



## How certain are the United Nations global population projections?

In its 2019 revision of the *World Population Prospects* (WPP), the United Nations projected that the world's population would grow from 7.7 billion in 2019 to reach 8.5 billion in 2030, 9.7 billion in 2050 and 10.9 billion in 2100.<sup>1</sup> These figures are based on the "medium-variant" projection, which assumes a decline in fertility for countries where large families are still prevalent, a slight increase in fertility in several countries where women have fewer than two live births on average over a lifetime, and continued reductions in mortality. Population projections, like any forecast, incorporate assumptions about the future that are subject to some uncertainty. This brief describes the degree and sources of uncertainty around the United Nations global population projections to 2100.

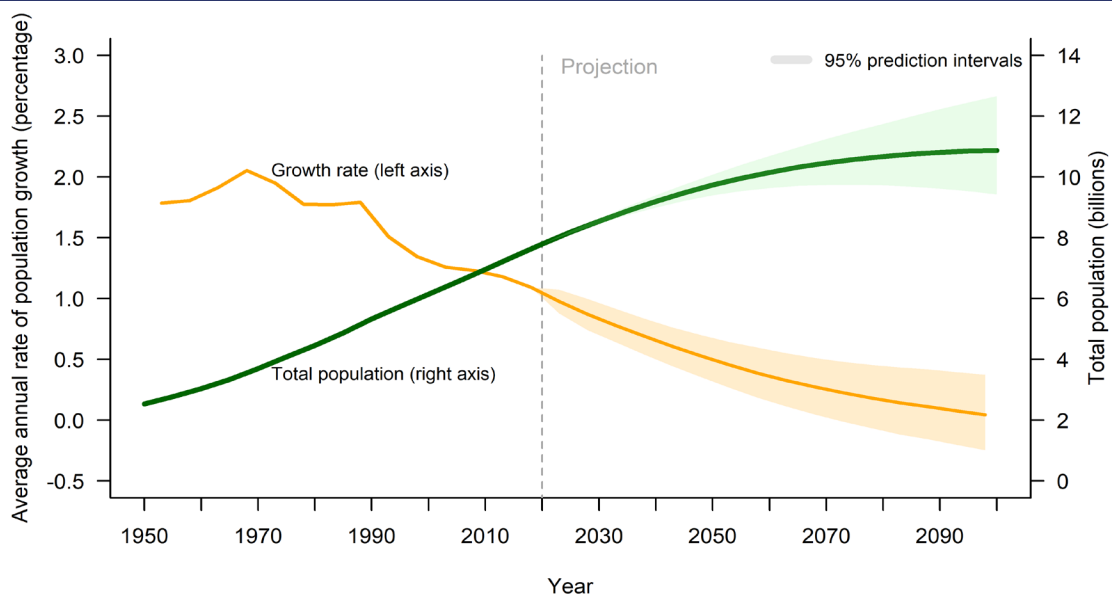
### 1. Future population trends are uncertain, especially over the long run

The future cannot be known with absolute certainty, but recent and historical experience can inform the

assessment of likely outcomes over both short- and long-term horizons. The uncertainty of population projections depends on the range of plausible future trends in the three demographic components of population change: fertility, mortality and international migration. In the WPP, likely trajectories of fertility and mortality have been assessed for each country or area using demographic and statistical methods.<sup>2</sup> This analysis concludes that, with a probability of 95 per cent (referred to hereafter as the 95 per cent prediction interval), the size of the global population will stand between 8.5 and 8.6 billion in 2030, between 9.4 and 10.1 billion in 2050, and between 9.4 and 12.7 billion in 2100 (figure 1; table 1).

Though the population will be increasing, projections point to a slowing rate of population growth through the end of the century. The medium variant anticipates that the rate of population growth will fall from just over 1 per cent annually in 2015-2020 to close to zero around the end of the century. The range of plausible

Figure 1. Population size and annual growth rate for the world: estimates 1950-2020, and medium-variant projection with 95 per cent prediction intervals, 2020-2100



**Table 1. Projected global population in 2030, 2050 and 2100 and average annual births and deaths in 2030-2035, 2050-2055 and 2095-2100, according to the medium-variant projection and 95 per cent prediction intervals (PI)**

	<i>Population (billions)</i>	<i>Births (millions)</i>	<i>Deaths</i>
	<b>2030</b>	<b>2030-2035</b>	
Medium variant projection [95% PI]	8.5 [8.5 - 8.6]	139.6 [126.9 - 152.2]	71.8 [68.2 - 75.1]
PI vs. medium variant (% difference)	-1.0% to +1.0%	-9.1% to +9.0%	-5.1% to +4.6%
	<b>2050</b>	<b>2050-2055</b>	
Medium variant projection [95% PI]	9.7 [9.4 - 10.1]	140.0 [120.6 - 161.2]	95.4 [90.3 - 100.0]
PI vs. medium variant (% difference)	-3.5% to +3.5%	-13.8% to +15.1%	-5.3% to +4.9%
	<b>2100</b>	<b>2095-2100</b>	
Medium variant projection [95% PI]	10.9 [9.4 - 12.7]	125.9 [94.2 - 171.3]	121.2 [115.7 - 127.3]
PI vs. medium variant (% difference)	-13.3% to +16.4%	-25.2% to +36.0%	-4.6% to +5.0%

trajectories indicates that there is roughly a 27 per cent chance that the growth rate could fall to or below zero and the world's population could stabilize or even begin to decrease sometime before 2100.

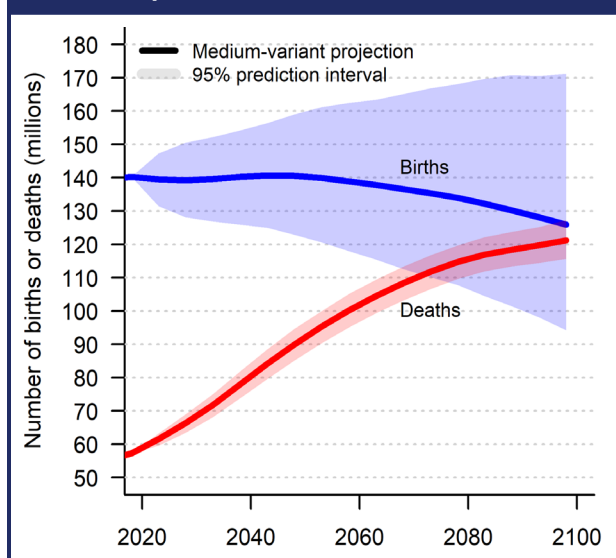
The prediction interval that surrounds the medium variant widens with the length of the projection horizon. The size of the world's population over the near future is relatively certain: more than one half of the people who will be alive in 2050, for example, have already been born. Population size over the longer term is more uncertain, in part because it will depend not only on the number of people alive today and the children they will have, but also on the future fertility levels of those descendants.

**2. Uncertainty around the size of the future population of the world is driven mostly by uncertainty about the projected number of births**

During the present period, there are roughly 140 million babies born each year worldwide. The medium variant expects that the number of births globally will remain fairly constant through the mid-century, declining gradually thereafter to below 126 million annual births by 2100 (figure 2; table 1). The 95 per cent prediction interval around global births widens to approximately  $\pm 9$  per cent of the medium-variant projection by 2030-2035, and further to -14 per cent to +15 per cent of the medium-variant by 2050-2055.<sup>3</sup> These intervals are much wider than the 95 per cent prediction intervals surrounding the number of deaths globally. In 2030-2035 the average annual number of deaths projected in the medium variant, at 71 million, is roughly half the number of births, and the relative width of the 95 per cent prediction interval is narrower, at about  $\pm 5$  per cent.

Whereas the prediction interval around births widens substantially with the length of the projection, the width of the prediction interval on global deaths remains nearly constant through the end of the projection horizon. By 2095-2100, the average annual numbers of births and deaths projected in the medium variant are nearly equal. However, the 95 per cent prediction interval ranges from -25 per cent to +36 per cent around births compared to just  $\pm 5$  per cent around deaths.

**Figure 2. Average annual number of births and deaths in the world: medium-variant projection with 95 per cent prediction intervals, 2020-2100**



### 3. The degree of uncertainty around projected births, deaths and population size varies according to the levels of fertility and mortality in each population

The WPP projections of fertility and mortality are informed by historical data on the demographic transition—the transition from higher to lower levels of fertility and mortality—that has unfolded universally around the world over the past two centuries, albeit with different timing and pace across countries. The contribution of the various countries and regions to future global population size is closely linked to their stage of the demographic transition: mid-transition populations with relatively high levels of fertility contribute more to the projected growth of the world’s population and to the associated uncertainty than post-transition countries with low average levels of fertility.

In 2019, the total population of sub-Saharan Africa, at 1.07 billion, is roughly the same size as the combined populations of Europe and Northern America (1.11 billion in 2019). Despite similar population size, the 36 million births taking place in sub-Saharan Africa each year is three times greater than the 12 million average annual births in Europe and Northern America. This difference highlights the different stages of the demographic transition of the two regions. The transition began more than a century ago in many parts of Europe and Northern America and the average fertility level has since fallen to 1.7 live births

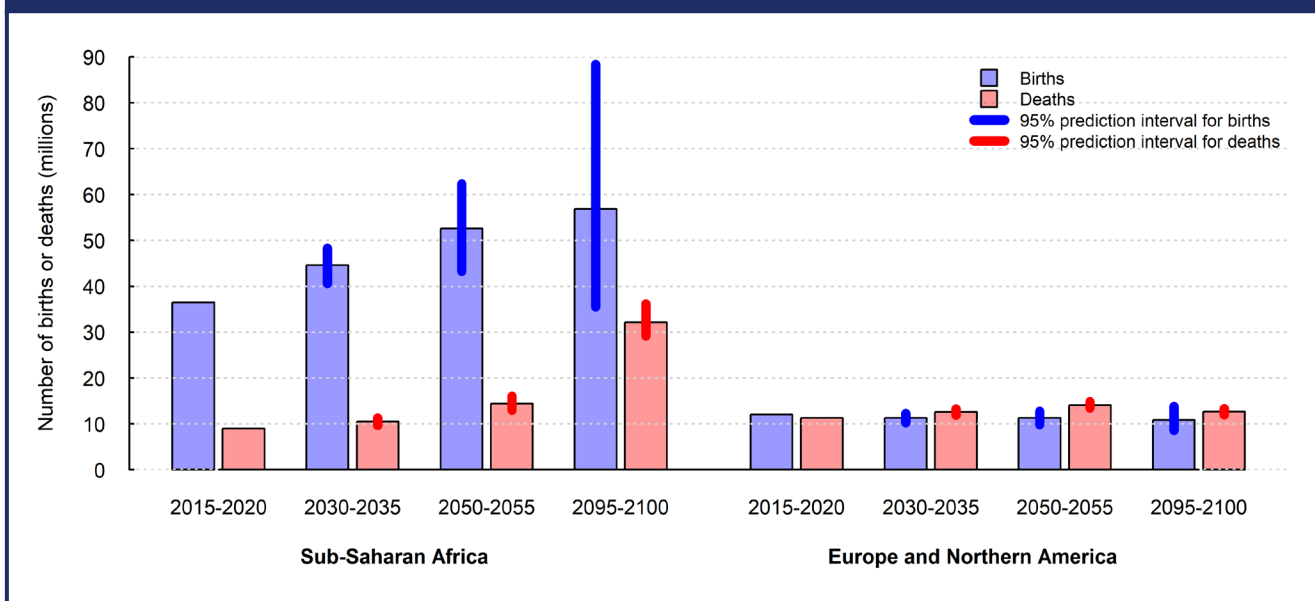
per woman in 2019. By contrast, the transition began more recently in sub-Saharan Africa and while fertility has fallen over recent decades, the average 4.6 live births per woman in 2019 remains much higher than in Europe and Northern America.

The theory of the demographic transition predicts that fertility levels in sub-Saharan Africa will decline further as the region continues to progress along multiple dimensions of economic and human development, including reductions in child mortality, increased levels of education, gender equality and empowerment of women, delayed ages at marriage, expanded access to reproductive health-care services including for family planning, and urbanization, among others. The pace of future fertility decline in the region remains uncertain however and that uncertainty is reflected in the wide prediction intervals around the projected number of births (figure 3). By 2050-2055, the 95 per cent prediction intervals suggest a plausible range in the average annual number of births in sub-Saharan Africa from 43 to 62 million.<sup>5</sup> By the end of the century that interval widens to 36 to 88 million.

The example of sub-Saharan Africa illustrates how the long-term effects of deviations from an expected trajectory of fertility are cumulative: more babies tomorrow mean more parents in the future.

History has shown that once the fertility level falls below an average of two live births per woman, it tends to remain at such low levels. The prediction

**Figure 3. Average annual number of births and deaths in sub-Saharan Africa and Europe and Northern America: estimates 2015-2020, and medium-variant projection with 95 per cent prediction intervals, 2030-2035, 2050-2055 and 2095-2100**



intervals surrounding future births in post-transition populations are thus relatively narrow: the 95 per cent prediction interval around average annual births in Europe and Northern America ranges from 9 to 14 million in 2095-2100. To be sure, there is meaningful uncertainty around future births in low-fertility

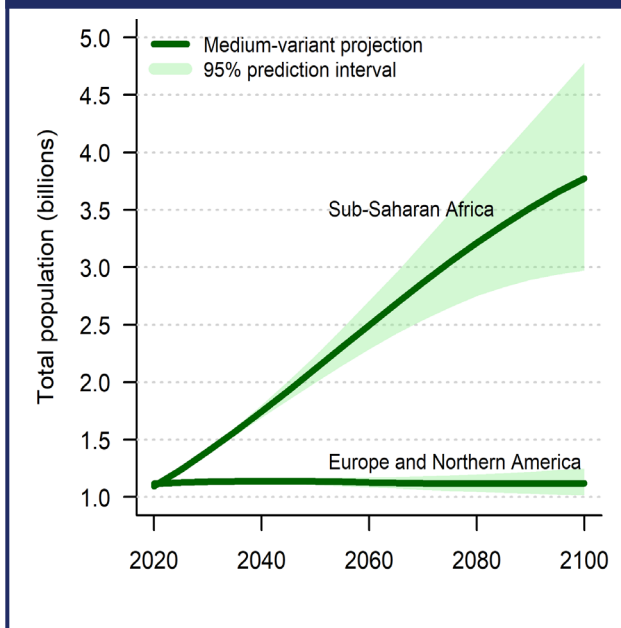
countries, but it is of a smaller magnitude than in mid-transition countries with higher levels of fertility and has a correspondingly lesser impact on the uncertainty around the projected total population size (figure 4).

#### 4. Compared to forecasts of global economic growth, population projections are far more certain

The global population projections presented in the WPP are subject to far less uncertainty than forecasts of other trends relevant for sustainable development. For example, one analysis forecast a 2.2 per cent average annual growth rate for the global gross domestic product over the period 2010-2050, with 80 per cent prediction intervals ranging from 1.2 per cent to 3.3 per cent.<sup>6</sup> This interval amounts to around  $\pm 50$  per cent around the central growth rate projection. By comparison, the medium-variant projection of global population growth over 2010-2050 is 0.84 per cent per year, on average, and the 80 per cent prediction interval is much narrower, ranging from 0.77 to 0.91 per cent, equivalent to just  $\pm 8$  per cent around the medium variant.

The relative certainty of future population trends offers Governments and policymakers opportunities to accurately anticipate coming demographic changes and incorporate that information into planning for sustainable development.

**Figure 4. Population size of sub-Saharan Africa and Europe and Northern America: medium-variant projection with 95 per cent prediction intervals, 2020-2100**



#### Notes

1. Every two years the United Nations Population Division releases its *World Population Prospects*, a comprehensive set of demographic data that describe population trends at the global, regional and national levels. The 2019 revision presents population estimates from 1950 until the present for 235 countries or areas, as well as population projections to the year 2100 that reflect a range of plausible outcomes. United Nations (2019). *World Population Prospects 2019*. <https://population.un.org/wpp/>.
2. United Nations (2019). *World Population Prospects 2019, Methodology of the United Nations Population Estimates and Projections*.
3. The asymmetry in the width of the prediction interval around the median that emerges in the longer-range projections of births reflects the greater cumulative uncertainty around higher fertility levels.
4. Uncertainty around future patterns of international migration contributes to the overall uncertainty of population projections as well. The effect is negligible at the global level, but for some countries and regions with large or fluctuating levels and trends in net international migration, the consequent additional uncertainty in future population size could be considerable. The degree of uncertainty associated with assumptions about the future levels and trends of net international migration is not reflected in the prediction intervals described in this brief.
5. Fertility levels well above an average of two births per woman have produced progressively larger cohorts of children in sub-Saharan Africa. These children grow up and become parents themselves, ensuring that the number of births continues to increase even as the level of fertility, as described by the average number of live births per woman, continues to decline.
6. Christensen P, K. Gillingham and W. Nordhaus (2018). Uncertainty in forecasts of long-run economic growth. *Proceedings of the National Academy of Sciences*, vol. 115, No. 21, pp. 5409-5414; DOI: 10.1073/pnas.1713628115.



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