Demographic projections of Africa's population for the period 2000–2050 taking account of HIV/AIDS and its implications for development

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ABSTRACT

Concerns about Africa's population in the next 30 to 50 years have been mooted in political circles. There is speculation as to whether Africa would become the most heavily populated continent, exceeding the populations of India and China. This study projects Africa's population by main geographical region, taking into account the impact of HIV/AIDS, and draws attention to the implications of the projections. The results indicate Africa's population increasing to 1.7 billion by 2050, with increases in the size of the school-going population, the labour market as well as the elderly population. By 2050, it is projected that the population of Africa would make up 22% of the world's population and would represent 39% of the population of Asia.

Key words: population, Africa, HIV, AIDS, development

INTRODUCTION

Using internationally recognised indicators of development, Africa is often depicted as a region with huge challenges regarding socio-economic development. For example, the bottom 20 countries in the United Nations' Human Development Index in 2006 (UNDP 2006) were African countries. Sub-Saharan Africa's human development score (0.472) in 2006 was lower than that of South Asia (0.599).

The relationship between population factors and socio-economic development has been well researched (see, for example, Tabah 1971; Cantrelle, Bahri, Blanc, Brass, De Graft-Johnson, Greig, Tabah & Remiche 1974) and is recognised by governments,

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international agencies and non-governmental organisations. According to the Copenhagen Declaration and Programme of Action of the World Summit for Social Development: "There is general agreement that persistent widespread poverty, as well as serious social and gender inequalities, have significant influences on and are in turn influenced by demographic parameters, such as population growth, structure and distribution" (UN 1995).

The size of Africa's population, estimated at approximately 905.9 million, constituted about 14% of the world's total population of 6.5 billion in 2005. The annual rate of population growth, estimated by the United Nations (UN) as 2.2% during the period 2000–2005, was higher than that of North America (1%), Asia (1.3%) and Europe (-0.1%) during the same period. There are concerns within certain sections of African governments about the future demographic status of the African continent in the next 30 to 50 years that raise some questions: Will Africa be the most heavily populated continent, with its population exceeding that of India and China? How would population factors impact on realising the Millennium Development Goals in Africa? The perceived demographic impact of the HIV/AIDS epidemic poses additional challenges to development on the African continent, and in the context of globalisation, there is unease as to whether or not Africa will command international attention, and whether or not Africa will still be a marginalised continent. To address some of these concerns, this author was requested by an African government department to quantify the demographic aspects of these questions independent of UN projections.

OBJECTIVES

While this study does not speculate on the policy, political or ideological aspects of these questions, it projects Africa's population from 2007 to 2050, taking into account HIV/AIDS, and examines the demographic aspects of these projections so as to provide the context in which policy-makers can consider the policy, political and ideological aspects of the questions raised. The study also draws attention to the implications of the demographic aspects of the projections for development.

DEFINITIONS OF REGIONS

The African regions referred to in this study are as defined by the UN (2006) and comprise the following countries:

- *Southern Africa*: Botswana, Lesotho, Namibia, South Africa, Swaziland

- *Eastern Africa*: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Reunion, Rwanda, Seychelles, Somalia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
- *Middle (Central) Africa*: Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, São Tomé and Principe
- *Northern Africa*: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, Tunisia, Western Sahara
- *Western Africa*: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, St Helena, Senegal, Sierra Leone, Togo.

DATA SOURCES

Series of demographic data (including population size, fertility, mortality and net migration) pertaining to every country of the world are available from international databases including those of the United Nations (UN), the Population Reference Bureau, the US Census Bureau, and the World Health Organisation. For comparison across countries and major regions of the world, the UN applies standard demographic techniques to the available data to estimate the population size of each country as well as other demographic parameters at certain given points in time (UN 2006).

The sources of data for the projections presented here are the historical data from these databases on the components of population change (namely, fertility, mortality and net migration) as well as the base population pertaining to the major regions of Africa up until 1995. A departure in this study from the figures in the international databases is the post-1995 demographic data, for several reasons, as will be explained.

Standard demographic techniques, including population projections, often require the use of model life tables. Two types of model life tables usually used in this context are the Coale-Demeny Regional and the UN model life tables for developing countries. However, these life tables are inappropriate in the context of HIV/AIDS, for several reasons:

- They did not take into account the African experience (except in the case of the UN model life tables where, of all the African countries, only Tunisia's experience was taken into account).
- They were developed prior to the onset of the HIV epidemic.

While the Coale-Demeny Regional model life tables were based on European mortality experience spanning the period 1871–1953, those of the UN were based

on the mortality experience of Middle Africa, Temperate South America, Tropical South America, East Asia, South Asia, Western South Asia and Tunisia, spanning the period 1920–1976 (Coale & Demeny 1983; UN 1982).

The mortality schedules depicted by these model life tables do not depict the characteristic 'hump' in the mortality curve at young adult ages (due to increased AIDS-attributable deaths in these age groups), as have been observed in many parts of Western, Eastern and Southern Africa (see Udjo 2008).

In view of this (and given that the first HIV cases in Africa were diagnosed in the early 1980s and that the incubation period of the virus is about 9–10 years on average for adults in African countries known to have high HIV prevalence), this study treated as suspect any estimates of demographic parameters post 1995, as contained in international databases, and such estimates were therefore not used in this study. However, the estimates prior to 1995 were treated as reliable. This is premised on the assumption that the HIV/AIDS impacts probably became substantial after 1995 in populations with a generalised epidemic and that current methodologies of estimating its impact on demographic parameters may be questionable on the grounds of the life tables used in the estimates. In order to incorporate HIV/AIDS in the projections from 1995 onwards, a model life table that incorporates HIV/AIDS was used, as explained in the next section.

METHODS

A 'bottom-up' approach may be utilised in population projections (in other words, projecting from smaller areas to a larger area) based on the argument that the components of population change (such as fertility, mortality and net migration) should be context-specific. If that argument were pursued logically, it would imply that since fertility and mortality are known to vary among socio-economic, racial or ethnic groups within a country, projections should start from the level where fertility and mortality are established to be homogeneous in the population. Apart from the difficulty of establishing such strictly homogeneous groupings with respect to fertility and mortality, Udjo (1999) has cautioned that such an approach may produce (and often does produce) inconsistent results from independent larger area projections, since data at lower levels of disaggregation may be of poorer quality than larger area data.

In this regard, outlining some general principles in population estimates, Shryock, Siegel and Associates (1976) have noted that, "In general, more direct data, data of better quality, and more information … are available for the larger areas, particularly for entire countries … than for smaller areas. … It is usually advisable, therefore, to adjust estimates of geographic subareas to agree with an independently estimated

area total." In view of this, a compromise approach was adopted in the present study by identifying large geographical areas of 'reasonable homogeneity' with regard to the main drivers of population change, while recognising that within these larger areas there would be some element of heterogeneity in fertility, mortality and net migration.

Although the factors that determine each of the components of population change are complex, the usual approach is to analyse past trends in the components of change in the larger (geographical) areas to enable assumptions to be made about the future on the basis of the past trends. The results presented in this study are projections – which analyse the implications of a certain set of demographic parameters for population size, composition and growth (Preston, Heuveline & Guillot 2001) – rather than population forecasts, which are population projections that are considered to yield a realistic picture of the probable future development of a population (UN 1958: 45). The quality of projections is determined by their internal validity, while the accuracy of population forecasts can only be evaluated *ex post* (Preston et al. 2001).

Mathematical or cohort component methods are used for population projections depending on the available data. Although the cohort component method is the preferred approach (because mathematical methods often yield unreliable results if the projection period exceeds ten years), it requires far more data than mathematical methods. The cohort component method entails projecting separately the components of population change, namely mortality, fertility and net migration (Shryock, Siegel and Associates 1976). In populations where HIV/AIDS prevalence is high, the mortality component is projected to include the impact of HIV/AIDS. This study utilised the cohort component method, as will be described.

Assumed survival ratios derived from a life table were applied to the age-sex distributions of the population at a given time t to estimate the number of survivors at time $t+n$, taking into account the impact of HIV/AIDS. Assumed age-specific fertility rates during the period t, $t+n$ were then applied to the projected number of women in the reproductive age group during the period t, $t+n$ to estimate the number of persons by sex aged 0–4 at the time $t+n$ adjusted for mortality. The projected number of net migration was then added or subtracted from each age-sex group based on an estimated age-sex distribution of net migrants. The assumptions about future fertility, mortality and net migration were based on analysis of historical trends in these components. Conventional approaches incorporate HIV/AIDS into projections after doing a demographic projection without AIDS. In both steps, model life tables that do not take into account HIV/AIDS are often used (Stover 1999). This study departs from conventional approaches by projecting the populations using life tables that take into account HIV/AIDS in the African regions in order to incorporate the impact of HIV/AIDS in the projections.

More formally, Preston et al. (2001) describe the projection of the mortality component for any age group, except for the youngest and oldest, as follows:

$$ {}_nP_x^{(m,f)}(t+n) = {}_nP_{x-n}^{(m,f)}(t).\ {}_nL_x/{}_nL_{x-n} \quad (1) $$

where

${}_nP_x^{(m,f)}(t+n)$ is the number of persons (male or female), in a specific age group x, in an age group interval n, at the end of the projection interval, $t+n$

${}_nP_{x-n}^{(m,f)}(t)$ is the number of persons (male or female), in a specific age group x, in an age group interval n, at the beginning of the projection t

${}_nL_x/{}_nL_{x-n}$ is the survivorship ratio (the proportion of persons aged x-n to x that will be alive n years later).

Preston et al. (2001) also describe the projection of the fertility component at time $t+n$ as

$$ {}_nP_{0-4} = {}_nF_x\ .\ n\ .\ [\{{}_nP_x^{(f)}(t) + {}_nP_{x-n}^{(f)}(t)\ .\ {}_nL_x/{}_nL_{x-n}\}/2] \quad (2) $$

where ${}_nP_{0-4}$ is the population aged 0–4 years at time $t+n$, ${}_nF_x$ is the age-specific fertility rate for a particular age group x, in the age group interval n. The total number of births during the period is then summed up over the lower and upper bounds of the childbearing ages as

$$ B[t, t+n] = \text{SUM}\ n/2\ .\ {}_nF_x\ [{}_nP_x^{(f)}(t) + {}_nP_{x-n}^{(f)}(t)\ .\ {}_nL_x/{}_nL_{x-n}] \quad (3) $$

where $B[t, t+n]$ is the total number of births during the period. The number of births is then split into males and females by applying the sex ratio at birth as follows:

$$ B^{(m,f)}[t, t+n] = [1/1 + SRB]\ .\ B[t, t+n] \quad (4) $$

where $B^{(m,f)}$ is the number of births (male or female), and SRB is the ratio of male to female births.

Since not all the births will survive to the end of the projection interval, the projected number in the youngest age group by sex is obtained as

$$ {}_nP_0^{(m,f)}(t+n) = \{B^{(m,f)}[t, t+n]\ .\ {}_nL_0\}/n.l_0 \quad (5) $$

where ${}_nL_0/n.l_0$ is the survival ratio from birth to age n during the projection interval.

ASSUMPTIONS AND SCENARIOS

Base population

Due to the issue of life tables in relation to HIV/AIDS, as already mentioned, the base year of the projections is 1995, although the period of interest of this study is 2000–2050. Since it is difficult to predict the future population of any country or region with absolute certainty, different scenarios embodying different sets of assumptions were developed for the projections. The assumptions were based on an analysis of historical trends in the regional levels of fertility, mortality and net migration. The assumptions in the scenarios were as described in the following sections.

Scenario 1: Declining fertility and mortality

Africa

For the entire continent, it was assumed that fertility and mortality would decline throughout the projection period. This, in effect, is a 'no HIV/AIDS scenario'. It was assumed that the average annual gain in life expectancy at birth during the period 1977–1992 would continue for the next 30 years (until 2022) among males and females; thereafter, the annual gain would reduce by one half. It was assumed that the average annual decline in total fertility rate (TFR) during the period 1983–2003 would continue, but would stabilise after 40 years (in 2042) at about the level of 2.04.

Southern Africa

It was assumed that the average annual gain in life expectancy at birth during the period 1978–1993 among males would continue for the next 15 years and that thereafter the average annual gain would reduce by one half annually for the next 15 years but stabilise thereafter. Regarding females, it was assumed that one half of the average annual gains in life expectancy at birth during the period 1978–1993 would continue for the next 30 years but stabilise thereafter. With regard to fertility, it was assumed that the average annual decline during the period 1983–2003 would continue for the next 15 years but thereafter stabilise at below replacement level at 1.75.

Eastern Africa

It was assumed that the average annual gain in life expectancy at birth during the period 1973–1993 among males and females would continue until the end of the projection period. It is assumed that the average annual decline in total fertility rate during the period 1998–2003 would continue for the next 25 years but thereafter stabilise at 4.1.

Middle Africa

It was assumed that the average annual gain in life expectancy at birth among males and females during the period 1973–1993 would continue until the end of the projection period. It was assumed that the average annual decline in total fertility rate during the period 1983–2003 would continue until the end of the projection period such that the total fertility rate in 2050 would be 5.2.

Northern Africa

It was assumed that half the annual gain in life expectancy at birth during the period 1987–1993 among males would continue for the next 30 years and stabilise thereafter at 69.1 years. A similar assumption was made for females, with female life expectancy stabilising at 73.5 years in 2023 until the end of the projection period. It was assumed that the average annual decline in total fertility rate during the period 1983–2003 would continue for the next 15 years and then stabilise at a level of 1.96.

Western Africa

It was assumed that the average annual gain in life expectancy at birth during the period 1983–1993 among males and females would continued for the next 30 years and stabilise thereafter. It was assumed that the average annual decline in total fertility rate during the period 1998–2003 would continue for the next 30 years, while the decline would reduce by half such that the total fertility rate is projected as 2.67 in 2050.

Scenario 2: Constant mortality and fertility

Africa

Regarding mortality, it was assumed that life expectancy at birth would remain constant after 2008 at the projected level of 53.2 years for males and 57 years for

females in 2008. It was assumed that the total fertility rate would remain constant at the projected 2008 level of 4.84.

Southern Africa

It was assumed that life expectancy at birth would continue at the projected level of 61.1 years for males and 68.7 years for females in 2008. It was assumed that the average annual decline during the period 1983–2003 would continue for the next 15 years and thereafter stabilise at below replacement level at 1.75.

Eastern Africa

It was assumed that life expectancy at birth would remain constant at the projected level of 50.7 years for males and 52.1 years for females in 2008. It was assumed that the total fertility rate would remain constant at the 2003 level of 5.6.

Middle Africa

It was assumed that life expectancy at birth would remain constant from 2008 onwards at the projected level of 47.2 years for males and 51.0 years for females in 2008 and that fertility would remain constant from 2008 onwards at the projected 2008 level of 6.2.

Northern Africa

It was assumed that life expectancy at birth would remain constant from 2008 onwards at the projected level of 65.3 years for males and 69.0 years for females in 2008 and that the total fertility rate would remain constant from 2008 onwards at the projected level of 2.73.

Western Africa

It was assumed that male life expectancy at birth would remain constant from 2008 onwards at the projected level of 51.7 years for males and 53.8 years for females in 2008 and that fertility would remain constant at the projected 2008 level of 5.33.

Scenario 3: HIV/AIDS impact

Scenario 3 is considered the most probable of the three scenario projections in this study.

Africa

It was assumed that life expectancy at birth would start to decrease by two years over a 15-year period after 1996 until the end of the projection period due to the impact of HIV/AIDS. Thus, male life expectancy at birth was projected as 49.4 years in 2008 and 43.4 years in 2050, while for females it was projected as 52.9 years in 2008 and 47.2 years in 2050. The evidence for this magnitude of decrease was based on South Africa's 1996 and 2001 censuses as well its death records from vital registration system for the period 1997 to 2003. The data indicated a decline in life expectancy at birth of about two years over a ten-year period (Udjo 2006). An average decline of two years in life expectancy at birth over a 15-year period due to HIV/AIDS was therefore assumed for the entire African continent, since HIV-prevalence is higher in Southern Africa than in the other African regions. This assumption is questionable, however, in the absence of other empirical data (other than those from projections), but it was the most pragmatic assumption that could be made under the circumstance. Besides, this assumption had very little impact at continental level, as was evident from the similarity in the results from scenarios 2 and 3, since HIV prevalence is relatively low in some regions of Africa compared to Southern Africa (see next section). The total fertility rate was assumed to decline to 3.51 in 2022 but to remain constant thereafter.

Southern Africa

It was assumed that life expectancy at birth would start to decrease by two years over a ten-year period after 1996 until the end of the projection period due to the impact of HIV/AIDS. Male life expectancy at birth was projected as 57.2 years in 2008 and 48.2 years in 2050, while the projection for females was 63.7 years in 2008 and 55.2 years in 2050. As already indicated, evidence for this magnitude of decrease was based on South Africa's mortality data, which were then assumed to be similar for the whole of Southern Africa, since this region has far higher levels of HIV prevalence (at least 10% based on antenatal data from most of the countries) and, by implication, a higher impact on mortality than in Western, Middle and Northern Africa. The total fertility rate was assumed to continue declining but to stabilise at 1.75 in 2018 and beyond.

Eastern Africa

It was assumed that life expectancy at birth would start to decrease by two years over a ten-year period after 1996 until the end of the projection period due to the impact of HIV/AIDS. Thus, male life expectancy at birth was projected as 46.6 years in 2008 and 38.8 years in 2050, while the projection for females was 48.3 years in 2008

and 39.8 years in 2050. The total fertility rate was assumed to continue declining but to stabilise at 4.10 in 2033 and beyond.

Middle Africa

Since Middle Africa has a lower level of HIV-prevalence (about 5% based on antenatal data) than Eastern and Southern Africa, it was assumed that life expectancy at birth would decrease by two years over a 20-year period after 1996. Male life expectancy at birth was thus projected as 44.5 years in 2008 and 40.4 years in 2050, while the projection for females was 48.3 years in 2008 and 44.1 years in 2050. It was assumed that the average annual decline in the total fertility rate over the period 1983–2003 would continue until the end of the projection period such that the TFR in 2050 would be 5.2.

Northern Africa

Life expectancy at birth was assumed to decline by one half of the annual gain in life expectancy during the period 1988–1993 for the next 15 years and to stabilise thereafter. For males, life expectancy at birth was projected to be 65.2 years in 2008 and 69.1 years in 2050, while the projection for females was 69 years in 2008 and 73.5 years in 2050. The total fertility rate was assumed to remain constant from 2008 onwards at the projected 2008 level of 3.16.

Western Africa

Since Western Africa generally has a lower level of HIV-prevalence (less than 5% based on antenatal data), it was assumed that life expectancy at birth would decrease by two years over a 20-year period after 1996. Male life expectancy at birth was thus projected as 47.7 years in 2008 and 43.5 years in 2050, while the projection for females was 50.0 years in 2008 and 45.8 years in 2050. Regarding fertility, it was assumed that the average annual decline in the total fertility rate during the period 1998–2003 would continue for the next 30 years.

Net migration

Due to a lack of data, perhaps the most challenging aspect of population projections is the incorporation of net migration. Data on the magnitude of net migration from various international agencies obtained from the statistical agencies of countries were examined, but inconsistencies were found between international databases and even between databases from the same department within the same international agency, thus making the analysis of trends using various data sources difficult. Despite this, a single source was utilised, namely data on international migration

in 2006 compiled by the UN Population Division in estimating and projecting net migration.

On the basis of the average annual net migration as well as the migration rate per thousand population (for both sexes combined) provided by the data source for the period 2000–2005, the number of net migrants for the base year of the population projections was computed using the geometric growth curve formula. It was assumed that the computed growth rate for the period 1995–2000 would hold throughout the projection period. Next, using the geometric growth formula, the assumed growth rate was used to project net migrants to 2050 for both sexes combined. The projected figures were then split by sex using the percentages of female international migrants provided by the international data source for the year 2000, which were assumed would hold from 2000 to the end of the projection period. These projected figures were held constant in the three scenario projections.

Sex ratio at birth

Based on available evidence (UNECA 1968), sex ratio at birth was assumed to be 103 in Western, Middle, Eastern and Southern Africa, while for Northern Africa it was assumed to be 105.

Model life tables

For the non-HIV/AIDS scenarios typified by scenarios 1 and 2, the UN's Far Eastern pattern model life table was used. This pattern is characterised by high male death rates at older ages, relative to their death rate at younger ages and very high sex ratios of mortality at the older ages. As already mentioned, conventional model life tables do not take into account the 'hump' in the age pattern of mortality due to increased AIDS-attributable deaths in young adult ages, as these standard mortality schedules were developed prior to the HIV/AIDS epidemic. Standard mortality schedules that take into account HIV/AIDS were recently developed – the INDEPTH model life tables for sub-Saharan Africa (INDEPTH Network 2004). These life tables depict some sub-Saharan countries' mortality experience in the era of HIV/AIDS. However, the published INDEPTH life tables do not provide survivorship ratios in the form specified in equation 1 that can be used for population projections.

Using the Patterns 1 and 2 INDEPTH life tables as standards, this author carried out several hundred simulations, firstly by varying the α and β parameters of the life table to obtain life expectancies at birth in the range of approximately 30 and 80 years: α defines the general level of mortality in the population while β defines the relationship between childhood and adult mortality in the Brass (1971) logit system. The possibilities were enormous, and, after a careful examination of the infant and

under-five mortality rates produced by the simulations, a second set of simulations was run by choosing and fixing a central value for β (= 0.9) but varying α to obtain life expectancies at birth in the range of approximately 30 and 80 years and thereafter computing the survivorship ratios corresponding to these life expectancies. This approach produced an expected pattern of infant and under-five mortality rates (in other words, decreasing infant and under-five mortality rates with increasing life expectancies at birth). In effect, the second sets of simulations were two-parameter life tables in the Brass (1971) logit system, which uses the INDEPTH life tables as standards.

RESULTS

The following sections present the results of the projections.

Changes in the size and structure of the population

Annual growth rate and size

The overall annual rate of population growth resulting from age-sex cohort changes provides an overall measure of the balance in the components of population growth at an aggregate level. Figure 1 shows the annual rates of population growth of the African continent in the three scenario projections. As seen in the graph, if fertility, mortality and net migration were to remain constant at current levels (Scenario 2), the annual growth rate of the population of Africa would only decrease from an estimated 2.5% per annum in 2000 to 2.2% per annum in 2050. However, if historical trends in the decline of fertility, mortality and net migration were to continue (Scenario 1), the annual growth rate of the population of Africa would decrease from an estimated 2.5% per annum in 2000 to a projected 0.7% per annum in 2050; if the HIV/AIDS epidemic is taken into account (Scenario 3), the annual growth rate of the population would decrease from an estimated 2.5% per annum in 2000 to a projected 0.8% per annum in 2050. Thus, in a situation of declining fertility and mortality, there are regional variations in the projected growth rates. For brevity and ease of comparison, the regional comparisons outlined are based on Scenario 3 (which is considered to be a more probable scenario). As seen in Figure 2, Middle Africa has the highest projected annual growth rates, while Southern Africa has the lowest. While the annual growth rate of the population of Middle Africa is projected to decrease from an estimated 2.9% per annum in 2000 to 2.1% in 2050, for Southern Africa the annual growth rate is projected to decrease from an estimated 2.2% per annum in 2000 to -0.8% in 2050. These differences are due largely to the lower fertility levels and pace of fertility decline in Southern Africa compared to Middle Africa.

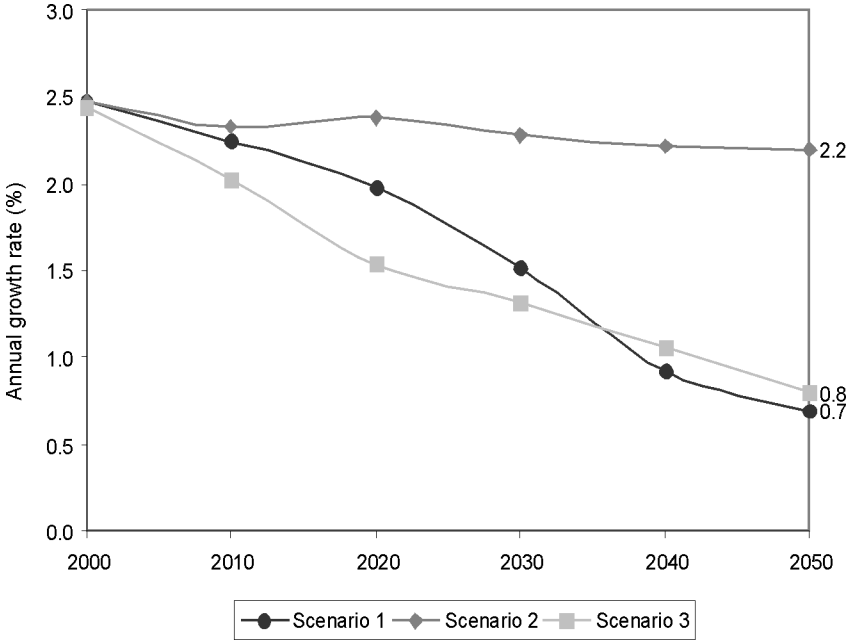

Figure 1: Projected annual growth rate of the population of Africa

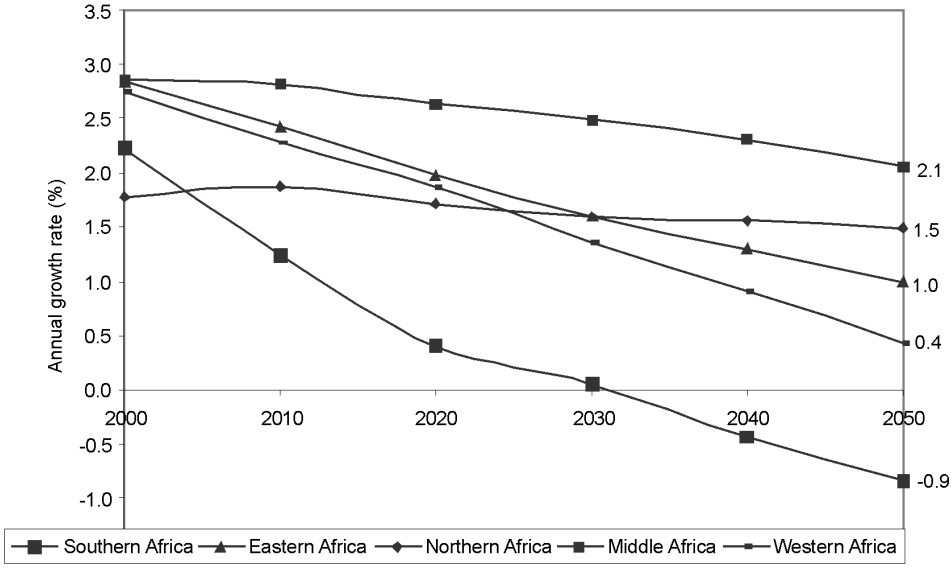

Figure 2: Projected annual growth of the population of Africa by region

Figure 3 shows the changes in population size resulting from the growth rates. If historical trends in the decline of fertility, mortality and net migration continue (Scenario 1), the population of Africa would increase from an estimated 825.1 million in 2000 to a projected 1.9 billion in 2050. If fertility and mortality rates were to remain constant at current levels (Scenario 2), the projected size of Africa's population would be approximately 2.7 billion by 2050 without taking into account HIV/AIDS. However, if historical trends in fertility and mortality continue, the HIV/AIDS epidemic is projected to reduce the size of the population of Africa to an estimated 1.7 billion by 2050 (Scenario 3). Taking into account HIV/AIDS, by 2050 about 3% of Africa's population are projected to reside in Southern Africa, 32% in Eastern Africa 20% in Northern Africa, 18% in Middle Africa and 27% in Western Africa.

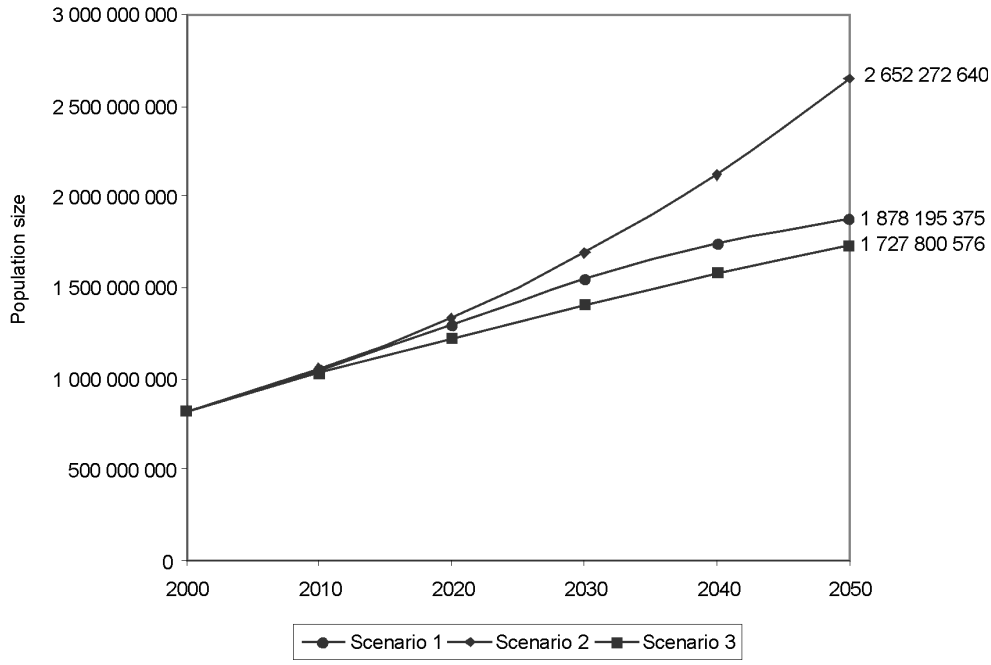

Figure 3: Projected population size of Africa

School age population

Population growth rates also have implications for the future size of the school age population (persons aged 6–16 years). If historical trends of the components of

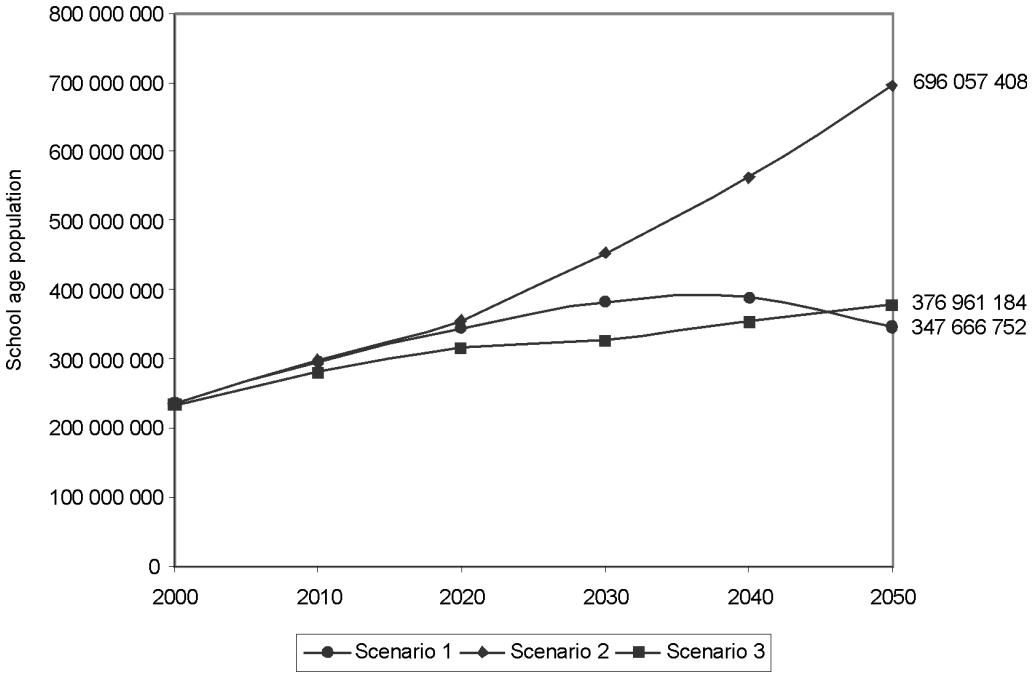

Figure 4: Projected size of the school age population of Africa

population change were to continue, and taking into account the impact of the HIV/AIDS epidemic, the size of the school age population in Africa would increase from an estimated 232.9 million in 2000 to approximately 376.9 million in 2050. However, if fertility and mortality were to remain constant at current levels, and without the HIV/AIDS epidemic, the projected size of the school age population in Africa would increase to approximately 696.1 million by 2050 (Figure 4). Although the projected size of the school age population would increase over time (up to 2040 in Scenario 1), the projected proportion of the size of the school age population, as a percentage of the projected population, would decrease gradually over time due to gradual ageing of the population. The projected proportions of the size of the school age population are generally lower in Southern Africa than in the other African regions. The decrease in the proportion of school age population is also projected to be more rapid in Southern Africa than in the other African regions (Figure 5).

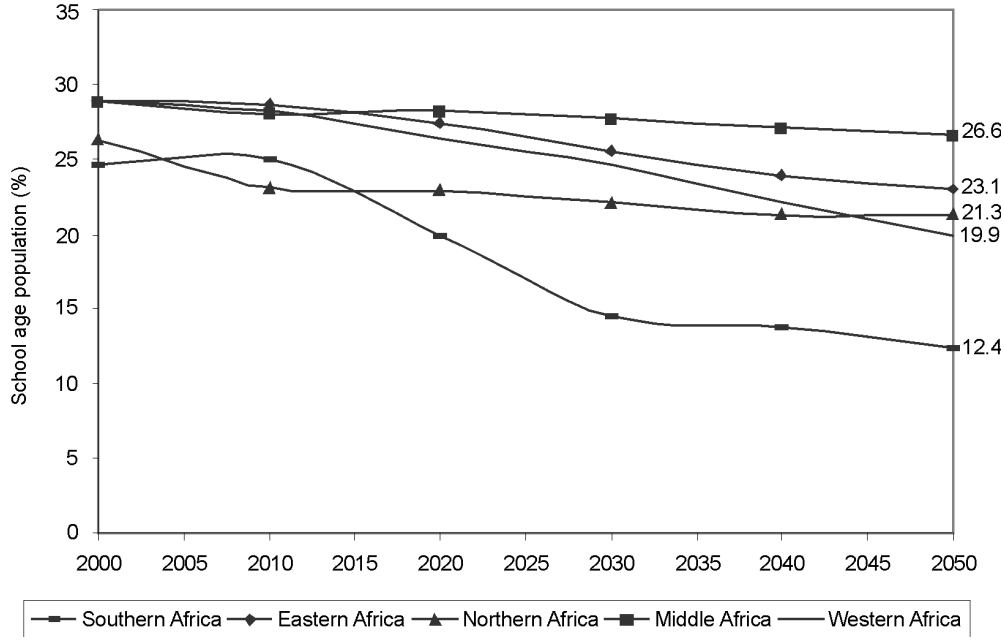

Figure 5: Projected percentage of the school age population of Africa by region

Population youthfulness and ageing

One of the summary indicators of the youthfulness and population ageing is the median age of the population. According to Shryock, Siegel and Associates (1976), populations with medians below 20 may be described as 'young', those with medians of 30 or above as 'old', while those with medians of 20 to 29 as being of 'intermediate' age. Using these criteria, and as seen in Figure 6, the population of Africa is projected to be youthful up to about 2020, but thereafter to enter the intermediate stage of ageing in the event that the historical decline in fertility and mortality continues and taking into account the HIV/AIDS epidemic (Scenarios 1 and 2 respectively). Figure 7 shows that the projected pace of population ageing would be faster in Southern Africa than in the other regions of Africa.

In absolute terms, the projected size of the elderly population (persons 60 years and older) in Africa would increase substantially from an estimated 41.7 million in 2000 to approximately 156.1 million in 2050 (Scenario 3). Moreover, the proportion of the elderly population on the continent is projected to rise steadily from an estimated 5.1% in 2000 to an estimated 9% in 2050. Although declining fertility would be

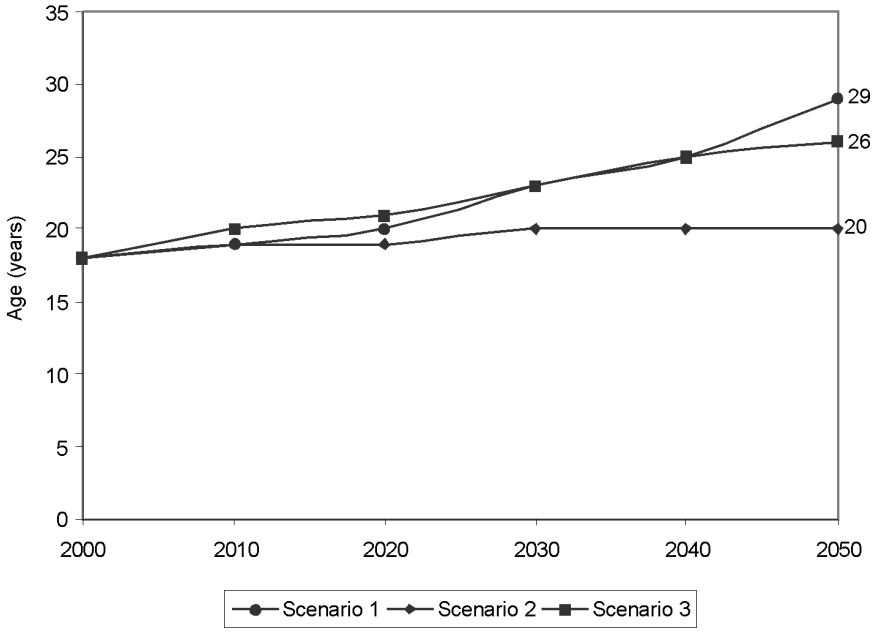

Figure 6: Projected median age of the population of Africa

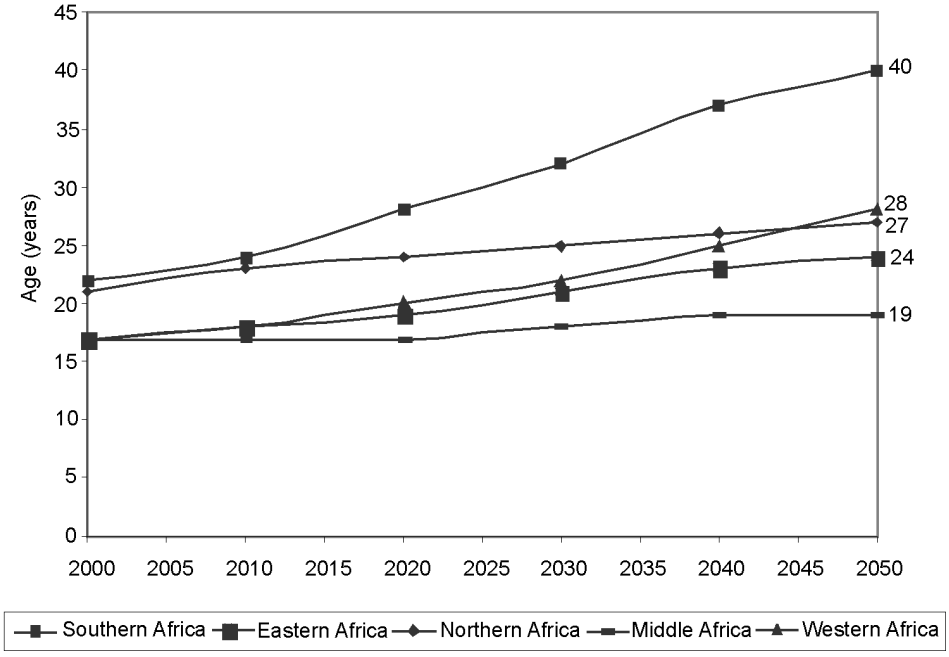

Figure 7: Projected median age of the population of Africa by region

mainly responsible for the projected increase in the population ageing, HIV/AIDS would accelerate the process due to increased AIDS-related deaths among young adults.

Another feature of the ageing process is the annual growth rate in the size of the elderly population. The projected annual growth rates of the elderly population (3.4% in Scenarios 1 and 2.7% in Scenario 3) are higher than the projected annual growth rates of the general population. The lower rate in the projected annual growth of the size of the elderly population in Scenario 3 is due to the impact of AIDS.

Changes in the labour market

Size of the labour market

Projections of the size of the labour market (comprising persons aged 15–64 years) provide an indication of the potential size of the future labour force and hence a rough indication of the future number of additional jobs that need to be created given the current stock of jobs. A better indication could be obtained by projecting the labour force if other information such as labour force participation rates were available. The size of the labour market of the African continent is projected to increase steadily in absolute terms, with or without the impact of HIV/AIDS, from less than half a billion in 2000 to over 1 billion in 2050 (Figure 8).

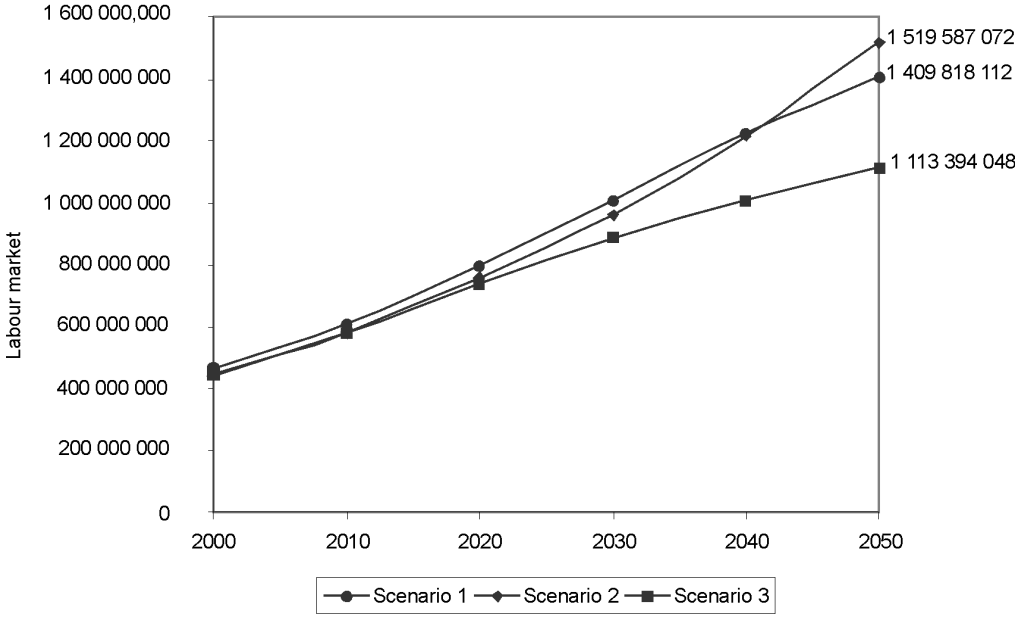

Figure 8: Projected size of the labour market of Africa

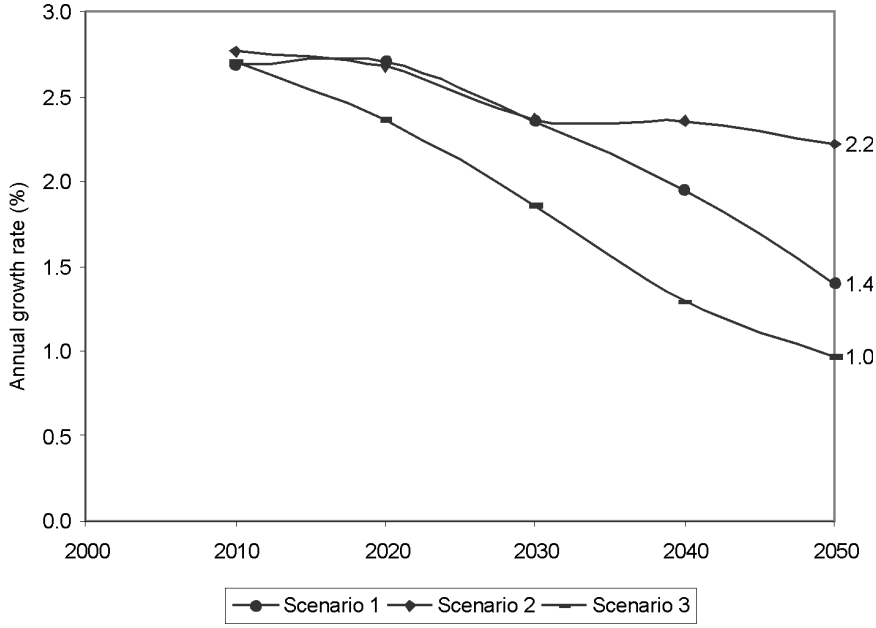

Figure 9: Projected annual growth rate of the labour market of Africa

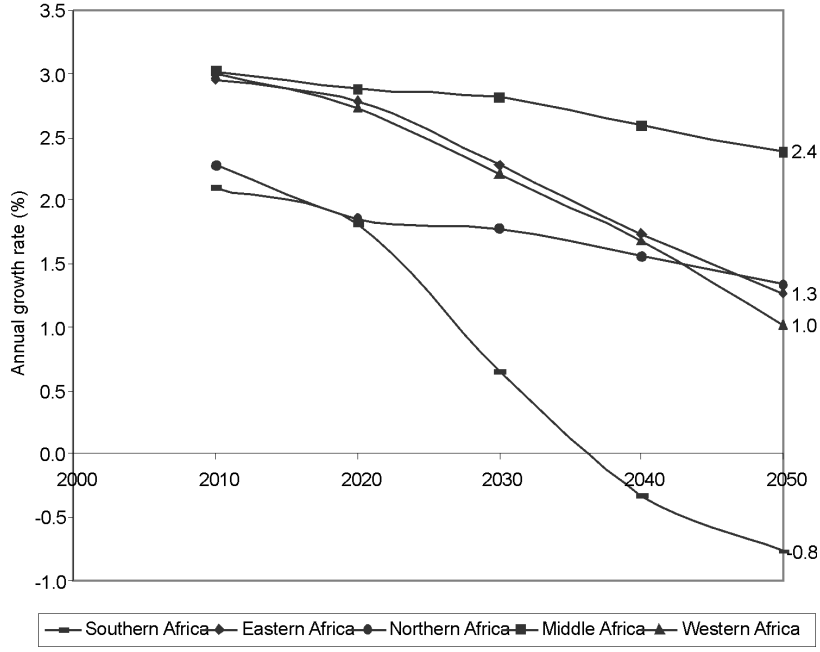

Figure 10: Projected annual growth rate of the labour market of Africa by region

Although the absolute size of the labour market is projected to continue to increase, in a situation of declining fertility, the number of persons entering the labour market would decline in the long term, and there would subsequently be a projected decrease in the annual growth rates of the size of the labour market. It is projected that the HIV/AIDS epidemic would accelerate this process due to increased numbers of AIDS-related deaths among persons in the working age group (see Figure 9). The projected pace of the decrease in the annual growth rates of the size of the labour market would be faster in Southern Africa than in other African regions. It is projected that by 2040, the annual rate of population growth of the labour market would be negative in Southern Africa (Figure 10).

Dependency burden

The dependency burden is a proxy measure for economic dependence (defined as the ratio of persons less than 15 years old plus persons 65 years and older to the number of persons in the working age group of 15–64 years). As seen in Figure 11, if the historical decline in fertility and mortality were to continue, it is projected that there would be a decline from 88 dependants for every 100 working persons in 2000 to 42 dependants for every 100 working persons (Scenario 1) in 2050. It is projected that the HIV/AIDS epidemic would, however, slightly increase the projected dependency burden (Scenario 3). The projected dependency burden is far higher in Middle Africa than in the other regions (Figure 12).

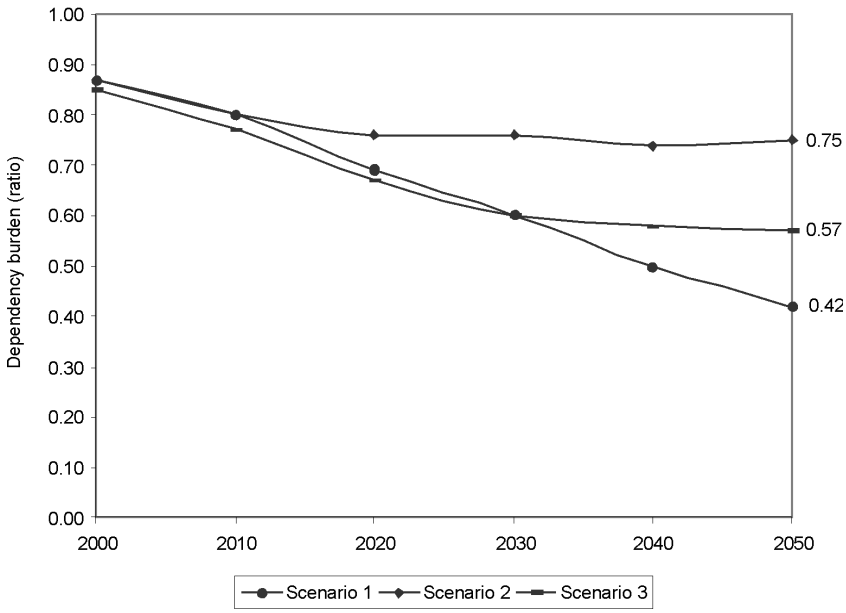

Figure 11: Projected dependency burden of the population of Africa

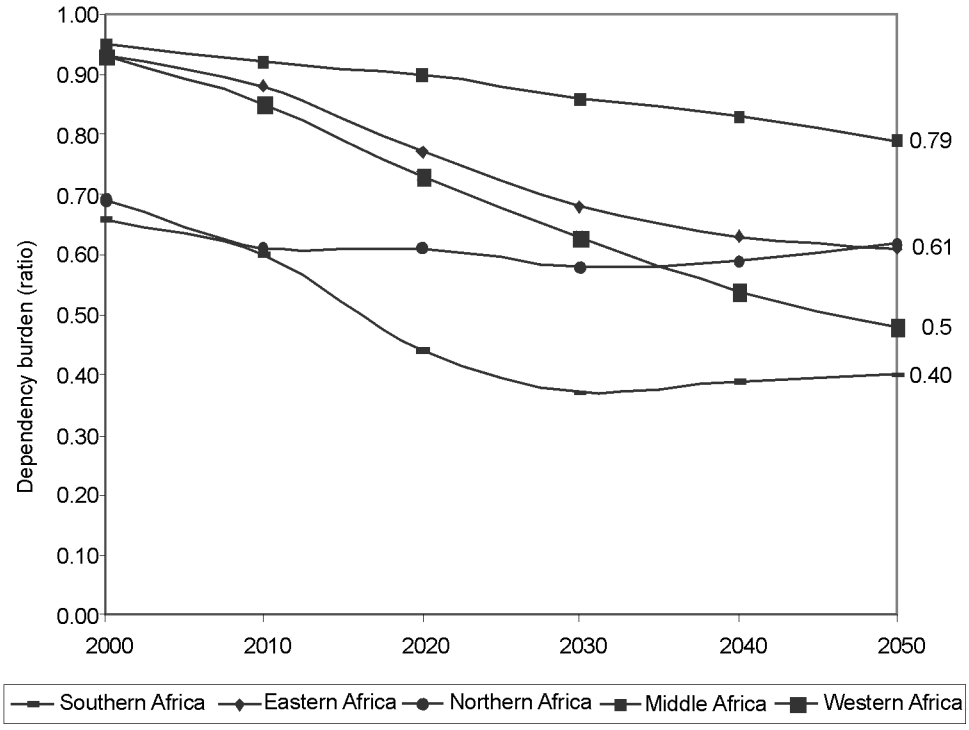

Figure 12: Projected dependency burden of the population of Africa by region

Changes in mortality

Due to the impact of HIV/AIDS, the projected crude death rates would increase from approximately 14 per 1 000 persons in 2000 to approximately 19 per 1 000 persons in 2050. The projected increase in crude death rates would be more marked in Middle Africa than in the other regions due to the higher level of mortality combined with the impact of AIDS in the region (Figure 13).

Changes in net migration

It is projected that the magnitude of the net loss of persons due to migration from the African continent would increase from approximately 454 000 in 2000 to about 477 000 in 2050. Western and Northern Africa are projected to be more affected by net migration than the other regions of Africa.

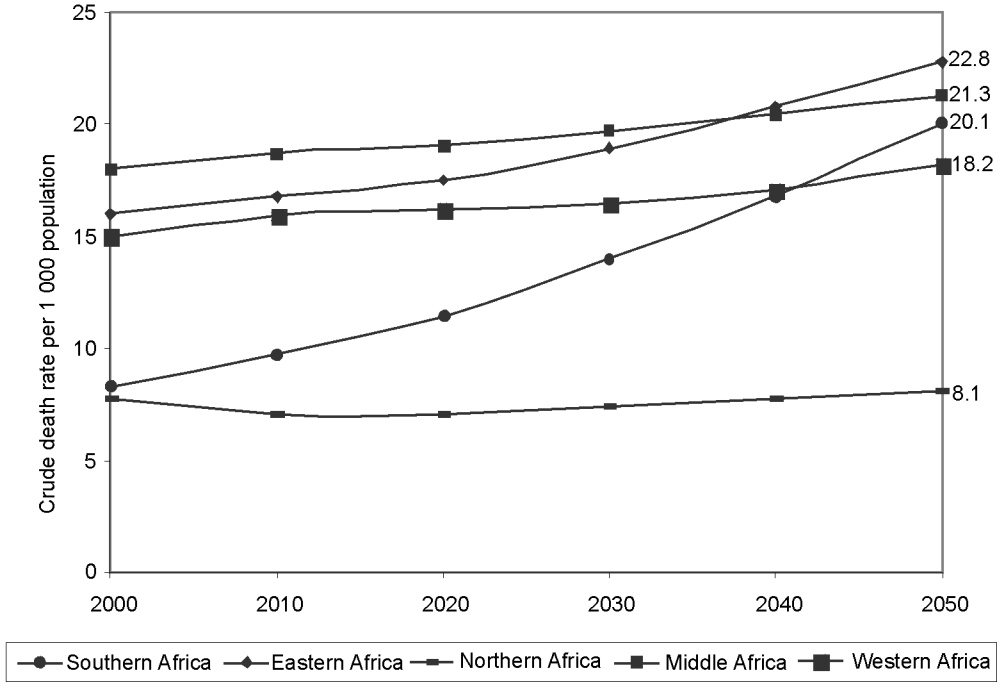

Figure 13: Projected crude death rates in Africa by region

DISCUSSION AND CONCLUSION

The main features of the projected demographic situation of Africa, taking into account the impact of AIDS, may be summarised as follows: a high but steadily decreasing growth rate of the population resulting in the increase in the size of the population from approximately 825 million in 2000 to about 1.7 billion in 2050; a growing school-going population, labour market and elderly population.

The results of this study, compared with the low variant of the UN projections of other regions of the world, are shown in Table 1. One needs to be cautious, however, in comparing results from different projections, as there is no accepted standard for judging the accuracy of other projections, and this can only be assessed after the fact (Preston et al. 2001). For this reason, the UN, for example, revises its projections continuously when new information becomes available.

However, if the assumptions in Scenario 3 hold, the results of this study imply that by 2050, Africa would represent about 22% of the world's population. Furthermore, the results imply that the size of Africa's population would be about 39% of Asia's population by 2050, would exceed China's population by about 44% and would also

exceed India's population by about 24%. The populations of China and India are projected to decline from their current sizes by 2050, while that of Africa is projected to increase from its current size.

Table 1: United Nations' low variant projections for selected regions/countries

Region/Country	Projected size of population in 2050
Africa (United Nations figure)	1 717 518 000
Africa (figure according to this study)	1 727 800 000
Asia	4 443 976 000
India	1 390 012 000
China	1 201 666 000
Latin America and the Caribbean	640 881 000
Russian Federation	107 832 000
Europe	566 034 000
North America	381 551 000

These demographic trends have socio-economic implications for the continent and pose challenges for development, some of which include the following: impact on scarce resources for various sectors of the economy; the environment; economic growth; provision of food, health, education and housing; and job creation, among others. For example, increasing population size puts pressure on the environment and can accelerate environmental degradation, as arable land may be depleted to provide housing for the growing population in urban areas. If housing provision cannot keep pace with the growing population, this might lead to urban slums. Ridker (1979) has noted, however, that the impact of population trends on the environment will vary between different contexts, depending on the level of technological advancement and effectiveness of policy and legislation to control environmental impact. Ridker believes that the potential impacts include increases in the annual use of commercial energy such as coal, with consequences for the environment, in an attempt to increase supply to meet demand, as well as increasing deforestation. Associated with this would be the deterioration of soils and the impact of global climate change. Ridker furthermore notes that increasing solid waste from urban sources (partly due to rural-urban migration leading to urban slums) and the problems of solid waste management pose pressure on the environment. Associated with this is increasing risk of the pollution of water resources.

It should also be noted that the impact of a growing population implies more people to provide food for over time, as well as increased demand for other social

services such as health, water, sanitation and education. With the increasing size of the labour market due to population growth, unemployment rates might be exacerbated if job creation is unable to keep pace. Increasing growth of the population of the elderly has implications for pension schemes and provision of special welfare services for the elderly. In this regard, the question may be posed whether sustainable development can be achieved in the context of these demographic trends in Africa.

ACKNOWLEDGEMENT

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