

We present here edited excerpts from **OPTIONS**, published by IIASA (International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria).—JM



Population, AIDS and Sustainable Development in Southern Africa by Wolfgang Lutz Leader, the IIASA Population Project

For the past ten years IIASA has been working on interdisciplinary models of Population-Development-Environment (PDE) interactions in individual countries and regions. The scientific aim of these studies is to gain a better understanding of the complex ways in which population trends and environmental change depend on each other. Because these dependencies are mediated by social, economic, political and cultural factors, a meaningful analysis of specific settings requires a case-study approach.

IIASA's case studies are based both on more traditional descriptive analyses from multidisciplinary perspectives and on interactive computer models. Such models can be used to demonstrate the long-term implications (typically to 2050) of alternative trends when interdependencies between the various aspects are considered.

The models are also powerful facilitating tools for work across different disciplines and for science-policy communication.

Current PDE studies focus on Namibia, Botswana and Mozambique. Early feedback from the studies indicates that the AIDS epidemic poses major new scientific challenges to the study of the future of these countries.

A Region in Crisis

Few other world regions are confronted with social, economic and environmental challenges comparable to those of the Southern African Development Community (SADC) region. While some SADC countries still have among the highest fertility rates in the world, life expectancy has recently fallen sharply by up to 20 years due to the AIDS epidemic.

For all we know, the epidemic has not yet reached its saturation point. First projections presented here, based on new methodologies incorporating the dynamics of HIV infection, show that quite apart from the tremendous degree of personal suffering associated with millions of premature deaths, serious societal

and economic consequences can be expected due to AIDS orphanhood, health expenditures and the significant loss in skilled human labor.

Significant investments in education seem to be a priority issue for the coming years both in improving reproductive health and fighting the further spread of the epidemic, as well as in training the younger generation that will have to quickly take over the work of those who prematurely die. Because slow human capital formation and the lack of skilled labor are already major problems for economic development in the region, strong additional efforts are required in this field.

In many of the SADC countries scarce water resources are also a major bottleneck for long-term development. For this reason the IIASA studies incorporate sophisticated water, soil erosion and wildlife models into the comprehensive longer-term models for evaluating alternative paths toward sustainable development in the region.

Fertility and Literacy: More than Education at Stake by Anne Goujon

Levels of education stratify the population into different patterns of demographic, economic and environmental behavior. Education is related to fertility, and hence population growth. Studies worldwide have shown that more children are born to women with lesser education, and the chances of survival for these children are lower. Levels of enrollment also determine the future amount and quality of human capital available in a country, which is one of the most important keys to social and economic development. In addition, education is essential to society's ability to cope with new challenges and hence to the achievement of sustainable development.

Figures on education in SADC countries show a region with two speeds of development. In Angola and Mozambique, more than 70 percent of the female adult population—and 40 percent of men—was still illiterate in 1995. Furthermore, enrollment has been decreasing during the last 15 years in Congo, Mozambique, Tanzania, and Zimbabwe. In those countries, civil wars and social and economic crises have disrupted the education sector. This will have lasting effects.

On the other hand, Botswana, Lesotho, Malawi, Mauritius, Namibia, Swaziland, Seychelles, South Africa, and Zambia have registered high enrollment

growth rates for both sexes and at both primary and secondary levels. Illiteracy rates have been decreasing fast. However, enrollment in tertiary education is still below 5.0 percent in Malawi, Botswana, Lesotho, and Zambia. Most of these countries are in the early stage of the transition to lower levels of fertility. The achievement in terms of educational attainment may speed up the decline of the population growth rate and influence positively the development process.

Population and Education in Tanzania

Figures 1 and 2 show the population of Tanzania by age, sex and level of education in 2046 according to two scenarios. In the first scenario, all projection parameters—fertility, mortality and transition between levels of education—are kept at 1996 levels. The total fertility rate (TFR) is 6.4 for women with no education, 5.9 for women with incomplete primary education, 5.4 for women with a complete primary education, and 3.2 for women with a secondary education or more.

Life expectancy at birth is kept constant at 1996 levels (i.e., no further impact of AIDS considered here): 50 years for men and 52.8 years for women. Twenty percent of male children leave school with less than a primary education (30 percent for female) and 80 percent have a primary or higher education. The resulting population in 2046 is 115 million people, more than triple the 1996 population of 31 million.

In the second scenario, fertility declines to lower levels, to a TFR of 2.5 for women with no education and 1.3 for women with a secondary education or higher. Enrollment levels increase regularly through the 1996-to-2046 projection period so that by 2046, all children will have at least completed primary education and 80 percent of all children—male and female—will have at least a secondary education.

Only mortality is kept constant at 1996 levels. The population growth is much lower, with 61 million in

2046. Also, the educational composition implies a much more productive labor force.

Bridging Regional Gaps: A Major Challenge for Namibia by Riikka Shemeikka

In addition to wide variations among the SADC countries, there are also remarkable differences within the countries themselves. Namibia is an example of such a country.

In Namibia, educational levels differ between the country's regions. In the Khomas and Karas regions, about half of the population aged 15 years or older had a secondary or higher education, whereas in Kunene and Omaheke, almost half of the population of that age had no formal education, according to 1991 data. In the 1993/94 National Household Income and Expenditure Survey, average annual per capita income was more than 10 times higher in Khomas than in Ohangwena.

Wide regional differences also exist in employment opportunities, school standards, the land tenure system and many other fields of life. Also, demographic characteristics such as fertility and mortality vary between the regions. IIASA's analysis is based on three so-called Socio-Ecological Regions (SER) of Namibia.

In addition to regional differences, there are wide urban-rural and intra-regional differences, especially in the wealthier regions. Differences between the language groups are even more pronounced than those between the regions. The highest standard of living is among German, English and Afrikaans speakers and the lowest among San, Rukavango and Lozi speakers. The UNDP Human Development Report 1997 states that in Namibia some language groups are living with qualities of life comparable to Luxembourg or Greece

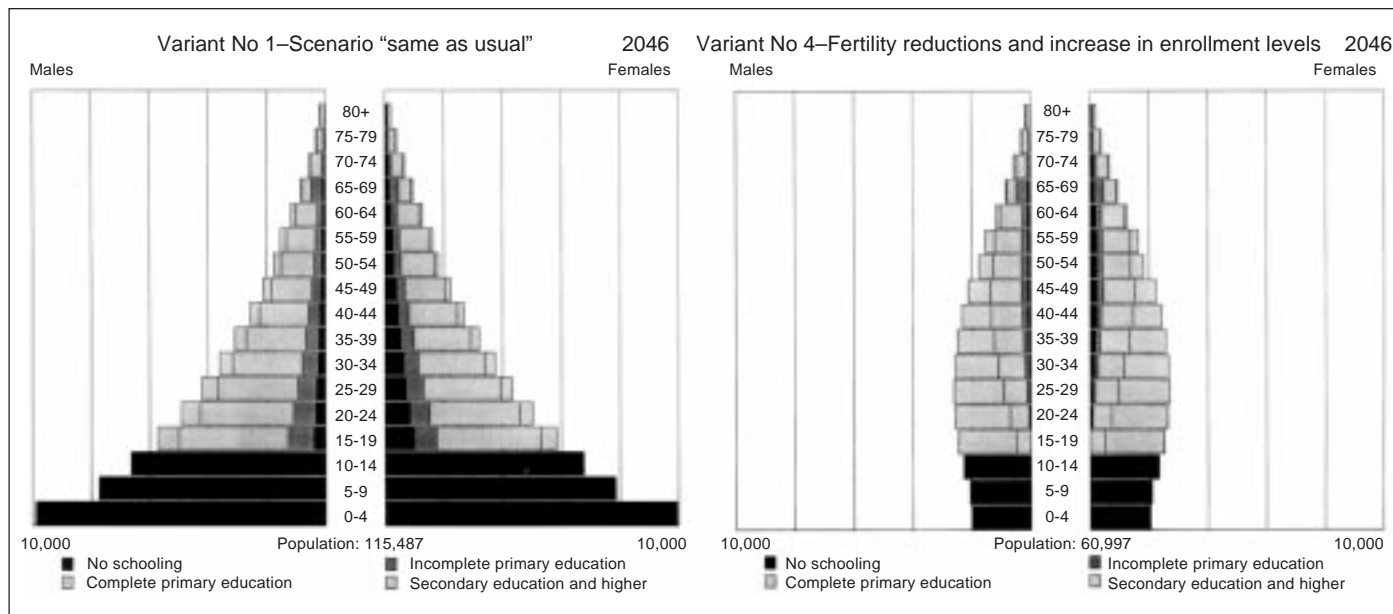


Figure 1. Population of Tanzania, Scenario 1

Figure 2. Population of Tanzania, Scenario 2

while others live at the level of Ethiopia or Mozambique.

Regional disparities in Namibia have their roots in the country's colonial history, particularly in the policy of ethnic segregation. The challenge of equal regional development is made even more severe because the vast majority of the population lives in the northern regions. There is also increased migration to the capital, Windhoek, located in the Khomas region, and to other urban localities. Among other problems, fast and unplanned migration puts pressure on the scarce natural resources in receiving areas, especially the safe water supply. The government is aware of the regional development problem and is working toward policy solutions.

AIDS in Southern Africa: Adjusting the
Data, Projecting the Impact
by Warren Sanderson

HIV infection is more widespread in Southern Africa than in any other region of the world. In some countries it is already so widespread that its effects are likely to be comparable in magnitude to the worst epidemics ever recorded in human history.

The most commonly available data on HIV in Southern Africa come from "Sentinel Surveillance Surveys." In these surveys, blood drawn from pregnant women seeking prenatal care is also tested for HIV. These tests are typically done anonymously and without any other deviation from the normal protocol of a first prenatal care checkup. As a rule, neither the women nor the doctors are told the result. There are no surveys for males that are comparable in scope.

Researchers in IIASA's Population Project have devised a new and still experimental methodology for adjusting observed prevalence rates from Sentinel Surveillance Surveys for different sources of bias and for using the corrected data to project future populations. They ran the new model using Botswanan Sentinel Surveillance data for 1993 and 1997 to determine prevalence rates by age, sex and education. They used those prevalence rates to compute new infection rates (technically speaking, incidence rates) for people whose behavior renders them susceptible to HIV. These projected incidence rates are based on assumptions concerning the relationship between prevalence and incidence rates and concerning possible future behavioral changes.

Assuming three population paths for Botswana from 1993 to 2020, the uppermost path shows what would have happened in Botswana, given the assumptions about fertility and mortality change, if HIV were nonexistent. It assumes that no one was infected with HIV in 1993 and that no subsequent infections occurred. The population rises nearly linearly, from 1.36 million in 1993 to 2.33 million in 2020.

The lowermost path takes the same assumptions about fertility and mortality, and shows what would happen assuming current (corrected) levels of HIV prevalence and no change in behavior. In this case, the population grows to a maximum of 1.52 million in 2001 and then decreases at an annual average rate of 1.2 percent per year to 1.28 million in 2020. This is more than one million people less than in the projection without HIV.

A third, middle path shows what would happen if, starting in 1998, risky sexual behavior substantially decreased among people reaching reproductive age. The susceptibility of people already in the reproductive ages is assumed to remain unchanged. The result is a Botswanan population of 1.43 million in 2020 instead of 1.28, an increase of 11.5 percent. In this case, the population of Botswana is only slightly less in 2020 than it is in 1998.

In all of the many projections done for Botswana, except those that postulate rapid and substantial behavioral change at all age groups, the country would experience either population shrinkage or very slow growth between now and 2020. Even after adjustment for all the biases discussed above, the high HIV prevalence rates in the Sentinel Surveillance Survey data imply substantial reductions in population growth, substantial changes in the age structure, and significant losses of human capital.

Similar research on Namibia, although not as advanced as that on Botswana, suggests that large effects of HIV will be experienced there as well.

IIASA's work indicates the likelihood that the high and rapidly growing HIV prevalence rates seen in the Sentinel Surveillance Survey data for Southern Africa could translate into death rates high enough to carry away a third or more of the young adult population over the course of a decade. Because of the rapid spread of HIV during the 1990s, the death rate peaks will be roughly synchronous across many of the region's countries. How this is likely to affect the economies of those countries and their economic interactions with one another remains high on IIASA's agenda for future research.

When countries are faced with the potential of such high young adult death rates, it is natural to ask what should be done. IIASA does not have any special expertise when it comes to answering this question. Public education programs would certainly be helpful, as would campaigns to reduce the prevalence of other sexually transmitted diseases, because these often facilitate HIV infection.

IIASA's Population project can, however, say something about the data. Given the seriousness of the matter, the data on HIV in Southern Africa are pitifully poor. Virtually no large-scale data exist on men in the entire region. The data on women require substantial adjustments, which require plausible, but untested, assumptions.

In its research, the Population project has tried to confront the biases inherent in the Sentinel Surveillance Survey data and make appropriate adjustments. Researchers have found that even after these adjustments were made, the demographic effects of HIV in Southern Africa are still likely to be very large. Ignoring the message in the Sentinel Surveillance data should no longer be an option.

And from our e-mail, on a lighter note:

The Y0K Problem

Translated from a Latin scroll dated 2 B.C.

My dear Cassius:

If you are well, that's good. I also am well. Or I would be if it were not for the Y-zero-K problem. Are

you still working on it? This change from B.C. to A.D. is giving us a lot of headaches and we haven't much time left. I don't know how people will cope with working the wrong way around. Having been working happily downwards forever, now we have to start thinking upwards.

You would think that someone would have thought of it earlier and not left it to us to sort out at the last minute. I spoke to the Emperor the other evening. He was livid that his Uncle Julius hadn't done something about it when he was sorting out the calendar. He said he could see why Brutus turned nasty.

We called in Consultus, but he simply said that continuing downwards using minus B.C. won't work, and as usual charged a fortune for doing nothing useful. Surely we will not have to throw out all our hardware and start again? Macrohard will make yet another fortune out of this, I suppose.

Table 1. HIV prevalence rates for Sentinel Surveillance surveys: recent data for 20 to 24-year-old women in selected Southern African locations

Place	Urban/Rural	Year	Prev. Rate
Botswana			
Gaborone	Urban	1997	41.3
Chobe District	Rural	1995	39.3
Malawi			
Lilongwe	Urban	1996	24.2
Kasina (Central Region)	Rural	1995	11.1
Namibia			
Ten Site Sample	Urban/Rural	1996	18.1
South Africa			
National Sample	Urban/Rural	1996	18.0
Swaziland			
National Sample	Urban/Rural	1995	18.8
Tanzania			
Dar es Salaam	Urban	1995-96	15.1
Zambia			
Lusaka-4 Site Un-weighted Avg ¹	Urban	1993	23.9
Macha (Southern Province)	Rural	1993	10.1
Minga (Eastern Province)	Rural	1993	21.8
Zimbabwe			
Harare	Urban	1995	33.0
Rusitu Valley ² (Manicaland Province)	Rural	1993-94	19.1

Source: U.S. Bureau of the Census, Population Division, International Programs Center, HIV/AIDS Surveillance Data Base, July 1998 Release.

¹ The four sites in Lusaka are Chelstone, Kalingalinga, Chilenje and Matero.

² Ages 20-29.

Table 2. Examples of the recent spread of HIV prevalence in Sentinel Surveillance survey data for selected places in Southern Africa: all women of reproductive age.

Place	Urban/Rural	Year	Prev. Rate
Botswana			
Gaborone	Urban	1997	34.0
Gaborone	Urban	1993	19.2
Malawi			
Lilongwe	Urban	1996	27.0
Lilongwe	Urban	1994	16.5
Namibia			
Six Urban Sites	Urban	1996	17.6
Six Urban Sites	Urban	1994	10.9
Four Rural Sites	Rural	1996	10.3
Four Rural Sites	Rural	1994	5.2
South Africa			
National Sample	Urban/Rural	1997	16.0
National Sample	Urban/Rural	1994	6.4
National Sample ¹	Urban/Rural	1993	2.8
Swaziland			
National Sample	Urban/Rural	1996	26.0
National Sample	Urban/Rural	1994	16.1

Source: Same as Table 1

¹ Excludes Bophuthatswana.

Note
 There are many possible biases in the prevalence rates derived from Sentinel Surveillance Survey data. For example, only some women seek prenatal care. If the HIV prevalence rates are different between those who seek care and those who do not, the observed prevalence rate will differ from the true one. Pregnant women are not a random sample of all women within an age group.
 In general, there are factors that produce upward and downward biases in the Sentinel Surveillance rates. The result when all these are taken into account must be determined on a case-by-case basis.

The money lenders are paranoid, of course! They have been told that all usury rates will invert and they will have to pay their clients to take out loans. It's an ill wind ...

As for myself, I just can't see the sand in an hour-glass flowing upwards. We have heard that there are three wise men in the east who have been working on the problem, but unfortunately they won't arrive until it's all over. I have also heard that there are plans to stable all horses at midnight at the turn of the year as there are fears that they will stop and try to run back-

wards, causing immense damage to chariots and possible loss of life. Some say the world will cease to exist at the moment of transition.

Anyway, we are still continuing to work on this blasted Y-zero-K problem. I will send a parchment to you if anything further develops. And if you have any ideas please let me know.

Your friend,
Horologius