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DEBATE

Towards a better understanding of the role of population policies in tackling climate change

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ABSTRACT As the global population hit eight billion in 2022 and climate change-induced extreme events have become more visible worldwide, there has been renewed public interest in the impact of population growth on climate change. This has also sparked a debate about the role of population control policies as a key strategy to curb global warming. This essay argues that the relationship between population dynamics and climate change is highly complex, and that having specific background knowledge could be beneficial for participating in this debate. To this end, this essay presents three points that readers may wish to consider when forming their judgements: (1) the role of demographers in assessing how human population impacts climate change; (2) the importance of acknowledging the demographic heterogeneity and complexity of the relationship between human populations and climate change; and (3) the disparities in resource consumption and the resulting emissions in the context of climate justice.

KEYWORDS Climate justice • Demographic heterogeneity • Global warming • IPAT • Population growth • Shared Socioeconomic Pathways (SSPs)

Population policies and climate change mitigation

A recent survey of scientists contributing to the Intergovernmental Panel for Climate Change (IPCC) assessment reports showed that the majority believe global temperatures are on a trajectory to rise to as high as 2.5 °C above pre-industrial levels (Carrington, 2024). This is alarming, considering that the current 1.2 °C of warming have already led to numerous extreme weather events. Likewise, a series of IPCC reports have presented solid scientific evidence confirming that the rise in global temperatures is human-made. The increase in greenhouse gas emissions from human activities, which is driven by increasing production and consumption due to population growth, implies that reducing population size is a potential strategy for addressing climate change (Sear, 2021). This has led to a rather heated debate about the role of population control polices and family planning programmes, such as those providing modern, inexpensive contraception, in climate change mitigation.

Before drawing the conclusion that addressing population growth is essential for tackling climate change, I would like to present three relevant issues that may inform

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people's judgements: (1) the role of demographers in assessing how human population impacts climate change; (2) the importance of acknowledging the demographic heterogeneity and complexity of the relationship between human populations and climate change; and (3) the disparities in resource consumption and the resulting emissions in the context of climate justice.

First, debates about how population dynamics and demographic trends contribute to climate change often lack the engagement of demographers. It is evident that social scientists and social science research are underrepresented in the IPCC reports (Vasileiadou et al., 2011). This has resulted in a failure to capture the complexity of social and human systems and their relationships with the climate system. The earlier sets of emission scenarios, such as the SRES scenarios[1], only considered how varying levels of economic growth, population growth and technological developments might impact greenhouse gas emissions. Focusing mainly on population size overlooks the importance of changing demographic structures for emissions. A decade later, a new set of scenarios, the Shared Socioeconomic Pathways (SSPs), were developed that provide five alternative narratives of future socioeconomic development trajectories (Riahi et al., 2017). Different dimensions of the SSPs, including population, have been quantified, and provide outlooks for future emissions trajectories and their implications for climate change.

In the SSPs, the population dimension was innovatively elaborated to capture for the first time the role of human capital as a key demographic characteristic of the human system. Lutz et al. (2014) showed that human population can be described in a multidimensional way given different sources of demographic heterogeneities beyond age and sex. It has been illustrated that when education is added as another source of heterogeneity, the resulting future population size can vary substantially (KC and Lutz, 2017). This is because the demographic behaviours (i.e., fertility, mortality and migration) underlying population dynamics vary considerably with levels of education.

Including the educational dimension as a key factor influencing population size is certainly an improvement, as it adds complexity to the human system. Indeed, future emissions projections in more recent IPCC reports are based on the new demographic scenarios, which vary by the socioeconomic development pathways influencing fertility, mortality and migration (O'Neill et al., 2020). What is still missing is the insight that differential population composition, not just population size, can directly influence emissions. At the micro level, it has been shown that individuals' energy consumption levels vary depending on their age (Estiri and Zagheni, 2019; Zagheni, 2011), gender (Osorio et al., 2024; Räty and Carlsson-Kanyama, 2010; Shrestha et al., 2021), education (Belaïd, 2016; Pachauri, 2004) and other demographic characteristics. There have been attempts to demonstrate that emission levels can be altered by changes in population composition, such as shifts in age structure, living arrangements and education; as well as by changes in population distribution, such as through urbanisation (Kluge et al., 2014; Liddle, 2014; Liddle and Lung, 2010). However, demographic heterogeneity in emission trajectories is not yet fully incorporated into Integrated Assessment Models (IAMs), which are systems tools based on the

1 The SRES scenarios, or Special Report on Emissions Scenarios, are climate change scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) that were published in 2000.

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scenarios approach that provide quantitative descriptions of the interactions between human systems (e.g., economies and societies) and natural systems (e.g., the climate system). In this regard, demographers and other social scientists can make significant contributions by examining pertinent socio-demographic variables that influence emission patterns, and by quantifying these factors (Lutz and Muttarak, 2017).

Second, as the impact of the human population on the environment and the global climate system is complicated, more complex modelling frameworks beyond IPAT are required to adequately explain this relationship. The $I = PAT$ equation – where I denotes environmental impact, P represents the population size, A signifies the average affluence or consumption per individual and T stands for technology – was developed in 1971 by biologist Paul Ehrlich and environmental scientist John Holdren (Ehrlich and Holdren, 1971). However, the effects of population, affluence and technology on the environment are sensitive to temporal and spatial scales. How much the population factor influences emissions has been shown to vary depending on the time periods and locations being studied (Li et al., 2024). Typically, the relationships between population and environmental impacts are mediated by changes in consumption levels associated with income growth and technological advancement (Wang and Li, 2016). There is also evidence that the impact of population dynamics on CO_2 emissions varies across economic structures, with lower elasticity in high-income countries and higher elasticity in lower-middle-income countries (Shi, 2003).

While the IPAT-based models were extended to incorporate age structure and to investigate its impact on CO_2 emissions (Dietz and Rosa, 1994; MacKellar et al., 1995), there is no consensus on whether a younger or an older age structure is associated with higher emissions. It has, for example, been shown that younger individuals have a positive impact on transport-related CO_2 emissions (Liddle 2004, 2011), whereas older people have higher residential energy consumption levels due to their higher demand for cooling and heating (Estiri and Zagheni, 2019; Tonn and Eisenberg, 2007). Using US household expenditure data, Zagheni (2011) analysed age-specific consumption profiles of CO_2-intensive goods and found that per capita CO_2 emissions tend to decline after age 60. However, the positive impact of the changing age distribution in the US on CO_2 emissions appears to be small. Applying the age-specific per capita CO_2 emissions profile from Zagheni (2011) and UN population projections to Germany, Kluge et al. (2014) showed that by the end of the century, as the proportion of the population that is older continues to increase, emissions are expected to decline to pre-1950 levels. These findings underscore the complexity of measuring the population's impact on emissions, as the temporal scale, e.g., population momentum, is also a crucial factor.

Likewise, it is also important to consider preferences, attitudes, activities, income levels and other relevant factors underlying demographic differentials in consumption behaviours. If, for instance, older people are more likely to live alone, then the energy intensity per capita in their households is naturally higher than that of families with more household members. It has, however, been shown that the higher demand for electricity and heating in older households is not due to age differentials in preferences for thermal comfort, but rather to the choice of dwelling, as older people tend to live in older buildings with low energy efficiency (Charlier and Legendre, 2021). This evidence indicates that the relationship between population and emissions is more nuanced than what is presented in the IPAT equation and its variants. Moreover, since the IPAT is based primarily on the values and consumption patterns of industrialised Western countries, it may not accurately represent the environmental impacts in non-Western societies.

This leads me to the third point related to climate justice. The global population is still growing, and is projected to reach between 9 and 11 billion by the end of the century (KC et al., 2024). However, the majority of this increase is expected to take place in Africa, where numerous nations continue to have relatively high total fertility rates averaging 4.2, compared to 1.9 in Asia and 1.8 in Latin America and the Caribbean (United Nations, 2022). Given that the demographic transition in Africa has not yet reached the advanced stage where the population stabilises, there have been calls to use family planning as a means to tackle climate change and build climate resilience (Evans and Larsen, n.d.; O'Connor, 2023). In 2019, An estimated 218 million women aged 15-49 in low- and middle-income countries had unmet family planning needs (Sully et al., 2020). Moreover, these women tend to reside in the regions that are most vulnerable to climate change. It has therefore been argued that access to family planning and reproductive health services can empower women and enhance their livelihoods, which will, in turn, equip them with the capability to tackle the climate crisis.

Certainly, access to contraception, abortion, fertility treatment, reproductive health and the freedom to make decisions concerning reproduction have been recognised as human rights since the International Conference on Population and Development (ICPD) in 1994 (ICPD, 1994). However, campaigning for reductions in population growth as a way to fight climate change will not contribute significantly to reductions in the amount of carbon dioxide in the atmosphere. This is primarily because population growth due to birth rates is a *flow,* whereas the pressure of human population on global warming runs through the atmospheric concentration of carbon dioxide, which is a *stock* (Arrhenius et al., 2024). Indeed, Kuruc et al. (2023) have quantified this relationship. In their stabilisation scenario, which assumes that total fertility rates (TFRs) will increase to reach the replacement rate of about 2.1, the long-run global population is projected to stabilise at about 13 billion people by 2200, corresponding to 4.22 °C of warming. Meanwhile, in their depopulation scenario, which assumes that the global TFR will converge to 1.66, the global population is projected to decline to about six billion people by the end of the 22nd century, corresponding to 4.17 °C of warming. Since the concentration of atmospheric greenhouse gases is cumulative, the differences in the warming levels that the two population paths are projected to generate by 2200 will not meaningfully influence the long-run stock of historical emissions already present in the atmosphere. Thus, it appears that reducing fertility rates to below replacement levels will not help to achieve the two-degree goal set in the Paris Agreement (Arrhenius et al., 2024). Instead, the process of decarbonisation needs to be accelerated to limit global warming effectively.

A somewhat misleading focus on population growth as a key driver of global warming undermines serious mitigation efforts in high-emission countries, and unfairly suggests that countries with high population growth should bear the responsibility for tackling climate change. However, it is well-known that the impact of climate change is not distributed evenly across nations and population subgroups (IPCC, 2014). Poorer countries/ populations bear the brunt of the negative consequences of climate change, while

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contributing only a tiny fraction of global greenhouse gas emissions. The bottom 50% of the income and wealth distribution (approximately 3.9 billion people) are responsible for 11.5% of global emissions, while the top 10% (approximately 771 million people) produce almost half (48%) of total emissions (Chancel, 2022). Similarly, it is not evident that countries with high population growth rates (mainly low-income nations) have the same GHG emissions growth rates as higher-income countries (Muttarak, 2024). Thus, it is rather unjust to blame overpopulation in poorer countries for driving global warming while wealthier nations do not fully commit to decarbonisation.

Whether population polices can help to tackle climate change is a question that is broader than the climate crisis itself. Certainly, regardless of climate change, population policies aiming to improve health and wellbeing, reduce all forms of inequality (including gender inequality) and promote reproductive rights and other human rights are fundamental for achieving the sustainable development agenda, and, above all, for upholding human dignity and freedom. Nevertheless, placing a heavy emphasis on population size as a major driver of global warming, as has been done in some scientific publications (Chaurasia, 2020; Dodson, et al. 2020), could cause us to miss what is now a very narrow window to limit the increase in the average global temperature to below 2 °C above pre-industrial levels. I hope this essay has provided essential background information to consider before engaging in a debate on the role of population policies in addressing climate change.

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