IIASA
options
Autumn '98

Population, AIDS and Sustainable Development in Southern Africa

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IIASA

Population, AIDS and Sustainable Development in Southern Africa

This issue of Options has been prepared with a special focus on the European Union-Southern African Development Community (SADC) Conference in Vienna which takes place under Austria's EU Presidency.

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.

So far IIASA has completed PDE studies on Mauritius (see book on page 10), Cape Verde and the Yucatan Peninsula; 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.

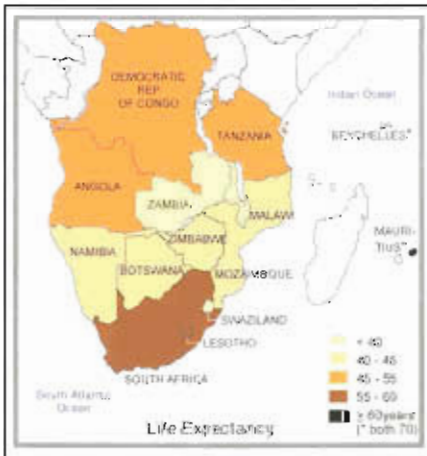
A Region in Crisis

Few other world regions are confronted with social, economic and environmental challenges comparable to those of the 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.

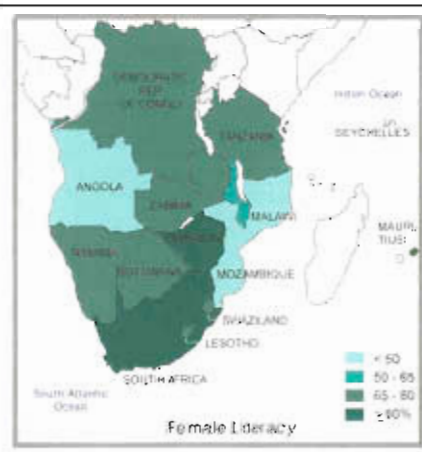
Significant investments in education seem to be a priority issue for the coming years both in improving reproductive health and fighting the further spread of the epidemic, as well as in training the younger generation that will have to quickly take over the work of those who prematurely die. Because slow human capital formation and the lack of skilled labor is already one of the 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.

Wolfgang Lutz, Leader
IIASA Population Project



Source: Population Reference Bureau, 1998.



Source: UNESCO Statistical Yearbook 1997.

AIDS delinks the traditional correlation between education and life expectancy.

Fertility and Literacy: More than Education at Stake

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.

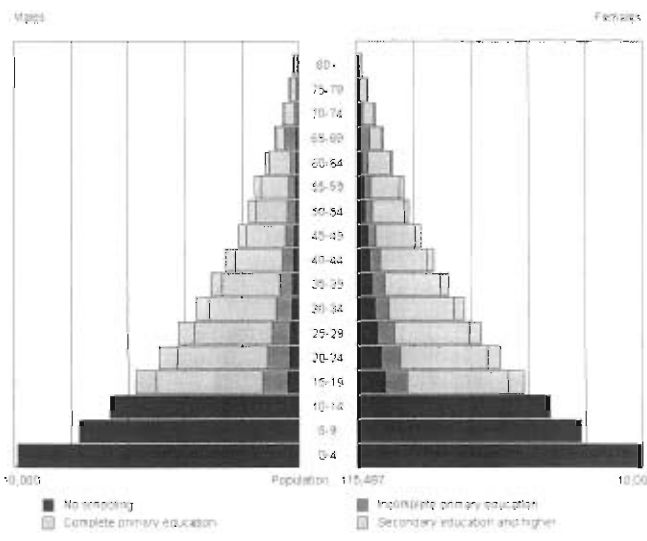
Population and Education in Tanzania

These two graphs show the population of Tanzania by age, sex and level of education in 2046 according to two scenarios. In the first scenario (bottom, left), 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.

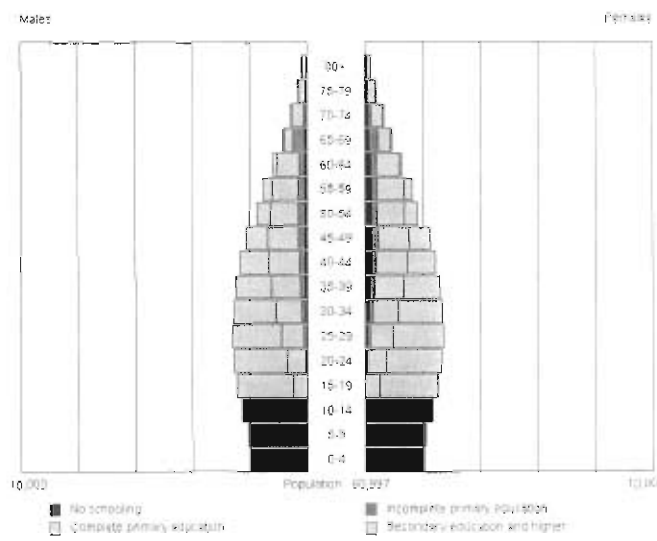
In the second scenario, fertility declines to lower levels, to a TFR of 2.5 for women with no education and 1.3 for women with a secondary education or higher. Enrollment levels increase regularly through the 1996-to-2046 projection period so that by 2046, all children will have at least completed primary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

—Anne Goujon

Variant No 1 – Scenario "same as usual" 2046



Variant No 4 - Fertility reductions and increase in enrolment levels 2046



Bridging Regional Gaps: A Major Challenge for Namibia

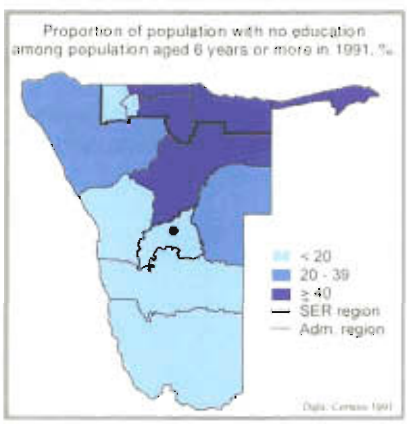
In addition to wide variations between the SADC countries, there are also remarkable differences within the countries themselves. Namibia is an example of such a country.

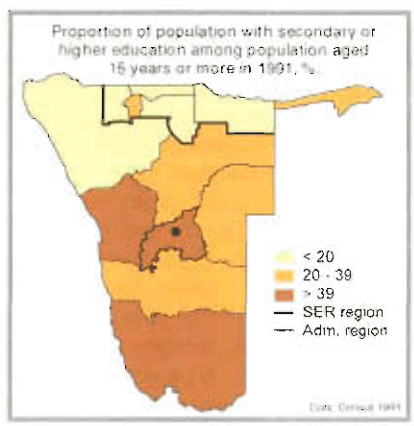
In Namibia, educational levels differ between the country's regions. In the Khomas and Karas regions, about half of the population aged 15 years or older had a secondary or higher education, whereas in Kunene and Omaheke almost half of the population of that age had no formal education, according to 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.

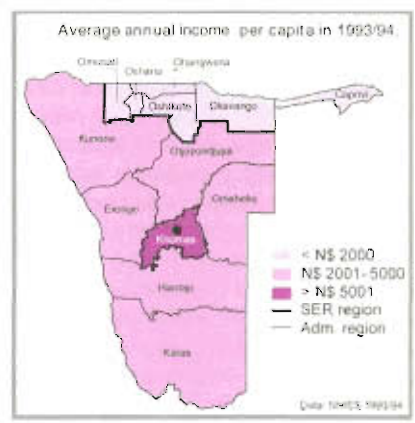
In addition to regional differences, there are wide urban-rural and intra-regional differences, especially in the wealthier regions. Differences between the language groups are even more pronounced than those between the regions. The highest standard of living is among German, English and Afrikaans speakers 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 while others live at the level of Ethiopia or Mozambique.

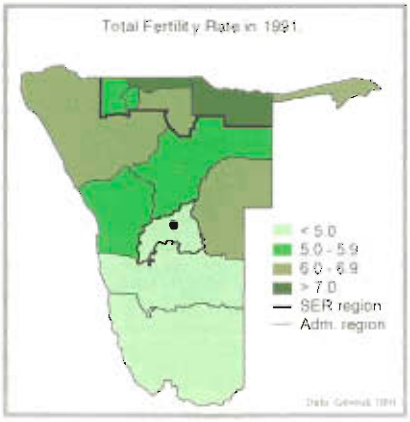
Regional disparities in Namibia have their roots in the country's colonial history, particularly in the policy of ethnic segregation. The challenge of equal regional development is made even more severe because the vast majority of the population lives in the northern regions. There is also increased 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.

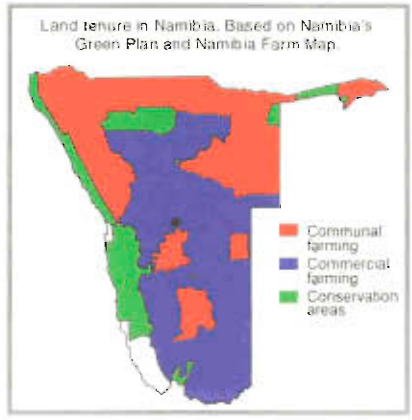
—Riikka Shemeikka

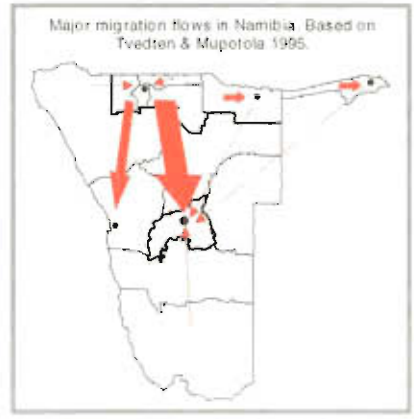












AIDS in Southern Africa: Adjusting the Data, Projecting the Impact

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.

Figure 1 shows 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 displayed in the upper line 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. The middle graph 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 effect 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.

—Warren Sanderson

Figure 1: Population paths for Botswana.

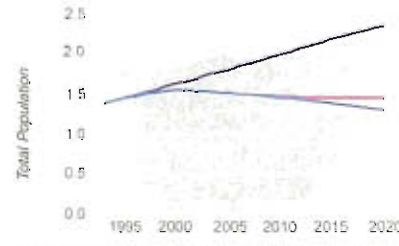


Table 1:
HIV Prevalence Rates for Sentinel Surveillance Surveys: Recent Data for 20-24 Year Old Women in Selected Southern African Locations

Place	Urban/Rural	Year	Prevalence 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 and Rural	1996	18.1
SOUTH AFRICA			
National Sample	Urban and Rural	1996	18.0
SWAZILAND			
National Sample	Urban and Rural	1995	18.8
TANZANIA			
Dar es Salaam	Urban	1995-96	15.1
ZAMBIA			
Lusaka - 4 Site Unweighted Average1	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 Valley2 (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	Prevalence 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 and Rural	1997	16.0
National Sample	Urban and Rural	1994	6.4
National Sample1	Urban and Rural	1993	2.8
SWAZILAND			
National Sample	Urban and Rural	1996	26.0
National Sample	Urban and 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 Impact of AIDS on Skilled Labor in Southern Africa

The literature on the macroeconomic impact of the HIV epidemic in Southern African countries suggests an effect that is going to be pervasive. Today about 12 percent of all adult South Africans are infected with HIV, the virus that causes AIDS, more than double the number only three years ago. In Botswana and Zimbabwe, more than a quarter of the adults are infected. Experts warn that it may be only a few years before South Africa, Namibia and other Southern African countries reach the 25 percent adult infection rate unless strong prevention programs are soon adopted.

The impact of the epidemic on skilled human resources in the various economic sectors is expected to be varied and complex. The productive sectors could experience an increase in labor costs not only due to the paucity of skilled workers but also as a result of high morbidity and increased absenteeism and labor turnover. The quality of the workforce is likely to deteriorate with the loss of skilled and experienced labor, resulting in a decline in productivity. Public and private sectors will experience budgetary pressures to replenish the losses in skilled and professional human capital as well as to meet higher remuneration costs engendered by the dearth of skilled human resources.

Inevitably, the future success in human resource development within the region will be determined to a greater extent by the degree to which respective governments effectively respond to the AIDS epidemic. Some of the heavy governmental investment in human capital development will be lost through AIDS, and there may be negative effects on savings and investments. Also, the budgetary costs of containing the disease and caring for the sick will take away from resources available for development.

—Paul Kibuuka, Development Bank of Southern Africa

Water Resources Systems Modeling: An Important Piece in the Population-Development-Environment Puzzle

Southern Africa's water resources are considered an important part of any economic development scenario for the region. Planning for sustainable development there requires information on the "sustainable" water resources, the capacity of the aquatic environment to assimilate water borne pollution from agriculture, industry and domestic uses, and the hydrologic requirements to maintain aquatic ecosystems and the habitats for wildlife.

The recent UN Comprehensive Freshwater Assessment (UN 1997) showed that Southern Africa is one of the most vulnerable regions for water related problems. The water resources problem is seen as a potential limit to development and a stress on population and economic growth.

The Assessment classified Botswana and Namibia's water resources as stressed and moving toward very vulnerable by 2025. Table 1 is a summary of the current status of water resource development in Botswana and Namibia. These national level screenings are based on water supply, population and GDP per capita levels. Although the screenings are helpful in targeting regions or nations at risk, they fail to capture the social, economic, and geographic nature of water resource management within a nation or region. In addition, much of the "available" water to both nations is from the Okavango River, which currently feeds into the Okavango Swamp, one of the worlds most important wetland ecosystems.

The Population Council (1994) and others have used these simple measures to draw conclusions on issues of population, development and the environment. However, such tools are of little value when addressing specific national policies of sustainable development, especially in the face of other social issues in the regions such as HIV and AIDS. IIASA's project on population, development and environment is developing models of the water resources of Botswana and Namibia that are regionally, socially and economically detailed. The following is a brief description of the modeling approach and some preliminary results.

Water Resource Modeling for Mid-Term Planning: A Case Study of Gaborone

While national level data shows Botswana withdrawing only 4 percent of its available water, the 1992 National Water Master Plan of Botswana predicted that the country's capital, Gaborone, will run out of water within the next 10 years based on current supplies and population forecasts. Gaborone, expected to be one of the SADC region's main centers of growth into the 21st century, receives its water supply primarily from surface water sources. In fact, groundwater is considered a non-renewable resource because of the very low recharge rates, and will only be used in cases of emergency to augment existing surface water supplies in Gaborone.

Table 1. Water Resource Development Status 1995

Water Resources Indices	Botswana	Namibia
Access to Safe Water		
-Urban Population %	100	100
-Rural Population %	39	60
Percent Population Rural %	79	73
Percent of Waste Treated %	0	na
Available Water Per Capita (m^3/capita/annum)	2010	4133
Annual Water Withdrawals (m^3/capita/annum)	85	171
Withdrawal over Available % Water Withdrawals	4	4
-Agriculture %	48	68
-Industry %	20	28
-Domestic %	32	14

Source: UN Commission on Sustainable Development. Comprehensive Assessment of the Freshwater Resources of the World, 1997

Model Results

A number of scenarios for the future population and economic growth of Gaborone were developed by the IIASA economic/demographic team. A water model was used to show the ability of the current infrastructure to supply the needed water resources and the ability of the aquatic environment to assimilate the increased waste load.

The model was run for multiple 50-year periods starting at 1995, using monthly climate data and yearly socio-economic drivers. The year at which the supply fails to meet demand was recorded as the "failure year". A probability distribution of the year to failure was developed.

No-AIDS and AIDS scenarios were run. The AIDS scenario leads to a slight delay in the time to failure (see figure 1). Because Southern Africa is potentially one of the most vulnerable regions to greenhouse-gas-induced climate change, a scenario reflecting this influence was run to show the time-to-failure distribution for a 50-year time series. A final run examined whether using surface water for dilution of municipal waste would be a short or long term alternative to building waste water treatment plants. The results are summarized in Table 2.

Insights

The results show that AIDS will impact the demand for water. Although AIDS will impact Botswana's population significantly, the impact on Gaborone's water supply is minimized, because due to urbanization, Gaborone's population is projected to increase despite AIDS. Even though the population is projected to level

over the next 20 years, the water infrastructure of Gaborone will become stressed. This "local" water crisis is not predicted by the simple methods described earlier.

The rapid urban growth is leading to a rapid increase of waste load to Gaborone's water supply. The results show that using surface water for water quality control via dilution will cause Gaborone's water supply to fail by the turn of the century. The cost alternative of waste water treatment plants must be studied urgently.

Finally, expected climate change will reduce the available surface water, resulting in a reduced sustainable water supply and in a midterm shortening of the time to failure.

IIASA's work shows the valuable and crucial linkage between the "engineering" side of water management and the demand side that can be seen at national levels of analyses. The direct incorporation of driving forces into the water demand model allows for more insightful results for water planners and social scientists alike. The next step in the research is to model the feedback that environmental quality might have on population and economic growth and long-term sustainable development.

—Kenneth M. Strzepek, Molly Hellmuth, Alyssa Holt, and Natalie Mladenov

Table 2. Model Results

Scenario Mean	Year of Failure
No AIDS	2009
AIDS	2011
Water Quality	1999
Climate Change & AIDS	2008

IIASA'S Water Supply and Demand Model

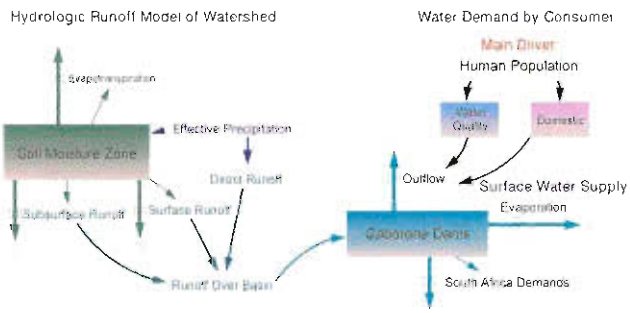
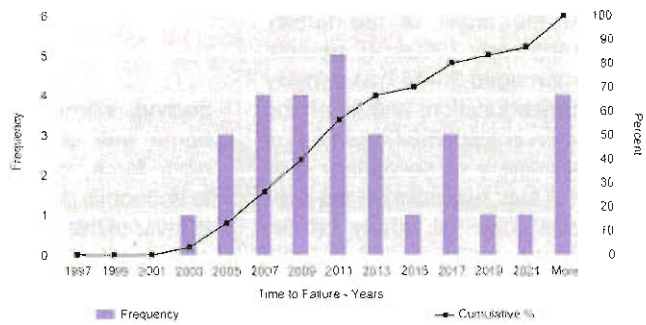


Figure 1. Time to Failure of Gaborone Water Supply: AIDS Scenario



Water Issues Facing Namibia

Namibia faces an extremely difficult situation in securing enough water to allow further development of the country. Namibia is the driest country south of the Sahel: 98 percent of the country is classified as arid or semi arid. In addition, the country has no perennial rivers running through its borders. There are few future water supply options, particularly for its capital, Windhoek. Most supply options have already been tapped. One of the more controversial ones is Namibia's plan to take out 17 million cubic meters a year from the Okavango river, which flows along its border with Botswana. Botswana fears damage to the Okavango delta and associated tourism.

Other options include pipelines to the Kunene and Okavango rivers, increased use of reclamation (already a major source for Windhoek), desalination, and redirecting water from irrigation to other uses as well as greater emphasis on demand management and cost recovery. All of these options are costly, in the region of US$1 or more per cubic meter, and will be politically difficult to pursue given the history of vast subsidies for water supply and Namibia's commitment to food self sufficiency. Although domestic consumers and farmers (about 70 percent of the population) pay close to full historic cost recovery, they do not yet pay the costs of future supply, which is 50 to 100 percent more expensive than present supply. Irrigation is even more heavily subsidized, although tariffs still cover only 50 percent of supply costs. Government policy promotes both cost recovery and irrigated crop production, which without subsidies is rarely viable.

—Rob Blackie, Ministry of Environment and Tourism, Namibia

For Further Information

Population-Development-Environment. Understanding Their Interactions in Mauritius

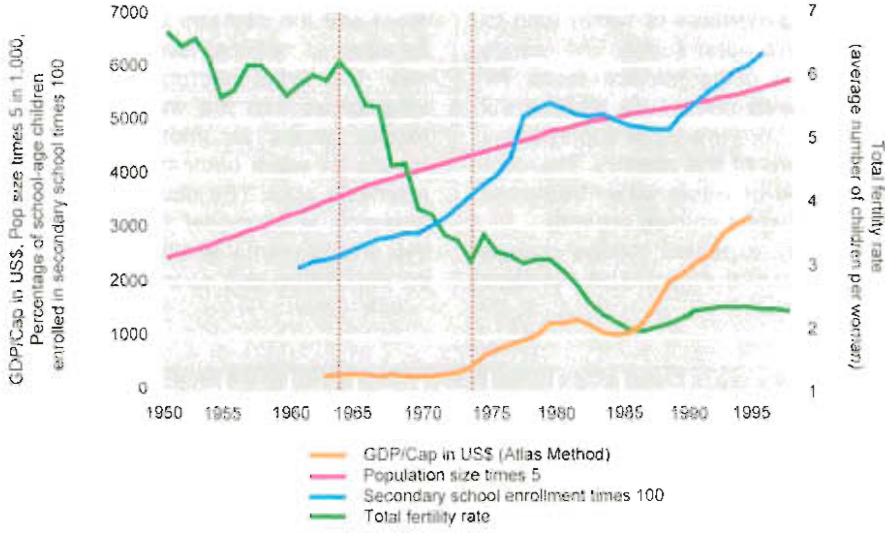
Edited by Wolfgang Lutz et al.

Education – not economic growth – is often the driving force of fertility decline. The example of Mauritius is exemplar. In less than 10 years, fertility on the island declined from 6.2 in 1963 to only 3.2 in 1972, the most rapid national fertility decline in the world. This decline happened simultaneously among all ethnic groups living in Mauritius. And even more interesting, it happened in the absence of economic growth. Per capita income was very low and even declined between the early 1960s and 1970.

The drastic decline in birth rates correlated to an increasingly educated population. At the onset of the fertility decline in the early 1960s, 40 percent of the women aged 35-44 had primary or secondary education, and four-fifths of the women in the 15-24 age groups had some primary or secondary level schooling. In fact, education of the population was one of many social improvement actions taken by Mauritius; others included family planning, health services, and pension schemes for all.

An interesting question is whether declining fertility did stimulate economic development. After the fertility decline, women, instead of being at home with children, could enter the labor force, contributing substantially to economic growth. Another argument in favor of this theory is the transition in attitudes that accompanied the fertility decline. Once individuals start planning the number of children they will have, this psychological transition results in longer-term investments into the future, including training (of oneself and of children) and economic activities.

Mauritius: A successful story of education and fertility decline.



From Population-Development-Environment. Understanding Their Interactions in Mauritius. IIASA, Laxenburg, Austria and Springer-Verlag, Berlin Germany. To order, contact Springer-Verlag, Heidelberger Platz 3, D-14197 Berlin, Germany. Contents:

Forward by Nafis Sadik, Executive Director, UNFPA
Preface by A.S. Kasenally, Minister of Economic Planning and Development, Mauritius
Part I: What do we Want to Understand?
Part II: Understanding through History
Part III: Understanding through Modeling
Part IV: Our Present Understanding: What Have we Learned?

About IIASA's Population Project...

IIASA's Population project, which is led by Wolfgang Lutz, studies the complex interactions between population changes (including aging), socioeconomic development, and the natural environment at the local, national and global levels. Results of the project's research appear regularly in *Options* and in the project's newsletter POPNET. For more information on IIASA's Population project visit its web site at www.iiasa.ac.at/Research/POP, or e-mail the project at popinfo@iiasa.ac.at.

Demo-Graphics & Tables '96 software

This is a new tool for population education from the United Nations Population Fund (UNFPA). It was developed in association with the Netherlands Interdisciplinary Demographic Institute (NIDI) by Gerhard K. Heilig (IIASA).You can use it to study population trends between 1950 and 2050 for all countries. The data are displayed in animated charts ("moving age pyramids"), maps and "smart" tables. To order, please send an e-mail to heilig@iiasa.ac.at, or a fax to +43-1-470-64-11 or visit the following web page: www.magnet.at/heilig/

YSSP '98

53 Young Scientists Participate in YSSP '98

At the beginning of June, some 53 young scientists from 22 countries convened at IIASA to participate in the Institute's annual, three-month Young Scientists Summer Program. The visiting scholars spend the summer months working closely with IIASA researchers, an experience that not only broadens the young scientists' research skills and career perspectives, but also introduces the scholars to a world-wide network of experts through IIASA's unique international environment.

The summer research program encourages a multidisciplinary approach to research that is enhanced by a Midsummer Workshop, where the scholars present their research to an open forum of other IIASA scholars and researchers.

Those young scientists whose work reflects particularly outstanding research are awarded scholarships to return to IIASA for three additional months. Two scholarships are awarded for this purpose: the Peccei and the Mikhalevich Scholarships. The Peccei Scholarship was established in memory of Dr. Aurelio Peccei, a founder of IIASA and former president of the Club of Rome, in an effort to recognize and further his aim of finding creative opportunities for young people to influence a shared future.

The Mikhalevich Scholarship honors Academician Vladimir S. Mikhalevich, former Soviet (subsequently, Ukrainian) NMO representative to IIASA and chairman of the IIASA Council, as well as academician of the Ukranian and Russian Academies of Sciences and professor at Kiev University.

IIASA's YSSP participants have access to an international network of scholars from a wide range of disciplines.

This year's YSSP participants are (in alphabetical order by country):

Austria: Hansjörg Albrecher, Gebhard Banko, Ulrich Berger
Bulgaria: Dimitre Dimitrov, Svetlin Mihnev, Irena Paunova
China: Yufeng Chen
Denmark: Jesper Katz
Finland: Tarja Joro, Heikki Lehtonen, Antti Saarnio, Petri Tapio, Esa Viitala
France: Claire Cadet
Germany: Matthias Koch, Oliver Moldenhauer
Hungary: Ferenc Nagy
Italy: Alessandro Tentori
Japan: Junichi Fujino, Yo Shimizu
Kazakstan: Svetlana Petelina
Lithuania: Ausra Lukseviciute
Netherlands: Mirjan Bouwman, Martijn Egas, Mark Huiskes, Paul Mensink, Machiel Van Dijk
Norway: Gidske Andersen, Ove Wolfgang
Poland: Raf Goebel, Tatjana Jaworska, Szymon Wilk
Russia: Boris Digas, Serguei Sourkov
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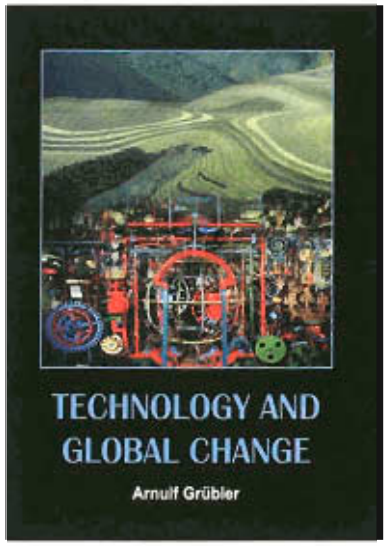
Spain: Dita Vizoso Martínez
Sweden: Anna Brismar, Samuel Broman, Darek Eriksson, Andreas Kühnel, Johannes Stripple
Turkey: Yücel Calbay, Önder Nomaler
Ukraine: Anton Dobronogov
United States: Andres Buenfil, Mojdeh Keykhah, Lisa Korf, Elizabeth Muller, Margaret Taylor, Louise Wells

N E W B O O K

TECHNOLOGY GLOBAL CHANGE



Technology and Global Change
By Arnulf Grübler
ISBN 0 521 59109 0
£ 30 (hardback)

Technology and Global Change describes how technology has shaped society and the environment over the last 200 years. It is the first book to give a comprehensive description of the causes and impacts of technological change and how they relate to global environmental change. It organizes history into a sequence of technology clusters, each with its distinctive environmental "footprint". The result is a new, original explanation of change — illustrated with innumerable quantitative examples, data, and graphics — that makes this book required reading for all now looking to technology for environmental solutions: technologists, environmentalists, policy makers, and academics.

Written for specialists and nonspecialists alike, this book will be useful for researchers and professors, as a textbook for graduate students, for people engaged in long-term policy planning in industry and government, for environmental activists, and for the wider public interested in history, technology, or environmental issues.

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Read more about *Technology and Global Change* in the next issue of *Options*.

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