COMMENTARY

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How population growth relates to climate change

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Currently, around 7.5 billion people live on our planet and scenarios for the future show a plausible range from 8.5 to over 12 billion before the population will level off or start to decline, depending on the future course of fertility and mortality (1, 2). These people will also have to cope with the consequences of climate change that may be in the range of 1.5 °C to more than 3 °C, depending on the scale of mitigation efforts. The paper by Scovronick et al. in PNAS on the "Impact of population growth and population ethics on climate change mitigation policy" (3) links these two global megatrends and asks how different population scenarios change the rationale for mitigation policies and vice versa. The paper shows convincingly that the answers depend on a rather abstract philosophical choice: namely, whether the goal is to maximize total utility (TU) or average utility (AU).

The field of population ethics, which deals with this question, is tricky because it is filled with contradictions and unacceptable conclusions, whatever position one takes on the issue. Ever since Bentham, the dominant utilitarian position has been that the overall goal is to maximize the wellbeing of the largest possible number of people. Under this TU view, the average wellbeing of people is multiplied with the number of people. But this would also imply that a world with many more people, who on average have a lower level of wellbeing than today, would be better, if it results in a higher TU. Since this implication is difficult to accept, it has also been labeled the "repugnant conclusion" (4). Much has been written about this unsatisfactory conclusion and many ways of dealing with it have been proposed (5), with a focus on average welfare instead of TU being the most popular one, since it seems most plausible and straightforward from a social science perspective: the task at hand is to improve the wellbeing of people alive and not that of hypothetical and possibly astronomically larger populations still to be born. However, this AU approach has not found much acceptance among philosophers because it also leads to implausible conclusions, such as that a society in which everybody leads a good life would be worse than a world of just one person leading an even better life (6).

What may seem like a rather esoteric philosophical debate, however, has direct implications for assessing

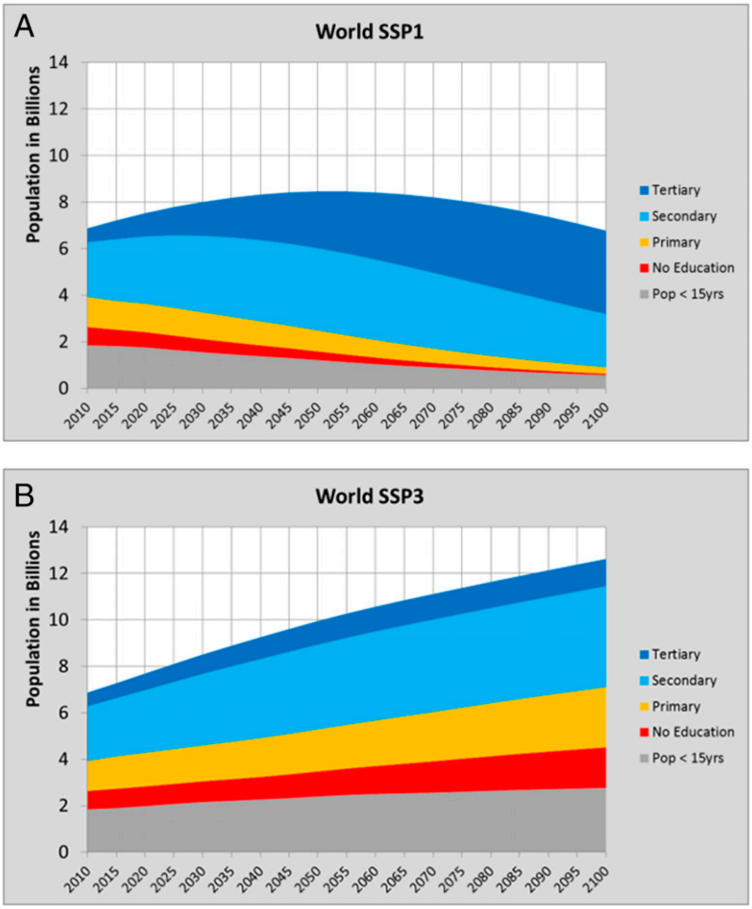

Fig. 1. Global population trends to 2100 by level of educational attainment according to the SSP1 (*A*) and SSP3 (*B*) scenarios. Reprinted with permission from ref. 14.

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the level of optimal climate change mitigation activities on the basis of cost-benefit climate–economy models (CEM). All leading CEMs have a TU approach underlying their models, which not only implies that a much bigger future world population would be better (unless this is associated with much lower welfare per person), but also implies that damages caused by climate change to a bigger future population are more serious, and thus justify more costly mitigation action now than in the case of low population growth. Under an AU approach, population growth would be less relevant for mitigation costs. The Scovronick et al. (3) paper shows that the difference in results of CEMs due to the TU vs. AU choice is as large as that of the hotly debated choice of discount rates. This finding alone makes the Scovronick et al. report an important paper.

Going beyond this specific point made within the framework of CEM models, one must ask, however, whether the highly artificial world of CEMs is really very useful in terms of dealing with real-world policy implications and priority setting. As a demographer working on world population scenarios and the interactions between population growth and climate change without using this framework, I feel uneasy with many of the strong assumptions made in most CEMs. The first reason is that in these models, gross domestic product and income are still fully and unconditionally equated with human wellbeing. I would have thought that after decades of justified criticism of such an approach and the highly influential Stiglitz et al. (7) report on "mismeasuring our lives," such assumptions would at least be qualified. The CEMs go even further in making the highly problematic choice to put a specific dollar price tag on the value of a human life lost due to climate change. Since this price tag is made dependent on national income levels, a life in the United States is considered many times more valuable than a life lost in Africa. This raises serious ethical issues related to equity.

Another problem in my view is the fact that such models treat human beings essentially as passive victims and not as active agents who can also adapt to changing conditions. The economic production function used does not consider improvements in human skills as a driver of economic growth, nor does the estimation of the consequences of climate change consider changes in adaptive capacity. A more appropriate view would see humans as agents who, if they are empowered through education and other capabilities, can actively contribute to raising their standards of living and helping themselves and others for having better and longer lives and adapting to the challenges posed by climate change. There is a large body of literature showing that better education clearly contributes to better health and better incomes through influencing our cognitive function, abstract thinking, and planning horizons, changes attitudes and behaviors, and equips us with better social and economic opportunities (8–11). It also has been argued that improvements in education enhance adaptive capacity to climate change in future generations in a predictable way (12). And there can be no doubt that education of women is a key factor for bringing about voluntary fertility decline in high-fertility countries, which in consequence will lead to lower population growth. Hence, human agency associated with empowerment through education matters greatly for population growth, as well as for economic growth and for adaptive capacity to climate change.

For operationalizing such a view of human agency and capabilities in a quantitative way, one must explicitly account for population heterogeneity. In quantitative models, population heterogeneity is best captured by measurable and observable individual characteristics, such as age, gender, level of education, labor force participation, occupation/income, and place of residence. When it comes to empowerment, then education levels by age and gender stand out as being of particular relevance. It has been argued that these three demographic dimensions are the most important sources of observable population heterogeneity when it comes to linking population growth and climate change (12). This view has over the past years also been translated into alternative scenarios by a broad consortium of scientists working on climate change and integrated assessment models in the form of the so-called SSPs (shared socioeconomic pathways) (13). These SSPs have been developed to capture the socioeconomic challenges associated with both climate change mitigation and adaptation. They capture possible future developments under which mitigation efforts and costs on the one hand, and climate change damages and adaptation costs on the other, depend on the future pathways taken. Different pathways are also associated with very different trajectories of population growth and human capital formation. They show that future population growth is clearly not independent from the other socioeconomic trends that matter for climate change mitigation and adaptation, something for which the CEMs do not account.

Fig. 1 illustrates this for two of the more extreme SSP scenarios in terms of population growth trajectories broken down by the educational attainment of the world population. While the gray area in Fig. 1 refers to children below age 15 y, the red area shows adults that have never been to school and the dark blue shows those with post-secondary education. SSP1 gives the case of very rapid social development that, together with the other economic and technological variables considered in the SSP, is labeled "sustainability." In contrast, SSP3 shows the case of stalled social development, which has also been labeled "divided world" (14). Consistent with the narratives of these two scenarios, SSP1 shows a rapid education expansion with a world population peaking around midcentury at a level of 8.5 billion people, while SSP3 shows education stalls associated with continued population growth that reaches almost 13 billion by the end of the century. This is likely associated with low human development and misery, which is enhanced by climate change, while the low population trajectory of SSP1 is associated with much higher average human wellbeing and likely lower mitigation and adaptation costs.

Where does this leave us with respect to the broader consideration of population ethics when linking the two megatrends of population growth and climate change? We have seen that the two are not independent and illustrated how the consideration of population heterogeneity and enhancement of human capabilities link both by leading to lower population growth, higher average wellbeing not only in terms of income but also health and other nonmonetary dimensions, and to lower mitigation and adaptation costs. Hence, for the time horizon until the end of this century, which has been discussed here and for which the SSP1 and SSP3 scenarios indicated a plausible range of future population trends, SSP1 seems clearly preferable both under an AU and a TU perspective. Even under a TU perspective, the difference in average wellbeing under these specific scenarios is larger than the difference in total population size.

What about the future beyond 2100? Recent model calculations, which assume that during the second half of this century all parts to the world will have fertility levels of 1.5–1.75—which is the current average of industrialized countries, including China—show that, depending on life expectancy having a ceiling at 90 or 120 y, world population in 2200 would come to lie within a range of 2–6 billion (15). But this would only be possible if Africa experienced a rapid education expansion followed by economic growth. However, this scenario provides the positive vision of the real possibility of a world of 2–6 billion well-educated, and therefore healthy and wealthy people, who will able to successfully cope with the consequences of already unavoidable climate change (16). I would much rather see my great grandchildren living in such world than in a SSP3 world, even if the absolute number of decedents carrying my genes should be smaller. And the danger that in the distant future people start to have lower levels of wellbeing because they feel lonely on this planet does not seem to be a likely problem for the foreseeable future and might be easily solvable by communication technology.

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