

EXECUTIVE SUMMARY

The *2002 Revision* is the eighteenth round of official United Nations population estimates and projections prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. These are used throughout the United Nations system as the basis for activities requiring population information.

The *2002 Revision* of the official United Nations population estimates and projections breaks new ground in terms of the assumptions made on future human fertility and the impact of the HIV/AIDS epidemic. For the first time, the United Nations Population Division projects that future fertility levels in the majority of developing countries will likely fall below 2.1 children per woman, the level needed to ensure the long-term replacement of the population, at some point in the twenty-first century. By 2050, the medium variant of the *2002 Revision* projects that 3 out of every 4 countries in the less developed regions will be experiencing below-replacement fertility.

This change in assumptions represents the third and final phase in a process of assessment of future trends in fertility. In 1997 the Population Division convened a meeting of experts to review the guidelines for the projection of fertility in countries with below-replacement fertility.¹ As a result of the deliberations of that meeting the fertility of low-fertility countries was maintained below replacement level during the whole projection period in the *1998 Revision*. In 2001, a similar meeting of experts was convened to discuss prospects for countries where fertility had not yet begun to decline or where fertility declines were incipient.² Already the *2000 Revision* projected that fertility in those countries would decline more slowly than in the *1998 Revision* and their pace of fertility decline is not projected to be much faster in the *2002 Revision*. Lastly, in 2002 a meeting of experts discussed guidelines on how to project the future fertility of intermediate-fertility countries, that is, those that had already experienced significant fertility decline but had not yet reached levels of fertility below replacement.³ The projections of fertility in the *2002 Revision* reflect the conclusions reached at that meeting.

A second important change in the *2002 Revision* is that it anticipates a more serious and prolonged impact of the HIV/AIDS epidemic in the most affected countries than previous revisions. The impact of the disease is explicitly modelled for 53 countries, up from the 45 considered in the *2000 Revision*. The dynamics of the epidemic are assumed to remain unchanged until 2010. Thereafter prevalence levels are assumed to decline in a manner consistent with modifications of behaviour that reduce the rates of recruitment into the high risk group as well as the chances of infection among those engaging in high risk behaviour. The resulting HIV prevalence levels remain relatively high until 2010 and then decline, but are still substantial by mid-century.

As a consequence of these changes, the *2002 Revision* projects a lower population in 2050 than the *2000 Revision* did: 8.9 billion instead of 9.3 billion according to the medium variant. About half of the 0.4 billion difference in these projected populations results from an increase in the number of projected deaths, the majority stemming from higher projected levels of HIV

¹ Below Replacement Fertility, *Population Bulletin of the United Nations*, Special Issue Nos. 40/41, 1999 (United Nations, 2000).

² United Nations Workshop on Prospects for Fertility Decline in High Fertility Countries, New York, 9-11 July 2001 (United Nations, ESA/P/WP.167).

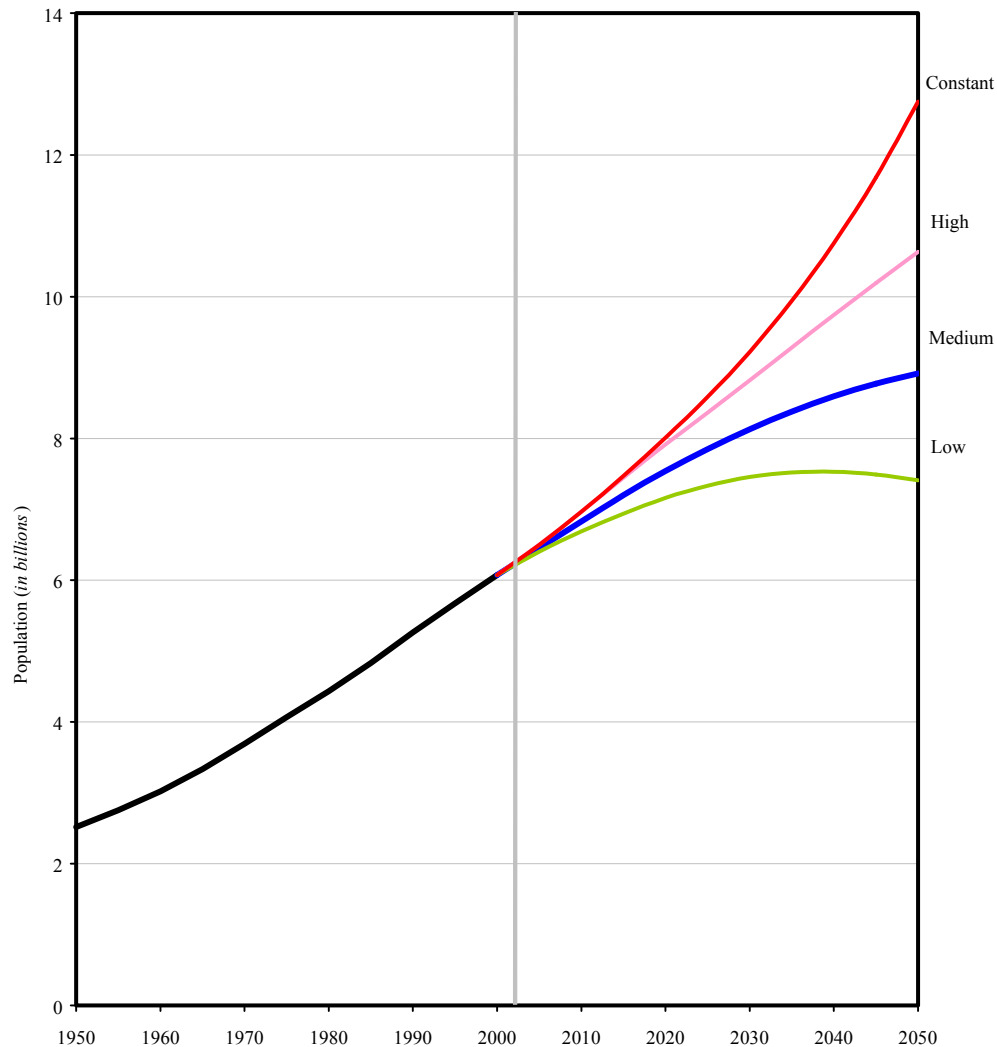
³ Completing the Fertility Transition (United Nations, ESA/P/WP.1/Rev.1).

prevalence. The other half of the difference reflects a reduction in the projected number of births, primarily as a result of lower expected future fertility levels.

The results of the *2002 Revision* confirm key conclusions from previous revisions and provide new insights into the sensitivity of population projections to future trends in fertility and mortality. The main findings of the *2002 Revision* are summarized below.

1. Despite the lower fertility levels projected and the increased mortality risks to which some populations will be subject, the population of the world is expected to increase by 2.6 billion during the next 47 years, from 6.3 billion today to 8.9 billion in 2050. However, the realization of these projections is contingent on ensuring that couples have access to family planning and that efforts to arrest the current spread of the HIV/AIDS epidemic are successful in reducing its growth momentum. The potential for considerable population increase remains high. According to the results of the *2002 Revision*, if fertility were to remain constant in all countries at current levels, the total population of the globe could more than double by 2050, reaching 12.8 billion. Even a somewhat slower reduction of fertility than that projected in the medium variant would result in additional billions of people. Thus, if women were to have, on average, about half a child more than according to the medium variant, world population might rise to 10.6 billion in 2050 as projected in the high variant. The low variant, where women have, on average, half a child less than in the medium variant, would result in a 2050 population of 7.4 billion (see figure on following page).
2. World population is currently growing at a rate of 1.2 per cent annually, implying a net addition of 77 million people per year. Six countries account for half of that annual increment: India for 21 per cent; China for 12 per cent; Pakistan for 5 per cent; Bangladesh, Nigeria and the United States of America for 4 per cent each.
3. The increasing diversity of population dynamics among the countries and regions of the world is evident in the results of the *2002 Revision*. Whereas today the population of the more developed regions of the world is rising at an annual rate of 0.25 per cent, that of the less developed regions is increasing nearly six times as fast, at 1.46 per cent, and the subset of the 49 least developed countries is experiencing even more rapid population growth (2.4 per cent per year). Such differences, although somewhat dampened, will persist until 2050. By that time, the population of the more developed regions will have been declining for 20 years, whereas the population of the less developed regions will still be rising at an annual rate of 0.4 per cent. More importantly, the population of the least developed countries will likely be rising at a robust annual rate of over 1.2 per cent in 2045-2050.
4. As a result of these trends, the population of more developed regions, currently at 1.2 billion, is anticipated to change little during the next 50 years. In addition, because fertility levels for most of the developed countries are expected to remain below replacement level during 2000-2050, the populations of 30 developed countries are projected to be smaller by mid-century than today (e.g., 14 per cent smaller in Japan; 22 per cent smaller in Italy, and between 30 and 50 per cent smaller in the cases of Bulgaria, Estonia, Georgia, Latvia, the Russian Federation and Ukraine).

**Estimated and projected population of the world by
projection variant, 1950-2050**



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2003). *World Population Prospects: The 2002 Revision. Highlights*. New York: United Nations.

5. The population of the less developed regions is projected to rise steadily from 4.9 billion in 2000 to 7.7 billion in 2050 (medium variant). Particularly rapid growth is expected among the least developed countries whose population is projected to rise from 668 million to 1.7 billion despite the fact that their fertility is projected to decline markedly in the future (from 5.1 children per woman today to 2.5 children per woman in 2045-2050). With sustained annual growth rates higher than 2.5 per cent between 2000 and 2050, the populations of Burkina Faso, Mali, Niger, Somalia, Uganda and Yemen are projected to quadruple, passing from 85 million to 369 million in total.
6. Large population increments are expected among the most populous countries even if their fertility levels are projected to be low. Thus, during 2000-2050, eight countries

- (India, Pakistan, Nigeria, the United States of America, China, Bangladesh, Ethiopia and the Democratic Republic of Congo, in order of population increment) are expected to account for half of the world's projected population increase.
7. The past 50 years witnessed a remarkable reduction of fertility levels in the less developed regions, with total fertility falling from 6 to 3 children per woman. Over the next 50 years, fertility in the less developed regions is expected to reach replacement level in 2030-2035 and fall below it thereafter. However, average fertility in the less developed regions as a whole is still expected to be slightly above 2 children per woman in 2045-2050, mainly because of the increasing heterogeneity of population dynamics among developing countries. Thus, the 49 least developed countries are expected to have a total fertility of 2.5 children per woman in 2045-2050, well above replacement level. That is, the *2002 Revision* foresees that by mid-century there will still be a significant number of countries where the transition to below-replacement fertility will not be completed.
 8. Increasing diversity is also evident with respect to future mortality levels. At the world level, life expectancy at birth is likely to rise from 65 years today to 74 years in 2045-2050. But whereas more developed regions, whose life expectancy today is estimated at 76 years, will see it rise to 82 years, that of less developed regions will remain considerably below, reaching 73 years by mid-century (up from 63 years today). In the group of least developed countries, many of which are highly affected by the HIV/AIDS epidemic, life expectancy today is still below 50 years and is not expected to exceed 67 years by 2050. So, although the gap in life expectancy between the different groups of countries is expected to narrow, major differences in the probabilities of survival will remain evident by mid-century.
 9. The *2002 Revision* indicates a worsening of the impact of the HIV/AIDS epidemic in terms of increased morbidity, mortality and population loss. Although the probability of being infected by HIV is assumed to decline significantly in the future (particularly after 2010), the long-term impact of the epidemic remains dire. Over the current decade, the number of excess deaths because of AIDS among the 53 most affected countries is estimated at 46 million and that figure is projected to ascend to 278 million by 2050. Despite the devastating impact of the HIV/AIDS epidemic, the populations of the affected countries are generally expected to be larger by mid-century than today, mainly because most of them maintain high to moderate fertility levels. However, for the seven most affected countries in Southern Africa, where current HIV prevalence is above 20 per cent, the population is projected to increase only slightly, from 74 million in 2000 to 78 million in 2050, and outright reductions in population are projected for Botswana, Lesotho, South Africa and Swaziland.
 10. The deeper reductions of fertility projected in the *2002 Revision* result in a faster ageing of the population of developing countries than in previous revisions. Globally, the number of older persons (60 years or over) will nearly triple, increasing from 606 million in 2000 to nearly 1.9 billion by 2050. Whereas 6 of every 10 of those older persons live today in less developed regions, by 2050, 8 of every 10 will do so. An even more marked increase is expected in the number of the oldest-old (80 years or over) at the global level: from 69 million in 2000 to 377 million in 2050. In less developed regions, the rise will be from 32 million to 265 million, again implying that most oldest old will live in less developed countries by 2050.

11. In more developed regions, the population aged 60 or over currently constitutes 19 per cent of the population; by 2050 it will account for 32 per cent of the population. The elderly population in more developed regions has already surpassed the child population (persons aged 0-14) and by 2050 there will be 2 elderly persons for every child. In the less developed regions, the proportion of the population aged 60 or over will rise from 8 per cent in 2000 to close to 20 per cent in 2050.
12. Increases in the median age, the age at which 50 per cent of the population is older and 50 per cent is younger than that age, reflect the ageing of the population. At the world level, the median age rose by scarcely three years between 1950 and 2000, from 23.6 years to 26.4 years, largely because most populations in less developed countries remained young. Over the next 50 years, however, the world's median age will rise by nearly 10 years, to reach 37 years in 2050. Among developed countries, 13 are expected to have a median age of 50 years or more, with Japan, Latvia and Slovenia (each with a median age of about 53 years), and the Czech Republic, Estonia, Italy and Spain (each with a median age of about 52 years) leading the list. In addition, three developing countries (Armenia, the Republic of Korea and Singapore) will also be in that group. At the other end of the spectrum, Angola, Burkina Faso, Mali, Niger, Somalia, Uganda and Yemen expect to have still young populations, with median ages lower than 23 years in 2050.
13. International migration is projected to remain high during the first half of the century. The more developed regions are expected to remain net receivers of international migrants, with an average gain of about 2 million migrants per year over the next 50 years. Averaged over the 2000-2050 period, the main net gainers of international migrants are projected to be the United States (1.1 million annual net migrants), Germany (211 thousand), Canada (173 thousand), the United Kingdom (136 thousand) and Australia (83 thousand), whereas the major net senders are projected to be China (-303 thousand annual net number of migrants), Mexico, (-267 thousand), India (-222 thousand), the Philippines (-184 thousand) and Indonesia (-180 thousand).

ASSUMPTIONS UNDERLYING THE 2002 REVISION

The *2002 Revision* includes six projection variants. Four differ among themselves with respect to the assumptions made regarding the future course of fertility. The fifth differs with respect to the assumptions made about the future course of mortality, and the sixth differs with respect to the future course of migration.

To describe the different projection variants, the various assumptions made regarding fertility, mortality and international migration are described first.

A. Fertility assumptions

Fertility assumptions are described in terms of the following groups of countries:

1. *High-fertility countries*: Countries that until 2000 had had no fertility reduction or only an incipient decline;
2. *Medium-fertility countries*: Countries where fertility has been declining but whose level was still above 2.1 children per woman in 1995-2000;
3. *Low-fertility countries*: Countries with total fertility at or below 2.1 children per woman in 1995-2000.

Medium-fertility assumptions:

1. Total fertility in high-fertility and medium-fertility countries is assumed to decline following a path derived from models of fertility decline established by the United Nations Population Division on the basis of the past experience of all countries with declining fertility during 1950-2000. The models relate the level of total fertility during a period to the average expected decline in total fertility during the next period. Under the medium variant, whenever the total fertility projected by a model falls below 1.85 children per woman, the value actually used in projecting the population is set to 1.85. That is, 1.85 children per woman represents a floor value below which the total fertility of high and medium-fertility countries is not allowed to drop before 2050. However, it is not necessary for all countries to reach the floor value by 2050. If the model of fertility change used produces a total fertility above 1.85 children per woman for 2045-2050, that value is used in projecting the population.
2. Total fertility in low-fertility countries is generally assumed to remain below 2.1 children per woman during most of the projection period and reach 1.85 children per woman by 2045-2050. For low-fertility countries whose total fertility in 1995-2000 is estimated to be below 1.85 children per woman, projected total fertility often declines further before increasing slowly to reach 1.85 in 2045-2050.

High-fertility assumptions:

Under the high variant, total fertility is projected to remain 0.5 children above the total fertility in the medium variant over most of the projection period. By 2045-2050, total fertility in the high variant is therefore half a child higher than that of the medium variant. That is, countries reaching a total fertility of 1.85 children per woman in the medium variant have a total fertility of 2.35 children per woman in the high variant at the end of the projection period.

Low-fertility assumptions:

Under the low variant, total fertility is projected to remain 0.5 children below the total fertility in the medium variant over most of the projection period. By 2045-2050, total fertility in the low variant is therefore half a child lower than that of the medium variant. That is, countries reaching a total fertility of 1.85 children per woman in the medium variant have a total fertility of 1.35 children per woman in the low variant at the end of the projection period.

Constant-fertility assumption:

For each country, total fertility remains constant at the level estimated for 1995-2000.

B. Mortality assumptions

Normal-mortality assumption:

Mortality is projected on the basis of the models of change of life expectancy produced by the United Nations Population Division. A medium pace of mortality decline is generally used to project future mortality levels. However, for countries highly affected by the HIV/AIDS epidemic, the slow pace of mortality decline has generally been used to project the reduction of general mortality risks not related to HIV/AIDS.

In addition, for the countries highly affected by the HIV/AIDS epidemic, estimates of the impact of HIV/AIDS are made explicitly through assumptions about the future course of the epidemic—that is, by projecting the yearly incidence of HIV infection. The model developed by the UNAIDS Reference Group on Estimates, Modelling and Projections⁴ has been used to fit past HIV prevalence estimates obtained from UNAIDS so as to derive the parameters determining the past dynamics of the epidemic. For most countries, the model is fitted assuming that the relevant parameters have remained constant in the past. For projection purposes, the parameters are kept constant until 2010. Thereafter, the parameter PHI, which reflects the rate of recruitment of new individuals into the high-risk or susceptible group, is projected to decline by a third over intervals of increasing length. In addition, the parameter R, which represents the force of infection, is projected to decline by 15 per cent over the same intervals. A reduction in R is based on the assumption that changes in behaviour among those subject to the risk of infection will reduce the chances of transmitting the virus.

⁴ Improved methods and assumptions for estimation of the HIV/AIDS epidemic and its impact: Recommendations of the UNAIDS Reference Group on Estimates, Modelling and Projections. *AIDS*, vol. 16, pp. W1-W14 (UNAIDS Reference Group on Estimates, Modelling and Projections, 2002).

Constant-mortality assumption:

For each country, mortality remains constant at the level estimated in 1995-2000.

C. International migration assumptions

Normal-migration assumption:

The future path of international migration is set on the basis of past international migration estimates and an assessment of the policy stance of countries with regard to future international migration flows.

Zero-migration assumption:

For each country, international migration is set to zero for the period 2000-2050.

The table below presents in a schematic way the different assumptions underlying the six projection variants. As shown, the four fertility variants (low, medium, high and constant-fertility) share the same assumptions regarding mortality and international migration. They differ among themselves only with respect to the assumptions regarding fertility. A comparison of their results allows therefore an assessment of the effects that different fertility paths have on other demographic parameters.

In addition to the four fertility variants, a constant-mortality variant and a zero-migration variant have also been prepared. They both have the same fertility assumption (i.e. the medium fertility). Furthermore, the constant-mortality variant has the same international migration assumption as the medium variant. Consequently, the results of the constant-mortality variant can be compared with those of the medium variant to assess the effect that changing mortality has on other demographic parameters. Similarly, the zero-migration variant differs from the medium variant only with respect to the underlying assumption regarding migration. Therefore, the zero-migration variant allows an assessment of the effect that non-zero migration has on other demographic parameters.

PROJECTION VARIANTS IN TERMS OF ASSUMPTIONS FOR FERTILITY, MORTALITY
AND INTERNATIONAL MIGRATION

<i>Projection variant</i>	<i>Assumptions</i>		
	<i>Fertility</i>	<i>Mortality</i>	<i>International migration</i>
Low	Low	Normal	Normal
Medium	Medium	Normal	Normal
High	High	Normal	Normal
Constant-fertility	Constant	Normal	Normal
Constant-mortality	Medium	Constant	Normal
Zero-migration	Medium	Normal	Zero

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2003). *World Population Prospects: The 2002 Revision. Highlights*. New York: United Nations.

Summary of the methodological changes made for the 2002 Revision

The following changes and adjustments were made in the *2002 Revision* in relation to procedures followed in the *2000 Revision*:

1. In the medium variant, the future fertility paths for countries with total fertility above 2.1 children per woman are projected using models derived from the past experience of all countries where fertility has already declined.
2. Countries with current total fertility above 2.1 children per woman are no longer constrained to stop their future fertility decline at 2.1 children per woman. Instead, their fertility levels can continue to decline until they reach 1.85 children per woman, the floor value below which total fertility is not allowed to fall in the medium variant. As in the *2000 Revision*, not all countries need to reach either a total fertility of 2.1 or 1.85 children per woman during the projection period in the medium variant.
3. The total fertility of all low-fertility countries is assumed to converge to 1.85 children per woman by the end of the projection period instead of reaching different target values as in the *2000 Revision*.
4. For all countries, total fertility in the high and low variants is projected to be 0.5 children above and 0.5 children below, respectively, from the total fertility of the medium variant. In the *2000 Revision*, a difference of 0.4 of a child was used in the case of low-fertility countries.
5. The estimation and projection of the impact of HIV/AIDS was modified to incorporate the model developed by the UNAIDS Reference Group on Estimates, Modelling and Projections. Use of the new model allows the formulation of projection hypotheses on the basis of parameters that are meaningful with respect to the dynamics of the epidemic.