Climate change, environmental shocks, and fertility: Global evidence from low- and middle-income countries

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Extended Abstract

Climate change is already happening and has numerous consequences for human societies, ranging from economic impact to human health and migration (Burke, Dykema, et al., 2015; Carleton et al., 2022; Hoffmann et al., 2022; IPCC, 2022; Andriano & Behrman, 2020). Potentially, climate change can also affect fertility both physiologically or indirectly through influencing the socioeconomic factors underlying fertility decisions and behavior. If climate change does influence fertility, it is essential to assess its impacts –given that fertility is the primary driver of long-term population dynamics (Sellers, 2022).

In the past years, an increasing number of studies have empirically analyzed the climate-fertility relationship (Barreca et al, 2018; Barreca, & Schaller 2020; Casey et al 2019; Cho, 2020; Davis, 2017; Eissler et al, 2019 ; Finlay, 2009 ; Gray and Call, 2023; Hajdu, 2024; Thiede et al 2022; Sellers & Gray, 2019). Existing studies are often limited to a single country or a specific catastrophic event, often with a focus on high-income countries. Comparative evidence covering multiple country contexts at a time is missing. Our study aims to addresses this gap by comprehensively examining the impact of climate change in low- and middle-income countries, where the effects of climate change are particularly pronounced.

The impacts of climate change on fertility are theoretically ambiguous and there is a lack of scientific consensus on the direction of the effects (Grace, 2017; Muttarak, 2021). It is possible that after exposure to a catastrophic natural hazard event, fertility may increase in response to child mortality. On the opposite, climate change can impact livelihoods, health, and wellbeing, potentially resulting in food insecurity and a subsequent deterioration in reproductive health, ultimately leading to a decline in fertility. Additionally, the question of the persistence of climate change impacts, specifically in the long run, remains unresolved.

This complexity arises from the multifaceted relationship between climate change and fertility. As illustrated by Grace (2017) (see diagram reproduced in Figure 1), individuals' fertility choices are linked to their household situations within specific geographical, economic, cultural, social, and political contexts. In this framework, climate change may have an impact through various mechanisms and at different scales. Firstly, the impact may be direct, affecting individuals at the individual level, either through changes in reproductive health or shifts in preferences.

Moreover, climate change may have indirect effects. It can alter the broader living conditions of households, such as when a storm destroys public infrastructure. Furthermore, these impacts might directly materialize within households, particularly by constraining on their future consumption of clean water and food. As a result, households might adjust their family planning choices, which could change the timing and/or the total of births. The multiplicity of impact channels and conceivable dominant mechanisms makes the a priori analysis of the impacts of climate change on fertility very challenging (Gray and Thiede 2024).

To study the effects of climatic shocks on fertility, we construct a comprehensive database at both national and subnational levels by extracting detailed birth history records from 290 Demographic and Health Surveys (DHS) spanning from 1980 to 2015. This database, compiled at both monthly and annual frequencies, covers 65 countries and 590 regions at the subnational level, representing a current population of 3.8 billion individuals (Figure 2). Combined with gridded climate data from the Climatic Research Unit of East Anglia (Harris et al 2020), this database allows us to analyze short to medium-run effects of temperature and precipitation shocks on fertility outcomes and to study heterogeneities across regions and population groups. Based on our empirical insights, we project changes in future fertility along the SSP-RCP scenarios, a matrix of scenarios used in climate modeling to explore how socioeconomic development and greenhouse gas emissions might evolve in the future.

To estimate fertility at the subnational level, we rely on an update and extension of a database by Belmin et al. (2022). We construct Age Specific Fertility Rates (ASFR) as main outcome and validate this measure with data from the World Population Prospects at the national level. ASFRs are estimated by dividing the number of births in a specific month and age group by the number of women in this age group living in the region (Siegel & Swanson, 2004). The DHS data allow us to reconstruct retrospectively fertility rates at the subnational level until 1980s for a large number of countries in our sample.

Our findings indicate that in the short term, temperature anomalies results in a significant decline in fertility approximately nine months later (Figure 3). However, in the medium term, we observe a rebound effect with fertility levels increasing in the years after a shock gradually compensating for the short-term reduction (Figure 4). Stronger reductions in fertility are observed for women in less developed regions and with lower levels of education suggesting a major inequality in the consequences of climate change across different regions and socioeconomic strata (Figure 5 and 6). Considering both the short-term negative and medium-term positive effects of temperature shocks, the overall impacts on fertility are small and close to zero. In terms of precipitation, we find significantly positive effects on fertility both in the short-term and long-term.

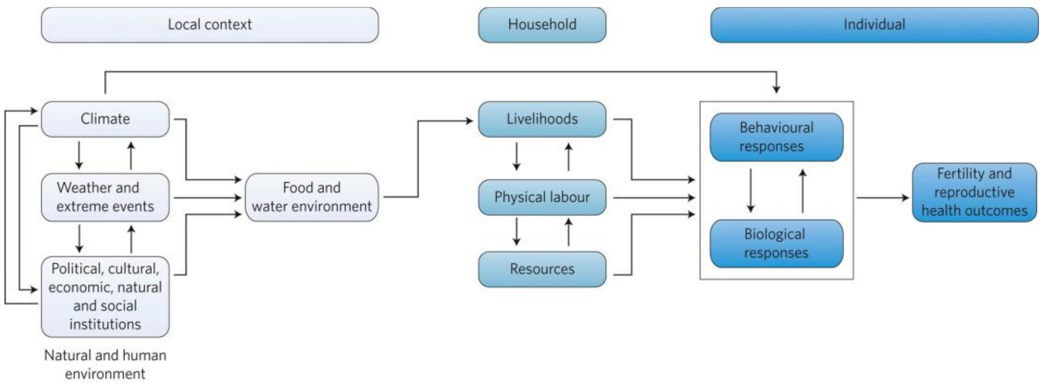

Figure 1. Conceptual framework linking fertility and reproductive health with short and long-term changes in climatic conditions (figure based on Grace, 2017)

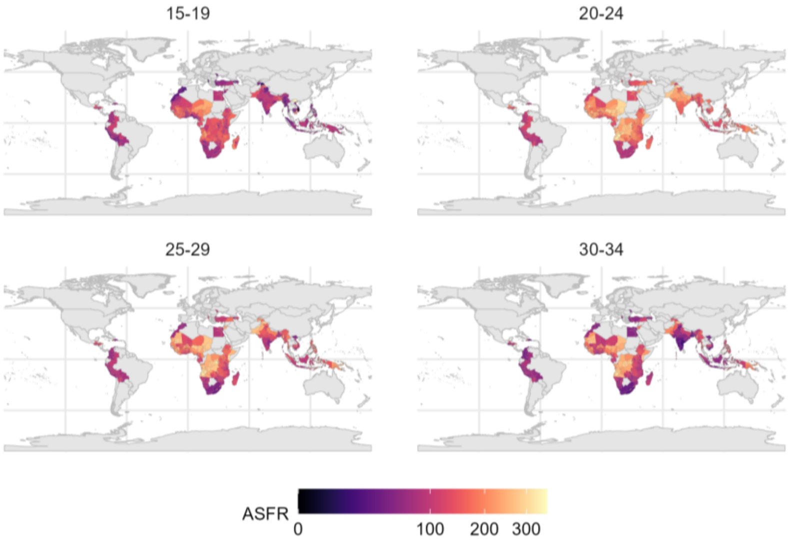

Figure 2. Fertility by age group in low- and middle-income countries (2001-2010). The graphs show the yearly age specific fertility rate (ASFR) at the subnational level for all countries included in the dataset.

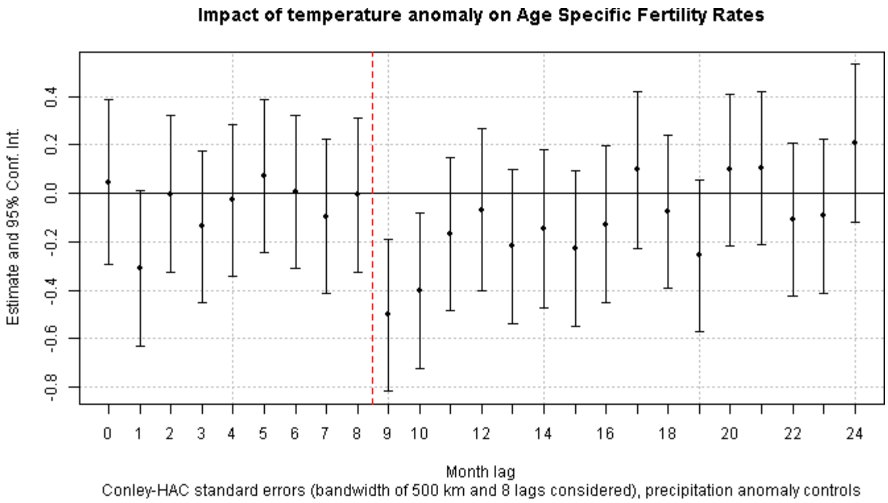

Figure 3. Baseline models: Impacts of temperature anomalies on Age Specific Fertility Rates for 65 countries.

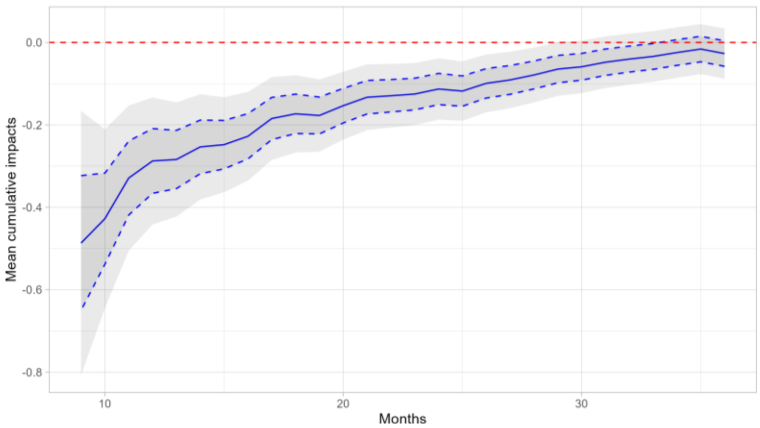

Figure 4. Average cumulative impacts of a one standard deviation temperature anomaly on Age Specific Fertility Rates with 95% confidence intervals.

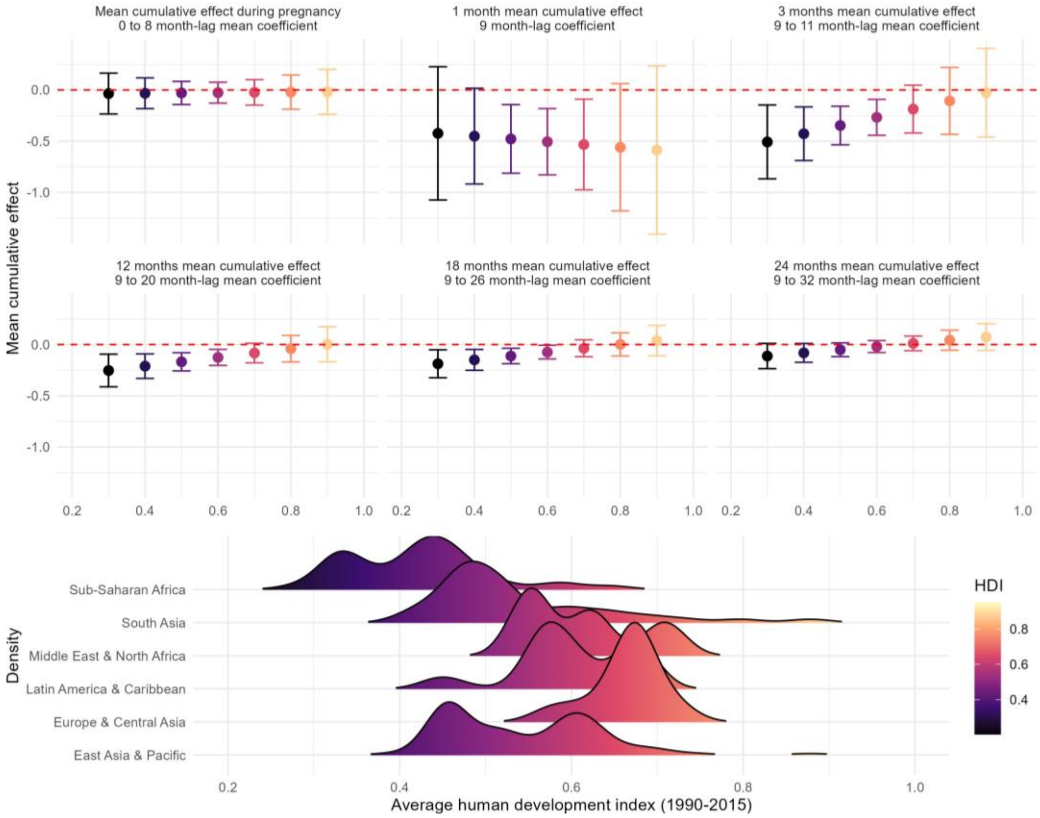

Figure 5. Heterogeneity in climate impacts on fertility by economic development level. Mean cumulative impacts of a one standard deviation temperature shock on ASFR by level of development

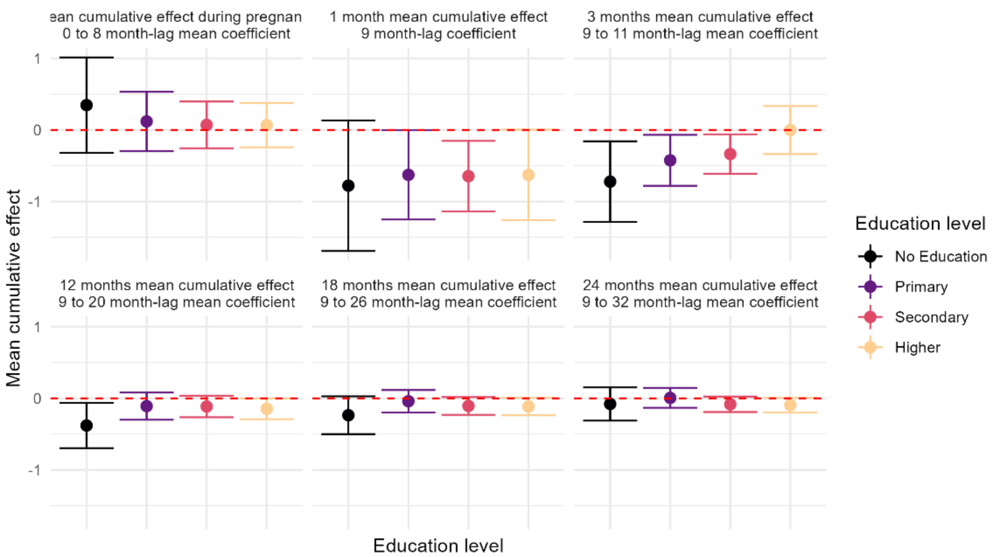

Figure 6. Heterogeneity in climate impacts on fertility by education. Mean cumulative impacts of a one standard deviation temperature shock on ASFR by level of education

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