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# Climate change impacts on fertility in low- and middle-income countries: An analysis based on global subnational data

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## Background

- ▶ Some reasons to believe that climate change could have a positive impact on fertility (through *replacement effect* and *insurance effect*)
  - 2004 Indian Ocean tsunami [Nobles et al., 2015], earthquakes in India, Pakistan and Turkey [Finlay, 2009], Hurricane Mitch in Nicaragua [Davis, 2017]
  - Exposure to drought during the growing season leads to earlier marriage for adolescent girls in Malawi [Andriano and Behrman, 2020] + Effect of SPEI on early marriage in Bangladesh presented yesterday by Francesca Tosi
- ▶ But some reasons as well to consider a negative effect on fertility
  - Negative effect of heat on reproductive health [Barreca et al., 2018], evidence in the US [Lam and Miron, 1996] or South Korea [Cho, 2020]
  - Exposure to adverse environmental conditions tends to decrease the ideal family size of women in 18 Sub-Saharan countries [Eissler et al., 2019]

# Background

- ▶ Potential direct as well as indirect effects
  - Directly, through physiological effects
  - Indirectly, through a reduction in crop yields, affecting maternal nutritional status, time use patterns and the need for physically demanding activities [Grace, 2017, Sellers and Gray, 2019]
  - Households may also choose to limit the number of children as a coping strategy when facing adverse environmental conditions [Thiede et al., 2022]

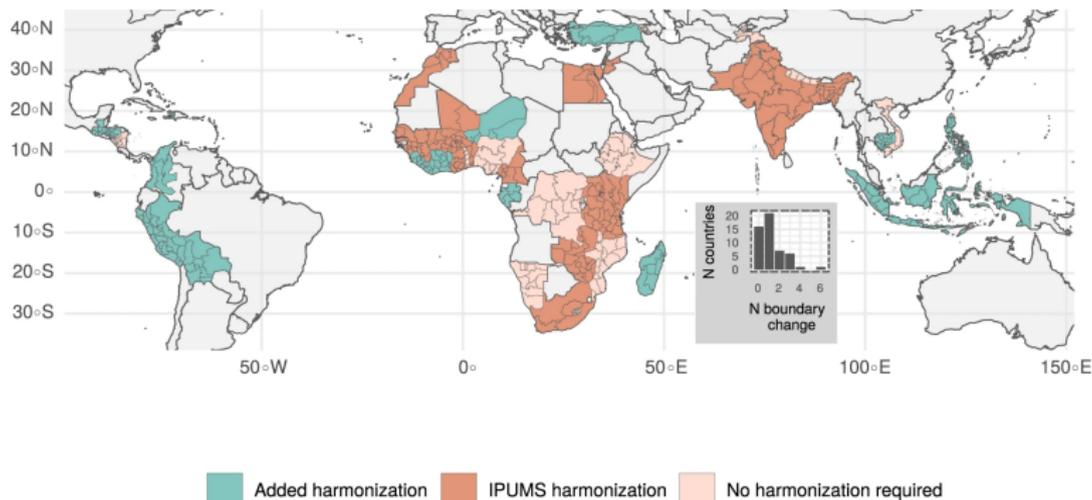
## A complementary approach

- ▶ With some notable exceptions most extant studies on the impact of climatic factors on fertility only focus on a single country or a single event
- ▶ We try to provide a complimentary view with the use of a cross-country database of fertility
- ▶ Is there already a global fertility database ?
  - Yes but not fit for our purpose  
[United Nations, 2022b, Raftery et al., 2014] due to the Bayesian estimation
- ▶ So we construct a harmonised subnational fertility database across countries over a long time period using the Demographic and Health Surveys (DHS)

# The Demographic and Health Survey data

- ▶ Nationally representative household surveys that are conducted at regular intervals from 1984 in approximately 90 low- and middle-income countries
- ▶ Records of women of reproductive age (15-49) include a birth history
- ▶ Usually used to estimate the fertility rate over the 36 months preceding the end of a survey
- ▶ It is possible to estimate a fertility rate over a different time period in a given spatial unit (national as well as subnational) exploiting the birth history

# The LivWell database and the DHS.Rates package



**Figure:** Countries covered by the LivWell database

- ▶ The LivWell database provides an harmonization of the DHS regions at a subnational level [Belmin et al., 2022]
- ▶ Estimation of the TFR, ASFR and TFR by educational attainment group with the DHS.rates R package [Elkasabi, 2019, Elkasabi, 2021]

## Joining data with inverse variance weighting

- ▶ Several fertility estimates overlap due to the long span of birth histories in different DHS surveys
- ▶ We combine the information to estimate a fertility rate that is as robust as possible
- ▶ We derive the standard error of the estimated fertility rate with a Jack-Knife estimator and combine estimates using inverse-variance-weighting:

$$fert_{r,t} = \frac{1}{\sum_{DHS_i} \frac{1}{V_{r,t,DHS_i}}} \sum_{DHS_i} \frac{fert_{r,t,DHS_i}}{V_{r,t,DHS_i}}$$
$$V_{r,t} = \frac{1}{\sum_{DHS_i} \frac{1}{V_{r,t,DHS_i}}}$$

Where  $fert_{r,t}$  is the final estimate of fertility in region  $r$  in month  $t$  and  $V_{r,t}$  is its standard error.

## An overview of the results

			Surveys	Countries
Yearly, quarterly, or monthly	TFR	National	241	61
		Subnational	179	51
	ASFR	National	240	61
		Subnational	177	51
	EdTFR	National	213	59

Table: Surveys considered in the database

- ▶ Perhaps, we should also consider ASFR broken down by educational attainment at the national level

# Subnational heterogeneity

Age-specific fertility rates in Senegal from 1980

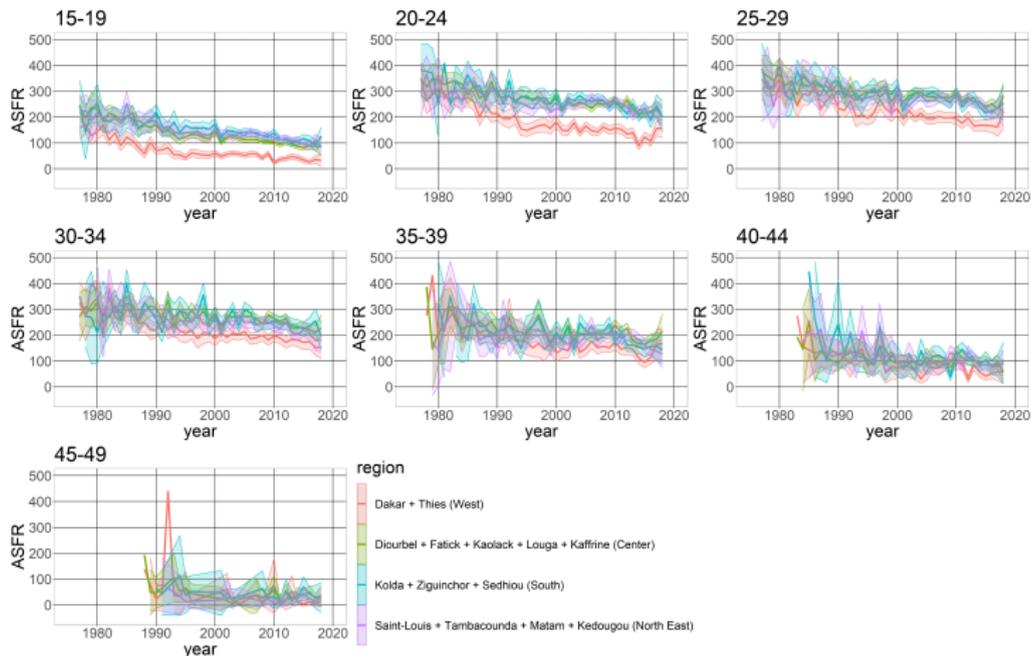
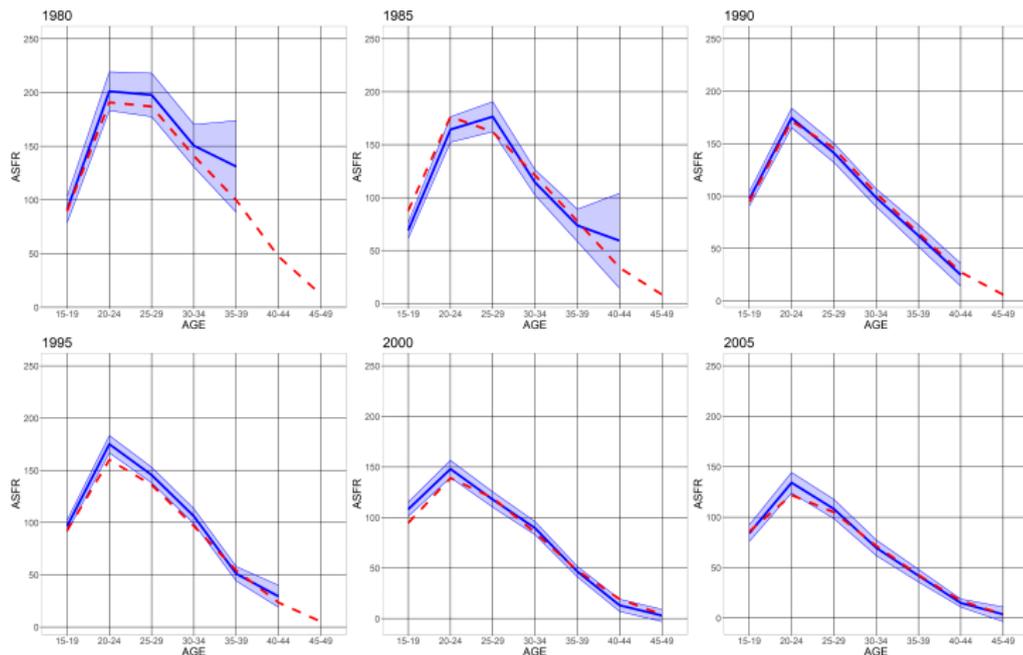


Figure: Age-specific fertility rate variation across time in Senegal

# Comparison with data from the WPP 2022

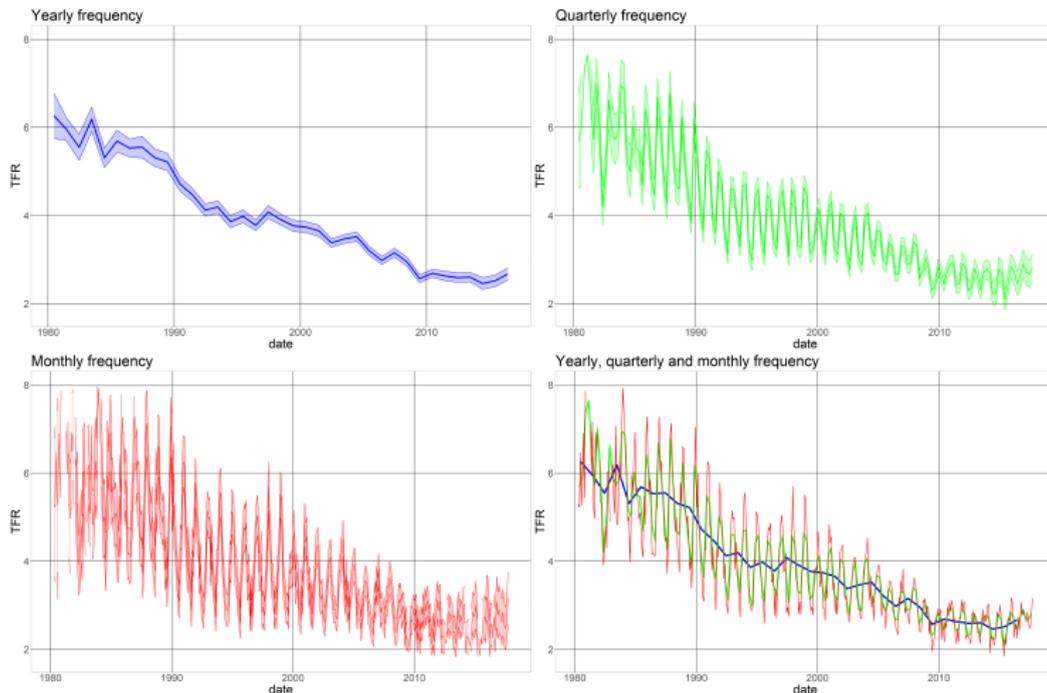
*Estimated age-specific fertility rates compared with WPP in Colombia*



**Figure:** Comparison of our estimates (blue) with estimates from the WPP 2022 (dashed red) in the case of Colombia

# Comparison of data with different frequencies

Yearly, Quarterly and monthly estimate of TFR in Bangladesh



**Figure:** TFR in Bangladesh with yearly (blue), quarterly (green) and monthly (red) frequency

## Which other data to consider?

- ▶ Climate measures with the relevant spatial and temporal granularity:
  - CRU-TS from the Climate Research Unit at the University of East Anglia<sup>1</sup>
  - ERA5<sup>2</sup>
- ▶ Data defining growing and harvesting seasons for a given crop at a given location to assess the mediating effect of agriculture<sup>3</sup> [Sacks et al., 2010]
- ▶ Data on contraceptive use? [United Nations, 2022a]

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<sup>1</sup><https://crudata.uea.ac.uk/cru/data/hrg/>

<sup>2</sup><https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5>

<sup>3</sup><https://sage.nelson.wisc.edu/data-and-models/datasets/crop-calendar-dataset/>

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## Some *limitations* of our approach

- ▶ There is an implicit hypothesis of non migration, or "compensating" migration
  - Estimate also the results restricted on the sample of women that never migrated?
- ▶ With the time lag, some age groups disappear from the data. That would bias considerably the estimate of TFR!
  - But in this case, the standard errors are very large, which reduces the importance of this point in the data with inverse variance weighting
  - It is also perhaps more relevant to just always consider ASFR

# Conclusion

- ▶ We produce a database of different fertility indicators at a national and subnational level in low and middle income countries, with various frequency that is of interest by itself
- ▶ Time frequency as well as the wide scope of the database and its spatial granularity seem to be suitable to bring a complimentary view on the impact of climate change on fertility

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