals for a sustainable future. They stress how the economic system is one of the most important tools for the needed transformations, and see reasons to be optimistic, as sustainable technologies and business models are becoming more profitable.

Figure 1



The planetary boundaries approach, introduced in a famous paper by Rockström et al. (2009), identifies nine major ways in which humans disrupt the biosphere, any one of which could undermine humanity's life support system if sufficiently disrupted, and attempts to quantify the limits for 'safe' disruption. Neither the original paper nor subsequent publications specify the role of human numbers or the size of the human economies in driving us past these boundaries.

Note that the existence of planetary boundaries, at least with respect to biodiversity, is the subject of much debate (see Montoya et al. 2018). Image CC BY 4.0, by J. Lokrantz/Azote based on Steffen et al. 2015.

Population reduction, the ultimate taboo

This is all well and good, and makes for excellent reading about our current predicament and possibilities for change. But what does the book say about the role of population? Unlike many recent scholars (see, for example, Dasgupta, 2019; Tucker, 2019; Lianos and Pseiridis, 2016), Rockström and Gaffney believe the current global population, or even one several billion larger, is ecologically sustainable. Unlike many population advocates, they believe population growth will cease without dedicated efforts to end it. One place they indulge this optimism is in a chapter aptly named 'Feeding 10 billion people within planetary boundaries'.

Our food system is at the centre of many of our largest global environmental problems and could all by itself undermine the goals of the Paris climate agreement. Rockström and Gaffney adequately portray the problems of our agriculture: how seventy per cent of all withdrawals of fresh water are used for food production, how the way we capture and produce our food is the main driver of the current mass extinction of species, and how food insecurity may increase due to climate change (but not that it is already increasing due to population growth). They state that fifty per cent of our planet's habitable land has been transformed for agriculture, and that we need to follow the Half-Earth principle of keeping the other half intact.

Somehow, though, the authors fail to mention that even if we only occupy half of the habitable land with our agriculture, we have already severely altered over 75 per cent of the planet's land surface, as stated in the 2019 IPBES report (IPBES, 2019). Or that people make many other demands on the landscape beyond agricultural production. Or that recent scholarship (Crist et al., 2021) suggests that achieving Half-Earth levels of biodiversity protection will demand much smaller overall human populations, perhaps two to three billion, maximum.

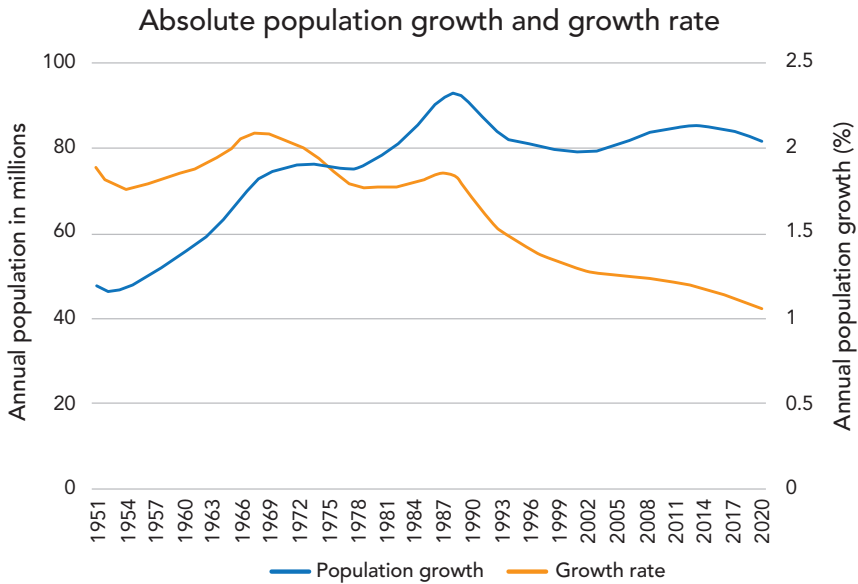
Rockström and Gaffney are optimistic that humanity will be able to feed everyone while operating within the planet's boundaries, if only we completely overhaul the current system by adopting a healthy planetary diet, reducing food waste and transitioning to more circular farming. The fact that climate change will probably decrease crop yields is mentioned, but not other instabilities, such as we have seen in disruptions to food markets after Russia's invasion of Ukraine (O'Sullivan, 2022).

In chapter 4, Rockström and Gaffney pose a pertinent question. Given that agriculture will need to draw fifteen per cent more water to provide food to our growing population, where will this come from? They don't answer the question in that chapter, nor do they answer it in the chapter on feeding ten billion people, despite having published an article which explores it (Gerten et al., 2020). In the book, they mention the worrying fact that water usage may be plateauing because there are few rivers left undammed or un-siphoned, but not where this fifteen per cent increase in water consumption will come from. Let's hope that the proposed circular farming, which the authors suggest will capture carbon while circulating nutrients and saving on water, solves this problem. And let's not forget about the effect on other species on this planet, who Rockström and Gaffney often seem to overlook.

The specific chapter in *Breaking Boundaries* that focuses on population growth, apart from being the shortest chapter, seems muddled and unclear in its message. On the one hand, Rockström and Gaffney ridicule people who say population size is a problem, implying that population activists think population will continue to grow exponentially so that we may reach 100 billion soon. They suggest that believing population is an important factor means believing that no other factor is important. These misrepresentations stand at the beginning of the chapter – not a promising start.

On the other hand, towards the end of 'The population bomb disarmed', coming out of the blue, the authors state that 'providing family planning and education to girls has the potential to avoid 85 billion tonnes (93 billion tons) of carbon dioxide emissions this century and to stabilize global population at levels that are manageable'. This is great! But that is all we get on that topic, and only after disparaging people who are advocating exactly this. There are clearly ways forward for population that can help limit climate change and help stay within other planetary boundaries, yet they remain unexplored in this chapter that is supposedly devoted to the problem. The chapter seems both to state that population is now a solved issue as the global growth rate has subsided, and simultaneously to acknowledge that efforts to decelerate growth would make a large contribution to staying within planetary boundaries. Could it be that the two authors don't agree on this issue? Either way, the message of this chapter is thoroughly muddled.

Figure 2



While population growth rate has decreased in the past 50 years, the annual growth in absolute number of people has stayed relatively stable around 80 million. Data from Worldometer (<https://www.worldometers.info/world-population/world-population-by-year/>).

To infer that a falling growth rate ensures population is stabilising is a misrepresentation we would not expect from a data scientist such as Rockström. Rockström and Gaffney state that the rate of population growth peaked in the 1960s and is now half of that. But they don't say that the number of people added to the global population this year will be even greater than it was in the 1960s. For fifty years it has been a fairly steady, undiminishing eighty million per year. It is a smaller percentage of what is now a much bigger population, but it's the increment that matters, not its percentage of the current population.

Suppose you are driving toward a cliff at sixty kilometres per hour. After one minute, you've travelled one kilometre. In the second minute, you increase the distance you have travelled by 100 per cent. In the sixth minute, you add another

kilometre to the five you already travelled: a twenty per cent increase. In the hundredth minute, you increase the journey by only one per cent. Do you say, 'don't worry, we'll stop before we go over the cliff: look how our travel rate has fallen'? You're still travelling at sixty kilometres per hour and the cliff is closer than ever.

Even if the peak growth increment has occurred in global population increase, this doesn't mean that there is nothing more for population advocates to do. Just ask the hundreds of millions of women in developing nations who desire but cannot access contraceptives, or who still lack bodily autonomy (UNFPA, 2020). This is a double standard not applied to other solutions Rockström and Gaffney advocate: just because positive change has begun happening in areas such as decarbonising energy or protecting forests, they don't suggest we rest on our laurels and just hope the projected trajectory continues. So why do they do that when talking about population?

Another rather unscientific statement is found in this chapter. Rockström and Gaffney state that an 'infinite exponential growth is not possible in the real world; instead, everything eventually slips into an "s curve", as growth rates slack off' (p. 166). This implies that some magic hand of restraint will lower birth rates before resource scarcity forces a population die-off. But not 'everything' has such happy endings: in nature, overshoot and collapse is a common pattern. Just ask the Greenland lemmings (Schmidt et al., 2012). A nice 's curve' stabilisation (or better still, a gradual rather than catastrophic decline) can only be achieved by making small families the norm. But Rockström and Gaffney invoke the inevitability of the 's curve' to argue that no intervention is necessary. It is a particularly odd argument in a book on how we must consciously and proactively work to avoid overshooting planetary boundaries. Another example of the double standard applied to population.

Interestingly, 'The population bomb disarmed' mentions that the population in 2100 could climb to eleven or twelve billion. Yet the authors themselves devote a whole chapter to the many challenges and difficulties of feeding ten billion people within the planetary boundaries. When they talk about feeding future populations, they say it can probably be done. Probably is not good enough when it comes to people's lives. What happened to the precautionary principle?

Rockström and Gaffney are optimistic about the necessary changes to achieve global sustainability and believe we are heading in the right direction. They seem nonchalant that this can be achieved with humanity's current population trajectory. This is great news if it is true. Then imagine if resources were also funnelled into promoting small families and providing contraceptives and education. We could create a world with a greater buffer to protect ecosystem services for people, and more habitat to share with other species. How much better off would we be if we also took population matters seriously?

References

Crist, E., H. Kopnina, P. Cafaro et al. 2021 'Protecting half the planet and transforming human systems are complementary goals'. *Front. Conserv. Sci.* **2** (761292) <https://doi.org/10.3389/fcosc.2021.761292>

Dasgupta, P. 2019. *Time and the Generations: Population Ethics for a Diminishing Planet*. New York: Columbia University Press.

Gerten, D., V. Heck, J. Jägermeyr et al. 2020. 'Feeding ten billion people is possible within four terrestrial planetary boundaries'. *Nat Sustain* **3**: 200–08. <https://doi.org/10.1038/s41893-019-0465-1>

IPBES. 2019. *Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on the Work of Its Seventh Session*. IPBES/7/10. Bonn: IPBES.

Lianos, T.P. and A. Pseiridis. 2016. 'Sustainable welfare and optimum population size'. *Environment, Development and Sustainability* **18**: 1679–99. <https://doi.org/10.1007/s10668-015-9711-5>

Montoya, J.M., I. Donohue and S.L. Pimm. 2018. 'Planetary boundaries for biodiversity: implausible science, pernicious policies'. *Trends in Ecology & Evolution* **33** (2): 71–73 <https://doi.org/10.1016/j.tree.2017.10.004>

O'Sullivan, J. 2022. Ukraine War: Temporary Glitch or Tipping Point? The Overpopulation Project: <https://overpopulation-project.com/ukraine-war-temporary-glitch-or-tipping-point/> (accessed 20 May 2022)

Rockström, J., W. Steffen K. Noone et al. 2009. 'Planetary boundaries: exploring the safe operating space for humanity'. *Ecology and Society* **14** (2): 32.

Schmidt, N.M., R.A. Ims, T.T. Høye, O. Gilg... and B. Sittler. 2012. 'Response of an arctic predator guild to collapsing lemming cycles'. *Proceedings of the Royal Society B: Biological Sciences* **279**: 4417–22. <https://doi.org/10.1098/rspb.2012.1490>

Steffen, W., K. Richardson, J. Rockström et al. 2015. 'Planetary boundaries: Guiding human development on a changing planet'. *Science* **347** (6223). <https://doi.org/10.1126/science.1259855>

Tucker, C.K. 2019. *A Planet of 3 Billion: Mapping Humanity's Long History of Ecological Destruction and Finding Our Way to a Resilient Future. A Global Citizen's Guide to Saving the Planet*. Atlas Observatory Press

UNFPA. 2020. Tracking Women's Decision-making for Sexual and Reproductive Health and Reproductive Rights. New York: United Nations Population Fund https://www.unfpa.org/sites/default/files/pub-pdf/20-033_SDG561_and_562-MASTER_DOC2.1-2020-03-06-1121.pdf (accessed 20 May 2022)

A version of this review was first published at The Overpopulation Project – <https://overpopulation-project.com>