

Review

Discussing the Silence and Denial around Population Growth and Its Environmental Impact. How Do We Find Ways Forward?

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Abstract: Academia and government often ignore or deny the impact of population growth on the environment. However, key scientific institutions and reports confirm that population growth is a major driver of climate disruption and other environmental crises. We review the environmental science of population growth. Issues that block dialogue are discussed, such as growthism, anthropocentrism, denial, religious and cultural taboos, fear of being called a racist, the issue of rights claims, seeking political power through numbers, the framing of social justice issues, and sophisticated claims regarding ‘racism’. We examine examples of denial about population in academia and government. We explore ways forward to gain dialogue, and we also consider success stories. We conclude that population growth, like overconsumption, must be foregrounded to create ecologically sustainable economies and a sustainable future.

Keywords: population; blocks to dialogue; growthism; anthropocentrism; denial; cultural taboos; rights; social justice; sophistry; ecological limits



Citation: Washington, H.; Kopnina, H. Discussing the Silence and Denial around Population Growth and Its Environmental Impact. How Do We Find Ways Forward? *World* **2022**, *3*, 1009–1027. <https://doi.org/10.3390/world3040057>

Academic Editors: Jane Nancy O’Sullivan and Céline Delacroix

Received: 20 September 2022

Accepted: 28 November 2022

Published: 2 December 2022

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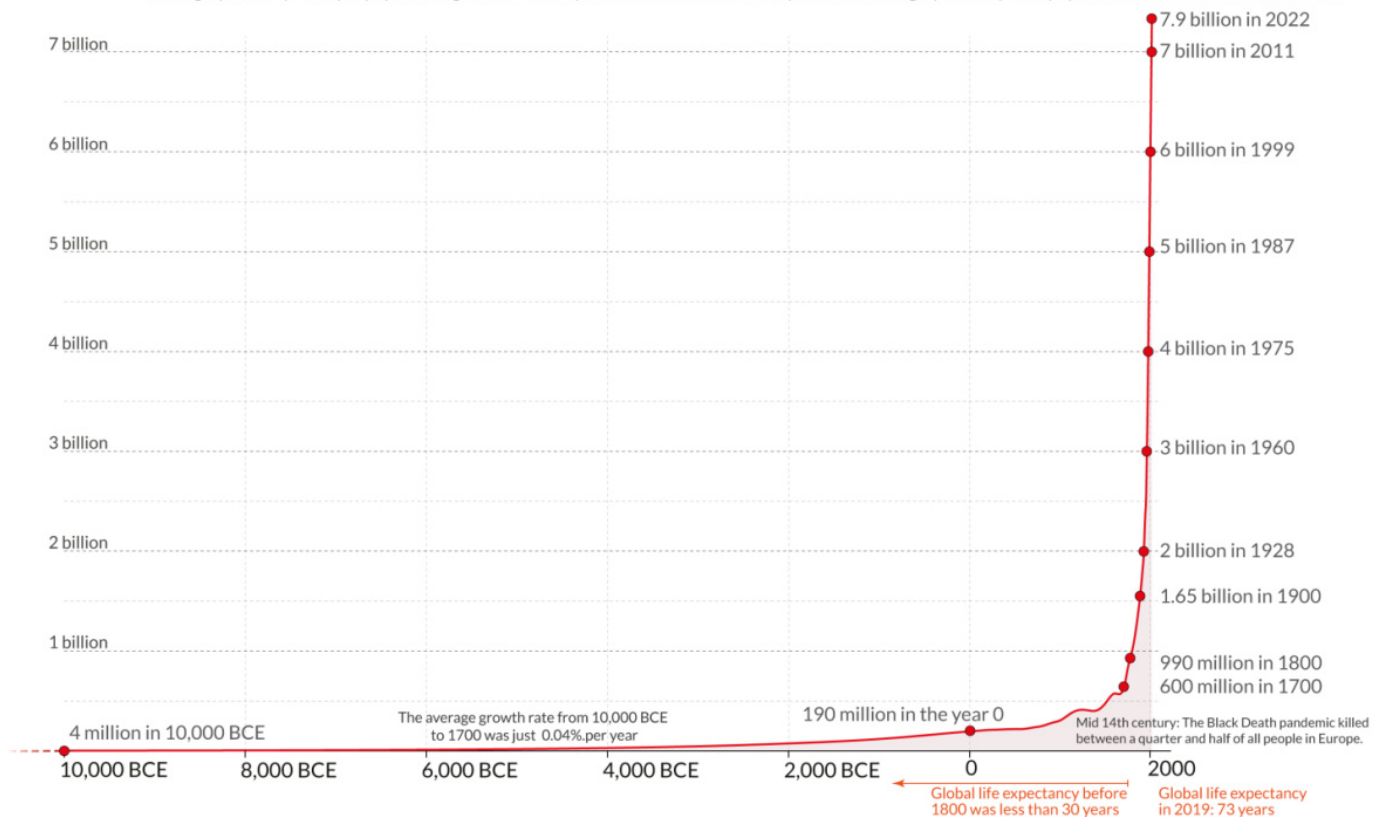
1. An introduction to Population

The world’s human population stood at 8 billion at the time of writing (Figure 1) [1,2]. Planet Earth has experienced a major rise in human population. World population reached one billion in 1804, two billion in 1927, three billion in 1960, four billion in 1974, five billion in 1987, six billion in 1999 and seven billion in 2011 [3]. Human population will reach 8 billion in late 2022. The UN [1] projects population will reach 9.7 billion by 2050 and 10.4 billion by 2100. While birth rates are dropping in many countries, age structure in some countries can include a high percentage of young people, and this means that (in the absence of a catastrophic rise in death rates) population will continue to rise as young people have children (population momentum) [4].

Thomas Robert Malthus in 1798 [5], pointed out that population can increase geometrically (exponentially), while resources such as food tend to increase only arithmetically (linearly). The problems of population growth were again foregrounded in 1968 by ecologists Paul and Anne Ehrlich in *The Population Bomb* [6]. Later the influential 1972 book *Limits to Growth* [7], reporting a ground-breaking computer modeling exercise, demonstrated there were ecological limits to the expansion of human activities. The issue of population growth was highlighted in William Catton’s seminal book *Overshoot* [8]. Taking the big picture, Gowdy [9] invites us to do a ‘thought experiment’ where (painlessly) humanity’s population is returned to a few hundred million, and ecosystems are restored. He notes however that if we keep the ideology of growth, accumulation and expansion, we would soon return to the current system-too many people consuming too much, and the Earth’s life support systems teetering on collapse.

The size of the world population over the last 12,000 years

Demographers expect rapid population growth to end by the end of the 21st century. The UN demographers expect a population of about 11 billion in 2100.



Based on estimates by the History Database of the Global Environment (HYDE) and the United Nations. On OurWorldinData.org you can download the annual data. This is a visualization from OurWorldinData.org.

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Figure 1. World Population growth over time (Source [2]).

However, despite these warnings, in recent decades, key government agencies, and much of academia, have largely failed to mention or act on population growth as a key part of transformative change. Malthus' warning was criticised at the time (e.g., [10]). The term 'neo-Malthusian', regarding those who advocate population control, has in some circles now become derogatory. The Ehrlichs have continued to discuss the issue [11,12]. However, apart from a few other environmental scientists (e.g., [13–17]), discussion of population in academia and government has drastically declined in recent years [18]. In this article, we discuss why this topic deserves detailed analysis, especially in regard to issues that block dialogue, and possible ways of moving forward.

2. Measuring and Framing the Population/Environment Connection

Carrying capacity and estimates of global ecologically sustainable population

A key concept in ecology is ‘carrying capacity’. Catton [8] (p. 4) defines it as: ‘The number of us, living in a given manner, which a given environment can support indefinitely’. Humanity has increased Earth’s carrying capacity greatly in the 20th and 21st century, through technological innovation and the use of fossil fuels. However, this increase may only be temporary, as evidence is rapidly accumulating of regional and global ecological decline. [8,19]. To grow beyond the Earth’s carrying capacity, humanity has in effect been usurping resources from a multitude of other species at an enormous rate [15,20]. Humanity is now in a predicament, where with our current population, we exceed the Earth’s natural carrying capacity [21,22]. Hence, Collins [22] argues for a ‘depopulation’ imperative, using non-coercive means.

The scientific evidence that humanity is beyond the environment’s carrying capacity comes from many sources, such as the Millennium Ecosystem Assessment [23], ecological footprint accounts (e.g., [24,25]), scientific papers (e.g., [13–15]) and books [22,26,27]. The impact of population, while not explicit as one of the nine planetary boundaries [28,29], is implicit in related research [30]. Barnosky et al. [31] expressed concerns that the Earth may be ‘approaching a state shift’ in its biosphere due to human actions. Wijkman and Rockstrom [27] conclude humanity is ‘bankrupting nature’ due to the overuse of environmental resources.

As we shall see later, population increase exacerbates all environmental problems, whether it is logging, mining, growing food and using water, energy use and climate disruption, land degradation, hunting wild animals (bushmeat), overfishing, etc. The *Second World Scientific Warning to Humanity* (Ripple et al. [13]) and the *World Scientific Warning of a Climate Emergency* (Ripple et al. [14]) make this clear.

Ecologically sustainable population estimates based on environmental indicators.

Environmental sociologist Eileen Crist [32] points out that the question re carrying capacity we should really ask is what is the number of humans (and at what level of consumption) that can live on Earth without turning it into a human colony founded on the genocide of the nonhuman?

If we made no change at all to consumption patterns, we could currently sustain a population, based on ecological footprint analysis, of 4.7 billion people [33] or 5.1 billion [34]. Lifestyles and consumption patterns must be taken into account in such calculations. For example, if everyone on the planet lived according to US standards, only 1.75 billion people could be sustained [35]. Desvaux [34] concludes that a sustainable global population is somewhere between 2 and 3 billion people. Three recent estimates of a global *maximum*, ecologically sustainable human population all come in around 3 billion [36–38]. On these estimates the world is clearly already overpopulated. Many scholars write of the need for a ‘smaller ecological footprint’, but as Dietz and O’Neill [39] (p. 78) point out: ‘we need smaller footprints, but we also need fewer feet’.

Jena [40] estimates that if one applies the SNQ model (S for ‘sustainability’, N for ‘room for nature’, Q for ‘quality of life’) that accepts ethically the vision of the ‘Nature Needs Half’ strategy (<http://www.natureneedshalf.org>, accessed on 1 October 2022), the ecologically sustainable (and ecocentrically ethical) population would be 1.2 billion people. Apart from Smil [41] and Gerten et al. [42] discussed later, all estimates that rely on environmental indicators are *lower* than our current population.

We should also consider that human actions have already degraded the ability of the Earth to support people. This is made clear by the MEA [23] which stated that 60% of ecosystem services were degrading or being used unsustainably. These changes triggered Ehrlich [12] to revise his estimate of a sustainable population from 2 to 1 billion. Ehrlich and Ehrlich [12] conclude it is highly questionable whether the current world population can be sustained in the long- or even medium-term. As Crist et al. [15] note, feeding a growing world population and maintaining biodiversity may not be compatible objectives.

Maximum population estimates not based on environmental science. Other estimates are not evidence-based in regard to environmental science, and are derived in a dubious manner. UNEP's report *One Planet, How Many People? A Review of Earth's Carrying Capacity* [43] on '65 different estimates' cited just two references. The UNEP [43] discussion paper is thus misleading, giving the impression that there are many reliable and scientific studies showing estimates far beyond 8 billion. This is not the case.

The most detailed (if dated) discussion of estimates is Cohen [19]. Appendix 3 of his book lists 53 estimates of how many people the Earth 'might' support, but focuses in the text on just eight. These range as high as 1022 billion [44]. These are *maximum possible* population estimates, whose failings include: (1) most consider just one limiting factor; (2) some argue water and nutrients are not limiting, when clearly they are; (3) some assume all photosynthesis output is used to feed humanity [44]; (4) some assume we more than double cultivated land (not possible as Ray et al. [45] note); (5) some make no deductions for poor soils, rough terrain and swamps; (6) some argue unrealistically we could harvest five crops a year in the tropics [46].

Such high estimates are fanciful and optimistic. They seem driven by a need to insist there are no limits to human population growth. They fail to show how many people the Earth could support indefinitely in an ecologically sustainable manner.

I = PAT and key scientific documents on population

In 1971 Paul Ehrlich and John Holdren coined the term [47]:

$$\text{Environmental Impact} = \text{Population} \times \text{Affluence} \times \text{Technology}$$

Or $I = PAT$, postulating that humanity's impact on the Earth is driven by the number of people times their affluence (per capita consumption of resources) times the technology they use. Washington et al. [48] discuss the key importance of this formula in terms of the environmental crisis. They note a big population has a big impact, especially as the developing world expands its economy and its consumer class [15,22,49]. The Second World Scientists Warning to Humanity [13], signed by 21,000 scientists, states:

We are jeopardizing our future by not reining in our intense but geographically uneven material consumption and by not perceiving continued rapid population growth as a primary driver behind many ecological and even societal threats.

Similarly, the *World Scientists' Warning of a Climate Emergency* identified stabilizing, or better yet reducing, the population as one of six critical steps [14]. These warnings are based on real world data which show that society is in 'overshoot', and these have been known for decades (e.g., [8]). The IPCC *Climate Change 2014 Synthesis Report* [50] and the IPCC [51] mitigation report of 2022 noted that economic and population growth continued to be the most important global drivers of increases in CO₂. The IPBES [52] extinction report press release similarly notes: 'Key indirect drivers include increased population and per capita consumption'. A 2016 Worldwatch Institute evaluation of 939 peer-reviewed scientific papers relating to population and the environment concluded that: 'The overwhelming majority of researchers who explore relationships between population growth and environmental degradation or resource scarcity either find empirically, or assert, that the former is an influential factor in the latter' [53] (p. 1). It is thus important (in the light of the denial discussed later) to understand that many major scientific institutions and reports make clear that population growth is a *key driver* of environmental crises.

A common dismissal of attempts to raise population concerns is that 'it's not all about population.' We do not argue that population growth is the *only* key problem humanity faces-action on overconsumption [54] and the growth economy [55] are also critical. However, it is equally wrong to say that population has no place in sustainability discourse. Overpopulation and overconsumption are entwined, and need to be addressed concurrently [17,56]. Ending economic growth without ending population growth would mean perpetually reducing resource use per person [57]. Given the interest in population taken by early ecological economists (e.g., Daly [55]), one might think that ecological economics would consistently foreground population. However, many streams of eco-

logical economics today avoid population entirely, as documented by Washington and Maloney [58,59].

Few scholars that advocate population action seek to play down the related problem of overconsumption. Indeed, environmental scientists have highlighted this for over four decades, being some of the first scholars to warn about overconsumption, and still do so [17,47,60]. However, many scholars who focus on overconsumption, downplay or ignore the relevance of population growth (e.g., [61,62]).

Population and climate change

GHG emissions are a product of emissions per person *times* the population. Hence, climate change cannot be blamed just on either consumption or population, action is required on both together [17]. The 2022 IPCC [51] Mitigation Report states:

Globally, GDP per capita and population growth remained the strongest drivers of CO₂ emissions from fossil fuel combustion in the last decade ... GDP per capita and population growth increasing emissions by 2.3% and 1.2% yr⁻¹, respectively.

While this statement is made in the full 2022 IPCC Mitigation Report, a reference to these drivers of GHG emissions has been omitted from the *Summary for Policymakers* [63]. We discuss this further below, but emphasise here that the world's key climate body acknowledges that population growth is a key driver of increasing GHG emissions.

Feeding a growing population

Given rising populations and incomes, to seek to feed all the world's people by 2050, a 70% increase in food production would be needed [64]. However, the same report notes that 25% of the world's land is already degraded, with water becoming increasingly polluted and scarce. Water and food insecurity are currently increasing due to population growth [17]. Increasing food production on existing croplands will not meet needs [45]. This makes us question whether society can feed 10 billion people in the long-term, given the many interconnected environmental problems that food production now faces (many of which are accelerating) [15,65]. Erb et al. [66] suggest this would only be likely if we degraded much of our remaining natural areas, already under stress, and increase crop area by 20%. This would cause massive negative impacts on nature [15] and accelerate the extinction crisis [52].

Smil [41] and Gerten et al. [42] argue we could feed 10 billion people (at least during this century). Both use optimistic assessments that depend on: (1) rational planning by governments; (2) major land use change; (3) effective food waste reduction; and (4) voluntary dietary changes (lower use of meat). This optimism appears unrealistic given our decades-long denial of environmental problems (e.g., [67]) and ongoing human conflicts. Indeed Gerten et al. [42] conclude that if planetary boundaries are strictly respected the Earth (at a diet of 2355 kcal per person per day) could support only 3.4 billion people using current patterns of food production and consumption. According to their analysis, sustainable sustenance for the other 6.6 billion would require radical changes to food production and consumption.

Crist [32] concludes the Earth is not able to support 8 billion omnivorous humans indefinitely. For this reason, the 10 billion estimate seems unrealistic, being unlikely to be ecologically sustainable in the long or even medium-term.

How population growth worsens a variety of environmental crises

Population at its current size (not to mention its future growth) does not just accelerate species extinction and the climate crisis, it worsens other crises:

Deforestation to create farmland. Between 2015 and 2020, the rate of deforestation was estimated at 10 million ha/yr. Agricultural expansion continues to be the main driver of deforestation and forest fragmentation [68]. As land degrades, people are forced to migrate, exploring new forest frontiers, thus increasing deforestation [69]. The expansion of agricultural land contributes around 60 per cent of total tropical deforestation [70]. Half of this is arguably for large scale commercial agriculture [68]. In Malawi, a 1 per cent increase in population growth increased deforestation by 2.7 per cent through the increase in agricultural land [71]. Oyetunji et al. [72] conclude that anthropogenic factors, especially

population growth, were the major forces responsible for deforestation in Nigeria. Kopnina et al. [73] explain that population growth in Nigeria exacerbates mining and logging.

Land degradation. The FAO [74] notes that one of the six major causes of land degradation is shortage of land due to increased population. The two most important driving forces of land degradation in Asia and the Pacific are limited land resources and population increase. In Ethiopia, population growth is the main cause of land degradation in general, and soil erosion in particular [75].

Killing more wild animals (known as bushmeat) for food. Population pressure is increasing the killing of bushmeat and accelerating extinction [76], causing ‘Empty Forest Syndrome’ [77].

Over-fishing. Mora et al. [78] note that demand for fish is expected to grow given escalating animal protein demands in developing countries and the rapidly increasing human population. The Center for Biological Diversity [79] notes that scientists are: ‘calling not only for reduced consumption and better regulation, but for alleviation of poverty and “stabilization of the world’s human population”’.

Wealth is often used as a surrogate for environmental impact. While there is certainly a correlation between incomes and greenhouse gas emissions, many other types of environmental impact, including habitat loss, soil degradation and pollution, are exacerbated by poverty. The ‘rich’ and the ‘poor’ are commonly referred to in a binary sense, as perpetrators and victims of environmental damage. Our aim here is to point out that they have different types of environmental impact. Population growth not only multiplies the impacts of individual behaviours, it often forces more impactful behaviours. Rapid population increase in the developing world (for example in Madagascar), has triggered massive deforestation and species extinction [52] as well as degradation of the soils and waterways on which their livelihoods depend [80]. Population growth today in the developing world does not assist the poor to live a ‘better’, healthy, more sustainable life.

3. Issues That Block Dialogue about Population Growth

Many issues block dialogue on population. We summarize what we consider the most important here, based on more than three decades of dealing with this topic.

Growthism and anthropocentrism as key paradigms

Modern industrial society is addicted to ‘growthism’ [55], which is the underlying assumption of the growth economy, as well as advocacy for a growing population. Growthism argues that an economy must grow, indeed grow forever. It is irrationally seen as the solution to our many problems [81], while in fact it is the cause of many environmental problems. Rees [82] (p. 5) notes that the: ‘flawed assumption that human well-being derives from perpetual growth has distorted the lives of more people than any other cultural narrative in history’. Meadows et al. [60] note that there is very little time left for the fantasy of an infinite globe. There are two key problems with growthism, first we have run out of room for this ecologically as a strategy (as shown by all environmental indicators). Secondly, it is not improving people’s wellbeing, especially in the wealthy societies that commonly espouse growthism [83]. However, despite all scientific evidence that growthism is a cause of environmental crisis, [22,55,60], many still deny this.

Another key problem that blocks dialogue about population growth is anthropocentrism or ‘human supremacy’ [32,84–86]. Human supremacy is anthropocentrism of the strongest sort, and puts forward the view that other species and the rest of nature are just resources for human beings to use as we choose, with no independent intrinsic value [87].

Population growth does not just impact on people, it accelerates the extinction crisis, wiping out our relatives on the evolutionary tree. If modern society adopted ecocentrism (<https://www.ecologicalcitizen.net/statement-of-ecocentrism.php>, accessed on 1 October 2022) and ecological ethics (which maintains nonhuman nature has moral standing and a right to exist for itself), we could no longer ethically continue strategies that cause massive ecological degradation [20]. As Collins [22] (p. 32) concludes: ‘... we have become the most acute moral issue that we face’.

The key problem of denial

Denial is about not accepting reality. Denial is not about whether the denier ‘believes’ in what they say (often they do), but whether their statements match up with reality. The denial of the costs of human population growth can validly be called a ‘tragedy’, both for nature and humanity [21]. Humans tends to deny a reality that is unfavourable [67,88]. We deny some things as they force us to ‘confront change’, others because they make us afraid, or are painful. Sometimes we cannot see a solution. Thus many of us tend to deny the root cause of the problem. Psycho-analysis sees denial as an: ‘unconscious defence mechanism for coping with guilt, anxiety or other disturbing emotions aroused by reality’ [89] (p. 5). Sociologist Zerubavel [90] explains that the most public form of denial is ‘silence’, where some topics are considered taboo. Campbell [91] concluded the spiral of silence about unsustainable population growth can be broken by pointing out it stops the poor from escaping poverty and ecological degradation. Campbell [91] points out that high fertility is not actually due to women’s desire for more children, if women are given freedom to control fertility via family planning, then fertility can decline [81,92].

Washington [21] argues denial can turn off not only logical reasoning, but also creativity and ethics. Denial (at the society level) makes worse conflict, starvation and disease, and can move us towards the collapse of civilization. Denial of problems, and subsequent collapse, have occurred in past civilisations [93]. Yet, many still deny both the environmental crisis, and the relevance of population growth to environmental damage.

Religious and cultural taboos against contraception

Family planning and modern methods of contraception are closely related to fertility levels. Yet, various religious doctrines oppose contraception [22], which can block dialogue. Religious influence may have waned in some parts of the world, but remains important in other areas [22]. Family planning and contraception are closely related to social norms associated with gender, sexuality, family, religion and culture. These highly sensitive issues need to be acknowledged. Developing a policy that reflects these sensitivities and respects cultural differences (and incorporates a dual vision of human and ecosystem well-being [94]) is an ongoing challenge.

The fear that discussing population may be interpreted as being ‘racist’

Many scholars self-censor due to fear that if they speak out on population then they will be attacked and called ‘racist’ or other perjorative terms. This is made clear by what happened to Prof Paul Ehlich [7] when he spoke out in 1968 [95]. This is a very real fear that all scholars must face when raising the population issue, yet surprisingly is little discussed [96]. It may even affect jobs or job prospects. Just to speak out on population growth and its environmental impact may mean one places one’s academic career on the line [97]. We are very aware of this and discuss it here purely because we believe society and academia should have greater dialogue on the issue.

The confused issue of ‘rights’

‘Rights’ are a confused and polarized issue. Collins [22] believes that at the core of the population problem is a conflict of rights: the right of the individual to reproduce, and the right of other species to continue to exist. Keyfitz [98] notes it is often said women can have as many children as they wish, but that every child *also* has a right to adequate nutrition. What if the two rights cannot co-exist? There has been a long-term assumption that couples have the ‘right’ to as many children as they want. This is now seen as a key ‘human right’ [99]. This was not the case however in many Indigenous societies, where it has been argued they controlled population at an ecologically sustainable level through a range of rules constraining individual freedoms [100]. Collins [22] argues we need to recover the sense that the right to have children belongs within the general context of the common good. Cafaro [20] concludes that today reproductive ‘rights’ should be limited to one child.

The problem is ‘rights’ are often described as *absolute* and inalienable, yet in practice no right is absolute. Every right must be weighed against other rights and important interests. UNFPA [101] defined ‘reproductive rights’ as the basic right of all couples and individuals to decide freely and responsibly on the number, spacing and timing of their children. We note however that the definition is strongly anthropocentric, as it only refers to humans, and excludes the non-human world [86], now suffering a major extinction event [52]. We argue the need for a careful balancing exercise between potentially conflicting rights.

Most people would likely agree that individuals have the right to choose the number of their offspring. How these rights should be influenced and interpreted in the context of an environmental crisis is a difficult, yet important question to ask. An environmental crisis carries the risk that the quality of life of these offspring becomes unacceptable, or life itself becomes impossible. Further, do future generations not have a ‘right’ to a sustainable world that has not suffered massive ecosystem collapse? Does not non-human nature herself also have a ‘right to exist’? [86]. The principle of Intergenerational Equity promoted by *Our Common Future* [102], the seminal document defining sustainable development, assumed future human generations *do* have a right to inherit a world that is not massively degraded. Arguably, humanity today is now sacrificing the interests of future generations (human *and* nonhuman) for short-term benefits [20].

It should be noted that the high estimates of possible human population noted by Cohen [19] include no discussion of whether nature has ‘rights’. The ‘Rights of Nature’ movement however asserts such rights, as do many philosophers (e.g., [84,85]) and environmental scholars [22,103]. The rights of nature are also implicit in the UN Harmony with Nature program [104]. Statements about ‘rights’ regarding population thus need to be fully unpacked and discussed through open dialogue. We recognize that women should decide the number, timing and spacing of their children. However, this not only implies being given the means to make these choices (in terms of access to family planning and contraceptives) but also means to be given the opportunity to make decisions in an informed way. At a minimum, this would entail understanding the level of environmental degradation and its broader implications for current and future offspring, as well as knowing that slowing population growth would improve the chances of solving the environmental crisis. At a higher level it should also involve publicizing the benefits of smaller families. In this way, women would be empowered to make responsible reproductive choices.

Political and social justice aspects

Population growth is now a polarised issue in sustainability discourse, with debates ranging from ambiguity to open hostility towards what is called ‘blaming’ overpopulation [97]. Often action on population growth is portrayed as conflicting with social justice [105–107]. We question whether social justice advocates (and most political factions) have a good understanding of the environmental crisis and environmental indicators. We would suggest also that (in our experience) they are predominantly anthropocentric in worldview, unconcerned about rights or justice for non-human nature [108]. The political Left (and much of the environment movement) have ignored or denied the importance of population growth [32,97]. For some, the message that fertility levels can be influenced by promoting family planning initiatives automatically evokes thoughts of coercive practices and human rights abuses such as the forced sterilisation program briefly applied in India. However, this example actually contradicted the very essence of family planning, which has always been about empowering people to choose mindfully when not to have children [109].

In the social justice critique, those who link population to sustainability are branded neo-Malthusian, racist, or misanthropic. The ethical question posed is that the global ‘North’ or ‘West’, experiencing low fertility levels, should not tell people in the ‘South’, experiencing higher fertility levels, what to do (see discussion [97]). However, the claim that environmental impacts are entirely due to overconsumption in the developed world ignores the fact that the developing world is rapidly increasing its consumption with the growth of the global middle class [15]. It further ignores that family planning programs

were not imposed by 'the West' and that these programs contributed to the emancipation of women and to general economic development [109].

In terms of environmental science, taking action on population growth is actually supportive of the poor in the developing world. If population continues to rise, leading to accelerating ecosystem collapse, the social justice issues of the poor will worsen (as will ecojustice for nonhuman nature [107]). In fact, the evidence shows that population reduction also reduces poverty [110,111]. Action to reduce overpopulation in a non-coercive way is thus a win/win situation for both social *and* ecological justice [53]. It should be noted that non-coercive solutions (e.g., [112]) are not 'talking down' to people, but rather seek to assist via education for girls and women, readily available contraceptives, family planning, and promoting the benefits of small families. They also assume that people in the developing world have agency, and the responsibility to help create sustainable and just societies.

Sophistry and how 'racist' claims block dialogue

The definition of sophistry is: 'the use of clever but false arguments, especially with the intention of deceiving' [113]. Sophistry often attempts to take the perceived 'moral high ground', dismissing opponents as immoral. Sophistry, as a communication strategy, is often used to deny environmental problems. Both sides of the population debate can make use of sophistry or accuse the other side of using it. If presented with argumentative skill, it can be difficult to refute, since the audience is often not equipped to judge who is accurately reporting the evidence and who is not. Faced with conflicting information, people tend to believe comforting arguments that diminish perceived risks or dismiss the need to change current practices [114].

Common examples of sophistry in the population debate are that past family planning programs were ineffective, that educating girls is the most effective means of reducing birth rates and that any mention of population abets draconian 'population control' measures. The word 'coercion' has been linked in the public imagination with the worst excesses of China's one-child policy, in which pregnant women were arrested and suffered involuntary abortions. However, merely advertising the benefits of smaller families is also labelled coercive and, by false association with China's actions, a gross abuse of human rights. Another impactful false claim is that population growth does not harm economic development, despite strong evidence to the contrary [110,111]. Hence, sincerely humanitarian efforts to reduce birth rates, in order to break the poverty cycle, are instead presented as acting against the interests of people in poor, high-fertility countries and conjure racist or neo-colonial motives.

This feeds into a major extension of sophistry, the ad hominem attack, undermining the credibility or moral standing of one's opponent rather than engaging with their arguments. Typically, proponents of greater action to slow population growth are labelled as 'racists'. The notion is that, since high birth rates are almost entirely confined to black and brown skinned people, problematizing population growth is no more than an attempt to suppress those races or to deflect blame away from the environmental impacts of rich Western countries. (e.g., [115]). The population debate has thus been tainted by what has been called 'population shaming' [116], where advocates for action on population are called hypocritical, racist, coercive and even anti-human [117,118].

There are many examples of 'racist' claims made about population action advocates [119–122]. Roberts [119] states: '... where you find concern over "population," you very often find racism, xenophobia, or eugenics lurking in the wings'. No evidence is provided. It is not credible that the Second Scientists Warning to Humanity (signed by 21,000 scientists, [13]), the IPCC, IPBES and other groups of scientists are racist or xenophobic. However, the accusation of racism is one reason why some scholars avoid discussing population. We point out that most racist claims fail to be substantiated, and contradict the scientific consensus on the problems of a growing population.

In regard to the 'antihuman' claim, Washington [21] notes that environmental scientists and scholars point out the danger of overpopulation for two key reasons. First, it is causing

the extinction of a massive amount of non-human life. Second, the overcrowding, depletion and degradation of natural resources is likely to lead to famine and war, and major loss of human life. The loss of non-human life is a tragedy already underway [52]. The loss of human life due to pushing ecosystems into collapse (including agro-ecosystems) would equally be a tragedy. Given the role of population pressure in the Rwandan genocide, the Arab Spring uprisings, wars in Syria and Yemen, increasing instability in the Sahel, and the resurgence of hunger in several African countries, this tragedy is arguably also unfolding. Hence, talking about population growth is not anti-human but arguably very pro-human.

4. Examples of Denial of Population in Government and Academia

History has shown a worrying decline in discussion of population issues from the 1970s onwards. This was especially true in the UN and scientific, policy and public arenas [15,18]. Campbell [91] argues that in 1994 the UN 'Cairo' conference stopped talking about 'family planning' and instead spoke only of 'women's reproductive health'. However, O'Sullivan [109] argues that the Cairo text did not belittle population concerns, and that this was done later by the United Nations Population Fund [123], who insisted that family planning programs had neglected people's reproductive aspirations or health. As O'Sullivan documents, such claims were exaggerated, and she argues they amount to a rewriting of history about family planning.

Policy documents to support the UN 'Sustainable Development Goals' (SDGs) also do not seriously address population issues [124]. More recently, the idea of 'planetary boundaries' [28,29] did not list 'population' as one, even though population directly impacts negatively on all the ecological boundaries identified. However, Steffen [125], a leading scholar working on planetary boundaries agrees population is centrally important. A new ecological economic model 'Doughnut Economics' [126], mentions population a few times, then avoids the issue. The recent Living Planet Index Report [127] has marginalized population, focusing on consumption [128]. Even some papers purporting to discuss ecological breakdown (e.g., [129]) have excluded population growth from discussion. Some economic 'degrowth' advocates also argue that population is not a key issue (e.g., [130]). This undermines their efforts, since shrinking the economy while adding to the number of people who depend on it is a losing political proposition.

The recent 2022 IPCC Mitigation Report Summary for Policymakers [59] demonstrates a denial that has become censorship. Chapter 2 of the full report, *Emissions Trends and Drivers* [51], notes that globally per capita GDP and population growth remained the strongest drivers of CO₂ emissions, and that population growth was increasing emissions by 1.2% a year.

However, Cafaro [131] notes:

... none of this discussion of population and economic growth made it into the 62-page Summary for Policymakers ... Unlike the full report, this document is vetted by political appointees. They apparently decided to censor anything that might call into question the goodness of continued growth.

This is major censorship about the necessity for action on population and economic growth to slow (then stop and reverse) climate change. It is worsened by the fact that most people, especially journalists only read the Summary for Policymakers. The result of such a trend is summarized by Derer [132]: 'Nowadays there is almost a complete silence about overpopulation, both in the media and academia.'

5. Ways Forward

Establishing population dialogue

As a society, we urgently need to find ways to openly discuss population growth. Dialogue on population is difficult because it is highly polarized, where many have ‘prepared positions’ they will not discuss. Academic journals are often reluctant to publish controversial views, and both authors of this paper have experienced their reluctance to accept papers that discuss population. Academic journals could make a great contribution by championing the need for dialogue on population growth and its environmental impact (along with championing the need for controlling over-consumption and replacing the growth economy with an ecologically sustainable one).

Likewise, environmental and sexual and reproductive health organizations can also play a key role to promote a constructive dialogue around population. Two strategies are crucial for constructive dialogue: (1) True listening; and (2) Mutual respect [133]. If participants to a forum agree to these ground rules, one has a much better chance of actually creating meaningful dialogue.

While the focus of this paper has largely been on academia, the media, as a means to share and shape information, also plays a critical role for population dialogue. However, most journalists tend to steer away from population, even despite acknowledging its importance. Roberts [119], for example, argues that addressing population is morally and politically fraught, and suggests the promotion of family planning and female education and empowerment *without* mentioning ‘population’. The problem with this ‘don’t mention it’ approach is that it sidelines the huge environmental impact of a growing population. It treats citizens like children, who cannot be told the truth or choose sensible policies to follow. There is also the problem that this experiment (yes to family planning “access”, no to population concerns) has been run for the past 30 years, and has arguably failed to slow population growth [134]. The rapid fertility declines experienced by many countries in the 1970s and ‘80s were achieved by voluntary family planning programs that actively promoted smaller families in order to slow population growth. Since adopting the ‘don’t mention population’ strategy, global fertility decline has almost stalled.

Another key area for dialogue is within the policy-making community in both government and non-government organisations. We noted previously that policy-makers who wrote the IPCC Mitigation Report [63] ‘Summary for Policymakers’ cut out reference to population as a key driver of GHG emissions. Part of the reason behind this is likely that policy-makers lack a strong grasp of environmental science. Regular and continuing discussion within the policy-making community would be a significant step forward.

Nine non-coercive strategies to stabilize population

Engelman [112] argues that overpopulation can be tackled by nine humane (non-coercive) strategies to stabilize population:

1. Assure universal access to safe and effective contraceptives and family planning for both sexes.
2. Guarantee education through secondary school for all, with a particular focus on girls.
3. Eradicate gender bias everywhere.
4. Offer age-appropriate sexuality education students.
5. End all policies that reward parents financially based on the number of their children.
6. Integrate teaching about population, environment, and development relationships into school curricula.
7. Put prices on environmental costs and impacts.
8. Adjust to population ageing rather than seeking to delay it through governmental incentives aimed at boosting childbearing.
9. Convince leaders to commit to ending population growth through the exercise of human rights and human development.

It has been argued that a key point missing is the promotion of small families as a social norm [37,135]. Kopnina et al. [86] in their discussion of Italy (with a slowly declining population) suggest that the *first three* strategies are most important for stabilising

population. Using similar strategies, Iran was able to halve its population growth rate from 1987 to 1994 [136]. Iran, Japan, Sri Lanka and Thailand are only some of the countries that have achieved replacement fertility levels in a matter of a decade after strong government communication campaigns combined with affordable family planning options [137].

It has been argued by Staples & Cafaro [138] that using non-coercive strategies, society could arguably reduce world population to 6 billion by the end of the century and to a sustainable 2–3 billion by the end of the following century. This would require the active promotion of small family norms, and governments embracing low fertility and population decline, despite an ageing population [139]. To do this, we must make the advantages of such a strategy widely known, and break the denial dam that keeps dialogue on population a taboo.

Stopping child bride marriage

Twenty-one per cent of young women globally are married before their 18th birthday [140]. Child bride marriages occur at the remarkable level of 33,000 a day [141] and likely result in millions of unwanted pregnancies [15,112,142]. Child bride marriage is common in developing nations such as Cambodia and Tanzania, arguably because of the economic importance of the bride price to the bride's family [94].

In 1962 the UN passed the *Convention on Consent to Marriage, Minimum Age for Marriage and Registration of Marriages* [143] which stated marriage requires the free and full consent of intending spouses. However, this did not halt child bride marriages. In 2016, UNICEF and the United Nations Population Fund (UNFPA) launched a programme to tackle child marriage in 12 key countries [144]. UNICEF's Director Anthony Lake stated action on child bride marriage is critical because the number of girls and women married as children will (without action) reach nearly 1 billion by 2030 [145]. Drastically reducing child bride marriages would significantly lower population growth rates in the developing world. Kopnina et al. [94] however note this must be done country by country in a culturally sensitive way.

Success stories-Tunisia

In the early 1960s, Tunisia became the first country on the African continent to significantly improve women's status and launch a voluntary national family planning program. Today, Tunisia has some of the most progressive reproductive rights policies in Africa, and is the most progressive of all Arab countries in terms of gender equality and women's rights. As a consequence, its fertility fell from 7 children per mother in the 1950's to around replacement level by the early 2000's [146]. Similar success stories can be told for many developing countries, including Thailand, Costa Rica, Brazil, Sri Lanka and Bangladesh.

Success stories-The Population Media Center

The Population Media Center [3] uses entertainment-education and mass media to promote social and cultural change by addressing the interconnected issues of the full rights of women and girls, population, and the environment. Their goals are to empower people to live healthier and more prosperous lives, and to stabilize global population at a level at which people can live sustainably with the world's renewable resources. The Center creates entertainment specifically designed to address deeply entrenched social norms, particularly addressing the status of women and girls. PMC's dramas create long-term social change and create demand for important services, like schools or health clinics. By enhancing the status of women and girls, PMC helps to eradicate the underlying causes that inflate population growth, while also addressing crucial human rights concerns [3].

Other constructive responses

The Overpopulation Project [147] has a range of suggested solutions at the individual, community, national and global level. A suggested global solution is to make 'ending population growth' one of the UN Sustainable Development Goals. Crist et al. [15] and The Overpopulation Project [147] list other specific solutions, many of which have proven impactful in past family planning programs, such as: deploying health workers for grassroots education and support; making counseling for couples available; eliminating government incentives for large families; and making sexuality education mandatory in school curric-

ula. Delacroix and Engelman [99] argue that reproductive rights should be linked with environmental sustainability. They believe that this can contribute to legitimising and strengthening family planning, and discuss how best to communicate this effectively.

6. Conclusions

Environmental science and declining ecological indicators show the world is clearly *beyond* a long-term, ecologically sustainable human population. However, we have shown that this fact is still denied across multiple sectors. We have discussed blocks to dialogue on this issue, which have proven difficult to overcome. These include growthism, anthropocentrism, religious and cultural taboos, confusion around rights, and the framing of social justice. These positions are bolstered by sophistry and prevalent myths about the motives and impacts of past ‘population control’ efforts, which are believed to have been universally coercive and harmful when they were almost always voluntary and highly beneficial, both for women’s health and rights and for economic betterment. We conclude that addressing the broader implications of population size and growth remain a difficult exercise as both public and academic discourse is dominated by dynamics of denial. However, if we are to reach an ecologically sustainable future, we urgently need greater dialogue on these issues. The starting point for such a dialogue should be that population, as a driver of environmental crises, must be no longer ignored, denied or stigmatized (just as overconsumption and the growth economy cannot be ignored).

While population growth as a driver of unsustainability continues to remain largely ignored, we fear that efforts to address our environmental and climate crises will have little chance of succeeding. Accordingly, it is time for academia, the media, policy-makers and the general public to commit to constructive dialogue on human population growth and its impacts.

Author Contributions: Conceptualisation H.W. and H.K.; original draft preparation H.W.; writing—review and editing H.W. and H.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We would like to thank Jane O’Sullivan of the University of Queensland and Robert Engelman and Céline Delacroix, Senior Fellows of the Population Institute (USA) for their extensive and constructive comments on the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

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