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POPULATION GROWTH AND POLICY OPTIONS IN SUB-SAHARAN AFRICA

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The modern expansion of human numbers in sub-Saharan Africa started around a century ago with the onset of a long-term decline in the death rate and by 1950 the population had risen slowly to 180 million. Since the middle of the 20th century, growth has accelerated sharply as a lower incidence of epidemics and famines as well as improvements in public health and standards of living resulted in rapid further declines in death rates. Population size more than quadrupled after 1950, reaching 769 million in 2005. Growth is expected to continue for several more decades, with the total reaching 1.75 billion in 2050 (United Nations 2009). This projection implies that the population will have multiplied nearly ten-fold in the century from 1950 to 2050.

This paper reviews population projections to 2050 for the continent and its major regions and countries. It then identifies and quantifies the demographic factors responsible for continued future expansion of human numbers and discusses policy options for slowing population growth. A concluding section summarizes the potential socio-economic, health and environmental benefits from slower growth and reduced birth rates. Estimates (1950-2010) and projections (2010-2050) of various demographic indicators used in the study are taken from the United Nations medium variant projection (United Nations 2009).

Past and future population trends

Since 1950 the population of sub-Saharan Africa has increased by 371 %. All countries in the continent have grown, but at quite different rates. Table 1 presents population size for 1950, 2010 and 2050 and percent change 1950-2010 and 2010-2050 by region and for the 24 countries with populations over 10 million in 2010. The percent increase in population from 1950 to 2010 varied substantially among countries:

- 200-300%: Burkina Faso, Guinea , Mozambique, Mali, South Africa,
- 300-400% : Angola, Cameroon, Chad, Ethiopia, Ghana, Madagascar, Nigeria, Rwanda, Sudan, Zimbabwe,
- 400-500% : DR Congo, Malawi, Tanzania, Senegal, Zambia,
- 500%+: Uganda, Kenya, Niger, Côte d'Ivoire

The reasons for these differences will not be explored here but it is noteworthy that recent rates of population growth in sub-Saharan Africa are substantially higher than occurred historically in the developed world. The quadrupling or quintupling of population size over the past half century in many sub-Saharan countries very rarely occurred in the now developed world except with massive

immigration. Two factors account for this extremely rapid expansion of population in this still largely traditional continent: the spread of medical and public health technology (e.g., immunization, antibiotics) after World War II, which led to rapid declines in death rates, and a lag in declines in birth rates.

Population growth is projected to continue for several more decades. The most recent UN medium projection (UN 2009) expects the population of sub-Saharan Africa to increase by 0.9 billion people between 2010 and 2050, thus more than doubling in size in the next 40 years. The projected percent increase in population to 2050 in the 24 largest countries are as follows

- 10-50%: South Africa
- 50-100%: Cameroon, Ghana, Mozambique, Nigeria, Sudan, Zimbabwe,
- 100-200% : Angola, Burkina Faso, Côte d'Ivoire, DR Congo, Chad, Ethiopia, Malawi, Mali, Madagascar, Kenya, Tanzania, Senegal, Uganda, Zambia
- 200%+: Niger

Future growth is expected to be slowest in South Africa which has been hit hardest by the AIDS epidemic and has the lowest fertility but most countries are expected to more than double in size. Extraordinary growth is projected for Niger which is expected to more than triple in size.

The impact of the AIDS epidemic

It may seem surprising that population growth continues at a rapid pace in sub-Saharan Africa given the massive mortality from a severe AIDS epidemic. The main explanation for this outcome is that the epidemic has peaked in most countries and is expected to decline in the future (Bongaarts et al. 2008). This unexpected development is probably at least in part due to a decline in high risk behavior, as prevention programs have encouraging abstinence, sexual fidelity, and condom use and discourage needle sharing. For example, in Uganda, following a vigorous campaign starting in the late 1980s, HIV prevalence declined by about half. There is strong evidence that behavioral change contributed to this decline. Both men and women report a reduction in sex with non-regular partners and a rise in condom use (Stoneburner and Low-Beer, 2004). Declines in high-risk behavior and infection rates have also occurred in Kenya, Malawi, Thailand and Zimbabwe as well as other countries (UNAIDS 2008, Potts et al 2008).

Another partial explanation for the peaking is that epidemics have reached their natural limits. Every population consists of a heterogeneous mixture of subgroups, each with widely varying infection risks from any epidemic. For HIV, sex workers and their clients, needle-sharing intravenous drug users, and homosexual men are at relatively high risk while men and women living in monogamous unions or without sexual partners are at low risk. At the onset of an epidemic, the virus quickly invades the highest-risk groups, but then encounters resistance when the pools of high-risk and most susceptible individuals are infected or die out. The epidemic reaches a plateau when the virus has achieved maximum penetration of the vulnerable subgroups. Regardless of the cause, the peaking will limit the future demographic impact of the epidemic.

Another important feature of the epidemic is that it varies widely in size. In a few countries in Southern Africa HIV prevalence among adults has reached over 20% before stabilizing, yet it remains at a fraction of a percent in much of North and West Africa (UNAIDS 2008). The limited size in parts of Africa is largely explained by the fact that HIV is not a particularly infectious agent in heterosexual relationships, which are the dominant mode of transmission in Africa. On average, the risk of transmission per sexual encounter between an infected individual and his or her uninfected heterosexual partner is about 1 in 1000 (Wawer et al 2005). This low transmission risk prevents large epidemics in most populations. The exceptions are populations that contain substantial proportions of individuals who engage in high risk sexual behavior (e.g.. frequent change of partners and multiple concurrent partners), especially if–as in Southern Africa–male circumcision is limited and the use of condoms is low.

The demographic impact of the epidemic can be assessed by comparing the standard population projection (which includes the epidemic's effects) with a separate hypothetical projection in which AIDS mortality is excluded. The former projects the sub-Saharan population to increase from 0.86 billion in 2010 to 1.75 billion in 2050, the latter expects population size to reach 1.87 billion in 2050. The difference between these projections with and without AIDS equals 0.12 billion (-6.5%) and is due to deaths from AIDS as well as to the absence of descendents from people who died from AIDS. The epidemic clearly has a large effect on death rates. However, the birth rates birth throughout the continent are expected to remain higher than these elevated death rates for the next half century, thus insuring continued rapid population growth and a doubling of population size of sub-Saharan Africa by 2050.

Table 2 presents the AIDS and no-AIDS projections to 2050 by country. The last column of this table estimates of the demographic impact of the AIDS epidemic as the difference between these projections. The decline in population size in 2050 due to AIDS ranges from less than 5 percent in eight countries to more than 20% in South Africa and Zimbabwe. No country is expected to see negative growth by 2050.

Why population growth continues

The future growth expected for any population is attributable to four main demographic factors (Bongaarts 1994, Bongaarts and Bulatao 1999):

High fertility

Fertility will be considered "high" if it is above the replacement level. Replacement is a critical factor in population projections because it equals the fertility level that, if maintained over time, produces zero population growth. Positive or negative deviations from replacement lead in the long run to persistent population growth or decline, respectively. Currently, replacement fertility equals 2.6 births per woman (bpw) in sub-Saharan Africa; it is expected to decline to 2.3 in 2050 . (These levels exceed 2 because children who die before reaching the reproductive ages have to be replaced with additional births, and because the sex ratio at birth slightly exceeds one).

The total fertility rate of sub-Saharan Africa has been high in recent decades, averaging above 6.5 bpw from the 1950s until the mid 1980s before beginning a modest decline to 5.1 in 2005-2010 (see Figure 1). Declines started first in Southern Africa which is the most developed sub-region (also its smallest with just 7% of the continent's population). Eastern and Western Africa's slow declines began in the 1980s while Middle Africa has seen little change to date. In 2005-2010 fertility averaged 5.3 bpw in East Africa, 5.7 in Middle Africa and 2.6 Southern Africa and 5.3 in Western Africa (United Nations, 2009).

The UN projections assume that fertility will decline in future decades, while remaining above replacement until 2050. The exception is Southern Africa which is expected to reach this point before 2050. If, as expected, average fertility remains above replacement until 2050, high fertility remains one of the key forces contributing to further growth throughout the continent.

From a policy perspective it is important to note that high fertility can in turn be attributed to two distinct underlying causes. First, *unwanted childbearing* (defined as births that occur after a woman has reached her desired family size) is quite common throughout the region. On average women in sub-Saharan Africa bear 0.8 unwanted births each over their life time. The second cause is a high *desired family size*. In sub-Saharan Africa, desired family size is typically near five children (Westoff and Bankole 2002). As will be discussed below these two components are associated with distinct policies.

Population momentum

Even if fertility could immediately be brought to the replacement level with constant mortality and zero migration, population growth would continue in many populations. The reason for this is a young age structure, which is the result of high fertility, low mortality and rapid population growth in recent decades. (The term "young" refers to current age structure relative to the age structure implied by the current mortality life table). With a large proportion of the population under age 30, further growth over the coming decades is virtually assured. The relative abundance of these young people results in a birth rate that is higher than the death rate even if fertility is at replacement. This age structure effect is called population momentum (Bongaarts and Bulatao 1999, Keyfitz 1971).

Other factors

As will be shown below the two main driving forces of population growth in sub-Saharan Africa are high fertility and a young age structure. However there are two other factors that also affect population growth: 1) declining mortality among adults (mortality at younger ages is taken into account in replacement fertility), and 2) migration. These two factors will not be discussed in any detail below because they are generally small in magnitude and of less interest to population policy makers.

Components of future population growth

The contribution of each of these demographic factors to future population growth projected in the medium variant UN projection can be estimated with a simple series of

hypothetical projections. In these projections, the influence of one factor is removed at each successive step. Four projections are involved (see Table 3):

1) The *standard* projection includes the contributions of all factors (i.e. young age structure, high fertility (wanted and unwanted), and mortality and migration. This is the medium variant projection of the UN with its assumptions of future trends in fertility, mortality and migration.

2) The *wanted* projection is identical to the standard projection but unwanted fertility is removed from 2010 onward.

3) The *replacement* projection is identical to the standard projection but fertility is set to the replacement level from 2010 onward. It is affected by the young age structure and by mortality and migration.

4) The *momentum* projection sets fertility to replacement and holds mortality constant and has no migration; it is only affected by the young relative age structure.

Figure 2 illustrates these projections for sub-Saharan Africa. From a baseline level of 0.86 billion in 2010, the standard, wanted, replacement and momentum projections yield population sizes of 1.75, 1.59, 1.28 and 1.24 billion respectively in 2050. Table 4 gives results for the largest countries.

The separate impact of each growth factors is estimated as the relative difference between the projection with and without the factor. For example, the effect of unwanted fertility equals the percent difference between the 2050 population in the standard projection and the 2050 population in the wanted projection; the effect of high wanted fertility equals the difference between the wanted and replacement projections. The results of this exercise are summarized in Table 5. For sub-Saharan Africa as a whole the effects of unwanted and wanted fertility, and young age structure are estimated at 10.0, 24.3, and 44.0 %, respectively. The young age structure (44%) is the largest driver of future population growth, followed by high wanted fertility (24.3%), and unwanted fertility (10.0%) . The combined effect of declining mortality the migration effect is just 3% (data not shown).

Table 5 also presents these population factors for each of the 24 largest countries. The effects vary widely among countries with the high-low ranges as follows:

- Unwanted fertility: from 17.9% in Uganda to 4.5% in Chad
- High wanted fertility: from 111% in Niger and -14.3% in South Africa
- Young rel. age structure: from 60.4% in Niger to 14.7% in South Africa

As expected, these country level effects are highly correlated with the underlying demographic behaviors or indicators. This is illustrated in Figure 3 for unwanted fertility. There is a strong and nearly linear association between the current level of unwanted fertility and the percent impact of this factor on population size in 2050. Uganda has the highest observed unwanted TFR of 1.6 births per woman which produces an impact of 17.9 %, and Chad has the lowest unwanted TFR of 0.2 bpw with only a 3.5% impact.

A similar strong association exists between wanted fertility and its impact (see Figure 4). Niger's high wanted TFR of 6.8 gives the largest population growth effect of +111% and South Africa's current low wanted TFR 2.3 gives a negative effect of – 14.3% (because wanted fertility is assumed to decline below the replacement level in future decades).

Interestingly, as shown in Figure 5, there is only a weak correlation between the momentum effect and indicators of the absolute age structure (the proportion of the population under age 30). The explanation for this finding is that the age structures of populations in sub-Saharan Africa are typical differ little from one another. Nevertheless it is clear that these populations are very young, with about three quarters under age 30, and that momentum contributes substantially to population growth, with typical effects between 40 and 60% .

Policy responses to rapid population growth

The difficult task of reducing poverty and bringing about sustainable development in sub-Saharan Africa will be made even harder by the expected large increases in population size by the middle of the next century. Efforts to slow this population expansion cannot include increases in mortality, and out migration is not a realistic option for most countries. The focus therefore has to be on accelerating fertility declines and reducing momentum. The following broad policy options can be pursued (Bongaarts 1994, Bongaarts and Bruce 2009):

Accelerate fertility decline

As noted, high fertility has two sub-components: unwanted and high wanted fertility. Separate policies are needed to address these issues

- *Reduce unwanted fertility and the unmet need for contraception by strengthening family planning programs*

In the developing world 137 million women who don't want to get pregnant are not using contraception (Singh et al 2003). The key cause of this unmet need for contraception is that contraception is often quite costly to individuals in terms of the commodities (pills, condoms, IUDs, etc.), transportation, and reimbursement of providers of contraceptives and health care services, even when subsidies are provided by the government. In addition, there are significant non-economic costs such as health concerns, social disapproval, and spousal resistance, as well as unnecessary medical barriers (e.g., requiring a doctor instead of a nurse or other trained health care worker to provide certain contraceptives (Casterline and Sinding 2000). This unmet need is in turn responsible for most of the 76 million unplanned pregnancies that occur each year. About half of these pregnancies end in abortion and the other half end in births); both contribute unnecessarily to health risks for mothers and children, to the cost of raising families, and to the adverse impact of population growth.

The existence of a high rate of unintended pregnancy and a large unmet need for contraception, first documented in the 1960s, convinced policymakers that family planning programs were needed and would be acceptable and effective. As a result, many governments in the South have implementation voluntary family planning programs in recent decades. The aim of these programs is to provide information about and access to contraception to permit women and men to take control of their reproductive lives and avoid unwanted childbearing. The choice of voluntary family planning programs as the principal policy instrument to reduce fertility is based largely on the documentation of a substantial level of unwanted childbearing and unsatisfied demand for contraception. In addition, the effectiveness of this approach was supported by experiments such as the one conducted in the Matlab district of rural Bangladesh (Cleland et al. 1994). When this experiment began in the 1970s, Bangladesh was one of the poorest and least developed countries, and there was considerable skepticism that reproductive behavior could be changed in such a setting. Comprehensive family planning and reproductive health services were provided in the treatment area of the experiment. The results of these improvements were immediate and pronounced, with contraceptive use rising sharply. No such change was observed in the comparison area. The differences between these two areas in contraceptive use and fertility have been maintained over time. The success of the Matlab

experiment demonstrated that appropriately designed services can reduce unmet need for contraception even in traditional settings.

In addition to the experiment's impact on reproductive behavior, Joshi and Schultz (2007) have demonstrated the positive impact of the program on family welfare indicators including women's health, earnings and household assets, use of preventive health inputs, and finally the inter-generational effects on the health and schooling of the woman's children.

Reduce the demand for large families through investments in human development

Even if unwanted fertility could be eliminated overall fertility would remain high in much of sub-Saharan Africa because many individuals and couples continue to want and have large families, in part because of fears of infant and child mortality as well as the need for children to support them in family enterprises and to support them in old age. High demand for children remains a fundamental cause of population growth in many developing countries, in particular in sub-Saharan Africa.

Countries in which wanted fertility is high will need declines in preferences to complete their fertility transition to replacement fertility. Such declines are usually achieved by improvements in socioeconomic conditions. Available evidence indicates that desired fertility is most responsive to improvements in human development, in particular in female education and child survival (Caldwell 1980; Jejeebhoy,1995; Sen 1999). This conclusion is strongly supported by the fact that low fertility has been achieved in some very poor societies such as Sri Lanka and the state of Kerala in India. Although poor, these populations have high levels of literacy and female empowerment and low infant and child mortality. According to Jejeebhoy (1995) women's education influences reproductive behavior through five types of autonomy: knowledge, decision making, physical (move freely outside the home), emotional, and economic and social.

Another relatively recent approach to stimulating human development are micro-credit schemes which can be potent agents of social change among poor women. The first experiment with group-based lending was conducted in 1978 in Bangladesh by Grameen Bank; but similar programs are now being implemented in other developing countries (Yunus 2007). Participation in micro-credit schemes empowers women and increases their autonomy and decision making within the household. In Bangladesh credit group participants were found to have increased use of contraception (Steele and Amin 2001).

Most governments already pursue investments in human and other development initiatives, independent of their potential role in lowering the rate of childbearing. The demographic benefits of these social policies simply strengthen the rationale for implementing them.

Address the momentum of population growth due to young age structure

While a young age structure-- the key force behind population momentum --is not amenable to modification, an option to offset momentum is available that has received relatively little attention in past policy debates. Further reductions in population growth can be achieved if the average age at which women begin childbearing rises (by delaying the first birth) and through wider spacing between births. For example, increasing the average age at childbearing by five years could reduce future population size by 15-20 % .

Young women in sub-Saharan Africa often have little choice about whether or not to have sexual relations, when or whom to marry, and whether to defer childbearing. Short intervals between generations are often a result of the pressures on young women to marry and to bear children early as a means of finding social acceptance and long-term economic security. The early onset of fertility and the close spacing of births present health risks to girls and young women, limit their education and livelihood possibilities. Delaying the onset of childbearing will therefore not only reduce population growth, it also significantly improves personal well being and the quality of family life, especially for women.

Governments that wish to encourage later childbearing have several options at their disposal. National legislation to raise the age at marriage has been moderately effective in a few countries, such as Tunisia and China. However, legislation has the drawback that it attempts to force rather than encourage changes in social customs that involve not only the young people but also their families. Indirect approaches are likely to be more effective. A greater investment in the education of girls, particularly at the secondary level, is the most obvious example. The longer girls stay in school, the later they marry and the greater the delay in childbearing. In general, supportive measures that enhance adolescents reproductive health, educational levels, and income-generating potential will lead to more rapid human capital development, to increased productivity, and it offsets population momentum (National Research Council, 2005)

Multiple impacts of policies

The above three general policy options have been presented as if each only affects one distinct demographic growth factor. In reality, however, each policy has impacts on multiple demographic factors thus yielding important mutually reinforcing effects as summarized below.

1) Effects of family planning programs on

- *Unwanted fertility*. The main objective of family planning programs is to reduce unwanted and unintended pregnancies. Estimates by Bongaarts (1997) indicate that a strong and well implemented program can reduce fertility by about 1.2 bpw compared to the level that would have prevailed in the absence of the program. This is therefore approximately the reduction in fertility that might be achieved by implementing a program in sub-Saharan countries with very weak or non-existent programs and high unwanted fertility levels (around 1.5 bpw in Ethiopia, Swaziland and Uganda).
- *Wanted fertility*. The potential role of family planning programs in reducing desired family size remains unclear. A review of the evidence by Freedman (1997) concluded that " ..family planning programs sometimes do not affect preferences but do help to crystallize latent demand created not by the program but by other development processes." He did not identify the reasons why an effect on preferences was found in a few studies but not in others. One possible explanation for this puzzle might be that his review was based mostly on studies from Asia. Asian programs were usually implemented after fertility preferences had already declined to intermediate levels so that a large unmet need was evident. This appears to have been the case the Matlab in Bangladesh where a carefully designed and conducted experimental intervention showed little or no effect of services on desired family size.

  This leaves open the possibility of on effect of programs on preferences in sub-Saharan Africa where desired family size is, on average, much higher than in Asia at the onset of their fertility transitions. It is noteworthy that Freedman rejected as not credible the results of a family planning pilot project in Nigeria (Farooq and Adeokun, 1976) in which the proportion of women wanting to limit family size rose from 28% in 1969 to 57% in 1972. Freedman may be correct that such a rapid rise is confounded by measurement and/or reporting errors, but this study raises the intriguing question whether the very high family size preferences measured in sub-Saharan African countries may be more

susceptible to change than the lower levels found in Asian countries at the beginning of their transition. If so, then the implementation of the family planning program in Kenya since the 1960s played some role in the large decline in desired family size from 7.2 in the 1970s to less than 3.8 in the 2003. This important topic deserves further study.

- *Timing of childbearing*. The preceding discussion has emphasized the role of family planning in averting unwanted births (i.e. births that occur after a woman has reach her desired family size) because this is what matters in the long run for the level of fertility. However, programs also avert mistimed births and this effect raises the age at first birth and increases the spacing between births. The net result is a shift in the timing of childbearing to higher ages which offsets momentum as discussed above.

2) Effects of education

Educational differentials in fertility are well established and the effects of years of schooling remain substantial and significant even after controlling for other socioeconomic factors (Caldwell 1980; Castro Martín and Juárez, 1995; Cochrane 1979; 1995; Cleland and Rodriguez 1988; Diamond et al.(1999); Jeejebhoy 1995; Jeffery and Basu 1996; Rodriguez and Aravena, 1991; Rutstein 2002; Singh and Casterline 1995; National Research Council 1999; United Nations 1987,1995). There is much less information on the effects of education on wanted and unwanted fertility. Figure 6 plots average levels of the total fertility rate and its wanted and unwanted components of fertility by level of education (none, primary and secondary+), using estimates from 30 sub-Saharan countries with DHS surveys in the past decade. As expected, women with secondary or higher education have on average lower fertility than women with no education (3.4 vs. 6.3 bpw) Figure 6 also plots the wanted and unwanted components of fertility.

- *Unwanted fertility* is lowest among women with secondary education (average 0.5 bpw), largely due to their higher degree of preference implementation. However, unwanted fertility is higher among women with primary than with no education. This unexpected finding is partly explained by the fact that women with primary education have lower desired family size and therefore are exposed longer to the risk of unwanted childbearing after they reach their desired family size. Other possible contributing factors include a shorter period of postpartum infecundability (which reduced birth intervals) among

women with primary education compared to those with no education. Of course the implementation of preferences is much easier if women have ready access to a range of contraceptive methods, regardless of the education level.

- *Wanted fertility*. With rising education levels wanted fertility declines from 5.47 to 4.58 to 2.92 bpw for women in the no/primary/secondary+ groups. The main reason for these differences is an inverse relationship between desired family size and level of education. In addition, the proportion of women that does not reach their desired family size (e.g. because of infertility or non marriage) rises with level of education.
- *Timing of childbearing*. Highly educated women remain in school longer, are more likely to be employed before marriage and marry later than their counterparts with no education. On average in 30 DHS countries in sub-Saharan Africa, the median age at first birth ranges from 19.1 years for women with no education to 21.6 years for women with secondary + education.

3) Effects of measures to delay childbearing.

Keeping girls longer in school and making job training and jobs available for young women can delay the onset of childbearing. A rise the age at childbearing has two general effects: A tempo effect which deflates fertility temporarily (as long as the rise lasts) and a quantum effect which reduces both wanted and unwanted fertility

- *Unwanted fertility*: delaying the onset of childbearing and wider spacing between births results in later age at which the desired family size is reached. As result the number of years of exposure to unwanted pregnancy are reduced.
- *Wanted fertility*. Delaying childbearing raises the chance that a woman does not reach her desired family size before becoming infertile. It also raises the probability of never marrying .
- *Timing of childbearing*. Later onset of childbearing translates into a higher mean age at childbearing if birth intervals remain unchanged.

Empirical estimates of all these effects are lacking, but there is little doubt that different policy measures affect overall fertility through multiple channels.

Benefits from slower population growth

The population policy options discussed in the preceding section, if implemented, would have several beneficial effects:

-*Lower environmental impact*. Rapid growth in human numbers and in consumption per capita have raised demands on our natural environment to unprecedented levels. These stresses on ecosystems are evident in a range of adverse trends: rising food and energy costs, global climate change, widespread deforestation, loss of biodiversity, shortages of fresh water, depletion of soils and rising pollution levels. Prospects are bleakest for the poorest countries (many of them in sub-Saharan Africa) with limited natural resources and extremely rapid population growth (Alexendratos 2005). For example, by 2050 Niger's population is projected to quadruple in size–from 13 million to 53 million–even though arable land is extremely limited and threatened by desertification, and much of the current population lives on the edge of famine. Slower population growth would help relieve these stresses on the natural environment.

-*Reduced growth in demand for public services*. Low income countries tend to have poor public services (e.g. health care, education, municipal), a largely untrained labor force and weak infrastructure (roads, water supply, electricity, telecommunications etc.). As governments struggle to overcome these problems, the situation is made more difficult by the need to serve ever larger populations. In the most rapidly growing populations new services, new graduates and new infrastructure have to be created at a rate of 3 or 4% per year simply to maintain conditions and to prevent their deterioration. A reduction in the birth rate and in population growth makes meeting these demands on the health care and education systems and on infrastructure more manageable.

-*More rapid economic growth:* Rapid population growth and high fertility are among the key causes of poverty which in turn contributes to poor health. Conversely, rapid fertility decline creates a so-called "demographic dividend" which boosts economic growth for up to a few decades by increasing the size of the labor force relative to both young and old dependents and by stimulating savings (Birdsall et al 2001). Improved education is one of the key drivers of economic growth and a reduction in unwanted fertility enables families and societies to raise investments in human capital.

-*Reduced maternal and infant mortality* Strengthening family planning programs and delaying the onset of childbearing will have several beneficial effects on health: 1) *Decline in unwanted and mistimed births and abortions.* Unintended pregnancies result in large numbers of pregnancy-related deaths among women and infants (Singh et al 2003). Strengthening family planning programs will reduce unintended pregnancies thus averting a proportion of these deaths as well as other pregnancy related adverse health effects. 2) *Declines in high risk pregnancies*. The risk of adverse health effects and maternal mortality vary with age and parity. The highest risks occur at the lowest and highest ages and among nulli-parous and high parity women (WHO 1994). As fertility declines so does the proportion of pregnancies at high ages and high parities. In addition, delays in the onset of child bearing reduces the pregnancy related health risks among young adolescents. 3) *Wider birth spacing*. Short intervals between successive births are associated with higher mortality of infants at the beginning and end of the interval and contribute to maternal depletion (Conde-Agudelo et al 2006, Cleland et al, 2006) Increased use of contraception for spacing birth is an effective way to reduce infant and child mortality.

Conclusions

The unprecedentedly high rate of population growth over recent decades has raised concern about the potential adverse impact of this growth on social and economic development, on health and on the environment. This expansion of human members is expected to continue at a rapid pace over the next decades particularly in sub-Saharan Africa.

The preceding analysis points to a wide range of multi-sectoral options for governments that consider current and expected future population growth rates higher than desirable. Three key strategies are proposed: Strengthen family planning programs to provide women with the knowledge and means to regulate their fertility; emphasize human development, in particular education, gender equality and child health, and encourage delays in childbearing by addressing the needs of young people. To be fully effective in addressing the expected population expansion policies should include but also go beyond the provision of services. Voluntary fertility reduction as a societal development goal is best achieved through mutually reinforcing investments in family planning, reproductive health, and a range of socioeconomic measures. Such policies

operate beneficially at both the macro and micro levels; the same measures that slow population growth improve individual health and welfare.

The implementation of these population policies will bring multiple benefits including less environmental deterioration, slower growth in demand for health services, more rapid economic growth, declines in health risks associated with unwanted and mistimed births and abortions, and declines in high risk pregnancies.

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Table 1 Population estimates (1950-2010) and projections (2010-2050), countries in sub-Saharan Africa with population size over 10 million in 2005

	Population (millions)			**Percent Increase**	
	1950	2010	2050	1950-2010	2010-2050
Sub-Saharan Africa	183.5	863.3	1753.3	371	103
Nigeria	36.7	158.3	289.1	331	83
Ethiopia	18.4	85.0	173.8	361	105
DR Congo	12.2	67.8	147.5	457	117
South Africa	13.7	50.5	56.8	269	12
Tanzania	7.6	45.0	109.5	489	143
Sudan	9.2	43.2	75.9	370	76
Kenya	6.1	40.9	85.4	572	109
Uganda	5.2	33.8	91.3	555	170
Ghana	5.0	24.3	45.2	389	86
Mozambique	6.4	23.4	44.1	263	89
Côte d'Ivoire	2.5	21.6	43.4	761	101
Madagascar	4.1	20.1	42.7	393	112
Cameroon	4.5	20.0	36.7	347	84
Angola	4.1	19.0	42.3	358	123
Burkina Faso	4.1	16.3	40.8	299	151
Niger	2.5	15.9	58.2	546	266
Malawi	2.9	15.7	36.6	445	133
Mali	4.3	13.3	28.3	212	112
Zambia	2.3	13.3	29.0	466	118
Senegal	2.4	12.9	26.1	432	103
Zimbabwe	2.7	12.6	22.2	360	75
Chad	2.4	11.5	27.8	374	141
Guinea	2.6	10.3	24.0	294	132
Rwanda	2.2	10.3	22.1	375	115

Source: United Nations (2009)

Table 2 Population projections (to 2050), with and without AIDS for countries in sub-Saharan Africa with population size over 10 million in 2005

	Population in 2050 (millions)		
	With AIDS	**Without AIDS**	**%decline due to AIDS**
Sub-Saharan Africa	1753.3	1874.7	-6.5
Nigeria	289.1	306.9	-5.8
Ethiopia	173.8	180.8	-3.8
DR Congo	147.5	151.8	-2.8
South Africa	56.8	75.1	-24.4
Tanzania	109.5	121.0	-9.6
Sudan	75.9	78.2	-3.0
Kenya	85.4	95.2	-10.3
Uganda	91.3	100.7	-9.3
Ghana	45.2	46.9	-3.6
Mozambique	44.1	52.1	-15.3
Côte d'Ivoire	43.4	46.6	-6.9
Cameroon	36.7	39.9	-8.0
Angola	42.3	43.9	-3.6
Burkina Faso	40.8	42.0	-2.8
Malawi	36.6	42.8	-14.5
Mali	28.3	29.0	-2.6
Zambia	29.0	34.5	-16.0
Zimbabwe	22.2	28.0	-20.8
Chad	27.8	29.4	-5.4
Guinea	24.0	24.7	-2.9
Rwanda	22.1	23.6	-6.5

No-AIDS projection is not available for Madagascar, Niger and Senegal

Source: United Nations (2009)

Table 3 : Factors affecting future growth by projection variant

Projection variant	Factors affecting future growth
Standard	Young age structure, declining mortality+ migr, high fertility (wanted+unwanted),
Wanted	Young age structure, declining mortality+migr, high wanted fertility
Replacement	Young age structure, declining mortality+migr
Momentum	Young age structure

Table 4 Alternative projections to 2050 for sub-Saharan Africa and the 24 largest countries

	Population projections to 2050 (millions)				
	Standard	**Wanted**	**Replacement**	**Momentum**	**Baseline (2010)**
Sub-Saharan Africa	1753.3	1593.4	1281.9	1242.9	863.3
Nigeria	289.1	273.2	228.6	222.0	158.3
Ethiopia	173.8	150.3	130.8	125.7	85.0
DR Congo	147.5	135.5	103.5	99.9	67.8
South Africa	56.8	51.4	60.0	57.9	50.5
Tanzania	109.5	98.6	68.0	66.9	45.0
Sudan	75.9	71.1	64.5	61.9	43.2
Kenya	85.4	73.0	61.8	59.6	40.9
Uganda	91.3	77.4	53.5	53.0	33.8
Ghana	45.2	41.3	35.5	34.2	24.3
Mozambique	44.1	40.7	33.1	31.8	23.4
Madagascar	42.7	39.5	32.0	30.7	20.1
Côte d'Ivoire	43.4	39.9	33.5	31.8	21.6
Cameroon	36.7	34.2	29.4	28.2	20.0
Angola	42.3		28.8	27.5	19.0
Burkina Faso	40.8	37.0	25.7	25.3	16.3
Niger	58.2	55.5	26.3	25.5	15.9
Malawi	36.6	32.3	24.0	23.2	15.7
Zimbabwe	22.2	20.5	20.2	18.8	12.6
Senegal	26.1	23.8	19.6	19.7	12.9
Mali	28.3	26.3	18.8	20.1	13.3
Zambia	29.0	25.8	19.3	18.7	13.3
Chad	27.8	26.6	17.2	17.2	11.5
Guinea	24.0	21.8	16.4	15.8	10.3
Rwanda	22.1	20.1	15.6	15.0	10.3

Source: Based on United Nations 2009

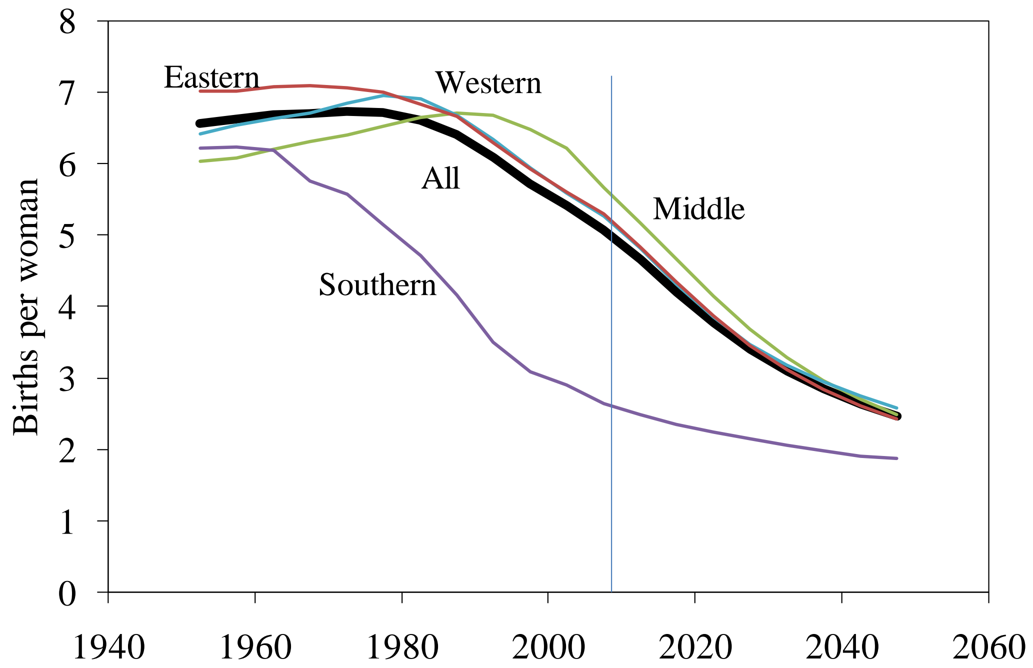
Table 5 Effects of components on population growth 2010-2050

	Components of population growth (%)			
	Unwanted fertility	Wanted fertility	Momentum	Total*
Sub-Saharan Africa	10.0	24.3	44.0	103.1
Nigeria	5.8	19.5	40.2	82.7
Ethiopia	15.6	15.0	48.0	104.5
DR Congo	8.8	31.0	47.2	117.5
South Africa	10.5	-14.3	14.7	12.5
Tanzania	11.0	45.0	48.5	143.0
Sudan	6.7	10.2	43.2	75.7
Kenya	17.1	18.1	45.9	109.0
Uganda	17.9	44.8	56.9	170.1
Ghana	9.6	16.1	40.7	85.8
Mozambique	8.5	23.0	36.0	88.6
Madagascar	8.0	23.5	52.3	111.9
Côte d'Ivoire	8.7	19.0	47.5	101.1
Cameroon	7.3	16.6	41.3	84.1
Angola			44.8	122.5
Burkina Faso	10.3	43.9	55.3	150.7
Niger	4.9	111.0	60.4	266.3
Malawi	13.2	34.5	47.9	133.1
Zimbabwe	8.0	1.6	48.6	75.4
Senegal	9.8	21.4	53.2	103.0
Mali	7.6	39.7	51.1	112.1
Zambia	12.3	33.5	41.3	118.4
Chad	4.5	54.1	49.8	141.4
Guinea	10.1	32.8	53.1	132.2
Rwanda	10.0	28.4	45.6	114.9

*Effects of components are multiplicative

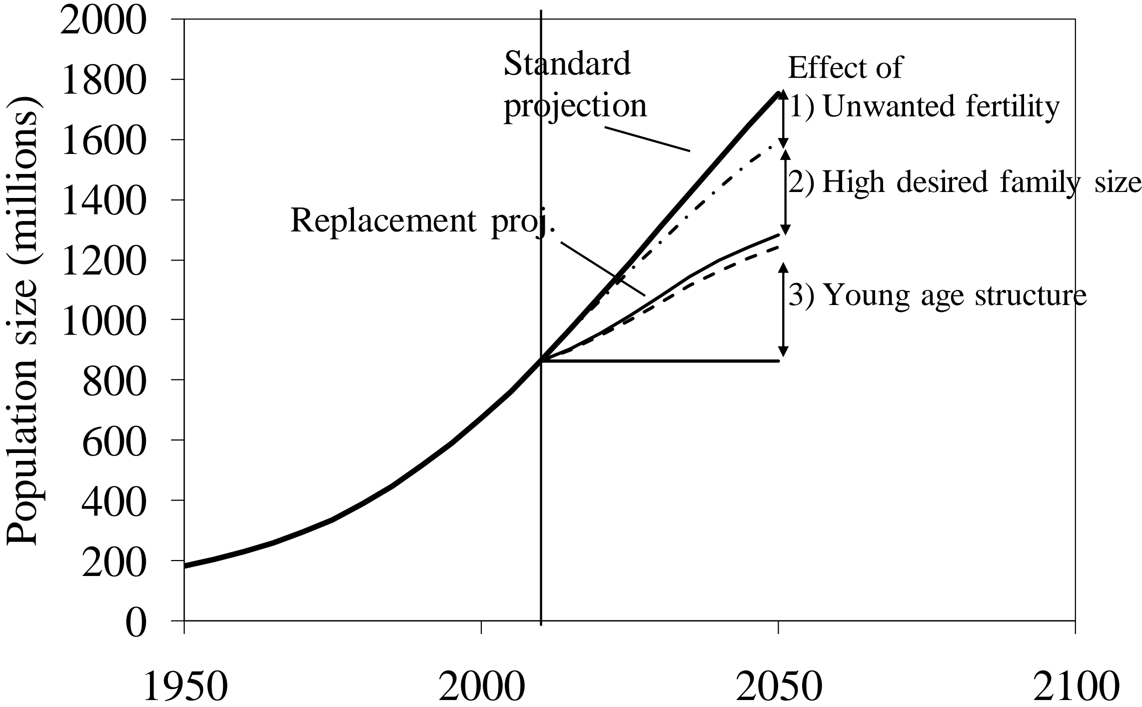
Source: Based on United Nations 2009

Figure 1: Total fertility rate, estimates 1950-2010 and projections to 2050, sub-Saharan Africa



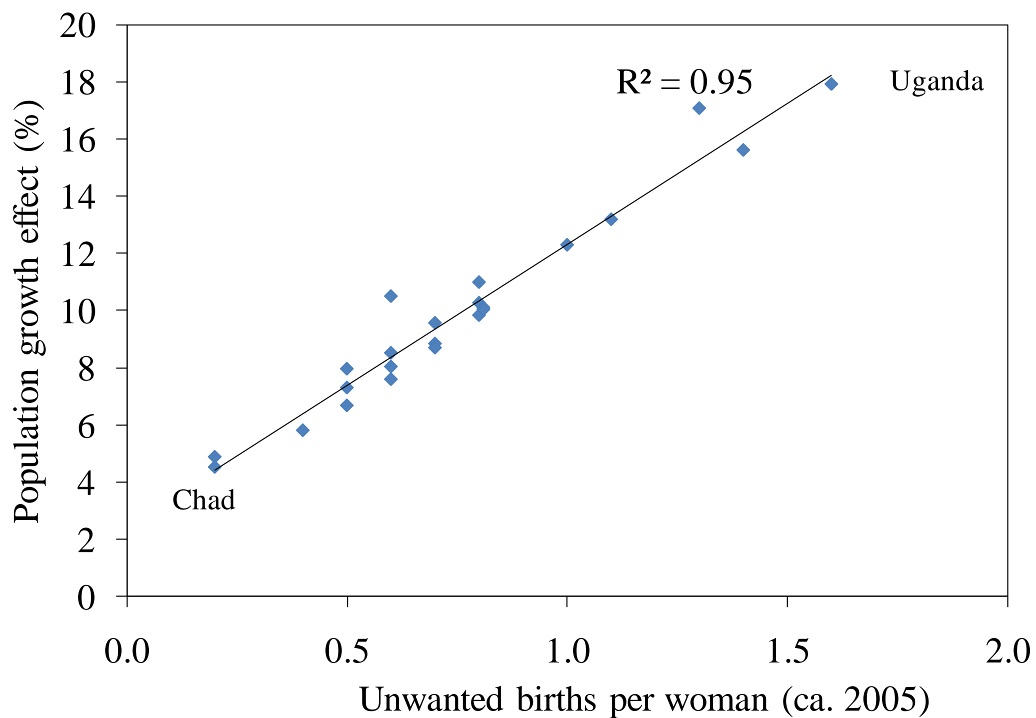
Source: United Nations 2009

Figure 2: Alternative population projections for 2010-2050 and effects of population growth components, sub-Saharan Africa



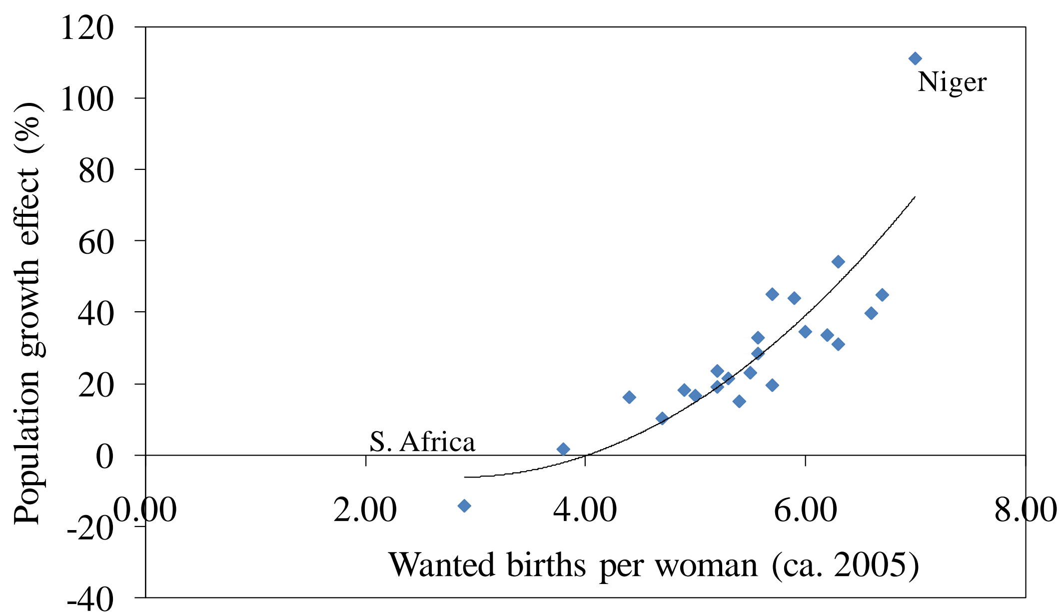
Source: Based on United Nations 2009

Figure 3: Population growth effect of unwanted fertility by current unwanted fertility, 24 countries in sub-Saharan Africa



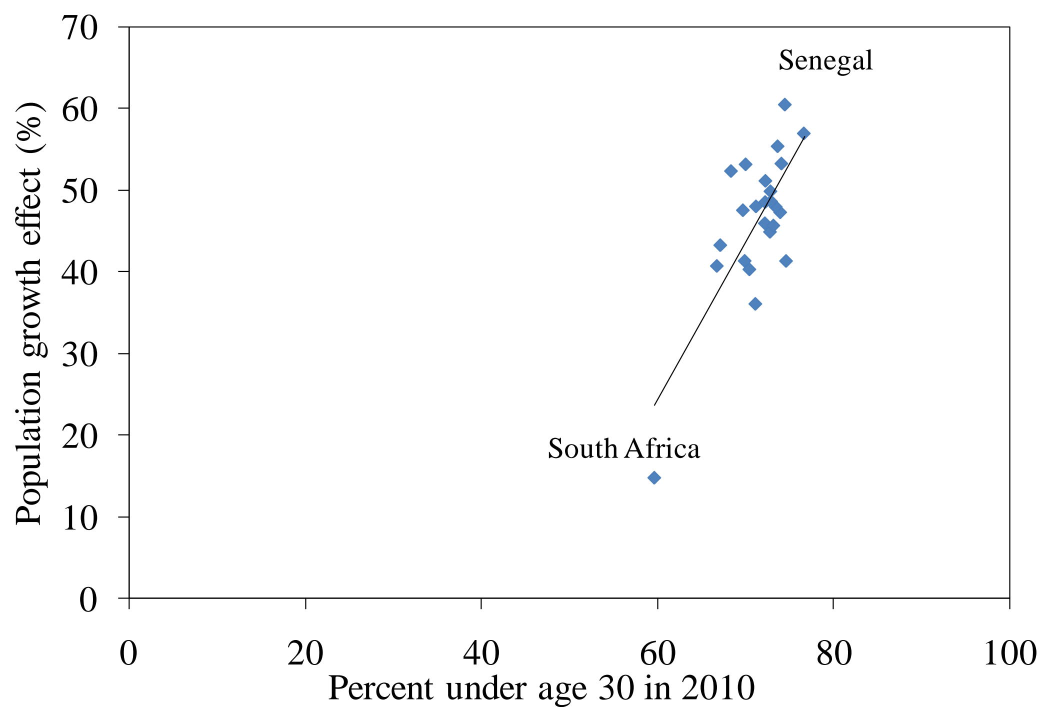
Source: DHS and Table 5

Figure 4: Population growth effect of wanted fertility by current wanted fertility, 24 countries in sub-Saharan Africa



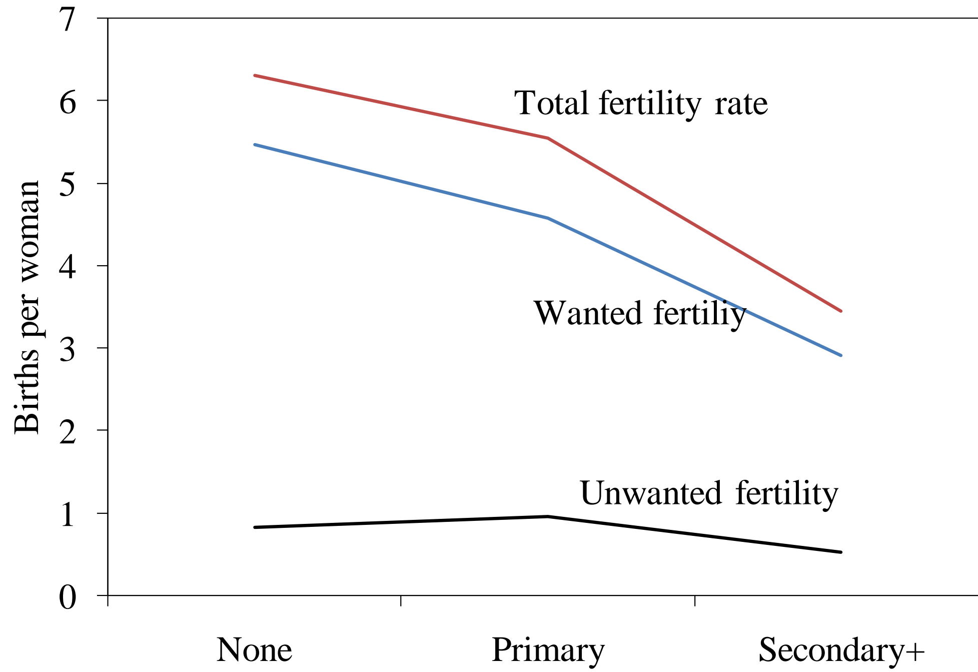
Source: DHS and Table 5

Figure 5: Population growth effect of momentum by proportion of population under age 30 in 2010, 24 countries in sub-Saharan Africa



Source: United Nations 2009 and Table 5

Fig 6: Total fertility rate and its wanted and unwanted components by education level, average of 30 countries in sub-Saharan Africa



Source: DHS