Extended Abstract - A Glimpse into the Future: The World's Population in 2100 and beyond

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In 2024, KC et al. published the last round of the population and human capital projection component of the Shared Socioeconomic Pathways (SSPs). The updated projections, referred to as WIC2023 (Wittgenstein Center population projections version 3.0), encompass 200 countries, reflecting the 2020 baseline information published by the United Nations (UN) as of July 2022 (WPP2022) (United Nations 2022)[1]. The updated data are available in the Wittgenstein Centre Data Explorer at this link https://dataexplorer.wittgensteincentre.org/wcde-v3/ (beta version) and in Zenodo (v.13). The earlier version of this work, referred to as WIC2013 was published in 2014 (Lutz et al. 2014)[2].

WIC2023 implemented several changes compared to WIC2013, and they are mainly of three sorts:

- Changing the base-year from 2010 to 2020.
- Updating the short-term assumptions (up to 2030) reflecting recent trends.
- Modifying the modeling methodology for fertility, migration, and education: Education-specific fertility levels have been updated with new estimates; education differentials in mortality are now country- and region-specific rather than being normalized to a single level by gender; education-specific migration rates are implemented in the projection model for the first time.

It is interesting to see what the differences for the age, sex and education composition are in 2020 comparing the observed with the estimated data by WIC2023, and secondly what are the implications for the future, according to the five different scenarios (SSP1-5). Africa is the continent where most differences occur.

One main result is that the population in Africa in 2100 would be 3.6 billion compared to 2.6 billion as originally estimated in WIC2013 (Table 1). Such a discrepancy (35%) merits an explanation, especially since no other regions exhibit that high a difference – for instance the difference in Asia between the two projection rounds is 3%.

Table 1: Projection of total population for the world and regions, 2020, 2050 and 2100 (under the medium scenario), according to WIC2013 and WIC2023

Population (in Millions)	2020 WIC2023	2020 WIC2013	2050 WIC2023	2050 WIC2013	2100 WIC2023	2100 WIC2013
World	7805	7639	9594	9174	9885	8991
Africa	1344	1268	2429	2019	3550	2622
Asia	4648	4557	5219	5135	4483	4368
Europe	747	748	725	755	671	703
Latin America	650	651	744	758	669	684
Northern America	373	372	419	447	450	521
Oceania	44	42	56	57	62	67

There are **two** main reasons behind the increasing projected population for Africa in the WIC projections. **Firstly**, the larger starting population, which can be seen by comparing the estimated population in 2020, compared to the projected according to WIC2013 -- 1.344 billion compared to 1.268 billion, a difference of 76 million (6%). There are mostly a mortality and a fertility component to

[1] In the meantime, the UN has published the 2024 update, which was not available at the time of the global projection exercise.

[2] The first update of the SSPs was produced in 2018 (Lutz et al. 2018). However, it was not incorporated into the SSP database in the absence of a general SSP update plan.

that change. Overall, life expectancy at birth (LE0) increased more during 2015-2019 than was projected in WIC2013 as the mortality situation has improved in many countries with high prevalence of HIV/AIDS and child mortality declined in higher mortality countries due to improvements in women's educations, the standard of living, and public health interventions such as antenatal and postnatal care, immunization, skilled birth attendance (Kipp et al. 2016) (see Figure 1).

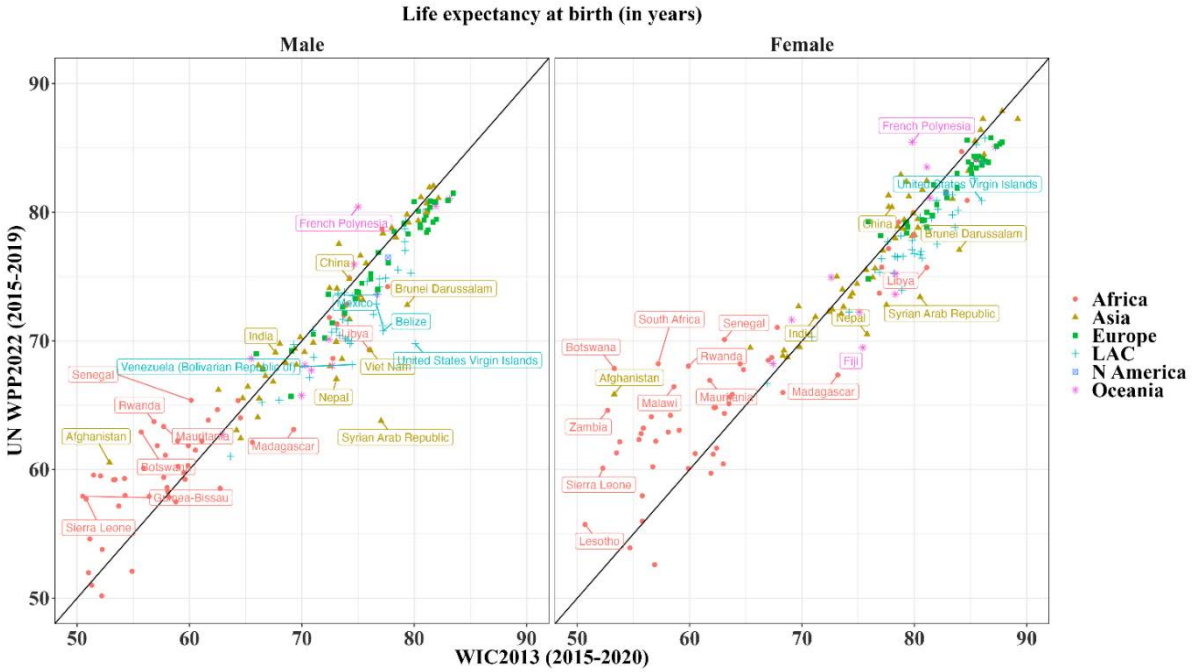

Figure 1: Difference in LE0 between WIC2013 assumptions & WPP2022 estimates for 2015-2020, all countries

Moreover, fertility did not decline as projected in WIC2013 (see data points above the diagonal line in Figure 2), especially in medium- and high-fertility countries, such as in sub-Saharan Africa. The stalls in fertility decline or less rapid fertility decrease than expected happened for multiple reasons that have mainly to do with stalled or slow socioeconomic development (Bongaarts 2020).

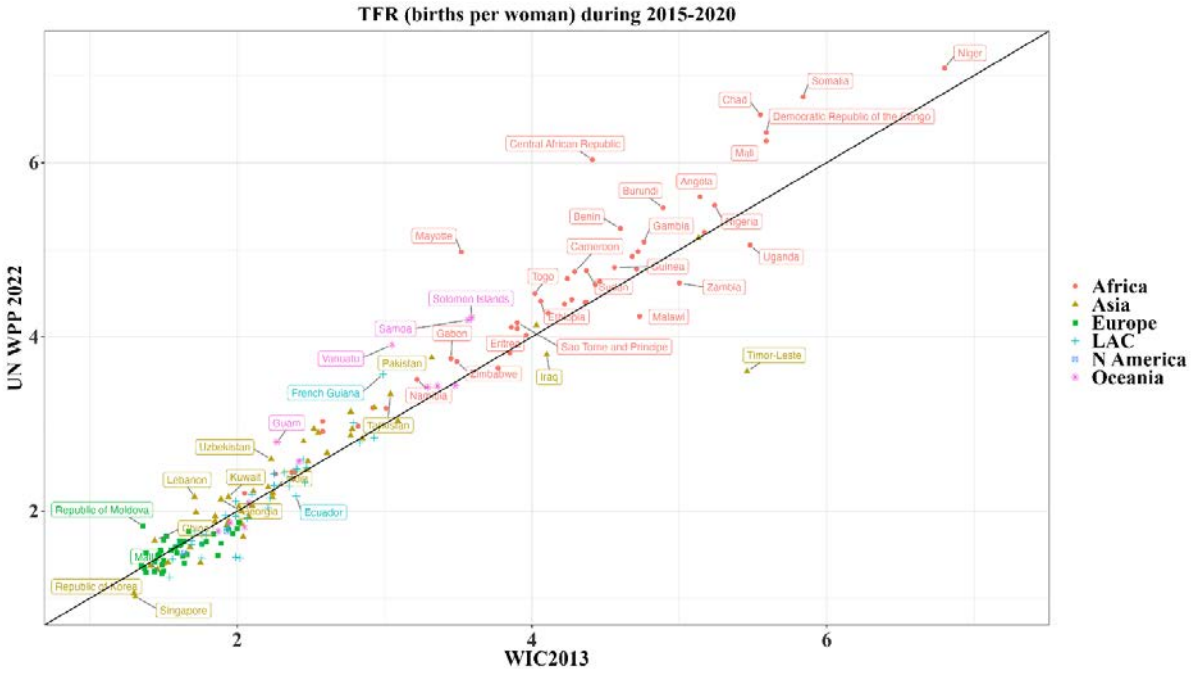

Figure 2: Difference in TFR for 2015-2020, projected in WIC2013 and estimated in WPP2022, all countries

Secondly, and related to the change in the base-year, there are certain changes in the pathways leading to the projected population until 2100. The fastest growing region would be Africa, whose population would not peak in this century, and would continue growing until 2100, reaching considerably higher level than projected in WIC2013 (3.55 compared to 2.62 billion in 2100, hence a 35% difference).

The different SSPs entail different outcomes in terms of educational composition of the population. According to SSP1 and SSP5, the world in 2100 is less populated and composed in a large majority of post-secondary educated individuals, across all ages and sexes. Conversely, SSP3 and to a lesser extent SSP4 lead to a larger populated Africa with lower levels of education. However, according to these scenarios, the progress of the past that have increased the share of population with an upper-secondary and post-secondary education stalls but does not reverse and still under this scenario, more than half of the population would have at least an upper-secondary education or more. There would be more women than men among the 'no education' and 'some primary' categories. SSP2 as the middle of the road scenario leads to a highly educated society by 2100, with large segments of the population having either acquired an upper-secondary or post-secondary education.

The accelerated decrease in child mortality, surpassing initial expectations, and the gradual demographic transition in many low-income countries, particularly in sub-Saharan Africa, are anticipated to result in a greater population growth and a larger absolute population in the year 2100 than previously projected in earlier versions. Population projections, whether in the short or long term, are subject to a spectrum of uncertainties influenced by various factors arising from complex interactions between demographic, social, and economic variables. Changing fertility rates, evolving cultural norms, and advancements in healthcare can contribute to unforeseen shifts in population dynamics over an extended period, with consequence for projection results.

Regular reassessment and adjustments based on evolving data and trends are essential for maintaining the reliability of both short and long-term population projections. In a last step, we extend the projections to 2300 (see Figure 3 with the example of 5 countries), highlighting the long-term consequences of current assumptions and the potential need for refinement in future updates.

References:

Bongaarts, J. 2020. Trends in Fertility and Fertility Preferences in Sub-Saharan Africa: The Roles of Education and Family Planning Programs." Genus 76 (1): 32.

Kipp, A. et al. 2016. Factors Associated with Declining Under-Five Mortality Rates from 2000 to 2013: An Ecological Analysis of 46 African Countries. BMJ Open 6 (1): e007675.

Lutz, W., W.P. Butz, and S. KC (Eds). 2014. World Population and Human Capital in the 21st Century. Oxford, UK: Oxford University Press.

Lutz, W., A. Goujon, S. KC, M. Stonawski, N. Stilianakis (Eds.). 2018. Demographic and Human Capital Scenarios for the 21st Century. Luxembourg: Publications Office of the European Union.

KC et al. 2024. Updating the Shared Socioeconomic Pathways (SSPs) Global Population and Human Capital Projections. IIASA WP xx/2024. Laxenburg, Austria: International Institute for Applied Systems Analysis. DOI:

United Nations. 2022. "World Population Prospects: The 2022 Revision." New York, NY: Department of Economic and Social Affairs, Population Division. http://esa.un.org/unpd/wpp/

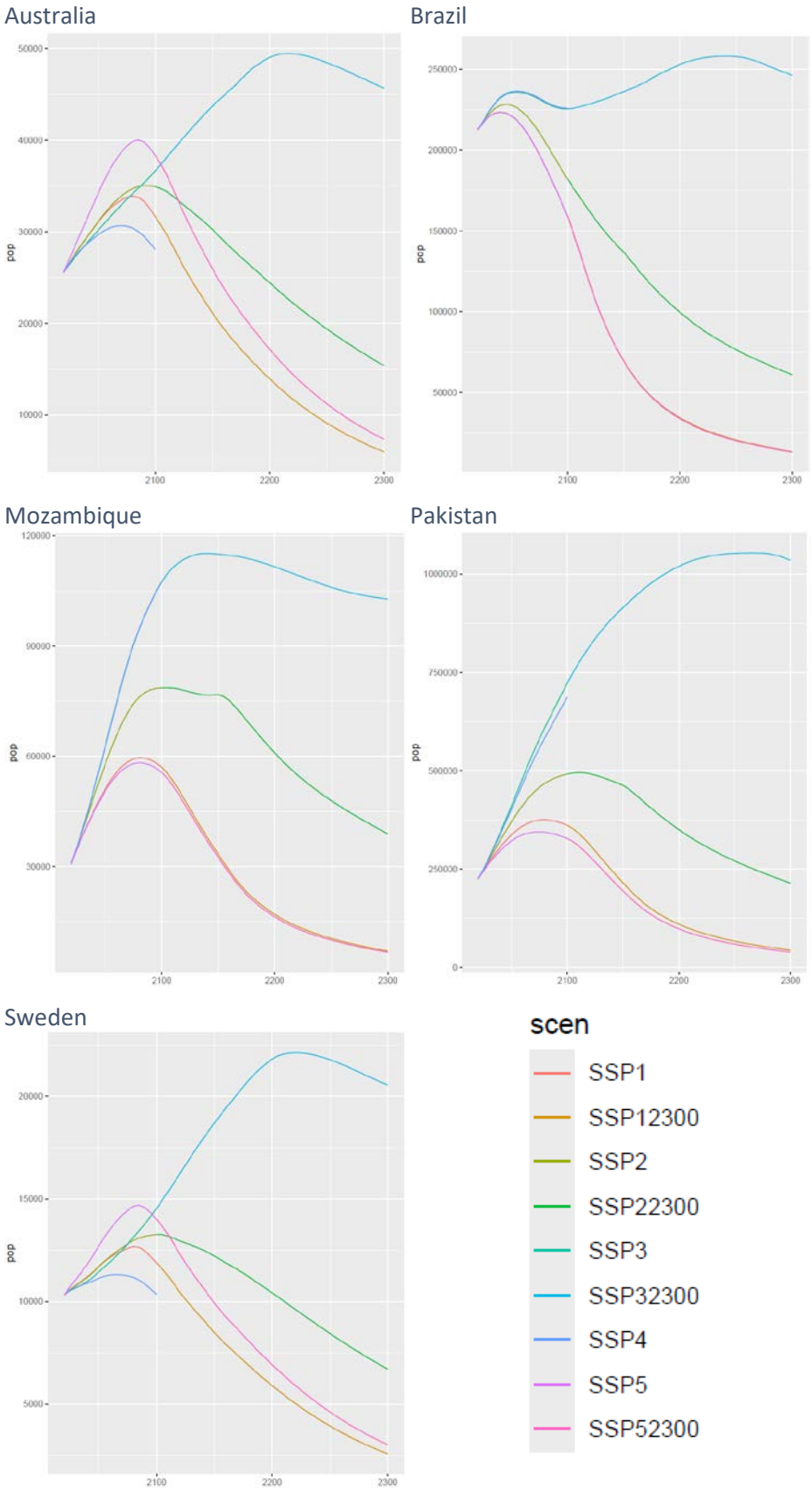

Figure 3: Projected population of 5 countries according to the SSPs until 2100 and extended to 2300 for SSP1, SSP2, SSP3 and SSP5