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'79 THREE

Regional Development – A Global and National Policy Problem

Å.E. Andersson*

One of the most important of all regional problems is worldwide real income inequality. The world seems to be in a permanent state of unequal distribution of consumption possibilities between macroregions like Europe, North America, Japan, Australia and New Zealand, and the CMEA region, on the one hand, and the mainly tropical and subtropical regions, on the other.

Regional inequality has been the focus of political and scientific discussions during the last decade. The problem is illustrated in Table 1, adapted from Leontief's UN study of the future of the world economy.

The data in the table indicate that the richest region of the world, North America, has a per capita income approximately 38 times higher than the per capita income of the poorest region, Rest of Asia. The table also shows that the *richest quarter of the world's population controls more than three-quarters of the world's purchasing power.*

Regional Equality through Automatic Adjustment or Planning

Will this difference in standard of living decrease automatically with current national policies of economic growth, or is there a need for systematic policy-induced interregional redistribution of resources? Regional economic theory does not provide a clear answer to this question. The answer depends on what paradigm is chosen as a starting point of the analysis.

Three paradigms are most often used as the bases of regional model building. The first one – the neoclassical paradigm – claims that there must, in the long run, be a steady decrease in the interregional inequality of standard of living. This is a consequence of reallocation of factors of production, through migration of labor and through trade in commodities and information.

The second paradigm – dynamic input–output theory in the Leontief or von Neumann tradition – would rather claim that economic growth can never solve the problem of interregional inequality. The most to be expected is a convergence of the growth rates of per capita income. This analysis suggests that there is indeed a need for international intervention in order to generate a global equalization of the standard of living.

A more empirically oriented paradigm, sometimes called "the theory of development stages," claims that, in the process of economic growth and development, there would be three stages of development of interregional inequality (Williamson 1965). At the first stage

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*Professor Åke E. Andersson of the University of Gothenburg, Sweden, joined IIASA's Regional Development Task in June 1978.

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of development, there would be an increasing inequality (as measured, for example, by a weighted coefficient of regional variation). A second stage would be characterized by stagnant inequality at a high level, to be followed by a third stage of neoclassical convergence of the standard of living in different regions.

Williamson used temporal statistical material from a set of completely different countries and also an international cross section of countries to substantiate his claim that interregional inequality follows an inverted U-shape through a development path that might cover tens of decades.

For the international policy maker, both the paradigm of dynamic input–output theory and Williamson's studies present an exceedingly pessimistic picture, unless new and efficient institutions for interregional redistribution of resources and purchasing power can be developed. Even the neoclassical theory, with its convergence implication, brings little comfort to the impatient policy maker, because nothing can be said about the time it takes to get a substantial convergence of real income per capita.

Thus, irrespective of theoretical paradigms, policy makers are worried about the regional inequality problem at the global level. The demand for a New World Economic Order is a consequence of the inability of the World market system and the current economic planning mechanisms to close the development gap between the rich and poor macroregions of the world.

Much of the research at IIASA is concerned with the development problem in this macroregional perspective. IIASA's population studies, its Food and Agriculture Program, its economic modeling activities, including the studies of international trade and regional growth, are all of great interest in this regard. I believe, therefore, that the Institute and its scholars should emphasize integration of these studies into a major analysis of regional inequalities in the world of today and tomorrow.

Regions	Share of world population, 1970 (%)	Share of world income, 1970 (%)
Developed		
North America	6.3	32.6
Oceania	0.4	1.3
Western Europe (high-income)	7.8	23.2
Japan	2.9	6.1
Eastern Europe and USSR	9.6	18.5
	27	82
Developing regions with major mineral resources		
South Africa	0.6	0.5
Western Europe (medium-income)	3.0	2.3
Latin America (low-income)	2.5	1.2
Oil-producing Africa and Middle East	3.5	1.1
Tropical Africa	3.9	0.7
	14	6
Developing regions without major mineral resources		
Latin America (medium-income)	5.2	3.5
Africa, arid	3.6	0.8
Asia, centrally planned	22.4	4.2
Rest of Asia	28.3	3.8
	59	12.3

SOURCE: Adapted from Leontief *et al.* (1977).

Table 1. Classification of Regions in the *Future of the World Economy*.

Underdeveloped Regions in Developed Countries

Within the richer nations and macroregions of the world there are pockets of poverty and underdevelopment. Most of these regions with insufficient growth, large unemployment, or simply nationally intolerable poverty are isolated by poor communication and transportation from other, more developed, regions. Sardinia and Sicily in Italy, Northern Ireland, Lapland in Sweden and Finland, and Brittany in France are examples of such dislocated poverty regions in rich countries.

Most regional economists would agree that net productivity of these regions is low because of poor accessibility to local infrastructure, production services, and national and international markets. A study of regional inequalities in the Common Market shows that there is indeed a very strong and statistically measurable relation between distance to the center of European economic activity and regional product per capita (Figure 1).

The coefficient of determination of the regression line shown in the figure is 0.7 when only the distance to the "center of Europe" is taken into account. If the size of the local economy is also taken into account, the determination coefficient increases to 0.8. This simple empirical example indicates that transportation/communication policies must be coordinated with policies for location of production and infrastructure in order to ensure efficiency within regions as well as equality between regions.

Equality problems can be avoided under certain economic policies by transfers of purchasing power to poor regions, direct investments in machinery and buildings for production, or other redistributive measures. The basic problems of regional underdevelopment cannot be solved by these means only, however, as long as the causes of low productivity of these regions persist. Even if the welfare of the low-productivity regions as such is increased, regional underdevelopment remains a problem for the economy as a whole.

IIASA is currently engaged in case studies of regional development of dislocated regions in Bulgaria and Poland and may also undertake a study of development policy problems of Sardinia.

The purpose of these studies is the creation and practical use of an integrated system for regional and sectoral development. The basic approach of these studies is to analyze the development problem in a framework of national and regional policy making. The problems analyzed concern investments in sectors of production, use of energy and other primary resources, interregional location and transportation policies, population development, planning of new and existing towns, and industrial and agricultural complex construction.

Regional and Environmental Studies

The figure shows clearly that certain regions, like Hamburg, have a very high income per capita, compared to regions in their vicinity – for instance, Bremen. Such income differences can be observed in most countries. There are at least two explanations for such anomalies. A higher income per capita can be a sign that the system is not in a population

equilibrium but that there will be a net migration from the area of lower income to the higher income area until the income per capita has been equalized. Such differences in income per capita can thus be used as a predictor of population flows between regions and as a forecasting basis for housing and other city planning activities. It has, however, been argued that the differences in income per capita between certain cities in Europe and the United States are justified and are compatible with a population equilibrium. The differences in incomes are in these cases necessary compensations for lower environmental standards in terms of crime rates, pollution, climatic conditions, and so on. In this way, regional analysis develops into a more general discussion of measurement of welfare and the importance of environmental factors for human well-being.

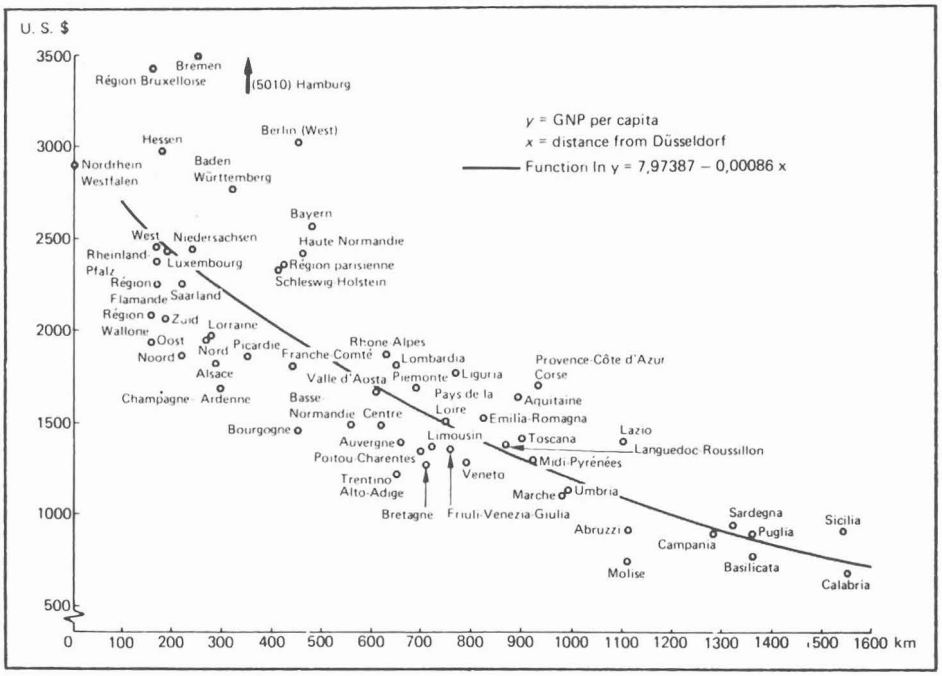

Figure 1. Relation in 1968 between regions' GNP per capita and distance from the high-income center of the EEC (from Biehl *et al*. 1972).

Our case study of Sweden focuses on the trade-off between the economic and environmental goals of policy making. The object of the study, the Skåne region, is comparatively rich, but has a problem of excessive claims on environmental resources like water and land for industrial, agricultural, and outdoor recreation purposes. It is the ambition of the IIASA regional planning studies to find methods to cope with such conflicts between goals of conventional economic planning and those of planning for the environment.

Long-range Development Problems In the Regional Context

Any of the regional development problems must by necessity be solved for very long time periods. Transportation systems, as well as urban infrastructure, are extremely durable and important for the structuring of economic and other social activities. Combined transportation/communication and location policies must therefore cover at least a few decades of the future.

This is one of the real reasons for a systems approach to regional development problems. Regional development problems are essentially dynamic, uncertain, and subject to intricate interdependencies. The most uncertain element of regional analysis is the technological forecasting and policy problem. This is a field where the concerns of the IIASA Management and Technology Area overlap with those of the regional studies.

At the theoretical level, research on the interactions of technological and economic development in the regional context is an important part of the regional studies at IIASA. One of these studies shows how the innovation diffusion phenomena in a regional system interact with the economic growth phenomena to generate an equilibrium between the growth of production and the growth of knowledge in different nodes of a network of regions. This model consists of equations describing industrial capital accumulation, growth of labor and human capital supply, and growth of technological knowledge. The model generates a balanced, stable growth path for all regions and sectors as long as the rate of taxation for R&D purposes and the propensity to invest are positive.

Furthermore, the model also shows that the share of production devoted to R&D must be positive with all standard criteria of optimal development. The optimal R&D share of production depends on the technological level at the outset.

This model has also generated some insight into the problem of long-term development of interregional inequalities, discussed above. The model shows through simulation that if we assume economies of scale in production in conjunction with a regional diffusion process dependent on distance between regions, then the development path must follow the Williamson path, on which inequality between regions first increases and then decreases.

This happens because of an immediate growth effect due to innovations in the regions most centrally located, with the growth rate of the peripheral regions increasing only after a long time lag. The most important factor determining the extent of this time lag is the capacity of the communication system for diffusion of knowledge. This again shows the importance of transportation/communication network planning as a part of regional policy analysis.

Conclusion

On the world scale, regional inequality is immense and permanent. Within each macroregion of the world, even in highly developed Western Europe, regional differences in rate of development are of great importance for policy makers. Methodology must be developed so that regional policy making can cope with the essentially dynamic, uncertain, and interdependent factors regulating economic and technological growth and structural change in regional macrosystems and mesosystems. Systems analysis was developed to cope with just such large-scale policy problems, and in my view IIASA has the international and interdisciplinary staff to do good applied systems analysis on the global and national regional policy problems.

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Big, Small, or Beautiful:

Questions of Scale

M.F. Cantley*

Schumacher's *Small is Beautiful* (1973) passionately questioned the validity of the decision criteria conventionally used by industry and government. His aggressive subtitle was "a study of economics as though people mattered." The accusation was clear: that significant criteria, particularly on the softer and less quantifiable dimensions of human values, were being omitted. To applied systems analysts, concerned to embrace the "total system" viewpoint, the challenge was one to be accepted.

The evidence of inadequate criteria rested on more than vague feelings of disquiet; there have been some obviously bad decisions. In hospitals of over a thousand beds, planners have underestimated the diseconomies not only of internal complexity of administration but of the greater travel and inconvenience costs imposed on patients, their visitors, and staff. Traffic congestion, crime rates, and policing costs rise more than proportionately with increasing size of conurbation. The reliability of large electricity turbine–generator sets has remained substantially poorer than that of smaller units. Nonetheless, the past 30 years have seen increasing attempts to coordinate supranational economic plans, to form multinational free-trade areas, to merge large companies, and in various ways to seek the presumed advantages of larger groupings. Big can be beautiful.

Research in IIASA's Management and Technology Area has, since January 1978, studied the decision-making methodologies in which questions of scale figure significantly. The philosophy of the Area was that this longer term objective should be pursued through specific case studies relevant to it, and these have included electricity generation and ethylene plants. The results arising from these case studies have contributed to a systematic review of the general subject of scale, which culminated in the June 1979 workshop described below.

Levels of Scale

Fundamental to a discussion of scale effects and alternatives is the distinction between different *levels*:

1. The *unit* or *engineering* level of individual pieces of physical equipment
2. The *plant* level (coinciding with level 1 in the case of the "single-train" plant)
3. The *organization* level, such as the multiplant firm or corporation
4. The level of national economic programs and industrial complexes — the *"co-operative"* level

Finally, there is the "level" of the "relevant context" within which decisions on the scale of major organizations or national programs are set. This level merits particular attention in situations where, in a country of small or medium size, economies of scale in an established industry are gradually forcing it to concentrate and rationalize into one or two plants — plants that are still smaller than those in the largest industrially developed countries. Thus a plant may be simultaneously large in relation to its context (with consequent risks of "all eggs in one basket") and yet smaller than the most efficient size. The option of allowing the country's capability to be extinguished, and relying totally on imports, is not a decision to be taken lightly, whether deliberately planned or left to market forces. Figure 1 illustrates this phenomenon for the case of ethylene plants in Canada compared with those in the United States.

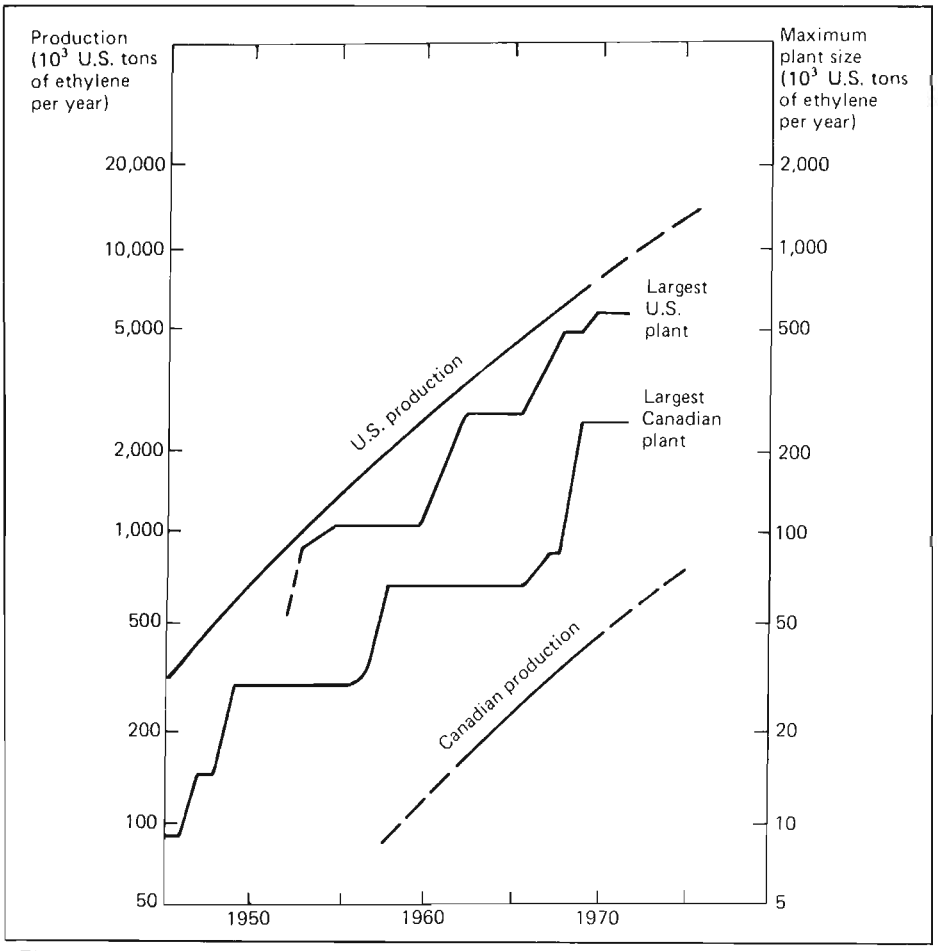

Figure 1. Growth in scale of ethylene production and maximum plant size, United States and Canada. In 1970, for example, largest Canadian plant size (250,000 tons) is 50 percent of Canadian production (500,000), but U.S. plants of 600,000 tons account for less than 10 percent of U.S. market. (Adapted from Simmonds, W.H.C. 1972. The analysis of industrial behavior and its use in forecasting. Technological Forecasting and Social Change 3:205–224.)

Factors of Scale and Disciplinary Approaches

Systems analysis naturally aspires to a greater degree of comprehensiveness than more specialized disciplines. Factors potentially relevant to the choice of scale may include political, social, economic, technological, organizational, managerial, and financial considerations. These terms overlap one another, and they also indicate the range of potentially relevant disciplines. Their relative significance will vary not only from case to case, but with the level of scale decision considered. What has become clear from our researches is the risk inherent in unidisciplinary approaches to scale decisions. As Bela Gold expressed it, in a classic study of Japanese blast furnaces:

> Actual scale adjustments cannot be adequately evaluated within the limited perspectives provided by prevailing economic theory or common engineering approaches. . . . More penetrating analyses of past or prospective decisions involving changes in scale would seem to require a broader

*Mark Cantley came to IIASA's Management and Technology Area from the Department of Operational Research of the University of Lancaster in January 1978. At IIASA his work focused on practical management projects in collaboration with other IIASA areas and with external organizations.

exploration of the relationships between the array of expected benefits and burdens of scale adjustments and the array of basic managerial objectives.

In every discipline reviewed — engineering, industrial economics, organization theory, the study of human settlements, control theory, and general system theory — questions of what constituted appropriate scale, or how to manage larger scale systems, featured significantly as important and unresolved problems.

Even within such an apparently long-established field for economies of scale as electricity generation, it became evident in studying recent research and data that serious misjudgments have been made. The nature of these, and the reasons for them, have an importance transcending the specific industry. Several points emerged.

Electricity Generation

The engineering successes in the evolution of designs of boiler—turbine—generator sets, as they were scaled up from 20 megawatts capacity in the mid-1940s to over 1,000 megawatts today, had led to widespread confidence in the continuing advantages of increased scale. Progress was always a matter of overcoming some technical constraint, such as transport problems, strength of materials, rate of heat dissipation, or precision of component manufacture or alignment. This belief ignored the interaction with three gradually increasing diseconomies of scale. First, the engineering cost of plant is by no means the total capital cost of a power station: the construction time has increased, particularly as the move to very large units of plant increases the amount of site fabrication, leading to greater accumulated financial charges before the plant starts to earn revenue. Second, the more intense demands on materials and components, the greater length of boiler tubing, increases the probability of breakdown, thus reducing effective available capacity. Third, the greater time lags required in planning giant plants mean that forecasts have to be made further ahead, with correspondingly greater uncertainty; therefore the level of spare capacity to be installed to achieve a specified level of security of supply must also increase.

Ethylene Plants

Some similar effects were found in the study of ethylene plants, which in the environments of the market economies had the additional complications of strong competitive interactions. Technically, the growth in scale of plants from 30,000 tons/year of ethylene to twenty times this size has yielded great economic improvements, where the plant could be fully loaded. However, cyclical economic fluctuations would lead producers to similar decisions at similar times, causing prices to slump until market growth restored utilization levels. The instability of this system was heightened as plant capacities increased and market growth leveled off; only the stock of older, smaller plants that could be closed enabled the slack to be more smoothly absorbed for a time.

The rapid increase in hydrocarbon feedstock price and the problems of securing assured supply have demonstrated how far outside engineering technicalities the question of plant scale reaches. Moreover, ethylene differs from electricity in that its demand is directly dependent on the demand for its hierarchy of derivative products. The shift to heavier feedstocks, with a correspondingly increased range of co-products, has meant that a much more tightly connected problem has to be solved: feedstock availability, plant design optimization, and the finding of market outlets for the various co-products. Moreover, on top of the general escalation of plant and construction costs, the capital equipment to produce these co-products has meant a great increase in the financial scale of a complete naphtha-based olefins complex, and there are good synergistic reasons for pairing such a plant with a refinery. The developing scale of ethylene plants has thus led to a situation in which the financial, supply, and marketing factors referred to require consortial arrangements between even very large companies. The scale of capital investment, direct and associated, has brought the plant decisions into a major role in national industrial strategy. Plants outgrow the financial capabilities of companies, markets outgrow the capacity of national boundaries; it is unlikely that anyone will again build in Western Europe a plant with a capacity of over 500,000 tons/year.

"Connected" Environments

These qualitative changes resulting from the quantitative growth of scale are not, of course, unique to petrochemicals. In many major industries, the relevant environment becomes more "tightly connected," with a declining number of major organizations becoming increasingly interdependent. Emery and Trist (1965) have described the characteristics of such "turbulent fields," which appear as the inexorable outcome of growth in organizational scale. Similar phenomena are observable in the fields of international trade and finance. Since the industrial products characterized by the greatest scale economies account for a much larger proportion of international trade (in manufactures) than of total output, the effects of scale have a direct connection with the international financial system.

Such "connectedness" is characteristic of "global" problems, which IIASA has studied in both physical contexts, such as the atmosphere, and economic contexts, such as world trade and energy supplies. More industry-specific studies depend on the establishment of appropriate contacts with scientists and policy makers in particular industries, and this is one direction of future work in the Management and Technology Area.

The June 1979 Workshop: Dynamic Scale

The diversity of aspects of scale problems was illustrated by the June 1979 workshop, "Size and Productive Efficiency: — The Wider Implications." A stated objective of the workshop was to generate suggestions on specific questions for further research. However, the range of subjects brought out (by the papers presented and the lively discussion periods) broadened rather than narrowed the potential field.

In particular, the growth in scale of organizations within a specific field, often associated with growth in plant and unit scale of the technology, was seen in a dynamic context by many participants. *Cumulative*, or *dynamic*, scale has been well documented by researchers into "learning curves" in several industries: technical performance can be improved in an apparently predictable pattern by the buildup of cumulative experience. Such an effect has implications at levels ranging from the setting of cost standards to corporate strategy, national policy on monopolies and mergers, and international technology transfer. At the workshop itself, confusion sometimes resulted from failure to specify or describe the mechanisms by which learning could occur, or indeed what "level" of scale was being referred to: a confusion which led Bela Gold to the sharp enquiry, "Who learns what?"

This question, in the context of theories of learning curves, itself merits further research. It illustrates only one of the several possible directions in which future work is required. At present, scale-related studies are continuing in the steel industry, and in electricity generation, with emphasis on co-generation of heat and electric power. More work is needed on organizational aspects. We are still a long way from knowing how to determine appropriate scale in a given case; what is clear is that "beauty" — be it of "big" or "small" — is often only skin deep.

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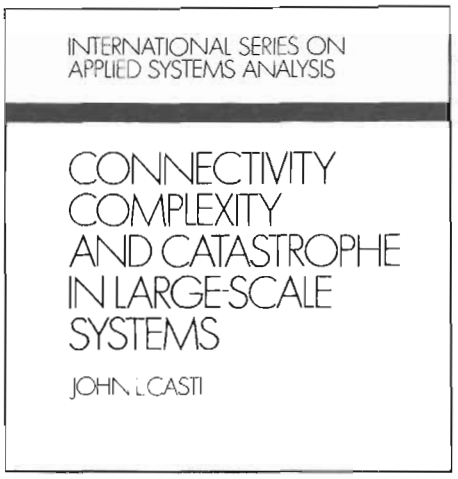
New Books from IIASA



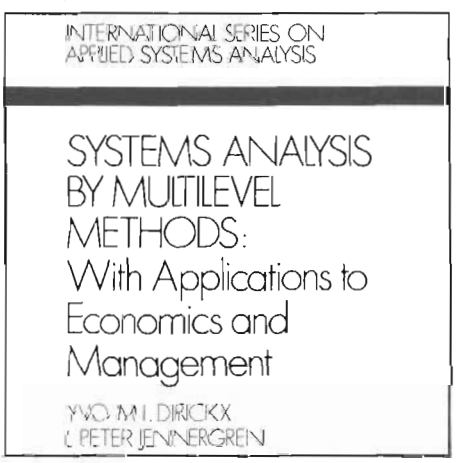
Multilevel Decision Problems

Systems Analysis by Multilevel Methods: With Applications to Economics and Management, by Yvo M.I. Dirickx and L.P. Jennergren, surveys the available and usable methods for modeling and solving multilevel decision problems in economics and management. These methods are principally extensions of linear programming, using column-generation and decomposition procedures.

After presenting the methods, the book describes cases in which these methods have been used in national and regional economic planning (in Hungary and Mexico in particular), in planning production and sales programs in corporations (in a slaughterhause and a paperboard factory in particular), in operations planning for production, in distribution systems, in freight-ship route scheduling, in electricity generation, and in water-pollution control.

The book concludes with an evaluation of these methods based on the cases it has considered.

Systems Analysis by Multilevel Methods: With Applications to Economics and Management, by Yvo M.I. Dirickx and L.P. Jennergren, ISBN 0 471 27626 X, may be ordered from John Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England. The price is U.S.$39.00.



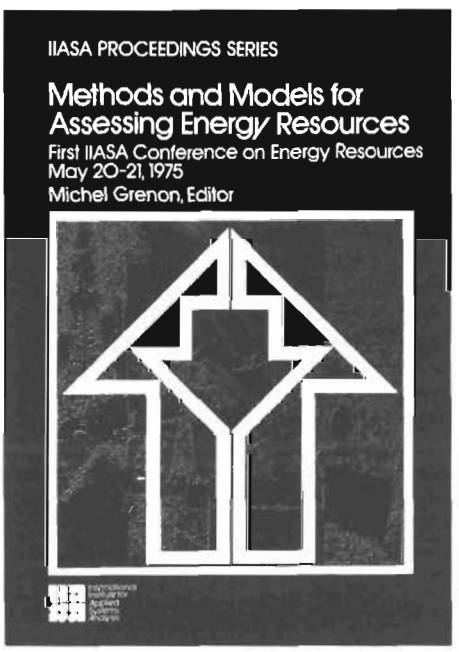
Large-Scale System Modeling

Connectivity, Complexity, and Catastrophe in Large-Scale Systems, by John Casti, presents an approach to large-scale system modeling that is a challenging synthesis for the systems analyst, the operations research worker, the systems theorist, the policy analyst, and the student of social systems.

After pointing out that the mathematical form of a system description dictates the types of questions that can be asked and answered by the model, the author declares that "there is no such thing as the model of a system: there are many models, each with its own characteristic mathematical features and each capable of addressing a certain subset of important questions about the system and its operation." The book supports this point with examples from a wide range of contexts (such as physics, economic activity, water-resource management, ecology, transportation, and physiology) viewed from the points of view of various models and theories (such as general system theory, control theory, graph theory, linear and nonlinear system theory, and catastrophe theory).

Against this broad background, the book then considers in depth the relations to large-scale systems of the theories of connectivity, complexity, stability, catastrophe, and resilience.

Connectivity, Complexity, and Catastrophe in Large-Scale Systems, by John Casti, ISBN 0 471 27661 8, may be ordered from John Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England. The price is U.S.$34.50.



The Coal Option

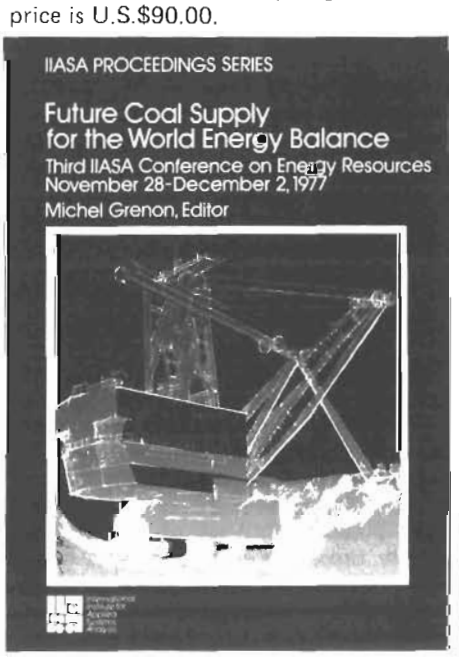
Coal was the focus of the Third IIASA Conference on Energy Resources, organized in Moscow in late 1977 with the help of our Soviet NMO (see OPTIONS 78/Winter). The Proceedings of the meeting, *Future Coal Supply for the World Energy Balance*, edited by M. Grenon, provide an overview of present know-how on global coal resources as well as on mining, gasification, and transportation technologies. In addition to the technological and economic aspects, the conference dealt with the national, international, and global coal policy problems we may be facing in the future.

Future Coal Supply for the World Energy Balance, edited by M. Grenon, ISBN 0 08 023437 2, can be ordered from Pergamon Press, Headington Hill Hall, Oxford OX3 0BW, England. The price is U.S.$75.00.

Energy Resources

Methods and Models for Assessing Energy Resources, edited by M. Grenon, the Proceedings of the First IIASA Conference on Energy Resources held at Laxenburg in May 1975, is a re-publication of our Collaborative Publication CP-76-4. This meeting, first in the series of conferences on resources organized by Professor Grenon, brought together some 100 specialists and was devoted to a number of general problems (including the key problem of resource terminology and classification) and included three other main sessions on conventional energy resources, namely coal, conventional hydrocarbons, and uranium.

Methods and Models for Assessing Energy Resources, edited by M. Grenon, ISBN 0 08 02443 2, can be ordered from Pergamon Press, Headington Hill Hall, Oxford OX3 0BW, England. The price is U.S.$90.00.



News from IIASA

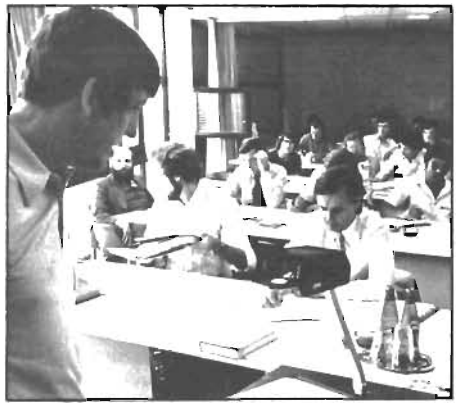
First IIASA Short Courses

In September, 1979 the Institute initiated a venture into the field of education by organizing two IIASA Short Courses. These short courses bring together specialists and users from the relevant disciplines and fields of activity to familiarize them with new methodologies and approaches developed at IIASA.

The first short course focused on "Migration and Settlements." It was organized by Dr. Frans Willekens of the University of Brussels, Belgium, who is a former member of IIASA's Human Settlements and Services Area. 29 scholars and analysts from 14 countries were introduced to the results of IIASA's work on migration and settlement, where a newly developed comprehensive methodology to study the evolution of populations in an interconnected system of regions was applied in different national settings (see OPTIONS 77/Autumn).

These case studies generated comparable information on multiregional population change in the Institute's 17 National Member Organizations' countries. The participants in the course were introduced to the analytical tools developed for this work; as a consequence some participants have already indicated that they intend to teach these new approaches at their home universities.

The second short course, "Management of Energy/Environment Systems," was directed by Professor Wesley Foell, of the University of Wisconsin. It dealt with concepts and methods of importance concerning the Energy/Environment interface, with particular attention to those developed and applied in four case studies carried out at IIASA (see OPTIONS 78/Autumn). These four studies were conducted by an international core team at the Institute working in close collaboration with energy and environmental institutions in the four regions: namely, Austria, the Rhone-Alpes in France, the German Democratic Republic, and the state of Wisconsin in the USA. The aim of this research effort was to develop a systems approach to energy/environment management and policy design within the framework of national and regional planning processes. Many of the studies' results are already being used for exploring alternative energy strategies, e.g. in Austria, the GDR, and Wisconsin. The second IIASA short course was attended by 23 participants from 16 countries. (For a detailed account of this work see *Management of Energy/Environment Systems*, edited by W.K. Foell, ISBN 0 471 99721 8, which may be ordered from J. Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England. The price is U.S.$39.50.)

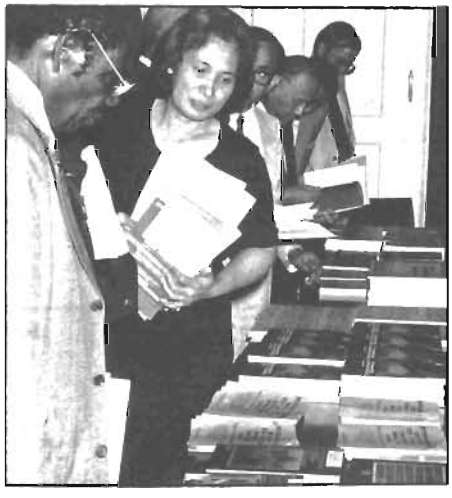


Professor Wesley Foell, IIASA alumnus and author of IIASA's Wiley Series' Volume "Management of Energy/Environment Systems" with his "class" during the Institute's second Short Course.

Although the Institute intends to continue this successful new activity, it has not yet been decided which topics will be taken up by the next IIASA Short Courses.

ACAST and UNCSTD

During August almost 5,000 scientists and politicians gathered in Vienna to attend the "United Nations Conference on Science and Technology for Development" (UNCSTD). In addition to UNCSTD the preceding "International Colloquium on Science, Technology, and Society: Needs, Challenges, and Limitations" of the U.N. Advisory Committee on the Application of Science and Technology (ACAST) took place. A Forum of Non-governmental Organizations and the "Alternative" meeting, that traditionally accompanies major U.N. conferences, were also held. Although many friends of IIASA were active in the UNCSTD and the ACAST colloquium, the Institute was not directly involved in the conference itself, but presented a paper at the ACAST meeting on "Sustainable Energy Supplies for Our World" by B. Spinrad and W. Sassin from the Institute's Energy Program.



For the many visiting groups, IIASA has prepared an information package including a slide show, a tour of the facilities, and a publications display, the latter proving a particular success.

In addition, many of the participants in the meetings visited the Institute. At a major reception IIASA hosted all the participants in the ACAST meeting — over 300 people. A visit to IIASA from members of the Soviet and the U.S. delegations to UNCSTD took place. There were also visits by two groups from the Science and Technology Committee of the U.S. House of Representatives. The Congressmen were particularly interested in the work of IIASA's Energy Program. The Institute also received the members of the Subcommittee for Science and Technology of the Council of Europe, for whom Professor Haefele, Leader of the Energy Program, and Professor Okada, from IIASA's Resources and Environment Area, presented aspects of the work done at Laxenburg. In addition to these groups, many individual visitors came to Laxenburg during this period. For example, IIASA acted as host to Professor N. Papazov, Chairman of the Bulgarian State Committee for Science, Technological Progress and Higher Education, Professor Lakdawala, Deputy Chairman of the Indian Planning Commission, as well as Dr. Wardiman, Assistant Minister at the Indonesian Ministry of State for Research and Technology.

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Conference Report

Pest and Disease Management Join Forces

In fall 1976 the participants in an IIASA meeting on Pest Management initiated the "Pest Management Network," an informal communication system for the exchange of papers and interim research results. The members of this network returned to Laxenburg in October 1979 for a conference on "The Management of Pest and Disease Systems." The conference brought together for the first time specialists from different disciplines. This led to a unique cross-disciplinary encounter: scholars engaged in research on pest control met with plant and human disease specialists. Their independent work had reached a stage of conceptual, mathematical, and experimental development, that made undertaking such a conference worthwhile.

Dr. Gordon Conway of the Imperial College, London, organizer of the meeting, pointed out that the control of pests and diseases affecting men and their crops and livestock is a complex and seemingly never-ending task. Although some spectacular successes have been achieved, due to the mass production of a range of synthetic insecticides, fungicides, herbicides, antibiotics and other medicines, many problems persist.

"Within only a few years the development of resistance, in particular to insecticides and antibiotics, the disturbing effects of pesticides on the natural regulating process of pest populations and the growing evidence of unwelcome side effects from the use of antibiotics and other drugs reminded us that the problems of pest and disease control remained complex. Malaria, for example, once thought to be readily eradicable in large parts of the world and brought very close to this point in countries such as India and Sri Lanka, has resurged with a vengeance, bringing millions of cases in 1978 to India alone," Dr. Conway said.

"The discovery of modern pesticides and drugs and the development of operations research and systems analysis together with an increased interest in the mathematical theory of animal population dynamics and the mathematical theory of epidemics as well as the growth of modern computing facilities made it possible to efficiently model and analyze complex pest and disease systems. This conference at IIASA represents the first occasion on which practitioners in pest management, human disease, and plant disease systems have come together to learn from each other's approaches and techniques," Dr. Conway added.

The participants of this international conference suggested a continuation and expansion of the information network sponsored by IIASA. As in the past, this network should serve as an instrument to exchange papers and new results, as well as helping to further the contacts established between the experts of these various disciplines.

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