# 1980

# The Human Settlements and Services Area

Andrei Rogers

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INTERNATIONAL INSTITUTE
FOR APPLIED SYSTEMS ANALYSIS
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# PREFACE

This status report is the third of a series initiated in January 1979 with a review of the first five years of the Human Settlements and Services Area at IIASA, prepared for the first meeting of the Area's Advisory Committee (the members of which are listed in the Appendix). A supplement describing 1979 activities was published a year later, and the same format has been retained for 1980: a review of the Area's activities, scientific staff, publications, and future plans.

ACKNOWLEDGMENTS

Following the pattern set by its predecessors this report is the result of the contributions of a number of individuals who have volunteered their time and effort toward its completion. Maria Rogers once again assembled the various pieces and drafted a number of sections. Several scholars in the Human Settlements and Services Area influenced various parts of the Research Plan; but I wish to acknowledge particularly the contributions of the Task Leaders: Pavel Kitsul, Piotr Korcelli, Giorgio Leonardi, Warren Sanderson, and Evgenii Shigan. Finally, Susie Riley typed the manuscript with her usual finesse. To all, my thanks.

CONTENTS

RESEARCH

During 1980, the seventh year of its existence, the Human Settlements and Services Area (HSS) published 21 Research Reports and 40 Papers. It convened a workshop and two task force meetings, participated in several sessions of the Second IIASA Conference, hosted its Advisory Committee, and produced articles for two journal issues devoted entirely to the work of the Area's scholars.

Thirty-one scholars from all over the world were in residence for periods of at least a month, and a much larger number visited the Area for shorter periods of time. They contributed to research activities carried out in the Area's five substantive tasks and its Core Task.

## The Core Task
(Andrei Rogers, USA, Chairman)

The principal activity of the Core Task in 1980 was the coordination of the former Migration and Settlement Task's concluding phases and the dissemination of its results. Seven national case studies were published as Research Reports in 1980: Sweden, German Democratic Republic, Netherlands, Canada, Hungary, Soviet Union, and Federal Republic of Germany. Six methodological papers were published as a special issue of the journal *Environment and Planning A*. Reviewing this methodological work in a recent article in *Sociological Methodology 1980* (reprinted as RR-80-33, *Multidimensionality in Population Analysis*), Professor Nathan Keyfitz, Chairman of Harvard University's Sociology Department, a member of the U.S. National Academy of Sciences, and a world-renowned demographer, paid tribute to IIASA's role in initiating the new discipline of multistate demography. As he states in the preface to the Research Report:

> In the elaboration of the several lines of work that are here put together, IIASA has had an important role... a new discipline has come into existence that, on the one hand, unifies preceding work, and, at the same time, reaches out to new kinds of interdisciplinary work.

As part of the dissemination activity, the Core Task invited several notable experts in the field of migration and development to spend the month of June with HSS. They were joined for shorter periods by equally notable visiting specialists. The result was the presence at IIASA of a stimulating collection of demographers, economists, and mathematicians from around the world that included Julie DaVanzo (USA), Yuri Dubov (USSR), Otto Eiben (Hungary), Victor Fuchs (USA), Robert Gibberd (Australia), Nathan Keyfitz (USA), Young Kim (South Korea), Jeff Williamson (USA), and others.

The group met with IIASA demographers and economists for intense sessions three mornings a week for four weeks to discuss current issues in demoeconomic modeling. The principal purpose of the seminar was to encourage discussion and feedback and to suggest future topics for HSS research. Subjects covered in the seminar included migration, multistate demography, urbanization, and economic development, manpower, and demometrics—all of which tie in closely with current HSS work.

### The Public Facility Location Task
### (formerly the Normative Location Modeling Task)
### (Georgio Leonardi, Italy, Task Leader)

The Public Facility Location Task, focusing on the optimal spatial patterns of urban public facilities and services, continues to make progress in carrying out its comparative analysis of applied location models and solution algorithms. Collaboration with scholars in the Area's Health Care Systems Task and in the Resources and Environment and System and Decision Sciences Areas at IIASA has led to the development of a new class of general location models that include nonlinear objective functions, biproportional techniques, and a stochastic programming algorithm based on quasi-gradients. Applications of these models to the location of high schools in Turin and of health care facilities in London have demonstrated their utility. These are the subject of a series of papers by Leonardi (Italy), Erlenkotter (USA), Ermoliev (USSR), and Mayhew (UK).

As part of its effort to develop an international network of information exchange and joint research, the Task held a small meeting at IIASA that compared the different approaches currently used in East and West to locate public facilities. Approaches covered by the invited papers ranged from spatial interaction-based models (Wilson, UK, and Shmulyian, USSR), to those addressing theoretical and applied economic issues (Lea, Canada, and Beckman, FRG), to the operations research/systems engineering approaches (Revelle, USA, and Khachaturov, USSR). The discussions

yielded insights into new theoretical and operational frameworks and provided valuable inputs for the planned comprehensive overview of current studies on the design and use of normative location models. A selection of papers presented at the meeting will be published as a special issue of the Italian journal *Sistemi Urbani*.

## The Health Care Systems Task
(Evgenii Shigan, USSR, and Pavel Kitsul, USSR, Task Leaders)

The major new feature of the Health Care Systems Task this year was the development of a model of health care resource allocation over space by Mayhew of the UK. Designed for use at the regional and sub-regional levels, this model enables a user to test the impact on service levels of changing population and morbidity, different spatial resource configurations, and changes in hospital loads. The model contrasts with the previous allocation model, DRAM, which is concerned with resource allocations between different patient categories and treatment modes. Associated with this new model, called RAMOS (resource allocation model over space), are three computer programs:

- A version for the parameterization of RAMOS
- An interactive version for forecasting purposes with a greatly enhanced range of options and outputs
- A version for use in the optimum strategic planning of health care services over a period of time

All three programs have been tested and are operating on IIASA's computer system, while two working papers describing the model and its application are now available. The spatial perspectives on health care systems are being further developed in collaboration with the Area's Public Facility Location Task, and a contract to produce a book on this subject has been secured with a publisher in London.

Work on the further theoretical development of the Task's disaggregate resource allocation model DRAM continued in 1980, and a Research Report written jointly by Hughes (UK) of the HCS Task and Wierzbicki (Poland) of the System and Decision Sciences Area reports on a recent methodological innovation that draws on the theory of nondifferentiable optimization. Practical applications of DRAM were carried out in Canada, Czechoslovakia, and the South West Region of the United Kingdom.

Behavioral modeling was introduced to the HCS work during the summer of 1980 with the contributions of Pauly (USA), a health economist from Northwestern University. By adding demand, disequilibrium, incentives, and further disaggregation to the Task's models, Pauly seeks to expand the interest and relevance of these models to countries with decentralized health care systems.

Work on improved methods of morbidity estimation by Kitsul (USSR) continues and has led to an important collaboration, set up in 1980, between the IIASA health care team and the Ministry of Health in Czechoslovakia. A preliminary model of health care manpower, developed by Pelling of the UK, is currently being implemented and documented.

## The Manpower Analysis Task
(Andrei Rogers, USA, Task Leader)

Adjustments in national and regional labor markets to reduced rates of population and industrial growth were the principal topics of study by scholars in the Manpower Analysis Task during 1980, the Task's first year. Work on labor supply at the national level by Coen (USA) was carried out in collaboration with the System and Decision Sciences Area at IIASA and led to an improved specification of the labor module of the Hickman-Coen model of the U.S. economy. Work at the regional level was carried out by Leveelahti (Finland) and Bartels (Netherlands). The former examined migration, labor market disequilibrium, and population patterns in a number of Finnish provinces; the latter considered the effects of discrepancies between job qualification requirements and the qualification of individuals on regional labor markets, drawing on the experience of the Netherlands in the 1970s.

During the year, considerable effort was devoted to the design of a program of research for the future. Subtasks on labor demand-supply relationships have been outlined at the international, national, and urban/regional levels. Work on international migration will commence in 1981, together with a study of the increasing pension costs of aging populations. Changing patterns of female labor supply and the impacts of technological change on the demand for labor are two additional topics that will be examined. Finally, the current studies of urban/regional labor markets will be more closely integrated with IIASA's tasks on Industrial and Regional Development.

## The Urban Change Task
(Piotr Korcelli, Poland, Task Leader)

Many industrialized countries have entered a period of stabilized and declining urban growth rates and of major settlement transformations. These developments call for the reformulation of urban policies and the improvement of urban planning models. The approach followed by the Urban Change Task has been to analyze the interrelations among the demographic, economic, and environmental factors underlying the observed trends. During the year, the Task focused on three aspects of settlement development in highly urbanized countries:

- The impacts of national and interregional demoeconomic trends on the structure of settlement systems

- The intersectoral and interlocational shifts in urban economies

- The interrelations between the internal structure of urban areas and their comparative growth performance

Within the first theme, the studies completed or those in progress, fall mainly in the domains of migration research and multiregional population analysis. Work by Ledent (France) has produced a comprehensive analysis of alternative general models of population movement and improved methods for constructing multiregional life tables. Research by Korcelli (Poland), Philipov (Bulgaria), Liaw (Canada), and Frey (USA) has advanced our understanding of interurban migration, the fertility and mobility behavior of the native and alien components of urban populations, and multistate population dynamics.

In the second theme research continued on the impacts of industrial development on regional/urban change. Supported by a grant from the ICSAR Fund* this activity is examining the national, regional, and urban consequences of industrial change and of shifts in various factors exogenous to the process of industrial growth. Results achieved during 1980 include the incorporation of population flows into intermetropolitan economic growth models (Ledent, France, and Gordon, USA) and the identification of economic preconditions for urban deconcentration (Sheppard, USA). A survey of concepts has been prepared relating to the spatial impacts of industrial innovations.

The third theme has generated studies on urban housing and transportation systems and on the implications of sectoral and regional policies for urban development. These contributions were presented at the workshop on Urban Systems Modeling, held in Moscow with the cosponsorship of the Committee for Systems Analysis of the USSR Academy of Sciences.

The network of institutions collaborating in the research on urban change has been expanded considerably. In addition to the earlier studies of Sweden and Poland, efforts are underway to develop case studies of the Ruhr region in the Federal Republic of Germany, the Randstad region in the Netherlands, and the Sofia region in Bulgaria.

## The Population, Resources, and Growth Task (Andrei Rogers, USA, and Warren Sanderson, USA, Task Leaders)

During 1980, the members of the Population, Resources, and Growth Task made significant progress toward the completion of several national case studies. Karlström (Sweden) spent the year

*The ICSAR Fund is a part of the U.S. National Academy of Sciences program of support for International Cooperation in Systems Analysis Research.

developing and implementing an economic-demographic simulation model of Swedish economic development in the late 19th and early 20th centuries. The initial phases of this work have been completed and a preliminary version of the model is now running on IIASA's computers. Shishido (Japan) carried out a similar study of Japanese economic growth in the early 20th century. His initial version of the model is now operational. Finally, Zalai (Hungary) started the construction of a general equilibrium model, which could be helpful for medium-term planning in a centrally planned economy. His work shows how the methodology employed in the other case studies could be of use to planners in East European economies. Zalai concludes that despite their fundamental conceptual differences in Eastern and Western settings, such models exhibit close technical similarities that makes the transfer of modeling techniques between market and centrally planned economies possible.

Several reports describing the Task's results were issued during the year. One, written by Sanderson of the U.S., reviews the usefulness of several national economic-demographic simulation models for policy analysis. Another, by Kelley and Williamson (USA), outlines a prototype general equilibrium model of the process of urbanization and development. Five other reports were collected together to constitute the third issue of IIASA's new journal, *IIASA Reports*. Intended as a means of informing the scientific community of the on-going scientific work of the Institute, the special issue on Population, Resources, and Growth focused on demographic models of urbanization, rural-to-urban migration in Kenya, productivity growth in Mexico, a demoeconometric model of Poland, and a demoeconomic model of Sweden's early urbanization.

In September the Task contributed to a small, three-day workshop at the Institute on the role that systems analysis might play in treating the problems facing the less-developed nations. The workshop was cosponsored by UNESCO and COSTED (the Committee on Science and Technology in Developing Countries of ICSU) and brought scientists from India, Sri Lanka, Trinidad, Nigeria, and Ghana to Laxenburg. Three members of the Population, Resources, and Growth Task described their studies of urbanization, development, and low-cost health service delivery. This workshop was followed in November by a four-day task force meeting on the subject of general equilibrium modeling, jointly sponsored with the System and Decision Sciences Area. Highlights of this meeting were a presentation of the first results of a sophisticated third-generation general equilibrium model developed by Allen Kelley (USA) and Jeffrey Williamson (USA) and a panel discussion organized by Sherman Robinson of The World Bank on the modeling of short-run disequilibrium phenomena. Members of this panel were János Kornai (Hungary), Kemal Dervis (The World Bank), and Francois Bourguignon (France).

Finally, considerable progress was made on the study of migration age patterns and synthetic migration schedules for use in situations where reported migration flow data are inadequate or inaccurate. This work provides the necessary empirical foundations for the development of a larger analytic model of the demographic transition in Third World countries. A report by Rogers (USA) and Castro (Mexico) is in the final stages of preparation.

## THE RESEARCH STAFF

Thirty-one research scholars were members of the HSS Area in 1980 for periods lasting at least one month. Together with the much larger number of short-term visiting scholars, they brought to the Area a wide variety of disciplinary skills, cultural backgrounds, and national perspectives. The brief biographies listed below give an indication of the richness of this mixture.

### Research Scholars

*Philip Aspden*, UK (April 1979-April 1980), joined the Health Care Systems Task to work on the application of mathematical models to the allocation of health care resources. Before coming to IIASA, he was a principal scientific officer at the Operational Research Unit of the Department of Health and Social Security in London. He received his Ph.D. in operational research from Lancaster University in 1971. Dr. Aspden has worked on the establishment of computerized information systems for the UK road program and for clinical research.

*Cornelis Bartels*, Netherlands (September 1980- ), joined the HSS Area to work on regional labor supply, the educational/occupational compositions of regional labor forces, and regional policy. Dr. Bartels received his Ph.D. in 1977 from the Free University of Amsterdam and is currently with the Faculty of Economics, University of Groningen, where he is engaged in research on regional economics, research methods in regional sciences, regional labor market analysis, and regional economic policy.

*Luis Castro*, Mexico (October 1977- ), came from Mexico to work with the HSS Area on a comparative study of migration and settlement patterns in IIASA countries and on a case study of Mexico's urbanization and development. Professor Castro received his civil engineering degree (1970) from the Universidad Nacional Autonoma de Mexico (UNAM) and his M.Sc. (1975) from the Urban Systems Engineering and Policy Planning Program at Northwestern University, Illinois. In Mexico, he was a professor at the Graduate School of Civil Engineering at UNAM and a project leader for a consulting firm.

*Julie DaVanzo*, USA (June 1980), is presently a staff member of The Rand Corporation, Santa Monica, California and an associate director of its Center for Population Studies. She received her M.A. (1968) and her Ph.D. (1972) in economics from the University of California at Los Angeles. Dr. DaVanzo came to the HSS Area to work on the economic determinants of migration; her scientific interests include migration, unemployment, and return and repeat migration in the U.S.

*Peter Fleissner*, Austria (January 1975- ), is from the Institute for Socio-Economic Development Research of the Austrian Academy of Sciences, Vienna. He joined IIASA on a part-time basis to develop frameworks for international comparisons of health care systems. Dr. Fleissner received a Dipl. Ing. in electronics (1968) and a Dr. Tech. in mathematics (1971) from the Technical Institute for Advanced Studies in Vienna and was a lecturer in econometrics at the Technical University (1971-1973).

*William Frey*, (September 1980-February 1981), came to IIASA to work in the Urban Change Task. Dr. Frey studied at Brown University and received his Ph.D. in sociology (demography) from there in 1974. He has been on the sociology faculty at Rutgers University (1973-1974), a research associate at the Center for Studies in Demography and Ecology at the University of Washington, Seattle (1974-1975), and a project director and research associate at the Center for Demography and Ecology, University of Wisconsin (1976-1980). His current research focuses on migration and population redistribution in metropolitan areas.

*Robert Gibberd*, Australia (June-July 1980), came to IIASA to work with the HSS Area on problems of aggregation in population projection models. He received his Ph.D. (1967) in mathematics from the University of Adelaide, Australia and is now a senior lecturer at the University of Newcastle. He has been a post-doctoral fellow at the University of Alberta, Canada, a research associate at the University of Texas, Austin, and a research fellow at the Australian National University. His principal interest is the application of mathematics to demographic phenomena.

*Bruce Johnston*, USA (August 1980), has previously worked with the HSS Area and rejoined IIASA this year to continue his studies of agricultural and rural development processes and problems of the provision of low-cost health care services.

Professor Johnston received his Ph.D. in agricultural economics (1953) from Stanford University. From 1945 to 1948 he was Chief, Food Branch, at the General Headquarters, Supreme Commander for the Allied Powers in Tokyo, and was later agricultural economist at the U.S. Mission to NATO and the European Regional Organization in Paris. He has been with the Food Research Institute at Stanford since 1954 and has published widely on agricultural development and structural transformation.

*Urban Karlström*, Sweden (July 1980- ), joined IIASA's HSS Area from the Stockholm School of Economics where he was involved in a study of the influence of an aging population on economic growth. He is pursuing doctoral studies focusing on macroeconomics, economic development, economic demography, and economic history. At IIASA, he is involved in the work of the Population, Resources, and Growth Task and has expanded its collection of national case studies with his general equilibrium demoeconomic model of the Swedish situation from 1870 to 1914.

*Young Kim*, Republic of Korea (June 1980), is currently an assistant professor in the Department of Population Dynamics, School of Hygiene and Public Health, Johns Hopkins University. She received her Ph.D. in biostatistics (1972) after obtaining a master's degree in physics. Dr. Kim has been working in formal demography—more specifically, the dynamics of populations with changing vital rates—and more recently she has extended this to include multiregional populations. She came to the HSS Area to further develop her interests in mathematical demography, particularly multiregional zero growth populations with changing rates.

*Pavel Kitsul*, USSR (December 1977- ), a research scholar at the Institute for Control Sciences of the USSR Academy of Sciences since 1970, came to IIASA to participate in the Health Care Systems Task. Dr. Kitsul received his Ph.D. in physics and mathematics (1973) from the Moscow Institute of Physics and Technology. His scientific interests include the theory and application of stochastic processes and identification and control in complex systems.

*Piotr Korcelli*, Poland (June 1979- ), has been associated with the HSS Area since October 1975, and has worked for IIASA for short periods of time since then. He is currently on leave from the Institute of Geography and Spatial Organization of the Polish Academy of Sciences, where he heads the Department of Urban and Population Studies. Dr. Korcelli received his Ph.D. in economic geography (1968) from the Polish Academy of Sciences and a Habilitation Doctorate in 1973. In 1973-1974 he was a research assistant at the University of Maryland.

*Jacques Ledent*, France (February 1977- ), joined IIASA to do research on demoeconomic studies of migration and human settlement evolution. Mr. Ledent received his degree in engineering (1969) from the Ecole Nationale des Ponts et Chaussees and his master's degree in civil engineering (1972) from Northwestern University, Illinois; he is currently writing his Ph.D. dissertation on urban systems engineering. He has been an engineer

with the Bureau Central d'Etudes pour les Equipements d'Outre Mer and a research specialist at the Division of Economic and Business Research, College of Business and Public Administration, University of Arizona.

*Georgio Leonardi*, Italy (October 1979- ), joined the HSS Area to work on problems of normative location modeling. Dr. Leonardi received his Ph.D. from the Polytechnic Institute of Milano, Faculty of Architecture in 1969. Presently he is with the Polytechnic Institute of Torino where his research involves activity location-allocation models, multifacility optimal models, dynamic spatial interaction models, and optimal natural recreational management models.

*Illka Leveelahti*, Finland (June-November 1980), from the Department of Economics of the University of Tampere, Finland, joined IIASA to work with the HSS Area on manpower problems. He received his M.Sc. in 1972 and his L.Sc. in 1979, both in economics from the University of Tampere. Dr. Leveelahti is interested in public and regional economics. In the last few years he has done research in migration movements, economics of migration, and labor market problems.

*Kao-Lee Liaw*, Canada (July 1980- ), joined IIASA to work on multiregional demography. He is currently an associate professor in the Department of Geography at McMaster University, Hamilton, Ontario, Canada. He studied at National Taiwan University and Kansas State University, USA, and received his Ph.D. in geography from Clark University, USA (1974). Dr. Liaw is interested in the analysis of interregional population systems and in recent years has focused his research on dynamic analyses of Canadian interregional population systems.

*Leslie Mayhew*, UK (March 1980- ), joined the Health Care Systems Task from the Department of Health and Social Security in London. He received his Ph.D. in geography from Birkbeck College, University of London (1979). At the Department of Health and Social Security, Dr. Mayhew was involved in the mathematical modeling of the interaction between the supply and demand for acute hospital services in the London region. Dr. Mayhew's scientific interests include regional science, econometric methods and computing.

*Zenji Nanjo*, Japan (April-July 1980), is a professor in the Department of Statistics at Fukushima Medical College. He received his B.Sc. in 1950 from Tohoku University and his Doctor of Medical Sciences degree in 1973 from Fukushima Medical College. Professor Nanjo was a lecturer in the Department of Mathematics at Fukushima University (1953-1962). In 1962 he joined the Department of Statistics of Fukushima Medical College, where he has been a full professor since 1968.

*Lennart Ohlsson*, Sweden (March-April 1980), a former member of the HSS Area, joined IIASA to participate in studies of changing regional specializations and their employment consequences. Dr. Ohlsson received his Ph.D. in economics (1974) from the University of Uppsala. Since 1974, he has been senior research

economist with the Expert Group on Regional Studies, Ministry of Industry, Stockholm, and in 1976 was awarded his docent title. Earlier, he had been a teaching assistant and lecturer in economics at the University of Uppsala and a research economist at the Industrial Institute for Economic and Social Research, Stockholm.

*Mark Pauly*, USA (June-September 1980), joined the Health Care Systems Task to work on microtheoretical behavioral models for health planning. Professor Pauly received his Ph.D. in economics from the University of Virginia (1967) and is now a professor of economics at Northwestern University. He has studied the behavior of patients covered by health insurance, the theory of agency as applied to physicians, and the development of theoretical and econometric models of hospitals. He has served as a consultant to the National Center for Health Services Research, the Health Care Financing Administration, the American Hospital Association, and the Michigan Hospital Association.

*Margaret Pelling*, USA (July 1980), received her D. Phil. (1973) in physics and became a member of the Department of Health and Social Security in London in 1976. Between 1973 and 1976, she was a research fellow in astrophysics at Cambridge and Oxford in England. She has since worked on social security problems and manpower models, which are her current primary interests. While at IIASA, Dr. Pelling worked with the Health Care Systems Task on the design of health manpower models that would estimate the demand for doctors and nurses in the UK.

*Dimiter Philipov*, Bulgaria (September 1977- ), came to the HSS Area from the Scientific Institute of Statistics at Sofia. Mr. Philipov studied mathematics, mathematical statistics, and probability theory at the University of Sofia. His scientific interests include the mathematics of population growth and demoeconomics. At IIASA, he is concentrating on the comparative study of migration and settlement.

*Philip Rees*, UK (July-August 1980), is a reader in population geography at the University of Leeds. He did his undergraduate work at the University of Cambridge and his graduate work at the University of Chicago, obtaining his master's degree in 1968 and his doctorate in 1973. On moving to the University of Leeds, he began to work in collaboration with Professor Alan Wilson, jointly publishing several papers and a book on spatial population analysis. His recent work has involved the application of population accounting methods to regional population projections and to multiregional life table construction. He came to IIASA to pursue further these interests and to continue his collaboration with the HSS Area.

*Andrei Rogers*, USA (July 1975- ), has led the HSS Area at IIASA since 1976. Professor Rogers received his bachelor's degree in architechture (1960) from the University of California at Berkeley and his Ph.D. in urban and regional planning (1964) from the University of North Carolina at Chapel Hill. Since then he has been a professor in the City and Regional Planning

Department at the University of California at Berkeley and the Technological Institute at Northwestern University, Illinois. His current research focuses on migration and the evolution of human settlement systems in both developed and developing countries.

*Warren Sanderson*, USA (September 1980- ), joined the Population, Resources, and Growth Task to work on the demographic-economic modeling of urbanization and development processes. Dr. Sanderson received his Ph.D. in economics in 1974 from Stanford University and was appointed assistant professor there in 1971. From 1969 to 1971 he worked with the National Bureau of Economic Research as a full-time scholar in New York and later as a part-time researcher at Stanford where he was also teaching. After his stay at IIASA, he will return to the State University of New York at Stony Brook as an associate professor. Dr. Sanderson's scientific specializations are in economic history, demography, and models of household decision making.

*Ahmed Seifelnasr*, Egypt (August 1979-August 1980), came to work on demographic analysis from the Johns Hopkins University on a Population Council fellowship. He began his studies in applied statistics and demography at Cairo University and went to the USA in 1974 to continue his work at the Department of Population Dynamics at Johns Hopkins University where he received his Ph.D. in 1979. Dr. Seifelnasr has been a lecturer at the University of Cairo and the University of Benghazi in Libya as well as a research assistant at the American University of Cairo.

*Eric Sheppard*, UK (March-June 1980), is an associate professor in the Department of Geography at the University of Minnesota where he teaches economic and urban geography and geographical analysis. He came to IIASA to work in the Urban Change Task on settlement system geography. Dr. Sheppard began his studies in geography at Bristol University, from where he graduated in 1972. He then continued his studies at the University of Toronto, Canada, where he received both his M.A. (1974) and his Ph.D. (1976). He is currently involved in research on the modeling of dynamic interdependencies in urban and regional systems.

*Evgenii Shigan*, USSR (November 1976-August 1980), came from the Central Institute for Advanced (Post-Graduate) Medical Training at the Ministry of Health of the USSR in Moscow. His research focuses on the application of operations research to public health. Professor Shigan graduated from the First Moscow Medical Institute and subsequently received his M.D. in 1960, his Ph.D. in medical statistics and epidemiology in 1964, and his second doctoral degree in Medical Science in 1973. In 1976 he became a professor of social medicine and public health.

*Oleg Staroverov*, USSR (October 1980), is a research scholar from the Central Economic Mathematical Institute (CEMI) of the Soviet Academy of Sciences in Moscow. He graduated in mathematics from Moscow University and received his Ph.D. in technical sciences (1968) from the Moscow Institute of Instrumentation and his second doctoral degree (1979) from CEMI. Since 1969 he has been a senior research scholar at CEMI studying economic problems.

*Svetlana Soboleva*, USSR (February-June 1980), spent five months with the HSS Area in 1979; she returned to the Area again in February 1980 to continue her work. She is from the Institute of Economics and Industrial Engineering, Siberian Branch of the USSR Academy of Sciences, Novosibirsk. Dr. Soboleva did her undergraduate studies at the Faculty of Mathematics of Tomsk State University. She received her Ph.D. in economics (1973) from the Institute of Economics and Industrial Engineering in Novosibirsk. Her scientific interests include problems of modeling migration, the influence of socioeconomic factors on demographic processes, and methodological problems of modeling.

*Ernö Zalai*, Hungary (July and September 1980), came to IIASA to work jointly with the HSS Area and the System and Decision Sciences Area on economic modeling. Dr. Zalai graduated from the Karl Marx University of Economics, Budapest (1966) with a specialization in mathematics and economic planning and received his Ph.D. from the same university in 1968. He is now the head of the Planning Methodology Section in the Department of National Economic Planning and Management at Karl Marx University and acts as a consultant to the National Planning Office regarding the application of mathematical models to planning problems.

## Research Assistants

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|---|---|---|---|---|
| Coen, Margery | USA | August 1979 | - | August 1980 |
| Just, Peer | FRG | January 1979 | - | |
| Karlström, Urban | Sweden | July 1979 | - | June 1980 |
| Kogler, Walter | Austria | September 1979 | - | |
| Shishido, Hisanobu | Japan | March 1980 | - | |

## PUBLICATIONS

The published results of the Area's research have appeared as one of the following four types of publications, depending on the nature of the work and its intended audience.

*IIASA Reports* is a journal intended to disseminate to a wide international audience the results of research carried out at IIASA.

The *Research Report* (RR) is IIASA's formal vehicle for reporting Institute research after it has been carefully reviewed. The RR classification is used to report final results and interim or contributing work when these results are felt to merit broad circulation.

The *Collaborative Publication* (CP) is used both for results of research done jointly with other research organizations and for proceedings of conferences and workshops.

The *Working Paper* (WP) provides a means for the informal distribution of intermediate results to scientific colleagues within and outside the Institute.

All of the HSS Area 1980 publications in these four categories are listed below.

## Journal

*IIASA Reports*

*Population, Resources, and Growth* Volume 2, Number 2

This collection of Research Reports reviews and summarizes the Area's recent efforts to contribute to an interdisciplinary analysis of the problems of population growth, urbanization, and economic development and to a multidimensional (systems) understanding of the strategic options available for coping with these problems. The volume includes contributions from J. Ledent (France), H. Rempel (Canada), C. Reynolds (USA), Z. Pawlowski (Poland), and U. Karlström (Sweden).

## Research Reports

*Comparative Dynamics of Three Demographic Models of Urbanization*
J. Ledent RR-80-1

The comparative dynamics of three related demographic models of urbanization are examined in this report. For each model, a differential equation that traces the impacts of different patterns of natural increase and net migration on the evolution of the urban to rural population is set out.

*Migration Patterns and Population Redistribution*
(Reprinted from *Regional Science and Urban Economics* 9:275-310)
A. Rogers RR-80-7

Fundamental concepts of migration measurement are set out, and several multiregional demographic models dealing with the redistributional dynamics of national populations are outlined in this reprinted article.

*Modeling the Dynamics of a System of Metropolitan Areas: A Demoeconomic Approach*
(Reprinted from *Environment and Planning A* 12:125-133)
P. Gordon and J. Ledent RR-80-8

A complete dynamic model of a system of metropolitan areas interacting through economic and demographic links is proposed. The model introduces interregional and intraregional effects of population. In addition, this model permits the simultaneous determination of migration rates, labor-force-participation rates, and unemployment rates.

*Essays in Multistate Mathematical Demography*
[Reprinted from *Environment and Planning A* 12(5):485-662]
A. Rogers, ed. RR-80-10

The six papers in this special issue were first presented at the session on mathematical demography held at the 1979 Annual Meeting of the Population Association of America in Philadelphia, 26-28 April. They are representative examples of work currently under way in a relatively new branch of mathematical demography becoming known as multistate demography, the study of the transitions that individuals experience over time in the course of passing from one state of existence to another.

*Economic-Demographic Simulation Models: A Review of Their Usefulness for Policy Analysis*
W.C. Sanderson RR-80-14

The formal modeling of demoeconomic processes of development is an "infant industry." A number of efforts to assess progress to date have been attempted, including this critical review of several economic-demographic simulation models that have been developed during the past 15 years to clarify the indirect effects of changes in the economic or demographic environment.

*Optimal Migration Policies: An Analytical Approach*
(Reprinted from *Regional Science and Urban Economics* 9:345-367)
F. Willekens RR-80-16

A methodology for quantitative policy analysis and policy design based on optimal control and system theory is used here to explore the analytical aspects of population distribution policies. The goals—means dimension of population distribution policy is added to demographic and demoeconomic models to derive policy models.

*Modeling Urbanization and Economic Growth*
A.C. Kelley and J.G. Williamson RR-80-22

A prototype model of the urbanization and development process is presented in this report. The model sets out a general equilibrium perspective that illuminates several fundamental aspects of the process of demoeconomic structural change and synthesizes the growing recent literature on general equilibrium modeling of dualistic development. The ideas that it strives to convey deal with urban growth, income distribution, structural change, and the demography of development. When subjected to empirical analysis, it should be capable of describing the past and of assessing alternative future consequences of rapid urbanization and city growth.

*DRAM: A Model of Health Care Resource Allocation*
D. Hughes and A. Wierzbicki RR-80-23

DRAM is a health care resource allocation model that simulates the allocation of limited supplies of resources among competing demands. This extension of the original version of DRAM allows the model to handle many health categories, many resources, and many modes of care within the health care system. New results are given about the resource allocation patterns that DRAM can represent, and new methods of parameter estimation are described that make direct use of historical allocation data.

*Do Cities Grow by Natural Increase or by Migration?*
[Reprinted from *Geographical Analysis* 12(2):142-156]
N. Keyfitz RR-80-24

In this article, Nathan Keyfitz analyzes the urbanization of a national population that at first is entirely rural. The population is subjected to fixed rates of natural increase and migration, and the evolution of its urban and rural subpopulations is studied by means of a pair of differential equations.

*A Demoeconomic Model of Interregional Growth Rate Differences*
[Reprinted from *Geographical Analysis* 12(1):56-67]
J. Ledent and P. Gordon RR-80-26

This report argues for a demoeconomic modeling of multiregional systems. It proposes a model that accounts for interregional growth rate differences by means of an endogenous and simultaneous determination of labor-force participation, migration, and unemployment.

*Multidimensionality in Population Analysis*
(Reprinted from *Sociological Methodology 1980* K. Schuessler, ed. pp. 191-218)
N. Keyfitz RR-80-33

Material from a number of sources, published originally under such headings as multiregional demography, increment-decrement life tables, marriage tables, and tables of working life, has been synthesized in this essay reproduced from *Sociological Methodology 1980*.

*A Demoeconometric Model of Poland and Its Application to Counterfactual Simulations*
Z. Pawlowski RR-80-35

This report presents an econometric model that uses a number of economic, technological, and demographic variables in order to explain the past growth of the Polish economy. The model shows the existing interrelations of economic and demographic phenomena.

*A Shift-Share Analysis of Regional and Sectoral Productivity Growth in Contemporary Mexico*
C. Reynolds RR-80-41

This case study of Mexico develops a shift-share analysis of labor productivity, focusing on the possible contribution to increases in labor productivity of interregional labor force migration and the impact of intersectoral labor force shifts within the Mexican economy.

*Urbanization and Industrialization: Modeling Swedish Demo-economic Development from 1870 to 1914*
U. Karlström RR-80-44

Following a number of earlier papers on Mexico and Poland, this analysis of Swedish development further expands the collection of national case studies that are envisioned as part of the Population, Resources, and Growth Task. In it, a general equilibrium demoeconomic model that captures development characteristics specific to Sweden is outlined and discussed.

## Research Reports on the Comparative Migration and Settlement Study

This collection of national reports deals with the comparative analysis of internal migration and spatial population growth in the 17 National Member Organization countries of IIASA. Patterns of population change are explored by applying the new multiregional methodologies and computer programs elaborated in the HSS Area. All reports have the same structure and include multiregional data on fertility, mortality, and migration; multiregional life tables, spatial mortality, fertility, and migration expectancies; and multiregional population projections. Each Migration and Settlement report is authored by a native collaborating scholar familiar with the demographic setting of his/her country. (The first two reports on the United Kingdom and Finland were completed in 1979.)

*3. Sweden*
A.E. Andersson and I. Holmberg RR-80-5

*4. German Democratic Republic*
G. Mohs RR-80-6

*5. Netherlands*
P. Drewe RR-80-13

*6. Canada*
M. Termote RR-80-29

*7. Hungary*
K. Bies and K. Tekse RR-80-34

*8. Soviet Union*
S. Soboleva RR-80-36

*9. Federal Republic of Germany*
R. Koch and H.P. Gatzweiler RR-80-37

## Collaborative Publications

*A Model to Assist Planning the Provision of Hospital Services*
J. Rousseau and R. Gibbs CP-80-03

*A Model of Balanced Links between Investment, Jobs, and Population*
F. Borodkin CP-80-08

*Spatial Modeling of Urban Systems: An Entropy Approach*
B. Shmulyian CP-80-13

*Dualistic Development and Phases: Possible Relevance of the Japanese Experience to Contemporary Less-developed Countries*
K. Ohkawa CP-80-29

*Perspectives for Urban Analyses and Policies*
P. Nijkamp CP-80-31

*A Simple Method of Measuring the Increase of Life Expectancy When a Fixed Percent of Deaths from Certain Causes are Eliminated*
Z. Nanjo CP-80-35

## Working Papers

*Rural-Urban Migration, Urbanization, and Economic Development*
J. Ledent WP-80-19

*On the Formal Equivalence of Some Simple Facility Location Models*
G. Leonardi WP-80-21

*Urban Change: An Overview of Research and Planning Issues*
P. Korcelli WP-80-30

*A Dual-based Procedure for Dynamic Facility Location*
T. van Roy and D. Erlenkotter WP-80-31

*Calibrating Alonso's General Theory of Movement: The Case of Interprovincial Migration Flows in Canada*
J. Ledent WP-80-41

*A Simple Sick-Leave Model Used for International Comparison*
P. Fleissner, K. Fuchs-Kittowski, and D. Hughes WP-80-42

*DRAM Balances Care*
P. Aspden, R. Gibbs, and T. Bowen WP-80-43

*Migration and Settlement: Soviet Union*
S. Soboleva WP-80-45

*Multiregional Zero Growth Populations with Changing Rates*
Y. Kim WP-80-46

*On the Choice of Models for Public Facility Location*
D. Erlenkotter WP-80-47

*The IIASA Health Care Resource Allocation Submodel: Model Calibration for Data from Czechoslovakia*
P. Aspden and M. Rusnak WP-80-53

*Urbanization and Industrialization: Modeling Swedish Demoeconomic Development from 1870 to 1914*
U. Karlström WP-80-54

*Multistate Population Projections*
D. Philipov and A. Rogers WP-80-57

*Migration and Commuting: A Theoretical Framework*
M. Termote WP-80-69

*Urbanization Level and Urban Concentration: Comparative Paths and a Performance Index*
A. Seifelnasr WP-80-70

*A Dynamic Approach to the Estimation of Morbidity*
P. Kitsul WP-80-71

*A Unifying Framework for Public Facility Location Problems*
G. Leonardi WP-80-79

*Alternative Approaches to Modeling Health Care Demand and Supply*
E. Shigan and P. Kitsul WP-80-80

*The One-Year - Five-Year Migration Problem*
P. Kitsul and D. Philipov WP-80-81

*Multiregional Demographic Analyses for Some Socialist Countries in Eastern Europe*
D. Philipov WP-80-84

*Constructing Multiregional Life Tables Using Place-of-Birth-specific Migration Data*
J. Ledent WP-80-96

*Spatial Interaction in Dynamic Urban Systems*
E. Sheppard WP-80-103

*An Improved Methodology for Constructing Increment-Decrement Life Tables from the Transition Perspective*
J. Ledent WP-80-104

*Changes in Comparative Advantages and Paths of Structural Adjustment and Growth in Sweden, 1975-2000*
L. Bergman and L. Ohlsson WP-80-105

*A Note on the Estimation of Interregional Migration Streams from Place-of-Residence-by-Place-of-Birth (PRPB) Data*
J. Ledent WP-80-106

*The IIASA Health Care Resource Allocation Submodel: DRAM Calibration for Data from the South West Health Region, UK*
P. Aspden WP-80-115

*A Multiactivity Location Model with Accessibility- and Congestion-Sensitive Demand*
G. Leonardi WP-80-124

*RAMOS: A Model of Health Care Resource Allocation in Space*
L. Mayhew and A. Taket WP-80-125

*A Nonlinear Multisectoral Model for Hungary: General Equilibrium Versus Optimal Planning Approach*
E. Zalai WP-80-148

*Repeat Migration in the United States: Who Moves Back and Who Moves On?*
J. DaVanzo WP-80-158

*Urban Change and Spatial Interaction*
P. Korcelli WP-80-161

*The Regional Planning of Health Care Services: RAMOS and RAMOS*$^{-1}$
L. Mayhew WP-80-166

*Choices in the Construction of Multiregional Life Tables*
J. Ledent and P. Rees WP-80-173

*Some Proposals for Stochastic Facility Location Models*
Y. Ermoliev and G. Leonardi WP-80-176

# THE RESEARCH PLAN: 1981-1985

## FOCUS

Growing global economic interdependence, increasing competition for diminishing stocks of resources, and widening disparities in material welfare have made future population growth an unavoidable issue in international affairs. World population today exceeds 4 billion, and it is expected to pass the 6 billion mark before the end of this century. Conservative estimates of the total at the midpoint of the next century range from 8 to 9 billion, a doubling within the next 70 years.

Rapid population growth has important social, economic, and political consequences. It affects levels of public health and welfare, and the quality of the environment in which people live. Many of the consequences are poorly understood, yet it is clear that a reduction of population growth alone can only ease, not resolve, the diverse problems associated with economic growth and development. Thus the polarized debate between those who would stop population growth and those who believe that a continuing steady stream of human progress and well-being will accompany such growth has become unproductive. The problem is not one of growth versus nongrowth; it is, rather, the design of appropriate policies and programs for redirection and redistribution. The development of improved methods for analyzing and understanding several of the fundamental issues associated with such policies and programs is the goal of the research program in the Human Settlements and Services (HSS) Area.

Specifically, the HSS Area is concerned with the dynamics of global population growth and distribution, the consequences of these dynamics for patterns of employment generation, resource consumption, and service demand, and the design of policies and programs that respond efficiently and equitably to such issues.

## WHY AT IIASA?

Although many other national and international organizations are conducting research focused on problems of human settlements and services, IIASA is in a particularly advantageous position to make contributions in coordination and

dissemination, multidisciplinary integration, and expansion of the state of the art in human settlement and services analysis.

First, IIASA's sponsorship by nations with diverse social and economic systems and its nongovernmental status confers important advantages for its role as an international forum where national experiences with common problems may be shared and disseminated. Second, IIASA's interdisciplinary character promotes a multidisciplinary systems perspective on problems that cross several traditional fields of inquiry. Finally, taking advantage of its links with national academies of sciences, IIASA can attract and direct the attention of scholars in its several National Member Organization countries to global problems in need of increased scientific study.

## RESEARCH AGENDA

Research in the HSS Area is concerned with people, their number and distribution in space, their needs for services, and their welfare. This concern is reflected in three overlapping research themes, differentiated according to the time horizon usually adopted by decision makers involved with such issues: urban systems management, human resources and services, and human settlement systems.

### Urban Systems Management

The principal focus of the first theme is on state-of-the-art reviews and dissemination of knowledge about the resolution of contemporary *urban systems management* problems. The decision maker addressing such problems typically is concerned with a short-run problem in the sense that he must deal with the urban system as it is and cannot fundamentally alter its basic structure. Traffic control through improved signalization procedures is a good example of such a management problem; it has been a focus of research in the HSS Area in the past. The location of a public facility such as a hospital is another example; it is a focus of current research in the HSS Area.

The public provision of urban facilities and services has a fundamental geographical dimension that arises as a consequence of the spatial separation of suppliers and consumers. Where to locate hospitals, schools, and libraries, for example, and who benefits from alternative locational arrangements are questions well suited for systems analysis. They are being studied in the HSS Area's Public Facility Location Task, which currently represents the urban systems management theme. Important methodological contributions have grown out of collaboration with scholars in the Optimization Task of the System and Decision Sciences Area. These will be included in a state-of-the-art review.

## Human Resources and Services

The *human resources and services* theme is concerned with the analysis of policies and programs that promote the full utilization of human potential and the cost-effective provision of social and personal needs. The decision maker's time horizon in dealing with such system problems is generally anywhere from 3 to 5 years. Thus, although minor alterations of the system are possible, the time horizon is too short to develop an entirely new system. Problems in manpower utilization and health service provision are currently being studied in the human resources and services theme.

The ways in which a national health care system allocates its limited supplies of doctors, nurses, and hospital beds, for example, and to whom, is a fundamental issue in all countries. Studies of such resource allocation processes have been carried out both at the national and the regional levels in a number of IIASA member countries by the Health Care Systems Task, whose main goal is to construct a health care systems simulation model for use in health service planning. Improved algorithms for the mathematical modeling of this problem have been developed through collaboration with nondifferentiable optimization theorists in the Optimization Task of the System and Decision Sciences Area.

Most industrialized economies are, or soon will be, experiencing diminishing growth in their working-age populations, resulting principally from declining birth rates. The global consequences for labor supply, demand, and productivity growth are likely to be far-reaching, and the magnitude of the consequences difficult to foresee. The Manpower Analysis Task, in collaboration with the Industrial Development Task, is examining the impacts of changes in patterns of world trade and national demoeconomic growth on labor supply, demand, and productivity. Collaborative work with the Economic Modeling Task of the System and Decision Sciences Area has produced a disaggregated national econometric model of labor supply for the US economy. Joint research with a team of economists in Finland is focusing on the dynamics of urban labor markets in the Nordic countries. These activities will be carried forward in 1981.

## Human Settlement Systems

At the far end of the time horizon spectrum perceived by decision makers are problems of *human settlement systems* development. The decision maker's temporal perspective is a long one in such matters, generally lying within the range of 15 to 20 years. For problems of development, the system can be altered structurally, and plans are the usual vehicle for guiding the instruments of implementation. Population growth, urbanization, resource demands, and economic development are interrelated facets that delineate two Tasks in the HSS Area concerned with global patterns of human settlement systems development.

Recent urbanization trends have followed divergent paths in the more developed and the less developed nations of the world today. The large urban agglomerations in the former have either experienced absolute population declines or are growing at rates lower than those of smaller urban centers; the major urban agglomerations of the latter, on the other hand, are growing rapidly, and the very largest continue to dominate the urban size hierarchy. These opposing trends have generated two major urban policy debates, one focused on metropolitan maturity and contraction, the other directed at urban primacy and excessive urban growth rates. The Urban Change Task is addressing the former problem; the Population, Resources, and Growth Task, the latter. The goal of these two Tasks is the achievement of an improved understanding of national urban development processes and their interrelationships with global and industrial development. In 1982, the two Tasks in this theme will be merged, in order to produce a global assessment of human settlement problems along the lines of the 1976 UN Habitat Conference.

Work on the human settlement systems theme is being carried out in collaboration with the Economic Modeling Task of the System and Decision Sciences Area and with the Regional Development Task. Links with the newly established Global and Industrial Development Tasks have been established, and future joint work on resource demands with the Resources and Environment Area is anticipated.

## FIVE-YEAR PERSPECTIVE

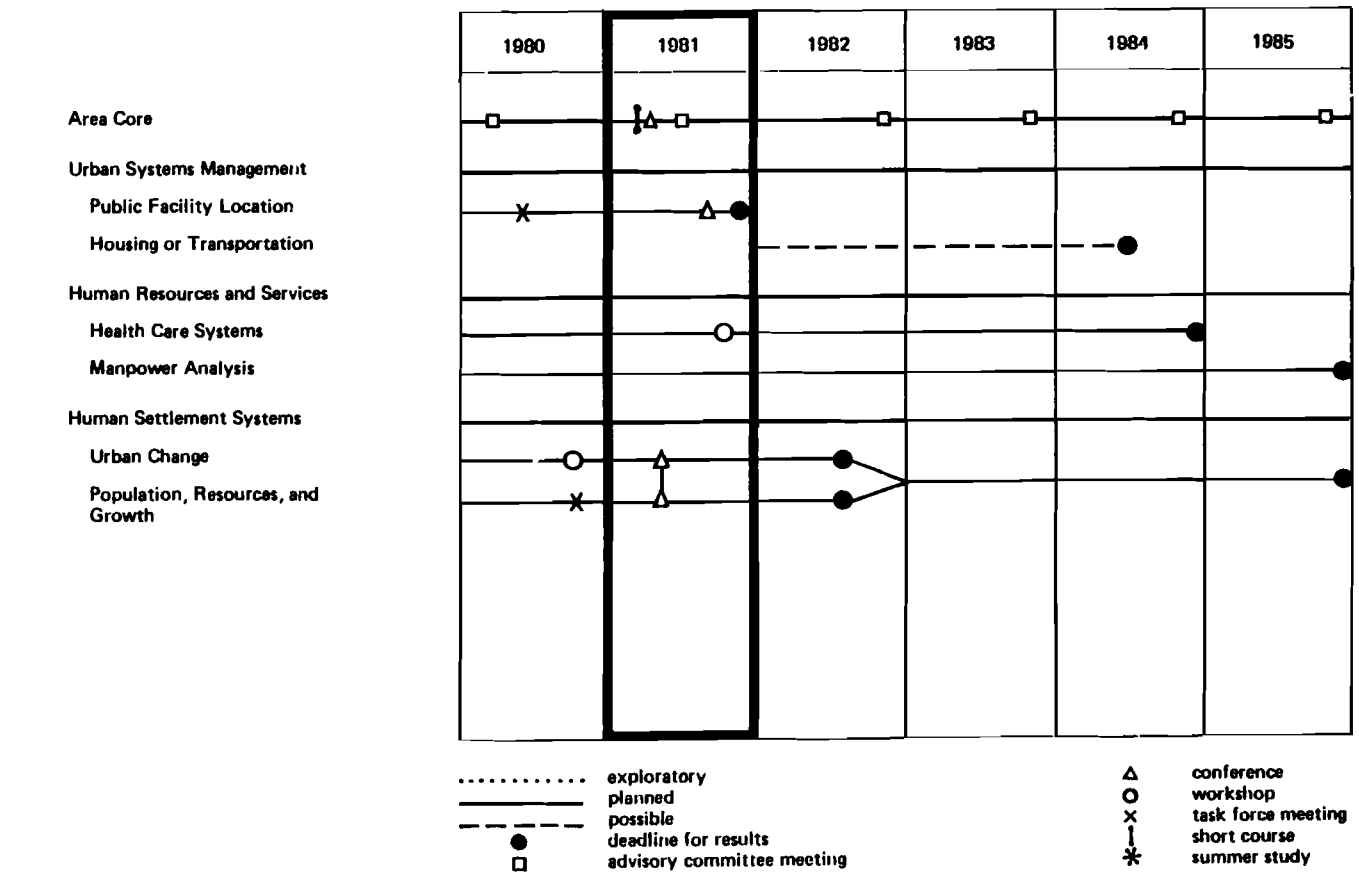
Work on the Area's three major themes will continue over the next 5 years, but the Tasks will change. Several Tasks, such as Public Facility Location, may be concluded. Other Tasks, such as Health Care Systems and Manpower Analysis, may continue with revised perspectives. And new Tasks, such as Housing or Transportation, may evolve.

Task/Budget Summary Sheet

| Tasks | 1981 Budget (AS) | | | |
|---|---|---|---|---|
| | Total Funds | IIASA Funds | | External Funds |
| | | Area Funds | Program Funds | |
| Area Core | 2,290,000 | 2,290,000 | - | - |
| Public Facility Location | 750,000 | 750,000 | - | - |
| Health Care Systems | 2,500,000 | 2,500,000 | - | - |
| Manpower Analysis | 1,000,000 | 1,000,000 | - | - |
| Urban Change | 2,500,000 | 2,500,000 | - | - |
| Population, Resources, and Growth | 2,500,000 | 2,500,000 | - | - |
| | 11,540,000 | 11,540,000 | - | - |

HUMAN SETTLEMENTS AND SERVICES AREA

Research Schedule



## Task 0: AREA CORE

### PURPOSE

Core activities include conceptualization of research, recruitment of scientists, task management, communication with advisory committees and policy makers, and dissemination of results. Core funds are used to support consultants, short-term appointments for exploratory studies, and distinguished visitors; collaborative activities such as task force meetings, seminars and short courses, planning workshops, and Advisory Committee meetings; and technical editorial assistance to help the scientific staff improve the clarity of their publications.

### ACTIVITIES 1981

In 1981, the Core budget will support the day-to-day management activities of the Area Chairman and his support staff. Exploratory studies in housing analysis and in transportation planning will be concluded, and a recommendation regarding their future task status will be developed.

The dissemination of the final outputs of the Migration and Settlement Task, concluded in 1978, will take place at an international conference based on the draft of the study's three-volume publication in IIASA's *International Series on Applied Systems Analysis*. Finally, training courses in migration and settlement modeling for Asian and African demographers may be offered.

### TASK RESOURCES

#### Funds and Person-Months

| | 1976-1979[a] | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | 3.25 | 1.8 | 2.3 | 1.75 | 1.75 | 1.75 | 1.75 | 14.35 |
| Person-months | 34 | 20 | 9 | 12 | 12 | 12 | 12 | 111 |

[a]Expenditures.

## Task 1: PUBLIC FACILITY LOCATION (formerly, Normative Location Modeling) (1979-1981)

### OBJECTIVES AND EXPECTED RESULTS

The public provision of urban facilities and services often takes the form of a few central supply points serving a large number of spatially dispersed demand points: for example, hospitals, schools, libraries, and emergency services such as fire and police. A fundamental characteristic of such systems is the spatial separation between suppliers and consumers. No market signals exist to identify efficient and inefficient geographical arrangements; thus, the location problem is one that arises in both East and West, in planned and in market economies.

The principal objective of the Public Facility Location Task is to conduct the first comprehensive international East-West assessment of the design and application of optimizing approaches in the location of public facilities and services in urban areas. It is planned that the assessment will be published as a volume in IIASA's International Series.

A secondary objective of the Task is to design a framework for examining the principal relationships between urban services and the other major components of urban activity systems. This framework will help to identify possible tools for optimal planning and control over space and time.

### Expected Results 1981

A final draft of the state-of-the-art book to be published in IIASA's *International Series on Applied Systems Analysis* will be completed. Six areas of facility location modeling that seem particularly promising for a comparative perspective will be considered:

- Models with fixed total demand, e.g., fire stations and schools
- Models with elastic total demand, e.g., shopping centers, libraries, and leisure and recreational facilities
- Different allocation rules, e.g., allocation to the nearest facility versus probabilistic allocation

- Different objective functions, with particular reference to the comparison between the classical travel-cost-minimizing (or accessibility maximizing) criterion and possible new multicriterion approaches
- Dynamic location problems, e.g., capacity expansion models (no demolitions allowed) for increasing-demand situations; maintenance and renewal models (demolitions allowed) for nonincreasing-demand situations; exact and approximate methods for sensitivity and stability analysis of medium- and long-range optimal policies
- Multifacility and multilevel location models, e.g., location of a network of health care facilities

## ACTIVITIES

### Point of Departure

It is expected that, as a result of work carried out in 1980, the Task will start 1981 with:

- An established network of international contacts through workshops, publications, and joint projects on both theoretical issues and applications
- A comparative critical analysis of the current major studies and approaches in public facility location modeling in the form of a preliminary draft of the state-of-the-art survey

### Activities 1981

A final draft of the state-of-the-art volume will be prepared and distributed for comments to scholars and decision makers in the NMO countries. A capstone conference will be held, and several paths towards generalizations for future research will be explored. Suggestions for topics to be developed within new tasks on urban systems management, such as housing and transport systems, will be outlined.

## TASK RESOURCES

### Funds and Person-Months

| | 1979[a] | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | .75 | 0.8 | .75 | - | - | - | - | 2.3 |
| Person-months | 3 | 6 | 12 | - | - | - | - | 21 |

[a]Expenditures.

Internal Collaboration

- System and Decision Sciences Area, Tasks 1 and 3
- Craft of Systems Analysis Task

External Collaboration

- Department of Industrial Engineering and Management Science, Northwestern University, Evanston, Illinois, USA
- All-Union Research Institute for Systems Studies, Moscow, USSR
- Institute of the Science of Architectural and Territorial Systems, Turin, Italy
- Department of Geography, University of Leeds, Leeds, UK

## Task 2: HEALTH CARE SYSTEMS (1975-1984)

### OBJECTIVES AND EXPECTED RESULTS

The main goal of this Task is to aid health service planning in planned and in market economies through the construction of Health Care System (HCS) simulation models. The result will be a family of submodels describing the main aspects of the HCS (such as population dynamics, morbidity, and resource allocation) and its interactions with the national economy. The submodels may be applied individually or collectively in a system-wide approach to health service planning.

The work is designed for regional, national, and international health planners and is meant to assist them in, for example, the examination of the consequences of policy options for resource supply levels. The submodels will be tested in a number of NMO countries with the assistance of the World Health Organization (WHO) and collaborating research centers in the NMO countries. The results should also be useful for international agencies such as WHO and the United Nations Development Program (UNDP).

### Expected Results 1981

- Development of stochastic methods for estimating important HCS parameters for different types of medical and demographic data, e.g., census data, annual reports, sampling studies
- A report on the application of the submodels in a number of NMO countries
- Analyses of the economics of health care

### Expected Results 1982-1984

Among the results of possible research directions after 1981 could be

- An enhanced set of models of the HCS with computer programs and application results, dealing with planning at the regional level and for coordination of regional and national planning
- Studies of market and insurance mechanisms in countries where they strongly affect the HCS

- Procedures to assist management and planning in individual sectors of the HCS (e.g., models of inpatient and outpatient services and emergency care)
- Analyses of the HCS of developing countries and studies of the influence of economic and environmental variables on the HCS
- A report on problems associated with the care of the elderly
- A Status Report describing the results of applying IIASA HCS models in various NMO countries, and including international comparisons, as well as suggested directions for further work

## ACTIVITIES

### Point of Departure

Although there are a large number of models for examining individual sectors and aspects of health care systems, there has been limited success in using systems modeling for the comprehensive planning of health services. To construct such models, aspects of health services are viewed in the Task as parts of a system for which submodels dealing with each aspect can be developed and linked. To date, submodels have been constructed for population, morbidity, resource requirements and allocation, and some aspects of resource supply. These have been tested using data from NMO countries, and one of them is being used in the United Kingdom to analyze health policy issues. Methodology, mathematical tools, and applications in a number of NMO countries are described in a Status Report prepared by the Task team.

The resource supply analysis has been concerned with medical manpower training, and this work has been a useful input to the Area's Manpower Analysis Task in 1980. Joint work on the development of the HCS submodels to improve their applicability at the regional planning level has been initiated with the collaboration of the Regional Development Task. Collaboration with the System and Decision Sciences Area on the use of optimization, identification, and other mathematical techniques for parameterization of health care system models has been started.

### Activities 1981

Apart from the extension, consolidation, and further application of the existing submodels, the HCS Task in 1981 will prepare plans for a set of new research activities, extending through 1984, that would carry the HCS work through its second phase of activity. Building on the experience gained during its first phase, the HCS team would develop plans to broaden its

focus to include health service planning problems in market economies and in developing countries. Health care manpower problems, the consequences of rising health care costs, and the design of programs for the provision of low-cost health services in poor countries would then receive further attention. A workshop is planned for late 1981.

## Activities 1982-1984

Possible activities of the Task during 1982-1984 include

- Dissemination of the experience gained through 1981
- Further development of the modeling approach to help in health care planning in both developed and developing countries and in both planned and market economies
- Analysis of problems connected with the care of the elderly
- Widening the focus of the current Task to take into account other aspects of human resource planning

## TASK RESOURCES

### Funds and Person-Months

| | 1975-1979[a] | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | 9.04 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | - | 21.54 |
| Person-months | 166 | 40 | 39 | 40 | 40 | 40 | - | 365 |

[a]Expenditures.

### Internal Collaboration

- System and Decision Sciences Area, Task 3
- Regional Development Task

### External Collaboration

- Institute of Socio-Economic Development Research, Vienna, Austria
- Department of Informatics and Operational Research, University of Montreal, Montreal, Canada

- Institute of Medical Bionics, Bratislava, Czechoslovakia
- Institute of Postgraduate Training of Physicians, Bratislava, Czechoslovakia
- Institute of Social Medicine and Organization of Health Services, Prague, Czechoslovakia
- Institute of Medical Data Processing, Statistics and Biomathematics (ISB), Munich, FRG
- Department of Scientific Theory and Organization, Humboldt University, Berlin, GDR
- Ministry of Health and the Environment, Leidschendam, the Netherlands
- Institute of Control Sciences, Moscow, USSR
- Central Research Institute of Social Hygiene and Public Health, Moscow, USSR
- Ministry of Health, Sofia, Bulgaria
- Human Resources Research Center, University of Southern California, Los Angeles, California, USA
- Operational Research Unit, Department of Health and Social Security, London, UK
- South Western Regional Health Authority, Bristol, UK
- World Health Organization, Geneva, Switzerland

## Task 3: MANPOWER ANALYSIS (1980-1985)

### OBJECTIVES AND EXPECTED RESULTS

Sharply reduced rates of population and industrial growth have been projected for many of the developed economies in the 1980s. In economies that rely primarily on market mechanisms to redirect capital and labor from surplus to deficit areas, the adjustments may be slow and socially costly. The more centralized economies may face increasing difficulties in determining investment allocations and inducing sectoral redistributions of a nearly constant or diminishing labor force. Both types of system may have functioned more smoothly in the past two and a half decades, when the number of new entries into their labor forces usually substantially exceeded the number of retirements, permitting some sectors and regions to decline rather painlessly, while expansion of others was nourished by the flow of new workers.

At the same time that developed nations face these internal labor adjustments, they are also experiencing extraordinary shifts in patterns of world trade and industrial development. Energy price increases and changes in exchange rates are having substantial impacts on sectoral and regional demands for labor within nations as they alter the competitive positions of various industries. Meanwhile, economic expansion of less developed nations and shifting trade patterns among the developed nations have opened and will continue to open new export opportunities for some sectors within developed nations, while reducing production and trade opportunities in other sectors. Such changes in world trade could exacerbate or mitigate adjustments to reductions in population growth, but little is known about the interactions of these forces.

The goal of the Manpower Analysis Task is to study such interactions and develop methods for analyzing and projecting the impacts of national and regional population dynamics on labor supply, demand, and productivity in the more developed nations. Initially, work at the national level will focus on the US economy, whereas work at the regional level will examine the Nordic urban labor markets. Collaboration with the Industrial Development Task is anticipated in both activities.

Expected Results 1981

- o A disaggregated national model of labor supply and unemployment for the US and one other economy to be selected
- o Further work on the Finnish urban labor market model and its extension and application to other Nordic countries

The former activity will be carried out in collaboration with the System and Decision Sciences Area; the latter topic will be studied jointly with the Area's Urban Change Task and the Regional Development Task.

Expected Results 1982-1985

- o A model describing the dynamics of changing population compositions and retirement patterns in near-zero-growth populations and their consequences for the service sector
- o A study of contemporary socioeconomic influences on labor force participation, the changing role of women, and recent shifts in people's attitudes toward work and their consequences for labor productivity
- o Effects of shifts in industrial structure on employment patterns

ACTIVITIES

Point of Departure

In collaboration with the Economic Modeling Task of the System and Decision Sciences Area, research has been taking place on an aggregative model of US economic growth that incorporates influences of population and its structure on labor supply, productivity, real wages, unemployment, and GNP. The model has been used to make annual projections of these key variables, conditional on population development, to the year 2000. Applications of the structure and methodology of this model to other nations have been initiated, including a survey comparing patterns and determinants of labor force participation and working hours across developed nations. The model has also been extended to account for economic influences on birth rates and for the interdependence of fertility and female labor force participation.

In collaboration with a group of economists at Tampere University in Finland, considerable progress has been achieved in constructing a Finnish urban labor market model that considers the impacts of migration, labor market disequilibrium, and production.

Activities 1981

In 1981 the national US model will be completed and another national case study will be started. The Finnish model will be applied to other Nordic countries. New elements, such as changing industrial specialization and strategy arising out of Norwegian oil production, will be introduced in the Nordic labor market model and will reflect the free movement of production factors among these countries.

The effects of international migration will be examined in both the US and the Nordic studies.

Activities 1982-1985

With the conclusion of the national and urban labor market modeling efforts, the activities of this Task will turn to an examination of service sector problems arising out of shortages of manpower in near-stationary national populations and the impacts of changing socioeconomic influences on labor supply and productivity.

TASK RESOURCES

Funds and Person-Months

| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | - | 0.6 | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 7.6 |
| Person-months | - | 8 | 19 | 16 | 16 | 16 | 16 | 91 |

Internal Collaboration

- o System and Decision Sciences Area, Task 2
- o Industrial Development Task
- o Regional Development Task

External Collaboration

- o Tampere University, Tampere, Finland
- o Department of Economics, Northwestern University, Evanston, Illinois, USA

## Task 4: URBAN CHANGE (1979-1985)

### OBJECTIVES AND EXPECTED RESULTS

Recent urbanization patterns have been characterized by a particular form of polarization. In the highly urbanized countries, the large urban agglomerations are either experiencing absolute population decline or are growing at rates lower than those of smaller settlements. These trends are related to declining rates of national population growth, intersectoral economic change, and interregional shifts in the migration of people and jobs. In the case of the less developed countries, on the other hand, the increase in the size of the urban population not only continues to be rapid but also is continuing to be concentrated in a few large urban centers. Associated with these trends are major sets of settlement policy questions, the one revolving around the so-called metropolitan maturity and the other around excessive urban expansion and primacy. In addition to the specific problems of growth and contraction, large cities also share common concerns relating to their declining internal manageability, such as the problems connected with the increasing costs of spatial interaction (including energy costs), and the various quality-of-life, social integration, and urban redevelopment issues.

To address these policy concerns and requirements, the existing models of urban systems need to be extended and reformulated. The objective of this Task is the study of interdependencies between economic, demographic, and spatial dimensions of urban systems evolution, and the development of demoeconomic models that forecast and simulate alternative patterns of urban change. The consequences for such patterns of alternative scenarios of global, regional, and industrial development will also be explored.

### Expected Results 1981

- Development of alternative demoeconomic theories of urban change and their application
- Reformulation and extension of theories of intra-urban systems
- Extension of the case studies on Sweden (on industrial development and regional-urban change), and Poland (on interurban population flows); exploratory development of case studies for the US, USSR, UK, the Netherlands, GDR, and Canada.

Expected Results 1982-1985

- Completion and application of demoeconomic models of urban change
- Conclusion of national case studies on urban-regional change
- Merger of the Urban Change Task with the Population, Resources, and Growth Task to produce a global assessment of human settlement developments, their consequences, and their resource and service demands

ACTIVITIES

Point of Departure

The Urban Change Task builds on the results of previous Tasks on Human Settlement Systems and Migration and Settlement, incorporating the empirical findings of the former and the methodology of the latter. Drawing on the complementary nature of these earlier Tasks, it is elaborating a new analytical focus on urban-metropolitan changes. The international network of collaborating scholars and institutions established by the two previous Tasks has been maintained and strengthened, and an exchange of data, models, and experiences has begun. The Urban Change Task has been partially supported by external funds (ICSAR project: Industrial Location and Regional Urban Change).

The effect on urban areas of changes in the location of production activities and population is being studied. More specifically, the following research questions are being addressed: (a) changing intersectoral proportions and locational requirements of individual economic sectors as determining factors in the evolution of urban systems, (b) the effect on the structure of urban systems of the evolution of fertility and mobility at the national and regional scales, and (c) adjustments of urban spatial structures to changing economic, technological, and social requirements (including the redistribution of jobs and changes in household size and composition and in housing demand).

The Task continues to focus on three forms of studies:

- Studies of urban changes arising from the interrelations between the national urban economy and the rest of the world (together with the Global and Industrial Development Tasks)
- Studies of urban changes attributable to demographic and economic interactions among urban regions (together with the Regional Development Task)
- Studies of the evolving internal organization of urban areas (together with the Public Facility Location Task)

Activities 1981

Work will continue to focus on settlement dynamics, giving special emphasis to migration, labor force composition, and education. It will draw on the studies of the anatomy of population flows and employment change carried out within the national case studies. Simulations of the impacts of intersectoral changes on urban-industrial specialization and population flows will be pursued, along the lines of the Swedish case study. In addition, the international review, assessment, and development of models of intraurban systems will be continued. A conference on urban development, sponsored jointly with the Population, Resources, and Growth Task, is planned for the month of June.

Activities 1982-1985 (after merger with the Population, Resources, and Growth Task)

Extensions and applications of analyses of settlement dynamics will be undertaken; efforts will be made to include resource and service demand submodels for health, manpower, and housing. Attempts will also be made to establish links between national-, regional-, and intraurban-scale human settlement studies. Applications to individual case studies will require the inclusion of alternative institutional frameworks. The research will be carried out in collaboration with the System and Decision Sciences Area, the Regional Development Task, the Manpower Analysis Task, and the Public Facility Location Task. After merger of the Task's activities with those of the Population, Resources, and Growth Task, a global assessment of settlement models and settlement change will be carried out, following the outlines of the UN Habitat Conference of 1976.

TASK RESOURCES

Funds and Person-Months

| | 1979[a] | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | 2.0 | 2.0 | 2.5 | (2.5) | (2.5) | (2.5) | (2.5) | 6.5 (16.5)[b] |
| Person-months | 35 | 40 | 53 | (40) | (40) | (40) | (40) | 128 (288)[b] |

[a]Expenditures.

[b]Merged with Population, Resources, and Growth Task.

Internal Collaboration

- o System and Decision Sciences Area, Task 2
- o Global Development Task
- o Industrial Development Task
- o Regional Development Task

External Collaboration

- o Institute for Geography and Geoecology of the Academy of Sciences of the GDR, Leipzig, GDR
- o Gakushuin University, Tokyo, Japan
- o Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warsaw, Poland
- o All-Union Research Institute of Systems Studies, Moscow, USSR
- o Stockholm School of Economics, Stockholm, Sweden
- o Department of Geography, University of Leeds, Leeds, UK
- o Department of Town Planning, University of Wales, Cardiff, UK
- o The Urban Institute, Washington, DC, USA
- o Center for Demography and Ecology, University of Wisconsin, Madison, USA
- o Faculty of Economic Research, Free University, Amsterdam, the Netherlands
- o Faculty of Economic Research, Erasmus University, Rotterdam, the Netherlands

## Task 5: POPULATION, RESOURCES, AND GROWTH (1977-1985)

### OBJECTIVES AND EXPECTED RESULTS

What are the probable resource and service demands caused by urban growth over the next 30 to 50 years in the more and the less developed countries? How important will urban population growth be relative to urban economic growth as a generator of increased demand? To what extent would urban management problems be eased by reduced urban growth rates? Such questions are part of a larger question of whether population increase will outstrip the growth in food supplies and exhaust the stock of natural resources.

A fundamental problem confronting mankind is that of attaining a balance between population and food. The Population, Resources, and Growth Task is studying the process by which urbanization and economic development affect food demand, and how, in turn, alternative agricultural policies influence urbanization and development. The evolution of a primarily rural agrarian economy into an urban industrial-service economy is being examined using data from several country case studies. The initial focus has been on spatial population growth and economic development; the implications of population growth, urbanization, and economic development for resource/service demands will be studied in the latter stages of the research.

### Expected Results 1981

- Numerical estimation of national models and simulation of urbanization and development in Mexico, Poland, Sweden, Japan, and Kenya
- Quantitative assessments of current global patterns of urban growth and urbanization

### Expected Results 1982-1985 (after merger with the Urban Change Task)

Demands for resources and services increase with economic development and growing affluence as well as with population growth. The Task will examine the relationship between resource/service demands and population and economic development, focusing in particular on land, energy, water resources, and health and educational services. For this examination we will

- Develop a model of the interdependence between population, development, and resource/service demands
- Apply this model in several national case studies

Finally, building on the national case studies, a global assessment of urbanization and economic development and demands for resources and services will be carried out in 1982 and 1983.

## ACTIVITIES

### Point of Departure

During 1978, case studies of urbanization and development were initiated for Mexico, Poland, and Kenya. The Swedish case study was started in 1979, and the Japanese case study in 1980. A task force meeting on general equilibrium modeling was held in 1980, with the support of the System and Decision Sciences Area and the Regional Development Task. Preliminary versions of demoeconomic models for Mexico and Poland have been developed, and a detailed study of rural-urban migration and economic development in Kenya is in press.

A report on the interdependence between technological change in agriculture and rural-urban migration has been published. Important contacts have been made and maintained with groups doing similar or complementary work in the International Labour Organization, the World Bank, the Population Council, the Mexican Ministry of Human Settlements, the Institute of Econometrics in Katowice, Poland, and the Food Research Institute at Stanford University in the US.

### Activities 1981

In 1981 the final estimations will be carried out on national models of urbanization and economic development. The interactions between rural-urban migration and technological changes in agriculture that were examined in 1979 and 1980 will be incorporated into the national models. The final reports on the Polish and Swedish case studies will be presented to the respective authorities. Work on resource and service demands will commence. A conference, jointly sponsored with the Urban Change Task, focusing on global patterns of urban development will be held in the month of June. Following this event, work at the global level will commence in anticipation of the planned merger of this Task with the Urban Change Task in 1982.

### Activities 1982-1985 (after merger with the Urban Change Task)

Research on urbanization and resource/service demands, started in 1981, will continue. A resource/service-demand model will be linked to the demoeconomic model. This work will be carried out in collaboration with the Resources and Environment Area.

TASK RESOURCES

Funds and Person-Months

| | 1977-1979[a] | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | Through 1985 |
|---|---|---|---|---|---|---|---|---|
| AS (millions) | 6.97 | 2.5 | 2.5 | (2.5) | (2.5) | (2.5) | (2.5) | 11.97 (21.97)[b] |
| Person-months | 118 | 40 | 39 | (40) | (40) | (40) | (40) | 197 (357)[b] |

[a]Expenditures.

[b]Merged with Urban Change Task.

Internal Collaboration

- o System and Decision Sciences Area, Task 3
- o Regional Development Task

External Collaboration

- o Ministry of Human Settlements, Mexico City, Mexico
- o College of Mexico, Mexico City, Mexico
- o Institute of Econometrics, Academy of Economic Science, Katowice, Poland
- o Stanford Food Research Institute, Stanford, California, USA
- o Department of Economics, Duke University, Durham, North Carolina, USA
- o Stockholm School of Economics, Stockholm, Sweden
- o Institute of Economics and the Organization of Industrial Production, Novosibirsk, USSR
- o International Labour Organization, Geneva, Switzerland
- o The World Bank, Washington, DC, USA
- o Population Council, New York, New York, USA

APPENDIX: The Human Settlements and Services Area's International Advisory Committee


Prof. Mark BLAUG
Research Unit in the Economics of Education
University of London
Institute of Education
Malet Street
London WC1E 7HS
UK

Prof. Kazimierz DZIEWOŃSKI
Institute of Geography and Spatial Organization
Polish Academy of Sciences
Krakowskie Przedmieście 30
00-927 Warsaw
POLAND

Dr. William GORHAM
President
The Urban Institute
2100 M. Street, NW
Washington, D.C. 20037
USA

Prof. Koichi MERA
Institute of Socio-Economic Planning
The University of Tsukuba
Sakura, Ibaraki 300-31
JAPAN

Prof. Theodore W. SCHULTZ
Department of Economics
The University of Chicago
1126 East 59 Street
Chicago
Illinois 60637
USA

Prof. Walter STÖHR
Interdisciplinary Institute for Urban and Regional Studies
University of Economics
Hasenauerstrasse 42/8
A-1180 Vienna
AUSTRIA

Prof. Dr. Horst STROBEL
University for Transport Studies "Friedrich List"
Friedrich List Platz 1
801 Dresden
GDR

Dr. Léon TABAH
Director
Population Division
United Nations
New York, New York 10017
USA

Dr. Dimitri VENEDICTOV
Deputy Minister of Health
Rachmanovski per 3
Minzdraw
Moscow
USSR

Prof. Tatiana ZASLAVSKAYA
The Institute of Economics and Industrial Management
The Siberian Branch of the USSR Academy of Sciences
Novosibirsk 630 090
USSR