POPULATION NETWORK NEWSLETTER

POPNET

Wolfgang Lutz, Editor

No. 28, Spring 1997

Population and Environment on the Yucatán Peninsula

In collaboration with the Center for Advanced Studies of the National Polytechnical Institute (CINVESTAV-IPN), Unidad Mérida, IIASA carried out a Population-Development-Environment (PDE) case study (building on the Mauritius study) with initial funding from UNFPA for the three Mexican states of Yucatán, Campeche, and Quintana Roo. This study also combined multidisciplinary descriptive analysis with interdisciplinary computer modeling under a very long time horizon.

New scientific challenges for this study included the long history of human-environment interactions on the Yucatán Peninsula, reaching back to the population increase during the Classic Maya period and the subsequent population decline, the unprecedented tourism boom around Cancún, and the apparent dichotomy between the modern sectors and traditional Maya agriculture. In addition to macrolevel modeling, this project included a microlevel anthropological dimension.

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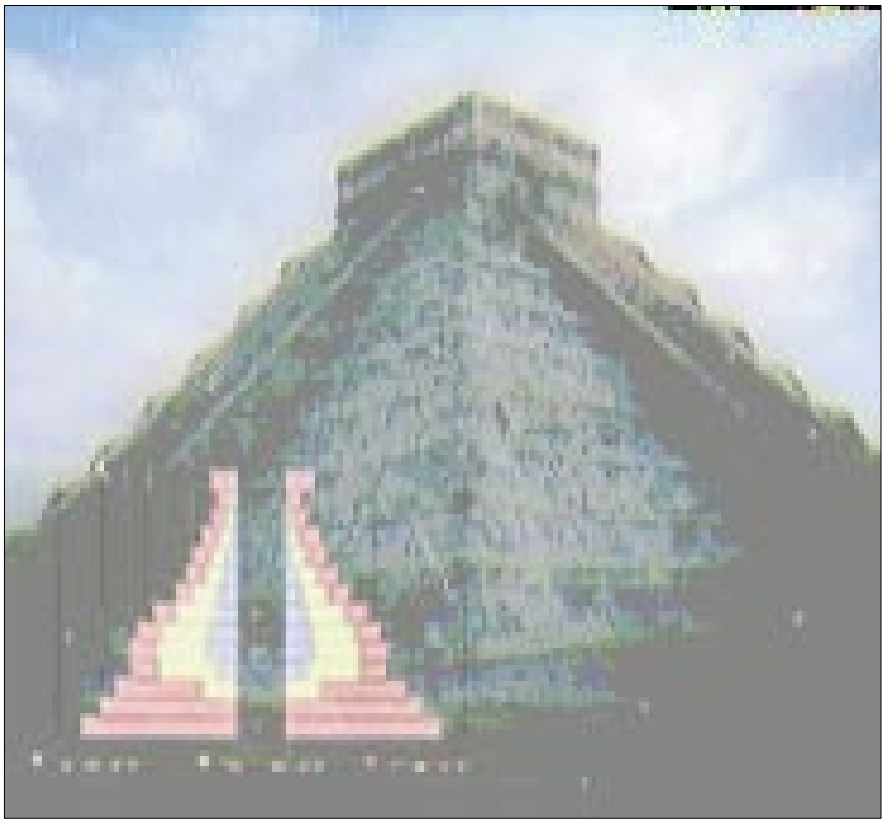

Photo: Wolfgang Lutz

Figure 1. *Pyramid at Chichén Itzá and population projections by education (2005) for the Quintana Roo Sur SER.*

Scenarios by Socio-Ecological Regions (SERs)

For the Yucatán study, significant efforts were made to define the appropriate regional level of analysis. Unlike the tiny island of Mauritius, which was treated as one region, the Yucatán Peninsula exhibits significant political, social, and ecological diversity. When trying to define subregions one immediately runs into the ubiquitous problem of every interdisciplinary study: namely, that social information tends to come by administrative units, whereas ecological regions follow geological, hydrological, topographic, and climatic determinants that usually do not stop at political borders. A simple pragmatic solution to this problem is usually to choose one unit of analysis at the expense of the other. A truly interdisciplinary analysis that aspires to study both the social and the ecological dimensions in some depth cannot make a simple choice of this sort. While it may still be possible to estimate the number of people living in a certain ecological zone using remote sensing, this method does not work if knowledge about the age

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structure and educational composition of the population is desired. Such information can only be derived from census data, which comes in administrative units. On the other hand, groundwater systems cannot meaningfully be modeled by political boundaries.

The only reasonable way out of this dilemma is to go to a more detailed level of spatial resolution in the census information until one reaches an administrative unit (in a way the greatest common denominator) that presents useful elements for a reconstruction of ecological zones. If census information is accessible at such a level, and one has a clear definition of the specific ecological zones (hydrological, land use, etc.), this is difficult but feasible, and will suffice for descriptive analysis. If one wants to do any kind of modeling, the additional problem is that one needs a common unit of analysis in the various sub-models that remains stable over time. For example, the metropolitan area of Mérida-Progreso is a meaningful unit in socioeconomic terms but less so in hydrological terms. Here the only solution is a compromise between the different socioeconomic and ecological dimensions of analysis. In cases of a difficult choice, one possibility is to perform the sectoral analyses at a different level of aggregation—e.g., merge Metropolitana (Mérida) with Henequenera (named after the previously important production of Henequen, or Sisal) creating the Semicirculo de Cenotes region for geohydrological analysis, but keep them separate for population and economic projections.

Extensive interdisciplinary discussions along these lines resulted in our defining 11 regions along municipal borders (the lowest level at which we could access the census data), which were called "socio-ecological regions" (SERs). This concept, which was developed specifically for the Yucatán Peninsula, is likely to present a useful addition to PDE analysis and to "integrated assessment" in general.

As an example of SER-specific projections, *Figure 1* gives a projection of the population by age, sex, and educational status for the Quintana Roo Sur SER.

A number of working papers produced under the Yucatán project and an extensive bibliography of publications and studies on the Peninsula can be accessed through the home page of the project at CINVESTAV-IPN, Mérida:

http://pde.cieamer.conacyt.mx:8080/

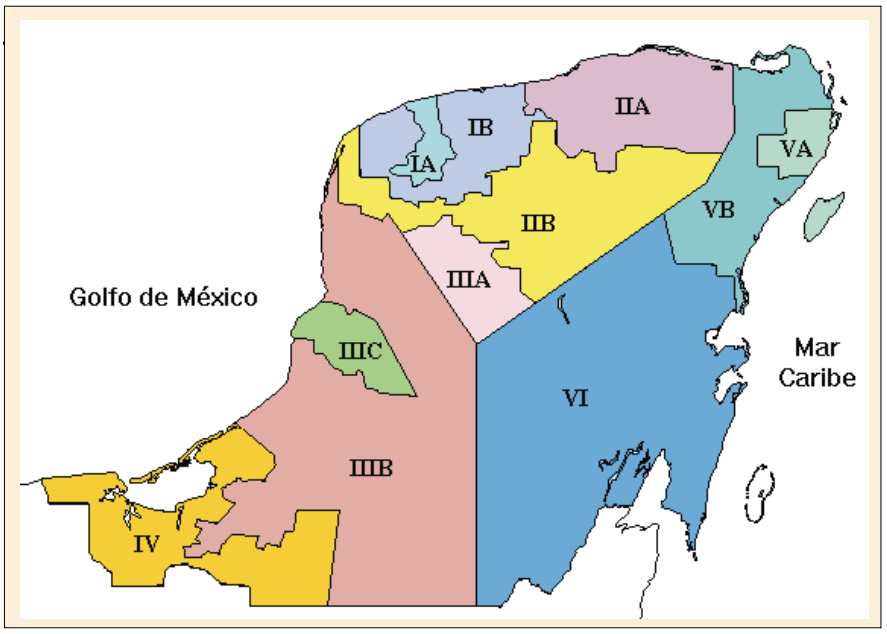


Figure 2. *SERs on the Yucatán Peninsula.*

Table 1. *Population densities of the SERs on the Yucatán Peninsula.*

Code	State	Region	Density per km^2
IA	Yucatán	Metropolitana	402.4
IB	Yucatán	Henequenera	39.5
IIA	Yucatán	Ganadera	11.6
IIB	Yucatán	Maicera	12.9
IIIA	Yucatán	Fruticola	15.5
IIIB	Campeche	Cerros y valles	5.7
IIIC	Campeche	Campeche	51.0
IV	Campeche	Candelaria	9.4
VA	Quintana Roo	Turística-urbana	95.9
VB	Quintana Roo	Norte	2.9
VC	Quintana Roo	Sur	5.7

Latin American Regional Meeting on Population and Environment

Mérida (Mexico), 23–25 April 1997, organized by AAAS and IIASA in collaboration with CINVESTAV-IPN, Unidad Mérida.

This meeting will discuss general issues and specific case studies of population-environment analysis in Latin America, with special emphasis on the Yucatán PDE study.

For more information contact Victoria Dompka at AAAS (e-mail: vdompka@aaas.org; fax: +1-202-289-4958) or Wolfgang Lutz at IIASA (e-mail: lutz@iiasa.ac.at; fax: +43-2236-71313).

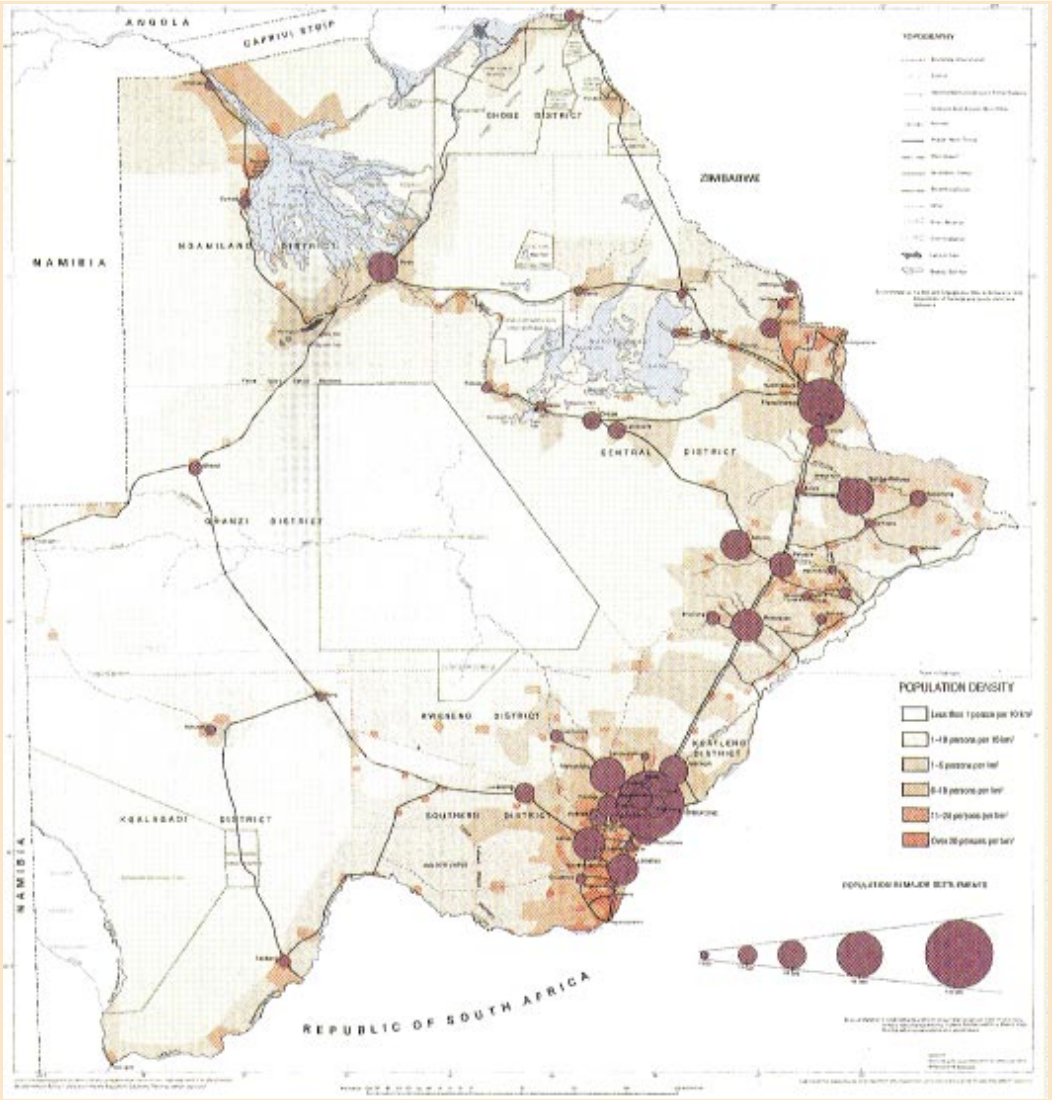


Figure 2. *Population distribution in Botswana. (Source: Government Printer Gaborone, Botswana, 1993.)*

Namibia shows very pronounced fertility differentials by education. Based on the 1991 census, the total fertility rate (TFR) of women with no formal schooling is 8.8—almost three times that of women who have completed grade 12 (TFR = 3.1). In certain parts of the country, the differentials are even more extreme: in the northern region Omusati (the most populous in Namibia), women in the lowest educational category had on average 10 children, while those in the highest category had 3 children. Educational fertility differentials appear to be a little smaller in the Namibian Demographic and Health Surveys of 1992, but are still very significant.

There are also huge differences in the regional distribution of educational attainment. While in Kunene, a northern region, half the adult population is without formal schooling, this proportion is only 12% in the southern region Karas, the most sparsely populated area of Namibia (only 0.4 inhabitants per km^2). The regional diversity partly corresponds to language/ethnic divides. The German-, English-, and Afrikaans-speaking populations have almost universal education, whereas 80% of young adult San (Bushmen) have never attended school.

As in other countries, there is evidence in Namibia that fertility and education are negatively associated in two ways: higher education decreases desired family size and increases contraceptive use, while on the other hand teenage pregnancies often force girls to leave school. The latter effect, of course, only occurs among the higher educational groups. R.R.

Riikka Raitis, who is working on a dissertation at the University of Helsinki on nuptiality and fertility in Northern Namibia, recently joined IIASA´s Population Project.

IIASA Starts New Initiative on Social Security Issues

Some background information by Landis MacKellar

Global Population Aging

There are four salient aspects of the postwar world demographic picture: (1) rapid demographic transition (mortality decline, followed after a variable interval by fertility decline) in LDCs, now beginning to appear even in Africa; (2) the postwar baby boom in the OECD, followed by the post-1970 emergence of persistent sub-replacement fertility; (3) in the former socialist bloc, the emergence of declining life expectancy and radically low fertility in the context of economic crisis and transition; and (4) globally speaking, rates of population growth that are much less rapid than expected, with high rates of growth concentrated among the poor (both globally and nationally).

Although the near-term population outlook is relatively certain, small differences in mortality and fertility assumptions made in the near term lead to massive differences in population 30 or 50 years in the future. Changes in fertility matter most: even in the context of the debate about aging, most of the relevant ratios are more sensitive to changes in assumed birth rates than to changes in assumed death rates. This is because, whereas mortality declines were once concentrated in early life and thus had a tremendous multiplier effect by permitting more girls to survive and become mothers, mortality improvements are now concentrated at the top end of the life span. Projecting fertility is difficult because no dominant model of fertility behavior has emerged for either MDCs or LDCs.

However, some demographic "virtual certainties" emerge when Monte Carlo simulations are performed using a range of fertility and mortality assumptions. One of these is an increase in the average age of populations. We should be careful to specify exactly what we mean by "population aging," however, because this term is used for a number of ongoing changes in global population age distributions. Several types of changes in population age distributions qualify as "aging" (see *Figure 1* and *Table 1*). It is projected that in the MDCs the proportion of the population aged 15–59 will decline by about 10 percentage points between 1995 and 2050, while the proportion of the population aged 60 or older will rise by 16 percentage points. The balancing item is the population of persons under 15, projected to decline by 6 percentage points. In contrast, in LDCs it is projected that the population aged 15–59 will remain roughly 60% of the total, while the population under 15 will decline by about 10 percentage points and the population over 60 will rise by about 10 percentage points.

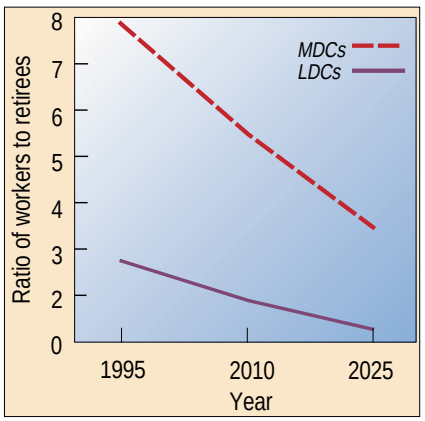


Figure 1 *Number of workers per pensioner in MCDs and LCDs.*

In both regions, the proportion of the population and the absolute number of people aged 60 or older is increasing; "population aging" is thus a global phenomenon. When the entire age distribution is considered, however, MDCs are "aging from the middle," whereas LDCs are "aging from the bottom." The main economic significance of the distinction lies in the impact on the labor force. In MDCs, aging is reducing the size of the labor force, as the proportion of 15–59-year-olds in the population declines. In LDCs, aging is increasing the size of the labor force: the proportion in the middle age group remains constant and population is redistributed, statistically speaking, from the under-15 group, where labor force participation is very low, to the over-60 age group, where labor force participation is substantial, especially in low-income countries.

Table 1. *World population (billions): central scenario*

Age group	1995	2020	2050
MDCs			
0–14	0.256 (20.5)	0.218 (16.3)	0.196 (15.9)
15–59	0.774 (61.9)	0.785 (58.6)	0.678 (51.7)
60+	0.221 (17.7)	0.336 (25.1)	0.444 (33.7)
Total	1.251	1.339	1.318
15–59:60+	3.5	2.1	1.5
Workers:retirees[a]	2.8	1.9	1.3
LDCs			
0–14	1.535 (34.5)	1.903 (29.1)	1.993(23.4)
15–59	2.596 (58.3)	3.931 (60.1)	5.072 (59.3)
60+	0.320 (7.2)	0.706 (10.8)	1.488 (17.4)
Total	4.451	6.540	8.553
15–59:60+	8.1	5.6	3.4
Workers:retirees[b]	7.9	5.5	3.5

Source: IIASA population projections.
Note: Figures in parentheses indicate percentage of total population represented by each age group.
[a]*Assuming labor force participation rate 15–59 = 0.7, labor force participation rate 60+ = 0.1*
[b]*Assuming labor force participation rate 15–59 = 0.7, labor force participation rate 60+ = 0.25*

Since we have spoken of the difficulties of projecting fertility, it is appropriate also to mention the ambiguities that surround future labor force trends. The following questions are among the most important. Will LDCs follow the well-worn pattern in which development is accompanied by a steep decline in labor force participation of males over 60? In MDCs, will the decline in labor force participation rates of younger men (in their forties and fifties) be reversed? What will happen to labor force participation rates of women?

Labor force participation and demography are inextricably linked and must be considered together: what happens to fertility affects women's labor force participation and vice versa; longevity and the length of the period of retirement to be financed will have an impact on the labor supply of older persons, etc. Finally, it is worth noting that many economic behaviors, among them saving and labor-supply decisions, are contingent on household size and composition. Thus, to uncertainties about population must be added uncertainties about the evolution of living arrangements.

The Economics of Population Aging

Population age structure cannot be dissociated from the rate of population growth: fast-growing populations are young ones, slow-growing populations are old ones. In the interwar period there was a great deal of concern about "demographic stagnation." After the war, concern was focused on rapid population growth and the resulting high youth-dependency ratios in LDCs. With the persistence of sub-replacement fertility in the North and fertility declines in the South that were more rapid than expected, it appears that the pendulum is swinging back: there currently is less talk of a Malthusian demographic trap and more talk of the specter of population aging.

Adopting a neoclassical view, the impacts of age-distribution changes on economic growth will be mediated through impacts on physical capital accumulation (i.e., savings and investment); human capital accumulation; labor force growth and absorption, including the distribution of labor between low- and high-productivity sectors; and economies of scale and technical and institutional change. In an open economy, impacts on trade and financial flows must also be considered, and they are likely to be especially important in the area of savings.

A plausible, but uncritical assessment is that population aging, defined as an increase in the absolute and relative number of persons over 60, has three effects: (1) it raises the number of retired households consuming accumulated assets relative to the number of younger households engaged in accumulation, thus causing the household saving rate to fall; (2) it slows the rate of technical progress by concentrating workers in the older age groups, while slower labor force growth increases the average age of the capital stock; and (3) it shifts the composition of demand, and thus the structure of the labor force, toward low-productivity service sectors, particularly health and personal care.

None of these deleterious effects is beyond question, however. Longer life expectancy and lower fertility lead to changes in household composition that affect labor supply and saving behavior. These microlevel household effects may interact in a complex fashion with compositional effects at the population-wide level. Changes in population age structure are also likely to give rise to changes in social structure and the nature of institutions.

Despite these uncertainties, one thing is clear: an older society requires greater provision, in the form of savings, for its aged population. Consider three societies. In the first, each person saves to finance his or her own retirement. In the second, children support parents directly through intrafamily, intergenerational transfers. In the third, Government supports the elderly through a pay-as-you-go (PAYG) pension system that transfers resources from current workers to current pensioners. Now let each of these societies experience an aging shock similar to that hitting the world today. In each case, old-age support system requirements go up: resources must be diverted from the young to the old. In the latter two cases, the diversion is across individuals at the same point in time; in the first case, it is at the level of the individual, who must save more when young in order to finance a longer period of retirement (or shorten the period of retirement by working longer).

Aging thus leads to an increase in social costs, which must be apportioned somehow. While these costs of aging cannot be eliminated, they can be minimized. One of the basic results of pension mathematics, Aaron's Law, states that when demographic and economic growth are high and real interest rates are low, a PAYG pension scheme is a relatively more efficient way of providing for the elderly than a private savings scheme (loosely speaking, the rate of return to contributions paid into a PAYG scheme is the rate of GDP growth), and vice versa when demographic and economic growth rates are low and real interest rates are high. As world population ages, it is practically inevitable, however vocal the interest groups that defend the status quo, that policy makers will look for ways to complement, if not replace, transfer-based social security arrangements with saving-based ones.

This is not to say that PAYG does not have advantages. Security is a multidimensional, socially constructed concept, and different pension arrangements insure against different contingencies with differing degrees of adequacy. Among the advantages of PAYG systems are that they effectively insure against longevity risk (living longer than anticipated) and they tend to be administratively cheaper than private saving schemes. However, in an aging world, the advantages of PAYG come at a rising efficiency cost.

Future Population and Education Trends: North Africa

Foreword by Gordon MacDonald (Director, IIASA)

The North African region has one of the most rapid population growth rates of the world. Whereas the population has increased by a factor of three since 1950, it is expected to further increase by at least a factor of two, most likely a factor of four, and possibly even a factor of eight, depending on future fertility, mortality, and migration trends. Given the extremely arid climate of this world region, where fresh water availability is already a serious problem, and that current climate models project significant further warming well above the expected average warming of the world, these population projections imply that there will be serious problems for the future of this region and possibly increased migration pressure into Europe.

This report provides a concise and comprehensive review of available data on past demographic trends in the region and combines this analysis with expert opinion on alternative future demographic trends (as described in the 1996 edition of *The Future Population of the World: What Can We Assume Today?*) to calculate likely ranges of future population growth.

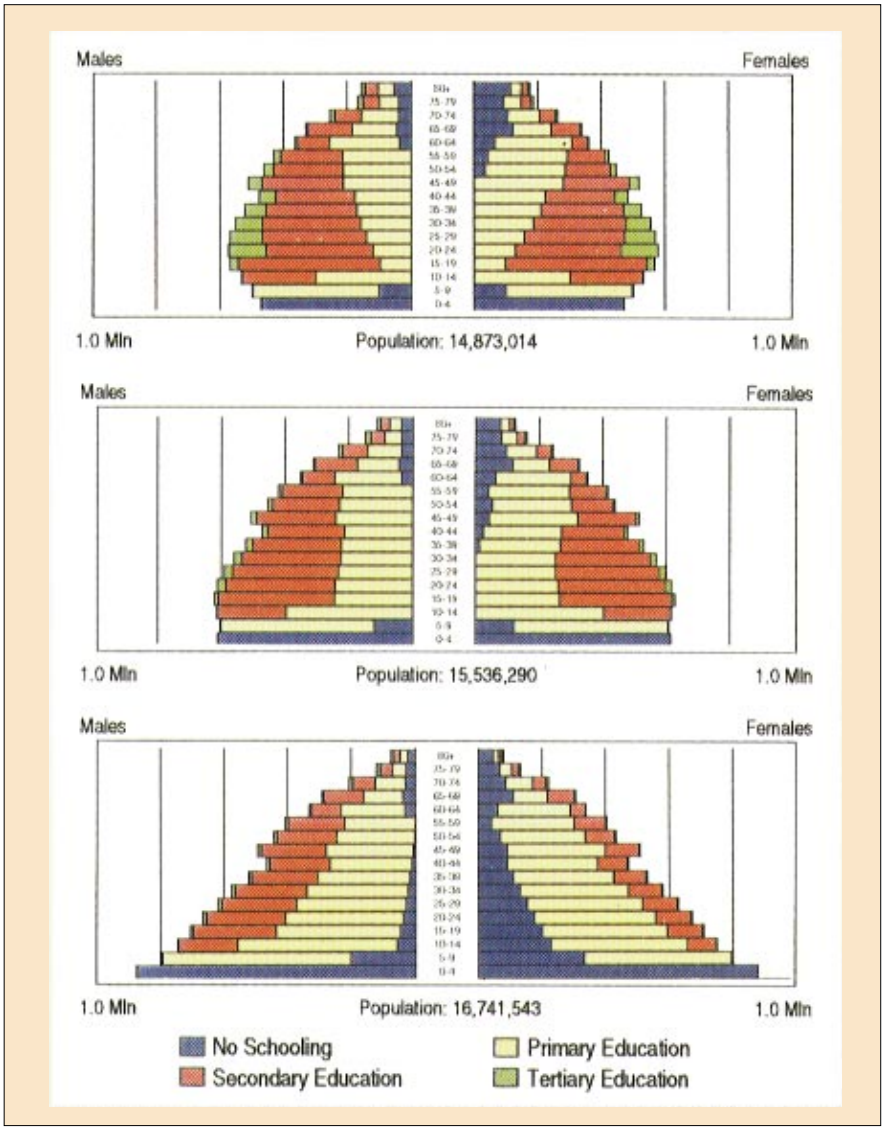
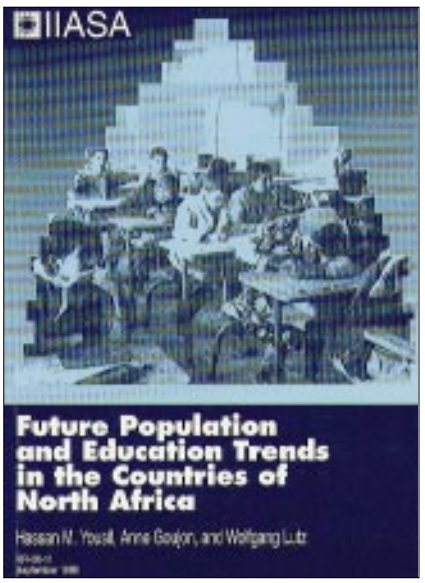


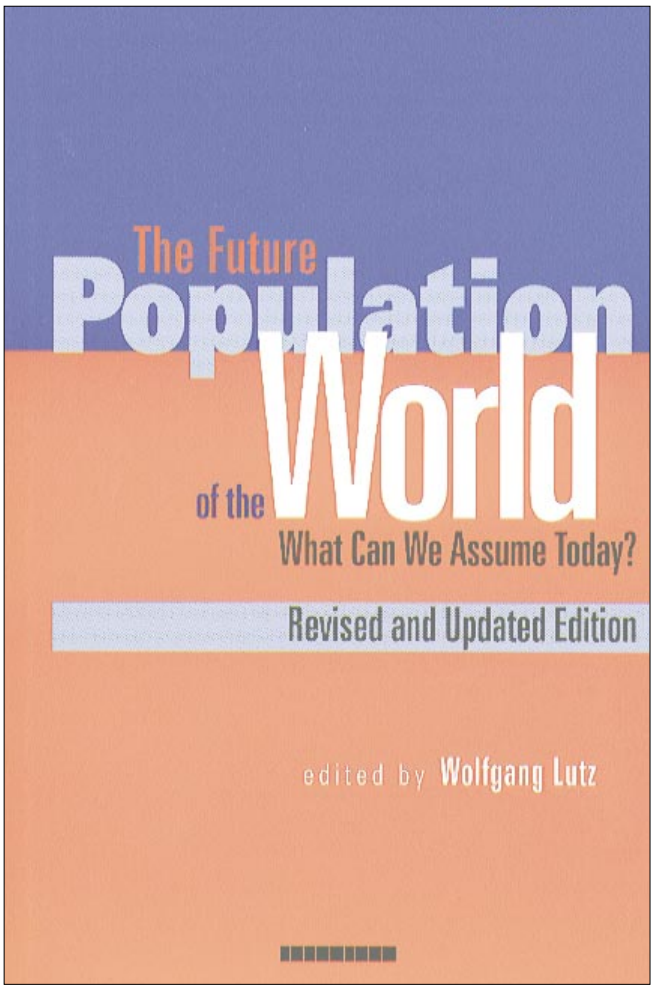
Figure 1 *Projected population of Tunisia in 2044 according to low, cental, and high scenarios (top to bottom).*

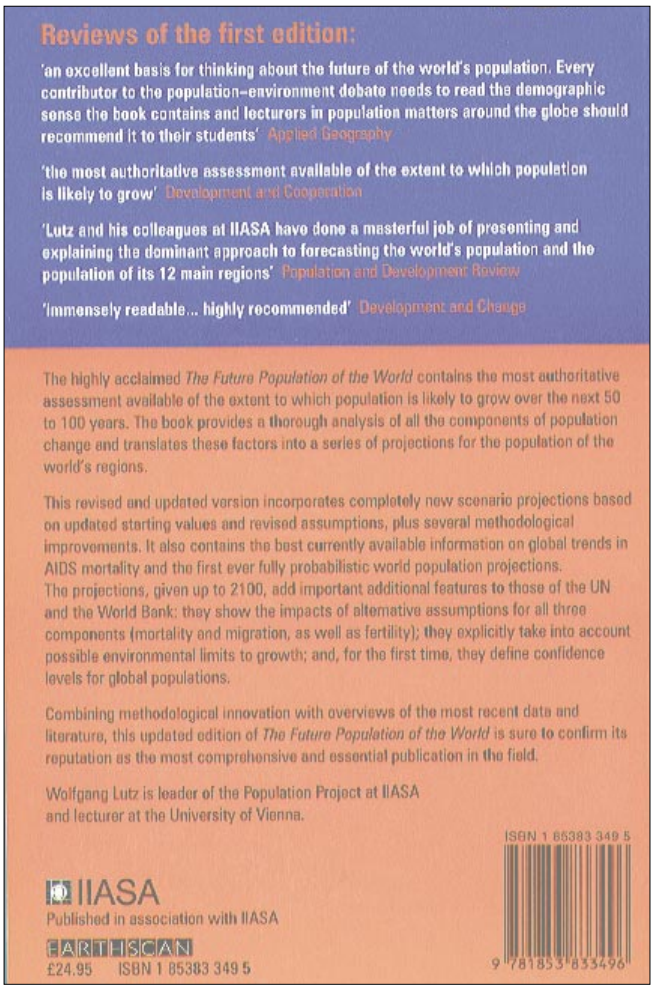


A very important and innovative feature of this study is that it explicitly includes the educational status of the population in its projections. This is done by means of multistate population projections, a method that largely originated at IIASA. Educational projections are an important task in themselves because education, as the major component of human capital, is a key factor in national development and in society's ability to cope with arising problems. But the projection of education is also particularly suitable for the demographic cohort–component method because it is the past and present school enrollment of the young cohorts that largely determines the future educational composition of the population. It turns out that, due to the large educational fertility differentials and the great inter-cohort differences in education in the countries of North Africa, an explicit inclusion of education in projections makes the population projections more accurate.

This study is not only relevant for the North African region and its neighbors; it also demonstrates that generally it is feasible and very useful to explicitly include education in population projections.

New IIASA Book





PART I: Why Another Set of Global Population Projections?

1 *Long-range Global Population Projections: Lessons Learned*, T. Frejka.
2 *Alternative Approaches to Population Projection*, W. Lutz, J.R. Goldstein, C. Prinz.

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3 *A Regional Review of Fertility Trends in Developing Countries: 1960 to 1995*, J. Cleland.
4 *Reproductive Preferences and Future Fertility in Developing Countries*, C.F. Westoff.
5 *Population Policies and Family-Planning in Southeast Asia*, M.B. Concepcion.
6 *Fertility in China: Past, Present, Prospects*, G. Feeney.

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10 *How Many People Can Be Fed on Earth?*, G.K. Heilig.

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17 *Epilogue: Dilemmas in Population Stabilization*, W. Lutz.

How to Obtain the Book

For information on purchasing *The Future Population of the World: What Can We Assume Today?* (Revised and Updated Edition), W. Lutz (ed.), ISBN 1-85383-349-5, contact Earthscan,120 Pentonville Road, London N1 9JN, UK: Fax: +44 171 278 1142; e-mail: earthsales@earthscan.co.uk

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Managing Editor: Wolfgang Lutz
Design/DPT: Anka James
Printed by St. Gabriel, Mödling

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