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Demographic Projections, the Environment and Food Security in Sub-Saharan Africa

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Abstract: Given above-average population growth, feeding sub-Saharan Africa's future population is an important challenge. This paper considers what we know about the relationship between population and food security and what population projections suggest will be the case over the next half century. It considers how the major sources of population change will affect food security in Africa during this period. Furthermore, it articulates the implications of population shocks, including HIV/AIDS and conflicts, on food security. The paper also discusses the implications of population increases on the environment and the use of land. Finally it suggests that land reform can be used to ameliorate some of the negative consequences of growth on food security.

Keywords: Population, food security, environment, HIV/AIDS, Africa, Development, malnutrition, natural resources.

JEL Classification: Q56: Environment and Development; Population Growth

1. Introduction

This paper considers what we know about the relationship between population and food security and what population projections suggest will be the case over the next half century. We cannot predict the constraints or possibilities that will determine future population trends, however population projections allow us to talk about the present and to appreciate the challenges of the future. The current size and pace of growth of the human population is unprecedented. The number of people to be fed in a population is determined by four possible flows: people enter or leave a population, by being born, dying, migrating in, or migrating out.

Demographers make projections under strong and conservative assumptions of a constant situation. Population projections are estimated on the basis of the basic components of population growth remaining constant. This assumption is necessary for projections. However, population forecasts are based on anticipated changes in the basic components of population growth. In the situation of no change, the population growth in Sub-Saharan African nations will continue to contribute to environmental degradation especially in situations where land holdings have become smaller and smaller. In the situation of positive changes such as declines in fertility, improved access to safe and nutritious food, increasing education, and land reform, population growth may not be a significant problem for food security.

There is a dynamic interrelation among population, food security, the environment, and natural resources (DasGupta 1993; Lutz et al. 2002; Sen 1999; UNCTAD 2010). Three crucial processes produce food insecurity: (1) food stocks—determined by the domestic production of food, and the capacity to import food for the population; (2) access to food—determined by the level of poverty and transportation and distribution systems within a given area; and (3) nutritional adequacy (a subject handled more fully in Thomas and Zuberi 2011). A food-insecure situation exists when necessary food stocks are not available to the population; and when there is insufficient access to food for the population to maintain consumption at adequate nutritional levels to maintain an active life style. Procuring adequate stocks of food and making them accessible to the population in need results in food security.

Population projections help us understand how current food insecurity may impact future populations. A key dimension of food insecurity is population undernourishment. Undernourishment remains a persistent problem in regions like sub-Saharan Africa (FAO 2009; UN 2009c). Estimates suggest that the population in sub-Saharan Africa suffering from hunger increased between 1990 and 2008 (FAO 2009). The current state of undernourishment is worse in sub-Saharan Africa when compared to other regions of the world in the recent past (UN 2009c). According to the United Nations sub-Saharan African nations have the highest percentage of people suffering from undernourishment (UN 2009c). According to the latest estimates, approximate 30% of the sub-Saharan population is undernourished. Importantly, these percentages vary widely among different sub-Saharan African

nations. This situation is further compounded by the projected growth of the African population relative to the rest of the world (Population Division ESA/UN 2011). In short, Africa will have a larger percentage of the world's population to feed. What this means is that Africa will be in an increasingly greater need of the total food production on Earth in order to sustain its food security.

The conditions for population growth in Africa were favorable in the 20th century and they are predicted to be even better in the 21st century. Population growth is imagined as a constraint on food security (DasGupta 1993; Lutz et al. 2002; and UNCTAD 2010). Here, the reasoning is due to the high fertility concentrated among individuals in poverty. Therefore, high fertility increases poverty, which is further related to a degradation of the land by placing pressures on agricultural production. These pressures then result in a growth of the population victimized by a food-insecure situation. If we assume that access to technology and food production processes remain constant, then these changes will put negative pressures on food security. Thus, if the population growth increases the size of the healthy population this could lead to pressures on the type of foods being produced both locally and imported. If a demand for more protein rich foods such as red meat is the result this could lead to increases in the prices of other types of food.

Africa's population growth is a result of increases in the number of people. This population increase is by definition a result of the demographic process. Is population growth a problem? No, it is a demographic fact. In fact, under every population projection scenario produced by the United Nations sub-Saharan Africa's population will increase. In the immediate future, Africa's population is going to achieve exceptional growth. Whether sub-Saharan Africa's population growth is a contributor to food insecurity is dependent on several factors. Underlying food security are issues of agricultural development, population health, climate change, and economic shifts that are directly related to the implementation of current technologies and the necessary governmental regulations to stimulate the implementation of these technologies as well as the resources to pay for the implementation of these technologies (Juma, 2011; Casale et al. 2010).

Given the fact of above average population growth, feeding sub-Saharan Africa's future population is an important challenge. For example, China has a larger population than the entire African continent, yet the Chinese can still feed themselves. In short, population growth itself is not the problem. We know that the African population is going to grow, and that this growing population will need to be fed; therefore, before concluding that this obvious situation is a constraint on food security we should begin by treating it as a challenge. Because, even if the rate of population growth is outpacing the capacity of Africa to produce its own food, the challenge for both Africa and the world is how do you change this situation. Likewise the current situation in Sub-Saharan Africa's food security is access and nutritional adequacy. If better access to food is not facilitated, and if better use of the local food is not fostered, then the food security situation will be aggravated. However, we also recognize that if

significant changes are not made to establish food security in Africa's near future, the challenges will only become exaggerated.

Food security will enhance African well-being. With 30% of its population suffering from chronic hunger and malnutrition, Africa has the highest percentage of undernourished people in the world (FAO 2009; UN 2009c). This food crisis in Africa is further aggravated by several population shocks and social and economic crises. The future offers the challenge of enhancing both the available food stocks and the access to these foods by the population. This paper will particularly focus on how changes in population composition are related to food security. We begin by discussing the general demographic factors of projected population growth in sub-Saharan Africa. In this first section we focus on the impacts of births and migration on population growth. We then take a closer look at mortality generally and morbidity and mortality from the HIV epidemic more specifically. We use these assessments as the basis of discussing various issues with a direct bearing on food security in sub-Saharan Africa, namely natural resources and environment, civil conflict, and land. We conclude with a few insights on food security in sub-Saharan Africa gained from the review.

2. Population Growth in sub-Saharan Africa

Population growth in any geographically defined areas can only come from two sources: birth and migration. The transformation in African population size is accompanied by the equally important changes in migration patterns and urban growth. Africa's natural environment is a result of the cumulative impact of human life and continues to change (Funk & Brown, 2009). In Africa, land scarcity and degradation of soils are major constraints on agricultural development (UNCTAD 2010). Patterns, rates of migration, and fertility are related to economic and social forces that influence where people reside and how they work and use land. The impact of changes in population, social and economic development, and environment have been mutually reinforcing. African populations must cope with increasing urbanization, food and water insecurity, and environmental changes.

Human population growth rates in sub-Saharan Africa accelerated in the 19th and 20th century as the impact of mortality decline began to settle (Zuberi et al 2003). This rate of growth reached a peak at 2.82 percent per year through 1980-1985 (Population Division ESA/UN 2011). Since this time population growth has been decelerating largely as a result of fertility decline. During the 2005-2010 period, the global population growth rate had reached 1.16 percent per year, and the rate is projected to decline to 0.34 percent by mid-century. During this same time period the sub-Saharan African population growth rate reached 2.45% per year, and the rate is projected to decline to 1.68% by mid-century.

The number of people on Earth will be significantly impacted by African population growth. This growth is the major challenge for understanding the relationship between population size and food security. Africa's relative proportion to the earth's human population will rise from its current 15 percent to an astonishing 22 percent by

mid-century. Comparatively, the population of Europe will decline from its current 11 percent to 8 percent during the same period. In part, this difference reflects the divergent trends and the growth rates of the human population. These trends are important for understanding the broader relationship between demography, environment, and food security. Shifts in population stocks are important for understanding the relationship between food security and land use, and also for understanding the relationship between food security and the environment.

The rate of fertility decline mentioned above has not been universal and varies greatly from country to country (Population Division ESA/UN 2011). The difference in population deceleration rates and population growth rates has different implications for different countries. Four African countries—Nigeria, Ethiopia, Democratic Republic of Congo, and United Republic of Tanzania, in order of population growth—are among the nine countries that will account for half of the projected population increase of the world by mid-century. In fact, at current projected rates Lagos, Nigeria and Kinshasa, Democratic Republic of the Congo will join the ranks of the 15 most populous cities in the world (Population Division ESA/UN 2009).

The highest fertility rates in the world are primarily to be found in Africa (Population Division ESA/UN 2011). Of the ten countries with the highest total fertility rates, 8 are in sub-Saharan Africa (UN 2009a). The trajectories of the current rate of decline in these countries and the rest of the world suggests that this situation will be the same at mid-century. While African fertility rates will continue to be among the highest, changes in the past 40 years and especially changes in the past decade suggest that fertility on the African continent will continue to decline. There may be a few exceptions however, such as the average number of children a woman will bear during her lifetime should continue to fall.

The percentage of the African population from ages 0-14 is projected to decline from its current 40 percent to 31 percent while the percentage of the African population between the ages of 25-59, the prime working ages, is projected to increase from its current 34 percent to 45 percent by mid-century (UN 2009a; Population Division ESA/UN 2011). What this means is that currently there are 416 million children between the ages of 0-14 on the African continent compared to 353 million adults aged 25-59. Compared to the mid-century projected population in which Africa would have a population of 546 million between the ages of 0-14 while the growth in the population ages 25-59 would increase to 892 million--twice as large as the current number.

Another major demographic impact of fertility decline and increased life expectancy is population ageing. Africa's population over the age of 60 is projected to increase from the current 6 percent to 10 percent by mid-century giving Africa the fastest rate of ageing among geographic regions (Population Division ESA/UN 2011). This is an important shift because it signifies a compositional redistribution of the African population. These changing proportions of child and elderly populations are an important shift because they signify a redistribution of the African population. It is

projected that there will be a lower dependency ratio on the population, thus resulting in a larger population available to participate in the workforce. The implications for food security are: an overall larger demand for food with a larger population available for agricultural labor and a larger demand from the sub-Saharan Africa population for agricultural output both domestically and internationally. Perhaps technological innovation will play a necessary and important role in enhancing the agricultural output locally on the African continent (Juma 2011)

The African continent consists of over fifty different countries. In 2010, the nearly 1 billion people living in Africa spoke over 800 languages and dialects. Between now and the middle of the twenty-first century, African population size is likely to increase from its 2010 level of about 1 billion to 1.4 billion in 2025 and up to 2 billion in 2050—more than double the current size. In 2010, over 800 million people lived in sub-Saharan Africa and the numbers are projected to increase to 1.2 billion in 2025 and nearly 2 billion in 2050 (UN/ESA 2009; Population Division ESA/UN 2011).

While the majority of Africans currently live in rural areas, the future of Africa is urban (UN/ESA 2010). The United Nations estimates that although sub-Saharan Africa is the least urbanized area (37.2 percent) in 2010 it is also the region with the highest growth rate (3.7 percent per annum) of the urban population. Africa is expected to increase its current 12% of the world's urban population to account for 20% of the world's urban population by mid-century.

Within sub-Saharan Africa, the United Nations (2010) estimates that southern Africa is the most urbanized sub-region (59 percent). By the early to mid-1990s, about close to one-third of Africa's population was living in urban areas (Chen and Zlotnik 1994; UN 1996), with an urban growth rate between 4.5 and 5 percent (UN 1996). This urban growth rate in sub-Saharan Africa is projected to systematically decline in every five years from 3.8% in 2005-2010 to 2.3% in 2045-2050 (Population Division ESA/UN 2011). It is not the urban population in Africa that has grown exceptionally by historical standards; rather it is the growth rate of urban populations that represents an unprecedented phenomenon.

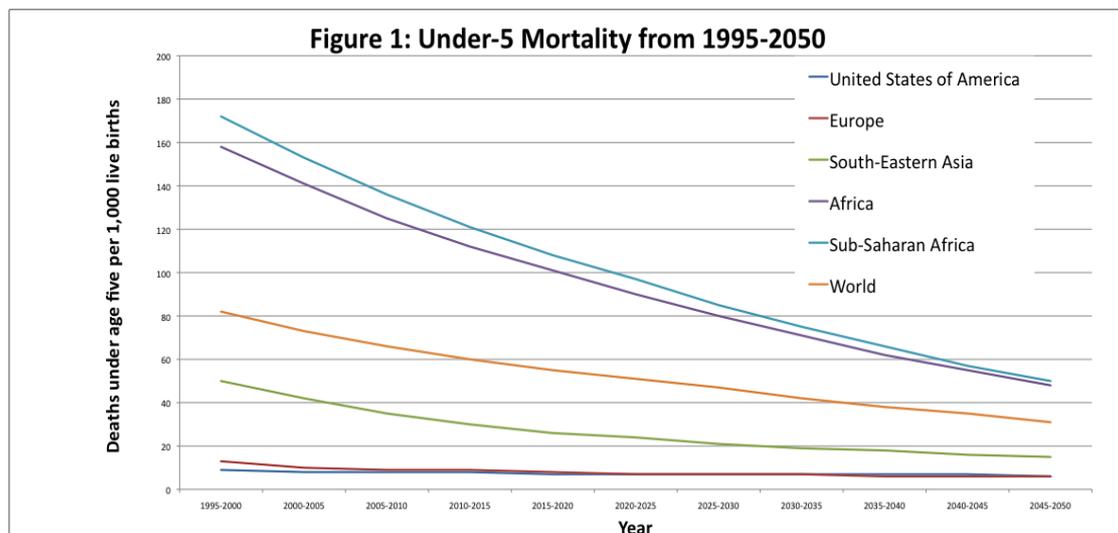
Increasing urbanization in sub-Saharan Africa is not so much about urban growth per se as its effects on the economy and the environment and the related rural areas from which many of the urban-dwellers migrate. However, historically urbanization has resulted in increased national productivity (Population Division ESA/UN 2010). Cities tend to attract businesses and jobs, and they bring together entrepreneurial resources to generate new ideas, practices, and technologies. And, these innovations have positive impacts on agricultural productivity (also see Juma 2011). Increasing rates of urbanization have also created a series of related problems: unemployment and underemployment in urban areas, poverty, crime, overburdening of social services, sanitation, and water and air pollution. Overall, this urban transformation is an important development; however, recent economic events suggest that the process is sensitive to shifts in the global economy.

3. Mortality

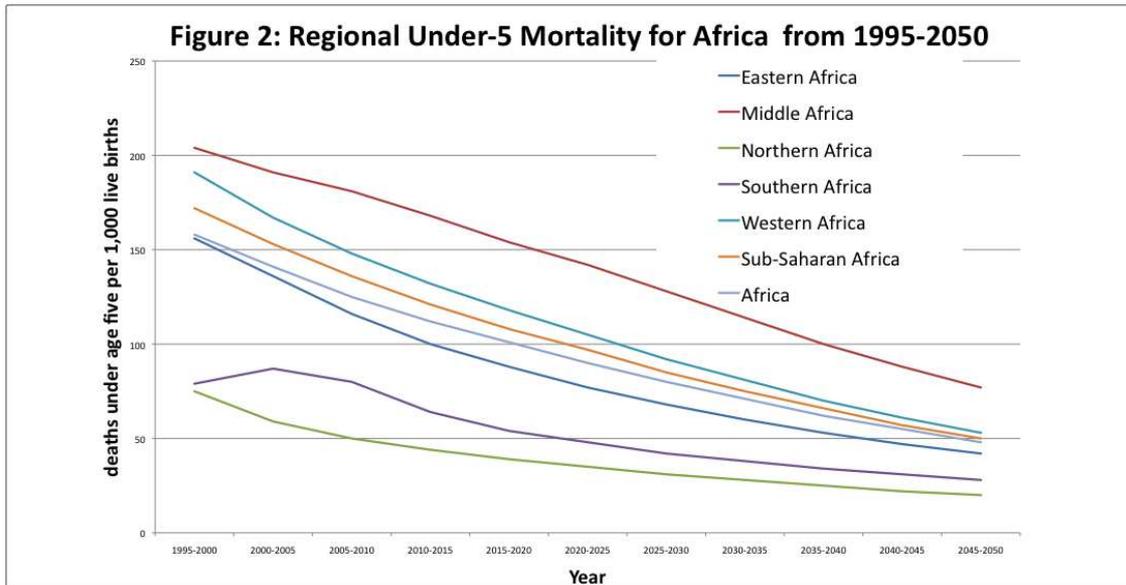
During the 20th century Africa witnessed its most rapid decline in mortality; however these improvements stagnated in the 1980s (UN 2009a). A significant amount of this stagnation was due to the HIV epidemic; however resurgence in infectious diseases such as tuberculosis and malaria also had a significant impact; and other factors such as the economic crisis, armed conflict, and famine have played a role. Under-five mortality is an important indicator of population health and child well-being.

Demographers typically measure under-five mortality as the probability of dying between birth and the exact age of five years. As such, child mortality has fallen in all countries, yet sub-Saharan Africa has lagged behind. By 2005 under-five mortality in South Central Asia declined to 76 deaths per 1000 births compared to the 136 deaths per 1000 births in sub-Saharan African (see Figure 1). Although the African rates of Under-5 mortality appear to be converging with the world average, these African rates continue to be substantially higher, and projections suggest a continuing convergence yet even by mid-century sub-Saharan African rates of Under-5 mortality are projected to be significantly above the world average.

Figure 2 provides a regional comparison of Under-5 mortality for the African continent. As expected, western and middle Africa suffer from the highest rates of Under-5 mortality while northern and southern Africa lead the way with the lowest Under-5 mortality. These regional variations should be kept in mind as we consider the impact they have on food security and the impact food security may have on these rates of mortality. The best way to think about the relationship between food security and child mortality is by looking at the prime causes of death for children under five.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision, <http://esa.un.org/unpd/wpp/index.htm>, Friday, June 24, 2011; 10:59:34 AM



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The reasons for the African differences in Under-5 mortality are a reflection of the various cause-specific contributors to difference in overall mortality. The prevalence of these specific causes of death is a first step in understanding the relationship between food security and Under-5 mortality. The most prevalent causes of death to sub-Saharan African children are malaria, diarrhea, pneumonia, other infectious diseases, and preterm birth complications (Black et al 2010). The most significant causes of death among children Under-5 in Africa is not from AIDS. The most important single causes of death to Under-5 sub-Saharan Africans were diarrhea, pneumonia, and malaria.

Demographically the number of children in sub-Saharan Africa is growing at a comparatively high rate, while the mortality rate among these children is declining. Food and disease among Under-5 children are directly related. Undernourished children are at a greater risk of several diseases that have an impact on the patterns of mortality among this age group (Black et al 2010). Under-nutrition is directly related to stunting, severe wasting, and deficiencies in vitamin A and zinc. These conditions are not typically presented as direct causes of death; however, they have been found to be an underlying cause in a third of the deaths in children younger than 5 years (Black et al 2008). Stunting, severe wasting, intrauterine growth restriction-low birth weight, are synergistically related to infectious disease and are a significant risk factor for Under-5 mortality (Black et al 2008 and Black et al 2010).

Studies of the relationship between food and child death would benefit greatly from a more expansive investigation of the relationship between malnutrition and the various subsequent causes of death. Typically, such an analysis would be conducted

using vital registration data as the numerator and population census data as the denominator. However, vital registration data are typically not available in sub-Saharan African countries with a few exceptions to be found in the Northern African region, countries like South Africa, and a few cities in West and East Africa. Quality vital registration data is simply not available in most of sub-Saharan Africa. A substitute could be found in the valuable verbal autopsy data being collected by INDEPTH projects and other sources in sub-Saharan Africa (For examples of the use of such data, see Bawah 2002 & Mswia 2006).

Over the first decade of the 21st century we have witnessed signs of increasing life expectancy in sub-Saharan Africa (Population Division ESA/UN 2011). In fact, life expectancy is projected to increase to age 67 in the years 2045-2050. And while this projected increase in life expectancy on the African continent is a promising scenario, it would still mean that Africa's population would have the lowest life expectancy on Earth. For example, African life expectancy will still be eight years lower than the life expectancy projected to be found in South-Central Asia at the same time. Even nations like South Africa that have been ravished by the HIV epidemic have life expectancy rates that are suggestive of a recovery. These positive signs will continue if efforts to reduce the expansion of the HIV epidemic prove successful, and efforts to treat the effects of the disease continue to show signs of progress.

4. HIV Epidemic

Food security is a consequence of and contributor to the HIV epidemic. The complexity of the HIV epidemic's relationship to food security is worthy of serious consideration. The factors contributing to the HIV epidemic differ by social economic and political considerations. Hence, different nations experience and respond to the HIV epidemic in different ways. Many sub-Saharan Africans confront multiple pressures such as social, health, political, and environmental. The HIV epidemic has been one of the major contributors to these pressures. In this way, HIV has been a shock to population growth and composition on the African continent.

Sub-Saharan Africa accounts for 72% of all global HIV deaths (Bongaarts, Pelletier, and Garland 2011). Consequently, compared to other world regions, it experiences the most deleterious consequences of the HIV epidemic on food security. These consequences are primarily concentrated in Southern Africa that has Africa's highest levels of HIV prevalence. Indeed, demographic projections suggest that HIV mortality has had what may be long-term consequences on the population composition of Southern African countries, primarily due to its considerable impact on mortality in the adult ages and among women (Population Division ESA/UN 2011).

These impacts of HIV on food security can be as detrimental as food insecurity has been on the epidemic. (Drimie and Gillipsie, 2010; Ferga et al. 2010; de Waal and Whiteside 2003). Moreover, HIV and secondary infections associated with the virus negatively affect the nutritional status of infected individuals (van Liere 2002; Ferga 2010). HIV impacts the population at the individual, household and societal level (See

Ferga et al. 2010; Drimie and Gillespie 2010). Individuals living with HIV have altered patterns of food utilization. HIV positive persons may experience increasing caloric requirements, while at the same time experiencing less appetite and reduced metabolism. For example, the HIV epidemic has contributed to problems in labor and problems for the laborer. The epidemic primarily attacked individuals in their prime labor ages and removes them ultimately from the labor force. This suggests that the epidemic has wider implications for food security across sub-Saharan African countries.

Other impacts of the epidemic are associated with the age and gender pattern of HIV mortality in sub-Saharan Africa. For example, HIV in sub-Saharan Africa is highest among women (Rehle et al. 2008). In terms of gender patterns, the concentration of HIV mortality among females has negative repercussions for the traditional significance of women for food security in sub-Saharan Africa. Since African women provide much of the labor needed for the production, processing, and marketing of food (Linares 2009), the adverse affects of HIV on females needs to be addressed in order to improve the region's food security outcomes. Across both sexes, however, HIV mortality is usually concentrated among the adult working-age population. The age pattern of mortality will have similar, though wider, implications for the supply of labor for food production and resources to buy food by households.

At the household level, HIV mortality has more immediate impacts on the availability of labor needed for food production (Also see Tibaijuka 1997). Moreover, deaths among adult household heads negatively affect both the supply of household labor and off-farm incomes received by households (Also see Gillespie and Kadiyala 2005). Related to the implications of HIV mortality within households are the morbidity consequences of the epidemic. The latter pose additional constraints to food security among households that bear the financial and physical costs associated with the long-term care of chronically ill HIV patients (Also see Haile 2005). Research in Southern Africa, for example, indicates that the burden of care faced by HIV households negatively affects the viability of farming livelihoods (Also see de Walle and Whiteside 2003). Without appropriate interventions to mitigate these morbidity-related consequences, the increasing use of anti-retroviral therapy (ART), which increases the life span of HIV patients, may further increase the medical expenses among households. In general, the financial and social costs associated with these burdens may in the long-run impact the capacity of households to meet their food needs and increase food insecurity. Individual food utilization impacts household access to food through HIV associated sickness and mortality. In most of sub-Saharan Africa, expenses for food make up a significant portion of the household budget. Changes in adult ability to generate income can significantly weaken the nutritional and financial profile of a household (Frega et al. 2010).

HIV positive persons may also suffer from the social stigma surrounding HIV. This negative stigma may impact the person's social capital and result in their loss of opportunities and access to social goods like education and jobs. Unlike the temporary shocks of many natural disasters, the cumulative impact of HIV can

contribute to social decline in a deeper way (see Frega et al. 2010; Drimie and Gillespie 2010). When a population suffers from an HIV epidemic the domestic production of food can be hampered. Southern Africa provides an example of these potential impacts.

Sub-Saharan Africa has the highest number of people living with HIV. The prevalence of HIV among adults aged 15-49 is estimated to be around 5% (UNAIDS and WHO 2009). This demographic crisis resulted in the mortality of around 1.4 million people. The HIV epidemic has had a tremendous impact on sub-Saharan Africa development (Fortson 2011). Nations with high levels of HIV experience unusually larger declines in education. The age distribution of mortality and morbidity from the virus among the cohort that compose the majority of the labor force negatively impacts economic productivity (Frega et al. 2010). While there is significant variation, sub-Saharan African nations can be categorized primarily as agricultural societies. Consequently previous research suggests that the HIV epidemic has had a significant impact on the agricultural workforce and thus a direct impact on food security. The social burden of care has reduced the ability of laborers in the household to earn a viable living from farming (de Waal and Whiteside 2003; Frega et al. 2010).

The influence of HIV on food insecurity is however more complex among young African children. Breastfeeding is a major nutritional source for newborn infants. HIV infected children are healthier when breast-fed rather than formula-fed (WHO 2008). Africa has the highest percentage of children dying from AIDS in the world at 4% (Black et al 2010). Almost all of these deaths to children occur in sub-Saharan Africa. Recent evidence suggests that breast-feeding results in much lower rates of HIV transmission to children in sub-Saharan Africa. Hence, exclusive breast-feeding has the potential to greatly enhance the survival rate of children born to HIV positive mothers (Black et al. 2008). Furthermore, antiviral treatment for pregnant or lactating women has also been shown to substantially reduce these resulting infections in sub-Saharan Africa. In the more extreme case however, mortality from AIDS have indirect consequences for the nutritional status of children whose parents died from HIV.

The impacts of the HIV epidemic on food security are negative; however, food insecurity also has negative implications for ending the epidemic. Food insecurity can impact the HIV epidemic (Gillespie and Kadiyala 2005 and Drimie and Gillespie 2010). Undernourishment increases the efficiency of HIV transmission through biological processes that decrease immunity and undermine the integrity of genital mucous.

5. Environment and Natural Resources

The reduction in mortality accompanied by the much slower decline in fertility characterized post-World War II African population growth. Important constraints influence the increasing size of African populations. These constraints have impacts on the growth rate of the population, and they are a major factor in the quality of life of the population. As indicated above, biologically, the population dynamics of mortality and reproduction determine the rate of population growth. In sub-Saharan Africa, both

environmental and social processes resist these dynamics and further regulate the rate of population growth, and the quality of life of the population (Zuberi et al. 2003).

Economic crisis, climate change and population growth interact in ways that will make sustaining food security a daunting task over the next 30 years for several African countries. Population interactions around the globe have increased, however most people in sub-Saharan Africa continue to eat food that is grown locally (Funk & Brown 2009; Garrity, et al. 2010). This trend is important when we consider that African countries tend to have weak purchasing power for food in the global market; however in some cases they rely on food imports. This weak condition leads to consumption deficits during times of high prices or declines in production. This situation might be reversed if African nations produced more food for growing populations while simultaneously combating poverty and hunger.

Natural resources like food, water, energy, land, phosphorus, and biological diversity can limit the size of the human population on earth. While there are various opinions about the carrying capacity of Earth, it has long been held that in situations of high populations growth, a natural constraint is obvious (Cohen 1995; Preston 1996; Pebley 1998). For example, if high population growth is not matched by increased food production, then food shortages relative to past consumption will follow. Natural resources are in part anthropogenic—the result of the influence of human beings on nature. How humans use these natural resources are also influenced by our social organization. The fact that there is enough fresh water for everyone on planet Earth does not automatically translate into everyone having access to a glass of drinkable water. The vast fertile soils, numerous water basins and rivers in sub-Saharan Africa do not automatically solve the food insecurity situation.

Africa is the continent most impacted by the lack of diffusion of improved technology for agricultural production (Juma 2011; Juma 2007; Evenson 1999). Global climate changes are projected to exacerbate the crises. While global integrations of biotechnological innovations in food production will offset famine, some local areas in Africa, like East Africa, are projected to face food shortages associated with the low levels of food production. Apparently, most of the populations in developing nations like sub-Saharan Africa depend on local food production (Funk and Brown 2009). The volatility of food prices makes local production important in food insecure areas like sub-Saharan Africa. The cost of maintaining access to food including the transportation costs make locally grown food that much more important (Also see Garrity 2010). In sub-Saharan Africa we can assume that the need for changes in agricultural production, changes in the climate, and increasing population are converging at this moment. Also it may be reasonable to assume that Africa will continue to have less purchasing power than other nations in the immediate future especially given the fact that imports are higher than exports (UNCTAD 2010). According to the United Nations (2010) 61% of the total sub-Saharan African labor force work in the agricultural sector, and the population of sub-Saharan Africa is projected to increase by nearly 1.1 billion persons by 2050, yet the continent could lose 247 million acres of farmland by the same date due to climate

change (See also UNCTAD 2010; Population Division ESA/UN 2011). This scenario defines the nature of the food security crisis confronting sub-Saharan Africa today and in the near future.

Food is one of the most important natural resources. Increases in agricultural productivity and a revolution in the capacity to manufacture and preserve food during the 20th century have enhanced the availability of food to feed larger numbers of people (Juma 2011). However, these improvements have not been sufficient to turn around the sub-Saharan food security crisis. Since the 1970s food production has tripled (UNCTAD 2010). In spite of this reality, nutritional inequalities persist throughout the world. The availability of food in African nations is defined by the domestic production and the capacity to import food from abroad, and the access of food depends on the purchasing power of the population and the food distribution system (Funk & Brown 2009; UNCTAD 2010; Garrity 2010). The net cereal imports of developing countries jumped from 30 million tons per year in the 1970s to 103 million tons in the 1990s and are projected to be as high as 260 million tons by 2030. Sub-Saharan African nations have been the hardest hit by the need for these imports. Food stocks are relative to population size. Therefore, if sub-Saharan African food stocks continue to decline relative to its growing population, then sub-Saharan African nations will need to increase their imports in order to make up the shortfall.

The local markets have traditionally produced African food stocks; however, recent shortages in the stock have resulted in increasing demands for the importation of food. The problem of feeding Africa's population reflects a regional problem. Eighty percent of the African diet is made up of maize, cassava, sorghum, millet, wheat, rice, plantains, and yams. Although, the bulk of this food is produced locally there are some important exceptions. Agricultural output in Africa has increased since the 1970s, however these increases in the production of wheat and rice have failed to see the pace of growth seen in other regions (UNCTAD 2010). These shortcomings are seen in the three major crops in Africa: rice, wheat, and maize. The combination of this shortcoming in agricultural production is further aggravated by recent economic downturn. For example, cassava, sorghum and millet consumption has been locally produced; on the other hand, the importation of wheat rose from 41% of African consumption in 1973 to 58% in 2006. Also, while 90% of Africa's rice is produced and consumed locally, many sub-Saharan African nations face a proliferation of local chronic food insecurities. These problems are a reflection of structural inefficiencies in food production at the local and regional level where food shortages are quite common (UNCTAD 2010).

The recent economic crisis led to an increase in the number of the under-nourished population from 923 million in 2007 to over 1 billion in 2009 (UN 2009c). The place with the highest proportion of undernourished population is to be found in sub-Saharan Africa where 30% of the people are chronically hungry (FAO 2009). This economic crisis may have contributed to the sub-Saharan African food security crisis.

Poverty and problems in the distribution system are major impediments to solving the undernourishment problem on the African continent (UN 2005; UN 2009b). While the

world's population has continued to grow, the number of people living in extreme poverty has fallen. Yet there is a lack of significant correlation between this apparent economic growth and improvement in the population's health as reflected in nourishment and education.

6. Civil Conflict and Population

The pestilent impact on Africa has been unpredictable, yet they have dominated the past 50 years. The more recent stagnation or reversal of mortality gains have been attributed to the poor performance of African economies, the rise of civil wars, and the continued prominences of diseases like malaria with the emergence in the last 20 years of new infections like HIV/AIDS. Certain social processes have also had a tremendous impact on population well-being, and these processes will continue to have an impact on African population and food security in the immediate future.

Sub-Saharan African population size seems to have an impact on increasing the likelihood of civil conflict (Bruckner 2010). Scientific studies of the impact of civil conflict and food security in sub-Saharan Africa are scarce. Civil wars, local conflicts, and other forms of social unrest have documented impacts on the production and availability of food (Allouche 2011; Gates et al. 2010; Clover 2002; Jenkins and Scanlan 2001). In fact, many recent occurrences of food scarcity in African countries are driven by the interaction of various forms of population pressures, environment challenges, and also include civil conflict (see Casale et al. 2010). During periods of conflict, food security is mainly compromised by direct attacks on the means of production, the failure to plan for food insecurity, and the use of food to reward allies or punish perceived enemies (Allouche 2011; Macrae and Ziwi 1992). Furthermore, as observed in recent conflicts in Sudan and Angola, hostilities can result in widespread hunger and starvation as a result of either limited access to vulnerable populations by aid organizations or the large-scale victimization of civilian populations by their governments (Allouche 2011; Clover 2002). The victims often survive and bear the scars of the conflict. For example, in Burundi and Rwanda orphanhood was more likely to result from armed conflict than from HIV/AIDS related deaths (UN 2009c).

A more obvious impact of African conflicts is their immediate effect on the disruption of food production and distribution systems (Jenkins and Scanlan 2001). This disruption can come from the targeted recruitment of fighters, from food producers in the working age population, by militias and by other warring parties. During the civil war in Sierra Leone, for example, both the Revolutionary United Front (RUF) and the Civil Defense Forces (CDF) heavily recruited fighters among rural farmers (Richards 2005). The impacts of conflicts, however, extend beyond targeted recruitments to more direct threats to existing food stocks. For example, during Liberia's civil war in the 1990s, rural farmers had their food confiscated by rebel forces before being allowed to move on to safer locations (Macrae and Ziwi 1992). Warring parties also sometimes use scorched-earth policies that include burning down farms, food stocks, and the means of food production (Flores 2004). Land mines also restrict population mobility during conflicts and can negatively affect food production and distribution

networks even after all hostilities have ended (Macrae and Ziwi 1992). Evidence suggests that guerrilla warfare in some sub-Saharan African countries sometimes create localized famines even in areas where fertile agricultural lands are widely available (Kalipeni and Oppong 1998). Moreover, evidence suggests that violent conflict may cause household hardship in sub-Saharan Africa (Lombe 2010)

Another critical demographic shock resulting from conflicts is associated with the impact of hostilities on population mobility and redistribution (Allouche 2011; Clover 2002). Conflict and persecution are major reasons why populations move from their homes, either within their own country or beyond their national borders. Such forced migrants (both internally displaced persons and refugees) face unique challenges that constrain their ability to produce, stock, and consume food. These consequences are exacerbated by the protracted nature of African conflicts, many of which last for more than a decade (Jacobsen 2002). As forced migrants flee their usual places of residence, they invariably move further from known sources of food. Their flight to more secure destinations is usually long and arduous, sometimes lasting for several weeks (Brennan and Nandy 2001). Yet, during this period, forced migrants are exposed to repeated episodes of hunger, malnutrition, and starvation. On arrival at safe destination areas, refugees and other displaced persons are usually assembled in resettlement campus, where the lack of resources and limited freedom of movement diminishes their ability to pursue sustainable livelihoods (Jacobsen 2002). Over time, residents of refugee and displaced camps become significantly dependent on food aid. However, these supplies are usually insufficient in quantity leading to frequent nutritional crises among forced-migrant camp populations (McGregor 1994).

7. Population and Land

African population growth has been at much higher rates than in any other region in the world (Population Division, ESA/UN 2011). This faster rate of population growth presents serious challenges for the issue of food security. The African population is expected to increase by over 360 million to 1.2 billion by 2025, and by over a billion to 1.9 billion by 2050. In fact, food production is barely keeping pace with African population growth. Many African farmers have been meeting these population challenges by intensifying their production beyond the point of being environmentally sustainable (UNCTAD 2010; Seo & Mendelsohn 2006).

Africa is experiencing shrinking availability of land for people to work. Africa could lose 247 million acres of farmland by 2050 due to changes in the climate (UNCTAD 2010; Seo & Mendelsohn 2006). Climate change in Africa is a real concern that will impact the masses of the population, especially the poor who depend on agriculture as a livelihood and a source of nourishment (For an example see Drimie and Gillespie 2010). This issue is especially acute in areas associated with specialized crop production and livestock farming, particularly in arid and semi-arid regions in Africa. Unfortunately, these are also the areas with the highest levels of fertility.

Water is a major source of food, and is essential for population health and sanitation and agricultural activity. Water is essential for agricultural activity, and safe water is important for the health of the population. Only 58% of the population in sub-Saharan Africa currently has access to safe drinking water, and this problem is growing along with increasing urbanization of the population (Banerjee & Morella 2011). Urban growth has been outpacing the development of sources of clean water.

The leading causes of infant mortality are a result of serious waterborne illnesses such as infectious diarrhea (Banerjee & Morella 2011; Black et al. 2010; Black et al. 2008). Access to clean water is one of the main challenges for African food security. Access to water in Africa differs by rural and urban regions with rural areas being more dependent on surface water (42% of the rural population). African nations have been increasing their access to clean water; however, the size of the population growth has outpaced these efforts and the number of people dependent only on surface water has increased significantly. As the rate of introducing improved sources of water increased the population growth outpaced access to clean water. In fact, in rural areas the main source of improved water (43% of the rural population) comes from boreholes. Access to clean water varies across nations. Countries with a larger urban population tend to develop the capacity to provide more piped water and sand posts in rural areas than other areas.

Directly related to water is the issue of sanitation, and the overwhelming majority of Africans in both the urban and rural areas who commonly use traditional pit latrines (Banerjee & Morella 2011). Improved sanitation in the form of septic tanks and improved latrines are rare facilities and accessible by less than 20% of Africa's population, and less than 10% of Africa's rural population has access to such facilities. Over 90% of the African population has access to traditional latrines, however the prevalence of open defecation in Africa is on the decline. Africa is predominantly a rural continent. This segment of the African population depends on its water supply to come from unsafe sources such as surface water followed by wells and boreholes.

The pressures of population growth and urbanization may have major impacts on the future availability of agriculturally productive land mass. Growing population and scarcer land are population pressures that will increase in the near future. Africa population growth results in more available laborers, yet, it also results in higher population density. Sub-Saharan Africa currently has 35 persons per square km, and this population density will more than double to 81 persons per square km by mid century.

Africa is producing a higher rate of laborers relative to other areas in the world. In fact, Africa is contributing to the laboring population of other continents via migration. Each year African births enter the labor force after 13 to 21 years of childhood and education. Even as the fertility level declines, the child population will continue to grow at a slower rate as infants age. This translates into more workers per dependent person in the population. The dependent population is defined as children (ages 0 to 13) and the retired elderly (60+). This population opportunity offers more hands to

help find solutions to the challenges of food security. The types of future solutions to Africa's agricultural production needs must address these realities. As more productive technologies are introduced, and the land mass used for agriculture declines, the management of the larger agricultural labor force will call for more innovative use of this important source of human capital. For example, small-scale food production may be a feasible strategy to address some dimensions of both the labor challenges and nutritional needs of the rural poor (Faber and Drimie 2010).

This window of population opportunity is beneficial only if productive labor exists or is created for the growing population of young adults. If this population opportunity is not seized then unemployment, migration and other forms of social dislocation will follow. It is this group that requires a much more dynamic and productive agriculture. The group also needs more education to allow for transitions to productive labor in the growing urban areas. Improvements in agricultural techniques, and the growing population will mean less demand for agricultural labor during the period of this population opportunity. The window of population opportunity closes as the population ages and the number of individuals entering the retirement-age rises 35 to 50 years later.

In terms of agricultural labor-intensive societies, this growth in population means the shrinking availability of land for people to work (Lipton 2009). Growing population, scarcer land, low and declining non-farm employment options increases pressure for land reform. Land reform has the potential to reduce large inequality in rural land rights, and thus cut poverty. This is what land reform has done in the past for so-called developed nations and it has the potential to do the same on the African continent.

Population growth and finite land suggest a demographic urgency for changes in the way that land is viewed at the national level. Most African nations are confronted with this demographic urgency of land reform on the African continent. Basically, many of the poor need technology and rural infrastructure to provide income, affordable food, and better opportunities for their children's education and health care (also see Juma 2011). The relationship of land to agricultural productivity is direct. Agriculture is produced on land. The relationship of land tenure systems on the future of food security in Africa is an important element in the equation. Land ownership has an impact on the use of agricultural laborers, and the degree that rural populations have access to land for productive labor. The transferring of user rights of large tracts of sub-Saharan land for foreign investment is on the rise (Robertson and Pinstrup-Anderson 2010). These acquisitions may have a negative impact on agricultural production in sub-Saharan Africa, and they have the potential to displace rural laborers and small farm holders.

Many African nations rely on foreign aid to meet a significant share of their food needs (UN 2009d). With nine of the top ten food insecure countries in the world located in sub-Saharan Africa, such aid is essential. These food security crisis nations in sub-Saharan Africa are also the largest transferors of user rights to foreign nations and corporations. Finally, possession of land is a major determinant of households'

productive abilities, and it may determine the households' capacity to invest in agricultural development.

Population insights on food security

Better data are needed in order for us to gain a better understanding of the relationship between causes of death and food security. Given the lack of quality vital registration data in sub-Saharan Africa, more support should be given to the efforts to collect verbal autopsy data in sub-Saharan Africa.

Africa is becoming more dependent on imports to meet its food needs. This situation has the potential to produce consumption deficits during times of high prices on the international markets or declines in sub-Saharan African production. This situation might be reversed if African nations produced more food for growing populations while simultaneously combating poverty and hunger. Aid directed at alleviating the high cost of food on international markets might also help.

The need for investment in sub-Saharan African agriculture is tremendous. If investment shortfalls continue food security may be intensified. Following the economic crisis and food security crisis in sub-Saharan Africa many nations are pursuing private investments in their agricultural sector. It is important that sub-Saharan African governments ensure that affected populations are given a voice in these transactions and compensated for losses they may incur.

If better access to food is not facilitated, and if better use of the local food is not fostered, then the food security situation will be aggravated. If significant changes are not made to establish food security in Africa's near future, the challenges will only become exaggerated.

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