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Information

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EDITORIAL INTRODUCTION

A Planet of 8 Billion and the Future of Humanity

David Samways – Editor

On 15 November 2022 the United Nations' Population Division marked the estimated birth of the 8 billionth member of the human population. António Guterres, United Nations Secretary-General, commented, 'The milestone is an occasion to celebrate diversity and advancements while considering humankind's shared responsibility for the planet' (UN, 2022). While he expressed concern about humanity's collective impact, the UN's general spin on 8 billion was positive and echoed the argument, most notably articulated by Julian Simon (1981), that every additional human being represents an opportunity rather than a problem. While it is clearly unfair to treat any of the 80 million individual children added to the global population each year as a problem, the ability to provide a good life to everyone whilst simultaneously tackling the environmental crisis becomes ever more difficult as the population grows (O'Neill et al., 2018).

Indeed, despite the overwhelming and growing scientific evidence of the (albeit indirect) role of population growth in the environmental crisis (IPCC, 2022; WWF 2022) the alarm around population growth has arguably been constantly diminishing since the publication of Paul and Anne Ehrlich's *The Population Bomb* (Ehrlich, 1968) in 1968. In part this is due to the success of the post WWII 'green revolution' in increasing agricultural yields, which contradicted claims of limits on food production (although it still entailed significant environmental externalities). Rather than the availability of food, the persistence of famine was recognised as due to social and political factors, with global inequality as the principal culprit.[1]

1 Also significant in the decline of population alarmism are discourses of population disavowalism (Coole, 2013; 2021).

In contrast, while population alarmism has seen a fairly steady decline, public concern about the environment has grown. Yet, despite accumulating evidence of the increasing toll of the human enterprise on natural systems and other species, public consciousness and concern has been somewhat spasmodic, rising in response to evidence of an impending crisis and abating as legislative and technical solutions are perceived to solve it. Two major nodes of environmental concern in the twentieth century, anxiety around industrial pollution and pesticides in the 1960s and the depletion of the ozone layer in late 1980s, can both be viewed as conforming to this pattern.

Both the increase in complacency about population growth and the chequered history of environmental concern may have a common root in the inability and unwillingness of individuals and communities to see beyond the relatively short term and acknowledge the broader consequences of the growth in the human enterprise. Environmental problems have largely been regarded as discrete issues rather than as symptoms of the wider and systemic consequences of human activity. Deeply embedded social discourses articulate the notion that the relatively recent past is indicative of the future and the evidence of the ever-greater refinement of our technical abilities is taken as a vindication of the idea of 'progress'.

Of course, the problem with the progressivist discourse lies not with the real and clearly observable improvements in human welfare, but with the largely hidden unsustainable environmental costs of progress. More recently, these environmental consequences have become more apparent with extreme events such a flooding, forest fires and droughts, alongside habitat destruction and accelerating species extinctions, reported in news media on an almost daily basis. Yet, there is little evidence that this knowledge and the genuine concern it has generated has prompted anything greater than moderate change in individual behaviour (see Taylor, 2012; Alcock et al., 2017; Fisher et al., 2018; Hill, 2019). Moreover, research suggests that the most significant voluntary changes in behaviour only occur after actual personal experience of catastrophic events caused by environmental change (Spence et al., 2011; Broomell et al., 2015; Demski et al. 2017).

Arguably, the long timescales involved in environmental and, particularly, demographic change engender complacency and a reluctance to act until the danger is imminent. From a sociological perspective, this might be explained by

the individual's focus upon the habitual and everyday dimensions of social life. While the broader environmental context is clearly acknowledged, agents have a 'hierarchy of purposes' and rank issues in order of priority with a tendency to focus upon more immediate or medium-term concerns.[2] Importantly, agents acknowledge the social structural context of action and the constraints they face in terms of their individual power and the collective nature of the problem. Moreover, the continuation of familiar socio-technical practices that have become axiomatic to 'a normal life' may help to preserve a sense of ontological security[3] in the face of underlying anxiety about potentially catastrophic environmental change.[4]

In our first article in this issue, William Rees argues that this inability or unwillingness of decision-makers and ordinary people to address the now abundantly clear biophysical overshoot of the human enterprise has a seldom considered evolutionary biological dimension. His central thesis is that cultural evolution and global social change have outpaced the biological evolution of the human brain and its cognitive processes leaving it 'functionally obsolete' and unable to cope with the ecological crisis.

Rees points out that the human brain evolved in a physical and social environment vastly different to that of the present day and was well adapted to conditions where social groups were small and the environmental conditions were largely cyclical and hence predictable. Where it came to coping with the unpredictable and unknown, such societies developed 'various tribal myths, gods and other forms of magical thinking' – thus, in sociological terms, providing the ontological security that human beings still desire. In contrast, modern techno-industrial (MTI) society represents a tiny fragment of our species' history and the challenges it presents are highly dynamic and complex. Arguably no challenge is greater or more complex than the impact that MTI society has had on the global environment. Rees argues that the lack of action in the face of the overwhelming

2 Evidence supports the idea that environmental concern is frequently displaced by anxiety about more immediate issues such as the economy or security (Kahn and Kotchen, 2011; Scruggs and Benegal, 2012; Taylor, 2012).

3 Ontological security, or security of being, is part of the agent's sense of contextual familiarity, of knowing how to proceed in various physical and social contexts. It is also concerned with the management of anxiety in the face of physical and social disruption.

4 For a discussion of environmental anxiety, see Clayton 2020.

evidence of impending catastrophe is symptomatic of the inability of our species to cope with the systemic complexity of the environmental crisis and that this maladaptation to the physical and social environment which we have created represents an existential threat.

Considering the problem of population growth, Rees notes that the UN's complacency, the reductionist simplicity of resistance to advocates of population reduction and, citing Nandita Bajaj and Kirsten Stade's article also published in this issue, pronatalism are obstacles to rationally dealing with human numbers as a factor in the environmental crisis.

Cataloguing the impact of the growth of consumption and population on the environment, like Rees, Bajaj and Stade argue that said impact not only represents an existential threat to many ecosystems and other species worldwide but will also mean enormous suffering for the poorest portion of humankind. They point out that organisations concerned with social and environmental justice have silenced discussion of human population growth but at the same time ignored the role of oppressive pronatalism in eroding reproductive autonomy. Bajaj and Stade's approach defines pronatalism in terms of 'cultural and institutional forces that compel reproduction', and as such challenges accepted notions of reproductive autonomy arising out of liberal rights discourse, as well as the notion of the authentic individual stepping outside of prevailing social discourses and making 'free' choices. In contrast, the authors identify a panoply of social, political, economic and cultural pronatalist pressures which shape reproductive decisions. Importantly however, they argue that by flinching from addressing population growth as a driver of the environmental crisis, those concerned with reproductive rights reinforce these pronatalist forces which limit reproductive autonomy.

As Bajaj and Stade's research makes clear, one of the most basic ways to reduce population growth is to the address the unmet need for contraception. Universal access to sexual, reproductive and child health care is an objective of the UN's Sustainable Development Goals (SDGs) and family planning is clearly central to this objective. Our third article by Aalok Chaurasia is concerned with how progress in meeting demand for family planning is measured. Chaurasia develops a composite index measuring progress in meeting family planning demand in three dimensions: provision of permanent methods (male and female

sterilisation); provision of modern spacing methods (such as inter-uterine devices, the contraceptive pill, condoms etc.); and expansion of choice in the method of family planning. This latter dimension is particularly important since the choice of method varies depending on the stage in the family building process, with spacing being more important in the early stages and permanent methods once desired family size has been achieved. The composite index thus considers both quantitative and qualitative aspects of family planning progress.

Chaurasia's analysis shows that progress in meeting demand for family planning is unsatisfactory in more than forty per cent of the 113 countries included in his research and that inter-country variation in progress is significant. In many countries, progress in some or all of the three dimensions of demand appears to have reversed. Importantly, Chaurasia notes that the opportunity to choose between spacing and permanent methods is not expanding in the majority of countries, suggesting that the family planning needs of both women and men are being neglected or not addressed at all. The differences between countries in family planning progress is shown to be largely the result of variation in meeting demand for permanent methods of birth control. Chaurasia remarks that, when the family planning movement was established nearly seventy years ago, reducing population growth was seen as central to the development of poor countries; however, while substantial progress has been made commitment to this objective appears to have waned. He concludes:

> Family planning needs to be treated as a development strategy for the realisation of the goal of planned family that is critical to sustainable development and human well-being rather than just an intervention to reduce fertility.

In our final full article of this issue, Theodore Lianos explores how some of the key elements of the modern steady-state economic model, particularly the notions of constant population and constant capital and wealth, can be found in the writings of Plato and Aristotle. Lianos argues that Plato and Aristotle are both concerned with the optimal relationship between the size of the population and the available land for a good standard of living. Importantly, Lianos observes that the central issue for these thinkers was the normative question of what is 'the best life' and how to achieve it. However, for the ancient Greeks, the notion of the best life

entailed more than just a material standard of living for the individual, embracing issues of collective good and social justice. Individual happiness, although dependent on sufficient wealth to live a temperate and generous lifestyle, was almost synonymous with a virtuous life. Lianos remarks that for these ancient Greek philosophers it was clear that regulating population size was axiomatic to a good life for all and that perhaps the ecological consequences of human numbers will lead to a reconsideration of their wisdom in modern societies.

The relatively simple environmental and social conditions of classical antiquity contrast starkly with those of the present. Reflecting on the ability of human beings to cope with complexity, as discussed earlier in this editorial introduction, it's clear that, as William Rees argues, averting the environmental crisis requires a systemic approach. Thus, rather than treating environmental problems as discrete issues to be tackled with technical and legislative patches, they must be seen as symptoms of the wider impact of humankind on the Earth's biophysical systems. By definition, if environmental sustainability entails an economy in a steady-state in terms of its biophysical footprint, it follows that, all other things being equal, a trade-off exists between the size of the population and per capita standard of living. What population size can be sustained at a given level of welfare depends on a number of factors, critical amongst them the socio-technical systems by which welfare is provided (O'Neill et al., 2018). However, shifting social conventions about what defines a good life, moving away from accumulative consumption and towards sufficiency and non-material factors while paying attention to social justice, as emphasised by both Plato and Aristotle, will also be a significant determinant of the size of population that can be socially and environmentally sustained.

We close this issue on a sad note with an obituary to Herman Daly, founding figure of the discipline of ecological economics, advocate of the steady-state economy and valued member of the JP&S editorial board, who died in October 2022.

References

Alcock, I., M.P. White, T. Taylor, D.F. Coldwell, M.O. Gribble, K.L. Evans, A. Corner, S. Vardoulakis and L.E. Fleming. 2017. '"Green" on the ground but not in the air: Pro-environmental attitudes are related to household behaviours but not discretionary air travel'. *Global Environmental Change* **42**: 136–47. https://doi.org/10.1016/j.gloenvcha.2016.11.005

Broomell, S.B., D.V. Budescu and H. Por. 2015. 'Personal experience with climate change predicts intentions to act'. *Global Environmental Change* **32**: 67–73. https://doi.org/10.1016/j.gloenvcha.2015.03.001

Coole, D. 2013. 'Too many bodies? The return and disavowal of the population question'. *Environmental Politics* **22** (2): 195–215. https://doi.org/10.1080/09644016.2012.730268

Coole, D. 2021. 'The toxification of population discourse. A genealogical study'. *The Journal of Development Studies*. https://doi.org/10.1080/00220388.2021.1915479

Clayton, S. 2020. 'Climate anxiety: Psychological responses to climate change'. *Journal of Anxiety Disorders*. https://doi.org/10.1016/j.janxdis.2020.102263

Demski, C., S. Capstick, N. Pidgeon, R. Gennaro Sposato and A. Spence. 2017. 'Experience of extreme weather affects climate change mitigation and adaptation responses'. *Climatic Change* 140: 149–164. https://doi.org/10.1007/s10584-016-1837-4

Ehrlich, P.R. 1968. *The Population Bomb*. New York: Balentine Books.

Fisher, S., R. Fitzgerald and W. Poortinga. 2018. 'Climate change. Social divisions in beliefs and behaviour'. In D. Phillips, J. Curtice, M. Phillips and J. Perry (eds), *British Social Attitudes 35*, pp. 146–71. London: The National Centre for Social Research.

Hill, L. 2019. *Aviation Index 2019 – Public attitudes towards aviation in the UK*. Paris: IPSOS Mori. https://www.ipsos.com/ipsos-mori/ en-uk/aviation-index-2019-public-attitudes-towards-aviation-uk (accessed 27 November 2019).

IPCC. 2022 *Climate Change 2022 Mitigation of Climate Change*, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/

Kahn, M. and M. Kotchen. 2011. 'Business cycle effects on concern about climate change: the chilling effect of recession'. *Climate Change Economics* **2** (3): 257–73. https://doi.org/10.1142/S2010007811000292

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

Scruggs, L. and S. Benegal. 2012. 'Declining public concern about climate change: can we blame the great recession?' *Global Environmental Change* 22: 505–15. https://doi.org/10.1016/j.gloenvcha.2012.01.002

Simon, J.L. 1981 *The Ultimate Resource*. Princeton: Princeton University Press.

Spence, A., W. Poortinga, C. Butler and N.F. Pidgeon. 2011. 'Perceptions of climate change and willingness to save energy related to flood experience'. *Nature Climate Change*. https://doi.org/10.1038/nclimate1059

Taylor, E. 2016. 'Concern about climate change: a paler shade of green?' In A. Park, J. Curtice, K. Thomson, M. Phillips, E. Clery, and S. Butt (eds), *British Social Attitudes: The 26th report*. pp. 91–118. London: Sage. https://dx.doi.org/10.4135/9781446212073

UN. 2022. Day of 8 Billion. https://www.un.org/en/dayof8billion

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

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COMMENT

Overshoot: Cognitive obsolescence and the population conundrum

William E. Rees[1]

Abstract

The human enterprise is in overshoot; we exceed the long-term carrying capacity of Earth and are degrading the biophysical basis of our own existence. Despite decades of cumulative evidence, the world community has failed dismally in efforts to address this problem. I argue that cultural evolution and global change have outpaced bio-evolution; despite millennia of evolutionary history, the human brain and associated cognitive processes are functionally obsolete to deal with the human eco-crisis. *H. sapiens* tends to respond to problems in simplistic, reductionist, mechanical ways. Simplistic diagnoses lead to simplistic remedies. Politically acceptable technical 'solutions' to global warming assume fossil fuels are the problem, require major capital investment and are promoted on the basis of profit potential, thousands of well-paying jobs and bland assurances that climate change can readily be rectified. If successful, this would merely extend overshoot. Complexity demands a systemic approach; to address overshoot requires unprecedented international cooperation in the design of coordinated policies to ensure a socially-just economic contraction, mostly in high-income countries, and significant population reductions everywhere. The ultimate goal should be a human population in the vicinity of two billion thriving more equitably in 'steady-state' within the biophysical means of nature.

Keywords: carrying capacity; cognitive obsolescence; systems complexity; economic contraction; population planning.

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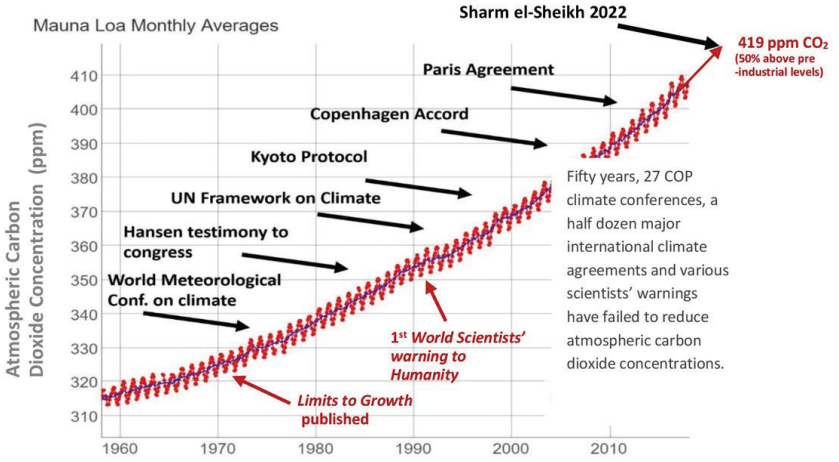
Introduction: Evolution and humanity's eco-predicament

This article attempts a more-than-usually systemic assessment of the human eco-predicament. It is inspired by two related facts: First, the human population substantially exceeds the long-term carrying capacity of Earth even at current average material standards. We are in overshoot, a state in which excess consumption and pollution are eroding the biophysical basis of our own existence (GFN, 2022a; Rees, 2020a). Second, national government and international community responses to even the most publicised symptom of overshoot, climate change, have been dismally limited and wholly ineffective (Figure 1).

Figure 1. Failed climate action – carbon dioxide levels still climbing



SOURCE OF CO2 DATA: NOAA (CURRENT)

Overshoot is a genuine existential threat. Climate change *alone* is capable of making large patches of Earth irreversibly uninhabitable for humans in this century and ultimately jeopardising global civilisation. How is it, then, that the wealthiest, most scientifically-aware, best-informed and globally hyper-connected generation of decision-makers and ordinary people seems incapable of applying the most basic rules of evidence to resolving this self-made predicament? Where in official circles is to be found even the *outline* of the cooperative international

strategy necessary to rescue modern civilisation and thousands of non-human species from probable ecological and geopolitical catastrophe?

There are many possible ways of addressing these questions but few seek answers in human nature itself. Modern techno-industrial (MTI) society is afflicted by human exceptionalism, the *beliefs* that *H. sapiens* is not really an 'animal-like-the-others', that human behaviour is determined by socio-cultural factors (nurture), and that humans are therefore somehow exempt from the laws of nature. Decision-makers thus operate from the implicit assumption that continuous economic growth enabled by greater efficiency and constantly improving technology – the motivational nerves of industrial capitalism and its handmaiden, neoliberal economics – is all we need to navigate the hazardous waters ahead. By contrast, this article argues, with illustrations, that the mainstream techno-optimist approach is not only delusional but threatens to sink the human ship of state. This argument is based partially on the *fact* that the human lineage, like those of all other species, has continuously evolved over millions of years and that our evolutionary history profoundly affects both our perception of crisis and how we respond to it. In short, to deny the implications of humanity's evolutionary heritage is to ignore a major key to our eco-predicament (and possibly how to resolve it).

The obsolescent human brain: Why our cognitive processing is not up to the task

> 'Nothing in biology makes sense except in the light of evolution'
> (Dobzhansky, 1964: 449)

My starting premise is that, despite their miraculous complexity accumulated over millennia, the human brain and associated cognitive processes are functionally obsolete to cope with the emerging eco-crisis. Functional obsolescence can occur by one of two mechanisms: either the entity of concern is superseded by a new version that operates more effectively or efficiently in performing functions essential to the entity's survival, or the entity's operating environment changes so dramatically that the entity is no longer capable of performing functions essential to its survival. In other words, the entity is maladapted to its changed circumstances. I argue, from available evidence: 1) that the putative obsolescence

of the human brain derives from the latter process and; 2) this reality poses a growing threat to the survival of *H. sapiens* – or at least MTI society – that may well play out by century's end.

As noted, this argument departs from the facts that modern *H. sapiens*, like all other species, is a product of organic evolution[2] and that human evolution has similarly been shaped by the forces of natural selection. Since both instinctive and emergent social behaviours are as much exposed to selective pressure as any other genetically-influenced human quality (Barash,1981), it is not much of a leap to extend Dobzhansky's (1964) principle to assert that *nothing in human affairs – including much of economic and socio-political behaviour – makes sense except in the light of evolution.* This is not to discount socio-cultural factors, which are also centrally involved. Rather, I am arguing that our understanding of humanity's ecological predicament and our ultimate fate is unintelligibly incomplete unless we factor in evolutionary considerations.

To begin, consider the social and ecological context that helped forge modern *H. sapiens'* central nervous system. The human brain evolved rapidly during the Palaeolithic (2.5 million to ~10,000 years ago) at least partially in response to selective pressure favouring increased social intelligence, the extra calories made possible by improving diet (due to the use of fire and cooking) and growing technological competence. The most rapid period of growth seems to have occurred with the challenges imposed by increasing climate variability 200,000 to 800,000 years before the present; the brain reached its current size ~500,000 years ago (DeSilva et al., 2021; MNH, 2022).[3]

Whatever the relative strength of various selection pressures, early hominids and even recent pre-agricultural human hunter-gatherers lived in tribal groups of perhaps a few dozen individuals in spatially limited, relatively knowable, predictably cyclical ecosystems. One would encounter only a few tens or hundreds of other people in his/her lifetime and would probably die within a few kilometres of place of birth. No doubt there was much about their limited

2 Culture, such as the shift to agriculture, may induce minor changes in human morphology (e.g., jaw structure) but even this process unfolds by natural selection.

3 However, there has been a rapid small but significant decrease in brain size in just the past three millennia (DeSilva et al., 2021)

'environments' that seemed fearsome and mysterious to early humans – indeed they developed various tribal myths, gods and other forms of magical thinking to cope with the unknown. However, *H. sapiens'* home-ranges were relatively small and consistently variable – even fearsome predators and other natural hazards would become familiar over the course of an individual's life-time, certainly that of several generations. In short, compared to contemporary, rapidly changing, mostly manufactured and unnaturally complex human environments, humanity's original natural habitats posed only limited challenges to the evolving brain and central nervous system.

One result of our evolutionary heritage is that contemporary humans tend to respond to problems in relatively simplistic, reductionist, mechanical ways. People don't generally think in terms of discontinuous behaviour – lags, thresholds (tipping points), and other non-linearities; we don't 'get' complexity. Humans have also evolved to develop habitual, socially-constructed (but neuro-synaptically embedded) patterns of group-think which often persist despite emerging contradictory evidence – consider political ideology, religious dogma, tribal myths, academic paradigm or even the 'latest thing' (Wexler, 2006); we are also innately short-sighted (Pratarelli, 2008). Many of our once-successful survival instincts, emotions and behaviours are ancient prescriptions of the human reptilian brain stem and limbic systems. Some may by now have outlived their 'best before' dates, but our primitive cognitive modes, shallow perceptions and resultant responses were perfectly adequate for 99.9 per cent of human evolutionary history. Is it any surprise that ordinary people today still seek explanations for unusual phenomena in terms of simple cause-effect relationships, that we deny uncomfortable truths, that we discount the future, and that many of our contemporaries are still given to mystical thinking?

'But wait', one might protest, 'surely MTI civilisation is not so constrained by humanity's early evolution; modern sensibilities developed in a dramatically different context.' True enough, the Enlightenment of the seventeenth and eighteenth centuries saw the new science begin to subdue superstition and demystify the natural world; literacy was becoming common; positive knowledge spread. Ironically, however, the emergence of Newtonian science, particularly analytic mechanics, actually reinforced *H. sapiens'* innate propensity for reductionist simplicity. Indeed, so-called 'normal' science was so extraordinarily

successful in generating successful predictive hypotheses, and in extending humanity's control over the physical world, that it spawned many intellectual imitations, including the neoliberal economic paradigm that is currently all but running the world. The latter pictures the economy as a self-perpetuating machine, separate and independent of nature, sustained by a simplistic myth of perpetual growth abetted by continuously improving technology.

And herein lies one proximate cause of the human eco-crisis. In just the past two centuries (0.08 per cent of human history) this socially-constructed economic *myth* has helped foster an eight-fold increase in human numbers (from one to eight billion) and a hundredfold expansion of real gross world product (GWP), all propelled by a >1,300-fold increase in climate-busting fossil energy (Rees, 2020a). Technology has expanded apace when not leading the way: most of the cultural artefacts that young people today take for granted – from jet planes to PCs, cell phones and the internet – were non-existent when this author was born.

The material result is a virtually alien world of mind-boggling complexity, an incomprehensible global concatenation of dynamically interacting and overlapping human and natural sub-systems. Each major sub-system is *in itself* so complex that no human mind can fully understand, let alone control, its structure or behaviour in isolation, far less as part of the integrated whole. Who fully understands the world economy or even the internet; does anyone really believe the climate system can be brought under human command and control? Only the hubris born of MTI sensibilities would argue the affirmative. The reality is that fast-paced cultural evolution, particularly the MTI variety, has so vastly outstripped our biological evolution (see Longrich, 2022), that *H. sapiens* is no longer adapted to the integrated socio-ecosystem that MTI culture has itself created.

Bottom line? MTI society is doubly compromised – both our heritable 'wetware' (the brain) *and* much of the socially-constructed cognitive software it has produced (particularly growthist economic theory) are functionally obsolete in the world we ourselves have created.

Climate change as fatal distraction

> 'If we are unable to identify reality and therefore unable to act upon what we see, then we are not simply childish but have reduced ourselves to figures of fun – ridiculous figures of our unconscious.'
> (Saul, 1995: 21–22)

We see solid evidence of reductionist simplicity in policymakers' (and mainstream media's) tendency to focus on one environment-related issue at a time. The past several years have seen a fixation on climate change. This was only briefly displaced by the Covid-19 pandemic, then the war in Ukraine but, with the fizzling out of COP-27 (November 2022), we are back to climate change as *the* existential threat to human civilisation. On rare occasions when analysts do see beyond their immediate concern, they usually make only one connection – e.g., food security to family planning (Owoo and Delacroix, 2022), climate change to population (O'Grady and Mahfouz, 2022) – and even then cause-effect relationships may be reversed or under-analysed. O'Grady and Mahfouz's (2022) report that the Egyptian government is worried that the country's expanding population is jeopardised by 'rising temperatures [which] increasingly threaten the country's food and water supplies', yet fail to acknowledge that it is growing human populations that are driving rising temperature and its negative impact on food and water supplies, while adding directly to the pressure on those same supplies.[4]

Why do simplistic hypotheses and explanations persist? Because human beings characteristically 'want simple answers to complex questions' (Kay and Schneider, 1995). This cognitive impairment is dangerously maladaptive for human societies in 2022. Climate change is indeed a horrific prospect, but it is only one symptom of a greater truly existential threat, ecological overshoot. *Overshoot implies overpopulation*: the bloated human enterprise is consuming even self-producing (renewable) resources faster than ecosystems can regenerate and dumping entropic wastes back into the ecosphere in excess of nature's assimilative

4 Similarly, reports of the role of climate change in the famines savaging the people of Ethiopia, Somalia, South Sudan, Yemen, and elsewhere rarely acknowledge that local water supplies and ecosystems productivity have been degraded, and relief operations complicated, by the doubling or trebling of local populations in recent decades.

capacities. Overshoot is therefore the *cause* of climate change[5] and numerous co-symptoms including plunging biodiversity, ocean acidification, tropical deforestation, landscape/soil degradation, contamination of food supplies, depleting aquifers, the pollution of everything – i.e., virtually all other so-called environmental problems including the pandemic. Contemporary MTI culture is literally consuming and polluting the biophysical basis of its own existence. (Arguably, overshoot is even one root of the Russo-Ukraine war, but that's a longer story.)

The continued erosion and contamination of the ecosphere is potentially fatal on several fronts. Formal acknowledgement that there are too many people consuming/polluting too much is therefore a crucial step toward assuring a future for global civilisation and restoring biodiversity. Nevertheless, policymakers and politicians at all levels still act as if population growth and overconsumption can be ignored, or, worse, that the resultant problems can be solved by yet more growth. Part of the reason is that bare-bones growth-oriented economic models totally ignore the spatial structure and complex dynamic behaviour of the biophysical systems – and even the social systems – with which the economy interacts in the real world (Rees, 2020a). Even those who acknowledge the ecological crisis are cognitively incapable of effective solutions, advancing instead the same '… old growth wine in new economy bottles – neo-Keynesian productivism, climate economy, Green growth, Green economy, Green new deal, new deal for nature, sustainable development, sustainable economic growth, bio-economy, circular economy, digital economy, knowledge economy' (Spash, 2021). Over-simplified and superficial, most contemporary MTI policy analysis, simply '…ignores data that do not fit with its [socially-constructed] myths and metaphors' (Washington et al., 2020).

These are serious assertions but well-supported by available evidence. Consider that mainstream, politically acceptable 'solutions' to global warming (e.g., wind turbines, solar panels, electric vehicles, green hydrogen, non-existent carbon capture and storage technologies, etc.) require major capital investment and are promoted on the basis of profit potential, thousands of well-paying jobs and bland assurances that climate change can readily be rectified. Non-experts are

5 Anthropogenic climate change is an excess waste problem; carbon dioxide is the greatest entropic waste by weight from industrialised economies.

readily persuaded that our future is assured by a deluge of promotional literature on allegedly green energy alternatives. Renewable energy (RE) advocates Breyer et al. (2022) review the literature on modern renewables and find that most of the studies show an energy future of 100 per cent renewables is economically feasible globally.[6] These authors present a vision of 'a net negative greenhouse gas emissions economy that can limit global warming to 1.5°C with a clearly defined carbon budget in a sustainable and cost-effective manner based on 100% renewable energy...' This comforting *one-issue* vision essentially proclaims that the solution to potential climate chaos lies in growth-bound 'business-as-usual-by-alternative-means'. Little wonder it has become the mainstream norm – indeed, most conventional efforts to address climate change, including the COP meetings, reflect MTI society's attempt to enshrine expansionist capitalism as the solution to, rather than the cause of, the problem (Spash, 2016).

Reductionist blinkers on, green energy advocates tend to gloss over or dismiss the evidence that the much-vaunted renewable energy transition isn't really happening as advertised. In 2021 fossil fuels still provided ~82 per cent of the world's primary energy; to put it in temporal terms, oil, coal and natural gas powered the globe for 300 of 365 days; hydro and nuclear power contributed forty days; modern non-hydro renewables – solar panels, wind turbines – where most investment is going *gave us just eighteen days*. Modern renewables produce electricity, but even in this domain fossil fuels are the largest contributors at 61 per cent of the world's power supply; non-hydro renewables provided twelve per cent wind and solar only about nine per cent (from data in BP, 2022).

A big part of the problem is that growth in demand for energy due to rising incomes and burgeoning populations in middle and low-income countries often outstrips the build-out of modern renewable sources (Chaurasia, 2020; Heinberg, 2022). But there are many other obstacles to a smooth energy transition: politically acceptable technologies are largely fossil-fuel (FF) dependent in manufacturing and installation; the associated mining, refining and transportation are otherwise ecologically problematic; renewables, hydrogen included, still face numerous technical problems; RE equipment/infrastructure is not 'renewable', it wears out and is merely replaceable (mostly using FF);

6 Note that Breyer et al. (2022) are also authors/co-authors of many of the studies reviewed.

grid-scale wind and solar generation is actually costlier than alternatives and becomes more expensive the higher their share of production; there are emerging supply-chain issues; and, in any case, electricity cannot substitute for many uses of FF (Heinberg, 2022; Schernikau et al., 2022; Seibert and Rees, 2021; Rees, 2022a; Michaux, 2021a,b; Turiel, 2020a,b). Even if all such problems were overcome, to replace just 45 per cent of FF use with electricity by 2030[7] would require building the equivalent of ~1.2 times the entire present cumulative global stock of wind and solar installations *every year* for the next seven years (based on data from BP, 2022), generously assuming that one unit of wind/solar electricity = ~2.6 units of FF energy; that all uses of FF can be electrified; and that there will be no increase in demand for energy).

This is obviously an impossible scenario. Indeed, there is no practical way to quantitatively substitute electricity for fossil fuels on a climate-friendly schedule. The fact is that, despite the significant uptake of modern renewables in the electricity sector and the ebullient assertions of RE advocates, atmospheric CO_2 concentrations are still increasing (Figure 1). We should also note that practical carbon-capture-and-storage techniques at scale continue to elude us; to imply that such non-existent technologies will help achieve net-zero emissions by 2050 adds to the dangerous illusion that a smooth energy transition is underway (Spratt and Dunlop, 2021; Dyke et al., 2021).[8] As matters stand, the world will blow past the 1.5 C° and likely also the 2.0 C° global warming limits set by the IPCC. Earth has already warmed by >1.1 C° and prominent climate scientists assert that, due to the prevailing energy imbalance and short-term lag effects, 'more than 0.5°C additional global warming is [already] in the pipeline' (Hansen, 2018: 9; see also Spratt and Dunlop, 2021). Indeed, we are currently on track for ~2.7 C° warming and catastrophic climate damage.

Overshoot: It's the population, stupid!

The foregoing analysis underscores why *H. sapiens'* innate myopia and naïve enthusiasm for technical fixes will not resolve our eco-predicament. Neither climate

7 Consistent with the Sharm el-Sheikh 2022/COP27 goal of reducing emissions sufficiently to limit mean global warming to 1.5 Co.

8 Another techno-fix, climate-changing geo-engineering (e.g., sun-blocking), is also narrowly focused and assumes there are no unknown, potentially disastrous, systemic feedbacks from the atmosphere/climate or connected bio-geo-systems.

change nor any other major symptom of overshoot can be solved in isolation from the others, particularly not by reference to the same beliefs, values, assumptions, narratives and behaviours that caused the problems in the first place. Overshoot is a complex systems problem; only by taking a systematic frontal approach can we hope to reduce or eliminate all co-symptoms simultaneously.

The proximate driver of overshoot is excess economic throughput, i.e., excess energy and material consumption and pollution. Both rising incomes and growing populations are contributing factors – high-income consumer societies account for 74 per cent of the problem historically (see Hickel et al., 2022a) – but population growth in all income quartiles is currently the greater contributor at the margin (grotesque inequality is a separate socio-political issue) (Rees, 2022b). Certainly population growth has been seen as 'a leading cause of increased greenhouse gas emissions and accelerating global climate change' (Cafaro, 2022; also Laublichler, 2022).

It follows that the best results from efforts to resolve the human eco-predicament will come from addressing overconsumption and overpopulation directly. The Global Footprint Network shows that the world is in overshoot by ~75 per cent (GFN, 2022b). This implies that global energy and material throughput must be reduced by disheartening 43 per cent for sustainability, much more in high-income countries.[9] Obviously, wasteful over-consumption by the wealthy and egregious inequality must be addressed but the world cannot afford to ignore the population component. The human family passed the eight billion mark in November 2022 and is still expanding. While the United Nations suggests that the growth rate has fallen below one per cent (80 million per year), other authorities argue that UN demographers understate population growth for political reasons and that the annual increment is closer to 90 million (O'Sullivan, 2022a).

Whatever the growth rate, overshoot makes clear that Earth is already significantly overpopulated. While estimates of the sustainable population vary from a paltry ~50 million to a truly ludicrous one trillion, there is some gravitation toward the

9 These data, while alarming, are almost certainly conservative. For several practical and theoretical reasons ecological footprint assessments characteristically underestimate the human demand for biocapacity (Rees, 2022b).

view that Earth might support ~two billion people indefinitely at a satisfactory material standard of living (e.g., Cafaro, 2021; Rees, 2022b). This implies a reduction of at least 75 per cent in human numbers.[10]

It is difficult to imagine a politically more daunting challenge. No secular wealthy society or country anywhere, has ever voluntarily permanently renounced its hard-won material wellbeing for the future greater good of humanity at large. Humans are temporal, social and spatial discounters *by nature* – we would rather risk uncertain future catastrophe that (we hope) will mostly affect total strangers and distant places than accept material sacrifice that would certainly affect our families and home communities today. (Discounting is a prime example of a once-adaptive human trait that may well be obsolete in the modern world.) And of course, the three billion people who still struggle at $5.50 per day to meet basic needs can hardly be expected to douse their flames of hope for a materially brighter future.

Managing populations is equally intractable. In many countries, calling for population planning would constitute political suicide. Even the United Nations Population Fund recently 'decried any expressed concern about population growth as "alarmist"' (O'Sullivan 2022b); strong advocates of population reduction strategies policies risk being vilified as racist, eco-fascists, eugenicists, anti-human or worse. Such attitudes and accusations are yet another manifestation of innate reductionist simplicity exacerbated by socially-constructed ideological blinders. Bajaj (2022) argues that the UN's taunt of population alarmism springs from widespread pro-natalist ideology 'which results in unrelenting pressures – a globally pervasive form of reproductive coercion – experienced primarily by women'. She further emphasises that that 'pronatalism is integral to our current growth-based economic system, which relies on constant population growth to supply new consumers continually'. Indeed, corporations in the US [and other countries experiencing 'peak population'] are sensationalising the idea of an economic 'baby bust' that threatens the nation with a paucity of workers, a

10 Alternately, Hickel et al. (2022) suggest that, for a just sustainability, wealthy nations need to reduce resource consumption by at least 70%. (Typically, these authors ignore the population question.) In the same vein, O'Neill et al. (2018) found that, with redistribution, Earth could provide basic needs for everyone. However, they suggest that to achieve qualitatively higher life satisfaction would require resource consumption six times above sustainable levels (or, they failed to add, a reduced population in the range of two billion).

reduced tax base and the loss of international economic clout. Many governments are responding with incentives to increase national fecundity.

Regrettably, rhetoric on the 'need for more workers, consumers, and taxpayers goes beyond just pushing women to have children and supports recent successful moves to ban contraception and abortions' (Dillard, 2022). It is also ecologically destructive. Bajaj and Stade (2022) posit that addressing overpopulation, and the pronatalism that drives it, must be central to international conservation and development efforts to elevate reproductive rights while also promoting planetary health. Similarly, Shragg (2022; also 2015) argues that taming human population growth is not only decidedly pro-human but also pro-nature in that it slows human-induced ecocide.

Bottom line? Pronatalism and similar socially-constructed single-focus beliefs are tragic from the perspective of controlling overshoot. Population stabilisation and decline in rich countries should actually be cause for celebration – each high-income consumer imposes ecological pressure on Earth equivalent to that of ten to twenty people living near-subsistence lifestyles. The greatest ecological leverage would come from absolute population reductions in high-income countries. But that does not mean low-income countries with higher birth-rates get a pass. Human exceptionalism notwithstanding, there is a greater systemic dynamic in play here. Many non-human species experience population outbreaks or 'booms' during favourable resource-rich periods. Booms are invariably followed by 'busts' as various forms of negative feedback – e.g., resource depletion, competition for habitat, predation, disease – re-assert themselves. There is no reason to believe that human population dynamics differ significantly from those of other species. Most importantly, populations of *H. sapiens* have the same potential to grow exponentially when relieved of natural negative feedback controls (e.g., disease, food/resource shortages, etc.). In fact, because resources have been plentiful for the past 200 years, and *population planning has not been an acceptable policy focus,* human numbers are now arguably in the boom phase and, nearing the peak of, a (likely one-off) population boom-bust cycle (Rees, 2020b). As previously noted, *H. sapiens* has increased eight-fold to eight billion since 1810, in just one 1250th as much time as it took our species to reach its first billion. The dramatic economic and population growth that the past few generations take to be the norm actually define the single most anomalous period in human history.

The recent boom was made possible by the scientific revolution – e.g., improved population health – and technologies based on abundant cheap energy, primarily fossil fuels (FFs). The latter: a) provided access to all the other resources necessary to grow the human enterprise and thus; b) temporarily relieved humanity of many forms of pre-industrial negative feedback.

This explains the population component of human eco-overshoot.

It is also exposes the closing jaws of an unprecedented technological trap. Modern civilisation depends utterly on abundant cheap energy. Consider the fate of the bloated human enterprise, in the absence of a 'Plan B', if we are forced to abandon FFs to avoid catastrophic climate change or if FFs become economically depleted – as is inevitable. Without climate-friendly quantitative substitutes for FF, it will not be possible to maintain anything like the present human population at acceptable material standards or to maintain the scale of the human economy. With failing energy supplies, humanity faces the prospect of broken supply lines, food and other resource shortages, local famines, reduced production, declining incomes, rising inequality, widespread unemployment, civil unrest, abandoned cities,[11] mass migrations, collapsed economies and possible geopolitical chaos.

On the other hand, if the world maintains its fossil-fuelled trajectory in blind allegiance to the growth paradigm and the illusion that 'technology-will-save-the-day (MTI society's apparent default position [Figure1]), we risk more and longer heat waves/droughts, accelerated desertification, melting permafrost, methane releases, water shortages, failing agriculture, famines, rising sea levels, the flooding (and eventual loss) of many coastal cities, uninhabitable regions, mass migrations, collapsed economies and possible geopolitical chaos. And we'd still run out of energy. Are not all these things not already emerging in nascent form?

In short, pursuit of either narrowly-conceived pathway suggested by our obsolete instincts and MTI sensibilities exposes humanity to the likelihood of a major, potentially catastrophic, population correction (the inevitable bust phase of our one-off global cycle) later in this century (Rees, 2020b).

11 Modern cities and mega-cities of millions are the creation of fossil fuels and provisioning cities remains dependent mostly on diesel-powered highway, train and marine transportation (see Friedemann, 2016).

One (the only?) way out

> 'Late capitalist society is a coyote suspended above an abyss, believing he still stands on solid ground. We are in the interval before he notices he is in thin air and plummets to the canyon floor'
> (Robbins 2022: 26)

The more attractive alternative is to engineer a deliberate, controlled, global-scale 'soft landing,' a radically transformative 'Plan B'. Any system dominated by positive feedback is self-destructive; avoiding chaotic collapse means that we must reintroduce negative feedback to the runaway human enterprise (see Rees, 2020a; 2022a). The necessary systematic frontal approach to overshoot would require a period of unprecedented international cooperation in structuring a socially-just economic contraction, mostly in high-income countries, and significant population reductions everywhere. This might well require declaration of a global 'wartime' emergency mindset and an intensive effort over several decades.

To begin, national governments, the United Nations and other international development-oriented organisations should formally acknowledge the reality of overshoot and the end of growth (i.e., neoliberal capitalism should be put to rest). We then need to initiate a global population reduction strategy, and a plan to restructure national and global economies, with the goal of remaining within global carrying capacity. This will require programmes to facilitate the adoption of sustainable lifestyles (even North Americans lived happily on half the energy/cap in the 1960s); a graduated approach to full-cost pricing of goods and service (abetted by ecological tax reform); learning to live on any 'allowable' carbon budget (while developing/improving sustainable energy alternatives); and limiting FFs use to essential needs – e.g., food production, home heating, essential transportation to provision cities – through rationing, quotas, etc. It will also be essential to implement programmes/policies for income/wealth redistribution; greater equality is not only ethically justifiable, but is psycho-socially better for everyone (Wilkinson and Pickett, 2010).

The ultimate goal should be a much-reduced human population (~ two billion) thriving more equitably in a sustainable 'steady-state' (Daly, 1991) well within the biophysical means of nature. Is there any other feasible way that post-MTI peoples can hope to enjoy both economic security and long-term ecological stability on

a (shrinking) finite planet? Is this not a more attractive prospect than staying the course and tempting chaotic collapse?

Time is clearly a crucial factor; there can be little delay. The growth momentum generated by the sheer numbers of people of reproductive age means that population growth 'will take decades to arrest, and even longer to reverse, making it virtually impossible for policymakers to respond dynamically to miscalculations or unforeseen challenges relating to a society's ability to provide for the needs of all its people' (Kuhlemann, 2023). Indeed, simulations suggest that, even under a successful universal one-child per couple policy, the population would continue to increase for 25 years and would take a century to achieve a 75 per cent reduction; that is, 'the total human population would peak in about 2047 and reach a (sustainable?) two billion in 2122' (Hughes, 2022). And there *will* be 'unforeseen challenges'.

Such data underscore the importance of mustering globally, urgently, every manner of non-coercive population planning strategy available. The world needs universal public education on overshoot as meta-problem; programmes to ensure greater economic independence and freedom of choice for women; specific education on contraception methods and family planning for all, accompanied by general access to – and preferably free distribution of – the means for birth control. Even if successful, the unavoidable lag before even a high-compliance strategy takes effect means that, *whatever we do*, billions of people will likely be exposed to accelerating climate change; energy, food and other resource shortages; and growing geopolitical tensions as the century unfolds. Never before has there been so urgent a need for universal human population planning and creation of a global social safety-net.

Bottom line? The future holds daunting prospects for humanity even in best-case scenarios. Earth will ultimately survive any human folly; the question is: will humans survive themselves? In theory, *H. sapiens* has the capacity for high intelligence, the ability to act upon the evidence and to change the future that would otherwise unfold. And, as suggested here and in many other recent publications (e.g., Hayden and Dasilva, 2022; Hickel et al., 2022a,b; Rees, 2020a), we know much of *what* needs to be done. But *how* to get it done is another matter entirely. Humans are cognitively-limited creatures driven (often unconsciously) by simple instincts, tribal myths/

suspicions, divisive competitiveness, careless emotions and impossible aspirations. We cannot really see the whole picture and what we do see, we often deny; how many policymakers and politicians effectively 'connect the dots' among our many ecological and socio-political crises? On the whole, our cognitive capacities are deficient; our dominant tribal myth is self-destructive. These factors, acting beneath consciousness, may well override humanity's collective intelligence in coping with the eco-crisis. Regrettably so – only serious self-examination, a colossal global exercise of consciousness-raising, clear-headed analysis of biophysical data/trends, a rethink of the economy-as-subsystem of the ecosphere and an unprecedented degree of international agreement and selfless cooperation for the common good (of humanity and nature) can succeed in taming overshoot.

And what if reason does fail to trump ideology and the urgings of those primitive 'whisperings within' (Barash, 1981)? Then brace yourself as humanity 'plummets to the canyon floor'.

References

Bajaj, N. 2022. Dismissal of "population alarmism" is rooted in pronatalist ideology. *Indepth News*, 3 November 2022: https://www.indepthnews.net/index.php/opinion/5709-dismissal-of-population-alarmism-is-rooted-in-pronatalist-ideology (Accessed 3 November 2022).

Bajaj, N. and K. Stade. 2022. 'Challenging pronatalism is key to advancing reproductive rights and a sustainable population'. *The Journal of Population and Sustainability* (online first) https://doi.org/10.3197/JPS.63799953906861

Barash, D. 1981. *The Whisperings Within – Evolution and the Origins of Human Nature***.** London: Penguin Books.

BP. 2022. *Statistical Review of World Energy 2021*. London, British Petroleum: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf (Accessed 24 November 2022).

Breyer, C., S. Khalili, D. Bogdanov, M. Rami et al. 2022. On the History and Future of 100% Renewable Energy Systems Research. *IEEE Access*: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9837910, (Accessed 24 November 2022) https://doi.org/10.1109/ACCESS.2022.3193402

Cafaro, P. 2021. What is the optimal human population? An eminent economist weighs in. *The Overpopulation Project* (Research and Outreach): https://overpopulation-project.com/what-is-the-optimal-human-population-an-eminent-economist-weighs-in/ (Accessed 28 November 2022).

Cafaro, P. 2022. 'Climate ethics and population policy: A review of recent philosophical work'. *Wiley Interdisciplinary Reviews: Climate Change* **13** (11). https://doi.org/10.1002/wcc.748

Chaurasia, A. 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

Daly, H. 1991. *Steady-State Economics* (2nd ed). Washington, Island Press.

DeSilva, J.M., J.F.A. Traniello, A.G. Claxton and L.D. Fannin. 2021. 'When and why did human brains decrease in size? A new change-point analysis and insights from brain evolution in ants'. *Frontiers in Ecology and Evolution* **9** https://doi.org/10.3389/fevo.2021.742639

Dillard, C. 2022. The global push for population growth shows we're not grappling with the climate crisis. *Other News*: https://www.other-news.info/the-global-push-for-population-growth-shows-were-not-grappling-with-the-climate-crisis/ (Accessed 29 November 2022).

Dobzhansky, T. 1964. 'Biology, molecular and organismic'. *American Zoologist* **4**: 443–52.

Dyke, J., R. Watson and W. Knorr. 2021. Climate scientists: concept of net zero is a dangerous trap. *The Conversation* (22 April 2021): https://theconversation.com/climate-scientists-concept-of-net-zero-is-a-dangerous-trap-157368 (Accessed 26 November 2022).

Friedemann, A.J. 2016. *When Trucks Stop Running: Energy and the Future of Transportation*. SpringerBriefs in Energy. Cham, Switzerland: Springer International Publishing https://doi.org/10.1007/978-3-319-26375-5

GFN. 2022a. *Earth Overshoot Day*. Global Footprint Network: https://www.footprintnetwork.org/our-work/earth-overshoot-day (accessed 24 October 2022).

GFN. 2022b. *Country Trends (World):* https://data.footprintnetwork.org/?_ga=2.134492657.1257217573.1669681616-285167670.1665603319#/countryTrends?cn=5001&type=BCtot,EFCtot (Accessed 27 November 2022).

Hansen, J. 2018. Climate Change in a Nutshell: The Gathering Storm: http://www.columbia.edu/~jeh1/mailings/2018/20181206_Nutshell.pdf

Hayden, A, and C. Dasilva. 2022. 'The wellbeing economy: Possibilities and limits in bringing sufficiency from the margins into the mainstream'. *Front. Sustain.* 3 :966876. https://doi.org/10.3389/frsus.2022.966876

Heinberg, R. 2022. The Renewable Energy Transition Is Failing. *Independent Media Institute*: https://independentmediainstitute.org/the-renewable-energy-transition-is-failing/ (Accessed 22 November 2022).

Hickel, J., D.W. O'Neill, A.L. Fanning and H. Zoomkawala. 2022a. 'National responsibility for ecological breakdown: a fair-shares assessment of resource use, 1970–2017'. *The Lancet (Planetary Health)* 6 (4): E342–E349. https://doi.org/10.1016/S2542-5196(22)00044-4

Hickel, J., G. Kallis, T. Jackson, D.W. O'Neill, J.B. Schor, J.K. Steinberger, P.A. Victor, D. Ürge-Vorsatz. 2022b. 'Degrowth can work — here's how science can help'. *Nature* 612: 400–03. https://doi.org/10.1038/d41586-022-04412-x

Hughes, D. 2022. *Simulation of the Effect Over Time of a One-child-per-couple Policy* (unpublished simulation). Personal communication.

Kay, J.J. and E. Schneider. 1995. 'Embracing complexity, the challenge of the ecosystem approach'. In L. Westra and J. Lemons (eds), *Perspectives on Ecological Integrity*. Environmental Science and Technology Library, vol 5. Dordrecht: Springer. https://doi.org/10.1007/978-94-011-0451-7_4

Kuhlemann, K. 2023. 'Population governance'. In E. di Nucci, J-Y. Lee and I.A. Wagner (eds), *The Rowman & Littlefield Handbook of Bioethics*. Lanham, MD: Roman and Littlefield.

Laublichler, M. 2022. 8 billion humans: How population growth and climate change are connected as the 'Anthropocene engine' transforms the planet. *The Conversation* (3 November 2022): https://theconversation.com/8-billion-humans-how-population-growth-and-climate-change-are-connected-as-the-anthropocene-engine-transforms-the-planet-193075

Longrich, N. 2022. 'Here is when and how humans attained "behavioral modernity"'. *Genetic Literacy Project* (26 October 2022): https://geneticliteracyproject.org/2022/10/26/here-is-when-and-how-humans-attained-behavioral-modernity/ (Acessed 2 November 2022).

Michaux, S.P. 2021a. *The Mining of Minerals and the Limits to Growth.* Report 16/2021, Geological Survey of Finland.

Michaux, S.P. 2021b. *Assessment of the Extra Capacity Required of Alternative Energy Electrical Power Systems to Completely Replace Fossil Fuels.* Report 42/2021, Geological Survey of Finland.

MNH. 2022. What does it mean to be human – brains. Smithsonian Museum of Natural History: https://humanorigins.si.edu/human-characteristics/brains (Accessed 1 November 2022).

NOAA. Current. *Trends in Atmospheric Carbon Dioxide* (continuously updated). Global Monitoring Laboratory, National Oceanic and Atmospheric Administration: https://gml.noaa.gov/ccgg/trends/mlo.html (Accessed 20 November 2022).

O'Grady, S. and H.F. Mahfouz. 2022. As climate change worsens, Egypt is begging families to have fewer kids. *The Washington Post* (6 November 2022): https://www.washingtonpost.com/world/2022/11/06/egypt-cop27-climate-change-population/ (Accessed 9 November 2022).

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

O'Sullivan, J. 2022a. World population is growing faster than we thought. *The Overpopulation Project* (research and outreach): https://overpopulation-project.com/world-population-is-growing-faster-than-we-thought/ (Accessed 27 November 2022).

O'Sullivan, J. 2022b. The United Nations celebrates World Population Day by shaming population 'alarmists'. *The Overpopulation Project* (research and outreach): https://overpopulation-project.com/the-united-nations-celebrates-world-population-day-by-shaming-population-alarmists/ (Accessed 28 November 2022)

Owoo, N.S. and C. Delacroix. 2022. Food security and family planning are linked. *Foodtank*: https://foodtank.com/news/2022/11/food-security-and-family-planning-are-linked/ (Accessed 17 November 2022).

Pratarelli, M. 2008. *Myopic Man: On the Nature and Universality of Human Self-deception and Its Long-term Effects on Our Environment*. Medici Publishing.

Rees, W.E. 2020a. 'Ecological economics for humanity's plague phase'. *Ecological Economics* **169**: 106519. https://doi.org/10.1016/j.ecolecon.2019.106519

Rees, W.E. 2020b. 'The fractal biology of plague and the future of civilization'. *The Journal of Population and Sustainability* **5** (1): 15–30. https://doi.org/10.3197/jps.2020.5.1.15.

Rees, W.E. 2022a. 'Why large cities won't survive the 21st century'. In R. Brears (ed.) *The Palgrave Encyclopedia of Urban and Regional Futures*. London: Palgrave Macmillan.

Rees, W.E. 2022b. 'The human eco-predicament: Overshoot and the population conundrum'. *Vienna Yearbook of Population Research* **21**. https://doi.org/10.1553/p-eznb-ekgc

Robbins, M. 2022. 'Apocalypse Nowish: The sense of an ending'. *Harper's Magazine* (December): pp. 25–30.

Saul, J.R. 1995. *The Unconscious Civilization*. Toronto: House of Anansi Press.

Schernikau, L., W.H. Smith and R. Falcon. 2022. 'Full cost of electricity "FCOE" and energy returns "eROI"'. *Journal of Management and Sustainability* **12** (1). https://doi.org/10.5539/jms.v12n1p96

Seibert M.K. and W.E. Rees. 2021. 'Through the eye of a needle: An eco-heterodox perspective on the renewable energy transition'. *Energies* **14** (15): 4508. https://doi.org/10.3390/en14154508

Shragg, K.I. 2022. *For Your Consideration: To be Anti-Growth is to be Pro-humanity.* https://karenshragg.medium.com/for-your-consideration-to-be-anti-growth-is-to-be-pro-humanity-e32a57e8b221 (Accessed 24 October 2022).

Shragg, K.I. 2015. *Move Upstream: A Call to Solve Overpopulation*. Minneapolis – St Paul: Freethought House Press.

Spash, C.L. 2016. 'This changes nothing: The Paris agreement to ignore reality'. *Globalizations* **13** (6): 928–933.

Spash, C.L. 2021. 'Apologists for growth: Passive revolutionaries in a passive revolution'. *Globalizations* 1123–1148. https://doi.org/10.1080/14747731.2020.1824864

Spratt, D. and I. Dunlop. 2021. *'Net Zero 2050:' A Dangerous Illusion*. Breakthrough National Centre for Climate Restoration. Melbourne, Australia: https://52a87f3e-7945-4bb1-abbf-9aa66cd4e93e.filesusr.com/ugd/148cb0_714730d82bb84659a56c7da03fdca496.pdf (Accessed 27 November 2022).

Turiel, A. 2020a. Hydrogen Rush 2.0 (1) *The Oilcrash*: https://crashoil.blogspot.com/2020/11/la-fiebre-del-hidrogeno-20-i.html (Accessed 25 November 2022).

Turiel, A. 2020b. Hydrogen Rush 2.0 (2) *The Oilcrash*: https://crashoil.blogspot.com/2020/11/la-fiebre-del-hidrogeno-20-ii.html (Accessed 25 November 2022).

UN. 2022. *World Population Prospects 2022: Summary of Results*. United Nations Department of Economic and Social Affairs: https://www.un.org/development/desa/pd/content/World-Population-Prospects-2022 (Accessed 20 October 2022).

Washington, H., I. Lowe and H. Kopnina. 2020. 'Why do society and academia ignore the "scientists warning to humanity" on population?' *Journal of Futures Studies* **25** (1): 93–106. https://doi.org/10.6531/JFS.20200_25(1).0009

Wexler, B.E.W. 2006. *Brain and Culture: Neurobiology, Ideology and Social Change*. Cambridge, MA: MIT Press.

Wilkinson, R. and K. Pickett. 2010. *The Spirit Level – Why Equality is Better for Everyone*. London: Penguin Books.

10.3197/JPS.63799953906861

PEER REVIEWED ARTICLE

Challenging pronatalism is key to advancing reproductive rights and a sustainable population

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Abstract

Social and environmental justice organisations have silenced discourse on human overpopulation due to fear of any association with reproductive coercion, but in doing so they have failed to acknowledge the oppressive role of pronatalism in undermining reproductive autonomy. Pronatalism, which comprises cultural and institutional forces that compel reproduction, is far more widespread, and as damaging to individual liberties as attempts to limit reproduction. The failure to recognise the enormity of pronatalism has led to the wholesale abandonment of voluntary, rights-based efforts toward a sustainable population despite widespread scientific agreement that population growth is a major driver of multiple cascading environmental crises. We examine the full range of patriarchal, cultural, familial, religious, economic and political pronatalist pressures, and argue that the reluctance to address population as a driver of the ecological crisis serves the very pronatalist forces that undermine reproductive autonomy. We posit that addressing overpopulation, and the pronatalism that drives it, must be central to international conservation and development efforts to elevate reproductive rights while also promoting planetary health.

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Introduction
Scientists are in general agreement that human population growth, as well as unsustainable production and consumption, are the main drivers of current levels of unprecedented and likely irreversible environmental destruction. Yet, notwithstanding widespread evidence of ecological overshoot, encompassing urgent concerns such as climate change, the biodiversity crisis, the depletion of soils and material resources, desertification and growing scarcities of fresh water (Rees, 2020; Bradshaw et al., 2021; Crist et al., 2022; IPCC, 2022), there is a tendency in both popular and academic circles to ignore, minimise and dismiss population as a factor in conservation (Bajaj, 2022). Although this tendency is rooted in concern over the history of population stabilisation efforts, which included coercive measures that violated women's reproductive autonomy, it ignores the prevalence of efforts to advance reproductive freedom through voluntary family planning and contraception in the history of international population activities, as well as the overwhelming benefits of these efforts to women and the environment. It also ignores the extent to which coercive pronatalism – which comprises the social and institutional pressures to bear children – has been a far more pervasive and equally destructive force in women's lives.

In this paper, we begin by establishing the link between human population and environmental destruction, then outline the history of international interest and action toward addressing this link. We review how, since the latter half of the last century, a period of international investment in family planning intended to lower birth rates and stabilise population growth has transitioned to an era in which such efforts have been largely abandoned. Furthermore, we show how disparate forces converged at the 1994 International Conference on Population and Development (ICPD) in Cairo, Egypt to cement the shift from a direct focus on family planning to a focus on the rights of women to choose the size of their families (Kopnina and Washington, 2016; Sinding, 2016; Kuhlemann, 2019; Coole, 2021). We discuss how the shift embodied in the Cairo Consensus fails to acknowledge that reproductive choice is strongly shaped by social and institutional pressures.

We argue that these pronatalist pressures, driven by patriarchal, social, cultural, political, economic, religious and nationalistic agendas, constitute a form of

reproductive coercion that is more widespread and impactful than the coercive population stabilisation efforts of the past and present that have played in the silencing of population discourse. We conclude by arguing that acknowledging and dismantling the many forms of pronatalism, which directly drive population growth, is key to both addressing the environmental crisis and elevating reproductive rights and self-determination.

Population and environmental destruction

Runaway human population growth and unconstrained consumption have led us to a state of ecological overshoot in which we are straining Earth's ecosystems far beyond their capacity to regenerate (Rees, 2020; GFN, 2022). The climate crisis and biodiversity collapse are threatening the continuation of life on Earth, causing catastrophic upheaval to human communities and driving many already imperilled species ever closer to the brink of extinction (Crist et al., 2017; Bradshaw et al., 2021). Agriculture alone, and its rapid expansion to meet the needs of our growing population, has been identified as the primary threat to 86 per cent of the species at risk of extinction. This is no surprise, given that deforestation and habitat destruction have converted roughly 40% of the planet's ice-free land area to crop production and livestock grazing (Crist et al., 2017). The magnitude of the biodiversity crisis can perhaps best be conveyed with the fact that, since the advent of agriculture 10,000 years ago, and compounded by the Industrial Revolution and the explosion of human population growth over the past 200 years, the biomass of terrestrial vegetation has diminished by half and that of wild animals by 83 per cent. Of the total biomass of terrestrial vertebrates, 59 per cent is represented by livestock, 36 per cent by human beings, and about five per cent by wild mammals, birds, reptiles and amphibians (Bar-On et al., 2018; Bradshaw et al., 2021).

Much of this destruction is of course attributable to the consumption habits of wealthy, western populations – consumers of meat, animal products and processed foods in the developed world. But with the human population projected to increase to ten billion by the 2080s, and half of that number among the middle class by 2030, demand for these agricultural products will inevitably grow (Crist et al., 2017). Indeed, as the demographic transition occurs when human populations achieve lower fertility rates, generally after they have reached higher levels of development and thus environmental impact, it is clear that the role of population growth in multiplying the effects of consumption cannot be

dismissed (Samways, 2022). Even with respect to climate change, where the vast majority of emissions come from populations in wealthy, low fertility countries, the foremost scientific body concerned with developing solutions to climate change, the Intergovernmental Panel on Climate Change (IPCC), recognises population growth as a substantial driver (IPCC, 2022). In fact, although economic growth has been the most significant driver of the global growth in carbon emissions since 1990, Chaurasia (2020) has shown that population growth accounted for around a third of the increase in emissions, and that improvements in energy efficiency and the transition to renewable energy technologies can only offset part of the emissions increases and other negative environmental effects of growth in population and per capita wealth. In addition, even outside the developed world, the impacts on biodiversity of subsistence agriculture (Kopnina and Washington, 2016), and the bushmeat trade (Ripple et al., 2016), which are growing along with population in the developing world, are undeniably significant.

Taken together, the enormity of these challenges represents not just an existential threat to planetary ecosystems and other species but also extraordinary suffering for our own species. The loss and compromise of ecosystems the world over, changed weather patterns, sea level rise, increasing war and conflict, emerging infectious diseases, toxic waste and pollution and food and water shortages are already taking an enormous toll on human communities, especially those who are already the most impoverished (Crist et al., 2022).

The silencing of population discourse

And yet, in recent decades the international conservation and development community has entertained a deafening silence on the importance of population to environmental conservation. Particularly since the ICPD, nongovernmental organisations, academics, policymakers and others concerned with conservation and development have been reluctant to acknowledge human overpopulation as a driving force behind these challenges (Kopnina and Washington, 2016; Sinding, 2016; Kuhlemann, 2019; Coole, 2021; Tucker, 2021). As a consequence, family planning[3] availability as a policy goal of international development has much diminished and has yet to recover its former prominence and funding, although

3 Here we use the term 'family planning' as it is commonly used as a synonym for using contraception to limit family size. We acknowledge, however, that the term privileges 'family' – and in particular traditional, heteronormative biological family – even though these institutions are toxic for many women.

recent years have witnessed some resurgence of interest (Bongaarts et al., 2012; Sinding, 2016).

This shift away from family planning is generally attributed to the conflation of any such efforts with reproductive coercion. Many of the architects of the Cairo Consensus, fearful of repeating the egregious human rights violations that had been committed in the name of population stabilisation, did everything in their power to centre discussions of population and development around women's health, empowerment and rights. However, as they invoked eugenics movements in the United States and Europe, India's and Puerto Rico's coercive sterilisation campaigns and China's one-child policy, they framed all previous population investment as coercive. In doing so, they dismissed the vast majority of voluntary international family planning efforts that had played a dramatic role in women's reproductive liberation in the preceding decades. In their concern to avoid undermining women's rights and autonomy, they set in motion changes that unravelled decades of progress for these very interests (Sinding 2008, 2016; Campbell and Bedford, 2009; Potts, 2014; Tucker, 2021).

In addition, seldom acknowledged is the influential role of the Vatican and other conservative ideological actors, whose active lobbying of delegates at the conference contributed to the consensus that derailed the family planning activities they opposed (Sinding, 2008; Coole, 2021; Tucker, 2021). The involvement of these actors may partially explain the failure of conference delegates to consider another major source of reproductive coercion: pervasive pronatalist forces that compel women globally to have children for familial, political, economic, religious or nationalistic reasons that undermine their own reproductive self-determination.

> Oddly, though, there was little attention paid to the coercion involved in forcing women to have pregnancies they did not want, which were and continue to be today, multiples larger. The disproportionate emphasis on coercive family planning helped to develop a strategy during the ICPD process for positioning issues about pregnancy and childbearing under a broad area of health problems that are particular to women, with the new title 'reproductive health'. As this term became widely accepted, the term 'family planning' became politically incorrect to use by itself in the policy and philanthropic communities (Campbell and Bedford, 2009: 3104).

This shift brought about the cessation of an extraordinary period of international cooperation and investment, whose targeted efforts, beginning in the mid-1960s, to extend rights-based contraceptive assistance to high-fertility countries, brought about a decline in fertility rates in those countries from an average of six children per woman in 1965 to fewer than three by 2008. Following this period of intensive international assistance for voluntary family planning in the 1970s and 1980s, since 1995 international funding for family planning has decreased by 35 per cent and still falls far short of meeting the global unmet need for contraception (Sinding, 2008).

To this day, the shift in focus since the Cairo Consensus has resulted in censoring of discourse and action surrounding overpopulation as a driving force underlying increasingly urgent environmental concerns (Campbell and Bedford, 2009; Kopnina and Washington, 2016; Kuhlemann, 2019; Coole, 2021). It is aided by elements of the political left who are suspicious of any interventions for demographic purposes (Roche, 2020) and argue with some justification that the environmental impacts of high fertility populations in the developing world are a small fraction of those in wealthy nations, and that even to raise environmental concerns in association with high fertility countries amounts to 'racism' (Kopnina and Washington, 2016).

But these narratives have not just constrained our ability to address ecological degradation. They have also harmed the very women for whose benefit they are supposedly disseminated. The report arising from the Cairo Consensus stated:

> All couples and individuals have the basic right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to do so (UN, 1994).

This emphasis on individual rights assumes that the fertility choices made 'freely' by women and couples are actually based upon their individual preferences. It assumes that once the 'information, education, and means' for family planning are provided, individuals will make authentic reproductive choices. The 'right to choose' approach assumes that:

> Free choice and voluntarism now exist and that they are marred only by incomplete distribution of contraceptives …[It fails to take] into

> account that at present, reproductive behaviour is under stringent institutional control and that this control constitutes, in many respects, a coercive pronatalist policy (Blake, 1974: 85).

Here we argue that, although continued lack of contraceptive access certainly does thwart women's reproductive empowerment – with 257 million women globally facing an unmet need for contraception, contributing to nearly half of all pregnancies being unintended (UNFPA, 2022) – it is far from the only factor impeding realisation of true reproductive autonomy.

Pronatalism exerts its influence in many forms

For a full understanding of factors impacting fertility, reproductive autonomy and population growth, we must account for the pervasiveness of pronatalism.

> Pronatalism is a social bias toward having children. No doubt because of its importance to human survival as a species it operates via a wide variety of mechanisms, ranging from the subtle to the overt, and from 'freely-chosen' to the coercive. Its measures are a cheap way of ensuring that people have children. Its premise is that reproduction is normal and 'natural' (Purdy, 2019: 113).

Pronatalist assumptions and pressures permeate every aspect of life for most women in cultures across the globe. Pronatalist discourse ranges from pressures for children or grandchildren exerted by family members, to religious messaging that encourages large families while stigmatising the childfree, to political restrictions on contraceptive use and abortion bans (Bajaj, 2022). In most cultures, voluntarily childless women are considered not just abnormal but dangerous, as they pose a threat to patriarchy by defying the institution of motherhood (Rich, 1995).

The authority and force of pronatalism are based on the premise that there exists a universal biological urge to procreate. Yet, fluctuating birth rates over time and across societies indicate that any 'urge' for biological offspring is largely socially constructed (Hollingworth, 1916; Carroll, 2012). In fact, women's stated preferences for number and timing of children vary in accordance with the norms of the community in which they reside (Dasgupta and Dasgupta, 2017).

Reproductive decision making is powerfully shaped by conformity with pronatalist social norms most often upheld by patriarchal religious and community leaders, as well as by politicians with economic, nationalist or military interests in the foreground. Given that the number of children that women desire is a social construct within a hegemonic framework of pronatalism – which is, so to speak, the water in which we are swimming – we must deconstruct that cultural landscape in order to illuminate the fertility level that women anywhere in the world might truly desire outside this construct (Hollingworth, 1916; Purdy, 2019).

Familial, cultural and social pronatalism

Some of the most intense pronatalist pressures women encounter are those that originate within their own families and generally stem from a desire to maintain the family's genealogical legacy. These pressures result in extreme social stigmatisation for women who cannot or do not fulfil this expectation. In diverse cultures across the world, childlessness and struggles with fertility result in feelings of abnormality, marginalisation and stigmatisation for women (Wells and Heinsch, 2019). Childless women in cultures as diverse as India (Hussain, 2009), Ghana (Ofosu-Budu and Hanninen, 2020), Nigeria (Naab et al., 2019), Gambia (Dierickx et al., 2018), Jamaica (Sargent and Harris, 1992) Australia (Turnbull et al., 2016) and China (Fu et al., 2014) are subject to stigmatisation, social isolation, negative economic consequences and marital neglect, abuse and divorce. For rural Punjabi childless women in Pakistan, the failure to produce a child is perceived as a communicable disease that warrants social isolation (Qamar, 2018). For many women, pronatalist pressure from their partners may be so strong, and so in opposition to their own desires to limit reproduction, that they engage in covert use of contraceptives (Heck et al., 2018).

Beyond pressures from their own families, women experience powerful pressure to reproduce from popular media and culture. Product advertising is full of images that paint motherhood as idyllic, and although the motivation may be simply to sell more product, the effect is to reinforce the cultural narrative that motherhood is the only complete manifestation of womanhood (Gotlib, 2016). Women's magazines, as well as the proliferation of mommy blogs and parenting sites, glorify and sentimentalise parenthood. Celebrity gossip fixates on the latest actor or influencer to exhibit a baby bump, and popular movies and television programmes frequently use pregnancy to 'complete' the character arc of a female

protagonist (Kaklamanidou, 2018). Neoliberal feminism has only advanced this narrative, as its advocacy for women to 'have it all' embodies the assumption that motherhood is mandatory to fulfilment (Rottenberg, 2017). Meanwhile, seldom does popular culture glorify or even mention the experience of those who are happily childfree.

The result of this popular cultural fixation on pregnancy, motherhood and 'family' as defined by the presence of biological children results in the marginalisation of single adults, childfree people, LQBTQ+ people, adoptive families and families that do not include offspring (Latchford, 2019; Bajaj and Ware, 2022). Widespread religious and cultural stigma surrounding abortion, which includes public protests around abortion clinics, misinformation that conflates contraceptives with abortifacients, and the growing scarcity of abortion providers even in those countries in which it is still legal, adds to the psychological burden of women as they wade through the already emotionally fraught landscape of carrying a pregnancy to term, and constrains women's reproductive choice and autonomy (Adair and Lozano, 2022).

One perspective that has been largely missing from these cultural narratives until recently is that of parents who regret their choice. While women without children are frequently warned of the possibility of regretting their absence – so frequently, in fact, that they may experience regret simply due to the power of suggestion (Alexander et al., 1992) – only recently has our cultural narrative begun to include the stories of those who regret being parents. A proliferation of popular media articles (e.g. Karklin, 2022; Mateo, 2022; Njoki, 2022), and sites like the popular Facebook Group 'I Regret Having Children' and the Reddit group 'Regretful Parents' has only recently begun to break through the powerful cultural taboo on parental regret, which is reinforced through societal judgement of women who defy the paradigm of women finding fulfilment in parenthood (Hollingworth, 1916; Donath, 2015). The mere existence of their regret is enough to bring extraordinary guilt and shame upon women who experience it, regardless of how completely they may love and provide for their children (Donath, 2015).

Medicalised pronatalism

Many individuals undoubtedly feel an authentic desire for children, and experience grief and loss as a result of infertility. But these feelings of inadequacy

are compounded by the enormous cultural stigma surrounding childlessness. The multi-billion dollar fertility industry has capitalised on this stigma, and contributed to the pronatalist pressures childless people experience and the sense of inferiority surrounding adoption and non-biological motherhood (Bell, 2019; Latchford, 2019).

Initially a medical specialty focused strictly on infertile couples, in-vitro fertilisation and other Assisted Reproductive Technologies (ART) in 2021 accounted for a $25 billion global industry. While undoubtedly of enormous value in helping infertile and LGBTQ+ people realise their reproductive desires, this industry also markets itself aggressively to a much broader population, offering expanded fertility services – many of which are of dubious clinical validity (Patrizio et al., 2022). Many studies have found the websites and marketing of the industry to be full of misleading claims, while 'survivors' of ART endure enormous financial, emotional and physical duress (Tsigdinos, 2022). The industry continues to capitalise on the sense of 'biological fault' experienced by infertile women (Wells and Heinsch, 2019), successfully exploiting the cultural glorification of biological motherhood to grow at an annual rate of nine per cent, with projected growth to a global $41 billion industry by 2026 (Patrizio et al., 2022). Meanwhile, adoption continues to decline (Bell, 2019).

This stigmatisation of infertility has allowed the industry to manufacture demand for its own services. Prior to the advent of reproductive technologies, infertility was viewed primarily as a social condition (Becker and Nachtigall, 1992). Since 1975, however, infertility has been medicalised and its definition broadened to include couples who have been trying to conceive for only one year, in contrast to the earlier criterion for diagnosis which was five years of trying to conceive without success (Madge, 2011). This medicalisation of the circumstance in which sexual intercourse does not result in pregnancy reinforces the message that there is something wrong with women and couples who do not or cannot conceive, and fuels the urgency many couples feel around becoming pregnant at all costs. The medical profession is but one particularly influential sector of a society whose bias for biological motherhood exerts powerful pressure upon women to endure great expense and physical discomfort to choose ART over adoption, which was once considered the obvious solution to infertility (Nandy, 2017; Bell, 2019; Latchford, 2019).

The notion of the 'biological clock' adds to a sense of urgency surrounding motherhood. The term first emerged in the mainstream press in the United States in the late 1970s, at a time of enormous social change where the breakdown of gender segregation, occasioned by the entry of large numbers of women into the workforce, created a need for new norms to regulate gender and reproduction along received pathways. The 'biological clock' became a culturally significant concept that helps to streamline women's lives along a traditional, culturally sanctioned pathway (Amir, 2006).

> The 'biological clock' that some women claim to hear ticking is also a 'social clock' reminding them that whatever else may be going on in their lives, motherhood is their destiny, the road to social acceptance and integration (Gimenez, 2019).

While based in the biological fact of diminished fecundity as women age, the term has become a convenient trope that allows avoidance of earnest exploration of a woman's true desires in favour of invoking an urgent and time-sensitive 'biological' imperative. Yet there is no evidence of such an imperative, otherwise fertility rates all over the world would be consistent and high, and rates of childfree adults would not have climbed in recent decades in countries where women have some freedom of reproductive choice (Carroll, 2012). The longing for meaning that many women – and men – feel around midlife is attributed by a pronatalist society to the 'biological clock', when, in fact, many other experiences besides childbirth can provide the sense of meaning and purpose that is sought (Stade, 2022). The biological clock notion has conveniently been exploited by the ART industry to market technologies such as egg freezing to increasingly younger women (Wyndham et al., 2012). Meanwhile neoliberal feminism has increased demand for such technologies with its insistence that career need not come at the expense of motherhood (Rottenberg, 2017).

While medicalised pronatalism fuels a sense of urgency among women who may be ambivalent about having children, it is also used to police the fertility of women who want none. These women may find themselves unable to locate a doctor willing to perform sterilisation, instead finding only practitioners who paternalistically assure them that they will regret having made that choice (Lalonde, 2018; McQueen, 2019).

For those women who do undergo pregnancy and childbirth, medicalised pronatalism continues to exert a powerful influence over the narratives that surround those experiences. Postpartum depression has increasingly been medicalised (Regus, 2007), signalling that the sadness and regret experienced by new mothers is solely a medical condition that must be treated, rather than a rational response to the sleeplessness, physical pain, loss of autonomy and dread of a radically changed future that are part of the postpartum experience. The prominence of medicalised postpartum depression narratives in popular culture serves to marginalise true feelings of ambivalence about motherhood, undermine frank and open examination of parental regret, and ensure that it is erased from the stories that reach young people considering parenthood.

Religious pronatalism

Religion is a pervasive element of most cultures, and the majority of religious traditions have strongly pronatalist teachings. Many branches of Christianity and Islam, the two largest religions in the world, include the moral imperative to procreate in order to fulfil religious duty. Conservative Christianity exalts women who fulfil that role and the babies they produce and shames women who cannot or do not fulfil it, while also pushing for coercive measures including the Catholic ban on modern forms of contraception (Carroll, 2012; de la Croix and Dellavalde, 2018) and bans or restrictions on abortion in many countries (Graff et al., 2019).

Judaism is also at its foundation a highly pronatalist tradition, with the Biblical commandment to 'be fruitful and multiply', as well as Biblical narratives depicting the suffering of infertile women, exerting a powerful push toward procreation for religious Jews (Raucher, 2021). The Holocaust gave rise to additional pronatalist pressures, with religious leaders calling for high fertility to enable Jews to 'replenish the Earth', while in Israel a combination of nationalism, the religious establishment and patriarchal 'familism' have so strongly promoted pronatalism that Israel has one of the highest fertility rates in the industrialised world (Courbage and Portugese, 2000; Fargues, 2000; Donath, 2015).

The recent ascendancy of right-wing populism across the globe has amplified the longstanding influence of religion in perpetuating gender inequality and pronatalist cultural norms. An alliance among right-wing nationalists, populists, traditional conservatives and religious fundamentalists has enabled these elements

to rise to prominence, giving them political power in countries as diverse as the Philippines, Hungary and the United States to enact increasingly strict abortion and other pronatalist policies (Graff et al., 2019). Central to these movements is a narrative that exalts masculinity, oppresses women and LGBTQ+ communities, and hinges on traditional gender roles to fuel demographic growth of desired ethnic groups (Gökarıkselet al., 2019). In Modi's India, this narrative also invokes threats of a surging Muslim majority, when in actuality the Muslim population had remained a steady minority for over fifty years (Quraishi, 2021). A similar insidious alliance between fundamentalist religion, white-supremacist ideology and right-wing populism animates recent calls for elevated fertility in Poland (Graff et al., 2019) and among white Germans (Gökarıksel et al., 2019), and fuels rhetoric in the United States about the displacement of the White race (Farivar, 2022).

Tribal, nationalistic and state-sponsored pronatalism

Wherever religion is highly embedded in the affairs of the state, religious pronatalism may be indistinguishable from nationalistic pronatalism. In Israel, religious pronatalism serves nationalistic ends as it seeks to advance the state's goal of Jewish demographic superiority to Palestinians; this 'demographic war' with Palestinians is among the factors underlying Israel's status as the foremost user of reproductive technologies in the world, wherein the state actually finances women's use of these technologies to give birth to their first two children (Raucher, 2021; Donath et al., 2022).

Palestinian fertility is shaped by similar socio-political influences, which are encapsulated in Palestinian leader Yasser Arafat's famous quote 'the womb of the Arab woman is my strongest weapon' (Mor and Rezek, 2017). Palestinians exhibit continued high fertility patterns despite high levels of education and low levels of infant mortality, which in other developing countries are predictors of lowered fertility (Pell, 2016).

State-sponsored pronatalism for economic and political purposes is far from unique to religious states. Women's reproductive capacity is frequently used as a tool to realise demographic, economic and nationalist goals. In Romania, for example, the Ceauşescu government in 1966 responded to below-replacement fertility by restricting access to abortion while implementing a number of other pronatalist policies; these policies resulted in an immediate spike in birth rate

(Hodgson, 2013). Similarly, following the War of Independence in the early twentieth century, Turkey turned to strong pronatalist policies to increase birth rates; when high birth rates started to threaten the economy in the 1960s, the government once again intervened to legalise contraception and abortion. The highly nationalistic Erdoğan government has now reinstated abortion bans and other pronatalist policies to arrest declining fertility rates (Dayi and Karakaya, 2019; Telli et al., 2019).

In Russia, President Vladimir Putin has recently revived the Stalin-era 'Mother Heroine' award in response to low birth rates, an honour that confers a substantial cash payment to women once their tenth child turns one year old (Bridger, 2007; Pavlova and Guy, 2022). This policy builds upon long standing Soviet and post-Soviet pronatalist policies with a goal of increasing the birth rate to grow the labour force and strengthen the nation (Rivkin-Fish, 2010). In this case, as with Turkey, religion has acted in concert with nationalistic and economic concerns to amplify pronatalist policies; the Russian Orthodox Church has been heavily influential in proposals to restrict abortion (Balmforth, 2015).

Pronatalism serves economic ends by ensuring a steady supply of workers, consumers and taxpayers. Its proponents also cite the need for high fertility rates to spur innovation, based on the assumption that it will automatically spring from a larger pool of potential inventors (Corfe and Bhattacharya, 2021) – while ignoring that the women stuck caring for large broods of offspring will likely experience constraints in the realisation of their innovative spirit. Popular figures such as Elon Musk, who has nine living children of his own and 103 million followers on Twitter, contribute to pronatalist discourse with statements like 'Doing my best to help the underpopulation crisis', and 'Population collapse is the biggest threat to civilization' (Neal and Neal, 2022).

Although rapid population growth by the middle of the last century led a number of countries to adopt national policies intended to limit fertility, the emergence of ageing populations and low birth rates in the latter half of the century has led many developed countries to adopt pronatalist policies (UNDESA, 2021). Ageing populations are increasingly viewed with alarm by economists, who are apparently unable to imagine a means of supplementing social security coffers (such as, to list only the most obvious, increasing taxation of the wealthy (Götmark

et al., 2018)) that does not involve coercing or bribing women to produce ever-growing cohorts of wage earners and taxpayers (Corfe and Bhattacharya, 2021).

As fertility has declined in developed countries, state-sponsored pronatalism has reached a fever pitch. Media coverage and popular literature have fanned the flames with sensationalist coverage that frames fertility decline as a 'collapse' or 'crisis' of existential proportions (Bricker and Ibbitson, 2020; Gordon, 2022; Mitter, 2022; Wallace, 2022). British newspapers in the early 2000s framed women's reproductive decisions as a matter of responsibility to protect the nation's identity from the looming threat posed by immigrants. In Italy, coverage of low fertility rates has questioned the morality and rationality of women who make that choice (Brown and Ferree, 2005) while political candidates in the United States have raised similar questions (Bruenig, 2021).

More than fifty countries now have policies to increase birth rates. Indeed, the number of countries with explicitly pronatalist policies – ranging from tax incentives and baby bonuses to abortion bans – rose from ten per cent in 1976 to 28 per cent in 2015 (UNDESA, 2021). In Iran, following a national family planning effort that led to significantly diminished fertility by 2006, political instability and economic sanctions have brought economic hardship and renewed pronatalist policies (Farvardin, 2020). In China, whose one-child policy in place from 1980–2016 is often invoked to warn against the dangers of 'population control', a two-child policy implemented for the explicit purpose of advancing GDP growth has recently been replaced by a three-child policy (Golley, 2017; Tatum, 2021).

In Hungary, concerns about preserving national identity, particularly against the influx of refugees in 2015, have prompted state policies offering financial incentives to heterosexual couples with children, including debt reduction and tax incentives to families with three or more children (UNDESA, 2021; Fodor, 2022).

In Poland, parents receive monthly financial payments for every child after the first (Dildar, 2022), while in Japan, state intentions of raising the low national birth rate to 1.8 resulted in the appointment of an obstetrician as Special Advisor for Low Birth Rate Countermeasures and Childrearing Support from 2013–2020 (Fassbender, 2021). Child tax credits paid to the primary caregiver, and federal policies mandating maternity leave, have the effect in cultures as disparate as

Canada and India of both encouraging childbirth, and reinforcing traditional gender roles in which a married woman cares for children while her spouse continues to work (Bhambhani and Inbanathan, 2020). While child tax credits and parental leave policies can irrefutably address socioeconomic disparities and reduce child poverty, these noble intentions might obscure motivations that are fundamentally pronatalist.

Several countries are so invested in raising birth rates for nationalistic reasons that they have resorted to state sponsorship of assisted reproductive technologies. In Iran (Tremayne and Akhondi, 2016), Turkey (Gürtin, 2016), India (Madge, 2011; Nandy, 2017) and Hungary (UNDESA, 2021), in addition to Israel, state-sponsored IVF treatment is marketed to women of reproductive age to encourage them to contribute children for the strength of the nation.

While many government entities enact policies that encourage biological parenthood, most have erected enormous barriers to adoption (Nandy, 2017). In addition to the exorbitant expense, prospective adoptive parents must endure lengthy waiting periods and bureaucratic effort to adopt a child, a process that ostensibly is in place to ensure suitable adoptive parents – although none of these barriers are raised to people considering biological procreation (Latchford, 2019). Thus, the incentive structure in place militates against couples who for environmental or other reasons would prefer to take care of an already-existing needy child, instead of bringing yet another child into the world.

Restrictions on abortion are an enormous part of our intensely pronatalist cultural landscape. Globally, 26 countries – impacting five per cent of women of reproductive age – restrict abortion altogether, while another 95 countries – impacting 36 per cent of women of reproductive age – allow abortion only to save the life or health of the mother (Center for Reproductive Rights, 2022). Restrictive abortion policies, which are highly correlated with high national fertility and unintended pregnancy rates (UNDESA, 2014; Bearak et al., 2020), are increasingly likely in countries where low fertility has been achieved and has persisted.

In these countries, demographic arguments are exploited by those who oppose abortion for religious or ideological reasons. The Vatican itself has joined the chorus of voices condemning abortion for its impacts on countries' social and

economic wellbeing, calling for abortion restrictions to stave off a 'demographic winter' brought on by low fertility rates (Hodgson, 2013).

In industrialised countries, state-sponsored pronatalism most often takes the form of reproductive policies seen as 'liberal' and 'family-friendly', such as parental leave, affordable child care, and part-time work for women with children. While these policies are undoubtedly desirable from a human rights framework, for many countries, their motivation is less humanistic than demographic.

Pronatalism in marginalised and colonised populations

Pronatalism emerges in particularly complex ways in communities impacted by genocide, slavery, eugenics and colonialism. Israel's pronatalism in part proceeds from calls to repopulate following the Holocaust (Fargues, 2000). Similarly, in Black communities in the United States, pronatalism has emerged in part as a response to the eugenics movement, the later phases of which targeted Blacks with forced sterilisation in the 1950s and 1960s, and to slavery itself in which Black women's reproduction was a tool for enriching the enslavers and propagating the institution (Kerr, 2016; Bajaj and Ware, 2022). In Puerto Rico, following the US government's egregious forced sterilisation of approximately one-third of Puerto Rican women in the middle of the twentieth century, many women are now opting for voluntary sterilisation as a convenient form of permanent contraception. Some feminists have propagated the narrative that this choice is doing the work of colonists – an argument that is handily wielded by religious leaders, giving them cover to promote pronatalism as a corrective measure for past reproductive injustices (Briggs, 1998). Similarly, India's coercive family planning programme in 1975–1976 that resulted in at least eight million sterilisations has, like China's one-child policy, become an object of universal condemnation (Gwatkin, 1979). On top of the reproductive and physical abuse of those who were already the most marginalised in Indian society, this programme definitively rendered any prospective family planning discourse suspicious. The overcorrection of grievous past injustice has only fortified the existing culture of coercive pronatalism that persists throughout much of India.

Suppression of population efforts has harmed women

It is clear that the many ways in which pronatalism permeates our political and cultural landscape have an undeniable impact on the fertility decisions made

by individuals, and on the population growth that results from these collective decisions – and hence on our increasingly urgent environmental predicament.

But it is also abundantly clear that the Cairo Consensus' de-emphasis on population and demographic concerns, the consequent withdrawal of support for family planning, and the ongoing denial of the importance of population stabilisation and reduction, have been harmful to the women and vulnerable populations it was intended to serve. Targeted aid to provide access to family planning, in addition to its success in increasing contraceptive use and reducing fertility, has been found to reduce maternal deaths, improve women's health and autonomy, increase household earnings, pre-empt conflict and political instability and reduce poverty (Bongaarts et al., 2012; Potts, 2014). Nearly all future population growth will occur in less developed countries, where women's status is already poor. Rapid population growth is producing large numbers of poorly educated youth in these countries, with little hope of improved economic prospects – conditions that are likely to increase violence and conflict, complicate governance and worsen the lives of women. It also degrades the natural environment and ecosystem services that are so vital to quality of life, especially for vulnerable populations in the developing world (Potts, 2014; Kopnina and Washington, 2016).

While criticism of family planning for demographic ends arises from an abundance of caution to avoid any hint of reproductive coercion preventing women from bearing children they want, there has been little attention to the much greater prevalence of reproductive coercion in the opposite direction: pronatalism that forces women to bear children they may not want. The suppression of the population conversation and of funding for family planning have directly abetted these pronatalist forces by denying women the means to plan their desired family size (Kopnina and Washington, 2016).

Contrary to the assumptions of those who demonise open discourse and advocacy surrounding family planning, there is every indication that the small family size it enables is itself a benefit for women. In cultures where improved education and contraceptive access for women has resulted in lowered fertility, staggering amounts of national investment in pronatalist incentives are insufficient to compel women to go back to the high fertility rates they have left behind. Countries such as Iran (Tremayne and Akhondi, 2016), China (Golley, 2017) and Japan (UNDESA, 2015) achieved lowered fertility as a result of improved conditions for women

and access to family planning, and are attempting unsuccessfully to convince women to reverse the trend. The failure of these attempts to produce the desired demographic goals does not mitigate the harm to women's autonomy and reproductive health of increasingly coercive pronatalist measures.

This failure suggests that the 'free and responsible' reproductive choices championed by the Cairo Consensus tend, in the presence of real reproductive and economic autonomy for women, toward lower fertility, a choice that has been described as women's 'latent desire' for fewer children (Campbell and Bedford, 2009).

Meanwhile, the diminishment of funding for contraception and reproductive healthcare services has denied women the ability to realise their latent desire. Contrary to the dominant discourse that 'population control' is what must be minimised to achieve reproductive autonomy, given current realities, a far more useful pursuit might be a project to neutralise pronatalism (Purdy, 2019) in addition to restoring direct efforts toward universal provision of family planning.

Conclusion

Taken together, pronatalist messages and policies, and religious, social and cultural constraints are an enormous force limiting the autonomy of reproductive decisions in the world today. These pressures complicate and belie the notion, invoked at the ICPD, that any choice about the number and spacing of children can be considered 'free'.

In an environment so shaped by pronatalism, that 'choice' is a poor foundation for reproductive policy discussions and women's rights. And by silencing discussions about overpopulation, representatives of the international environmental conservation and development community are themselves carrying water for pronatalist and patriarchal forces that insist women's primary and inarguable function is to bear children.

While the population taboo arises from a worthy concern for women's reproductive rights that have so frequently been subjugated to other concerns deemed more pressing, we do women no favours by refusing critical examination of population growth and its root causes. On the contrary, frank discussions of the role of population size and growth in causing environmental destruction –

along with healthy policy discourse on how best to neutralise the pronatalist forces that undermine reproductive autonomy – are essential to full realisation of reproductive rights as well as environmental sustainability across the globe.

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References

Adair, L. and N. Lozano. 2022. 'Adaptive choice: Psychological perspectives on abortion and reproductive freedom'. *Women's Reproductive Health* **9** (1): 1–26. https://doi.org/10.1080/23293691.2021.1999624.

Alexander, B.B., R.L. Rubinstein, M. Goodman and M. Luborsky. 1992. 'A path not taken: A cultural analysis of regrets and childlessness in the lives of older women'. *The Gerontologist*, **32** (5): 618–626.https://doi.org/10.1093/geront/32.5.618.

Amir, M. 2006. 'Bio-temporality and social regulation: The emergence of the biological clock'. *Polygraph: An International Journal of Culture and Politics* **18**: 47–72.

Bajaj, N. 2022. 'Dismissal of "population alarmism" is rooted in pronatalist ideology'. *In-Depth News*, 3 November. https://www.indepthnews.net/index.php/opinion/5709-dismissal-of-population-alarmism-is-rooted-in-pronatalist-ideology (accessed 5 November 2022).

Bajaj, N. and A. Ware (Hosts). 2022. 'Dr. Kimya Nuru Dennis: The unique challenges of being Black and childfree'. (No. 75) [Audio podcast episode] In The Overpopulation Podcast. *Population Balance*, 24 May. https://www.populationbalance.org/episode-75-the-unique-challenges-of-being-black-and-childfree (accessed 1 September 2022).

Balmforth, T. 2015. 'Russian patriarch calls for abortion curbs, touts conservative values'. *Radio Free Europe Documents and Publications*, 22 January. https://www.rferl.org/a/russia-religion-patriarch-abortion/26807767.html (accessed 1 September 2022).

Bar-On, Y.M., R. Phillips and R. Milo. 2018. 'The biomass distribution on Earth'. *Proceedings of the National Academy of Sciences* **115** (25): 6506–6511. https://doi.org/10.1073/pnas.1711842115.

Bearak, J., A. Popinchalk, B. Ganatra, A.-B.Moller, Ö.Tunçalp, C. Beavin, L. Kwok and L. Alkema. 2020. 'Unintended pregnancy and abortion by income, region, and the legal status of abortion: Estimates from a comprehensive model for 1990–2019'. *The Lancet Global Health*, **8** (9). https://doi.org/10.1016/s2214-109x(20)30315-6.

Becker, G. and R.D. Nachtigall. 1992. 'Eager for medicalisation: The social production of infertility as a disease'. *Sociology of Health and Illness* **14** (4): 456–471. https://doi.org/10.1111/1467-9566.ep10493093.

Bell, A.V. 2019. 'Trying to have your own first; it's what you do: The relationship between adoption and medicalized infertility'. *Qualitative Sociology* **42** (3): 479–498. https://doi.org/10.1007/s11133-019-09421-3.

Bhambhani, C. and A. Inbanathan. 2020. 'Examining a non-conformist choice: The decision-making process toward being childfree couples'. *International Journal of Sociology* **50** (5): 339–368. https://doi.org/10.1080/00207659.2020.1797265.

Blake, J. 1972. 'Coercive pronatalism and American population policy' in R. Parke Jr. and C. Westoff (eds), *Aspects of Population Growth Policy* pp. 85–108. Washington, DC: US Commission on Population Growth and the American Future, USGPO.

Bongaarts, J., J. Cleland, J. Townsend, J. Bertrand and M. Gupta. 2012. 'Executive summary – family planning programs for the 21st Century: Rationale and design'. https://doi.org/10.31899/rh11.1017.

Bradshaw, C.J., P.R. Ehrlich, A. Beattie, G. Ceballos, E. Crist, J. Diamond, R. Dirzo, A.H. Ehrlich, J. Harte, M.E. Harte, G. Pyke, P.H. Raven, W.J. Ripple, F. Saltré, C. Turnbull, M. Wackernagel and D.T. Blumstein. 2021. 'Underestimating the challenges of avoiding a ghastly future'. *Frontiers in Conservation Science* **1**. https://doi.org/10.3389/fcosc.2020.615419.

Bricker, D.J. and J. Ibbitson. 2019. *Empty Planet: The Shock of Global Population Decline*. First ed. New York: Crown.

Bridger, S. 2007. 'Heroine mothers and demographic crises: The legacy of the late Soviet era'. In R. Kay (ed.), *Gender, Equality and Difference During And After State Socialism. Studies in Central and Eastern Europe*, pp. 105–122. London: Palgrave Macmillan. https://doi.org/10.1057/9780230590762_6.

Briggs, L. 1998. 'Discourses of "forced sterilization" in Puerto Rico: The problem with the speaking subaltern'. *Differences* **10** (2): 30–66. https://doi.org/10.1215/10407391-10-2-30.

Brown, J.A. and M.M. Ferree. 2005. 'Close your eyes and think of England'. *Gender & Society* **19** (1): 5–24. https://doi.org/10.1177/0891243204271222.

Bruenig, E. 2021. 'Invasion of the baby-haters'. *The Atlantic,* 11 August. https://www.theatlantic.com/ideas/archive/2021/08/jd-vance-childless-left-culture-wars/619705/ (accessed 1 September 2022).

Campbell, M. and K. Bedford. 2009. 'The theoretical and political framing of the population factor in development'. *Philosophical Transactions of the Royal Society B: Biological Sciences* **364** (1532): 3101–3113. https://doi.org/10.1098/rstb.2009.0174.

Carroll, L. 2012. *The Baby Matrix: Why Freeing Our Minds From Outmoded Thinking About Parenthood & Reproduction Will Create a Better World.* United States: LiveTrue Books.

Center for Reproductive Rights. 2022. The World's Abortion Laws. https://reproductiverights.org/maps/worlds-abortion-laws/ (accessed 1 September 2022).

Chaurasia, A. 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.

Coole, D. 2021. 'The toxification of population discourse. A genealogical study' *The Journal of Development Studies* **57** (9): 1454–1469. https://doi.org/10.1080/00220388.2021.1915479.

Corfe, S. and A. Bhattacharya. 2021. 'Baby bust and baby boom: Examining the liberal case for pronatalism'. *Social Market Foundation.* https://www.smf.co.uk/publications/baby-bust-and-baby-boom/ (accessed 1 September 2022).

Courbage, Y. and J. Portugese. 2000. 'Fertility policy in Israel. The Politics of Religion, gender, and nation'. *Population* (French Edition) **55** (2): 401. https://doi.org/10.2307/1535043.

Crist, E., C. Mora and R. Engelman. 2017. 'The interaction of human population, food production, and biodiversity protection'. *Science* **356** (6335): 260–264. https://doi.org/10.1126/science.aal2011.

Crist, E., W.J. Ripple, P.R. Ehrlich, W.E. Rees and C. Wolf. 2022. 'Scientists' warning on population'. *Science of The Total Environment* **845**: 157166. https://doi.org/10.1016/j.scitotenv.2022.157166.

Dasgupta, A. and P. Dasgupta. 2017. 'Socially embedded preferences, environmental externalities, and reproductive rights'. *Population and Development Review* **43** (3): 405–441. https://doi.org/10.1111/padr.12090.

Dayi, A. and E. Karakaya. 2021. 'Neoliberal health restructuring, rising conservatism and reproductive rights in Turkey: Continuities and changes in rights violations', in A. Dayi, S. Topçu and B. Yarar (eds), *The Politics of the Female Body in Contemporary Turkey: Reproduction, Maternity, Sexuality,* pp. 17–42]. London: I.B. Tauris. https://doi.org/10.5040/9780755617432.ch-001.

de la Croix, D. and C. Delavallade. 2018. 'Religions, fertility, and growth in Southeast Asia'. *International Economic Review* **59** (2): 907–946. https://doi.org/10.1111/iere.12291.

Dierickx, S., L. Rahbari, C. Longman, F. Jaiteh and G. Coene. 2018. '"I am always crying on the inside": A qualitative study on the implications of infertility on women's lives in urban Gambia'. *Reproductive Health* **15** (1). https://doi.org/10.1186/s12978-018-0596-2.

Dildar, Y. 2022. 'The effect of pronatalist rhetoric on women's fertility preferences in Turkey'. *Population and Development Review* **48** (2): 579–612. https://doi.org/10.1111/padr.12466.

Donath, O. 2015. 'Regretting motherhood: A sociopolitical analysis'. *Signs: Journal of Women in Culture and Society* **40** (2): 343–67. https://doi.org/10.1086/678145.

Donath, O., N. Berkovitch and D. Segal-Engelchin. 2022. '"I kind of want to want": Women who are undecided about becoming mothers'. *Frontiers in Psychology* **13**. https://doi.org/10.3389/fpsyg.2022.848384.

Fargues, P. 2000. 'Protracted national conflict and fertility change: Palestinians and Israelis in the twentieth century'. *Population and Development Review* **26** (3): 441–82. https://doi.org/10.1111/j.1728-4457.2000.00441.x.

Farvardin. 2020. 'Reproductive politics in Iran: State, family, and women's practices in postrevolutionary Iran'. *Frontiers: A Journal of Women Studies* **41** (2): 26. https://doi.org/10.5250/fronjwomestud.41.2.0026.

Farivar, M. 2022. 'What is the Great Replacement Theory?' *Voice of America*, 18 May. https://www.voanews.com/a/what-is-the-great-replacement-theory-/6578349.html (accessed 1 September 2022).

Fassbender, I. 2021. *Active Pursuit of Pregnancy: Neoliberalism, Postfeminism and the Politics of Reproduction in Contemporary Japan*. Leiden: Brill. https://doi.org/10.1163/9789004499553_007.

Fodor, Éva. 2022. *The Gender Regime of Anti-liberal Hungary*. London: Palgrave Macmillan.

Fu, B., N. Qin, L. Cheng, G. Tang, Y. Cao, C. Yan, X. Huang, P. Yan, S. Zhu and J. Lei. 2015. 'Development and validation of an infertility stigma scale for Chinese women'. *Journal of Psychosomatic Research* **79** (1): 69–75. https://doi.org/10.1016/j.jpsychores.2014.11.014.

GFN. 2022. 'Measure what you treasure'. Global Footprint Network https://www.footprintnetwork.org/ (accessed 1 September 2022).

Gimenez, M.E. 2019. *Marx, Women, and Capitalist Social Reproduction: Marxist Feminist Essays*. Chicago: Haymarket Books.

Golley, J. 2017. 'Population and the economy: The ups and downs of one and two'. *China Story Yearbook 2016: Control*. Canberra: The Australian National University, ANU Press. https://doi.org/10.22459/csy.06.2017.03.

Gordon, N. 2022. 'China's population will start shrinking sooner than expected, threatening its economy years ahead of schedule'. *Fortune*, 25 July. https://fortune.com/2022/07/25/china-population-decline-collapse-crisis-2025-sooner (accessed 1 September 2022).

Gotlib, A. 2016. '"But you would be the best mother": Unwomen, counterstories, and the motherhood mandate'. *Journal of Bioethical Inquiry* **13** (2): 327–347. https://doi.org/10.1007/s11673-016-9699-z.

Graff, A., R. Kapur and S.D. Walters. 2019. 'Introduction: Gender and the rise of the global right'. *Signs: Journal of Women in Culture and Society* **44** (3): 541–560. https://doi.org/10.1086/701152.

Gwatkin, D. R. 1979. 'Political will and family planning: The implications of India's emergency experience'. *Population and Development Review* **5** (1): 29. https://doi.org/10.2307/1972317.

Gökarıksel, B., C. Neubert and S. Smith. 2019. 'Demographic fever dreams: Fragile masculinity and population politics in the rise of the global right'. *Signs: Journal of Women in Culture and Society* **44** (3): 561–87. https://doi.org/10.1086/701154.

Götmark, F., P. Cafaro and J. O'Sullivan. 2018. 'Aging human populations: Good for us, good for the Earth'. *Trends in Ecology & Evolution* **33** (11): 851–62. https://doi.org/10.1016/j.tree.2018.08.015.

Gürtin, Z.B. 2016. 'Patriarchal pronatalism: Islam, secularism and the conjugal confines of Turkey's IVF boom'. *Reproductive Biomedicine & Society* Online, **2**: 39–46. https://doi.org/10.1016/j.rbms.2016.04.005.

Heck, C.J., S.A. Grilo, X. Song, T. Lutalo, N. Nakyanjo and J.S.Santelli. 2018. 'It is my business: A mixed-methods analysis of covert contraceptive use among women in Rakai, Uganda'. *Contraception* **98** (1): 41–46. https://doi.org/10.1016/j.contraception.2018.02.017.

Hodgson, D. 2013. 'How problematic will liberal abortion policies be for pronatalist countries?', in A. Kulczycki (ed.), *Critical Issues in Reproductive Health*, pp. 153–176. Heidelberg: Springer Dordrecht. https://doi.org/10.1007/978-94-007-6722-5_8.

Hollingworth, L.S. 1916. 'Social devices for impelling women to bear and rear children'. *American Journal of Sociology* **22** (1): 19–29. https://doi.org/10.1086/212572.

Hussain, S. 2009. 'Motherhood and female identity: Experiences of childless women of two religious communities in India'. *Asian Journal of Women's Studies* **15** (3): 81–108. https://doi.org/10.1080/12259276.2009.11666074.

IPCC, 2022: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van

Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781009157926.

Kaklamanidou, B.-D. 2018. 'The voluntarily childless heroine: A postfeminist television oddity'. *Television & New Media* **20** (3): 275–293. https://doi.org/10.1177/1527476417749743

Karklin, D. 2022. 'The women who wish they weren't mothers: An unwanted pregnancy lasts a lifetime'. *The Guardian*, 16 July. https://www.theguardian.com/lifeandstyle/2022/jul/16/women-who-wish-they-werent-mothers-roe-v-wade-abortion (accessed 1 September 2022).

Kerr, C.-G. 2016. *How Pronatalism Became Black: The Path from Black Antinatalism to Black Pronatalism.* Amherst: Amherst College.

Kopnina, H. and H. Washington. 2016. 'Discussing why population growth is still ignored or denied'. *Chinese Journal of Population Resources and Environment* **14** (2): 133–143. https://doi.org/10.1080/10042857.2016.1149296.

Kuhlemann, K. 2019. 'The elephant in the room', in N. Almiron and J. Xifra (eds), *Climate Change Denial and Public Relations: Strategic Communication and Interest Groups in Climate Inaction*, pp. 74–99. London: Taylor & Francis. https://doi.org/10.4324/9781351121798-6.

Lalonde, D. 2018. 'Regret, shame, and denials of women's voluntary sterilization'. *Bioethics* **32** (5): 281–88. https://doi.org/10.1111/bioe.12431.

Latchford, F.J. 2019. *Steeped In Blood: Adoption, Identity, and the Meaning of Family*. Montreal: McGill-Queen's University Press.

Madge, V. 2011. 'Infertility, women and assisted reproductive technologies'. *Indian Journal of Gender Studies* **18** (1): 1–26. https://doi.org/10.1177/097152151001800101.

Mateo, D. 2022. "I had no choice': The people who regret becoming parents'. *Neptune Pine*, 16 July. https://neptunepine.com/i-had-no-choice-the-people-who-regret-becoming-parents/ (accessed 1 September 2022).

McQueen, P. 2019. 'A defence of voluntary sterilisation'. *Res Publica* **26** (2): 23755. https://doi.org/10.1007/s11158-019-09439-y.

Mitter, R. 2022. 'Baby bust: China's looming demographic disaster'. *The Spectator*, 6 August. https://www.spectator.co.uk/article/baby-bust-chinas-looming-demographic-disaster (accessed 1 September 2022).

Mor, T. and Y. Rezek. 2017. 'Pro-natalism policy, demography and democracy – Nonlinear Dynamics Analysis'. *Proceedings of the 2nd International Conference on Complexity, Future Information Systems and Risk*. https://doi.org/10.5220/0006367301240129.

Naab, F., Y. Lawali and E.S. Donkor. 2019. '"My mother in-law forced my husband to divorce me": Experiences of women with infertility in Zamfara State of Nigeria' *PLOS ONE* **14** (12). https://doi.org/10.1371/journal.pone.0225149.

Nandy, A. 2017. *Motherhood and Choice: Uncommon Mothers, Childfree Women*. New Delhi: Zubaan.

Neal, Z.P. and J.W. Neal. 2022. 'More than 1 in 5 Us adults don't want children'. *The Conversation*, 3 August. https://theconversation.com/more-than-1-in-5-us-adults-dont-want-children-187236 (accessed 1 September 2022).

Njoki, L. 2022. 'The brutally honest truth about having kids that no one tells you'. *The Good Men Project*, 19 July. https://goodmenproject.com/featured-content/the-brutally-honest-truth-about-having-kids-that-no-one-tells-you/ (accessed 1 September 2022).

Ofosu-Budu, D. and V. Hanninen. 2020. 'Living as an infertile woman: The case of southern and northern Ghana'. *Reproductive Health* **17** (1). https://doi.org/10.1186/s12978-020-00920-z.

Patrizio, P., D.F. Albertini, N. Gleicher and A. Caplan. 2022. 'The Changing World of IVF: The pros and cons of new business models offering assisted reproductive technologies'. *Journal of Assisted Reproduction and Genetics* **39** (2): 305–13. https://doi.org/10.1007/s10815-022-02399-y.

Pavlova, U. and J. Guy. 2022. 'Putin revives Stalin-era "Mother Heroine" award for women with 10 children'. *CNN*, 18 August. https://www.cnn.com/2022/08/18/europe/putin-mother-heroine-award-decree-intl/index.html (accessed 1 September 2022).

Pell, S. 2016. 'Reproductive decisions in the lives of West Bank Palestinian women: Dimensions and contradictions'. *Global Public Health* **12** (2): 135–55. https://doi.org/10.1080/17441692.2016.1151541.

Potts, M. 2014. 'Getting family planning and population back on track'. *Global Health: Science and Practice* **2** (2): 145–51. https://doi.org/10.9745/ghsp-d-14-00012.

Purdy, L. M. 2019. 'Pronatalism is violence against women: The role of genetics', in W. Teays (ed.), *Analyzing Violence Against Women*. pp. 113–29. Switzerland: Springer Nature. https://doi.org/10.1007/978-3-030-05989-7_9.

Qamar, A.H. 2018. 'The social value of the child and fear of childlessness among rural Punjabi women in Pakistan'. *Asian Journal of Social Science* **46** (6): 638–67. https://doi.org/10.1163/15685314-04606003.

Quraishi, S.Y. 2021. *The Population Myth: Islam, Family Planning and Politics in India*. Uttar Pradesh, India: HarperCollins.

Raucher, M. 2021. 'Jewish pronatalism: Policy and praxis'. *Religion Compass* **15** (7). https://doi.org/10.1111/rec3.12398

Rees, W.E. 2020. 'Ecological economics for humanity's plague phase'. *Ecological Economics* **169**: 106519. https://doi.org/10.1016/j.ecolecon.2019.106519.

Regus, P. 2007. 'The Emerging Medicalization of Postpartum Depression: Tightening the Boundaries of Motherhood'. Thesis, Georgia State University. https://doi.org/10.57709/1062357.

Rich, A. 1995. *Of Woman Born: Motherhood as Experience and Institution*. United Kingdom: W.W. Norton and Company.

Ripple, W.J., K. Abernethy, M.G. Betts, G. Chapron, R. Dirzo, M. Galetti, T. Levi, P.A. Lindsey, D.W. Macdonald, B. Machovina, T.M. Newsome, C.A. Peres, A.D. Wallach, C. Wolf, and H. Young. 2016. 'Bushmeat hunting and extinction risk to the world's mammals'. *Royal Society Open Science* **3** (10): 160498. https://doi.org/10.1098/rsos.160498.

Rivkin-Fish, M. 2010. 'Pronatalism, gender politics, and the renewal of family support in Russia: Toward a feminist anthropology of maternity capital'. *Slavic Review* **69** (3): 701–24. https://doi.org/10.1017/s0037677900012201.

Roche, J. 2020. 'Marx, population and freedom'. *The Journal of Population and Sustainability* **5** (1): 31–46. https://doi.org/10.3197/jps.2020.5.1.31.

Rottenberg, C. 2017. 'Neoliberal feminism and the future of human capital'. *Signs: Journal of Women in Culture and Society* **42** (2): 329–48. https://doi.org/10.1086/688182.

Samways, D. 2022. 'Population and sustainability: Reviewing the relationship between population growth and environmental change'. *The Journal of Population and Sustainability* **6** (1): 15–41. https://doi.org/10.3197/JPS.63772239426891.

Sargent, C. and M. Harris. 1992. 'Gender ideology, childrearing, and child health in Jamaica'. *American Ethnologist* **19** (3): 523–37. https://doi.org/10.1525/ae.1992.19.3.02a00060.

Sinding, S.W. 2008. 'What has happened to family planning since Cairo and what are the prospects for the future?' *Contraception* **78** (4). https://doi.org/10.1016/j.contraception.2008.03.019.

Sinding, S.W. 2016. 'Reflections on the changing nature of the population movement'. *The Journal of Population and Sustainability* **1** (1): 7–14. https://doi.org/10.3197/jps.2016.1.1.7.

Stade, K. 2022. 'I am not a slave to the biological clock'. *Ms. Magazine*, 11 July. https://msmagazine.com/2022/07/11/women-biological-clock-child-free-world-population-day/ (accessed 1 September 2022).

Tatum, M. 2021. 'China's three-child policy'. *The Lancet* **397** (10291): 2238. https://doi.org/10.1016/s0140-6736(21)01295-2.

Telli, P., T. Cesuro lu and F.T. Aksu. 2019. 'How do pronatalist policies impact women's access to safe abortion services in Turkey?' *International Journal of Health Services* **49** (4): 799–816. https://doi.org/10.1177/0020731419855877

Tremayne, S. and M.M. Akhondi. 2016. 'Conceiving IVF in Iran'. *Reproductive Biomedicine & Society Online* **2**: 62–70. https://doi.org/10.1016/j.rbms.2016.07.002.

Tsigdinos, P.M. 2021. 'An IVF survivor unravels "fertility" industry narratives'. *Journal of Marketing Management* **38** (5–6): 443–59. https://doi.org/10.1080/0267257x.2021.2003847

Tucker, C. 2021. 'It's time to revisit the Cairo consensus'. *The Journal of Population and Sustainability* **5** (2): 63–73. https://doi.org/10.3197/jps.2021.5.2.63.

Turnbull, B., M.L. Graham and A.R. Taket. 2016. 'Pronatalism and social exclusion in Australian society: Experiences of women in their reproductive years with no children'. *Gender Issues* **34** (4): 333–54. https://doi.org/10.1007/s12147-016-9176-3.

UN. 1994. *Report of the International Conference on Population and Development*. United Nations: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/icpd_en.pdf (accessed 1 September 2022).

UNDESA. 2014. *Abortion Policies and Reproductive Health Around the World*. United Nations Department of Economic and Social Affairs: https://www.un.org/en/development/desa/population/publications/pdf/policy/AbortionPoliciesReproductiveHealth.pdf (accessed 1 September 2022).

UNDESA. 2015. *Government Response to Low Fertility in Japan*. United Nations Department of Economic and Social Affairs: https://www.un.org/en/development/desa/population/events/pdf/expert/24/Policy_Briefs/PB_Japan.pdf (accessed 1 September 2022).

UNDESA. 2021. *World Population Policies 2021: Policies Related to Fertility*. United Nations Department of Economic and Social Affairs: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/undesa_pd_2021_wpp-fertility_policies.pdf (accessed 1 September 2022).

UNPFA. 2022. *Nearly Half of All Pregnancies Are Unintended – a Global Crisis, Says New UNFPA Report*. United Nations Population Fund: https://www.unfpa.org/press/nearly-half-all-pregnancies-are-unintended-global-crisis-says-new-unfpa-report# (accessed 1 September 2022).

Wallace, T. 2022, 'Europe faces ageing population nightmare in absolute collapse'. *The Telegraph*, 13 July. https://www.telegraph.co.uk/business/2022/07/13/europe-faces-ageing-population-nightmare-absolute-collapse/ (accessed 1 September 2022).

Wells, H. and M. Heinsch. 2019. 'Not yet a woman: The influence of socio-political constructions of motherhood on experiences of female infertility'. *The British Journal of Social Work* **50** (3): 890–907. https://doi.org/10.1093/bjsw/bcz077.

Wyndham, N., P.G. Marin Figueira and P. Patrizio. 2012. 'A persistent misperception: Assisted reproductive technology can reverse the aged biological clock'. *Fertility and Sterility* **97** (5): 1044–47. https://doi.org/10.1016/j.fertnstert.2012.02.015.

10.3197/JPS.63799953906866

PEER REVIEWED ARTICLE

Family Planning Progress in 113 Countries Using a New Composite Progress Index

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Abstract

This paper analyses family planning progress in 113 countries in the context of meeting the demand for family planning through a composite progress index that measures progress in three dimensions – demand for permanent methods, demand for modern spacing methods and expansion of method choice – following the progress triangle approach. This paper suggests that in more than forty per cent of countries analysed, family planning progress remains far from satisfactory in meeting the family planning demand and there is substantial inter-country variation in the progress. In some countries, progress appears to have reversed. The inter-country variation in family planning progress is primarily the result of inter-country variation in meeting the demand for permanent methods. The analysis calls for the reinvigoration of family planning efforts to meet the target set under the United Nations 2030 Sustainable Development Agenda and the FP2030 initiative.

Keywords

Sustainable development; family planning progress; composite index; contraceptive prevalence; family planning demand

Introduction

The world population is now estimated to have passed the eight billion mark. The United Nations projects that the world population will increase to around

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10.43 billion by 2086 and then decrease to 10.36 billion by the end of the century (United Nations, 2022). This means that around 2.55 billion people will be added to the world population in the next sixty years. This increase will exert pressure on the environment that sustains life on the planet. Population growth has a negative impact on sustainability as it raises both resource demand and generates more waste on all levels of resource use per capita. The reduction in global emissions of greenhouse gases (GHG) between 1990–2019 as a result of technological advancement has been found to have been seriously compromised by population growth (Chaurasia, 2020a). A number of studies have attempted to estimate the optimal population size the planet can sustain (Dasgupta, 2019; Lianos and Pseridis, 2019; O'Neill et al., 2018) with figures varying from three to seven billion, which suggests that world population beyond seven billion is likely to seriously compromise prospects of sustainable development.

Population growth is primarily the result of individual choices and opportunities to produce children. Regulating individual fertility through family planning has been the mainstay of efforts to control population growth. In 1952, India was the first country to launch an official family planning programme in the context of reducing poverty and hastening social and economic progress. By 1996, as many as 115 countries had adopted explicit family planning policies (Bongaarts et al., 2012). Family planning is also recognised as an essential intervention for universal access to sexual, reproductive and child health care in the United Nations 2030 Agenda for Sustainable Development (United Nations, 2015). The dividends of family planning go beyond the reproductive rights of women and the reduction of unintended pregnancies by contributing to improving the health and nutrition of children and reducing maternal mortality. Family planning is highly cost-effective and has a demonstrable impact on poverty reduction (Bongaarts et al., 2012).

Family planning efforts typically generate and respond to the demand for family planning. Family planning progress can, therefore, be measured in terms of the demand generated and the demand satisfied. An indicator of family planning progress is the ratio of the demand satisfied to the actual demand for family planning, the higher the ratio the more advanced the family planning progress. Family planning demand is contingent upon family building strategy – how many births to have and when to have them – and can be divided into the demand to postpone or space births and the demand to prevent births. The demand

satisfied, on the other hand, is contingent upon the efficiency of family planning efforts in meeting the actual demand. The gap between the actual family planning demand and the demand satisfied is called 'the unmet demand' for family planning and occurs either due to demand side or supply side factors (Senderowicz and Maloney, 2022).

The unmet demand for family planning can be further classified into unmet demand for spacing births and unmet demand for preventing births. Different family planning methods are made available to satisfy different family planning demands which may be divided into modern spacing methods, permanent methods and traditional methods. Modern spacing methods (e.g. condom and traditional methods e.g. rhythm method) are reversible. They can be used for both spacing and stopping births. Permanent methods are irreversible and cannot be used for spacing births. The demand for spacing and the demand for preventing births vary with the stages of the family building process. Method choice, therefore, is an important factor in satisfying family planning demand and has been recommended as a guide for optimal family planning services delivery (WHO, 2014). Method choice is also linked with family building strategy that includes family size goals and timing of births. It reflects both demand for and supply of family planning. A dominating factor that influences method choice is the availability of a range of family planning methods. It has, therefore, been emphasised that the charting of family planning progress should not be confined to just counting the users of family planning but should also consider method choice (United Nations, 2019).

Measuring family planning progress in terms of family planning demand satisfied is a multidimensional construct, three dimensions of the progress can readily be identified: 1) progress in satisfying the demand for modern spacing methods; 2) progress in satisfying the demand for permanent methods; and 3) progress in expanding method choice. The progress in the three dimensions can be combined into a single composite progress index which presents the progress in all three dimensions of family planning as one aggregate value. The composite index enables the ranking of countries in terms of family planning progress and also permits analysis of spatiotemporal variations in progress. One argument that has been put forward against the use of a composite index is that it masks the variation in progress in different dimensions of family planning, however this is

unavoidable when one looks into the breadth of family planning efforts (Apablaza and Yalonetzky, 2011). It may, however be argued that a composite index reinforces the uniqueness of the progress in different dimensions of family planning.

In this paper, I develop a composite index to chart family planning progress in 113 countries that combines progress in satisfying demand of modern spacing methods, in satisfying demand of permanent methods and progress in expanding method choice. The index presents the 'big picture' by offering a rounded assessment of family planning progress. The change in the composite index can be decomposed into the change in the three dimensions of family planning. This decomposition is important in the context of the action plan adopted at the 1994 International Conference on Population and Development and the United Nations 2030 Agenda for Sustainable Development which advocate a rights-based approach to advancing family planning.

The paper is organised into five sections. The first describes the composite progress index. The second describes the data source. The paper is based on the United Nations database of survey-based estimates of method-specific prevalence and unmet need for spacing and limiting (United Nations, 2020). Following this, section three discusses the family planning progress in 113 countries. Section four groups countries in terms of progress in the three dimensions of family planning, and section five analyses temporal changes in family planning progress. The sixth and final section of the paper summarises the findings of the analysis and discusses their policy and programme implications.

Composite Family Planning Progress Index

Details regarding the construction of the composite family planning progress index are given in the appendix. The composite progress index is based on the progress triangle approach (Nold and Michel, 2016). Let p_s denote the index of the met demand of modern spacing methods, p_p the index of the met demand of permanent methods and p_q the index of method choice such that all the three indexes range from 0 (lowest) to 1 (highest). The composite progress index, p, is then defined as

$$p = \frac{\sqrt{p_s * p_p} + \sqrt{p_p * p_q} + \sqrt{p_q * p_s}}{3} \quad (1)$$

The index p ranges between 0 and 1, the higher the index the more advanced the family planning progress. When $p_s=p_p=p_q$ the index p is the simple average of the three indexes. The index p is always less than the simple average of the three indexes. The difference between the simple average of the three indexes and the index p reflects the inequality in progress in the three dimensions of family planning. If p_i denotes progress inequality, then

$$p_i = \frac{p_s+p_p+p_q}{3} - p \tag{2}$$

The indexes p_s, p_p and p_q are constructed from the method-specific prevalence and the unmet demand of spacing and limiting in the following manner:

$$p_s = \frac{c_s}{c_s+c_t+u_s} \tag{3}$$

$$p_p = \frac{c_p}{c_p+u_p} \tag{4}$$

$$p_q = 1 - \sqrt{\frac{\sum x_j^2-\left(\frac{1}{n}\right)}{1-\left(\frac{1}{n}\right)}} \; when\; n > 1 \; and \; s = 1 \; when \; n = 1; \; \sum_{j=1}^{n} x_j = 1 \tag{5}$$

Here c_s is the prevalence of modern spacing methods, c_t is the prevalence of traditional methods, c_p is the prevalence of permanent methods, u_s is the unmet demand for spacing, u_p is the unmet demand for limiting, x_j is the proportionate prevalence of the method j or the share of the method j in the total family planning use and n is the number of family planning methods available. Modern spacing methods include intra-uterine devices (IUD), implant, injectable, pill, male condom, female condom, vaginal barrier methods, lactational amenorrhea method (LAM), emergency contraception and other modern methods. Permanent methods include female and male sterilisation. It is assumed that use of traditional methods is a reflection of the unmet demand for modern spacing methods. The rationale behind the construction of the three indexes is discussed at length in the appendix of the paper.

The index p presents a different perspective of family planning progress than the traditionally used contraceptive prevalence (CPR) or modern methods prevalence (mCPR) or the recently recommended demand satisfied by modern methods

(MDM) which is also one of the progress indicators of Goal 3.7 of the United Nations 2030 Sustainable Development Agenda (United Nations, 2015). The rationale for using CPR or mCPR to chart family planning progress may be traced to the strong negative relationship between CPR or mCPR and total fertility rate (TFR) based either on cross-country data (Bongaarts, 1978; Bongaarts and Potter, 1983; Ross and Mauldin, 1996; Jain, 1997; Tsui, 2001; Stover, 1998; United Nations, 2020) or on longitudinal data (Bongaarts and Hodgson, 2022). Many country-specific studies, especially in the context of sub-Saharan Africa, however, have highlighted the inconsistency between CPR and TFR (United Nations, 2020; Westoff and Bankole, 2001; Adamchak and Mbizvo, 1990; Bongaarts, 1987; Thomas and Mercer, 1995; Jurczynska, Kuang and Smith, 2016; Jain et al., 2014). There are studies that have attempted to explain this inconsistency (Bongaarts, 2015; 2017; Biestsch et al., 2021; Choi et al., 2018; Bongaarts and Hodgson, 2022). Srinivasan (1993) has argued that the CPR-TFR relationship may also be influenced by targeting family planning efforts.

The term 'demand' and the term 'satisfied' used in measuring family planning progress need some clarification. The term 'demand' does not reflect the stated desire of women to use family planning but it is a combination of family planning use and unmet need of either spacing or limiting based upon stated fertility preferences (FP2020, nd). Similarly, the term 'satisfied' does not reflect satisfaction of the user but could be interpreted as the total potential demand met by the use of family planning methods (FP2020, nd). The limitation of CPR or mCPR and MDM is that they do not consider method choice, although method choice is a key principle of both quality of care and rights-based family planning. These indicators do not distinguish between the demand of modern spacing methods and the demand of permanent methods. This distinction is important as the context of using modern spacing methods is different from the context of using permanent methods. Not distinguishing between the demand for modern spacing methods and the demand for permanent methods is equal to the implicit but very strong assumption of perfect substitutability between the two, which may lead to erroneous conclusions about family planning progress.

The index *p* measures family planning progress in terms of family planning outcomes – met demand of modern spacing methods, met demand of permanent methods and method choice. Family planning progress has also been measured

in terms of the strength of family planning efforts (Ross and Mauldin, 1996; Ross and Stover, 2001; Rosenberg, 2020). The perspective of family planning progress based on the strength of efforts is different from the perspective based on family planning outcomes. One limitation of this 'effort index' is that it is based on the responses of key informants that may be biased by their knowledge.

Data

The analysis is based on the database on family planning use maintained by the United Nations which contains 1,317 observations from 196 countries from 1950 to 2019 (United Nations, 2020). The present analysis is limited to 113 countries that fulfil the following criteria: 1) the latest survey was carried out during 2010–2019; 2) method-specific prevalence is available for currently married or in-union women aged 15–49 years and 3) estimates of unmet demand are available separately for spacing and limiting. Out of the 113 countries included in the analysis, 47 are in Africa; 30 in Asia; 20 in Latin America and the Caribbean; 11 in Europe and 5 in the Pacific. These countries also include 65 of the 69 lowest-income countries identified as focus countries under the FP2020 Initiative.

Details of the methods, definitions, data sources and data limitations in the database of the United Nations are described elsewhere (United Nations, 2020). Data for different countries available in the database are not strictly comparable because of differences in survey design and implementation and in the representativeness of the sample over time and across countries. Prevalence of different family planning methods, in some cases, is also affected by rounding and the small size of the sample. The database provides survey-based prevalence of 13 methods which are grouped into permanent methods (female sterilisation, male sterilisation); 2) modern spacing methods (IUD, implant, injectable, pill, male condom, female condom, vaginal barrier methods, LAM and emergency contraception and 3) traditional methods (any traditional method). Prevalence of all thirteen methods is, however, not available for all 113 countries. In some countries, prevalence of some methods is either not available or not reported. In all such cases, prevalence is assumed to be zero. The database also provides estimates of unmet need of spacing and limiting. The definition of the unmet need is not consistent across countries, but it is broadly defined as the proportion of currently married or in-union women of reproductive age who want to stop or delay childbearing but are not using any modern method.

Family Planning Progress in 113 Countries

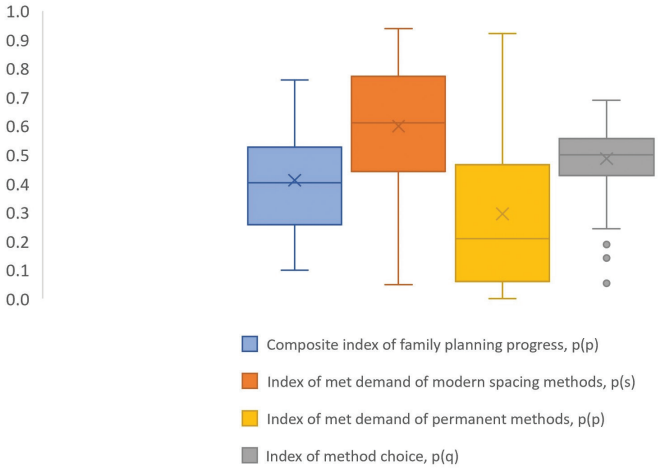
Appendix Table 1 gives values of indexes p, p_s, p_p and p_q for 113 countries. Inter-country variation in these indexes is summarised in Table 1 and Figure 1. The index p is the lowest in Sudan (2014) but the highest in Nicaragua (2011–2012). In 24 (21.2 per cent) countries, $p< 0.250$ while in 54 (47.8 per cent) countries, $0.250 \leq p < 0.500$. Nicaragua (2011–2012) is the only country where the index is more than 0.750.

Among the three indexes that constitute the index p, the index p_s is the lowest in Albania (2017–2018) but the highest in Democratic Republic of Korea (2017). There are only 5 countries where $p_s < 0.250$ whereas $p_s \geq 0.750$ in 33 countries. On the other hand, there are 7 countries: Benin (2017), Burkina Faso (2018), Côte d'Ivoire (2018), Ethiopia (2018), Guinea-Bissau (2018–2019), Libya (2014) and Sudan (2014), where the index $p_p=0$ while there are only 3 countries: Nicaragua (2011–2012), Colombia (2015–2016) and Dominican Republic (2014), where $p_p \geq 0.900$. In the majority of countries, the index p_s is higher than the index p_p but there are 20 countries where $p_s < p_p$. The most notable example is India where p_p is more than 83 per cent but p_s is only around 50 per cent. Finally, the method choice index, p_q, is the lowest in Democratic Republic of Korea (2017) but the highest in Guinea-Bissau (2014). In Democratic Republic of Korea, IUD alone accounts for more than 95 per cent of the total modern methods use. The index p_q is also very low in Turkmenistan (2015), Morocco (2018), Sudan (2014) and in India (2015–16) which indicates that the mix is highly method skewed. In 57 countries, the index $p_q < 0.500$.

There are four countries: Turkey (2018), Nepal (2016–2017), Sri Lanka (2018) and Pakistan (2017–2018), where p_s, p_p and p_q are very nearly the same but the inequality in progress in the three dimensions of family planning is the highest in Ethiopia (2018) followed by Burkina Faso (2018–2019) and Côte d'Ivoire (2018). There are 68 (60.2 per cent) countries where inequality in progress in the three dimensions is very small. In 13 countries, however, progress in three dimensions is markedly different. The inequality in progress in the three dimensions has implications for meeting the dynamic and diverse family planning needs of the people as it reflects a bias towards specific dimensions at the cost of other dimensions. For example, in Ethiopia (2018), the index p is more than 53 per cent lower than the simple average of the three indexes p_p, p_s and p_q because the met

demand of permanent methods is zero and the method choice is very limited. This means that family planning efforts in Ethiopia are biased towards modern spacing methods at the cost of permanent methods.

Figure 1: Inter-country Variation in Different Indexes of Family Planning Across 113 Countries



SOURCE: AUTHOR

The inter-country variation in the three indexes p_s, p_p and p_q is essentially different (Figure 1). The inter-country variation in index p_p explains only about 23 per cent of the inter-country variation in the index p_s and just about 4 per cent of the inter-country variation in the index p_q. Similarly, inter-country variation in the index p_s explains less than 4 per cent of the inter-country variation in index p_q. These observations justify treating met demand of modern spacing methods, met demand of permanent methods and method choice separately in measuring family planning progress. Figure 1 also suggests that there are four countries where the method choice is extremely limited.

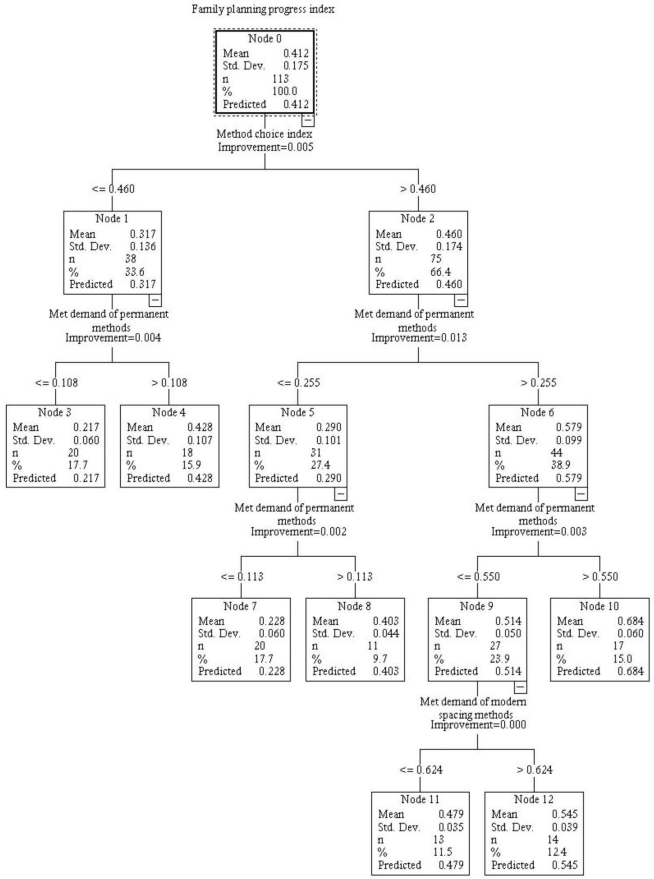
Countries rank different in terms of index *p*, mCPR and MDM. Nicaragua (2011–2012) is the only country which has the same rank in the index *p*, mCPR and MDM. Only five countries – Nicaragua (2011–2012), Costa Rica (2018), Colombia

(2015–2016), North Macedonia (2011) and Uganda (2017) – have the same rank in the index *p* and mCPR and only two countries, Nicaragua (2011–2012) and Mali (2018) have the same rank in the index *p* and MDM. In 50 countries, rank in index *p* is lower than that in mCPR. The Democratic Republic of Korea ranks 6 in mCPR but 78 in index *p* whereas Oman ranks 89 in mCPR but 44 in index *p*. In 49 countries, rank in index *p* is lower than that in MDM. Turkmenistan ranks 21 in MDM but only 101 in index *p*. Family planning progress revealed through the index *p* is different from that revealed through either mCPR or MDM.

Classification of Countries

The classification modelling approach (Han et al., 2012; Tan et al., 2006) has been used to group countries on the indexes p_s, p_p and p_q and to analyse the variation in the index *p* across different groups. The classification and regression tree (CRT) method (Brieman et al., 1984) was used for classification modelling (see appendix). Results of classification modelling exercise are presented in Table 2 and the classification tree is depicted in Figure 2. At the first stage of classification, countries are divided based on the index p_q. In 38 countries, $p_q \leq 0.460$ (Node 1) but in 75 countries $p_q > 0.460$ (Node 2). The 38 countries of Node 1 are classified further based on the index p_p. The index *p* in Node 3 is substantially lower than that in Node 4. The countries in Node 2 are divided into four groups based on the index p_p – countries where $p_p \leq 0.113$ (Node 7); countries where $0.113 < p_p \leq 0.255$ (Node 8); countries where $0.255 < p_p \leq 0.550$ (Node 9); and countries where $p_p > 0.550$ (Node 10). The index *p* is the lowest in Node 7 but the highest in Node 10. Countries of Node 9 are further classified based on the index p_s – countries having $p_s \leq 0.624$ (Node 11) and countries having $p_s > 0.624$. The index *p* is lower in Node 11 compared to Node 12. Figure 2 suggests that 113 countries can be classified into 7 mutually exclusive groups based on p_s, p_p and p_q and the index *p* varies across the 7 groups.

Figure 2: The Classification Tree



SOURCE: AUTHOR

Temporal Variation in Family Planning Progress

The temporal variation in family planning progress is analysed for 86 countries where at least two surveys took place during 2000–2019. The temporal variation is measured in terms of annual per cent change (*APC*) in the index *p* between two surveys. When there were more than two surveys, the temporal variation was measured in terms of average annual per cent change (*AAPC)* which is the weighted average of *APC* (see appendix). The temporal variations in the index *p*

Figure 3. Annual Proportionate Change (APC) and Average Annual Proportionate Change (*AAPC*) in the Index *p* in 86 countries

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Africa																					
Algeria							0.315														0.315
Benin		-0.937					-0.718					7.829									-1.266
Burkina Faso				5.429							-6.949						3.355	38.667			1.716
Burundi											1.183										1.183
Cameroon					-2.066							1.812									-0.903
Congo						2.604						9.470									4.893
Côte d'Ivoire												5.896					2.520	-30.451			0.221
DR Congo								12.175			-3.391										4.392
Egypt	-1.520			3.557		-0.961			1.712												0.710
Eritrea			0.188																		0.188
Eswatini							4.589				-2.611										0.989
Ethiopia	0.957					8.706					-3.366			31.009	-2.052	-1.678		-31.675			1.692

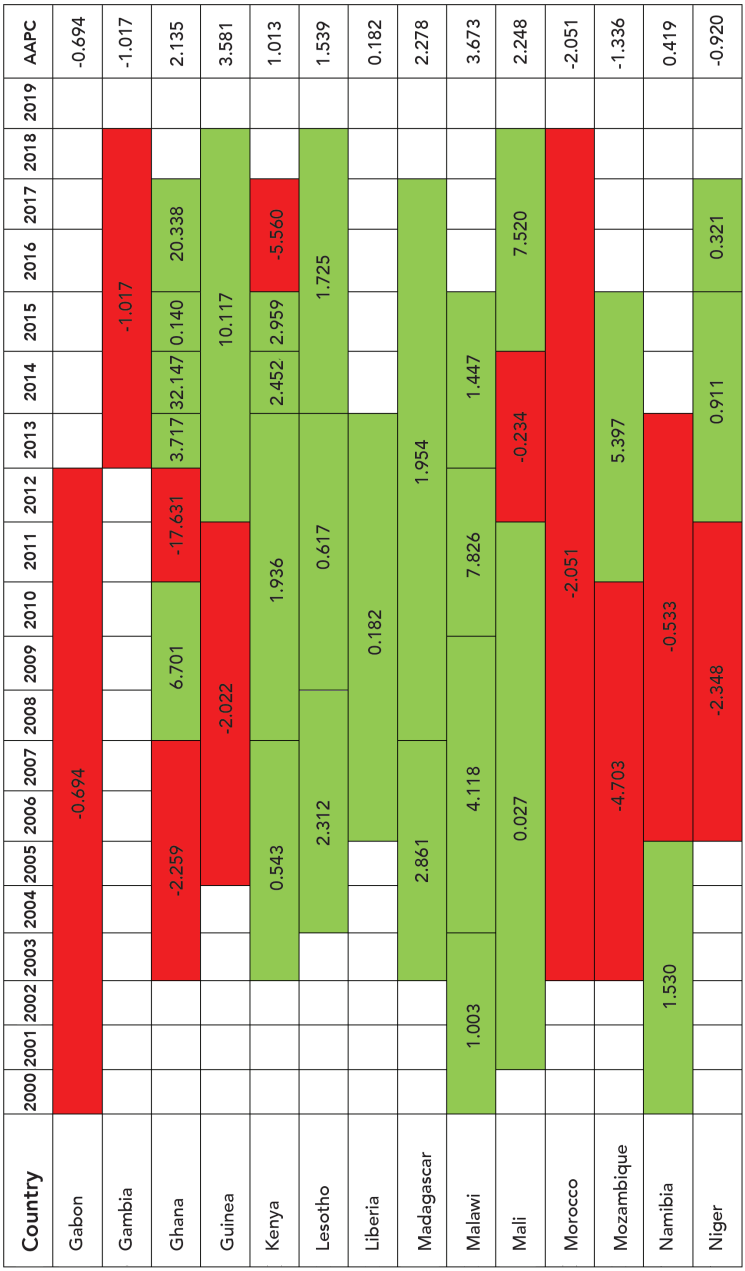
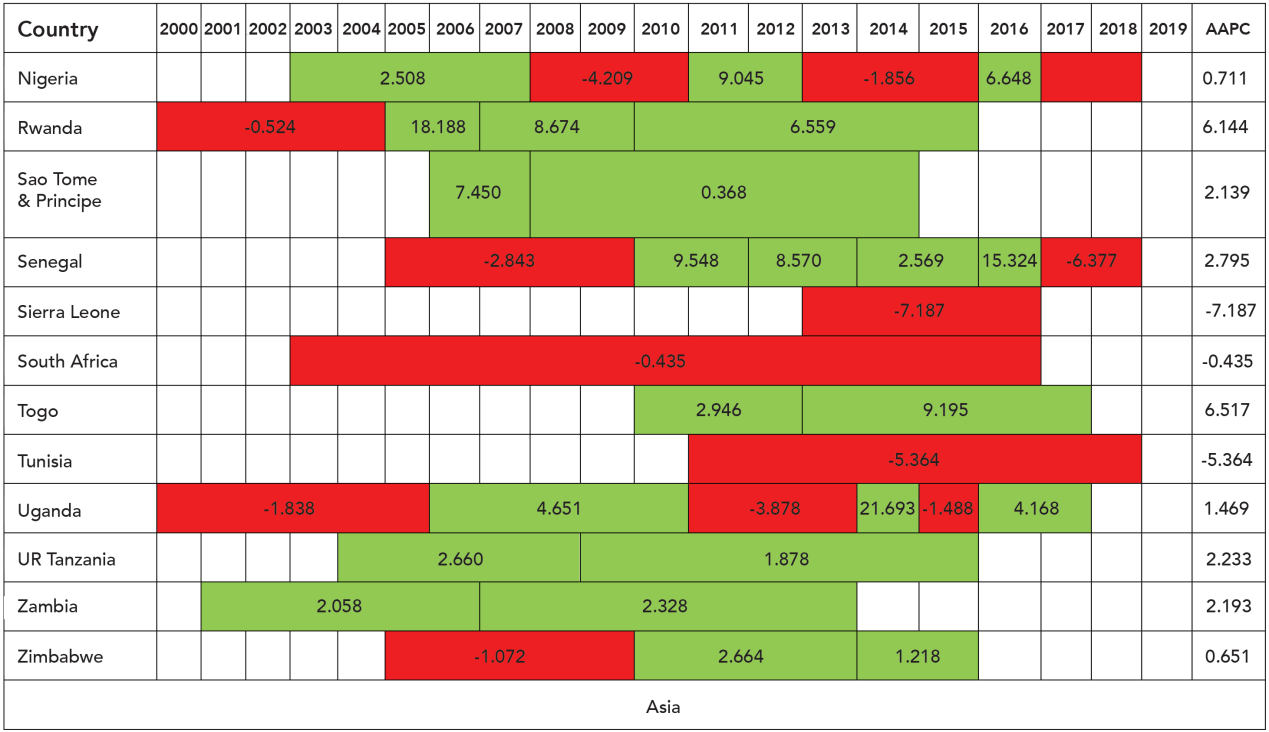

Country
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 AAPC
Gabon -0.694 -0.694
Gambia -1.017 -1.017
Ghana -2.259 6.701 -17.631 3.717 32.147 0.140 20.338 2.135
Guinea -2.022 10.117 3.581
Kenya 0.543 1.936 2.452 2.959 -5.560 1.013
Lesotho 2.312 0.617 1.725 1.539
Liberia 0.182 0.182
Madagascar 2.861 1.954 2.278
Malawi 1.003 4.118 7.826 1.447 3.673
Mali 0.027 -0.234 7.520 2.248
Morocco -2.051 -2.051
Mozambique -4.703 5.397 -1.336
Namibia 1.530 -0.533 0.419
Niger -2.348 0.911 0.321 -0.920

Figure 3. Continued



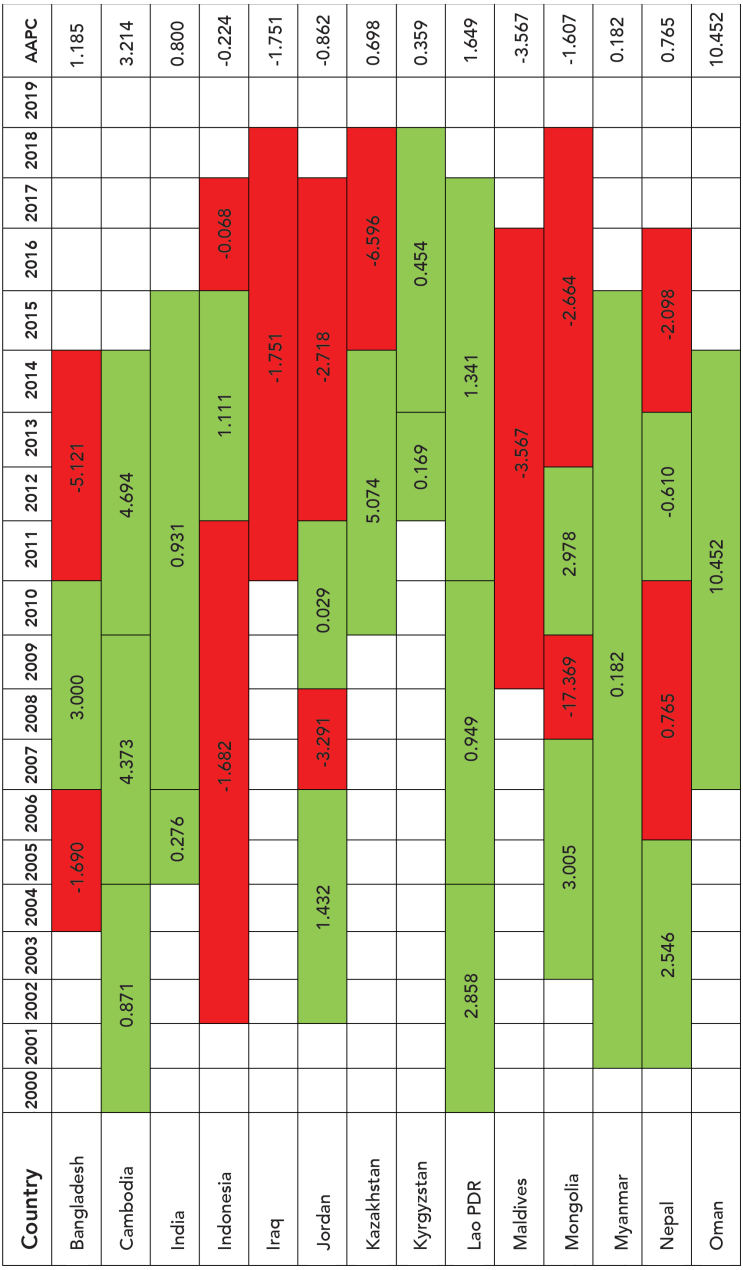
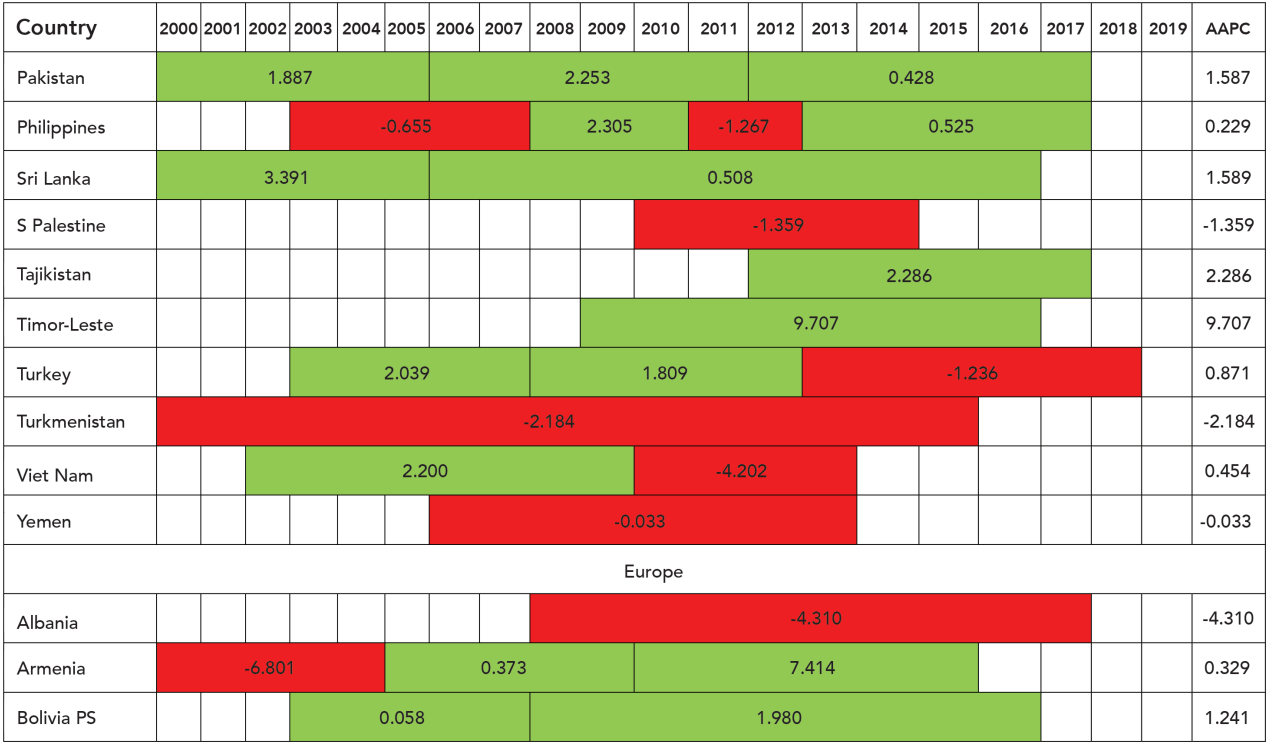

Country
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 AAPC
Bangladesh
-1.690
3.000
-5.121
1.185
Cambodia
0.871
4.373
4.694
3.214
India
0.276
0.931
0.800
Indonesia
-1.682
1.111
-0.068
-0.224
Iraq
-1.751
-1.751
Jordan
1.432
-3.291
0.029
-2.718
-0.862
Kazakhstan
5.074
-6.596
0.698
Kyrgyzstan
0.169
0.454
0.359
Lao PDR
2.858
0.949
1.341
1.649
Maldives
-3.567
-3.567
Mongolia
3.005
-17.369
2.978
-2.664
-1.607
Myanmar
0.182
0.182
Nepal
2.546
0.765
-0.610
-2.098
0.765
Oman
10.452
10.452

Figure 3. Continued



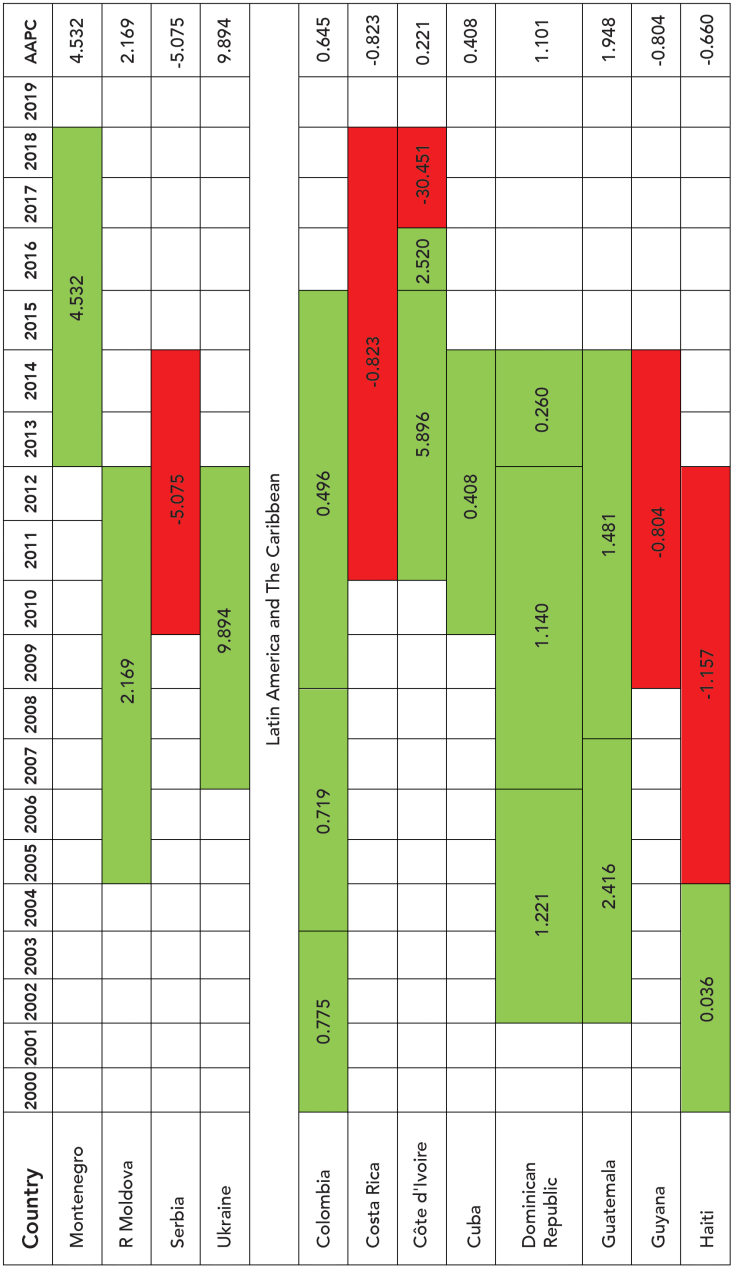

Country
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 AAPC
Montenegro 4.532
R Moldova 2.169
Serbia -5.075
Ukraine 9.894
4.532
2.169
-5.075
9.894
Latin America and The Caribbean
Colombia 0.645
Costa Rica -0.823
Côte d'Ivoire 0.221
Cuba 0.408
Dominican Republic 1.101
Guatemala 1.948
Guyana -0.804
Haiti -0.660
0.775
0.719
0.496
-0.823
5.896
2.520
-30.451
0.408
1.221
1.140
0.260
2.416
1.481
-0.804
0.036
-1.157

Figure 3. Continued

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Honduras						1.466															1.466
Mauritania								2.138				2.138									2.138
Mexico										1.981					0.931						1.806
Nicaragua		0.555					0.905														0.730
Panama														-12.971							-12.971
Peru	-0.670				-0.232			0.639		0.233	1.131	-0.223	2.161	0.963	4.146	0.941	-0.504	0.799			0.420
Suriname											-3.781										-3.781
Trinidad & Tobago							0.846														0.846
Pacific																					
Samoa										2.991											2.991
Solomon Islands							-2.561														-2.561

SOURCE: AUTHOR

Remarks: The AAPC period differs depending on the country, as shown through the coloured cells. For example, AAPC in Peru refers to the period 2000–2018 whereas AAPC in Panama refers to the period 2013–2015.

in 86 countries are summarised in Figure 3 (see p. 12). The period of negative *APC* is shown in red while the period of positive *APC* is shown in green. The period of *APC* and *AAPC* varies by country as shown in Figure 3. The negative *AAPC* in 26 countries indicates a reversal in family planning progress. In Panama, the index *p* decreased by more than 12 per cent per year during 2013–2015. The decrease in the index *p* was also substantial in Sierra Leone during 2013–2016; Tunisia during 2011–2018 and Serbia during 2010–2014. By contrast, *AAPC* was 5 per cent and above in only five countries: Rwanda during 2000–2015, Togo during 2010–2017, Timor-Leste during 2009–2016, Ukraine during 2007–2012 and Oman during 2007–2014. In 31 countries, the *APC* in the index *p* was negative in one period but positive in other periods. There are only 37 countries where *APC* in the index *p* was positive in all periods and in only five countries: Bolivia, Cambodia, Congo, India and Zambia – *APC* in the index *p* increased consistently. The temporal variation in the three indexes that constitute the index *p* was inconsistent in most of the countries. There is no country where all the three indexes improved consistently.

The contribution of the change in indexes p_s, p_p and p_q to the change in index *p* in each country is presented in the appendix Table 2 and the variation in the contribution is summarised in Table 4. There are only 27 countries where change in all the three indexes contributed to the increase in the index *p* whereas there are 6 countries where change in all the three indexes contributed to the decrease in the index *p* (Table 5). In the remaining 53 countries, contribution of the change in the three indexes to the change in the index *p* was mixed. In these countries, there was progress in some dimensions but reversal in other dimensions. In 14 countries, the index *p* increased despite a decrease in the index p_q. In these countries, family planning progress improved despite reversal in progress in the dimension of method choice. Similarly, in 10 countries family planning progress reversed despite improvement in meeting the demand of permanent methods because the progress reversed in meeting the demand of modern spacing methods and in expanding the method choice. The change in the index *p* varied across the countries because of the variation in the change in the three indexes related to the met demand of modern spacing methods and permanent methods and the change in method choice. The inter-country variation in the index p_p is substantially larger than the inter-country variation in the change in the index p_s (met demand of modern spacing methods) and in the change in the index of method choice. The contribution of the inter-country variation in the change in

the index p_p to the inter-country variation in the index p, therefore, is more than the contribution of the inter-country variation in the change in either the index p_s or the index p_q (progress in expanding the method choice).

Discussions and Conclusions

This paper uses a composite index to measure family planning progress that considers progress in meeting the demand of modern spacing methods, progress in meeting the demand of permanent methods and the progress in expanding the method choice. The index offers a holistic assessment of family planning progress in terms of the demand satisfied for family planning by considering both quantitative and qualitative aspects of family planning. The index may serve as the basis for monitoring family planning progress and for spatiotemporal comparisons from multidimensional perspective. The advantage of the index is that it can be constructed from the already available data and does not require the collection of any new data. The decomposition of the change in the index to the change in its constituent dimensions helps in taking appropriate policy and programme level action.

The present analysis reveals that, in most of the countries, family planning progress remains far from adequate in satisfying the demand for family planning. This appears to be one reason why the ambitious target of recruiting 120 million new recipients of family planning by 2020 set under the FP2020 Initiative could not be achieved (FP2020, 2020). In many countries, progress appears to have reversed in some or in all the three dimensions of family planning demand. Family planning efforts in almost all countries are essentially a prerogative of the government. As such, the analysis presented here calls for a reinvigoration of efforts to meet the family planning demand.

The analysis also reveals that, in the majority of the countries, family planning method choice has not expanded. This is not a welcome feature of family planning progress and indicates that family planning needs of a substantial proportion of women and men may have remained neglected or unmet. Similarly, progress in meeting the demand for modern spacing methods and in meeting the demand for permanent methods has differed in most of the countries examined suggesting that family planning efforts are biased towards either modern spacing methods or permanent methods. There are only a few countries where progress in the

three dimensions of family planning is nearly equal. This is important since the inequality in progress in different dimensions of family planning has implications for meeting the demand for family planning.

The global family planning movement is now almost seven decades old (Robinson and Ross, 2007). The genesis of the movement was grounded in the proposition that regulating fertility and curtailing population growth through family planning would contribute significantly towards addressing a range of development concerns facing the poorer countries of the world. Following this premise, substantial efforts were put in place, resources mobilised and commitments made to mainstream family planning in the development discourse of almost all developing countries of the world. These efforts have resulted in substantial increase in the use of family planning methods and decrease in fertility (Bongaarts and Hodgson, 2022). The present analysis, however, suggests that when it comes to satisfying the diverse and the dynamic demand for family planning, international, national, local and individual commitments appear to have fallen short of expectations. Family planning needs to be treated as a development strategy for the realisation of the goal of planned family that is critical to sustainable development and human well-being rather than just an intervention to reduce fertility.

References

Adamchak, D.J. and M.T. Mbizvo. 1990. 'The relationship between fertility and contraceptive prevalence in Zimbabwe'. International Family Planning Perspectives **16** (3): 103–106. https://doi.org/10.2307/2133307.

Albach, H. and A. Moerke. 1995. 'Die Überlegenheit der japanischen Unternehmen im globalen Wettbewerb. Berlin, Wissenschaftszentrum Berlin für Sozialforschung'. Discussion Paper FS IV 96-4.

Apablaza, M. and G. Yalonetzky. 2011. 'Measuring the Dynamics of Multiple Deprivations among Children: The Cases of Andhra Pradesh, Ethiopia, Peru and Vietnam'. *Young Lives Research in Progress.* Oxford, University of Oxford.

Bertrand, J.T., T.M. Sullivan, E.A. Knowles, … J.E. Shelton. 2014. 'Contraceptive method skew and shifts in method mix in low- and middle-income countries'. International *Perspectives on Sexual and Reproductive Health* **40** (3):144–153. https://doi.org/10.1363/4014414.

Bertrand, J.T., J. Rice, T.M. Sullivan and J.D. Shelton. 2000. 'Skewed method mix: a measure of quality in family planning programs'. Chapel Hill, NC, University of North Carolina, Carolina Population Centre, Measure Evaluation Working Paper No. 00–23.

Bertrand, J.T., J. Ross, T.M. Sullivan, …J.D. Shelton. 2020. 'Contraceptive method mix: updates and implications'. *Global Health Science and Practice* **8** (4): 666–679. https://doi.org/10.9745/GHSP-D-20-00229

Biestsch, K., A. Arbaji, J. Mason, … M.A. Ouri. 2021. 'Shifting dynamics: Changes in the relationship between total fertility rate and contraceptive prevalence rate in Jordan between 2012 and 2017'. *Gates Open Research* **4**: 160. https://doi.org/10.12688/gatesopenres.13188.2

Bogan, C.E. and M.J. English. 1994. *Benchmarking for Best Practice: Winning through Innovative Adaptation.* New York, McGraw Hill.

Bongaarts, J. 1978. 'A framework for analyzing proximate determinants of fertility'. *Population and Development Review* **4** (1): 105–132. https://doi.org/10.2307/1972149

Bongaarts, J. 1987. 'The proximate determinants of exceptionally high fertility'. *Population and Development Review* **13** (1): 133–139. https://doi.org/10.2307/1972125

Bongaarts, J. 2015. 'Modeling the fertility impact of the proximate determinants: Time for a tune-up'. *Demographic Research* **33**: 535–560. https://doi.org/10.4054/DemRes.2015.33.19

Bongaarts, J. 2017. 'The effect of contraception on fertility. Is sub-Saharan Africa different?' *Demographic Research* **37**: 129–146. https://doi.org/10.4054/DemRes.2017.37.6

Bongaarts, J., J. Cleland, J.W. Townsend, … Das Gupta, M. 2012. *Family Planning Programs for the 21st Century. Rationale and Design.* New York, Population Council. https://doi.org/10.31899/rh11.1017

Bongaarts, J. and D. Hodgson. 2022. *Fertility Transition in the Developing World.* New York, Springer. https://doi.org/10.1007/978-3-031-11840-1

Foldvary, F.E. 2006. 'The measurement of inequality, concentration and diversification'. *The Indian Economic Journal* **54** (3): 179–188. https://doi.org/10.1177/0019466220060312

FP2020. 2020. 'Progress Report 2012–2013: Partnership in Action'. Washington DC, FP2020.

FP2020. nd. *'FP2030 Measurement Framework'*. https://fp2030.org/sites/default/files/Draft-framework-20211029.pdf.

Han, J., M. Kamber and J. Pei. 2012. *Data Mining. Concepts and Techniques.* Amsterdam: Elsevier.

Horvitz, C., D.W. Schemske and H. Caswell. 1997. 'The relative "importance" of life-history stages to population growth: prospective and retrospective analyses.' In S. Tuljapurkar and H. Caswell (ed.) *Structured-population Models in Marine, Terrestrial, and Freshwater Systems.* London, Chapman and Hall, Population and Community Biology Series **18**: 247–271. https://doi.org/10.1007/978-1-4615-5973-3_7

Jain, A.K. 1997. 'Consistency between contraceptive use and fertility in India'. *Demography India* **26** (1): 19–36.

Jain, A., J. Ross, J. Gribble and E. McGinn. 2014. 'Inconsistencies in the total fertility rate and contraceptive prevalence rate in Malawi'. Washington DC, Futures Group, Health Policy Project.

Jurczynska, K., B. Kuang and E. Smith. 2016. 'Accounting for the mismatch between predicted and observed fertility in sub-Saharan Africa'. Paper presented at the Population Association of America Annual Meeting, Washington, D.C.

Lianos, T.P. and A. Pseridis. 2016. 'Sustainable welfare and optimum population size.' *Environment, Development and Sustainability* **18** (6): 1679–1699. https://doi.org/10.1007/s10668-015-9711-5

Measure Evaluation. 2018. 'Family planning method choice. Key indicators.' Chapel Hill, University of North Carolina, Carolina Population Centre, Measure Evaluation.

Nold, H. and L. Michel. 2016. 'The performance triangle: a model for corporate agility'. *Leadership and Organization Development Journal* **37** (3): 341–356. https://doi.org/10.1108/LODJ-07-2014-0123

Foldvary, F.E. 2006. 'The measurement of inequality, concentration and diversification'. *The Indian Economic Journal* **54** (3): 179–188. https://doi.org/10.1177/0019466220060312

FP2020. 2020. 'Progress Report 2012–2013: Partnership in Action'. Washington DC, FP2020. FP2020. nd.

'FP2030 Measurement Framework'. p2030.org/sites/default/files/Draft-framework-20211029.pdf.

Han, J., M. Kamber and J. Pei. 2012. *Data Mining. Concepts and Techniques.* Amsterdam: Elsevier.

Horvitz, C., D.W. Schemske and H. Caswell. 1997. 'The relative "importance" of life-history stages to population growth: prospective and retrospective analyses.' In S. Tuljapurkar and H. Caswell (ed.) *Structured-population Models in Marine, Terrestrial, and Freshwater Systems.* London, Chapman and Hall, Population and Community Biology Series **18**: 247–271. https://doi.org/10.1007/978-1-4615-5973-3_7

Jain, A.K. 1997. 'Consistency between contraceptive use and fertility in India'. *Demography India* **26** (1): 19–36.

Jain, A., J. Ross, J. Gribble and E. McGinn. 2014. 'Inconsistencies in the total fertility rate and contraceptive prevalence rate in Malawi'. Washington DC, Futures Group, Health Policy Project.

Jurczynska, K., B. Kuang and E. Smith. 2016. 'Accounting for the mismatch between predicted and observed fertility in sub-Saharan Africa'. Paper presented at the Population Association of America Annual Meeting, Washington, D.C.

Lianos, T.P. and A. Pseridis. 2016. 'Sustainable welfare and optimum population size.' *Environment, Development and Sustainability* **18** (6): 1679–1699. https://doi.org/10.1007/s10668-015-9711-5

Measure Evaluation. 2018. 'Family planning method choice. Key indicators.' Chapel Hill, University of North Carolina, Carolina Population Centre, Measure Evaluation.

Nold, H. and L. Michel. 2016. 'The performance triangle: a model for corporate agility'. *Leadership and Organization Development Journal* **37** (3): 341–356. https://doi.org/10.1108/LODJ-07-2014-0123

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

Rees, M., P.J. Grubb and D. Kelly. 1996. 'Quantifying the impact of competition and spatial heterogeneity on the structure and dynamics of a four-species guild of winter annuals.' *American Naturalist* **147** (1):1–32. https://doi.org/10.1086/285837

Rees, M., C.P. Osborne, F.I. Woodward and S.H. Taylor. 2010. 'Partitioning the components of relative growth rate: how important is plant size variation?' *The American Naturalist* **176** (6). https://doi.org/10.1086/657037

Robinson, W.C. and J.A. Ross. 2007. *The Global Family Planning Revolution: Three Decades of Population Policies and Programs*. Washington, D.C. The World Bank. https://doi.org/10.1596/978-0-8213-6951-7

Rosenberg, R. 2020. *The National Composite Index for Family Planning (NCIFP): 2017 Global Report*. New York, Avenir Health.

Ross, J., J. Keesbury and K. Hardee. 2015. 'Trends in the contraceptive method mix in low- and middle-income countries: analysis using a new "average deviation" measure'. *Global Health Science and Practice* **3** (1): 34–55. https://doi.org/10.9745/GHSP-D-14-00199

Ross, J.A. and W.P. Mauldin. 1996. 'Family planning programs: efforts and results.' *Studies in Family Planning* **27** (3): 137–147. https://doi.org/10.2307/2137919

Ross, J.J. and J. Stover. 2001. 'The family planning program effort index: 1999 cycle.' *International Family Planning Perspective* **27** (3): 119–129. https://doi.org/10.2307/2673833

Schütz, H., S. Speckesser and G. Schmid. 1998. 'Benchmarking labour market performance and labour market policies: theoretical foundations and applications.' Berlin, Wissenschaftszentrum Berlin für Sozialforschung. Discussion Paper FS I 98–205.

Seiber, E.E., J.T. Bertrand and T.M. Sullivan. 2007. 'Changes in contraceptive method mix in developing countries'. *International Family Planning Perspective* **33** (3): 117–123. https://doi.org/10.1363/3311707

Senderowicz, L. and N. Maloney. 2022. 'Supply-side versus demand-side unmet need: Implications for family planning programs.' *Population and Development Review* **48** (3): 689–722. https://doi.org/10.1111/padr.12478

Srinivasan, K. 1993. 'A critique on contraceptive prevalence rate (CPR)'. Paper presented at 1993 IUSSP General Conference, Montreal, Canada.

Stover, J. 1998. 'Revising the proximate determinants of fertility framework: What have we learned in the past 20 Years?' *Studies in Family Planning* **29** (3): 255–267. https://doi.org/10.2307/172272

Sullivan, T.M., J.T. Bertrand and J.D. Shelton. 2006. 'Skewed contraceptive method mix: why it happens, why it matters'. *Journal of Biosocial Science* **38** (4): 501–521. https://doi.org/10.1017/S0021932005026647

Tan, P-N., M. Steinbach and V. Kumar. 2006. *Introduction to Data Mining*. Boston, MA, Pearson Addison-Wesley.

Thomas, N. and C. Mercer. 1995. 'An examination of the fertility/contraceptive prevalence anomaly in Zimbabwe'. *Genus* **51** (3–4): 179–203.

Tsui, A.O. 2001. 'Population policies, family planning programs and fertility: the record'. *Population and Development Review* **27** (5): 184–204.

United Nations 2015. *Transforming Our World: the 2030 Agenda for Sustainable Development*. Resolution adopted by the General Assembly on 25 September 2015. New York, United Nations. A/RES/70/1.

United Nations 2019. *Contraceptive Use by Method. Data Booklet.* New York, United Nations, Department of Economic and Social Affairs. Population Division

United Nations 2020. *Estimates and Projections of Family Planning Indicators 2020*. New York, United Nations, Department of Economic and Social Affairs, Population Division.

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

Westoff, C.F. and A. Bankole. 2001. 'The contraception fertility link in sub-Saharan Africa and in other developing countries'. Calverton: ORC Macro (DHS Analytical Studies No. 4).

World Health Organization 2014. *Ensuring Human Rights in the Provision of Contraceptive Information and Services: Guidance and Recommendations.* Geneva, World Health Organization.

Yeakey, M.P. and K.P. Gilles. 2017. 'Expanding method choice for successful family planning programs'. Washington DC, Population Reference Bureau.

Zeine, R., C.A. Boglarsky, P. Blessinger and L. Michel. 2014. 'External adaptability of higher education institutions. The use of diagnostic interventions to improve agility'. *Change Management: An International Journal* 13. https://doi.org/10.18848/2327-798X/CGP/v13i04/50757

Table 1: Inter-country Distribution of Different Indicators of Family Planning

Progress	Index				Progress inequality	
	p_p	p_s	p_q	P	p_i	
	Frequency distribution (number of countries)					
Very slow (<0.250)	60	5	5	24	Very high (≥0.150)	3
Slow (0.250-0.500)	30	34	52	54	High (0.150-0.100)	13
Good (0.500-0.750)	10	41	56	34	Low (0.100-0.050)	29
Very good (≥0.750)	13	33	0	1	Very low (<0.050)	68
Number of countries	113	113	113	113	113	
	Summary measures					
Minimum	0.000	0.049	0.054	0.100	0.001	
Q1	0.066	0.450	0.429	0.258	0.012	
Median	0.209	0.611	0.500	0.403	0.038	
Q3	0.465	0.767	0.552	0.525	0.078	
Maximum	0.921	0.939	0.689	0.760	0.187	
Inter-quartile range	0.399	0.317	0.122	0.267	0.066	
Coefficient of variation	0.919	0.343	0.234	0.424	0.880	

SOURCE: AUTHOR

Table 2: Classification of Countries in Terms of the Index *p* Based on Indexes p_s, p_p and p_q

	Node ID						
	3	7	8	4	11	12	10
	Defining characteristics of the cluster						
p_s	*Any value*	*Any value*	*Any value*	*Any value*	*≤0.624*	*>0.624*	*Any value*
p_p	*≤0.108*	*≤0.113*	*(0.113, 0.255)*	*>0.108*	*(0.255, 0.550)*	*(0.255, 0.550)*	*>0.550*
p_q	*≤0.460*	*>0.460*	*>0.460*	*≤0.460*	*>0.460*	*>0.460*	*>0.460*
	Mean values of progress indicators						
p	0.217	0.228	0.403	0.428	0.479	0.545	0.684
p_s	0.478	0.373	0.592	0.761	0.502	0.787	0.763
p_p	0.044	0.043	0.189	0.324	0.402	0.398	0.756
p_q	0.374	0.565	0.540	0.357	0.557	0.512	0.556
MDM	0.403	0.317	0.516	0.720	0.481	0.713	0.763
mCPR	0.228	0.154	0.333	0.513	0.317	0.517	0.614
N	20	20	18	11	13	14	17
Countries	Burundi	Angola	Ghana	Algeria	Mauritius	Eswatini	Malawi
	Ethiopia	Benin	Lesotho	Egypt	Tanzania UR	Kenya	Bhutan
	Gabon	Burkina Faso	Rwanda	Madagascar	Cambodia	Namibia	Iran IR

Table 2: Continued

Gambia	Cameroon	Uganda	Morocco	Iraq	South Africa	Nepal
Liberia	Central African Republic	Zambia	Zimbabwe	Oman	Bangladesh	Sri Lanka
Libya	Comoros	Afghanistan	Korea DPR	Pakistan	Indonesia	Thailand
Mozambique	Congo	Maldives	India	Philippines	Qatar	Turkey
Niger	Côte d'Ivoire	Timor-Leste	Jordan	Bolivia PS	Viet Nam	Belize
Sierra Leone	Congo DR	Yemen	Kazakhstan	Papua New Guinea	Belarus	Colombia
Sudan	Equatorial Guinea	Georgia	Kyrgyzstan	Samoa	Republic of Moldova	Costa Rica
Tunisia	Eritrea	Guyana	Lao PDR	Solomon Islands	Barbados	Cuba
Tajikistan	Guinea		Mongolia	Tonga	Panama	Guatemala
Turkmenistan	Guinea-Bissau		Myanmar	Vanuatu	Saint Lucia	Honduras

Armenia	Mali	State of Palestine	Trinidad & Tobago	Mexico
Bosnia & Herzegovina	Nigeria	Ukraine		Nicaragua
Montenegro	Sao Tome and Principe	Dominican Republic		Paraguay
North Macedonia	Senegal	El Salvador		Peru
Serbia	South Sudan	Suriname		
Haiti	Togo			
Mauritania	Albania			

SOURCE: AUTHOR

Table 3: Average Annual Per Cent Change (*AAPC*) in Different Indexes of Family Planning Progress in 86 Countries During 2000–2019

Trend	Frequency of AAPC value range in			
	p_s	p_p	p_q	p
Progress reversed (*AAPC*<0)	19	33	37	26
Marginal progress (0≤*AAPC* <1.0)	17	10	21	23
Mild progress (1.0≤*AAPC* <2.0)	17	4	12	15
Moderate progress (2.0≤*AAPC* <3.0)	8	6	4	11
Substantial progress (*AAPC*≥3.0)	25	33	12	11
Number of countries	86	86	86	86
Minimum	-6.196	-36.823	-4.341	-12.971
First quartile	0.064	-2.514	-0.750	-0.686
Median	1.364	0.996	0.154	0.721
Third quartile	3.168	5.282	1.385	2.088
Maximum	16.198	98.295	12.796	10.452
Inter-quartile range	3.104	7.996	2.134	2.774
Coefficient of variation	1.704	4.099	4.349	4.378

SOURCE:AUTHOR

Table 4: Direction of Change in Indexes p_s, p_p and p_q and the Direction of Change in the Index p

Contribution of			Direction of change in p		
p_s	p_p	p_q	Positive	Negative	Total
Negative	Negative	Negative	0	6	6
Negative	Negative	Positive	1	5	6
Negative	Positive	Negative	6	10	16
Negative	Positive	Positive	6	4	10
Positive	Negative	Negative	3	0	3
Positive	Negative	Positive	3	1	4
Positive	Positive	Negative	14	0	14
Positive	Positive	Positive	27	0	27
Total			60	26	86

SOURCE: AUTHOR

Appendix Table 1: Indicators of Family Planning Progress in 113 countries, Latest Available Data

Country	Period	p_s	p_p	p_q	p
Africa					
Algeria	2012–2013	0.798	0.185	0.141	0.294
Angola	2015–2016	0.315	0.008	0.531	0.176
Benin	2017–2018	0.313	0.000	0.541	0.137
Burkina Faso	2018–2019	0.595	0.000	0.494	0.181
Burundi	2016–2017	0.494	0.042	0.460	0.254
Cameroon	2014	0.464	0.027	0.590	0.253
Central African Republic	2010–2011	0.337	0.029	0.481	0.207
Comoros	2012	0.316	0.090	0.581	0.275
Congo	2014–2015	0.424	0.041	0.488	0.242
Côte d'Ivoire	2018	0.434	0.000	0.524	0.159
Democratic Republic of the Congo	2013–2014	0.164	0.104	0.560	0.225
Egypt	2014	0.901	0.129	0.429	0.399
Equatorial Guinea	2011	0.254	0.077	0.657	0.258
Eritrea	2010	0.237	0.029	0.584	0.194
Eswatini	2014	0.906	0.282	0.540	0.532
Ethiopia	2018	0.709	0.000	0.348	0.166
Gabon	2012	0.383	0.072	0.349	0.230
Gambia	2018	0.434	0.046	0.446	0.242
Ghana	2017	0.547	0.123	0.617	0.372
Guinea	2018	0.428	0.039	0.602	0.264
Guinea-Bissau	2014	0.454	0.029	0.689	0.272
Kenya	2017	0.850	0.269	0.463	0.486

Country	Period	p_s	p_p	p_q	p
Lesotho	2018	0.901	0.181	0.531	0.468
Liberia	2013	0.450	0.032	0.389	0.217
Libya	2014	0.276	0.000	0.434	0.115
Madagascar	2017	0.668	0.182	0.382	0.372
Malawi	2015–2016	0.798	0.582	0.467	0.604
Mali	2018	0.475	0.053	0.498	0.269
Mauritius	2014	0.399	0.465	0.580	0.477
Morocco	2018	0.788	0.120	0.188	0.281
Mozambique	2015	0.580	0.029	0.455	0.253
Namibia	2013	0.831	0.444	0.500	0.574
Niger	2017	0.467	0.042	0.456	0.246
Nigeria	2018	0.416	0.029	0.652	0.255
Rwanda	2014–2015	0.733	0.144	0.491	0.397
Sao Tome and Principe	2014	0.662	0.037	0.537	0.298
Senegal	2017	0.589	0.068	0.529	0.316
Sierra Leone	2016	0.545	0.011	0.426	0.210
South Africa	2016	0.872	0.485	0.547	0.619
South Sudan	2010	0.070	0.014	0.598	0.108
Sudan	2014	0.370	0.000	0.243	0.100
Togo	2017	0.457	0.083	0.594	0.313
Tunisia	2018	0.786	0.089	0.398	0.338
Uganda	2017	0.572	0.202	0.479	0.392
United Republic of Tanzania	2015–2016	0.566	0.347	0.578	0.488
Zambia	2013–2014	0.700	0.209	0.534	0.443
Zimbabwe	2015	0.903	0.154	0.383	0.401

Country	Period	p_s	p_p	p_q	p
Asia					
Afghanistan	2015–2016	0.470	0.205	0.607	0.399
Bangladesh	2014	0.778	0.468	0.485	0.565
Bhutan	2010	0.903	0.741	0.552	0.721
Cambodia	2014	0.609	0.307	0.525	0.466
Democratic People's Republic of Korea	2017	0.939	0.265	0.054	0.281
India	2015–2016	0.502	0.834	0.257	0.490
Indonesia	2016–2017	0.864	0.311	0.461	0.510
Iran (Islamic Republic of)	2010–2011	0.616	0.890	0.619	0.700
Iraq	2018	0.594	0.270	0.533	0.448
Jordan	2017–2018	0.632	0.161	0.437	0.370
Kazakhstan	2018	0.855	0.117	0.416	0.378
Kyrgyzstan	2018	0.724	0.173	0.407	0.387
Lao People's Democratic Republic	2017	0.811	0.331	0.424	0.493
Maldives	2016–2017	0.325	0.242	0.501	0.344
Mongolia	2018	0.762	0.191	0.426	0.412
Myanmar	2015–2016	0.888	0.309	0.437	0.505
Nepal	2016–2017	0.557	0.564	0.634	0.584
Oman	2014	0.371	0.444	0.653	0.479
Pakistan	2017–2018	0.463	0.533	0.535	0.509
Philippines	2017	0.623	0.404	0.480	0.496
Qatar	2012	0.758	0.271	0.546	0.494
Sri Lanka	2016	0.735	0.758	0.667	0.719
State of Palestine	2014	0.686	0.281	0.408	0.436
Tajikistan	2017	0.659	0.066	0.338	0.276

Country	Period	p_s	p_p	p_q	p
Thailand	2015–2016	0.893	0.895	0.483	0.736
Timor-Leste	2016	0.507	0.189	0.480	0.368
Turkey	2018	0.607	0.578	0.531	0.571
Turkmenistan	2015–2016	0.817	0.078	0.071	0.190
Viet Nam	2013–2014	0.717	0.446	0.477	0.537
Yemen	2013	0.495	0.148	0.510	0.349
Europe					
Albania	2017–2018	0.049	0.103	0.571	0.16
Armenia	2015–2016	0.435	0.099	0.425	0.281
Belarus	2012	0.766	0.5	0.501	0.58
Bolivia (Plurinational State of)	2016	0.561	0.37	0.677	0.524
Bosnia and Herzegovina	2011–2012	0.241	0.034	0.426	0.177
Georgia	2018	0.638	0.221	0.545	0.437
Montenegro	2018	0.376	0.054	0.44	0.235
North Macedonia	2011	0.27	0.056	0.356	0.191
Republic of Moldova	2012	0.624	0.484	0.477	0.525
Serbia	2014	0.289	0.036	0.325	0.172
Ukraine	2012	0.692	0.333	0.451	0.475
Latin America and Caribbean					
Barbados	2012	0.792	0.316	0.526	0.518
Belize	2011	0.729	0.735	0.543	0.664
Colombia	2015–2016	0.82	0.919	0.545	0.748
Costa Rica	2018	0.864	0.751	0.594	0.73
Cuba	2014	0.903	0.845	0.537	0.748
Dominican Republic	2014	0.757	0.907	0.383	0.652
El Salvador	2014	0.735	0.894	0.421	0.66

Country	Period	p_s	p_p	p_q	p
Guatemala	2014–2015	0.576	0.797	0.5	0.615
Guyana	2014	0.63	0.218	0.645	0.461
Haiti	2012	0.611	0.075	0.39	0.291
Honduras	2011–2012	0.725	0.834	0.569	0.703
Mauritania	2015	0.374	0.01	0.304	0.152
Mexico	2015	0.812	0.814	0.492	0.693
Nicaragua	2011–2012	0.884	0.921	0.526	0.76
Panama	2014–2015	0.767	0.474	0.548	0.587
Paraguay	2016	0.89	0.563	0.594	0.671
Peru	2018	0.657	0.709	0.602	0.655
Saint Lucia	2011–2012	0.802	0.447	0.542	0.583
Suriname	2018	0.655	0.272	0.385	0.416
Trinidad and Tobago	2011	0.687	0.372	0.56	0.528
Pacific					
Papua New Guinea	2016–2018	0.538	0.395	0.574	0.498
Samoa	2014	0.473	0.28	0.483	0.403
Solomon Islands	2015	0.37	0.395	0.546	0.432
Tonga	2012	0.434	0.537	0.491	0.486
Vanuatu	2013	0.522	0.477	0.581	0.525

SOURCE: AUTHOR

Appendix Table 2: Decomposition of *AAPC* in the Index *p*

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Africa						
Algeria	2006	2012	0.315	-0.130	1.043	-0.598
Benin	2001	2017	-1.266	1.448	-2.307	-0.407
Burkina Faso	2003	2017	1.716	3.154	-0.833	-0.604
Burundi	2010	2016	1.183	1.625	-1.077	0.635
Cameroon	2004	2014	-0.903	1.605	-3.735	1.228
Congo	2005	2014	4.893	2.957	0.356	1.579
Côte d'Ivoire	2011	2018	0.221	1.582	-2.788	1.427
Democratic Republic of the Congo	2007	2013	4.392	1.809	0.132	2.450
Egypt	2000	2014	0.710	0.014	0.109	0.587
Eritrea	2002	2010	0.188	-0.077	0.000	0.265
Eswatini	2006	2014	0.989	0.529	0.692	-0.232
Ethiopia	2000	2018	1.692	3.038	-0.890	-0.457
Gabon	2000	2012	-0.694	1.364	-0.835	-1.223
Gambia	2013	2018	-1.017	3.615	-3.824	-0.808
Ghana	2003	2017	2.135	1.302	0.812	0.021
Guinea	2005	2018	3.581	2.402	1.080	0.098
Kenya	2003	2017	1.013	1.220	0.080	-0.288
Lesotho	2004	2018	1.539	0.583	0.880	0.076
Liberia	2006	2013	0.182	2.775	-1.256	-1.337
Madagascar	2003	2017	2.278	1.145	1.597	-0.464
Malawi	2000	2015	3.673	1.124	2.047	0.502

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Mali	2001	2018	2.248	1.796	0.582	-0.129
Morocco	2003	2018	-2.051	-0.046	-1.281	-0.723
Mozambique	2003	2015	-1.336	0.472	-1.560	-0.247
Namibia	2000	2013	0.419	0.284	0.272	-0.136
Niger	2006	2017	-0.920	0.647	-1.563	-0.005
Nigeria	2003	2018	0.711	0.615	0.029	0.068
Rwanda	2000	2014	6.144	5.075	1.735	-0.666
Sao Tome and Principe	2006	2014	2.139	-0.326	0.316	2.149
Senegal	2005	2017	2.795	2.578	0.439	-0.222
Sierra Leone	2013	2016	-7.187	2.123	-7.603	-1.707
South Africa	2003	2016	-0.435	-0.100	-0.599	0.264
Togo	2010	2017	6.517	1.678	4.236	0.603
Tunisia	2011	2018	-5.364	0.157	-5.315	-0.205
Uganda	2000	2017	1.469	0.918	0.945	-0.394
United Republic of Tanzania	2004	2015	2.233	0.876	1.040	0.317
Zambia	2001	2013	2.193	1.150	0.958	0.086
Zimbabwe	2005	2015	0.651	0.200	-0.753	1.204
Asia						
Bangladesh	2004	2014	1.185	0.331	0.476	0.378
Cambodia	2000	2014	3.214	1.218	2.404	-0.408
India	2005	2015	0.800	0.612	0.030	0.158
Indonesia	2002	2016	-0.224	0.004	-0.070	-0.158

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Iraq	2011	2018	-1.751	0.216	-2.294	0.327
Jordan	2002	2017	-0.862	-0.026	-0.868	0.032
Kazakhstan	2010	2018	0.698	-0.210	-0.112	1.020
Kyrgyzstan	2012	2018	0.359	0.389	-1.102	1.072
Lao People's Democratic Republic	2000	2017	1.649	0.551	1.475	-0.377
Maldives	2009	2016	-3.567	-1.030	-2.340	-0.197
Mongolia	2003	2018	-1.607	-0.255	-1.296	-0.055
Myanmar	2001	2015	0.182	0.573	-0.093	-0.298
Nepal	2001	2016	0.765	0.377	0.038	0.350
Oman	2007	2014	10.452	3.098	7.210	0.144
Pakistan	2000	2017	1.587	0.262	1.487	-0.161
Philippines	2003	2017	0.229	0.662	-0.171	-0.262
Sri Lanka	2000	2016	1.589	0.851	0.351	0.387
State of Palestine	2010	2014	-1.359	-0.056	-1.154	-0.149
Tajikistan	2012	2017	2.286	0.209	1.056	1.022
Timor-Leste	2009	2016	9.707	0.600	4.800	4.307
Turkey	2003	2018	0.871	0.235	0.498	0.138
Turkmenistan	2000	2015	-2.184	0.071	-1.355	-0.900
Viet Nam	2002	2013	0.454	0.225	-0.728	0.957
Yemen	2006	2013	-0.033	0.591	-0.709	0.084
Europe						
Albania	2008	2018	-4.310	-1.827	-2.495	0.012
Armenia	2000	2015	0.329	0.805	-0.126	-0.351

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Bolivia (Plurinational State of)	2003	2016	1.241	0.381	0.690	0.170
Montenegro	2013	2018	4.532	-1.547	6.218	-0.140
Republic of Moldova	2005	2012	2.169	0.285	1.394	0.490
Serbia	2010	2014	-5.075	-1.603	-1.909	-1.563
Ukraine	2007	2012	9.894	0.265	8.855	0.773
Latin America and Caribbean						
Colombia	2000	2015	0.645	0.448	0.238	-0.042
Costa Rica	2011	2018	-0.823	-0.172	-0.798	0.147
Cuba	2010	2014	0.408	-0.224	0.585	0.046
Dominican Republic	2002	2014	1.101	0.478	0.050	0.573
Guatemala	2002	2014	1.948	0.944	0.937	0.067
Guyana	2009	2014	-0.804	-1.205	0.018	0.384
Haiti	2000	2012	-0.660	0.682	-0.612	-0.730
Honduras	2005	2011	1.466	0.434	0.968	0.064
Mauritania	2007	2015	2.138	0.928	0.666	0.544
Mexico	2009	2015	1.806	0.570	-0.563	1.799
Nicaragua	2001	2011	0.730	0.210	0.760	-0.240
Panama	2013	2014	-12.971	0.014	-14.128	1.143
Peru	2000	2018	0.420	0.117	0.393	-0.091
Suriname	2010	2018	-3.781	-0.839	-2.338	-0.604
Trinidad and Tobago	2006	2011	0.846	-0.494	1.420	-0.080

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Pacific						
Samoa	2009	2014	2.991	0.049	2.184	0.758
Solomon Islands	2006	2015	-2.561	-0.910	-2.209	0.557

SOURCE: AUTHOR

APPENDIX

Composite Family Planning Progress Index

The family planning progress is measured in terms of the progress in three dimensions: 1) met demand of modern spacing methods; 2) met demand of permanent methods; and 3) expanding method choice. Let c_s denote the prevalence of modern spacing methods, c_p denote the prevalence of permanent methods, c_t denote the prevalence of traditional methods, u_s denote the unmet need for spacing and u_p denote the unmet need for limiting. Then, assuming that the prevalence of traditional methods reflects the unmet need of modern spacing methods, an index p_s of the met demand of modern spacing methods can be constructed as

$$p_s = \frac{c_s}{c_s + c_t + u_s} \quad (1)$$

Similarly, an index p_p reflecting the met demand of permanent methods can be constructed as

$$p_p = \frac{c_p}{c_p + u_p} \quad (2)$$

Both p_s and p_p range from 0 to 1 and the higher the index the better the progress and vice versa.

On the other hand, there is no standard indicator to measure method choice (Bertrand et al., 2014). The method mix is recommended as one of the key indicators of method choice (Measure Evaluation, 2018). Method-mix is also one of the outcome indicators of the FP2030 Measurement Framework (FP2020, nd). A dispersed method-mix reflects an expanded method choice whereas a skewed method-mix reflects limited method choice. Method-mix is influenced by many factors including poor capacity of family planning efforts in providing methods of choice to potential users, poor counselling and policy and provider bias. Method-mix is also influenced by user preferences which are shaped by cultural norms and societal practices. It has, however, been argued that cultural and social barriers or myths or misconceptions about different methods can be overcome through effective counselling (Yeakey and Gilles, 2017). It is also naïve to believe that just one or two family planning methods can meet the entire family planning demand

during different stages of the family building process. It can, therefore, be argued that method-skew can serve as an indicator of method choice, the higher the method skew the more limited the method choice.

Different approaches have been suggested to measure method-skew. The method-mix is termed as skewed if the proportionate share of a single method in total family planning use is at least 50 per cent (Bertrand et al., 2014; Seiber et al., 2007; Sullivan et al., 2006). This approach classifies the method-mix in only two categories: skewed and not skewed. It does not measure skewness on a scale and, therefore, has limited use in measuring family planning progress. Another approach is based on comparing the observed method-mix with some pre-specified standard or benchmark (Bertrand et al., 2000). There is, however, no universal benchmark so that measuring skewness, in this approach, is contingent upon the benchmark adopted. This approach also does not measure method-skew on a scale. The third approach uses average deviation in the prevalence of different family planning methods (Ross et al., 2015; Bertrand et al., 2020). Average deviation, by definition, is a measure of dispersion, not concentration, and is influenced by both the degree of concentration and the number of units (Foldvary, 2006).

Chaurasia (2021) has proposed a method-skew index that measures skewness on a scale and is based on the concept of the dominance of one family planning method over others. If x_j is the proportionate prevalence of method j among n methods available, then the method skew index, s, (Chaurasia, 2021) is defined as

$$s = \sqrt{\frac{\sum x_j^2 - \left(\frac{1}{n}\right)}{1 - \left(\frac{1}{n}\right)}} \; when\; n > 1 \; and \; s = 1 \; when \; n = 1; \; \sum_{j=1}^{n} x_j = 1 \qquad (3)$$

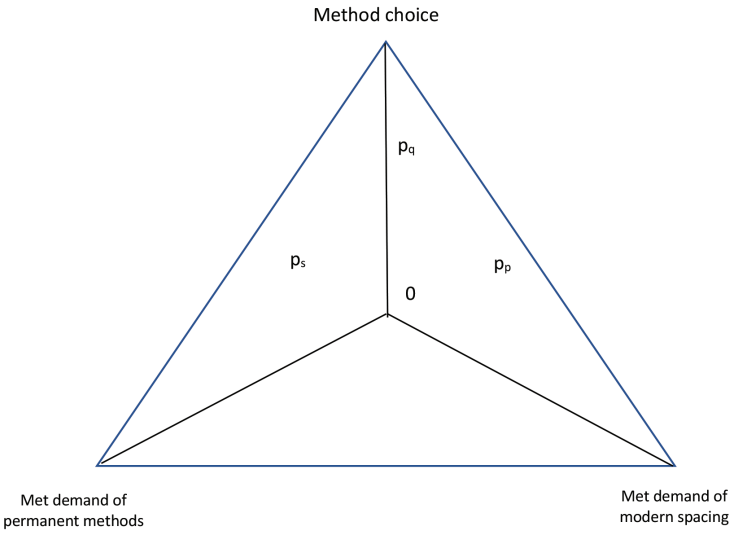
When entire family planning use is confined to one method only, s=1, while s=0 when family planning use is evenly distributed across different methods available. Using the index, s, an index to measure progress in method choice may be defined as

$$p_q = 1 - s \qquad (4)$$

The index p_q ranges between 0 and 1 and the higher the index, the more expanded the method choice and vice versa.

A composite index of family planning progress may now be constructed by combining p_s, p_p and p_q through an appropriate aggregation function. The commonly used aggregation function is the arithmetic mean. The geometric mean, or the generalised mean can also be used. The value of the composite index, however, depends upon the aggregation function used, although, the upper and lower limits of the composite index remain unchanged. Using the same values of p_s, p_p and p_q, the composite index is the highest when the simple arithmetic mean is used as the aggregation function but the lowest when the three indexes are multiplied. When the geometric mean is used, the composite index is lower than the composite index obtained by using the simple arithmetic mean. When generalised mean is used, the composite index is sensitive to the power of the mean.

Figure 1: The Family Planning Progress Triangle



SOURCE: AUTHOR

Alternatively, the three indexes reflecting the progress in the three dimensions of family planning may be combined to constitute the family planning progress triangle as shown in Figure 1 and the area of the triangle may serve as a composite progress index that reflects, simultaneously, the progress in the three dimensions of family planning. This approach of measuring progress is widely used in economics and in private sector management (Albach and Moerke 1995; Bogan and English 1994; Domptin 1997). It has also been used in the measurement of labour-market performance (Schütz, Speckesser and Schmid, 1998) and in measuring the external adaptability of the higher education institutions (Zeine et al., 2014) and can also be used to construct a composite index of family planning progress.

Figure 1 suggests that family planning progress triangle comprises of three sub-triangles, all of which have the common vertex and the same angle at vertex. The area, A, of the triangle is then the sum of the area of the three sub-triangles. In other words,

$$A = \frac{1}{2}\left(p_s * p_p + p_p * p_q + p_q * p_s\right) * \mathrm{Sin}(360^o/3) \quad (5)$$

When $p_s = p_p = p_q = 0$, $A = 0$. When $p_s = p_p = p_q = 1$, the area of the family planning progress triangle is the maximum and is given by

$$A_{max} = \frac{1*1*\mathrm{Sin}\,(360^o/3)}{2} + \frac{1*1*\mathrm{Sin}\,(360^o/3)}{2} + \frac{1*1*\mathrm{Sin}\,(360^o/3)}{2} = \frac{3}{2}\mathrm{Sin}\,(360^o/3) \quad (6)$$

Dividing (5) by (6), the normalised area of family planning progress triangle, A_n, which varies between 0 (minimum) to 1 (maximum) is given by

$$A_n = \frac{A}{A_{max}} = \frac{\frac{1}{2}\left(p_s*p_p+p_p*p_q+p_q*p_s\right)*\mathrm{Sin}(360^o/3)}{\frac{3}{2}\mathrm{Sin}(360^o/3)} = \frac{\left(p_s*p_p+p_p*p_q+p_q*p_s\right)}{3} \quad (7)$$

It may be noted that the increase in A_n with the increase in the indexes p_s, p_t and p_q is not linear but concave so that with the increase in the indexes p_s, p_t and p_q the increase in A_n also increases. For example, when p_s=p_p=p_q=0.200, A_n=0.040 and when p_s=p_p=p_q=0.300, A_n=0.090 which means that an improvement of 0.100 in each of the three indexes leads to an increase of 0.050 in A_n. However, when p_s=p_p=p_q=0.700, A_n =0.490 and when p_s=p_p=p_q=0.800, A_n =0.640 so that the same improvement of 0.100 in each of the three indexes leads to an increase of 0.150 in the index A_n. This is not the desirable property of any progress index. Moreover,

A_n gives equal weight to three dimensions irrespective of the progress in the dimension. From the perspective of measuring progress, it is imperative that more weight should be assigned to that dimension in which progress is lagging.

Problems associated with A_n can be addressed by using the positive square root of three indexes p_s, p_t and p_q. This modification gives more weight to that dimension in which the progress is lagging comparative to other dimensions. The composite family planning progress index, p, may now be defined as

$$p = \frac{\sqrt{p_s * p_p} + \sqrt{p_p * p_q} + \sqrt{p_q * p_s}}{3} = \frac{p_{sp} + p_{pq} + p_{qs}}{3};\ p_{sp} = \sqrt{p_s * p_p},\ \text{etc.} \quad (8)$$

Since the indexes p_s, p_p and p_q range between 0 and 1, the index p also ranges between 0 and 1 and the lower the index p the poorer the family planning progress. It may, however, be emphasised that the upper and lower limits of the index p are the technical limits. It is rare that the index p will be either 0 or 1 in any country. The upper and lower theoretical limits of the index p actually serve as the goal posts to measure family planning progress.

The temporal change in any index in a period is measured in terms of annual per cent change (*APC*) under the assumption that *APC* is constant throughout the reference period. When *APC* is not constant throughout the reference period, it may lead to an erroneous conclusion about the temporal change. A segmented approach is, therefore, needed in which the reference period is divided into smaller time segments and in each time segment, *APC* is assumed to be constant but *APC* in different time segments may be different. The weighted average of *APC* in different time segments with weights proportional to the length of the time segment then gives average annual per cent change (*AAPC*) during the reference period (Clegg et al., 2009). In this approach, the relative contribution of *APC* in a time segment to *AAPC* is a function of the length of the time segment. A high *APC* in a short time segment has only a small contribution to *AAPC* whereas a moderate *APC* in a long time segment has substantial contribution. If the time period t^b (beginning) to t^e (end) is divided into k time segments such that $t^b < t^1 < t^2 < \ldots < t^k < t^e$ and p^1 is the composite index in the year t^1 and p^2 is the composite index in the year t^2, then the *APC* in the time segment (t^1, t^2) is calculated as

$$APC = \frac{(p^2 - p^1)}{p^1 \times (t^2 - t^1)} \quad (9)$$

and the *AAPC* is calculated as

$$AAPC = \sum_{i=1}^{k} w_i * APC_i \quad (10)$$

where

$$w_i = \frac{t^{i+1} - t^i}{t^e - t^b}; \sum w_i = 1 \quad (11)$$

An *AAPC*>0 indicates positive change while *AAPC*<0 indicates reversal in the progress. When *AAPC*=0, progress remains unchanged.

The *APC* in the index *p* can be decomposed into three components, one each attributed to p_s, p_p and p_q. The difference $p^2 - p^1$ may be decomposed as

$$p^2 - p^1 = \frac{p_{sp}^2 + p_{pq}^2 + p_{qs}^2}{3} - \frac{p_{sp}^1 + p_{pq}^1 + p_{qs}^1}{3} = \frac{1}{3}\left[\left(p_{sp}^2 - p_{sp}^1\right) + \left(p_{pq}^2 - p_{pq}^1\right) + \left(p_{qs}^2 - p_{qs}^1\right)\right] \quad (12)$$

We can write

$$\left(p_{sp}^2 - p_{sp}^1\right) = \frac{(p_{sp}^2 - p_{sp}^1)}{ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right)} * ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right) = LM_{sp} * \ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right) = LM_{sp} * \left[ln\left(\frac{\sqrt{p_s^2}}{\sqrt{p_s^1}}\right) + ln\left(\frac{\sqrt{p_p^2}}{\sqrt{p_p^1}}\right)\right] \quad (13)$$

where

$$LM_{sp} = \frac{(p_{sp}^2 - p_{sp}^1)}{ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right)} \quad (14)$$

is the logarithmic mean (Carlson, 1972). Similarly,

$$\left(p_{pq}^2 - p_{pq}^1\right) = LM_{pq} * \left[ln\left(\frac{\sqrt{p_p^2}}{\sqrt{p_p^1}}\right) + ln\left(\frac{\sqrt{p_q^2}}{\sqrt{p_q^1}}\right)\right] \quad (15)$$

$$\left(p_{qs}^{2}-p_{qs}^{1}\right)=LM_{qs}*\left[ln\left(\frac{\sqrt{p_{q}^{2}}}{\sqrt{p_{q}^{1}}}\right)+ln\left(\frac{\sqrt{p_{s}^{2}}}{\sqrt{p_{s}^{1}}}\right)\right] \quad (16)$$

so that

$$p^{2}-p^{1}=\left\{\frac{(LM_{sp}+LM_{qs})}{3}*\ln\left(\frac{\sqrt{p_{s}^{2}}}{\sqrt{p_{s}^{1}}}\right)\right\}+\left\{\frac{(LM_{sp}+LM_{pq})}{3}*\ln\left(\frac{\sqrt{p_{p}^{2}}}{\sqrt{p_{p}^{1}}}\right)\right\}+\left\{\frac{(LM_{pq}+LM_{qs})}{3}*\ln\left(\frac{\sqrt{p_{q}^{2}}}{\sqrt{p_{q}^{1}}}\right)\right\} \quad (17)$$

$$p^{2}-p^{1}=\partial p_{s}+\partial p_{p}+\partial p_{q} \quad (18)$$

Substituting from (18) into (9), we get

$$APC=\frac{\partial p_{s}}{p^{1}\times(t^{2}-t^{1})}+\frac{\partial p_{p}}{p^{1}\times(t^{2}-t^{1})}+\frac{\partial p_{q}}{p^{1}\times(t^{2}-t^{1})}=S+P+Q \quad (19)$$

Where *S* is the contribution of the change in the index p_s; *P* is the contribution of the change in p_p; and *Q* is the contribution of the change in p_q. The *AAPC* in the index *p* is now decomposed as

$$AAPC=\sum_{i=1}^{k}w_{i}*S_{i}+\sum_{i=1}^{k}w_{i}*P_{i}+\sum_{i=1}^{k}w_{i}*Q_{i}=C_{S}+C_{P} \quad (20)$$

Equation (20) holds for every country so that inter-country variation in *AAPC* in the index *p* can be decomposed as

$$Var(AAPC)=\sum Var(C_{i})+2\sum_{i\neq j}Cov\left(C_{i},C_{j}\right),\ i,j=S,P,Q \quad (21)$$

Equation (21) suggests that the contribution of inter-country variation in C_i to the inter-country variation in *AAPC* may be small because either $Var(C_i)$ is small or covariance terms $Cov(C_i, C_j)$ are negative so that equation (21) may not reflect the true importance of inter-country variation in the change in the three indexes to the change in the index *p*. This problem can be circumvented by using absolute

values of covariance terms in equation (21). Thus, the relative importance of the inter-country variation in the change in the indexes p_s to the inter-country variation in the change in the index p can be calculated as (Chaurasia, 2020b; Horvitz et al., 1997; Rees et al., 2010: Rees et al., 1996)

$$I(p_s) = \frac{Y(p_s)}{Y(p)} \tag{22}$$

where

$$Y(p_s) = Var(C_S) + |Cov(C_S, C_P)| + \left|Cov\left(C_S, C_Q\right)\right|, \text{ etc.} \tag{23}$$

and

$$Y(p) = Y(p_s) + Y\left(p_p\right) + Y\left(p_q\right) \tag{24}$$

It may be noted that contribution of indexes p_s, p_p and p_q to the index p is not additive. As such, the classification modelling exercise (Han et al., 2012; Tan et al., 2006) was carried out to classify countries based on indexes p_s, p_p and p_q. The classification and regression tree (CRT) method (Brieman et al., 1984) was used for this purpose. CRT is a non-parametric recursive partitioning method that divides countries into mutually exclusive clusters in such a way that within-group homogeneity in the index p is the maximum. A cluster in which all countries have the same value of the index p is termed as 'pure'. If a cluster is not pure, the impurity in the cluster can be measured through the Gini index. If the dependent variable is a categorical one, the method provides cluster-specific distribution of the dependent variable. If the dependent variable is a scale variable, the method provides estimates of arithmetic mean and standard deviation of the dependent variable for each cluster (Chaurasia, 2018). The TREE routine of the SPSS software package was used for classification modelling.

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INVITED ARTICLE

Population and Steady-State Economy in Plato and Aristotle

Theodore P. Lianos[1]

Abstract

The basic ideas of the modern steady-state economy model can be found in the writings of the two major ancient Greek philosophers, Plato and Aristotle. Plato in his Laws *and Aristotle in his* Politics *discuss the optimal relationship between population and available land that would give enough wealth to the city and allow the citizens to enjoy the best life. They discuss questions of income inequality and approaches to population control. The guiding thought in these models is what the two philosophers define as the 'best life'.*

Keywords: Aristotle, Plato, Steady-state Economy, Population

Introduction

Some of the underlying ideas of the modern steady-state economy model are to be found in the writings of the two major ancient philosophers, namely Plato and Aristotle. The important question on which the development of the Platonic and Aristotelian philosophies was based had been stated by Socrates and it was a simple one: how should we live?

Before Socrates, philosophy was mostly associated with Mathematics (Pythagoras and Zeno of Elea) and Physics (Heraclitus and Democritus). However, after

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Socrates, all schools of philosophy attempted to provide an answer to the question of how we should live and philosophy thus became synonymous with ethics. The teachings of the Cynics, the Stoics, the Epicureans and, of course, Plato and Aristotle are all concerned to a great extent with Ethics. One characteristic that distinguishes Plato and Aristotle from the other ancient philosophers is that their ethical teachings concern not only the moral behaviour of individuals, but are also embedded in models concerning the ideal organisation of society.

As a background to what follows, it should be noted that the code of values for most philosophers, and more so for Plato and Aristotle, gave priority to individual moral behaviour, respect and obedience to the laws of the city, and social justice. Social justice, particularly in the distribution of income and wealth, was considered a precondition for social harmony. Of course, Plato's and Aristotle's ideas were not developed in an intellectual vacuum but in the context of concern with the growing population and fear that an imbalance would develop between the size of the population and availability of land. The population of Greece itself is estimated to have grown to three million by the second half of the fifth century BC, just before the Peloponnesian War (Feen, 1996); but colonisation of the Mediterranean from the eight century BC had increased Greek controlled territory.

Indeed, pressure on resources due to population growth had become evident as early as the time of Homer (8th century BC). In a lost hymn (Homer [trans. Evelyne-White], 1920: 'The Cypria', fragment 3), the poet attributes the Trojan War to overpopulation. He sings:

> There was a time when the countless tribe of men, though wide dispersed, oppressed the surface of the deep-bosomed earth, and Zeus saw it and had pity and in his wise heart resolved to relieve the all-nurturing earth of men by causing the great struggle of the Ilian war, that the load of death might empty the world. And so the heroes were slain in Troy and the plan of Zeus came to pass.

What is a steady-state economy?

To compare the models of Plato and Aristotle with the modern concept of the steady-state economy we must examine two defining elements: constant

population, and constant capital and wealth. In a chapter on the 'stationary' economy, J.S. Mill suggests that 'Even in a progressive state of capital, in old countries, a conscientious or prudential restraint on population, is indispensable, to prevent the increase of numbers from outstripping the increase of capital' (Mill, 1970: 112). Also: 'It is scarcely necessary to remark that a stationary condition of capital and population implies no stationary state of human improvement. There would be as much scope as ever for all kinds of mental culture, and moral and social progress.' (Mill, 1970: 116)

Recently, Herman Daly has defined the steady-state economy as 'an economy with constant population and constant stock of capital, maintained by a low rate of throughput that is within the regenerative and assimilative capacities of the ecosystem' (Daly, 2008: 4)

Both Mill and Daly speak of the need for constant population and capital but they are reluctant to specify the proper ratio between the two. This is probably due to their unwillingness to suggest a standard of living for the average individual, given that every combination of capital and population implies a different per capita product, given the technology of production. In contrast, Plato and Aristotle begin their analyses by specifying what they consider a satisfactory standard of living. As will be seen below, a judgment about the right standard of living is the basis of the Platonic and Aristotelian models.

Plato's Model

Plato developed two models for the organisation of the city state. The first appeared in his *Republic (Politeia),* written around 380 BC. According to Plato, 'The first and highest form of the state and of the government and of the laws is that in which there prevails most widely the ancient saying that "Friends have all things in common"' (Laws, 739 C). This model includes the communion of women and children and of property, and for Plato it is the ideal State. Probably because he realised that such a society could not be realised at his time, however, he developed a second model in his *Laws*, which was written late in his life and published in 347 BC. It is this second model which contains some basic elements that justify its characterisation as a steady-state economy, and which, 'when created, will be nearest to immortality and the only one which takes the second place' to that described in the *Republic* (Laws, 739 E).

Plato expounds his model by imagining the creation of a new colony. The first thing to do, he argues, is to 'let the citizens at once distribute their land and houses and not till the land in common, since a community of goods goes beyond their proposed origin and nurture, and education' (Laws, 740 A). The distribution of property should be such that there would 'be no disputes among citizens about property' (Laws, 737 B). The next task is to determine the number of people and the size of land. These must be determined simultaneously so that two requirements must be satisfied: first, citizens must have a decent standard of living, and second, the size of the population must be large enough to be able to defend the city and also help neighbouring cities. In Plato's words, 'The number of citizens can only be estimated satisfactorily in relation to the territory and the neighbouring states. The territory must be sufficient to maintain a certain number of inhabitants in a moderate way of life – more than this is not required; and the number of citizens should be sufficient to defend themselves against the injustice of their neighbours, and also to give them the power of rendering efficient aid to their neighbours when they are wronged.' (Laws, 737 C, D)

The exact size of the land is not specified but the number of farmers[2] given by Plato is 5,040. However, this precise number is chosen because it is divisible by all numbers from one to ten and is helpful in "all contracts and dealings". What is important in the relation between population and land is that they form a common factor, or they become a pair. Plato's text says '**γενόμενα ανήρ και κλήρος συννομή**' which Jowett translates 'so that every man may correspond to a lot'.

Plato's central idea here is that land and population should be determined simultaneously in such a way that citizens might enjoy a good but moderate standard of living and the city should be safe from enemies.

Of course, not all land should be allocated for agricultural production. Some land should be set aside for other purposes. Thus, the legislator

> should assign to the several districts some God, or demi-god, or hero, and, in the distribution of the soil, should give to these first their chosen domain and all things fitting, that the inhabitants of the several districts may meet at fixed times, and that they may readily supply their various

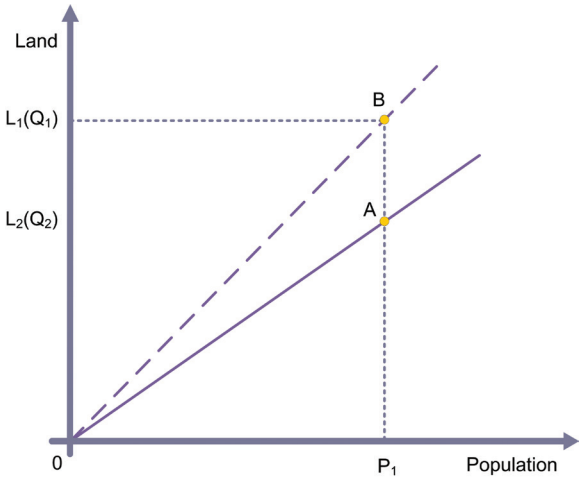
2 Jowett, whose translation I am using, renders the word **γεομόροι** as 'citizens'.

> wants, and entertain one another with sacrifices, and become friends and acquaintances; for there is no greater good in a state than that the citizens should be known to one another. (Laws, 728 D)

Each holder of land should cultivate his piece, but they should all remember that their land is the common land of their country and therefore they should care for it better than a mother cares for her children. Parenthetically, it is interesting that Plato believes that of all educational studies the best for the economy, as well as for politics and the arts, is arithmetic. This shows not only his interest in mathematics but also a concern for the productivity of land since agricultural production was the main supplier of the basic necessities of life.

Plato's steady-state economy can be presented in a simple diagram. The horizontal axis of Figure 1 measures population and the vertical axis measures land and, implicitly, the level of agricultural production. If all land is devoted to farming the standard of living is given by the slope of the line 0B which determines product per person, i.e. L1/P1 and therefore Q1/P1, since the quantity produced (Q) is determined by the available land (L). If part of the land, shown by the distance L1L2, is used for other purposes, e.g. temples, ceremonies and parades, the product per person will be less – as shown by the slope of line 0A.

Figure 1. Plato's model of steady-state



What makes this model a steady-state economy is the following requirement, which Plato states strongly: 'And in order that the distribution may always remain, they ought to consider further that the present number of families should be always retained, and neither increased nor diminished' (Laws, 740 B). In other words, population must be constant. Plato suggests several ways that this can be done. The farm should be inherited by only one child so that the property will not split. Incentives, disincentives and proper advice may be given to encourage or discourage changes in population, as needed. Finally, if necessary, immigration or emigration may be allowed.

Plato recognises that although all citizens may have equal opportunities to begin with, wealth inequalities may arise. Regarding the question of the level of economic inequality that should be allowed among citizens, Plato proposes that the richest citizen be no more than four times richer than the poorest and any excess wealth, however acquired, should be turned over to the city. In his words:

> The form of law which I should propose as the natural sequel would be as follows: In a State which is desirous of being saved from the greatest of all plagues – faction, but rather distraction – there should exist among the citizens neither extreme poverty, nor, again, excess of wealth, for both are productive of both these evils. Now the legislator should determine what is to be the limit of poverty or wealth. Let the limit of poverty be the value of the lot; this ought to be preserved, and no ruler, nor anyone else who aspires after a reputation for virtue, will allow the lot to be impaired in any case. This the legislator gives as a measure, and he will permit a man to acquire double or triple, or as much as four times the amount of this. But if a person have yet greater riches, whether he has found them, or they have been given to him, or he has made them in business, or has acquired by any stroke of fortune that which is in excess of the measure, if he give back the surplus to the state, and to the Gods who are the patrons of the State, he shall suffer no penalty or loss of reputation; but if he disobeys this our law, any one who likes may inform against him and receive half the value of the excess, and the delinquent shall pay a sum equal to the excess out of his own property, and the other half of the excess shall belong to the Gods. And let every possession of every man, with the exception

> of the lot, be publicly registered before the magistrates whom the law appoints, so that all suits about money may be easy and quite simple. (Laws, 744 D, E–745 A)

Plato also discusses what today we would call monetary policy, but not for the purpose of regulating the economy. He suggests that money should be used for transaction and not for accumulation of wealth. Accumulation of wealth in the form of gold and silver is prohibited. The rationale for this suggestion is that happiness is to be found in virtue, not in wealth. He goes so far as to say that:

> The citizen must indeed be happy and good, and the legislator will seek to make him so; but very rich and very good at the same time he cannot be, not, at least, in the sense in which the many speak of riches. For they mean by 'the rich' the few who have the most valuable possessions, although the owner of them may quite well be a rogue. (Laws, 742 E)

Aristotle's Model

Aristotle's model of the steady-state economy appears in Book VII of his *Politics* (*Politica*), written sometime after 336 BC. It is based on the same key variables as that of Plato, namely land, population and standard of living. Aristotle's analysis, however, is more elaborate and includes some variables ignored by Plato.

(i) The Land of the City

Aristotle states that the land of the city-state should be within a lower and an upper limit. The lower limit is determined by the need for autarky, for self-sufficiency, a situation in which the city can produce everything and in which the citizens need nothing more. The upper limit is that territory which the city can easily defend against invaders. Aristotle does not specify the upper limit but it is reasonable to assume that it is related to fertility of the land, the military technology of the time, the existing transportation system etc.

Self-sufficiency is very important for Aristotle, and he comes close to equating self-sufficiency with happiness because they are both chosen not for something else but for themselves, i.e. they are both intrinsically good. Self-sufficiency is not meant to apply to a man by himself, one who lives alone, 'but also for parents,

children, wife, and in general for his friends and fellow citizens, since man is born for citizenship' (NE 1097b 11–13). In *Politics*, Aristotle discusses self-sufficiency when referring to the city limits. 'Very much the same holds good about its territory. As to the question, what particular kind of land it ought to have, it is clear that everybody would command that which is most self-sufficing (and such is necessarily that which bears every sort of produce, for self-sufficiency means having a supply of everything and lacking nothing). In extent and magnitude, the land ought to be of a size that will enable the inhabitants to live a life of liberal and at the same time temperate leisure.' (*Politics* 1326b 28–34)

Although the land of the city is divided into public and private land, Aristotle favours private ownership[3] on the grounds that common ownership discourages work and interest in the property, and reduces responsibility. While private property is under the management of the household and the produce belongs to the owner, it can be taxed. The produce of the public land or, in general, the revenues from it can be used for two purposes. First, to finance a system of common meals, through which subsistence is ensured to all citizens, and second, to finance religious ceremonies and worship of Gods.

> As to common meals, all agree that this is an institution advantageous for well-organized states to possess … But the common meals must be shared by all its citizens, and it is not easy for the poor to contribute their assessed share from their private means and also to maintain their household as well. And moreover the expenses connected with religion are the common concern of the whole state. It is necessary therefore for the land to be divided into two parts, of which one must be common and the other the private property of individuals; of the common land one portion should be assigned to the services of religion, and the other to defray the cost of the common meals. (*Politics* 1330a 3–14)

(ii) The Size of Population

According to Aristotle, the size of the city's population should be within limits. The lower limit is that below which the autarky of the city is lost and thus the

3 In *Politics* (1263a 38–41), Aristotle says 'It is clear therefore that it is better for possessions to be privately owned, but to make them common property in use; and to train the citizens to this is the special task of the legislator'.

reason for its creation and development is negated. The upper limit of population size is determined by considerations related to the effective administration of the city. If the size of population is too large, it will be difficult to run the city effectively and to enforce the law. For example, it would be difficult to find a town crier with a stentorian voice. Also, in an overcrowded city it would be difficult to make the correct decisions regarding the distribution of public offices according to merit, since this requires adequate knowledge of the abilities of individual citizens. Contrary to Plato, who specifies the exact number of farmers, Aristotle provides no exact limit except in one case by way of an example: 'You cannot make a city of ten men, and if there are a hundred thousand it is a city no longer. But the proper number is presumably not a single number, but anything that falls between certain fixed points.' (*Nicomachean Ethics* 1170b 30–33)

However, Aristotle further develops his thesis, arguing:

> Similarly, a state consisting of too few people will not be self-sufficing (which is an essential quality of the state), and one consisting of too many, though self-sufficing in the mere necessaries, will be so in the way in which a nation is, and not as a state, since it will not be easy for it to possess constitutional government – for who will command its over-swollen multitude in war? Or who will serve as its herald, unless he who have the lungs of Stentor? It follows that the lowest limit for the existence of a state is when it consists of a population that reaches a minimum number that is self-sufficient for the purpose of living the good life after the manner of a political community. It is possible also for one that exceeds this one in number to be a greater state, but, as we said, this possibility of increase is not without limit, and what the limit of the state's expansion is can easily be seen from practical considerations. (*Politics* 1326b 2–13)

Clearly, Aristotle suggests that increasing population up to a certain size goes along with the increasing capability of the state to perform its function efficiently, but after a certain size, strong diseconomies appear. Therefore, between the two extremes there is an optimal population size. The actual optimal size is related to the territory of the city and notion of good life.

(iii) The Best Life

The relationship between population and land is determined by the notion of the 'best life', which presupposes wealth of material goods and virtue. 'But a better definition would be "to live temperately and liberally" (for if the two are separated a liberal mode of life is liable to slip into luxury and a temperate one into a life of hardship), since surely these are the only desirable qualities relating to the use of wealth' (1265a 33–38). The attribute of the best life refers both to individuals and to the state. 'For the present let us take it as established that the best life, whether separately for an individual or collectively for state, is the life conjoined with virtue furnished with sufficient means for taking part in virtuous action' (1323b 40 – 1324a 2). Thus, for Aristotle, possession of wealth is intrinsically desirable, but only insofar as it is put to good use. Wealth is necessary for the well-being of citizens and of the state; Aristotle defines it as 'the plenty of coined money and territory, the ownership of numerous, large and beautiful estates; also the ownership of numerous and beautiful implements, livestock, and slaves. All these kinds of property are our own, are secure, gentlemanly and useful.' (*Rhetoric* 1361a 12–15) However, contrary to the claims of the Athenian statesman Solon[4], Aristotle believes that the contribution of wealth, i.e. of external goods, to welfare has a limit:

> For the amount of such property sufficient in itself for a good life is not unlimited, as Solon says that it is in the verse. (*Politics* 1256b 30–34)
> For external goods have a limit, as has any instrument (and everything useful is useful for something), so an excessive amount of them must necessarily do harm, or do no good, to its possessor. (*Politics* 1323b 7–10)

(iv) Population Control

For the regulation of population, Aristotle thinks that 'there must be a limit fixed to the procreation of offspring' (*Politics* 1335b 23–24). Also, he suggests that 'it is fitting for women to be married at about the age of eighteen and the men at thirty-seven or a little before' (*Politics* 1335a 28–30). The last suggestion is made

4 It is interesting that the difference between Aristotle and Solon has its modern expression in the difference between neoclassical economists who claim that utility increases monotonically with income and those who claim (for example, Layard 2003 and Easterlin 2001) that after a level of income further growth does not raise welfare.

for population health purposes, but is clear that it can keep population growth in control. He also suggests for the same purpose that 'persons exceeding this age [of fifty for men] by four or five years must be discharged from the duty of producing children for the community' (*Politics* 1335b 22–24). It is characteristic of the significance Aristotle attributes to population control that he suggests that 'if any people have a child as a result of intercourse in contravention of these regulations, abortion must be practiced on it before it has developed sensation and life' (*Politics* 1335b 24–25).

(v) Poverty

Aristotle recognises that in every society there will always be rich and poor people. Poverty is a danger to the city, and there are two ways to deal with it. One is the welfare system. Aristotle believes that the welfare system can offer temporary relief but does not solve the problem 'because this way of helping the poor is the legendary jar with a hole in it' (*Politics* 1320a 32–33). On the contrary, it perpetuates the problem. However, common meals as part of a welfare system are accepted and recommended (*Politics* 1330a 2–5). The other way to reduce poverty is through substantial financial aid to poor citizens in order to buy property and start some productive activity, or to allow them to use land for the same purpose:

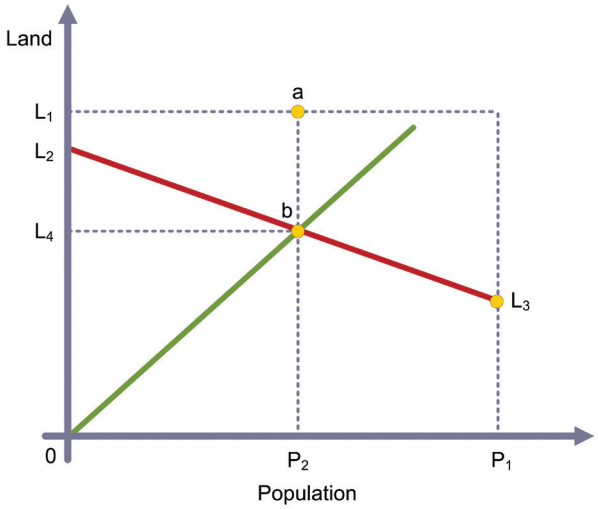
> Measures must therefore be contrived that may bring about lasting prosperity. And since this is advantageous also for the well-to-do, the proper course is to collect all the proceeds of the revenues into a fund and distribute this in lump sums to the needy, best of all, if one can, in sums large enough for acquiring a small estate, or, failing this, to serve as capital for trade or husbandry. (*Politics* 1320a 35–40)

(vi) A Graphical Representation of Aristotle's Model

The above elements, i.e. city size, division of land, population and best life, can be combined in a simple diagram to make explicit the Aristotelian model of optimal population size. The vertical axis of Diagram 1 shows the size of land. The beginning of the axis at point 0 corresponds to the minimum size required for autarky and point L_1 corresponds to the maximum size so that the city can be defended effectively. The horizontal axis measures the size of population. The beginning of the axis at point 0 corresponds to the minimum size required

for autarky and point P_1 corresponds to a population size beyond which serious diseconomies become effective. When the size of population is at the beginning of the axis, the public land which is needed to finance common tables and religious worship is L_1L_2 and the remaining $0L_2$ is private land. When population increases to, say, P_2, the needed public land also increases to ab. In other words, as the size of population increases, more public land is required. Thus, line L_2L_3 divides the land in private and public for every population, given the territory of the city. It is drawn with a negative slope on the assumption that the number of people in need increases with the size of population.

Figure 2. Aristotle's model of steady state



The size of population will be determined by the combination of land and population that produces a level of output per citizen sufficient for a wise and generous life. If such a combination is, for example, the one corresponding to b, then the size of the population would be P_2, the size of private land would be $0L_4$ and the rest of land of a size L_4L_1 or ab would be public land the proceeds from which would cover the expenses for common tables and religious worship and ceremonies. The land-population ratio is equal to the slope of the line going through the origin and point b. Thus, in this case the population of citizens should be $0P_2$, total land should be $0L_1$ private land $0L_4$ and public land L_1L_4.

From this graph it becomes obvious that as soon as the limits of land and population are determined, the critical factor for the determination of the actual land/population ratio are two: (a) the optimal per citizen output, and (b) the division of land between private and public. It should be noted that the optimal per citizen output is not the maximum average product of labour except by chance. In Aristotle's thinking, the biggest size or the maximum quantity is not necessarily optimal. Optimality is defined in terms of what constitutes the best life.[5]

Discussion

In comparing the two models outlined above with those of modern writers, one should keep in mind some obvious differences in both the content of terms and in social institutions. Thus, land or territory in the ancient texts should be taken to represent resources in modern terminology, and distribution of land and products is the equivalent of distribution of wealth and income, respectively. Technology of production is not mentioned and is implicitly assumed to be constant, but changes in technology can be easily introduced in the two models presented above.

Plato and Aristotle are very much concerned with social justice and the happiness of citizens as individuals and also as a totality which forms society. In modern times it is implicitly assumed that higher income brings happiness or that it is a precondition for achieving happiness. For these ancient writers, wealth is not a precondition for a happy life. Of course, it should be high enough to allow a temperate and generous life-style but happiness is almost synonymous with virtuous action.

Population control is important for Plato and Aristotle as a means of achieving equilibrium between limited land, i.e. fixed resources, and the production needed for a comfortable standard of living. Today, with environmental problems bringing the Earth to the brink of catastrophe, many writers ignore the effects of overpopulation and population control is beyond their consideration. Many modern writers seem to hold the naïve belief that technology has all the answers to the environmental and social problems and/or that population controls interfere with the liberties and the free choices of individuals. At the same time

5 For a more detailed presentation of Aristotle's model see Lianos (2016).

they ignore the negative externalities of overpopulation and the limited capacity of the planet to provide a good life for all.

Conclusion

The models of Plato and Aristotle presented above are not just part of the history of ancient economic thought. They contain two important truths. First, social harmony presupposes a certain relationship between the available resources and the size of population. Second, that relationship requires communal decision-making regarding the size of population and social controls enacted to avoid overpopulation.

In Plato and Aristotle (and also in the Stoics, Cynics and Epicureans) the life-style implied in their version of steady-state economies was a rational choice based on their idea of the 'best life'. In modern writers the model of a steady-state economy (and also the ideas of degrowth, agrowth, simpler life, green New Deal, etc.) becomes a necessity if we wish to avoid the ecological catastrophe foreseen by many. It is interesting to speculate that future generations, fearing universal misfortune and even the extinction of the human race, may come to reconsider, albeit possibly slowly and gradually, the approach taken to reproduction within the wisdom of the ancient Greek philosophers.

References

Aristotle, 2005. *Politics*. Cambridge, MA: Loeb Classical Library.

Aristotle, 1947. 'Nicomachean Ethics', in R. McKeon (ed.) *Introduction to Aristotle*. New York: The Modern Library – Random House.

Daly, H.E., 2008. *A Steady-State Economy*. UK: Sustainable Development Commission.

Easterlin, R.A., 2001. 'Income and happiness: Towards a unified theory'. *Economic Journal* **111** (473): 465–484. https://doi.org/10.1111/1468-0297.00646.

Feen, R.H., 1996. 'Keeping the balance: Ancient Greek philosophical concerns with population and environment'. *Population and Environment* **17** (6): 447–458. https://doi.org/10.1007/BF02208335.

Homer, 1920 [trans by Hugh G. Evelyn-White]. *The Homeric Hymns and Homerica*. New York: Williams Heinemann.

Layard, R., 2003. *Happiness: Has Social Science a Clue?* Lionel Robbins Memorial Lectures 2002/3, LSE.

Lianos, T.P., 2016. 'Aristotle on population size'. *History of Economic Ideas* 24 (2): 11–26.

Mill, J.S., 1970. *Principles of Political Economy.* Middlesex: Penguin.

Pimentel, D., Z.R Whitecraft, L. Scott et al., 2010. 'Will limited land, water, and energy control human population number in the future?' *Human Ecology* 38 (5): 599–611. https://doi.org/10.1007/s10745-010-9346-y.

Plato, 2008/2013 [trans by B. Jowett]. *Laws.* The Project Gutenberg Ebook.

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OBITUARY

Herman Edward Daly
21 July 1938 – 28 October 2022

David Samways

Herman Daly, founding figure of the discipline of Ecological Economics and valued member of the Editorial Board of the *JP&S*, has died at the age of 84.

Kenneth Boulding once wryly observed: 'Anyone who believes that exponential growth can go on forever in a finite world is either a madman or an economist.' Herman Daly devoted his working life to building a saner economics. As one of the first modern ecological economists, his lasting professional achievement was the exposition and development of the notion of the steady-state economy operating within planetary boundaries.

Herman's distinguished career included academic positions at Yale, Louisiana State University, and latterly the University of Maryland. He also spent a period (1988–1994) as Senior Economist in the Environment Department of the World Bank where he helped develop policy guidelines for sustainable development.

In 1973 Daly edited the still-influential anthology *Toward a Steady-State Economy* and, in 1989, he co-founded the academic journal *Ecological Economics*. In that same year, he and John B. Cobb proposed an ecologically informed alternative to gross domestic product (GDP) in their Index of Sustainable Economic Welfare (ISEW).

Daly's ecological economics stressed that the economy is a subsystem of the Earth. As such, the economy cannot continue to grow without meeting physical limits imposed by the natural world. In particular, through the work of Frederick

Soddy and Nicholas Georgescu-Roegen (a mentor during his doctoral studies at Vanderbilt University), Daly's approach emphasised the role of the entropic flow of materials and of solar energy – on which nearly all of life on Earth is dependent. From this basis, he concluded that the growth of populations of human beings and their physical stuff (homes, cars, factories, farms, domesticated animals, power stations etc.) are limited by biophysical boundaries. A truly sustainable economic system must operate within these fixed boundaries. Therefore, a large portion of the ecosystem must be left free of human interference to provide a low-entropy source of materials and energy, a high entropy waste sink and life-support services to ourselves and other species. To be sustainable, the global economy would not only have to be considerably smaller than it is currently, but operate at a steady-state in terms of physical throughput.

Inevitably, Daly concluded, a sustainable economy necessitates a trade-off between human population size and the level of per capita welfare. He confessed that he was unable to specify the exact size of a sustainable population and standard of living but observed 'we do know that it is not more people at a higher per capita consumption' (2018: 26). While acknowledging the relationship between economic development and lower fertility, Daly rejected the notion of demographic transition as some natural force that would automatically solve 'the population problem'. Indeed, he pointed out that, while demographic transition provided the politically easiest route to lower fertility, if such development led to a globally higher per capita consumption rate it would be environmentally ineffective.

As Peter Victor (2021) has observed, the influence of Daly's Christian upbringing on his ethics and worldview was evident in his work. Thus Daly's case for a steady state economy is not merely technical-ecological but ethical. Rejecting the value neutrality and emphasis on preferences central to conventional economics, Daly argued that decision-making elites are committed to economic growth not to provide a good life for all, but to maximise the standard of resource consumption for a small minority at the expense of future generations, the world's poor and other species.

Daly's value driven, purposeful and integrated approach to social, economic and environmental problems contrasted with what he saw as the morally nihilistic 'metaphysical naturalism' dominant in the intelligentsia: he observed that it 'is hard to imagine, under such a vision, from where the elite, or anyone else,

would get the inspiration to care for Creation' (2018: 31). For Daly, some notion of intrinsic value was necessary to defining the objectives of the human enterprise and our place in nature more generally. However, human welfare was central to his thinking and while acknowledging narrow anthropocentrism as ultimately contradictory and destructive of human interests, Daly was critical of what he termed 'absurdly strong sustainability' and the notion of the inviolability of nature (Daly, 1995). In a 2014 interview he commented:

> We need to ask ourselves what real happiness is while improving our sense of ethics. If we seek growth that exceeds resources, we will create pain for ourselves. We once had plenty of forests and people suffering from poverty; therefore, economic growth was meaningful. The solution to poverty is not the redistribution of capital, but equal growth. In this sense, it is reasonable for us to think about returning to lifestyles of the past. (Daly, 2014)

In 1996 Herman Daly was the recipient of the Right Livelihood Award for 'defining a path of ecological economics that integrates the key elements of ethics, quality of life, environment and community'.

He also received a number of other awards for his work including:

- The Heineken Prize for Environmental Science
- The Leontief Prize
- The Medal of the Presidency of the Italian Republic
- The NCSE Lifetime Achievement Award
- The Blue Planet Prize of the Asahi Glass Foundation.

Herman's contribution to academia will ensure that he will be remembered long after his death, but perhaps most importantly he will be remembered by those who knew him as courteous and kind, generous with his time and encouraging to others. In an interview published when receiving the Blue Planet Prize, Herman said:

> My dream is that everyone on the earth will strive for sustainability to ensure that everyone can enjoy a happy life. (Daly, 2014)

References

Daly, H.E. 1995. 'On Wilfred Beckerman's critique of sustainable development'. *Environmental Values* **4** (1): 49–55.

Daly, H.E. 2014. 'Prof. Herman Daly Interview Summary', Blue Planet Prize. https://www.af-info.or.jp/better_future/html/vol_V/2014/Prof_Daly/2014a_Daly1.html

Daly, H.E. 2018 "Envisioning a successful steady-state economy'. *The Journal of Population and Sustainability* **3** (1): 21–33. https://doi.org/10.3197/jps.2018.3.1.21

Victor, P.A. 2021. *Herman Daly's Economics for a Full World: His Life and Ideas*. London: Routledge.

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