
EDITORIAL

Population dynamics, economic growth and planetary boundaries

David Samways

While this journal is principally concerned with the population dimension of environmental sustainability, it is impossible to understand the role of demographic factors in environmental impact in isolation from their relationships to wider social and economic structures. At the broadest level of analysis, the IPAT equation is a useful heuristic device for capturing how population size (P), the per capita level of affluence or consumption (A), and the resource intensity of the technical means of production (T) affects environmental impact (I). Thus, the growth of the human enterprise in the industrial era can be crudely framed as the outcome of the use of fossil fuel technologies, the growth in human numbers and the growth in per capita material consumption. However, it is clear that the historical growth of human environmental impact has significantly outstripped population growth in comparison to the massive expansion of the global economy – in other words, consumption growth has been the greatest culprit (Steffen et al., 2015). Importantly, further disaggregation shows that the vast majority of the historical growth in consumption has been concentrated in the Global North (Steffen et al., 2015).

Yet despite this, while growing consumption remains the most significant factor, population growth continues to be a significant indirect driver of all impacts (Brondizio et al., 2019; Almond et al. 2022; IPCC, 2023). In respect of greenhouse gas emissions, economic growth accounted for around two thirds of their growth with population growth accounting for the rest. And while technical improvements and alternatives to fossil fuels have reduced the resource intensity of production, it has been shown that emissions due to population growth alone eclipsed more than 75 per cent of these savings (Chaurasia, 2020).

All forecasts predict the global population to grow well into the middle of this century (Lutz et al. 2018; Volsett et al. 2020; UN 2022). Viewed in the context of the multiple measures showing the transgression of sustainability (Steffen 2021; Lin et al 2018), this indicates that the prospects of providing good welfare for all within planetary boundaries to be dependent on significant global and regional changes in economic and social systems in addition to the necessary technical changes (O'Neill et al. 2018; Callegari and Stoknes 2023).

Despite the warnings of the scientific community, economic growth remains the global orthodoxy – a fact reflected in the centrality of economic growth in the manifestos of the major political parties in the recent UK general election, and common to political discourses in all rich, high consumption, countries. Nonetheless, with more than sixty per cent of the global population living on less than \$10¹ a day and the majority of these people living in developing countries (Rosser, 2021), it is clear that meeting their welfare needs will require their national economies to grow.

The United Nations Sustainable Development Goals (SDGs) aspire to square the need for economic development on a finite planet, but as Nandita Bajaj, Eileen Crist and Kirsten Stade argue in this issue, the UN fails to fully acknowledge the full extent of the environmental crisis wrought by the present and growing size of the human enterprise. Bajaj, Crist and Stade contend that, as a pivotal agent of post-war international governance and development, the project of the United Nations was and continues to be framed in a growth paradigm. Summarising the ecological overshoot² consequent on the massive expansion of the human enterprise, Bajaj et al. identify growth in population, the economy and the technosphere as the major factors in the environmental crisis. All three factors can be understood as having a quantitative or population dimension in terms of the growth in the population of economic consumers³ and populations of all associated human 'stuff' including livestock, infrastructure, buildings, mechanical and electronic devices etc. Bajaj and colleagues argue that, at its founding, the UN reflected the prevailing notions of human exceptionalism which saw nature merely as a resource employed in the pursuit of endless economic growth and

1 International-\$ at 2011 prices.

2 The exceeding of the capacity of natural systems to absorb and process the waste generated by human activity.

3 Economic consumption here understood as qualitatively distinct from simple economic subsistence.

prosperity. What boundaries were considered to exist could be overcome through human intelligence and technology.

However, as Bajaj et al. relate, the UN's position on human population growth did not entirely concur with this exceptionalist ideology. Prior to the 1970s, the UN embraced concern about population growth being a fetter to development and possibly outpacing food production (Bongaarts and Hodgson, 2022) and pursued active rights-based policies which had a significant impact on lowering fertility. Yet, by the 1990s, the UN, under the influence of a somewhat unlikely sounding coalition of stakeholders including feminists, human rights advocates, religious conservatives and neoliberal economists, radically shifted its position, sidelining the concerns of demographers, family planning advocates and environmentalists. According to Bajaj et al. the UN's 1994 Cairo population conference 'became the death knell for an understanding that a sustainable population and the elevation of human rights could be *twin goals* for achieving reproductive and ecological justice'. International funding for family planning plummeted and regressive pronatalism thrived resulting in the stalling or reversal of fertility declines in countries experiencing high population growth.

Despite the clear evidence of environmental overshoot and of economic and population growth as indirect drivers, Bajaj et al argue that the United Nations remains resolutely wedded to a growthist agenda and largely denies the connection between population growth and environmental harm. Interrogating the United Nations Population Fund's (UNFPA) 2023 State of the World Population report, Bajaj et al. find insufficient attention paid to pronatalist pressures combined with attempts to repudiate respected scientific work (such as that from the UN sponsored IPCC) which connects population growth with the environmental crisis. Indeed, the authors find that the UN in general is in a state of denial regarding population growth and pins its hopes on so called 'green economic growth' to achieve its developmental and security objectives.

Bajaj, Crist and Stade conclude that, in order to address the environmental crisis, the UN must break with its current ideological paradigm and lead the way in reducing the size and scale of the human enterprise. This can be achieved principally through rights-based population reduction and scaling back the global economy by focussing on welfare rather than economic growth. In turn

this will help reduce the size of the technosphere, allowing ecosystems and other species to revive.

The question of sustainable economic development is considered at a more granular level in our next article by Akosua Mawuse Amankwah, Edward Appiah, Charles Frimpong and Aguinaldo dos Santos. The UN's SDG 12 calls for reductions in production and consumption and Amankwah et al. note that circular economic strategies, following principles of reduce, reuse and recycle, could be employed to achieve this goal in the developing Ghanaian fashion industry whilst also meeting the needs of a growing and more affluent population.

Ghana's population currently stands at around thirty million and is expected to grow significantly this century. Importantly, like most developing countries, Ghana is rapidly urbanising with nearly half of all urbanisation over the last decade occurring in the two major economic regions of Greater Accra and Ashanti. Ghana's population structure has also shifted as the dominance of children under the age of fourteen has given way to a youth-bulge of 14–35 year-olds. Along with these quantitative demographic shifts, the authors point to the growth of the urban middle-class as contributing to a boom in Ghana's fashion industry. However, the clothing industry is associated with a number of environmental problems at both ends of a garment's life-cycle.

In this context Amankwah and colleagues investigate the potential for the uptake of circular economic strategies amongst owner-designers of small and medium-sized clothing manufacturers. They find that, although some businesses are already and unknowingly employing circular economic strategies, producers are understandably focused on the economics of their enterprises rather than environmental sustainability and other factors. Owners cite cost, time, labour as well as consumer attitude and behaviour as barriers to shifting to circular strategies. However, Amankwah et al. argue that, with the right government policies aimed at creating awareness and encouraging adoption and implementation, circular strategies could be effective in making the clothing industry in Ghana more sustainable in the face of increasing demand.

As Baja et al. note in their survey of ecological overshoot, one of the major challenges facing a growing population is that of freshwater availability. Unlike

many other resources essential to our civilisation, water is entirely renewable – in practical terms the amount of water on the planet does not change. It is the spatial and temporal availability along with changes in the quality of water that is at the core of the water problem. In the scientific literature, along with changing consumption (usually associated with changing practices linked to increasing affluence), population growth is universally recognised as a major factor in the anthropogenic disruption of the water cycle and a challenge going forward. However, it is also the case that over the last century demand for water has grown twice as fast as population (Liu et al., 2022). This disruption is further exacerbated by climate change leading to shifting weather patterns depleting precipitation in some areas/seasons and increasing it in others. Since water is a renewable resource, unsustainable use comes down to the depletion of stocks at a faster rate than they are replenished by flows.

Our *Perspective* article from John Pattison and Peter Cooke looks at the problem of 'global drying', as population growth, urbanisation and climate change lead to stress on groundwater aquifers – which account for thirty per cent of freshwater resources. As the authors note, discussion of global warming and sea level rise is common, but the depletion of groundwater aquifers less so. Through a range of examples, Pattinson and Cooke focus on the most striking visible effect of groundwater depletion – sinking cities. While sea levels are rising and threatening island nations, many cities such as Mexico City are experiencing serious building subsidence as the ancient aquifers on which they are built are depleted leading to unstable ground conditions. They point out that, while increasing affluence is a major driver of the growth in demand for freshwater, both population growth per se, but more particularly urbanisation, have exacerbated total urban water consumption and led to many cities and regions to abstract water from ancient aquifers at a faster rate than it can be replenished. Importantly, until subsidence occurs, aquifer depletion is invisible, which encourages mismanagement from organisations often focussed on short-term political objectives. Moreover, private abstraction via bore-holes or wells is difficult to regulate. Pattison and Cooke ask 'can a good life be provided to all within regional water boundaries if they are better managed?' Forward planning in the management and governance of water resources is clearly a central consideration in sustainability, but Pattison and Cooke draw attention to tackling population growth as part of the long-term strategy of providing sufficient fresh water to all.

In our final article, Aalok Chaurasia analyses the detail of the mortality transitions of China and India. He points out that as the world's most populous countries, constituting around 36 per cent of the total global population (UN, 2022), the demographic prospects of China and India are closely linked to future global demographic trends. Presently both have similar population sizes – just over 1.4 billion. However, China and India show significant differences in their mortality transition over the last seven decades. In 1950, both were developmentally and demographically similar but, where China is at an advanced stage of demographic transition with its population just starting to decline, India's population is still growing. Moreover, over the same period, life expectancy at birth has gone from the early 40s in both countries to more than 78 years in China but only a little over 67 years in India.

Nonetheless, Chaurasia shows that the conventional measure of aggregate average life expectancy at birth is compromised and obscures much detail. He argues that for the analysis of the aggregate mortality transition the geometric mean of the age-specific probabilities of death is more representative of the actual population. More importantly, at the more granular level, employing a time trend and decomposition analysis to compare the mortality transition in the two countries, Chaurasia shows that China's mortality transition has been fairly evenly spread across all age cohorts, meaning that both child mortality and mortality for other age groups has improved. In contrast, India's mortality transition has largely been confined to younger age groups with little mortality transition occurring in the 55–90 age group.

Since India's total fertility rate is now at replacement levels and likely to continue to fall, in years to come population ageing will be a more significant issue. Chaurasia argues that India's healthcare system must be reinvigorated and shift from the successful delivery of healthcare tackling infectious and communicable diseases amongst the young, towards the particular healthcare needs of its growing older population.

Ageing populations are not confined to India and China, of course; the population is ageing globally. Under all projection scenarios, while the global population will continue to grow in this century, the global average total fertility rate is expected to continue falling, shifting the population age structure upwards (Lutz et al. 2018;

Volsett et al. 2020; UN, 2022). By 2050 over-65s will constitute sixteen per cent of the population and will outnumber children under five by 2:1 (UN, 2022).

The fact that, since 1950, the global average length of life, or life expectancy at birth, has increased from 46 to more than 78 years (Andreev et al., 2013; United Nations, 2022) might suggest that the claim ‘most of our population growth is not due to births but to most of us living much longer’ (Dorling, 2022) is correct. However, most of the increase in life expectancy is not due to years added at the end of life but due to declines in infant and adolescent mortality. Prior to the industrial era, across all types of society, it is thought that around half of all children died before reaching puberty but, over the last 200 years, infant and child mortality has fallen to the current level of just over four per cent (Dattani et al., 2023). This child mortality transition has been the principal driver of population growth since survival into adulthood has a multiplier effect on population as people go on to have children of their own, while longevity after family building does not. Increasing longevity does contribute to population growth, but its major effect is to retard the point at which births fall below deaths. At present births exceed deaths by about seventy million a year and, although this figure is expected to decrease, births are expected to continue to exceed deaths until 2085 (UN, 2022). Even when the reductions in mortality across all ages are aggregated into a single figure, fertility and population momentum combined, that is births, will contribute the greatest amount to population growth over the next century (Andreev et al., 2013).

Across the world, but more immediately in high income countries, population ageing represents a significant adaptive challenge (Volsett et al. 2020). Policymakers in many nations with below replacement birth rates, such as Japan, South Korea, much of Europe, the United States and more recently China, have expressed concern about the economic and social consequences (as well as the geopolitical implications) of population ageing and the shrinking of the working age population (Economist, 2024). In some countries the response has been the enactment of pronatalist policies, but these have proved impotent in increasing the birth rate (Economist, 2024). Immigration has also been posited as the solution to labour shortages – however recent experience across Europe and America indicates this would not be achieved without political difficulty. The extent to which the alarmism around population ageing is justified is debatable

(see Spijker and MacInnes 2013; Calvo-Sotomayor et al., 2020), yet clearly regional population shrinking is highly problematic to the growthist paradigm which dominates economic and political discourses. Bajaj, Crist and Stadel's critique of the orthodoxy that claims economic growth as the route to a good life for all appears apposite to tackling the social as well as the environmental problems facing late modernity.

References

Almond, R.E.A., M. Grooten, D. Juffe Bignoli, and T. Petersen (eds). 2022. *Living Planet Report 2022 – Building a Nature- Positive Society*. Gland, Switzerland: WWF.

Andreev, K., V. Kantorová and J. Bongaarts, 2013. *Demographic Components of Future Population Growth*. United Nations Department of Economic and Social Affairs Population Division Technical Paper No. 2013/3. New York: United Nations. <https://www.un.org/en/development/desa/population/publications/pdf/technical/TP2013-3.pdf>

Bongaarts, J. and D. Hodgson. 2022. *Fertility Transition in the Developing World*. Springer International Publishing AG. <https://link.springer.com/book/10.1007/978-3-031-11840-1>

Brondízio, E.S., J. Settele, S. Díaz and H.T. Ngo (eds). 2019. *Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Bonn: IPBES secretariat.

Callegari B. and P.E. Stoknes. 2023. *People and Planet: 21st-Century Sustainable Population Scenarios and Possible Living Standards Within Planetary Boundaries*. Earth4All: https://earth4all.life/wp-content/uploads/2023/04/E4A_People-and-Planet_Report.pdf (accessed 17 December 2023).

Calvo-Sotomayor I., E. Atutxa and R. Aguado, 2020. 'Who is afraid of population aging? Myths, challenges and an open question from the civil economy perspective'. *International Journal of Environmental Research and Public Health* 17 (15): 5277. <https://doi.org/10.3390/ijerph17155277>

Chaurasia, A.R. 2020. 'Population effects of increase in world energy use and CO2 emissions: 1990–2019'. *The Journal of Population and Sustainability* 5 (1): 87–125. <https://doi.org/10.3197/jps.2020.5.1.87>

Dattani, S., F. Spooner, H. Ritchie and M. Roser, 2023. *Child and Infant Mortality*. Our World in Data: <https://ourworldindata.org/child-mortality> (accessed 14 June 2024).

Dorling, D., 2022. 'Don't panic about the birth of Baby 8 Billion. Before he's 65 our numbers will be in reverse'. *The Observer* 20 November. <https://www.theguardian.com/commentisfree/2022/nov/20/dont-panic-about-birth-baby-8-million-before-hes-65-numbers-will-be-in-reverse> (accessed 14 June 2024).

The Economist, 2024. 'Can the rich world escape its baby crisis?' *The Economist* 21 May. <https://www.economist.com/finance-and-economics/2024/05/21/can-the-rich-world-escape-its-baby-crisis> (accessed 14 June 2024).

Intergovernmental Panel on Climate Change (IPCC), 2023. *Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/9781009325844>

Lin, D., L. Hanscom, A. Murthy, A. Galli, M. Evans, E. Neill, M.S. Mancini, J. Martindill, F-Z. Medouar, S.Huang and M. Wackernagel, 2018. 'Ecological footprint accounting for countries: updates and results of the National Footprint Accounts, 2012–2018'. *Resources* 7 (3): 58. <https://doi.org/10.3390/resources7030058>

Liu, X., W. Liu, Q. Tang, B. Liu, Y. Wada and H. Yang, 2022. 'Global agricultural water scarcity assessment incorporating blue and green water availability under future climate change'. *Earth's Future* 10 (e2021EF002567). <https://doi.org/10.1029/2021EF002567>

Lutz, W., A. Goujon, S. Kc, M. Stonawski and N. Stilianakis (eds). 2018. *Demographic and Human Capital Scenarios for the 21st Century: Assessment for 201 Countries*. Luxembourg: European Commission, Joint Research Centre, Publications Office of the European Union. <https://doi.org/10.2760/41776>

O'Neill, D.W., A.L. Fanning, W.F. Lamb and J.K. Steinberger. 2018. 'A good life for all within planetary boundaries'. *Nature Sustainability* 1: 88–95. <https://doi.org/10.1038/s41893-018-0021-4>

Roser, M. 2021. *The Economies that are Home to the Poorest Billions of People Need to Grow if We Want Global Poverty to Decline Substantially*. Our World in Data: <https://ourworldindata.org/poverty-growth-needed> (accessed 14 June 2024).

Roser, M. 2024. *Fertility Rate*. Our World in Data: <https://ourworldindata.org/fertility-rate> (accessed 14 June 2024).

Spijker J. and J. MacInnes, 2013. 'Population ageing: the timebomb that isn't?' *British Medical Journal* 347: f6598. <https://doi.org/10.1136/bmj.f6598>

Steffen, W. 2021. 'Introducing the Anthropocene: The human epoch'. *Ambio* 50: 1784–1787. <https://doi.org/10.1007/s13280-020-01489-4>

Steffen, W., W. Broadgate, L. Deutsch, O. Gaffney and C. Ludwig. 2015. 'The trajectory of the Anthropocene: The Great Acceleration'. *The Anthropocene Review* 2 (1): 81–98. <https://doi.org/10.1177/2053019614564785>

United Nations (UN). 2022. *World Population Prospects 2022. Online Edition*. New York, Department of Economic and Social Affairs, Population Division.

Vollset, S.E., E. Goren, C.-W. Yuan, J. Cao et al. 2020. 'Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: A forecasting analysis for the Global Burden of Disease Study'. *The Lancet* 396 (10258): 1285–1306. [https://doi.org/10.1016/S0140-6736\(20\)30677-2](https://doi.org/10.1016/S0140-6736(20)30677-2)