What also hinders a sustainable development are the various forms of environmental contamination, some of them natural accompaniments of early stages of development. And each additional person living in the way that people have to live in the half-developed condition adds to the problems. European and North American countries went through the same stage, except that they had smaller populations, the possibility of mass emigration, and a nearly virgin nature that still could absorb contamination. These interactions between population, economic development, and the environment on which all depend have local and global dimensions. IIASA’s Population Program has recently started to study these.

Very few countries now have birth and death rates that in the long run would stabilize their population size. Much of the Third World is increasing rapidly, despite efforts to induce restraint. The First and Second Worlds, on the other hand, are mostly below reproduction, and on present trends their populations will start to decline soon, perhaps by as much as one-quarter in each generation. The major difference between these worlds seems to be their level of development, not only economic but in respect of education, health care, and infrastructure.

Development seemed for a while to be in full course, and yet now in many respects and in many countries it is stalled. The stalling is seen in different ways: indebtedness, inflation, unemployment, even worsening living conditions. What in the developed countries has been the longest period of prosperity in modern history shows up very differently in the Third World. There the high childbearing itself seems to slow the process of development that, if continued, would sooner or later check childbearing. Especially in Africa, there is every reason for governments to be concerned, and to back population control programs.

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In any intelligent discussion of global environmental problems, the principal focus must be people—their habits, their life-styles, and, above all, their numbers. A century ago, there were about one billion people on this planet. Then as now, most of them went about blithely abusing their environment. The difference was that they got away with it, and they probably could have done so indefinitely if population had stayed at that level. Forests, air, and oceans could absorb the abuse of a billion people, and it would have taken centuries for that many people to exhaust the Earth’s nonrenewable resource.

But today there are five billion of us. And in 40 years time, depending on which estimate you choose, there will be five to ten billion more. The planet is simply not robust enough to withstand that level of abuse. Those seeking to understand the problems of environment and development must begin with the problem of population. And the focus must be on the Third World.
Snapshots of Tomorrow

For half a century Nathan Keyfitz, leader of IIASA’s Population Program, has watched his fellow demographers boldly predict the future, and fail. Again and again he has seen their forecasts upset by unexpected events, such as the postwar baby boom or surges of immigrants. Fortunately for their reputations, says Keyfitz, most projections are “mercifully forgotten long before they can be checked.” But the many failures prove that precise forecasting of the societies of tomorrow remains as much an act of faith as an act of science.

In a study published this summer, Keyfitz’s colleagues at IIASA adopted a different approach, one that yields a more complicated but useful preview than traditional projections (page 7). The results form the final chapter of a new book (Future Demographic Trends in Europe and North America: What Can We Assume Today?, Academic Press) that offers a broad survey of contemporary thinking on demographic trends in the United States and Canada, Western Europe and Eastern Europe, including the European portions of the Soviet Union (page 10). Readers looking for a simple, definitive population forecast will be disappointed. What they will find instead is a study that separates demographic trends that appear inevitable, regardless of shifting social and political habits, from demographic wild cards that are beyond anyone’s ability to predict.

The study, conducted by five IIASA staff members led by Wolfgang Lutz, deputy leader of the Population Program and editor of Future Demographic Trends, was based on 10 different scenarios embracing a wide range of hypotheses about demographic trends among the billion residents of Europe and North America. Among findings consistent across all scenarios: moderate increases in populations throughout the Western world by 2010, even if birth rates continue to decline; a massive shift upward in age, with people 60 and older doubling and tripling their share of the population; and a relatively stable block of working-age people (20 to 59) which will decline only marginally during the next 30 years.

The trends could not be more different in the developing world, home to four-fifths of the world’s 5.2 billion people. There the population explosion continues. Birth rates have slowed in many Asian and Latin American countries, but in Africa, especially, populations continue to soar. The United Nations estimates that even if fertility drops suddenly in Africa—a questionable assumption—there will be another 1.1 billion people on Earth a decade from now, and 3.3 billion more by 2025, almost all of them in developing countries. But the billion or so privileged citizens of the developed nations will still consume most of the world’s resources.
Perhaps the most striking conclusion of the IIASA study was pervasive aging throughout Western society. Europe and North America are rapidly going gray, and it appears that nothing short of a social revolution will stop it. Lutz and his colleagues developed several scenarios that would dent the trend—a tripling of youthful Third World immigrants with a mean age of 23, or a surge in fertility to replacement levels—but the trend stubbornly persisted. "The potential for aging in the present population is so massive," said Lutz, "that only absurd assumptions—say, all people die at 60, or women average four or five children each—seem sufficient to reverse it over the next decades."

The change is likely to be most pronounced in Eastern Europe. There, people aged 60 and over currently comprise 10.5 percent of the population. By 2020, they are likely to comprise 16 to 22 percent; one scenario shows 39 percent by 2050. The 10 scenarios indicated that in Western Europe, where they already account for 14 percent of the population, their proportion will rise to 19 to 26 percent by 2020. If life spans lengthen slightly and fertility continues to decline, as it has for most of the past century, the figure could reach 44 percent by 2050. The 10 scenarios indicated that in North America the proportion of citizens 60 and older will rise during the next 30 years from 12.5 percent to 15 to 24 percent.

A second strong tendency in the Lutz study, mirroring the first, was a decline in the proportion of young people. The proportion of people under age 20, currently 22.6 percent in Eastern Europe, 18.6 percent in Western Europe, and 21.4 percent in North America, will decline further if present trends continue. Fertility rates throughout the industrialized world have declined more or less steadily for a century, with the exception of postwar baby booms of varying duration. By 1985 only Eastern

### THE SCENARIOS

The IIASA study used 1985 data to project populations to 2020 and 2050 for three regions that effectively comprise the developed world outside Japan and Australia: industrialized North America, meaning Canada and the United States; Western Europe, including Iceland; and Eastern Europe, excluding Albania. Central Asian republics of the Soviet Union were excluded, in recognition of the high demographic and social variation within the country (page 10). The data includes all of the Russian SFSP. The 10 scenarios:

1. **UN Projection** – Used as base case. An extrapolation of the UN's 1988 projection, which stopped in 2025, to 2050; all rates constant at UN medium variant for 2025.

   The UN assumes further increases in life expectancy in every region and for both sexes, with the greatest improvement (eight to nine years) in Eastern Europe; longevity improves five to six years in Western Europe and North America. TFR (total fertility rate, or average live births per woman) to decline 7 percent in Eastern Europe, from 2.09 to 1.94; increase 12 percent in Western Europe, from 1.62 to 1.82; and increase 7 percent in North America, from 1.80 to 1.93. Overall increase, 4 percent.

   No migration is assumed.

2. **Replacement Fertility** – Assumes increases in TFR to 2.1 by the year 2000, or an increase of 0.7 percent in Eastern Europe, 16 percent in North America, and 30 percent in Western Europe. Mortality and migration assumptions as per UN base case.

3. **Continued Fertility Decline** – Based on continued decline of TFR in all regions to 1.1 by 2025, or roughly 50 percent of replacement, then remaining steady to 2050. Mortality and migration as per UN.

4. **Mortality Stagnation** – Assumes that steady decreases in mortality come to a halt; life spans remain constant at 1990 levels. Reflects view of some demographers that increased stress, pollution, and unhealthy life-styles will counteract medical and economic advances. Or can be assumed to represent unforeseen epidemic. Fertility and migration as per UN.

5. **Strong Mortality Decline** – Based on continuing increase in longevity in all regions by 2025 to 90 years for men and 95 for women, with no improvements thereafter. Fertility and migration as per UN.

6. **Fertility and Mortality Decline** – Combines scenarios 3 and 5.

7. **Moderate Immigration** – Assumes Third World immigration levels to remain at current levels of about one million per year to North America and half a million to Western Europe. Also assumes 500,000 immigrants from Eastern Europe to Western Europe each year until 2000, then reduced to zero. Immigration to Eastern Europe from Third World 50,000 yearly. Fertility and mortality as per UN.

8. **High Immigration** – Tripling of Third World immigration by 2010 to 3 million yearly to North America and 1.5 million to Western Europe, then constant. Immigration to Eastern Europe increases to 1.5 million yearly by 2030. Fertility and mortality as per UN base.

9. **High Immigration/Low Fertility** – Combines scenarios 3 and 8. Assumes deliberate increases in immigration to compensate for declining fertility, with little success. Mortality as per UN.

10. **High Fertility/Low Mortality/Low Fertility** – Combines scenarios 3, 5, and 8, implying continued declines in fertility and mortality as observed throughout the Western world, plus high immigration.
AIDS: AMID THE GLOOM, SOME HOPE

Worldwide, AIDS continues its rampage. In parts of central and east Africa up to 25 percent of the adult population tests positive for HIV infection. In some European countries, AIDS in the 1990s could become one of the leading killers of young adults aged 24 to 40, ranking next to car accidents and suicides. But a study by IIASA demographer Gerhard Heilig indicates that, in Europe at least, there is some cause for hope.

Heilig's study suggests that, contrary to widespread fears, AIDS appears not to be spreading widely among the European populace. The numbers of reported AIDS cases — and deaths — will almost certainly continue to rise in the 1990s. But infection rates in some European countries appear to have peaked in the mid- to late-1980s. Heilig cautioned that even within Europe the nature and scale of the AIDS epidemic varies widely from country to country. But Heilig said it appears likely that for Europe, at least, AIDS will not become the modern plague that some people predicted: "For Europe, this doomsday scenario can be rejected."

Growth rates of AIDS cases have slowed significantly in the past three years in several countries, including France, the United Kingdom, Sweden, Norway, and the Federal Republic of Germany. Patterns of transmission vary widely within Europe but, significantly, have been relatively stable for five years. Reports of AIDS diagnoses show that the disease remains confined to three primary groups: homosexual and bisexual men, intravenous drug users who share needles, and heterosexuals with a partner in one of these groups. Rates of infection of heterosexuals outside these groups remain very low. In addition, widespread testing of donated blood will also reduce rates of infection of hemophiliacs and patients getting blood transfusions.

Still, the overall number of cases will continue to grow for several years because of the long incubation period of the disease. Said Heilig: "Most of the AIDS cases we see during the 1990s will be only the terminal stage of HIV infections contracted in the late 1970s and early 1980s." But if present trends continue, the number of AIDS cases in Europe will probably peak in the mid-1990s, then begin to decline.
of postwar baby-boomers can be projected with fair accuracy, barring war or catastrophic epidemics. Projection of childbearing trends, however, entails guesswork.

The IIASA study indicates as much. The proportions of people aged 0 to 19, while consistently lower than current values, vary widely from scenario to scenario, a clear sign of a demographic wild card. Said Lutz: "The volatile percentage of children in the populations means that long-term planning for schools and other institutions presents a difficult challenge."

But Lutz said that planners can take heart in the relative stability of the working-age population, despite general aging. The vast block of baby-boomers now in the first half of their working lives will ensure a solid wealth-generating core at least until the year 2020. The 10 IIASA scenarios consistently indicated that by 2020 the proportion of people aged 20 to 59 would decline only two or three percentage points, if at all, from the current level of 66 to 67 percent in all regions. The most extreme decline was less than seven points.

The 10 scenarios showed somewhat greater variation in overall population, depending on the assumptions. Currently the total population of industrialized Europe and North America is just over one billion; 38 percent live in Western Europe, 35 percent in Eastern Europe, including the European republics of the Soviet Union, and 27 percent in the United States and Canada. One point was consistent in all scenarios: the overall population is almost certain to increase by 2010, even if birth rates continue to fall, because of the disproportionate numbers of postwar baby-boomers who are now having children of their own.

A return to replacement levels of fertility, which would amount to an unexpected baby boom, coupled with gradually increasing life spans (scenario 2) would result in a total population in 2020 of 1,130 million, an increase of 11 percent, and 1,164 million by 2050. Even if fertility declined to the low levels observed in parts of Italy and West Germany (scenario 3) the population would increase marginally by 2010, thanks to the procreation of baby-boomers. Thereafter, however, lower fertility would lead to a rapid decline to 771 million by 2050. The population of Western Europe would decline most dramatically, from 384 million to 270 million.

Lutz and his colleagues also posited higher intakes of youthful immigrants to offset slumping birth rates (scenario 9). Such a scenario, coupled with a significant lengthening of life spans, could indeed counteract fertility declines, leading to a population of 1,153 million in 2020 and 1,113 million in 2050. But Lutz pointed out that it would take a tripling of immigration — already a political problem in many countries — to achieve those results. M. Clark

**THE PERILS OF PROJECTION**

All population projections are based on assumptions about the three factors at the heart of demography: birth, death, and migration. But assumptions about the future are of necessity little more than "best guesses," says IIASA's Wolfgang Lutz. Not surprisingly, they are often controversial. UN projections made in 1984 assumed that fertility in all European nations would rise to replacement levels by 2025, despite a steady decline to levels currently 30 percent below replacement. "Evidently," said Princeton University's Charles Westoff, who contributed a chapter on fertility study to *Future Demographic Trends*, "the loss of a member state is an intolerable prospect for the UN."

History has not been kind to demographers' conventional forecasts. Generally, says Nathan Keyfitz, leader of IIASA's population program, the underlying assumptions "look reasonable. But they are rarely backed by any substantial effort to check with the demographic reality." Still, even the most conscientious demographer has no crystal ball; given the general failure to predict the baby boom of 30 years ago, who can say that the UN's 1984 projection — since revised — was wrong?

The IIASA study discussed in the accompanying article avoids heroic assumptions. Instead, Lutz and four colleagues used a multi-scenario approach, mixing and matching various theories on demographic trends to develop 10 scenarios, including some based on what Lutz called "extreme but not impossible assumptions." The result is not a tidy graph showing high, medium, and low estimates, as in conventional projections, but snapshots of many possible futures. Readers can choose the scenario that appears to them most likely; say, a continued fall in birth rates, gradually increasing life spans, and increased immigration.

But the true value of a multi-scenario study lies in viewing it as a whole. Elements common to all scenarios point to trends that resist societal swings and are therefore nearly certain to come about. Conversely, elements that vary widely from scenario to scenario reveal demographic wild cards. For long-term planners, such insights can be invaluable.

Conventional projections reflect none of these subtleties. They do, however, appear to give clients one thing that multi-scenario studies cannot: a simple answer to the seemingly simple question, How many people will there be in the future? In fact, the failures of conventional projections prove that the question is not simple at all.
Sizing up the New Germany

How different are the two German societies after 40 years of separation, and what will a unified Germany look like? Two IIASA demographers began addressing those questions last December. Drawing on data previously unavailable, Gerhard Heilig, from the Federal Republic of Germany, and Thomas Büttner, a native of the German Democratic Republic, are compiling a detailed demographic analysis of a unified Germany. They expect to publish their findings as a book within a year. But already their research has yielded a broad outline of the new Germany, and allowed them to pinpoint some of the opportunities and problems that lie ahead.

Unification will not create a demographic superpower, but it will reinforce the Federal Republic’s position as the most populous country in Europe. The German Democratic Republic is almost half as large in area as the Federal Republic (44 percent), but with 16 million people it has only a quarter the population. Indeed, the population of the GDR has shrunk noticeably over the past 40 years, primarily because more than a fifth of the population left the country. Still, the combination of the two nations will lift Germany above other major European states, making it some 20 million larger than Italy (57 million), the United Kingdom (57 million), or France (56 million).

The demographic differences between East and West are dramatic. The GDR is generally a younger society, especially in rural northern areas. Young people in the GDR marry earlier and have more children, in part because of government incentives to do so. The result is that for each 100 adults in the East aged 15 to 64, there are 37 children under 15; in the West, there are 28. The comparison is especially dramatic in Berlin. In East Berlin, there are two children under 15 for each person 65 or more; in West Berlin, there are slightly more elderly than children.

The data confirmed somewhat shorter life spans in the East. Life expectancy in the GDR is 2.5 years less for women and 2.0 years less for men. “This is not a small divergence for two industrialized countries which started at approximately the same level of mortality 40 years ago,” said Büttner. The difference is not attributable to infant mortality, as the infant death rates are comparable. Büttner’s conclusion: “Living conditions were harder in the GDR than in West Germany. The health system obviously suffered from major difficulties.”
Overall, West Germany is one of the most densely populated countries in the world, with an average 246 persons per square kilometer. East Germany averages just 145 persons per square kilometer. Northern regions are especially sparse, with as few as 30 to 40 persons per square kilometer.

Heilig and Böttner do not rule out a redistribution of people from West to East, especially if the East experiences the Wirtschaftswunder, or economic miracle, enjoyed by the West in the 1950s. But they suggest a more likely scenario: a revitalization of the old industrial heartland around Chemnitz and Dresden in the southern GDR will draw people from the rural north, further distorting the distribution of people in the East. Indeed, they foresee an axis developing between the industrial areas of the West around Stuttgart, Munich, and the Ruhrgebiet, and the old industrial areas in the southern GDR. Kassel, Oberfranken, Erfurt, and Gera, currently remote areas along the East-West border, will be right in the middle.

Berlin, still the largest city in Germany, is isolated on the eastern fringe of the country, far from the western and southern areas where most Germans live. Heilig and Böttner calculate that Germans must travel on average 370 kilometers to reach Berlin, but only 247 kilometers to reach Frankfurt. If, as expected, Berlin becomes the capital of a unified Germany, the country will face a substantial bill for infrastructure, including autobahn and railways, to link the people to their new capital.

Berlin itself is a remarkable urban island. The surrounding area of Brandenburg, always lightly populated, is now “nearly deserted,” said Heilig. For 40 years West and East Berliners alike have been isolated from it, West Berliners by concrete and barbed wire, East Berliners by an administrative wall that limited migration from the city. Said Heilig: “One does not have to be a prophet to predict a massive out-migration from the city to its hinterland.”

The city of Hamburg will also be rejoined to its natural hinterland in the districts of Rostock and Schwerin. Already there have been proposals for a major new airport between Hamburg and Berlin to serve both centers.

The opening of the GDR’s demographic books also presents an opportunity to review a unique experiment in social engineering. Alarmed by falling birth rates, GDR officials in 1972, 1976, and again in 1986 introduced hefty incentives to encourage young people to marry and have children. For instance, young people encountered great difficulties getting apartments unless they married and had at least one child. “The GDR is one of the few developed countries that really tried to influence population through policy measures,” said Heilig. “Now we can study the response.”

Preliminary analyses indicate that the measures may have had some effect on marriage and birth rates, at least briefly. Marriage rates in the GDR are three times as high as in the FRG. And there is clear evidence that the incentives motivated East Germans to marry younger. On the other hand, birth rates, which climbed noticeably after the measures were introduced, have begun to fall back, though not as low as levels in the West. “We rather believe that traditional, family-oriented values are still very widespread in the GDR,” said Böttner. “We have to reconsider whether the higher fertility in the GDR was only a short-time response to policy measures.”
Rossiya, rodina slonov
(Russia, homeland of elephants)
— old Russian proverb

In truth the Russian empire, however large, was never a home for elephants. But that traditional metaphor for vastness applies equally to the nation that grew out of the empire: the Soviet Union remains a world within a world and a nation of nations. State radio and television broadcast in 70 languages to 286 million people. The 1979 Soviet census recognized about a hundred distinct natsional nost, or ethnic groups. It also confirmed that the balance among those groups was shifting as never before.

Today that shift continues undiminished. Research by IIASA demographers Sergei Scherbov and Wolfgang Lutz confirms that the Soviet Union is undergoing a radical perestroika of population, with the balance rapidly tilting southward. There, on the mountains and steppes of the Caucasus and Soviet Central Asia, the Moslem peoples of six republics are raising families two and three times as large as their European neighbors' to the north. In a study to be published this year in Future Demographic Trends in Europe and North America (Academic Press), Scherbov and Lutz present evidence that southern birth rates have begun to decline, but not enough to prevent the remaking of Soviet society.

The implications are enormous. Soviet authorities are reviewing their pension system, and have asked IIASA to relate its demographic work to pension issues (page 11). As for the southern republics, recent battles between Kazakhs and Uzbeks over land and housing reveal the darkest possible consequence of the population explosion.

A Perestroika of Population
the same as in other industrialized societies: longer lives and lower birth rates are leading to higher average ages and little or no growth. By contrast, the Moslem societies to the south have more in common with the developing world, with high birth rates — women average four to six children each — leading to ever larger and more youthful societies.

In 1959 the five mostly Moslem republics of Uzbekistan, Turkmenia, Kirghiz, Tajikistan, and Azerbaijan, plus the neighboring republic of Kazakhstan, together comprised about 10 percent of the Soviet population. Today they account for 20 percent, or 57 million people, and a third of all births. If current trends continued until 2050, the Russian republic would decline from 51 to 38 percent of the population. By contrast, Uzbekistan alone would rise from 6 to 18 percent. Moreover, it would be home to fully 25 percent of people under 20, compared with Russia’s 30 percent.

In fact, the population shift is not likely to be so great, says IIASA’s Scherbov. His preliminary research suggests that birth rates have declined in four of the six southern republics. And it presents evidence that the last holdouts, Tajikistan and Uzbekistan, have begun a classic transition from natural to controlled fertility.

Still, southern birth rates remain high enough to ensure a realignment of population and profound challenges for Soviet planners. Growth in the labor force would be confined almost exclusively to the south, given continued slow growth in European republics. The southern baby boom will stress local health and educational systems. And the rise of ethnic groups could foster political tensions, as it has from Quebec to Scotland to the Basque country in Spain. The clashes between Uzbeks and Kazakhs demonstrate clearly that ancient rivalries, though diminished, still linger.

### THE PENSION PROBLEM

A preliminary study of Soviet pension problems by IIASA demographers had its roots in a visit to IIASA last December by Soviet Deputy Prime Minister Nikolai Laverov. After researchers briefed Laverov and his delegation on their research into Soviet population trends, Laverov asked if the work could be related to pension issues. Sergei Scherbov and four colleagues set to work, and within two months Laverov had their report. In it report Scherbov cautioned that, with time short and little economic data available, it should be seen only as “rough information, . . . a crude macro-perspective.” Still, it offers a glimpse of the challenge ahead.

Soviet society is aging rapidly. In 1979 there were on average 3.2 Soviets of working age for each person over the official retirement age (55 for women, 60 for men). By 1989 that ratio had sunk below 3.0 to 1.0. The IIASA study estimates that by 2049 the ratio will be about 2.0, meaning that, other factors being equal, state pension costs would rise some 50 percent.

The study also noted that since 1950 Soviet workers have retired ever earlier. Indeed, the country’s mean retirement ages of 54.2 for women and 58.4 for men rank among the lowest in the world, below the Netherlands, Italy, France, Canada, and East and West Germany. The IIASA study indicated that, in theory, a five-year increase in official retirement age could maintain the current ratio of pensioners to working-age, wealth-generating people.

But national averages mean little in a country as diverse as the Soviet Union. Growth is stagnant in European republics, including Russia, the Ukraine, and the Baltic states, but soaring in southern republics such as Uzbekistan, Azerbaijan, and Tajikistan. Worker-to-pensioner ratios vary from 2.4 in the Ukraine to 4.9 in Uzbekistan. The IIASA study indicated that a gradual five-year increase in retirement age might maintain the balance between pensioners and workers in European republics, where populations are relatively old and stable. But it could “destabilize” the pension systems of fast-growing southern republics. The report recommended that Soviet planners “consider differentiating the pension system by republic.”

Scherbov acknowledged that such a change could run afoul of regional interests. A decade ago Soviet officials sparked a brisk debate when they proposed redirecting family support payments to slow-growing urban areas, meaning the European republics, and away from fast-growing rural regions, especially the south. Officials of southern republics successfully resisted.

The report’s other recommendations could be applied to many developed countries. It recommended that Soviet officials consider the Japanese practice of protecting certain jobs in which the elderly could contribute, such as small-scale farming or retail and repair work. It also recommended that they encourage people to work longer, perhaps by allowing older workers who stayed on the job to get a portion of their pension; encourage private savings to supplement state pensions; and encourage children to help retired parents. The report concluded that, in the end, Soviet authorities must deliver the same message to their people as in other developed countries: “No feasible state security scheme will do the whole job of ensuring a good living for the old people.”
The Indian Ocean island of Mauritius has become the focal point of a unique attempt by IIASA scientists to explore the complex links between people, their life-styles, and their environment. A team of five researchers led by demographer Wolfgang Lutz, deputy leader of the institute’s Population Program, began work on the project this summer in collaboration with a team from the University of Mauritius. Within two years they expect to produce an easy-to-use, dynamic computer model that will simulate interactions of population, technology, economics, and environment on the island. And they expect to have intermediate results early in 1992, in time for display in Brazil at the UN Conference on Environment and Development.

The Mauritius project will be the first test of the Population Program’s new Population and Sustainable Development Project. The project, begun earlier this year, reflects principles that lie at the heart of IIASA: it will bring together scientists from various disciplines in an attempt to produce rounded pictures of the world, and provide decision makers with scientifically sound, usable tools. Previous attempts at interdisciplinary cooperation have often failed, said Lutz, because the themes tended to be so global as to defy specifics. The result, he said, "was statements so general as to be empty. Everybody went back frustrated to their own disciplines." But by narrowing the focus to a case study of Mauritius, Lutz and his colleagues believe that they have an opportunity to develop new approaches to interdisciplinary cooperation which can then be applied to other, larger projects.

The research team will include demographers, sociologists, economists, ecologists, and computer scientists. When they finish, authorities on Mauritius expect to use their computer model to evaluate policy options, especially regarding land use and manpower; for instance, if they were considering more widespread use of agricultural chemicals, they could use the model to gauge the potential impact on soil toxification and water quality. Lutz added that it should be possible to modify the model for application elsewhere. It should produce easy-to-understand, high-quality graphics on a personal computer and be usable with minimal training. And it should make an excellent educational tool for use worldwide.
The goals are ambitious, but Mauritius is an ideal test case. The island is small, 1,865 square kilometers with one million inhabitants, and geographically isolated. The economy is relatively simple, relying primarily on textiles, tourism, and sugar cane. Lastly, the researchers can draw on an unparalleled data base, thanks to regular censuses by the former British colonial government and a thorough study of the island’s economy and demography prior to its achieving independence in 1968. Together, said Lutz, these factors greatly enhance the chances of success.

A team of IIASA researchers began work this summer on an ambitious attempt to weave together the issues of population, development, and environment on a global scale. The study was commissioned by organizers of the 1992 UN Conference on Environment and Development, and is to be ready in time for the conference. The goal is to provide a global overview of the interplay among people, their technology, and the natural world; to show how this interaction threatens mankind’s survival; and to pinpoint the most pressing threats.

At the time of writing, project leader Roderick Shaw and his team were considering several alternative approaches. One was to link a series of specific models covering everything from population growth to crop production to energy use and climate change. Another was to develop a global geographic information system, or GIS. The GIS would act as a sort of global accounting tool, tracking changes over time in a series of grid squares that covered the globe, while constantly cross-checking from square to square to see how events in one influence the others. The GIS would also be supported by a series of outside computer models that would perform specific tasks based on information in the GIS frame; for instance, calculation of climate change based partly on patterns of energy consumption and land use indicated by the GIS.

In the end, Shaw’s group may opt for a combination of several approaches. Regardless, their intention is to produce a dynamic simulation of mankind’s interaction with his planet, one that demonstrates how unrestrained growth threatens survival, and to define critical issues for delegates to the 1992 conference.
Interview

Professor Nils Sture Öberg

In April Swedish geographer Sture Öberg joined IIASA's Population Program, following a 23-year career as a leading researcher and adviser to government. Since 1986 he has been head of the Department of Social and Economic Geography at the University of Uppsala. Öberg is expected to play a key role in IIASA's Population and Sustainable Development Project, including a study to be done for the 1992 UN Conference on Environment and Development.

Q... What do you want to accomplish at IIASA?
A... I want to concentrate on two issues. First, I want to investigate mass migrations in Europe. The second thing that I want to do is to put more social science into environmental research. Existing environmental models and theories concentrate on natural process. There are no people in them, they take human behavior for granted. It is people who are polluting, and only people can agree upon how to lower rates of pollution. There must be more input from social sciences in environmental research.

Q... How would you change the models?
A... There are several things that should be done, at different levels in the research process. First, existing models can be better adapted to the political discussion by including measures of more popular interest. What are the tolerable limits of chlorofluorocarbons, or greenhouse gases? How much would it cost to secure sustainable development in some of its different aspects? There are estimates that it would cost trillions of US dollars just to cut CO₂ emissions by 20 percent in North America alone. How much would technological transfer to the LDCs really affect our prognoses? These are all questions of great interest to the international discussion, and they should be better addressed in quantitative models.

Second, existing models should take into account population growth, consumption patterns, and production systems. This incorporation of social science would probably make the conflict between economic growth and environmental considerations sharper.

A third priority is to improve the technical performance of models and geographical information systems (GIS). I am particularly interested in GIS. They work with a system of static overlaying maps representing time steps. Researchers from different disciplines contribute transformation rules that determine changes in the attributes of objects or territories. We could apply those transformation rules to interacting processes. For instance, we could interlink changes in population with changes in climate and land use, and the model would keep track of those processes in time and space. In Sweden my colleagues and I tried this time-geographic approach with some success on complex population systems.

Q... What do you think more refined models would show?
A... Frankly, I don't know. This has never been done on the scale and in the way that it could be. But that only makes it more urgent and interesting that we work with such models.

Q... Let's turn to your other area of interest, mass migrations in Europe.

Q... There are no people in environmental models. That must change.

A... We know that demographic and geopolitical changes are the main causes of mass migration. Since the 1960s Western Europe has become a place of refuge. In Sweden, with a population of 9 million, we have received nearly 100,000 refugees from outside Europe, including Iranians, Assyrians, Syrian, Kurds, Eritreans, Vietnamese, and Palestinians. And there will be more. These streams are caused essentially by geopolitical changes, including wars. But for Europe as a whole I imagine that it is the demographic drama on the world stage that will determine in-migration.

The world population is growing by about 250,000 each day, mostly in the poorer countries. That is bound to cause migratory pressures. What can Europeans learn by studying the US experience? The situation along the Mediterranean coast is in some ways comparable to the US-Mexican border: a wealthy, developed society with slow population growth next to a poorer region with high unemployment, a very young population, and strong growth.
The next wave of immigrants to Europe will likely be from the Mediterranean. Our situation is comparable to the US–Mexican border.

Many scientists believe that Europe's next immigration wave will be from the southern and eastern Mediterranean. In 10 years time there will be another 50 million people living in those areas. Italian authorities estimate that already there are more than a million North Africans living illegally in Italy.

Q... Do you expect resistance from native Europeans?
A... Yes. There is a long tradition of ethnic chauvinism in Europe, and there will be social and political conflicts to solve. That is a good reason for doing studies in this field.

Q... How will recent political changes affect European migration?
A... Western European Common Market politicians have said very clearly that they will make it easier for people to migrate between EC countries. The same might soon happen in Eastern Europe. The Soviets have said that they are going to allow people to migrate freely within the Soviet Union, and to the West as well. I can only speculate about the possible impact, of course, but it could be enormous. Soviet officials have estimated that two million well-educated people could immediately get jobs in the West.

And there are serious ethnic tensions in Eastern Europe that could cause large flows of migrants within the region. We have seen this happen many times in European history.

Q... Are there other aspects to intra-European migration?
A... Yes. In the USA they have yuppies; in Europe we have Euppies. Multinational companies send their people all over Europe in a systematic way. And outside these large companies there are large numbers of educated, highly mobile people working in other countries for the experience. It is not truly a mass migration, but it is worth investigating. These people have influence beyond their numbers.

Another interesting group is the woopies: well-off old people. Northern Europeans have bought hundreds of thousands of summer homes along the Spanish coast and elsewhere in the European sun belt. Usually, they do not appear in statistics on migration, because they are still registered in Newcastle or Stockholm or wherever.

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Another interesting group is the woopies: well-off old people. Northern Europeans have bought hundreds of thousands of summer homes along the Spanish coast and elsewhere in the European sun belt. Usually, they do not appear in statistics on migration, because they are still registered in Newcastle or Stockholm or wherever. But they stay half the year in southern Europe. I want to see how many there really are, and how much time and money they spend in the Mediterranean. Europe is aging and the lifestyle of the elderly will affect patterns of consumption, and hence production. They are changing the face of Europe.

Q... Why did you choose to do your research at IIASA?
A... Many reasons. I have some excellent colleagues in the Population Program. And Vienna is a nice city to live in.

And I find IIASA itself very well positioned when it comes to environmental work. The opportunity to write a scientific report for the 1992 UN Conference is very flattering for IIASA and a great opportunity for the staff. I will be partly responsible for this work, as senior scientific coordinator. For a social scientist, it is a great challenge.
RESEARCH

A study of airborne transport of heavy metals in Europe indicates high concentrations of potentially dangerous heavy metals in some parts of the continent. The study is not yet complete, but preliminary results indicate high rates of deposition of cadmium, zinc, and arsenic in certain areas, notably the Federal Republic of Germany, southern Poland, the Donets Basin in the USSR, and the Benelux countries.

An IIASA research team led by Joseph Alcamo modified two computer models developed for acid rain research (TRACE and EMEP) to determine how heavy metals are distributed by atmospheric transport around Europe. Preliminary results indicate that airborne arsenic and zinc are deposited in West Germany and southern Poland at a rate 40 times higher than on the fringes of the continent. In the Donets Basin, northern Spain, southern Poland-northern Czechoslovakia, and the Benelux countries, deposition of airborne cadmium is about 15 times the levels in Nordic countries. Alcamo’s team is also studying atmospheric transport of lead, which appears to distribute more evenly around Europe.

Each of the four metals has been recommended for monitoring by the Paris Commission, which is concerned with pollution of the North Sea, or the Helsinki Commission, which monitors the Baltic Sea. Arsenic and cadmium are known carcinogens, and high concentrations of lead cause a variety of health problems. Zinc at high concentration levels is known to be moderately toxic to plants.

A second group of IIASA researchers is carrying out a more detailed study of heavy-metal pollution in the Rhine River basin. A team under William Stigliani is attempting to develop the first complete picture of heavy-metal contamination in the region.

Their intention is to couple the aerial pollution studies of Alcamo’s group with additional studies of heavy-metal pollution from other sources, including local industry and agriculture. The result should be the first comprehensive overview of heavy-metal pollution in one of the most densely populated and highly industrialized areas on Earth.

CONFERENCES

Recent Conferences

Economic Reform and Integration. Laxenburg, Austria, 1–3 March.
Western policy advisers and Soviet and Eastern European policymakers met to discuss ways of furthering economic reform in Eastern Europe, and to establish a continuing program of research and consultation on the reform process through IIASA’s Economic Reform and Integration Project (ERI). As a result of the meeting, Soviet officials have agreed to refer draft legislation on economic reform to ERI for review and comment by one of five working groups. (Contact: Petr Aven, IIASA)

Managing Inflation in Socialist Economies. Laxenburg, Austria, 6–8 March.
This policy seminar brought together government officials and advisers, representatives from international organizations, and leading academics to discuss economic reforms in Eastern Europe. The discussion focused on the causes and cures of high inflation rates, which have begun to appear in some Eastern European countries undergoing reform. The event was organized by the Economic Development Institute of the World Bank and hosted by IIASA. (Contact: Simon Commander, Economic Development Institute, 1818 H Street NW, Washington, DC 20433, USA)

Risk Analysis, Standards, and Abnormal Occurrences. Laxenburg, Austria, 2–3 April.
The second conference of the European section of the Society for Risk Analysis (SRA–Europe) attracted over 100 participants from 19 countries. They presented more than 50 interdisciplinary papers ranging from discussion of technical considerations, such as safety standards for nuclear power plants and offshore oil rigs, to sociological considerations, such as health risks associated with chemical use. The conference was cosponsored by IIASA and the World Health Organization Regional Office Europe, which also organized a series of special sessions devoted to communication of risk and public participation. The conference included discussions of the benefits and limits of quantitative risk analysis and of the effectiveness of public risk communication. (Contact: Björn Wahlström, IIASA)
World Climate Program–Water (WCP–Water), Laxenburg, Austria, 30 April–4 May.
The fifth planning meeting of WCP–Water was organized jointly by the United Nations Educational, Scientific, and Cultural Organization, the World Meteorological Organization, and IIASA, to review progress in existing projects of WCP–Water, and to develop proposals for future activity. (Contact: Zdzisław Kaczmarek, IIASA)

Global Hydrology, Sopron, Hungary, 14–18 May.
This meeting was organized jointly by IIASA’s Water Resources Project and the Hungarian Committee for Applied Systems Analysis to allow participants to exchange information about current developments in large-scale hydrology; to define what needs to be done to construct macro-hydrological models that can predict the impact of climate change on water storages and fluxes of all kinds, allowing for analysis of impact on regional water resources; and to explore the usefulness of such models in the context of global vegetation modeling. (Contact: Sandra Harrison, IIASA)

Economic Reforms in Middle and Eastern Europe, Laxenburg, Austria, 22–23 May.
This conference was sponsored by the Egon Sohmen Foundation in collaboration with IIASA to assess the process and progress of economic reforms in five countries of Eastern Europe: Czechoslovakia, the German Democratic Republic, Hungary, Poland, and the USSR. (Contact: Friedrich Schmidt-Bleek, IIASA)

This third and final task force meeting under IIASA’s project on Social Security, Family, and Household in Aging Societies was organized with and hosted by the Department of Demography of the University of Rome, La Sapienza. Participants discussed the main findings of the project and reviewed the first drafts of 13 country reports. The results are to be published by the spring of 1991. (Contact: Thomas Büttner, IIASA)

Computer Integrated Manufacturing, Laxenburg, Austria, 1–4 July.
Some 105 leading researchers from 22 countries, including Eugene Merchant, the acknowledged doyen of computer integrated manufacturing, met to discuss the ongoing industrial revolution brought about by CIM. Papers and discussions focused on four areas: CIM technology; its diffusion; managerial and organizational implications; and economic and social implications. Robert Ayres, leader of IIASA’s CIM Project, also summarized the project's work, which is to be published in five volumes beginning later this year. (Contact: William Haywood, IIASA, or Robert Ayres, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, PA 15213, USA)

Council Meeting

The IIASA Council held its 35th meeting June 11–12, under Chairman Vladimir Mikhalevich. The Council voted unanimously to appoint Peter de Jánosi to a three-year term as IIASA director, beginning 16 August 1990. De Jánosi, who has extensive management experience in social research, education, and corporate environments, was IIASA’s senior consultant on management from 1977 to 1979. Since November 1987 he has been US representative on the IIASA Council, and a member of the Council’s executive committee. He is currently vice-president of the Russell Sage Foundation in New York. The Council passed a resolution conferring the title of IIASA Honorary Scholar on Robert Pry for his outstanding contribution to the consolidation
of the institute and the advancement of its objectives during a crucial period.

The Council also welcomed a new member, Risto Seppälä, of the Finnish Committee for IIASA. Seppälä, an IIASA alumnus, heads the Department of Mathematics at the Finnish Forest Research Institute in Helsinki. He succeeds Helge Gyllenberg, who was awarded the title of IIASA Honorary Scholar in recognition of his contributions to the institute.

Council members examined IIASA's 1991 Activity Plan, approved a new dues structure, and discussed the renewed support of IIASA by the US and French governments. They agreed to accept a proposal by the French government through Jean-Michel Chasseriaux, an official of the Ministry of Research and Technology, to give IIASA AS 3.7 million as payment of back dues from 1984 to 1987, and to set up a fund of AS 4.3 million to finance projects of mutual interest.

On 5 January 1990 Allan Bromley, Assistant to US President George Bush for Science and Technology, officially notified IIASA's US representative that the White House had decided to resume regular funding of the institute. The White House designated the US National Science Foundation as the government agency that would deal with IIASA.

NSF officials have agreed to provide up to US $1.4 million in financial support in the 1990 fiscal year, and agreed to provide support in subsequent years of US $2.2 million per year.

Appointments

Ferenc Rabar, leader of IIASA's Food and Agriculture Program from 1975 to 1980, and again from 1985 to 1987, was appointed Minister of Finance of Hungary.

Merton Peck of the Department of Economics at Yale University in New Haven, Connecticut, USA, was named leader of IIASA's Economic Reform and Integration Project.

In Memoriam

The deaths of two IIASA associates have recently been announced. Louri Tchijov of the USSR, a research scholar with the Computer Integrated Manufacturing Project since 1986, died in Vienna, 3 May 1990.

IIASA also regrets to announce the death of Todor Popov of Bulgaria, a scholar from 1976 to 1978 with IIASA's Food and Agriculture Program.

IIASA Books

Two new IIASA books, now off press, are available from your regular book supplier or direct from the publisher.


IIASA Reports

In addition, the following IIASA reports are now available from the Publications Department at the price indicated:


For further details contact Robert McInnes.
Future Demographic Trends in Europe and North America
What Can We Assume Today?

EDITED BY WOLFGANG LUTZ

A state-of-the-art report on what demographers and scientists in related disciplines assume today about the future of human reproduction, longevity, and migration. Alternative views are translated numerically into several scenarios on possible future population structures in Europe and North America.
IIASA's ROLE
The International Institute for Applied Systems Analysis is a non-governmental research institute sponsored by scientific organizations from East and West. It brings together scientists from more than 20 nations and a variety of disciplines. Its purpose is to develop practical options to deal with issues of international importance through the application of system sciences. The Institute's effectiveness is rooted in its international sponsorship and focus, its nonpolitical status, its freedom to choose its research agenda from a variety of pressing international issues, its interdisciplinary base, and its worldwide network of collaborating organizations.

RESEARCH
Recent projects have included studies on global climate changes, world agricultural potential, energy resources, acid rain, computer integrated manufacturing, the social and economic impacts of demographic changes, and the theory and methods of systems analysis. The basis of IIASA's scientific research is the development and use of computer models to help define how global issues and problems may evolve in the future. The objective is to develop viable policy options that can be implemented through international cooperation.

MEMBERSHIP
IIASA was founded in 1972, on the initiative of the USA and the USSR, with the eventual participation of another 14 countries in the East and West. IIASA has member organizations in the following countries: Austria, Bulgaria, Canada, Czechoslovakia, Finland, France, the German Democratic Republic, the Federal Republic of Germany, Hungary, Italy, Japan, the Netherlands, Poland, Sweden, the Union of Soviet Socialist Republics and the United States of America.

FURTHER INFORMATION
Further information about IIASA and its work is available from: The Office of Communications International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria. Telephone: (02236) 715 21-0.