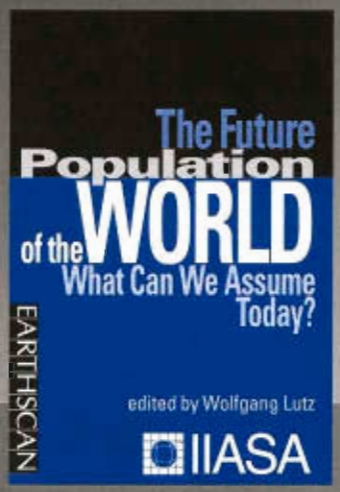
IIASA

options

International Institute for Applied Systems Analysis Autumn '94

World Population



IIASA BOOKS

The Future Population of the World

What Can We Assume Today?

Wolfgang Lutz, Editor

This book gives a thorough analysis of the components of population change – fertility, mortality, and migration – and translates alternative assumptions about these factors into a series of projections for the population of 12 world regions. The scenarios are the first to explicitly take into account possible environmental limits to population growth and to consider a range of other factors, such as the impact of AIDS. These new scenarios differ significantly from projections already available from the UN and the World Bank, and are likely to become benchmarks for future discussions of population.

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EDITORIAL

In recent years IIASA has been transformed from a center for collaborative East–West research to an important international institution devoted to the interdisciplinary study of the human dimensions of global change, including the complex transitions now under way in the former centrally planned economies. During this transformation IIASA was able to build on its past accomplishments and scientific networks, while at the same time adding many new substantive and organizational elements. In scientific circles IIASA's new role is now well recognized and accepted.

Notwithstanding its nongovernmental status, most of IIASA's budget comes from governments. The founders of the institute were in positions to commit governments in their countries to secure funding of IIASA plus the freedom to pursue research without political constraints. This combination of commitment and freedom served IIASA well in earlier years. The time is now right for governments to reaffirm their interest in a reconstituted IIASA.

The apparatus of government takes its signals from its leaders of today. A new generation of political leaders and government officials does not know IIASA as well as the leaders of the 1970s. For IIASA to serve current leaders' interests as well as it did their predecessors', the signals need to be renewed. The best way to do this is a clear restatement of political support for IIASA.

For this reason, Austrian Chancellor Franz Vranitzky has invited ministers from each of the seventeen countries that actively support IIASA member organizations to a meeting at the institute in November 1994. The meeting would give ministers and senior officials responsible for IIASA in their own countries an opportunity to learn about the institute and to consider IIASA's current and future activities. Not since IIASA's establishment has there been a meeting at such a high political level to discuss the role of the institute. A joint communiqué restating their interest in IIASA and support for its goals can help the institute to achieve its objectives.

We at IIASA look forward to the meeting eagerly, confident that it will add a much-needed political commitment to the existing scientific endorsement.

Peter E. de Jánosi
Director

CONTENTS

FEATURE

New World Population Scenarios

Population growth is one of the most controversial issues of our time; almost everyone agrees that it affects environmental, economic, and political stability, both globally and regionally, but there is little consensus on what, if anything, should be done about it. IIASA's Population Project has for several years studied the complex links between population, society, and the natural world. One result is Population–Development–Environment: Understanding Their Interactions in Mauritius, *published recently by Springer Verlag. Following are brief descriptions of other work on global population scenarios and a new database and education tool.*

Why has IIASA's Population Group made the effort to prepare a new set of world population projections when the UN and the World Bank routinely publish their own projections of future population? Because these existing projections are too limited in scope for the study of global change.

Scientists working in ecology, climatology, hydrology, agriculture, energy, and other fields increasingly demand long-term population figures that explicitly address the issue of uncertainty. Their scenario analyses are becoming more sophisticated; often they are more interested in the boundaries of future world population rather than a best guess. Moreover, in the design of robust policy options, consideration of alternative population scenarios is a must.

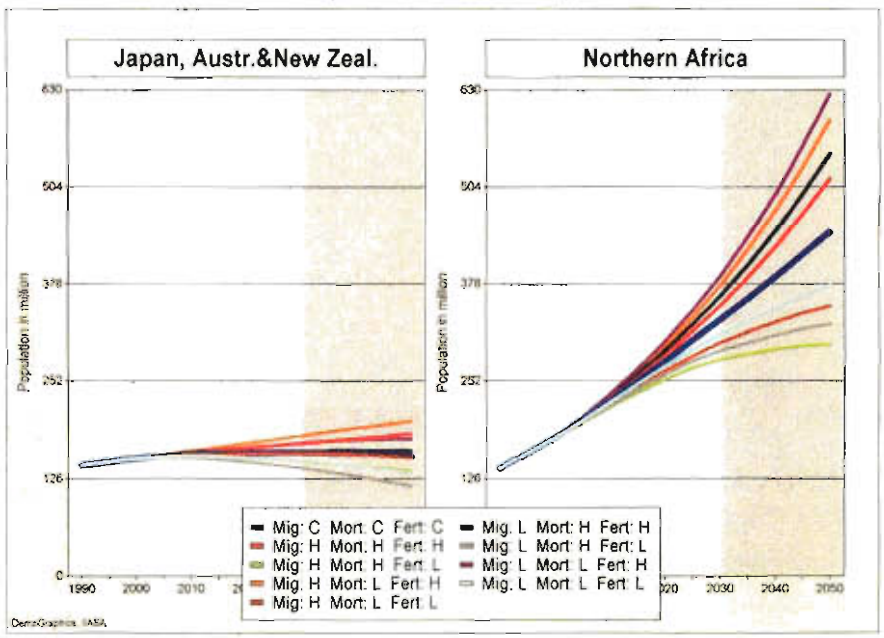
At IIASA we have developed a set of nine scenarios of world population growth, based on the opinions of some of the foremost experts in the field about future trends in fertility, mortality, and migration. Taken together, the scenarios reflect a wide range of views by experts about possible future trends in population.

The Scenario Approach

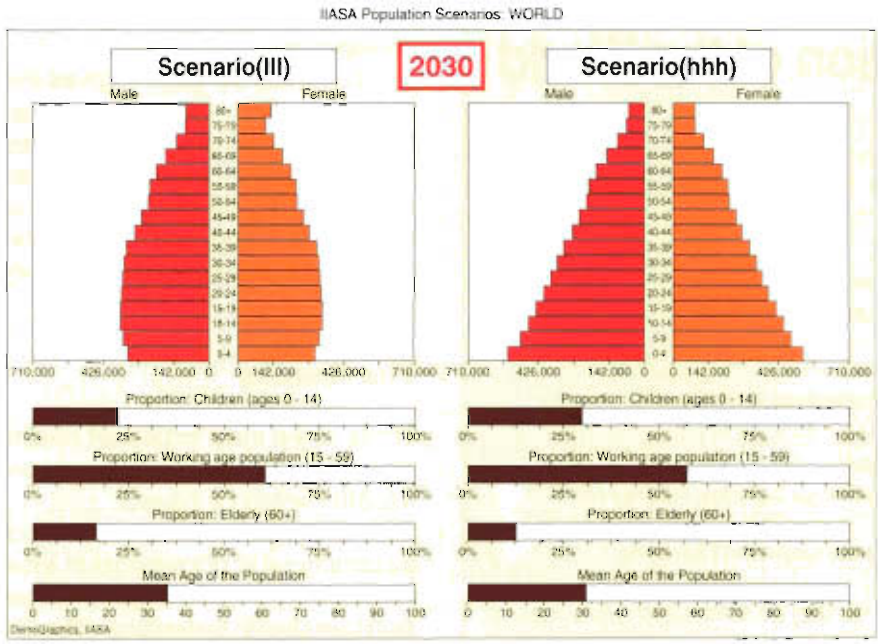
More and more, demographers write of scenarios of population rather than the more traditional variants. The scenario approach has gained followers for several reasons. Scenarios emphasize the if/then nature of the calculation rather than a best-guess prediction. Scenarios underscore the importance of assumptions about trends in fertility, mortality, and migration – the numbers behind the numbers. Given enough scenario combinations, it is also possible to do a sensitivity analysis of these three components.

Deciding on the assumptions to use in the IIASA scenarios was no easy task. The first step was to request papers from invited experts in the fields of fertility, mortality, and migration analysis. Each expert expressed views on likely trends and less likely but not-impossible trends in the three demographic components, including variation by region. These papers were the starting point

IIASA Population Scenarios: Total Population



Projected population size in Northern Africa versus Japan, Australia, and New Zealand.



World population age structure in 2030 under two extreme scenarios: assumptions of low fertility and low mortality compared with high fertility and high mortality.

for many chapters in *The Future Population of the World: What Can We Assume Today?* (see page 6). The book also contains a detailed explanation of the IIASA population projections.

Each expert was asked specifically to suggest possible high and low assumptions for future fertility, mortality, and migration levels to the year 2030.

The next step was to invite some of the experts to a meeting at IIASA where, in vigorous debate, they challenged each other's views and discussed options for building scenarios. Based on these qualitative discussions we developed a range of quantified assumptions on future trends in fertility, mortality, and migration in each of 12 world regions (other regional groupings and aggregations are possible). These demographic trends are thought to be extreme, but not impossible.

A systematic permutation of the high and low assumptions in each of the three components results in eight scenario combinations. These eight scenarios provide a basis for sensitivity analysis. Systematic permutation also reveals the relative impact of changes in individual components under given age structures.

In addition to the eight combinations, a central scenario was obtained by combining the arithmetic means of the low and high fertility, mortality, and migration assumptions. This central scenario is tantamount to the group's most reasonable guess.

None of the experts was willing to speculate about trends in population beyond 2030. This is understandable: demographers' record in long-range projection has been dismal. Still, many global-change researchers study systems and problems that evolve over decades and centuries – climate change, for example – and need population projections to match.

We prepared two sets of long-term extensions of the expert scenarios until the year 2100. One set attempts plausible extensions for all 12 world regions. The major assumption regards the future course of demographic transition to lower fertility and mortality.

The second set of scenarios is not comprehensive but illustrative. It explores some features of population dynamics, particularly the possible effect of feedback from population size and ageing on fertility and

Three Certainties for the Future

The nine scenarios developed by IIASA explore a wide range of possibilities, but some conclusions are consistent from scenario to scenario. For practical purposes, they are certainties for the future.

1. **World population will continue to grow.** By 2030, world population will increase by at least 50 percent and may even double in size. Short-term growth is inevitable: it is built into the age structure of today's world population. The question is not if world population will grow, but rather how large will it become.

2. **Developing countries will account for a greater share of the world population.** By 2030, today's developing countries will represent between 85 and 87 percent of the world population — this is a very small margin of uncertainty resulting from extremely different scenarios. Under all scenarios, Africa's share of world population will increase most rapidly.

3. **All populations will become older.** The average age of all world regions will increase under all scenarios. The more rapidly fertility declines, the faster the population ages.

The Future Population of the World

Below are the contents of *The Future Population of the World: What Can We Assume Today?*, edited by Wolfgang Lutz, Earthscan Publications, London.

mortality. Only selected regions are considered.

The table on page 7 gives the disaggregation into 12 regions. Regional populations were projected simultaneously by a multi-state model assuming region-specific paths of age-specific fertility and mortality and full matrices of interregional migratory streams.

The Results

Three of the most important results of the scenario analysis are summarized in the box on page 5.

An important characteristic of our assumptions is uncertainty in mortality, something lacking from other world population projections. (The UN varies assumptions only about fertility, while the World Bank publishes only one scenario. Neither set of projections considers alternative paths of migration.) The impact of mortality is clearly evident from the projections of world population (see cover). Other things being equal, by 2030 high and low mortality assumptions make a difference in world population of not less than 0.7 billion – not as great as the 1.7 billion range between the high and low fertility assumptions, but still highly significant.

The wide differences in growth trends can be seen clearly in the table and in the figure on page 4. In 1990 two of the regions, Northern Africa and Japan/Australia/New Zealand, each had 140 million inhabitants. The combined population of Japan/Australia/New Zealand is likely to stabilize around that figure, but by 2050 Northern Africa's population might easily triple.

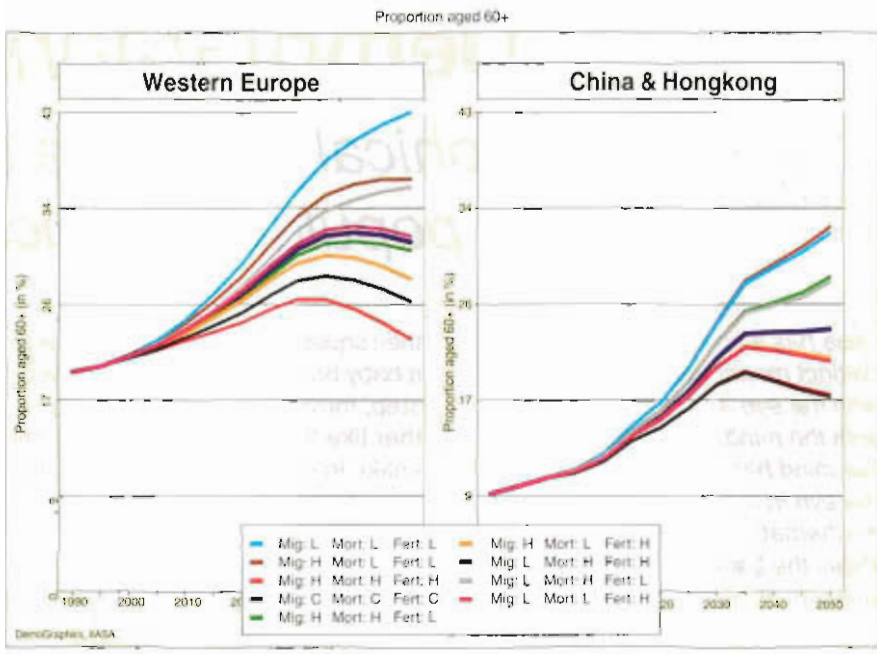
Future trends in population ageing are as pronounced and uncertain as trends in total growth. As shown in the figure on page 5, by 2030 the world's age structure would still have the shape of a pyramid under assumptions of high fertility and high mortality; but in low fertility–low mortality scenarios it takes the shape of a bottle. This implies radically different societies.

Trends in population ageing are

again very different in different parts of the world. This trend is already apparent in developed countries. Countries that are affected later are likely to experience even more rapid ageing. The figure on this page shows the example of China.

When comparing projections of ageing to population growth, one very important feature becomes apparent. Scenarios that result in high population growth show only moderate population ageing, while those showing a levelling off in population size imply very rapid population ageing. Generally, rapid population growth and rapid ageing are both considered undesirable, but the scenario projections clearly show that one cannot avoid both.

Wolfgang Lutz and Christopher Prinz



Proportion of elderly population (aged 60 and over) in China and Western Europe.

Total population size in 12 world regions under the central scenario (in millions)

	1990	2010	2030	2050	2070	2100
Northern Africa	140	226	332	440	529	595
Sub-Saharan Africa	502	924	1,499	2,097	2,561	2,700
North America	277	325	376	420	475	577
Central America and the Caribbean	147	219	289	342	370	371
South America	294	407	516	604	667	727
Western and Central Asia	197	312	442	553	632	682
South Asia	1,191	1,806	2,428	2,874	3,065	2,855
China and Hong Kong	1,159	1,469	1,722	1,873	1,945	1,968
Southeast Asia	518	735	937	1,076	1,129	1,082
Japan, Australia, and New Zealand	144	158	160	158	154	151
Eastern Europe	345	368	380	385	392	427
Western Europe	377	404	416	416	415	426
Developing regions	4,149	6,097	8,167	9,859	10,897	10,980
Industrialized regions	1,142	1,255	1,333	1,378	1,437	1,582
World total	**5,291**	**7,352**	**9,499**	**11,238**	**12,334**	**12,562**

FEATURE

Demo*Graphics*

A graphical database and tool for population education

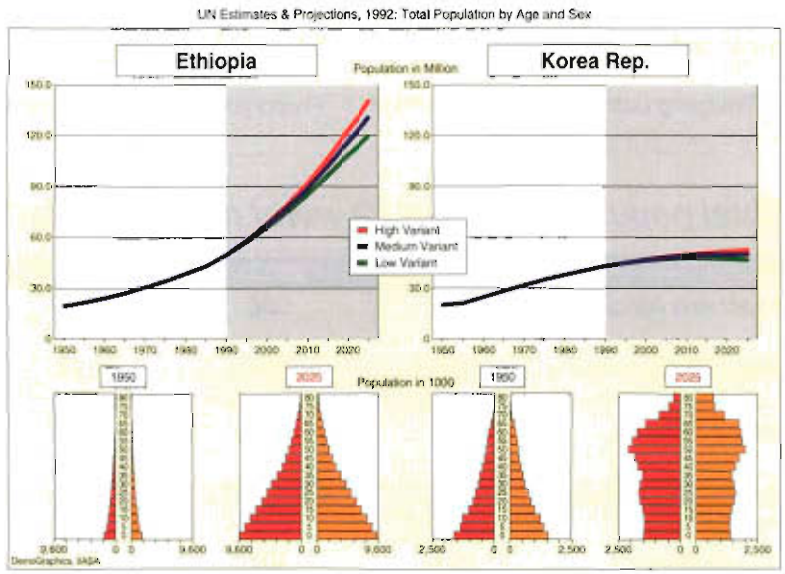
I see *has always had two distinct meanings: to perceive with the eye and to understand with the mind. For centuries the mind has dominated the eye in the hierarchy of mathematical practice; today the balance is being restored ... .*

From *On the Shoulders of Giants: New Approaches to Numeracy*
L.E. Steen

To most laymen demography is a discipline of dry statistics and tiresome models, a subject only for people who like numbers and equations. Politicians and planners are especially uneasy with demographic data, assessments, and projections, which might explain why demographic trends are often ignored and their social, economic, and political consequences are underestimated or misunderstood.

Part of the solution lies, as L.E. Steen has written, in restoring the balance between mind and eye. This was our goal in developing Demo*Graphics*, an educational software package. Demo*Graphics* is a system for easy retrieval, graphical display, and animation of complex demographic data. The software automatically translates data into charts (population pyramids), thematic maps, scatter plots, and other graphics.

The illustrations on these pages hint at what Demo*Graphics* can do. But the real strength of Demo*Graphics* is its ability to animate time series data. Graphs and charts move and change in time, like the societies they represent. A drop in birth rates pinches the base of an age pyramid, then squeezes it in progressive steps; a baby boom causes a bulge at each step, moving through a pyramid rather like the elephant eaten by the snake in de Saint-Exupéry's fable.



Alternatively, viewers can *see* the demographic momentum as the broad base of Nigeria's population pyramid moves upward to child-bearing age.

Just as a static age pyramid shows the demographic structure of a society at a given moment, so a moving pyramid makes clear the changes in structure over time. Demo*Graphics* helps users to understand the nature, scale, and speed of demographic change.

A second advantage is easy access and comparison of data – anyone who has used a 600-page set of tables like the *UN Population Estimates and Projections* knows how important this feature is. With Demo*Graphics* the user simply picks countries or regions from a list with a click of the mouse. The data are directly displayed in color graphics, in synchronous time steps. Side-by-side comparison makes trends and patterns obvious.

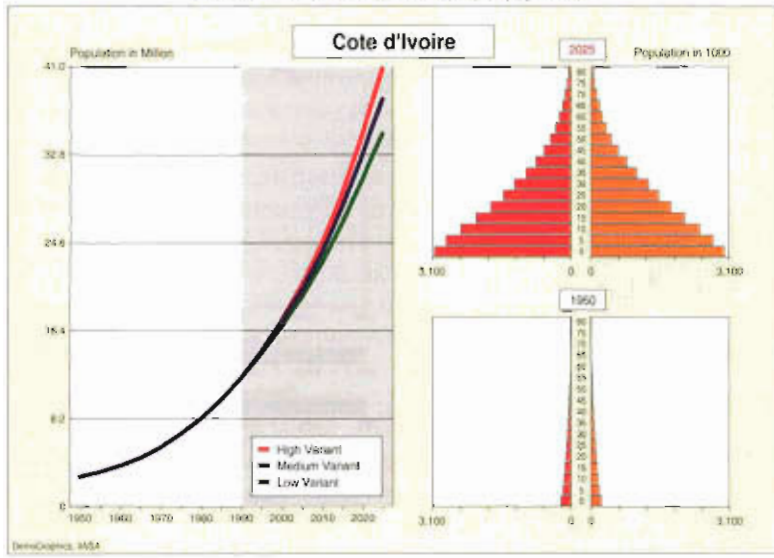
Currently, Demo*Graphics* is set up for use with two data sets:

- the 1994 World Population Scenarios and European Country Scenarios developed by IIASA (see the previous article);
- the 1992 revision of the UN Population Estimates and Projections, with data on 180 countries.

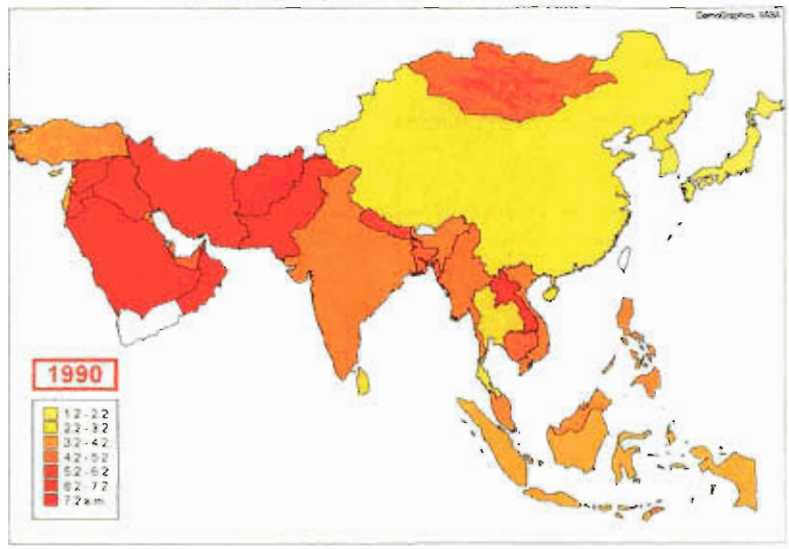
The IIASA population scenarios are included with Demo*Graphics* software. But because of copyright restrictions, IIASA cannot distribute UN data sets; they can be ordered directly from the UN. The data can automatically be added to the Demo*Graphics* database during installation. The box contains details on what the user should order from the UN.

The system is not restricted to UN and IIASA data: other sets of population data, such as detailed country reports or data for provinces or districts, could be added. Demo*Graphics* could also be configured for much larger databases.

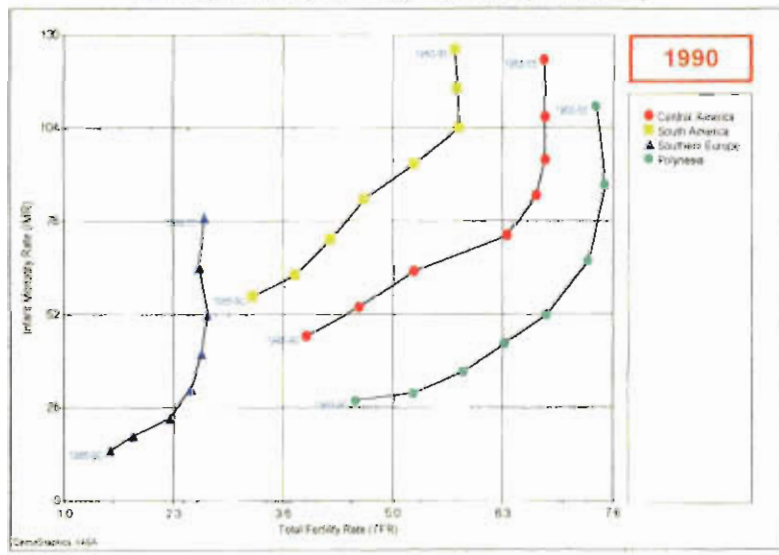
UN Estimates & Projections, 1992: Total Population by Age and Sex



UN Estimates & Projections, 1992: Total Fertility Rate (TFR)



UN Assesments & Projections, 1992: Total Fertility by Infant Mortality



Some Technical Details

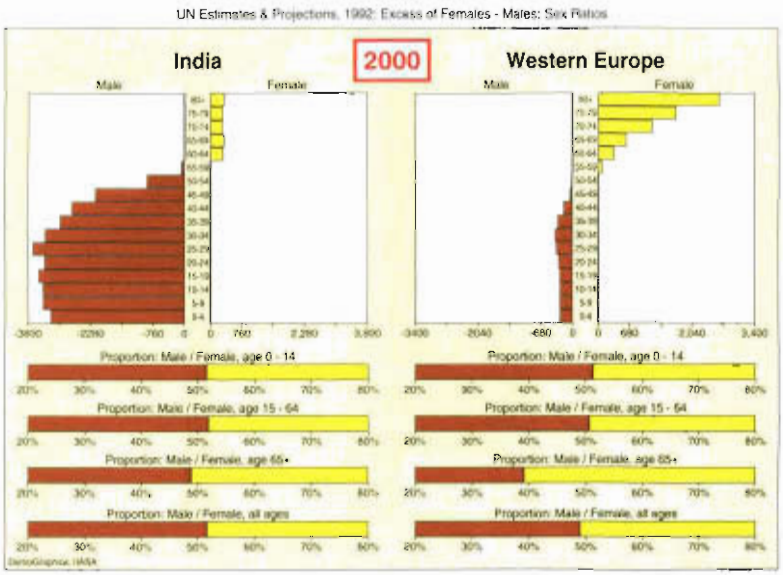
Demo*Graphics* runs under MS-Windows 3.1 on DOS-based personal computers. It can be run on a 386 PC, but for practical purposes users need something better: we recommend a 486/66 Mhz PC with a fast hard disk and a 256-color video board.

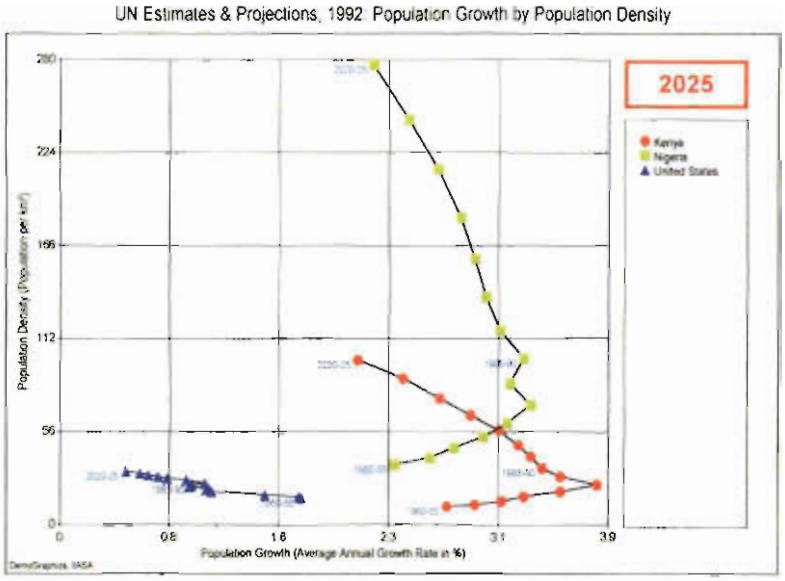
Demo*Graphics* was created with the help of AniVis, a software tool for designing graphical databases and animating data. Both Demo*Graphics* and AniVis were developed by Martina Dippolt and the author at IIASA.

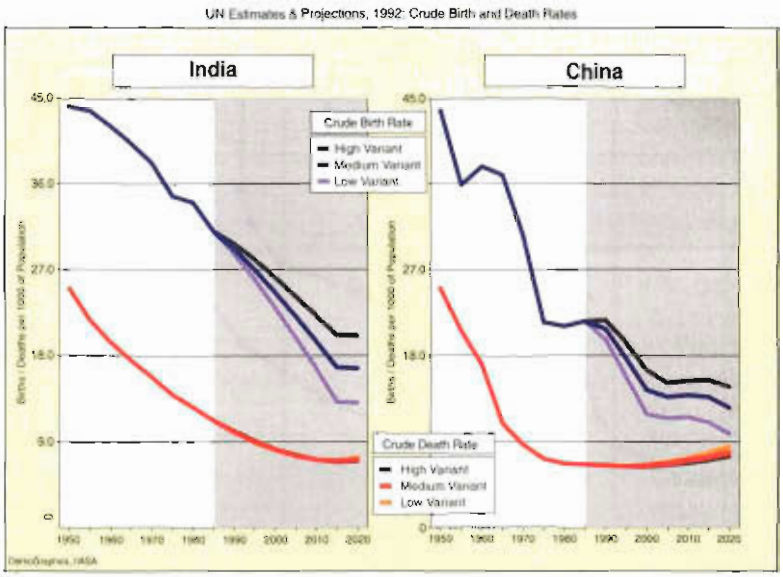
Our intention in creating AniVis was to develop software which would make it possible to build friendly but powerful user interfaces for electronically distributed databases. The AniVis Database Development Tool enables the development of graphical database shells under Windows. Users can combine different sets of data with a flexible menu system and a set of graphical displays, including charts and maps.

Perhaps most important, AniVis makes it possible for developers to specify data-generated animation to help the eye to see what the mind has perceived.

Gerhard Heilig







How to Get **Demo***Graphics*

Demo*Graphics* is free, but IIASA charges US $35 for processing, handling, and mailing. The package includes five 3.5-inch diskettes and a 36-page user's manual. The manual includes setup information and a tutorial for Demo*Graphics*; a brief discussion of population issues, generally, and the IIASA world scenarios, in particular; a description of the AniVis development tool; and a list of frequently asked questions. The author can be contacted at IIASA (see back cover for address and fax number) or by e-mail at **<heilig@iiasa.ac.at>.**

Every effort has been made to remove bugs in both the data and the program, but the program cannot be serviced or supported in any way.

UN Population Databases

Demo*Graphics* is configured to load directly the 1992 revisions of:

- Demographic Indicators, 1950–2025 (3 diskettes).
- Sex and Age, 1950–2025 (3 diskettes).
- Age Patterns of Fertility, 1950–2025 (1 diskette).

The diskettes are available from:
The Director
Population Division
United Nations
New York, NY 10017, USA
Phone 212 963-3209
Telefax 212 963-2147

NEW PROJECT

Modeling Land Use and Land Cover Change in Europe and Northern Asia

Natural forces have always influenced and shaped the surface of planet Earth. Material transfers and energy flows at global, regional, and local scales have caused both gradual and catastrophic transformations of the atmosphere, lithosphere, hydrosphere, and biosphere. With the appearance of *homo sapiens* another agent of global change emerged. As their knowledge and technology level developed, human beings have acquired an ever increasing capability to transform the surface of the Earth.

This project is intended to advance scientific understanding of the processes of changes in global land use and land cover and their possible consequences. Under a three-year research program, members of a multinational, multidisciplinary team will analyze the spatial characteristics, temporal dynamics, and environmental consequences of changes in land use and land cover in Europe and Northern Asia between 1900 and 1990, considering a wide range of socio-economic and biophysical forces. Based on this analysis they will define plausible future changes in land use and cover for the period 1990 to 2050 using different sets of assumptions for future demographic, political, economic, and social development.

Europe and Northern Asia were selected because of their diversity in social, economic, and political organization, which have undergone rapid changes recently, with major implications for current and future land use and cover.

The research team will be closely associated with several core projects of the International Geosphere-Biosphere Programme, with research funded by the Commission of the European Union (DG-XII), with national research programs throughout the study area. They expect to make a significant contribution to international science by developing and testing new research methods and contributing new knowledge on land use and land cover change. Among the questions at issue:

- How is land use likely to change at the regional level given various trends in demand (food, fiber, fuel, recreation, etc.) and supply (technology)?
- How sensitive is regional land-use change to variation of demand/supply factors?
- How are changes in land use likely to affect other physical resources (quality and quantity of water supply, degradation and contamination of soils, climate, etc.)?

These are complex questions. Project members must consider a wide range of:

- Spatial scales — from individual farms to river basins to watersheds, to regions and provinces, to national, supranational, and continental levels,
- Temporal scales — the daily cycle of advanced crop growth models, the 20-year cycle of changes in crop varieties, the multi-decade process of climatic change, and other time scales for processes of investment, land conversion, plantation growth, formation of national agricultural policies, construction of canals, reservoirs, dams, changes in coastal structures, etc.,
- Economic sectors — agriculture, forestry, tourism, energy,
- Administrative levels — county, region/province, nation, union of nations,
- Uncertainties and surprises — demographic development, technological innovations, discontinuities in the biophysical system,
- Management/policy issues — the study seeks to provide useful knowledge for policy makers who are in a position to influence the social, political, and economic processes involved in land use.

Work will be organized in the following five phases. Four of the five phases will be primarily the responsibility of the project core team at IIASA: the case studies will be largely organized and implemented by local study teams. The core team will first define a common case study protocol, then guide the analysis.

Project Management and Methodology

The first phase will concentrate on critically reviewing past studies and approaches, refining research plans and protocols, and establishing the infrastructure needed to successfully implement the project. A workshop involving the main participants will help to elaborate methodological and logistical aspects.

Development of an Integrated Model of Land Use and Land Cover

Most land-cover change is now driven by human rather than natural causes. A systems analysis of this process requires an interdisciplinary framework emphasizing the linkages and the constraints between social, economic, and political forces, on the one hand, and natural systems on the other. The framework must accommodate interactions at several spatial and temporal scales. The challenge is to analyze the global impact (through systemic and cumulative effects) of decisions taken by millions of individuals and to project how the foundations for

individual decisions (e.g., agronomic, economic, cultural, psychological) are affected by global change.

The IIASA core group will construct a database, formulate and implement a continental-scale model of land use and cover, validate the model and conduct sensitivity tests, and use it to derive long-term projections of land use and cover.

Case Studies

Representative case studies will provide better understanding of historical changes in land use and cover in relation to characteristic combinations of biophysical, socioeconomic, and political conditions. These studies will be conducted largely by regional research teams. Regional team leaders will spend time at IIASA to ensure consistency and comparability between the case studies, which will be conducted in parallel with model development at IIASA.

Integration and Policy Orientation

It is essential that the (continental-scale) model-building and the (regional) case studies proceed together. Information must flow both up and down. Examination of case study results will allow improved parameterization of model components used for the continental assessment; simulation results from the continental modeling can be used to project exogenous forces in the case studies in a consistent manner. Finally, the continental assessment will be viewed in the global context.

Assessment of Policy Implications

The study can be viewed as an analysis of the local and national forces driving global changes in land use, as well as an assessment of possible national and local response strategies to impacts of global change. In the past twenty years there has been much discussion about problems of synthesizing scientific information from different disciplines and communicating relevant results to the policy makers. This project will use a policy exercise approach developed and tested at IIASA in the 1980s to generate and assess policy responses regarding land use.

The aim of the project is to advance scientific knowledge about land use and land cover, to provide insight into likely future trends in land use, and to inform policy makers, international organizations, and the public about relevant issues.

The scientific results will include an advanced methodology for analysis of human and biophysical dimensions of land-use and cover change at different spatial and temporal scales and a validated model of such changes, based on improved knowledge of interrelations and mechanisms of human impacts on the global environment. The model will be used to project changes in land use and land cover under various economic, policy, and climate scenarios. Based on the results, the project will make recommendations to local and national policy-makers on various aspects of land-use policy and possible socio-economic strategies.

The work and the findings will be reported in a book and in various scientific papers and journal articles. the project will also yield improved digital databases of land use and land cover in the study region.

IIASA is uniquely placed for such research. It has an outstanding network of scientists in Western and Eastern Europe, the former USSR, China, and Japan, and it has a long record of developing and managing successful interdisciplinary environmental research projects.

In addition, there are a number of current projects at IIASA which incorporate expertise, databases, and validated models which can make an important contribution to work on land use and land cover. These include a world agriculture model, forest sector models, a global assessment of water resources, expertise in regional material balance approaches, a regional energy scenario framework, climate models, and demographic databases and models. This project will draw on resources in existing IIASA projects, and in turn will help members of these projects to better understand some of the key aspects of global change.

Günther Fischer

Personnel and Institutions

The project coordinator and principal researcher in residence at IIASA will be **G. Fischer**, with a core team of six to eight researchers. Other participants will be at IIASA for various periods of time. Case-study teams in Russia will be coordinated by **V. Rojkov**, Dokuchaev Soil Science Institute, Moscow, and in Japan and China by **T. Kitamura**, Kyoto University. A steering committee of distinguished scientists will be chaired by **M.L. Parry**, University College, London, UK.

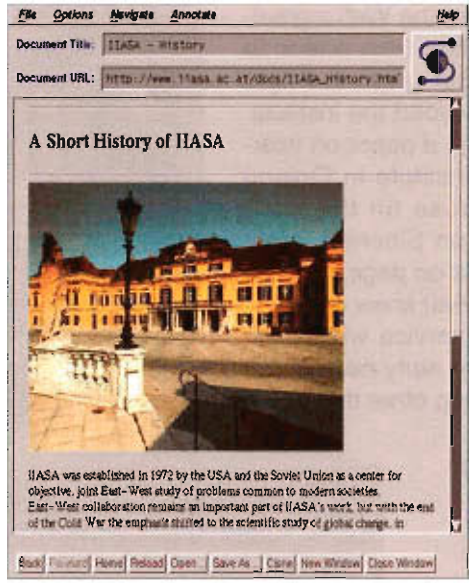
At present the principal collaborating institutions are: in Russia the **State Committee on Land Use and Planning, All Russia Information Research Centre on Forest Resources, Institute of Geography,** and **Moscow State University**; in Japan the **University of Tokyo** and **University of Tsukuba**; in Germany **the Max-Planck Institute for Meteorology** and **Potsdam Institute for Climate Impact Research**; in the Netherlands the **Centre for World Food Studies** and the **National Institute for Public Health and Environment**; and the **Institute of Geography of the Chinese Academy of Sciences**.

FEATURE

IIASA Joins the World Wide Web

Gopher, Web, Infobahn – the flood of new jargon can be overwhelming, but in the end it means the same thing: more people getting access to more information, more quickly and more easily, than ever before.

IIASA's latest venture onto the information superhighway begins this September, when the institute joins the World Wide Web. The first steps will be modest, giving users limited information about IIASA, some of its research, and its publications. But in time the Web will become one of the institute's main connections to the world and a principal source of information about IIASA and its work.



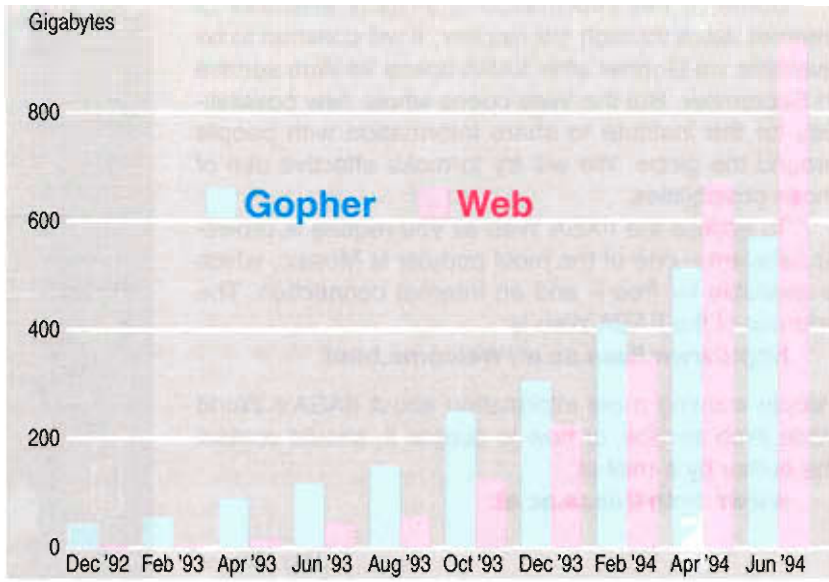
A few words on terminology. The **Internet** is literally a network of networks. It comprises thousands of regional computer networks in more than 50 countries. Having an Internet connection can mean access to many services, including electronic mail, interactive conferencing, and network news, as well as the ability to transfer files. The growth of the Internet has been amazing: use doubles every eight months. On a typical day more than 20 million people now use it to send and receive information.

A **Gopher** is a sort of electronic library available via the Internet. First used by US universities, Gophers have now been set up by thousands of academic and research institutions, government agencies and non-governmental organizations, and private firms. IIASA's Gopher service has been running for more than a year.

The **World Wide Web**, developed at the CERN physics laboratory in Switzerland, can be thought of as a highly advanced sort of Gopher. Like Gopher, it uses the Internet as a carrier of information. But it is much easier to use and can do many more things. Where Gopher is primarily for text, the Web can deliver integrated text, sound, color graphics, and even video. Moreover, the use of hypertext provides links to documents on related subjects all around the world. The number of cross-links is practically limitless – hence the "world wide web" of information.

Use of the Web is now growing at twice the rate of the Internet. By the summer of 1994 Web users could watch a video animation of the latest asteroid crashing into Jupiter, courtesy of NASA's Jet Propulsion Laboratory in California. Or they could listen to a radio show from the Canadian Broadcasting Corporation. Or they could browse through a florist's catalogue, choose a bouquet, then fill out an on-screen order form stating what they chose, where and to whom to send it, and what credit card to charge.

In September they will be able to use it to browse through an introduction to IIASA's Demo*Graphics* software, described on pages 8–10 of this issue of *Options*.



This page shows a sequence of how a Web user might investigate Demo*Graphics*, simply clicking the mouse on points of interest at each stage.

For scientists and researchers, this ability to browse through the system with a click of the mouse on a highlighted word or picture is one of the Web's greatest strengths. In the illustration, the flow from screen to screen keeps the user in IIASA. But given the right hypertext links it could easily lead beyond the institute. For instance, a user browsing through a paper on international forestry from a research institute in Finland might find that a click of the mouse on the word "Siberia" leads to IIASA's project on Siberian forest resources (the project's home page is on page 13). The Web can open doors that the user never knew existed.

As noted above, IIASA's Web service will at first carry only limited information. But by early next year it should provide Web users with, among other things:

- complete texts of recent working papers,
- descriptions of current research projects,
- a searchable, cross-referenced catalog of IIASA publications,
- information about weekly events, upcoming conferences and workshops, press releases, etc.,
- most of the latest Research Plan and Annual Report,
- information about the Young Scientists Summer Program,
- general information about IIASA, its history, membership, etc.

Some of this information is already available to Internet users through the Gopher; it will continue to be available via Gopher after IIASA opens its Web service in September. But the Web opens whole new possibilities for the institute to share information with people around the globe. We will try to make effective use of those possibilities.

To access the IIASA Web all you require is browser software – one of the most popular is Mosaic, which is available for free – and an Internet connection. The address of the IIASA Web is:

http://www.iiasa.ac.at/Welcome.html

People wanting more information about IIASA's World Wide Web service, or how to access it, should contact the author by e-mail at:

wwwadmin@iiasa.ac.at.

Jörg Messer

WORKSHOP

Remediation and Management of Degraded River Basins in Central and Eastern Europe

13–16 June, Laxenburg, Austria

This meeting, one in a series of Advanced Research Workshops sponsored by NATO (the North Atlantic Treaty Organization), allowed 47 experts from 17 countries to discuss tools, strategies, and policies of watershed and water quality restoration. The specific objectives were to explore the applicability of Western experiences in this field in Central and Eastern Europe and to develop new and innovative strategies for water resource management which take account of the political and economic realities of the region. Proceedings will be published by Springer Verlag.

It was apparent to workshop participants that, even though the present degradation of the environment in many Central and East European (CEE) countries outwardly resembles the situation in the West some 20 or 30 years ago, the process of environmental management and restoration may not exactly repeat developments in the West. Participants concluded that Western experience should be disseminated widely but applied only after consideration of the very specific economic, political, and social conditions of CEE countries (see *Options*, Summer '94).

Most CEE countries have the scientific base to quickly assimilate Western experience and know–how. This workshop helped in that process.

What follows are some of the conclusions and recommendations of the participants.

Water Pollution Problems Specific to the CEE Region and Related Issues

- Unlike in the West, where pollution problems have been recognized sequentially during the past 20 or 30 years, water pollution problems throughout the CEE region are not new to the experts. Scientists of the region identified them years ago, but the problems were not officially recognized, or even suppressed, by the previous authorities. Also, unlike the West, where the recognition and solution of problems sequentially progressed from traditional point sources and pollutants to nonpoint sources and priority pollutants, the sudden emergence of the problems in the CEE countries presents a dilemma for management and priority establishment.

- Water, sediment, and soil contamination in the CEE region is significant and extensive. For these reasons remediation and abatement may take longer than in the West. Priorities must be established, beginning with the protection of human health, followed by protection of aquatic biota and other water-body uses.

- Some management and planning practices in the CEE typical of the previous central planning system persist today. Change is difficult. Important tools and traditions of environmental management, such as lobbying, have no tradition. Environmental nongovernment organizations are not yet strong enough to exert significant pressure on the government.

- The involvement of scientists in formulation of environmental policies is often not satisfactory. Significant gaps exist between science, practice, and decision-making.

- Monitoring of conventional pollutants is satisfactory in most CEE countries, but monitoring of priority pollutants, which often requires specific and costly instruments, is insufficient. Consequently, adequate water quality and hydrological databases are available only for flow and for traditional pollutants in most CEE countries. Getting access to this data is sometimes not easy.

Methods, Technologies, and Engineering

- While the necessary skills are available in most CEE countries, local personnel often do possess the appropriate methods, technologies, and tools. Knowledge of methodologies and technologies can be transferred relatively quickly to most countries, although there is considerable diversity among the scientific and technical communities of CEE countries.

- Careful evaluation of different methods and technologies is needed, respecting local conditions and focusing on economic efficiency. For the transition

period, realistic and achievable water quality standards must be developed within the CEE rather than uncritically imported from the West. New environmental standards and restrictions should consider the risk to the population and the aquatic ecology.

- CEE countries should in most cases avoid imitating expensive, high technology Western solutions to problems of water quality management. There is a strong need in many regions, both urban and rural, for less expensive, innovative, low technology solutions. A focus on less expensive technologies is appropriate for industrial and municipal as well as agricultural sources of pollutants or, in a broader sense, to watershed management. The CEE region therefore has specific research and development needs.

Policy Implications

- The scheduling of goals and standards, as well as the phasing in and enforcement of goals and standards during the next 20 or 30 years, are crucial. The starting point should be definition of overall quality goals for receiving waters set by central legislative bodies. Implementation (action) plans should be basin-wide, as basins are the natural unit of water management.

- Integrated river basin management is the only feasible management process. The relative advantage of CEE countries is that the related management agencies have already been established and some of the known failures of the West can be avoided.

- Efforts should be made to develop step-wise planning and management procedures to identify goals, objectives, and alternatives, as is done in many Western countries. Basin-wide water quality planning and management is an established process used widely in the West. Central, command-type planning has been discredited and must be avoided. On the other hand, pure market approaches to water quality management are not possible.

- Water quality impact and economic implications should be evaluated jointly when formulating new environmental control legislation.

- Local authorities in CEE countries should begin implementing pollution control as early as possible and not wait for external instruction and assistance.

- Institutional changes presently under way in CEE countries should be seen and utilized as an opportunity to introduce economic instruments for water quality management holistically.

- Efficient mechanisms should be developed for the transfer of costs and funds for pollution abatement and environmental remediation among jurisdictions. The polluter-pays principle is widely accepted as equitable and should be followed where possible. The use of subsidies for pollution control, which has been the prevalent practice in CEE countries, should be critically re-evaluated. Subsidies should be applied cautiously during specific transition periods.

- Key actors, including ministries, inspectorates, water dischargers, local governments, scientists, the general public, and nongovernmental organizations should be involved in the decision-making process. Policy workshops should be organized for a broad audience including members of these groups, in addition to more narrowly focused technical and scientific meetings and workshops.

Education, Communication, and Information Exchange

- Improved education is needed on all levels to make people more aware of the importance and impacts of consumption habits and to improve overall attitudes toward the environment and prevention of pollution.

- Improved interactions are needed between scientists, engineers, practitioners, and decision-makers. The research community should be more closely involved in forming and analyzing legislation and prompting other policy debates.

- Efforts to integrate CEE professionals with their Western counterparts are desirable and needed. In this respect, the present international professional organizations may serve as a means and forum of communication and knowledge exchange.

- Technology and transfer of know–how from Western countries to the CEE region is important to enhance the likelihood of appropriate technology applications therein. Incentives are needed to avoid a brain drain.

- Access to basic scientific publications, good libraries, and international and regional networking are lacking for several CEE countries.

- Dissemination of models, methods, and results of their application to the broader community (managers, legislators, etc.) are essential for successful applications of science to real-world problems.

- There is a need to summarize Western standards, environmental laws, etc., and to compare them with those presently in force in CEE countries. Such a summary and comparison should be distributed in the CEE region to key persons.

László Somlyódy and Vladimir Novotny

In Memory of

Luis Donaldo Colosio

On July 15 a brief ceremony was held at IIASA to honor Luis Donaldo Colosio, the IIASA alumnus and candidate for the presidency of Mexico who was assassinated in March 1994. The photographs show Diana Laura Riojas de Colosio, his widow, addressing the ceremony and with IIASA Director Peter E. de Jánosi. Among others attending were Jaime Serra Puche, Mexican Minister of Commerce, Luis Javier Castro, an IIASA alumnus and close friend of Colosio, and Andrei Rogers of the University of Colorado at Boulder. Rogers, the former leader of IIASA's Human Settlements and Services Area, brought Colosio to IIASA in 1978 to work on a case study of urban growth in Mexico.

The ceremony marked the formal announcement by de Jánosi of a new ***Luis Donaldo Colosio Fellowship****. The fellowships will allow young Mexican researchers to spend time at IIASA working with scholars from around the world, as Colosio himself did, and help IIASA to pursue his dream of harnessing the science of the industrialized North to address the problems of the developing South.*

To further that goal, IIASA's Governing Council has also established a ***North–South Fund****, which will be used to promote the globalization of IIASA's programs, staff, and membership.*

Discussions are under way with several developing countries, including Mexico, about membership in IIASA.

Susan Riley

INSIDE IIASA

RESEARCH GRANTS

Population, Environment, and Development

The UN Population Fund has awarded IIASA a grant to support a case study of population/environment/development interactions on the Cape Verde Islands, using methodology developed for an earlier IIASA case study of Mauritius. The grant will allow testing of basic model assumptions and results. Contact: *Anne Babette Wils*

Radioactive Contamination Study

The W. Alton Jones Foundation of Charlottesville, Virginia, USA, has given IIASA a grant to support activities within a new project on Radiation and the Biosphere. The grant will be used to support a two-year interdisciplinary study of radioactive contamination of the Mayak nuclear complex in the southern Ural Mountains of Russia. Contact: *Boris Segerstahl*

Management of Russian R&D

The John D. and Catherine T. MacArthur Foundation of Chicago will fund further studies at IIASA of research and development management in Russia's transition to a market economy. IIASA began work in this field in 1990, at the request of senior officials in the Russian government. Contact: *Il'dar Karimov*

River Basin Information System for Mexico

With support from the Grupo Profesional Planeacion y Proyectos, on behalf of the Mexican National Water Commission, IIASA will adapt and further develop a River Basin Management Information System, designed in collaboration with Thames Water International, Reading, UK, for use in the Lerma catchment area of Mexico, including Lake Chapala. Contact: *Kurt Fedra*

Photo: Neubauer

Participants in a roundtable for journalists on Science and Technology in the European Reform Process held in Salzburg, July 27. From right to left: IIASA Director Peter E. de Jánosi, Netherlands Prime Minister Ruud Lubbers, Austrian Vice-Chancellor Erhard Busek, who hosted the meeting, Russian Science Minister Boris Saltykov, and the Czech Minister of Education, Youth, and Sport, Ivan Pilip.

CONFERENCES

Restructuring and Recovery of Output in Russia,
9–11 June, Laxenburg, Austria.
Twenty-four economists attended this meeting, one of a series of seminars on Russia's transition to a market economy. Topics of discussion included macroeconomics and public policy regarding output, the costs of lowering inflation, behavior of enterprises, unemployment, and domestic and international competition. Contact: *János Gács*

Decomposition and Parallel Computing Techniques for Large-scale Systems,
13–23 June, Laxenburg, Austria.
About 25 mathematicians and computer scientists attended this workshop to consider new developments in the field and new applications. Eighteen sessions allowed extensive discussions of a range of topics. Some of the most fruitful discussions concerned ways to exploit structural properties of problems to facilitate their solution, augmented Langrangian decomposition techniques, and application of these techniques to problems of uncertainty and large-scale complex models for systems analysis. Contact: *Andrzej Ruszczyński*

The Nature and Dynamics of Organizational Capability,
16–18 June, Laxenburg, Austria.
This workshop was held to assess the state of the art and to explore the possibilities of further research regarding the character, structure, origins, and development of capabilities in business firms. The focus was on replication of existing capabilities, on the assumption that a better understanding of the ability to replicate capabilities would provide support for structured comparisons across diverse empirical settings. Contact: *Iouri Kaniovski*

International Energy Workshop,
21–22 June, Honolulu, USA.
This workshop is an annual event, jointly organized by IIASA and Stanford University. The 1994 meeting, hosted by the East–West Center, featured papers and discussions on the latest IEW poll of energy experts, global energy systems and CO_2 emission control policies, developing countries' energy strategies in coping with climate change, the impact on energy issues of conversion of the Russian arms industry, the post-Soviet oil outlook, and national studies of various energy issues in Argentina, Canada, China, India, Mexico, and Slovenia. About 45 energy experts attended. The 1995

IEW will be held at IIASA, 20–22 June. Contact: *Leo Schrattenholzer*

Employment and Unemployment in Russia from a Microeconomic Perspective,
23–25 June, Laxenburg, Austria.
This seminar, the last in a series on Russia's economic transition, was attended by 30 economists and officials from various Russian and international organizations. Discussions included a review of recent developments in employment and unemployment in Russia, adjustments in the use of labor, case studies of the coal industry and conversion of military production in small towns, and a comparison of Russian experiences with those of Bulgaria, the Czech Republic, and Slovakia. Contact: *János Gács*

Technological Regimes, Industrial Demography, and the Evolution of Industrial Structures,
11–13 July, Laxenburg, Austria.
This workshop,with some 35 participants, dealt with two related methodological issues. The first was a review of stylized facts concerning industrial evolution, especially regularities in industrial demography, distribution of industrial performance, dynamics of industrial structures, and the intersectoral differences conditional to certain technological regimes. The second issue was the appreciative theorizing which has been built on these stylized facts by identifying key factors underlying patterns of industrial evolution. Contact: *Iouri Kaniovski*

Evolutionary Economics,
14–22 July, Laxenburg, Austria.
This colloquium featured seven lectures and discussions in the growing field of evolutionary economics. Papers were delivered on industrial evolution, the emergence of market structure, bounded rationality and learning, evolutionary game dynamics, technological adoption and urn processes, the evolution of organizations, and simulating artificial economies. Contact: *Peyton Young*

Ozone Modeling Workshop,
25–26 July, Laxenburg, Austria.
Seven experts in computer science and atmospheric physics and chemistry were invited to IIASA for this meeting to discuss various approaches to modeling ground-level ozone. Topics of discussion included local regression modeling versus a matrix approach, ozone-related emission sources including soil NO_x and vehicles, a case study of ozone formation in Berlin, and the effects of altitude and time on ozone concentations. The workshop was intended to help IIASA determine a scientific direction for future ozone modeling efforts. Contact: *Markus Amann*

APPOINTMENTS

Full- and part-time

Klaus Astner (Austria), from the University of Vienna, and **Reema Shah** (India), from the UNISYS Corporation, have joined the Advanced Computer Applications project.

Helmut Breitmeier (Germany), from Tübingen University, **Hua Dong** (China), from Emerson College, Massachusetts, USA, **Marc Levy** (USA), from the Woodrow Wilson School at Princeton University, New Jersey, and **Olav Schram Stokke** (Norway) and **Torunn Laugen** (Norway), from the Fridtjof Nansen Institute, have joined the International Environmental Commitments project.

Francesca Chiaromonte (Italy), from the University of Minnesota, has joined the Technological and Economic Dynamics project.

Andrei Gontchar (Russia) and **Iouri Osipov** (Russia), both from the Russian Academy of Sciences, and **Thomas Schelling** (USA), from the University of Maryland, and **Harvey Brooks** (USA), have joined IIASA for part of the summer 1994 as Institute Scholars.

Pavel Ivanov (Russia), from the Institute for Water and Environmental Problems, Siberian Division of the Russian Academy of Sciences (Barnaul), has joined the Water Resources project.

Vladimir Novikov (Russia), from the Nuclear Power Problems Laboratory at the Kurchatov Institute of Atomic Energy, Moscow, has joined the Radiation Safety of the Biosphere project.

Warren Sanderson (USA), an IIASA alumnus from the State University of New York at Stony Brook, has joined the Population project.

Antonie Stam (the Netherlands), from the University of Georgia, has joined the Methodology and Decision Analysis project.

Dirk Torn (Netherlands), from the Agricultural University of Wageningen, has joined the Transboundary Air Pollution project.

Chihiro Watanabe (Japan), former deputy director of technology development at Japan's Ministry of International Trade and Industry, has joined IIASA as a senior adviser to the director regarding research on technological innovation and industrial development.

NEW PUBLICATIONS

Reports

The following reports are now available from IIASA's Publications Department for the amounts indicated. For payment by Visa or Mastercard, please send the number of your credit card, the expiry date, and a copy of your signature. A complete publications list is on the Internet Gopher at gopher.iiasa.ac.at.

Emission Factors for Aqueous Industrial Cadmium Discharges to the Rhine Basin: a Historical Reconstruction of the Period 1970–1988. F. Elgersma, S. Anderberg, W.M. Stigliani. RR-94-1. US $10.

The Transportation Sector: Growing Demand and Emissions. A. Grübler. Reprinted from the Pacific and Asian *Journal of Energy*, Volume 3, no. 2 (179–199), December 1993. RR-94-5. US $10.

Global Scenarios for Carbon Dioxide Emissions. A.S. Manne, L. Schrattenholzer. Reprinted from Energy, Vol.18, No.12, pp. 1207–1222, 1993. RR-94-6. US $10.

Energy Gases –The Methane Age and Beyond. N. Nakićenović. Reprinted from *The Future of Energy Gases, U.S. Geological Survey Professional Paper.* RR-94-8. US $10.

Books

The following book is now available from booksellers or from the publisher.

Population–Development–Environment: Understanding Their Interactions in Mauritius. W. Lutz, editor. Springer-Verlag. ISBN 3-540-58301-7.

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