IIASA

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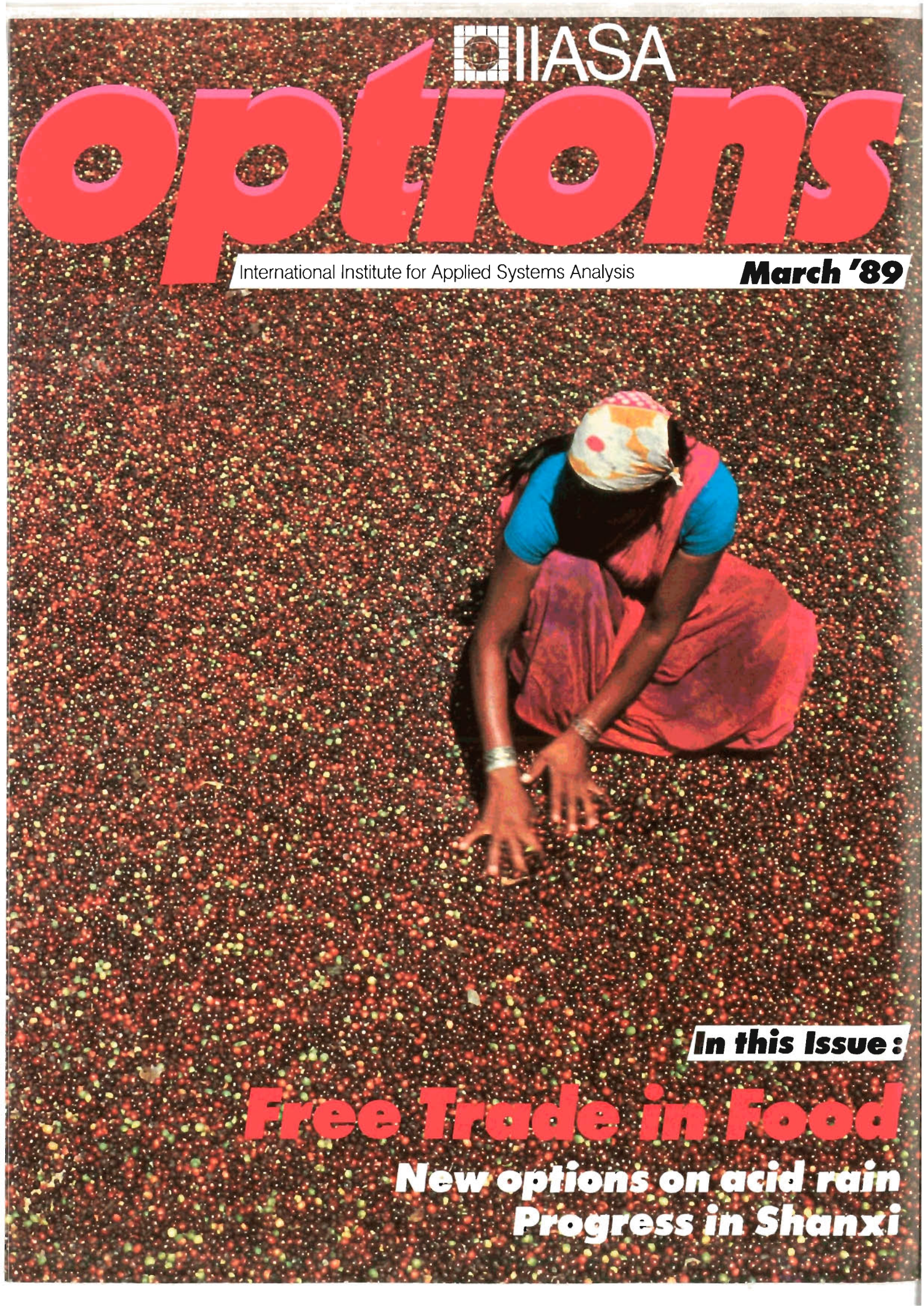
International Institute for Applied Systems Analysis

March '89



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Free Trade in Food

New options on acid rain

Progress in Shanxi

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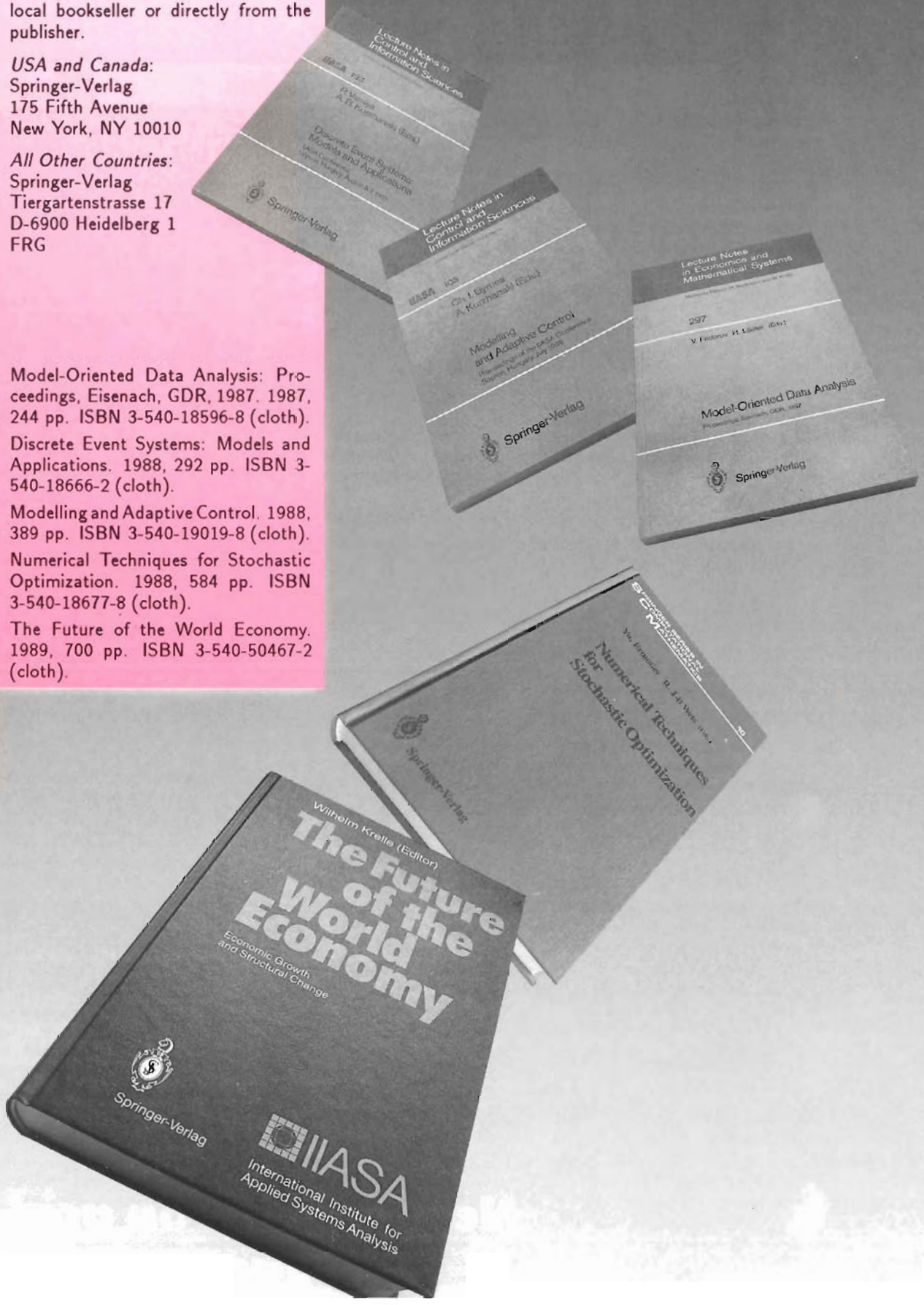

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IIASA is an international research institution, which draws on the scientific and financial resources of member organizations in 16 countries to address problems of global significance.

It has four established research Programs, continually updated to target on emerging issues in areas of major international concern.

* Environment
* Technology, Economy, and Society
* System and Decision Sciences
* Population

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EDITORIAL

The articles in this edition of OPTIONS, the first of 1989, illustrate, above all, the relevance of the Institute's work to important current policy debates. The features on acid rain, methane, and free trade in agriculture are all based on models developed at IIASA that have been used by researchers here and throughout our collaborating organizations to cast new light on major international issues. Several new, viable options for international negotiators are proposed, each supported by detailed evidence on costs, benefits, and distributional effects obtained from scenario analyses. In addition, we report on several new software products, including a set of fully documented prototype decision support sytems that have been developed to a transferable level for field-testing, and a custom-built, prototype expert system developed by IIASA's Advanced Computer Applications Group and recently installed in the People's Republic of China. These examples are further evidence of the Institute's conviction that the principal purpose of applied systems analysis is to provide tools for developing plans and policy options to deal with critical issues.

Robert H. Pry, Director

CONTENTS

FEATURE

Winners and losers from free trade in food

IIASA study yields important findings for GATT negotiators.

Most OECD countries would gain significant economic benefits over the next decade from an agreement to reduce their agricultural tariffs and quotas, but many developing countries would suffer as a consequence, according to results of analyses made using IIASA's global model of food production and trade. The findings have important implications for the soon to-be-held General Agreement on Tariffs and Trade (GATT) Uruguay Round negotiations.

"The clear winners from freer trade in agriculture would be the countries of the European Community, Austria, Japan, New Zealand, and the USA; the results for Canada and Australia are mixed," according to Professor Wouter Tims, IIASA Council Member, and spokesman for the IIASA project team that prepared the 350-page report, *Towards Free Trade in Agriculture*. "The outcomes for developing countries such as Kenya, Nigeria, Argentina, and Thailand are positive, but for others, such as Brazil, Mexico, Egypt, and possibly Indonesia and India, there are significant net losses."

Elimination of Subsidies

The benefits of freer trade in most developed countries would result mainly from elimination of costly subsidies and a reallocation of resources to other sectors of their economies. Any decline in agricultural production and income would be more than offset by gains in these other sectors. Higher world market prices could be a benefit for developing countries that export agricultural products, but would constitute an extra cost to consumers in developing countries that import food.

The report concludes that measures to compensate farmers in OECD countries whose incomes may be reduced by freer trade in agriculture may be "politically necessary" and "socially justifiable." It also recommends that the interests of developing countries should be represented in current GATT Uruguay Round negotiations on agricultural trade policy.

The report assesses impacts to the year 2000 of different scenarios for liberalizing trade in agricultural products. These were developed and tested using IIASA's Basic Linked System (BLS), 34 computer models of national and regional agricultural systems, together covering all the world's nations, linked together through trade and capital transfers.

The issue of agricultural tariffs and subsidies is at the heart of the disagreement among GATT members that resulted in an impasse at the most recent set of negotiations in Montreal at the end of 1988. The GATT negotiations are to resume in 1989.

While hunger and malnutrition are endemic in many countries, the world's granaries are bursting with nearly 400 million tonnes of surplus grain. For rational domestic reasons, national governments collectively spend upward of $120 billion a year perpetuating excess production, compounding the problem of what to do with the surplus.

FAO photo

FEATURE

Proposals range from complete removal of all protective measures over a limited time period to maintaining the current system with minor adjustments.

The liberalization of trade in agricultural products among OECD countries, which are the most highly protected, would have the greatest effect on world agriculture. The probable impacts foreseen by the study within the next decade include:

- WORLD TRADE – The overall price of agricultural products involved in world trade, relative to nonagricultural products, rises by about 10% (US$ 65 billion). Higher prices produce an increase in world agricultural production and trade. Global rice exports, for example, rise by 37%, and trade in animal products rises by 12–35%.
- OECD COUNTRIES – Removing protection generally lowers consumer prices for food, lowers OECD production, and increases demand. Imports from outside the OECD increase to fill the gap. The world market prices of OECD products including cereals, protein feed, and animal products rise by 10–20%, dairy products by 30%. The net result is a gain of 0.57% (US$ 62 billion, 1980 dollars) in Gross Domestic Product for OECD countries by the year 2000, compared with the no-change scenario. This is due mainly to the reallocation of resources away from agriculture into more productive areas of economic activity.
- THE EUROPEAN COMMUNITY (EC) – Increases its overall GDP due to more efficient allocation of resources, and consumers benefit from a significant drop in food prices. The EC generally loses market shares in agricultural exports. Farm incomes decline slightly as the loss in terms of volumes and prices is partly offset by migration of labor from agriculture. The gains in GDP as a result of trade liberalization exceed the income loss of farmers permitting, in principle, measures to compensate them for lower incomes. Such payments, for all EC countries, would be equal to about 0.5% of GNP, significantly below the present budgetary cost of farm support measures.
- JAPAN – Increases imports of all agricultural commodities, including rice. Farm incomes decline, but the loss is offset by increased prices, and out-migration of labor. Gains in GDP are large enough to compensate farmers for lower incomes. The cost of such payment would represent about 1.0% of GDP, much less than current government expenditures on farm support measures.
- CANADA – Reduces its exports of wheat and coarse grains. Under free trade, higher food prices result in a decline of equivalent income. Elimination of dairy quotas in Canada and an open US border lead to a more than doubling of production and Canada becomes a major exporter of dairy products, providing nearly 30% of global exports. Farm incomes improve as a result of generally higher world prices for food.
- INDIA and PAKISTAN – Become exporters of wheat.
- ARGENTINA – Gains significantly from liberalization, expanding production and exports of beef and poultry. Wheat and coarse-grain production decreases. The domestic price of food increases.
- DEVELOPING COUNTRIES – Experience negative effects from higher food prices, since most are dependent upon imports. This results in lower food consumption per capita, producing a rise in the incidence of world hunger. Agriculture is spurred by higher prices in some developing countries. These countries expand production of commodities for export to developed countries.
- THE USA – Benefits from lower consumer prices for food. Exports of wheat and coarse grains dominate the market, with a share of 90% by the year 2000.
- AUSTRIA – Gains in all available indicators, including GDP, value of agricultural products, food prices, and stability of farm incomes. Exports of dairy products increase by 250%. Austrian farmers gain in income. ■

The report Towards Free Trade in Agriculture, *prepared for IIASA by K.S. Parikh, Günther Fischer, K. Frohberg, and O. Gulbrandsen, is published by Martinus Nijhoff Publishers (part of the Kluwer Publishing Group).*

FEATURE

Methane- Bridging the energy gap

Findings from a recently released IIASA study suggest natural gas, methane, may provide an energy bridge to the future, pending longer-term solutions to energy problems. As a result, the Soviet Union may emerge as the prime source of European energy by the year 2030.

An Energy Dilemma

Enhanced awareness of the potentially disasterous ecological impacts of burning fossil fuels has recently refocused world attention on the energy sector.

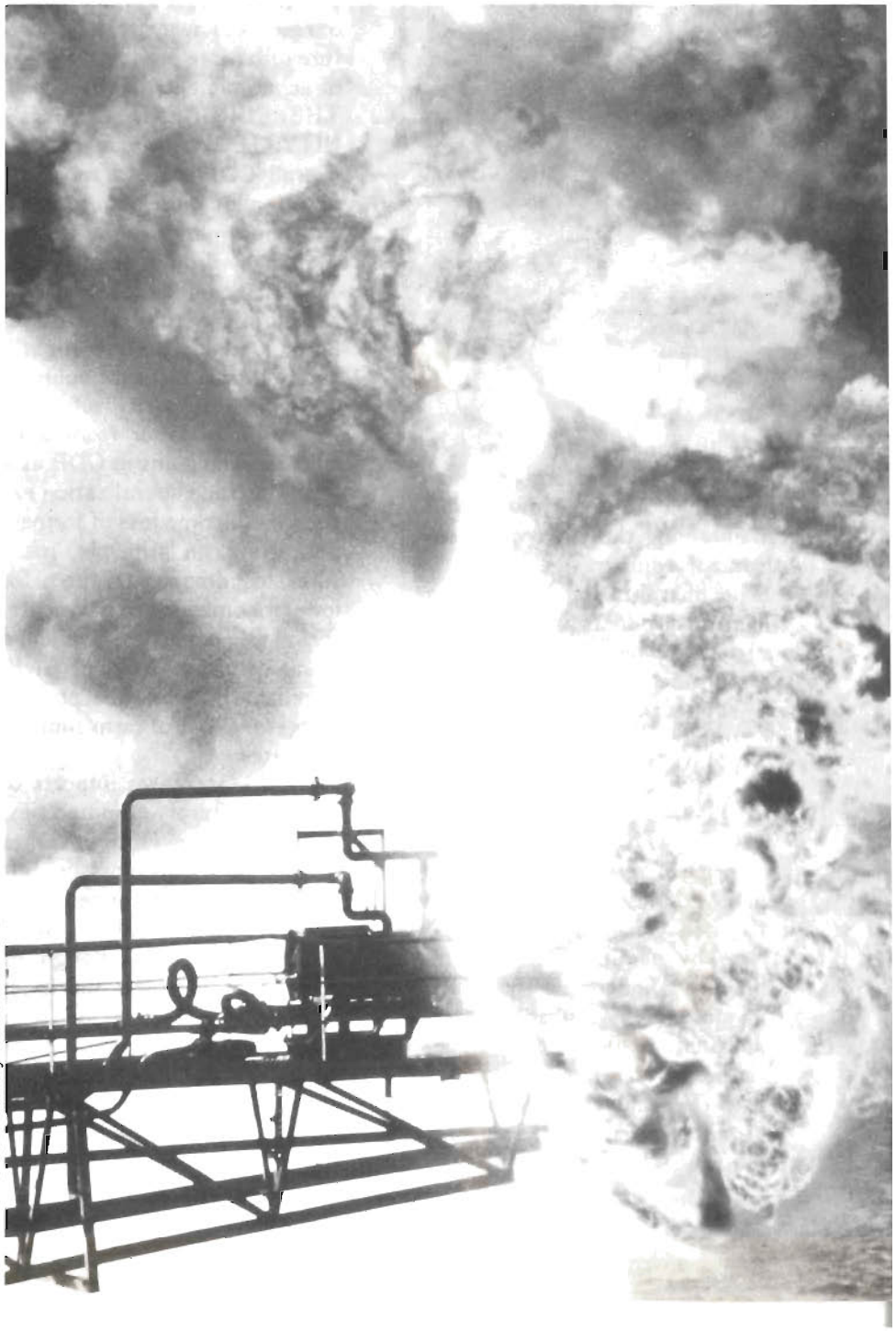
Acid rain (see article titled "Working Together to Reduce Acid Rain") and, more especially, the buildup of CO_2 and other "greenhouse" gases in the atmosphere can be traced directly to our use of fossil fuels.

The search is on to find an ecologically benign, sustainable, and safe energy alternative and, equally important, appropriate usage technologies.

In the longer-term, nuclear energy may hold promise of providing at least part of the solution; but, with questions of risk and waste disposal still unanswered all evidence suggests it is still too young and unproven for large-scale, widespread proliferation. At least for the time being, nuclear technologies remain publicly unacceptable – as referenda in Austria and Sweden demonstrate.

Analyses conducted at IIASA have looked at the penetration rates of past technologies and support this general picture. They show that market penetration curves of successive energies have been remarkably consistent, characterizing the technological, economic, and social constraints involved in achieving transfer from one to the next. The use of coal,

Recent work challenges conventional attitudes and establishes methane as an important energy source in its own right.



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which replaced wood as dominant energy, peaked between 1920 and 1930. In turn, coal gave way to oil. Seen in this perspective, the market penetration of nuclear power to date has been faster than usual, and a temporary hold on further expansion, as is now occuring, is only to have been expected.

A Viable Way Forward

The world thus faces an energy dilemma: it has plentiful reserves of fossil fuels, especially of coal, that for ecological reasons shouldn't be used, but, technologically and societally is unprepared to be committed to a nuclear future.

The results of IIASA's work on methane, recently published in *The Methane Age* and in several reports and journal articles, suggest there is a viable way forward, with natural gas providing a hitherto unrecognized "bridging" energy for the next 50 years. The study findings are backed up by those from the analysis of market penetration rates, which also suggest that gas, rather than nuclear, is the logical successor to oil.

"Natural gas is a practical solution because supplies are abundant; its use releases much less CO_2 than either coal or oil and no SO_2, and the conversion of generating plants from coal to gas can be done quickly and at low cost," says Dr. Hans-Holger Rogner, who has led the methane study at IIASA.

The European Scene

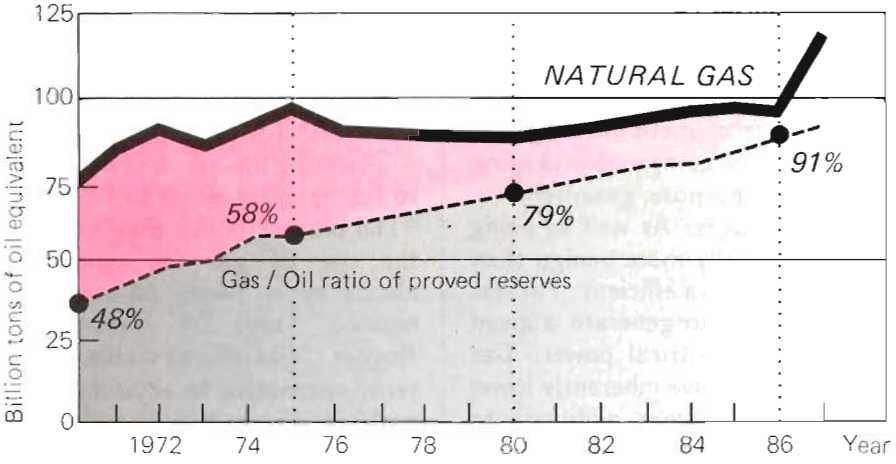
Projections from the study indicate that by the year 2030 the European energy picture will look very different from that proposed by more conventional analyses:

- Natural gas replaces coal and oil as primary source of energy, with a market share of about 30%.
- The Soviet Union becomes a prime supplier of natural gas for Eastern and Western Europe.
- Imports of oil decline by 20%, and the oil market share drops from the current level of 60%, to 25% by the year 2030.
- Coal, a leading contributor to CO_2 and sulfur emissions, declines in use.
- The level of reliance on nuclear energy is lower than present forecasts suggest.

Why do IIASA's projections differ so greatly from those of other studies? Dr. Rogner states: "Most conventional analyses have failed to take account of the youth of the technologies associated with natural gas, which means they have ignored the enormous scope for efficiency improvement that these technologies offer. Also, we've tended to regard natural gas as a scarce and valuable resource – a fossil fuel found only in association with oil. As a result, using gas to generate electricity has been prohibited in several countries, magnifying the apparent transport disadvantages of gas use. In fact, geopolitical factors and government involvement generally have impeded otherwise commercially viable methane projects."

Dr. Hans-Holger Rogner, Leader of IIASA's Natural Gas Study and a key contributor to The Methane Age.

> *"Gas offers a viable, short-term alternative to environmental problems. Governments and industry need to abandon conventional wisdom and practices, and begin to plan on that basis."*



Proven global reserves of gas have increased relative to those of oil.

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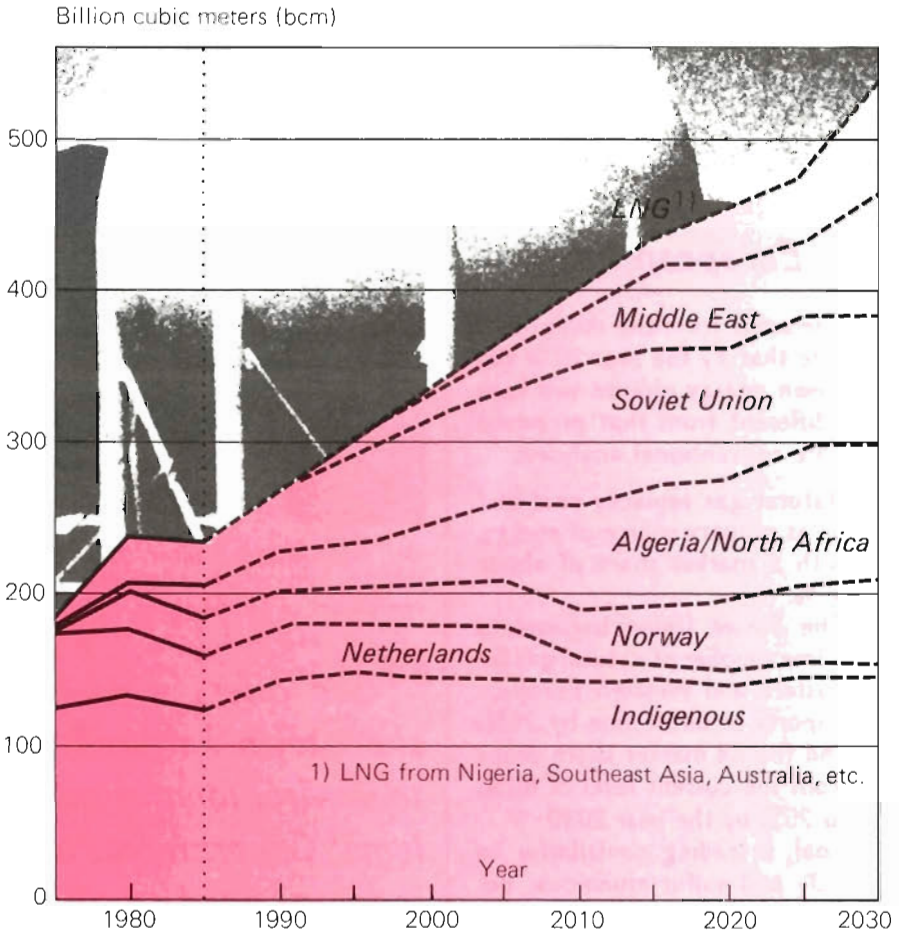

Potential demand for natural gas in Western Europe, and sources of supply.

Recent work challenges the conventional view of gas as a scarce resource, suggesting there may be large unassociated reserves. "To date, we have looked for gas through an *oil window*. By widening the scope of exploration, the full potential extent of methane reserves is only now becoming apparent. In fact, despite low energy prices that have depressed the level of gas exploration, proven global reserves of gas have increased relative to those of oil, and have expanded at a rate that is three times that of gas production. Since it is now viable to think of gas occurring at greater depths than before, the added effect of compression becomes a significant factor in calculating the likely amounts of gas recoverable from a reservoir of any given volume. It all adds up to a much larger potential resource base than was previously suspected."

Gas-Fired Generation

Although current government regulations in Western Europe ban the use of methane to generate electricity, compared with using coal for this purpose, gas offers several advantages. As well as being environmentally more benign than coal, gas is more efficient: Far less gas is needed to generate a given quantity of electrical power. Gas plants also involve inherently lower capital costs. Since additions to capacity can be small-scale, in the order of 10–100 megawatts compared with a minimum 400 megawatts for coal-fired or nuclear plants, they also provide greater flexibility in terms of lead times and geographic location. Overall, gas represents a robust and responsive solution that avoids rushing into quick but uncertain technological fixes.

Ecological Impact

If IIASA's projections hold true, the emergence of gas as the dominant source of Western European energy, along with a projected 10% reduction in overall energy consumption (made possible by improved energy efficiency), will have enormous ecological impact. The Toronto target on CO_2 emissions for Western Europe, which calls for a 20% reduction in emissions by the year 2005, could virtually be achieved just by transferring to methane use.

Natural gas for Western Europe would come from a range of different sources. The largest world gas reserves known to date are in and around the fringes of Europe. Approximately 200 billion cubic meters per annum is already supplied indigenously and from offshore reserves tapped by the Netherlands and Norway. As methane use grows over the next 50 years, these supplies are likely to be maintained and additional demands met by imports from the Soviet Union (which will quickly emerge as the single greatest external supplier), the Middle East, and North Africa (see graph).

To bring this vision of the future to reality, what needs to be done? "The present policy that excludes the use of gas for generating electricity is based on mistaken notions," says Dr. Hans-Holger Rogner. "Gas offers a viable, short-term alternative to environmental problems. Governments and industry need to abandon conventional wisdom and practices, and begin to plan on that basis." ■

FEATURE

Working together to reduce acid rain

Recent IIASA findings show that acid rain damage to European lakes and forests could be greatly reduced if, rather than spend funds as presently committed, the countries of Western and Eastern Europe pooled funds to reduce sulfur emissions from the main sources. More than twice the degree of environmental improvement could be assured at about the same cost.

Current Commitments

Signed in 1979, the UN Economic Commission for Europe's International Convention on Transboundary Air Pollution was a major first step in achieving cooperative action across European states to reduce problems caused by acid deposition. Prompted by damage to lakes and forests (see box), the convention foresees action in various countries to reduce emissions of acid-forming nitrogen and sulfur oxides. It targets an overall reduction in European sulfur emissions of about 20% by 1993.

The convention foresees total spending of 12 billion Deutsche Marks (DM) per year to reduce emissions in 16 countries, with each state footing its own bill for the actions taken within its borders. Summing the projected spending of the individual Western European signatories to the convention and comparing this with the sum to be spent by the Eastern European signatories, results in an even split: DM 6 billion in Western Europe; DM 6 billion in Eastern Europe.

RAINS

Using RAINS, a computer model developed at IIASA that organizes information and computations on acid rain in Europe

ACID DEPOSITION

First associated with acidification of small, freshwater lakes in southern Scandinavia, acid deposition has emerged as one of the most serious, if not the most serious, current environmental problem in Europe and North America. Resulting from emissions of sulfur and nitrogen oxides during the combustion of fossil fuels, it causes soil acidification over extensive regions.

Once soils acidify a cascade of negative effects follows: a depleted capacity to buffer against additional acidic inputs, losses of nutrients, leaching of toxic metals, acidification of lakes, and degradation of aquatic habitats.

Acid deposition impacts on both abiotic and biotic elements of affected ecosystems. In Norway, freshwater acidification halved formerly stable brown trout populations by 1978 and depleted remaining stocks a further 40% by 1983. Other fish species have been similarly affected.

Acidification of forest soils has been linked to forest dieback; in Central Europe, 15% to 20% of the growing stock of exploitable forest (equivalent to more than five years' fellings) has suffered moderate to severe damage or death.

APA/DPA

FEATURE

(see box) to evaluate likely effects of the convention, Dr. Roderick Shaw, leader of IIASA's Transboundary Air Pollution Project, finds that the presently committed reductions will have less real impact than one might expect on forest soil acidification even if most countries realize their emission reduction targets. "The difficulty with the convention as it stands is that many of the major sources of pollution are in Eastern Europe where low levels of emission control are combined with the use of low-grade, brown coal. This is where money for emission reduction must be concentrated if we are to halt environmental damage."

While some of the wealthier countries, for example Austria and the Federal Republic of Germany, are able to make commitments to reduce emissions by as much as 65% and 70% (well over the specified emission targets set by the convention), for economic reasons some Eastern European countries, like Poland, have been unable to make any commitment. Yet, even a small percentage reduction of emissions in Poland would have greater absolute effect than large percentage reductions in countries where emission levels are already low.

"Emissions in Eastern Europe could be reduced either by applying technology to the plants burning brown coal or by switching fuels. While this would be costly, involving a greater level of expenditure than Eastern European countries have currently committed, money spent there would go much further than in Western Europe owing to the lower marginal cost of taking out each extra tonne of sulfur in Eastern Europe," argues Dr. Shaw.

Funding Emission Reduction

Of course, in Eastern Europe there's often difficulty in finding the funds to bring in the necessary measures. The IIASA study concludes that part of the money to be spent in Western Europe should be used to reduce emissions in the German Democratic Republic, Czechoslovakia, Poland, and Hungary. A transfer of DM 2 billion each year is recommended.

If all signatories to the existing agreement meet their targets, the area of Europe subject to annual sulfur deposition rates of more than 1 g/m^2 will drop from 63% (assuming no controls) to 53%. By pooling and reallocating available funds as IIASA recommends, the area affected could be further reduced to 50%. More significantly, peak deposition rates, which would fall from >10 g/m^2 in a no-controls scenario to 8 g/m^2 under the terms of the current agreement, would be further slashed to 5 g/m^2 under IIASA's reallocation proposal.

The real meaning of a transfer of funds becomes clearer by looking at its effect on forest soils. Taking a soil pH of 4.0 as the critical threshold (since a pH of <4.0 begins to cause stress to forest), the currently committed emission control effort will slow the rate of increase in the area of acidified forest soil in Central Europe (currently 17%) but will not halt the trend to acidification. Under a no-controls scenario, the area of acidified forest soil would rise to 67% by the year 2040. It would rise less sharply, to 47%, under the terms of the current convention but could drop again and stabilize at around 5% by redistributing available funds as IIASA recommends. The reduction in acidification would be over twice as great as under current commitments.

Effects of a Transfer

Such a transfer of funds would dramatically improve the environment, not only in Eastern Europe, but in bordering states. One outstanding finding from IIASA's work is that, even from the standpoint of reducing acid deposition in Western European countries, it can be more effective to spend money abroad than at home. The environmental return to the Federal Republic of Germany, for example, would be greatest if funds earmarked for domestic emission reduction were reallocated to emission reduction efforts abroad. "An effort at East–West cooperation to reduce emissions from Eastern Europe would benefit all of Europe," said Dr. Shaw. ■

POLICY CONCLUSIONS

- *Presently committed sulfur emission reductions will not arrest soil acidification in Central Europe.*
- *Presently committed funds could be spent more effectively in ways that would secure twice the level of environmental protection.*
- *An East–West transfer of funds should be considered, especially for emission reductions beyond the present commitments.*

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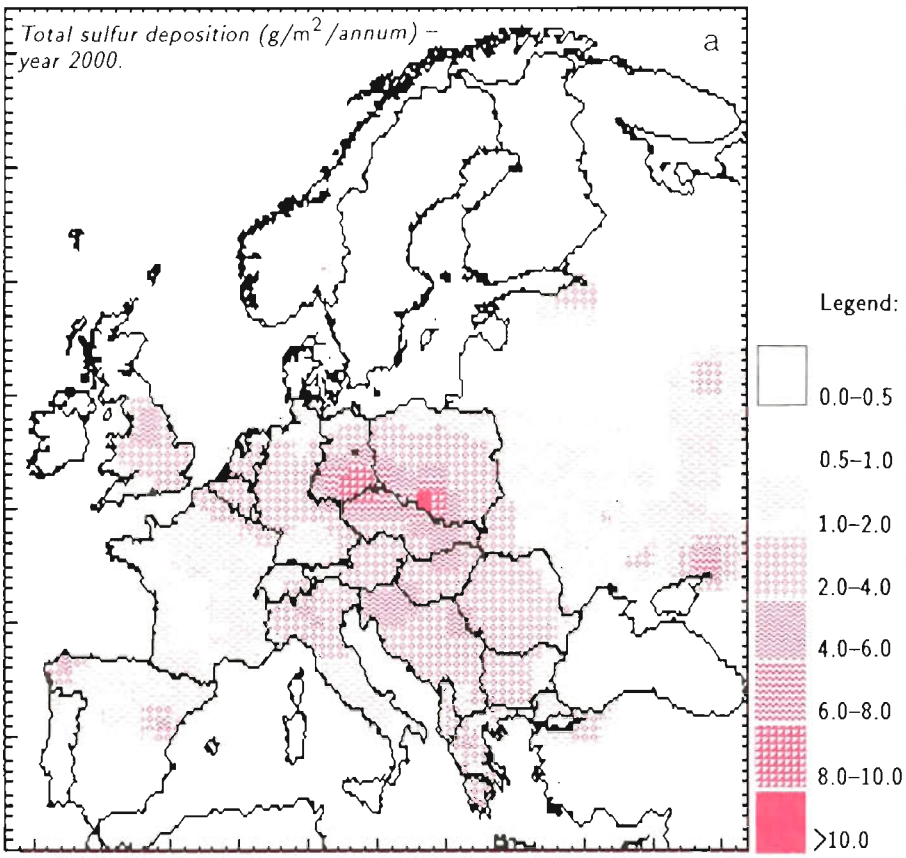
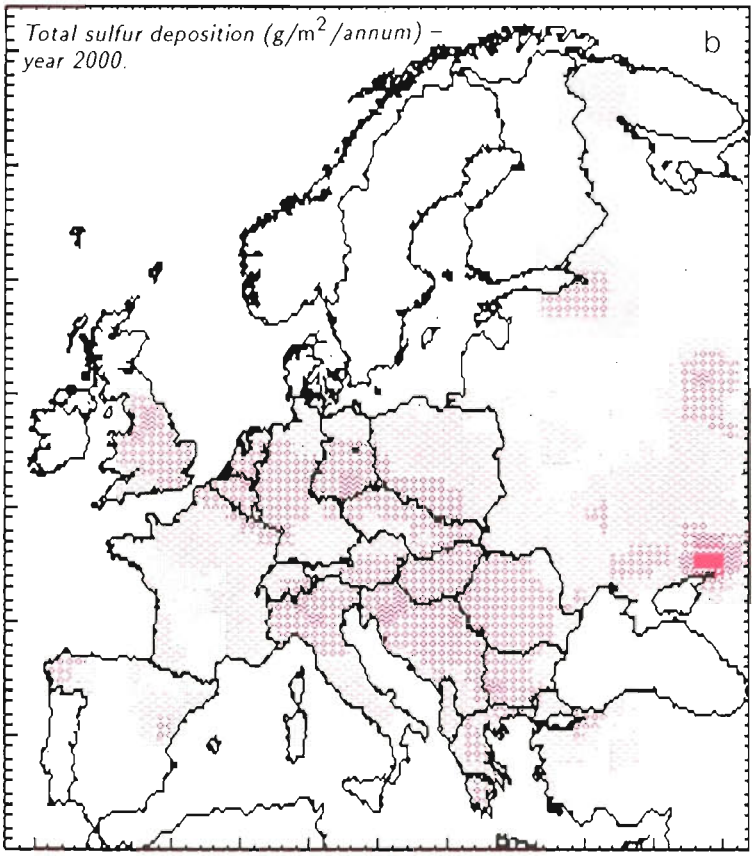




Large reductions in sulfur deposition, further to those gained under the existing agreement (figure a), could be achieved by reallocating committed funds as IIASA recommends (figure b).

Dr. Roderick Shaw, Leader of IIASA's Transboundary Air Pollution Project.

RAINS

Dr. Shaw points to the underlying importance of the RAINS model. "One of the main reasons for developing a model like RAINS is to help design the most efficient emission control strategies. Acid deposition is a major problem, but reducing the emissions that cause acid rain is very expensive. If you can convince people there are better ways of reducing emissions, more cost-effective ways than those currently being tried, they're more likely to do something effective about the problem. One of our goals at IIASA, is to use the strategic perspective afforded by RAINS to widen the range of options available to policymakers, tabling viable solutions that, otherwise, might never even come under consideration."

IIASA ACHIEVEMENTS

Integrated development planning in Shanxi

ACA's custom-built software helps chart a path for progress in Shanxi.

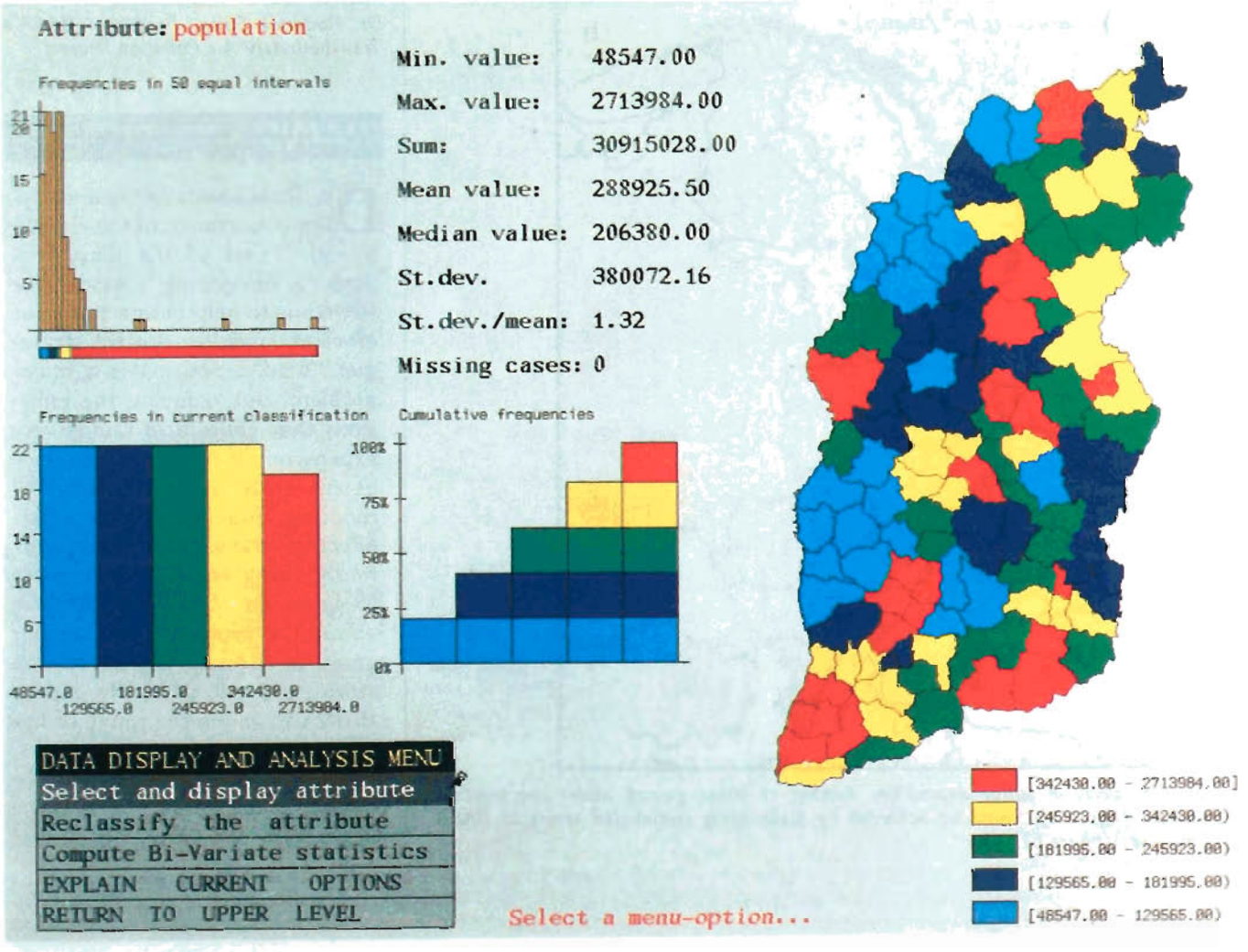
Shanxi Province in the People's Republic of China (PRC) is the nation's powerhouse, with commitments to supply coal and electricity for China's overall development. Its most outstanding resource is high-quality coal, with over 200,000 million tonnes of proven reserves and 860,000 million tonnes of estimated reserves. The problem facing Shanxi Province is to plan for its own regional development while still meeting its obligations as the main energy supplier for the rest of the PRC.

IIASA's Advanced Computer Applications Group (ACA), working with Chinese academics and officials, has developed and recently installed a prototype expert system, custom-designed to meet Shanxi's planning requirements. The Project was funded by the State Science and Technology Commission of the People's Republic of China (SSTCC).

Information Overload

To coordinate the development of a region, and especially its industrial structure, many interrelationships and impacts have to be considered simultaneously. Large amounts of background information from many different subject domains, economics, engineering, environmental sciences, and so forth, are needed. Equally, to design and evaluate alternative development policies, one needs not only a vision, but information, plans, and tools to explore new policies without having to put them to expensive real-world tests.

While computers and simulation models are clearly part of the answer, what's needed is a way for overcoming the potential problem of information overload that they present – a way to avoid becoming lost in vast amounts of complex and largely technical information



and arrays of relevant, but very complicated, scientific tools.

This is a problem common to decision making in many areas where the substantive issues addressed involve interrelation among several disparate areas of expertise.

Customized Software

ACA's solution is to build customized software to handle the information and scientific tools relevant to a particular client's problems, marrying these with decision-support software, and a user-friendly menu-driven interface. The interface guides the nonexpert user through the processes of extracting useful information and developing/testing policy options.

Consistent with this approach, ACA's system for Shanxi blends elements of artificial intelligence, operations research, and applied systems analysis in an operational, prototype-level, expert-system that embraces more than 120,000 lines of code.

The system has been built to an open-architecture and modular design to allow for addition, update, or exchange of databases and models. The underlying idea is that of rapid prototyping, so that the client is supplied quickly with the essentials of a working system that can be further developed and extended as understanding of his needs and his particular problem area increase. The prototype system is seen as a way of helping in this learning process with further development facilitated by the system's open-architecture, numerous interconnections, and consistent interface.

Modular Design

The system installed in Shanxi takes in several modules (models and scientific procedures) developed by ACA, other IIASA research Projects, and collaborating organizations. These include DISCRETE, a multiple objective decision support tool from IIASA's DIDAS program family.

Mrs. Deng-Nan and a delegation from the State Science and Technology Commission, PRC, on a visit to IIASA, June 1988, meet the Institute's Director, Dr. R.H. Pry.

Other component modules of the current prototype are REPLACE, an expert system for matching activities with suitable sites; MAED-BI, for energy-demand analysis; MITSIM, for water-resource analysis; an air pollution simulation model based on EPA's Industrial Source Complex (ISC) model; and MACSIM, for conducting macroeconomic simulations. GLOBINV, for global investment analysis, was developed in the People's Republic of China and has been incorporated within the prototype system along with several other Chinese modules: COAL, a model of the coal economy of Shanxi Province, and CONFRES, which describes conflict resolution in investment allocations between urban and rural areas.

Interaction with the system is via a highly developed graphics interface that provides information quickly and in a form that is easy to understand. Rapid visualization enables the user to assimilate results and continue logical interaction with the system. It also makes best use of decision makers' short-term memory to compare policy alternatives. The system can provide basic information about the region, make interregional comparisons at a macroeconomic level, place information about the region into a national context, develop and compare policy options and investment decisions, and trace development scenarios over time.

Now completed, the two-year Project has seen not only the development and installation of the prototype system, but also a collaboration between ACA and researchers from the People's Republic of China that has provided an important educational experience for both partners. At the same time, a team of Chinese experts has been trained in the systems approach and software technology used for the system. As ACA begins new negotiations with the PRC on further collaborative software development projects, this first system is beginning to be used to chart a path for progress in Shanxi. ■

INTERVIEW

Prof. F. Schmidt-Bleek

Leader of IIASA's Technology, Economy, and Society (TES) Program is Professor Friedrich Schmidt-Bleek (FRG), who joined IIASA in April 1988 from the Umweltbundesamt, Federal Republic of Germany. Professor Schmidt-Bleek studied at the Universities of Bonn and Mainz and performed thesis work in radiation and nuclear chemistry at the Max-Planck Institute for Chemistry in Mainz. After teaching at universities in the USA, he returned to Europe, taking responsibility first for national environmental chemicals control in the FRG, and later heading the OECD Chemicals Division in Paris. From 1985 to 1987 he also headed the Environment Office of the World Economic Summit.

Q... What's been your priority since taking up leadership of the TES Program?

A... The TES Program has its roots in several earlier IIASA Programs and Projects dealing with technology, energy, risk, innovation, and long-term social developments. As it stood, there seemed to be insufficient weight given to work in the economics and social systems areas – an imbalance that concerned the Council considerably. So, since arriving, my first priority has been to restructure – to develop a consistent, coherent, and balanced work Program relevant to some key issues. The restructuring is still underway. Some projects have now reported out, others have been redefined to give greater treatment to social and economic aspects, and we're beginning some new Projects that will inject relevance and direction as well as bind the Program together and forge stronger links with other IIASA Programs.

Q... Could you give examples of some of the new Projects?

A... One, which especially illustrates my points on balance, relevance, and links to other IIASA Programs, is a pilot study we've just begun to examine the legal and administrative situations in different NMO countries and beyond with regard to control of potentially risky consumer products and technologies. We're beginning with pesticides and will likely add personal computers or telecommunications equipment next. Pesticides we will tackle jointly with WHO/EURO upon their request. Our aims are to see what pre- and post-market controls exist to safeguard human health, ensure labor safety, and minimize environmental impacts; to see whether the protections presently enshrined in legal provisions are adequate and at reasonably similar levels across countries with different legal and economic structures; and to examine the processes through which decisions to allow or ban products are reached. It's clear that to avoid non-tarrif barriers to trade, controls should be harmonized internationally. World trade in chemicals comes close to $US 1000 billion annually. Also, so that all countries can have confidence in the adequacy of each others' approach to management, the procedures used for assessing products and technologies need to be objective and transparent. What's needed is scientific guidance on how to make practical risk analyses. Here's an obvious potential bridge to the System and Decision Sciences (SDS) Program. There's also an ecological rationale to this work: Decisions about products made in one country impact the environmental quality in other countries; for example, the private-industry decision 50 years ago to go ahead with producing chlorofluorocarbons (CFCs) begins now to affect climatic conditions for all people. This ecological aspect obviously ensures that work on this Project will be closely linked with that of IIASA's Environment Program.

"whatever the paths of technological, economic, and social changes, they'll have to be analyzed also with respect to potential environmental impacts"

Q... Are there any other new ventures?

A... We've just begun a few pilot studies to see whether IIASA could

develop new quantitative indicators for describing the state and long-term development of technological, economic, and social sytems. The aim is to arrive at measures that would be applicable across countries of different size, social structures, and economic systems. If successful, these new *measuring yardsticks* would enable countries to approach the sustainability issue in a more quantitative way (for example, with the help of efficiency indicators, indicators for capital vintages, productivity, labor, and time allocations) and set targets accordingly. Let me give an example. For the moment, agricultural statistics are mostly given by output or input per unit area – yet, we've known for some time that land area is not as critical a factor as the energy efficiency of food production, processing, and distribution. Currently, we've no indicator to take account of the total energy efficiency of, say, producing and selling a loaf of bread and therefore we lack the basis of meaningful comparison between countries. And beyond this, energy efficiency is not only of enormous economic importance, it also has direct environmental impact. To steer development along a sustainable path, countries need better guidelines.

Q... Several times, you've mentioned the environment. Is this to be an underlying theme in future TES work?

A... It's now clear that taking care of the environment is an absolute necessity. Our planet is the ultimate resource upon which we all depend. It's equally clear that we're in a position, technologically, to force major changes in this resource base: intentionally, unintentionally, and through misguided accounting systems that currently exclude environmental costs. We must factor the environment into our decision making in just the same way as economists take available capital into consideration. The situation is reminiscent of that faced toward the end of the last century with respect to social externalities, which took 30 to 50 years to factor into how we conduct business. No one would now dream of sending 12 year olds into underground mines to labor for 12 or 14 hours a day. Environmental impacts have still to be *internalized* in the ways we price goods and services. The role of science is to optimize the reaction of society to the new reality and provide guidelines on the loads the environment can accept while retaining sustainability. Since environmental issues are – almost without exception – international issues, it's clear that an international organization like IIASA can, and must, deal with them. It's equally clear that this is, in part, the responsibility of TES since, from now on, whatever the paths of technological, economic, and social changes, they'll have to be analyzed also with respect to potential environmental impacts. So, TES will henceforth routinely raise the question of potential unintended impacts of technology options upon society and the environment. This is, for instance, the case in our wide-ranging studies in the area of computer-integrated technologies, where questions of social impacts, new educational strategies, and possible future environmental impacts are becoming very important.

Q... Energy consumption is clearly a very important element in the way human activities impact the environment. What new work will TES be doing in this area?

A... We're developing a research plan through which TES will cooperate closely with the Environment and Population Programs to look, within a 30-to-50 year time frame, at technological and economic options for reducing emissions of climate relevant gases as well as options for society to adapt to changes of surface temperature and other climatic changes. The Project is still in a formative stage, but we're aiming to capitalize on IIASA's East–West dimension to make realistic energy demand-and-supply projections across the major industrialized countries as a basis for assessing several policy options: cutting back on the use of carbon-based fuels; converting to natural gas; increasing the efficiency of energy production, conversion, transport, and end-use; a transfer to hydrogen fuels; and so forth. Generally, the assumption is made that conservation of energy is probably the most realistic option in the short run. It would be important to analyze the reality of this option very carefully. As well as the technological feasibility of these options, we'll be assessing the economic and environmental implications. We'll also be looking at the risk factors, including risk acceptance for various technological options.

Q... In what general direction would you like to see TES develop in the future?

A... Very briefly, I see TES using its own and others' projections on technology, innovation, diffusion, social trends, population, and environmental boundary conditions, together with mathematical know-how and the best available models, to see what options, within a given economic frame, we can develop in the area of societal needs. Basically, this means tabling viable, new options, in understandable forms, to the right people. This is an exciting time as new trends and priorities are emerging in socialist countries, and as Europe strives toward a more unified common market. Our still-rudimentary analyses in TES of the working of East–West joint ventures may help to gauge and understand better the trends toward more harmonized international economic development and help IIASA to find a new, challenging role in facilitating a prosperous, sustainable, and peaceful future. ■

RESEARCH

Decision Support

The Methodology of Decision Analysis (MDA) Project, within IIASA's System and Decision Sciences Program, has recently brought several of its prototype decision support software products to a transferable level to permit testing and refinement in real decision-making environments. Each of the products is a member of MDA's DIDAS family of decision support system methodologies, is implementable on a microcomputer, has a well-developed user interface, and is fully documented.

Field trial and refinement of the concepts for decision support embodied within the prototype software is the scientific next-step from the already-accomplished theoretical validation. In this sense, the software is seen as the vehicle for communicating these concepts to other scientists and to decision makers involved in the field trials. Several users have already been identified, and the project has received many requests from organizations wanting to use the software.

The chief concept underlying the whole DIDAS family of decision support methodologies is that of aspiration-led decision making, an original contribution of the MDA group. The basic philosophy is to treat decision making as a learning process through which the decision makers' aspirations change and become better defined as knowledge of the limits of the system under consideration increases.

For further details about DIDAS, contact Dr. Andrzej Lewandowski, MDA Project Leader, at IIASA. For information about the availability of DIDAS software and documentation, contact IIASA's Publications Department.

AEZ Planning Tool for Kenya

IIASA's Food and Agriculture Program, a participant in the original joint FAO/IIASA/UNFPA study on "Population Supporting Capacities of Lands in the Developing World," will participate in the final phase of a continuation study. On completion of the original study in 1983, the United Nations Food and Agriculture Organization (FAO) initiated a detailed case study of Kenya, as a means both to prepare plans for Kenya and to refine the Agro-Ecological Zones (AEZ) methods developed during the original study. Agreement has been reached with FAO for IIASA to collaborate in preparing and documenting the detailed *AEZ Planning Tool for Kenya*. (Contact: *Dr. Günther Fischer*, IIASA)

Methodology of Socioeconomic Comparisons

A four-year collaborative agreement with IIASA's Technology, Economy and Society (TES) Program has been signed by the Central Laboratory of Social and Economic Measurements (CLSEM) of the Academy of Sciences of the USSR and the State Committee for Statistics, by which CLSEM will contribute to the TES Project on Dynamics of Change and Sustainability of Systems (DOS). Researchers from CLSEM will play an active part in defining the scope of a new project on quantitative socioeconomic indicators and will prepare a cross-national database reflecting the social effects of institutional and technological changes. They will also contribute to ongoing work on quantitative indicators, which includes comparative analyses of countries with different economic and social systems, focusing primarily on employment patterns, income distribution, and other major social issues. (Contact: *Dr. Nebojsa Nakicenovic*, IIASA)

Soviet Population Trends

IIASA's Population Program has signed a three-year agreement of collaboration with the new Institute of Socioeconomic Problems of Population (ISEPP) of the Academy of Sciences of the USSR and the USSR State Committee for Labor and Social Problems, to study Soviet fertility trends. (Contact: *Dr. Wolfgang Lutz*, IIASA)

CONFERENCE CORNER

Recent Conferences

Food and Agriculture Network Meeting, Laxenburg, Austria, 5–6 December 1988.
Representatives of IIASA's Food and Agriculture Network organizations met to coordinate their research for 1989. Updating IIASA's Food and Agricultural Policy Analysis Model was a priority to be accomplished by late summer 1989. The joint research topic to be taken up later in 1989 will focus on policy reform in agriculture. (Contact: *Dr. Günther Fischer*, IIASA)

New Advances in Decision Support Systems (DSS), Laxenburg, Austria, 5–7 December 1988.
Twenty-seven participants attended this Seminar on New Advances in DSS, organized by IIASA's Methodology of Decision Analysis Project, to discuss applications for the software products and publications of IIASA's three-year collaborative research with the Institute of Automatic Control of the Warsaw University of Technology. (Contact: *Professor Andrzej Lewandowski*, IIASA)

Inter-Secretariat Meeting on Joint Ventures, Laxenburg, Austria, 15 December 1988.
Representatives of the International Chamber of Commerce (Paris), the United Nations Economic Commission for Europe, and the International Labor Office (both in Geneva) joined experts from IIASA to review each organization's planned activities in the field of joint ventures and to study the content of the first issue of a newsletter on the topic. Participants agreed to repeat similar intersecretariat meetings at least once a year. (Contact: *Professor Friedrich Schmidt-Bleek*, IIASA)

Vienna Population Colloquium, Laxenburg, Austria, 15 December 1988.
IIASA's Population Program hosted the first meeting of the "Vienna Population Colloquium," an effort to bring together demographers working at different institutions in the Vienna area to discuss topics of common interest. In this first event, representatives from the Austrian Central Statistical Office delivered a presentation on "Past, Present, and Future Pop-

ulation Trends in Vienna." Future meetings will be held biannually on a rotating basis at the United Nations Office of Vienna, the Austrian Central Statistical Office, and IIASA. (Contact: *Dr. Wolfgang Lutz*, IIASA)

Policy Responses to Large Accidents, Laxenburg, Austria, 16–18 January 1989.
IIASA organized this conference to assess the existing body of knowledge concerning response mechanisms to large accidents like Seveso, Bhopal, and Chernobyl. Among the topics covered were monitoring and assessments after accidents, societal costs of large accidents, international and national responses to recent large accidents, the impact of perceptions on policy design, and credibility and communication in crisis situations. Future research priorities and directions were clarified. IIASA plans to produce a book on the theme "Chernobyl and Europe." (Contact: *Dr. Gerhard Krömer*, IIASA)

Technological Change, Employment, and Competitiveness, Laxenburg, Austria, 17 January 1989.
This meeting was held to further the feasibility study on "International Comparisons of the Impact of Technological Change on Labor, Employment Patterns, and Competitiveness," prepared for IIASA by *Professors Frans Prakke* and *Luc Soete* of the Maastricht Economic Research Institute on Innovation and Technology (MERIT), the Netherlands. The study is initiated and supported by the American Academy of Arts and Sciences, the Foundation IIASA–Netherlands, and the Swedish Council for Planning and Coordination of Research. (Contact: *Dr. Nebojsa Nakicenovic*, IIASA)

International Negotiations: Problems and New Approaches, Laxenburg, Austria, 30 January–3 February 1989.
As a follow-up to the meeting of 8–9 June 1988, members of the international committee of IIASA's Processes of International Negotiations (PIN) Project met to discuss submitted contributions to the planned IIASA monograph *International Negotiations: Problems and New Approaches* and to prepare a blue print for second drafts. (Contact: *Professor Victor Kremeniouk*, IIASA)

Forthcoming IIASA Conferences

June 5–9: Nonlinear Synthesis, Sopron, Hungary (Contact: Professor Alexander Kurzhanski, IIASA).

June 14–16: Diffusion Technologies and Social Behavior: Case Studies, Theories, and Policy Applications, Laxenburg, Austria (Contact: Dr. Nebojsa Nakicenovic, IIASA).

June 20–22: International Energy Workshop, Laxenburg, Austria (Contact: Dr. Leo Schrattenholzer, IIASA).

July 17–19: 3rd Annual Workshop on Computer Integrated Manufacturing, Strasbourg, France (Contact: Professor Jukka Ranta, IIASA).

July 24–28: IFIP/IIASA Conference on Inverse Problems of Control for Distributed Parameter Systems, Laxenburg, Austria (Contact: Professor Alexander Kurzhanski, IIASA).

September 25–29: ECE/IIASA Seminar on Computer Integrated Manufacturing, Sofia, Bulgaria (Contact: Professor Jukka Ranta, IIASA).

June 1990: INRIA/IIASA 9th International Conference on Analysis and Optimization of Systems, Antibes, France (Contact: Professor Alexander Kurzhanski, IIASA).

Other Forthcoming Conferences

June 27–30: 10th European Conference on Operational Research, Beograd, Yugoslavia (Contact: Sava Centra, EURO X, Milentija Popovica 9, YU-11070 Beograd, Yugoslavia).

July 3–7: 14th IFIP Conference on System Modeling and Optimization, Leipzig, GDR (Contact: Professor Dr. Heiner Müller-Merbach, University of Kaiserslautern, P.O. Box 3049, D-6750 Kaiserslautern, FRG).

July 12–14: AMSE International Conference on Signals and Systems, Brighton, UK (Contact: AMSE, 16, avenue de Grange Blanche, F-69160 Tassin-la-Demi-Lune, France).

July 14–16: Reliability '89, Brighton, UK (Contact: Ms. A. Games, NSCR-UKAEA, Wigshaw Lane, Culcheth, Warrington, Cheshire WA3 4NE, UK).

August 14–18: Joint ALIO/EURO Workshop on Practical Combinatorial Optimization, Rio de Janeiro, Brazil (Contact: Professor R.D. Galvao, COPPE/UFRJ, P.O. Box 68-507, 21945 Rio de Janeiro RJ, Brazil, or Professor S.K. Jacobsen, IMSOR, Bldg. 321, Technical University of Denmark, DK-2800 Lyngby, Denmark).

August 14–18: International Conference on Soils and the Greenhouse Effect, Wageningen, the Netherlands (Contact: A.F. Bouwman, Conference Secretary, tel: 31-8370-19063).

August 28–31: IFAC Symposium on Large-Scale Systems: Theory and Applications, Berlin, GDR (Contact: Professor Dr. Dietrich Ohse, Fachbereich Wirtschaftswissenschaften, Johann Wolfgang Göthe University, P.O. Box 111932, D-6000 Frankfurt/Main, FRG).

August 28–31: ECOLOGY '89 – Our Common Future: Industry and Society, Gothenburg, Sweden (Contact: Harriet Sohlman Information, Mossenbergsvagen 12, S-16134 Bromma, Sweden).

September 17–22: 14th World Energy Conference, Montreal, Canada (Contact: I.D. Lindsay, Secretary General, WEC, 34 St. James Street, London SW1, UK).

October 9–12: International Symposium on the Safety Assessment of Radioactive Waste Repositories, Paris, France (Contact: IAEA, P.O. Box 100, A-1400 Vienna, Austria).

October 16–20: International Symposium on Environmental Contamination Following a Major Nuclear Accident, Vienna, Austria (Contact: IAEA, P.O. Box 100, A-1400 Vienna, Austria).

October 23–26: International Conference on System Simulation and Scientific Computing, Beijing, PRC (Contact: Secretariat, P.O. Box 301, Beijing, 10083, PRC).

October 23–27: International Symposium on Research Reactor Safety, Operations and Modifications, Chalk River, Canada (Contact: IAEA, P.O. Box 100, A-1400 Vienna, Austria).

LETTERS

As well as receiving many encouraging letters from OPTIONS readers offering general comments on the new style of our magazine, several letters have been received covering very specific aspects of articles that appeared in the November 1988 edition. Some are reprinted below along with extracts from letters received earlier reacting to our, then proposed, new series on IIASA achievements. As mentioned in the November editorial, we invite correspondence about published material or more generally about Institute matters and plan to publish a "Letters" column on a regular basis.

The New OPTIONS

We have received the November 1988 issue of OPTIONS. I found it both interesting and informative; in fact, I have already ordered a couple of books it recommends. May I therefore take the opportunity to thank you for sending OPEC OPTIONS on a continued basis. *Dr. Subroto, Secretary General, OPEC, Vienna, Austria.*

I've just received and read the November 1988 issue of OPTIONS and would like to congratulate you on your decision to take on a new appearance, style, and sectional format. I find this issue most informative and wish you and your collaborators further success. *Academician K. Ya. Kondratyev, Institute for Lake Research of the USSR Academy of Sciences, Leningrad, USSR.*

Achievements

In the ultimate listing of IIASA's work, I hope a broad definition of achievements and applications will be used. The concept of applications is very fuzzy and, in my world, includes not only a direct use of a research result by a policymaker, but also the process of data collection, new understanding of problems, and general changes in how an issue is understood. Assuming broad definitions of the use and value of IIASA's work, the following are some suggestions for the achievements series: water allocation issues, fair representation, population heterogeneity, nondifferentiable optimization, and systems of input–output models and their linkage. *Peter E. De Janosi, Vice President, Russell Sage Foundation, New York, USA.*

I did my Ph.D. research under Myron Fiering on spruce budworm management in eastern North America. He started the research at IIASA and received US National Science Foundation funding to continue the work at Harvard. I went on and did more work on the problem sponsored by a joint US–Canada CANUSA program. Although the character of this later work was much different, it was an outgrowth from the initial IIASA study, and has led to the development of statistical methods for determining the optimal time for insecticide applications and statistical characterizations of the dynamics of the insect–forest system with and without spraying. *J. R. Stedinger, Associate Professor, School of Civil and Environmental Engineering, Cornell University, Ithaca, USA.*

AIDS

In the Research Section of OPTIONS (Nov. 1988, p. 16), there is reference to a soon to-be-finalized software product that will consist of an epidemiological database on AIDS for use on a microcomputer. Our Animal Health Service is involved in a possible adaptation of WHO's Epi-Info program for animal disease purposes, and it may be that the program IIASA is now preparing could well be of interest to them. Would it be possible for you to supply me with further details? *C.B. Coulson, Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy.*

In addition to letters, we had other feedback about the new OPTIONS. Several items appearing in the November 1988 issue were republished in newsletters produced by IFORS, the International Federation of Operational Research Societies, IFIAS, the International Federation of Institutes for Advanced Study, and the International Association of Computer Simulation. Over 200 additional copies of OPTIONS were supplied at marginal cost plus postage in response to specific requests. In addition, as a result of publicity given to several products, we received many inquiries about the availability of IIASA publications and software featured in the November 1988 issue.

NEWS

IN MEMORIAM

The deaths of two distinguished IIASA supporters have recently been announced. *Professor Gennady M. Dobrov*, a former IIASA Research Scholar with the Management and Technology, and the Food and Agriculture Programs (1976–1979), died in Kiev, USSR, 4 January 1989. The death was also announced of *Mr. Kari Kairamo*, member of IIASA's Advisory Board since 1985 and Chief Executive of the Nokia industrial enterprise, in Helsinki, Finland, 18 December 1988.

Honors and Awards

The Institute's Director and two former Deputy Directors have recently received honors and awards. *Director Robert H. Pry* was elected to the Executive Committee of the Board of Trustees of the International Federation of Institutes for Advanced Study (IFIAS). Launched in 1972 on the joint initiative of the Nobel Foundation and the Rockefeller Foundation, IFIAS is an association of almost 40 independent research institutions, which both develops and facilitates international research. Its current program covers human responses to global change, coastal resources management, complex systems, urban risk, science and technology in global economic change, and responses to desertification. *Professor Dr. Wolf Häfele*, Chairman of the Nuclear Research Center in Jülich, FRG, a former IIASA Deputy Director, and a current member of the IIASA Council, has been appointed a foreign member of the Academy of Sciences of the USSR. Another former Deputy Director, *Professor Robert E. Munn* (Canada), has recently been awarded the title of Honorary Scholar by the IIASA Council in recognition of his important contributions to IIASA.

In addition, two IIASA alumni have recently received recognition for their scholarly contributions. *Professor Kullervo Kuusela* (Finland), an IIASA Scholar in 1988, has been awarded the 1988 International Research Prize of the Wihuri Foundation for his outstanding work in the fields of forest resources inventory, international and global forest utilization studies, and forest ecosystems. Meanwhile, *Dr. Kirit Parikh*,

Leader of IIASA's Food and Agriculture Program (1980–1986), and present Director of the Indira Gandhi Institute of Development Research in Bombay, India, has been appointed as one of four members of the Economic Advisory Council of the Prime Minister of India for a period of two years.

Appointments

Following the recommendation of Director Pry, the IIASA Council approved the nomination of *Professor Bo Döös* (Sweden), Leader of the Environment Program, as Deputy Director of the Institute. *Academician Zdzislaw Kaczmarek* of Poland has been appointed to lead the Water Resources Project within IIASA's Environment Program. A former IIASA Research Scholar (1974–1976), Academician Kaczmarek is a distinguished hydrologist. Since 1981 he has been Scientific Secretary of the Polish Academy of Sciences and Deputy Chairman of the Committee of Science and Technology.

YSSP

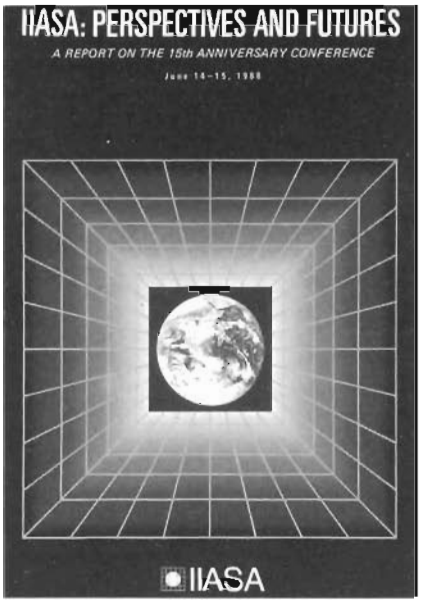
Recipients of the 1988 Peccei awards have recently been announced. The first was equally shared by *Mr. Harry O. Helmisaari* (Sweden) and *Mr. Nedjalko Nikolov* (Bulgaria) for their joint work in the Biosphere Project on "The Ecological Characteristics of Boreal Tree Species in Fennoscandia and the USSR." The second scholarship was awarded to *Mr. Olivier Dordan* (France) for work in the System and Decision Sciences Program on "Qualitative Simulation."

External Relations

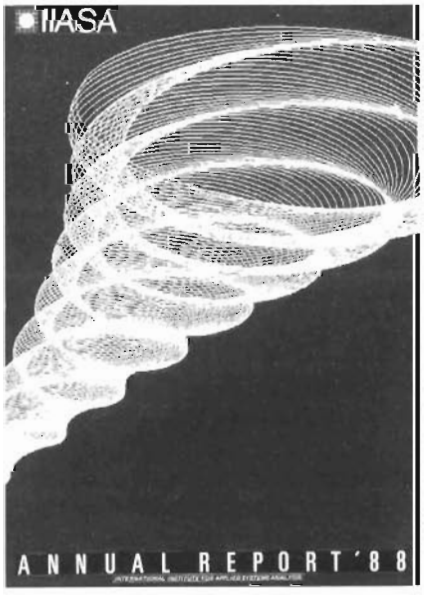
IIASA held two news conferences, followed by information sessions for embassies and representatives to the United Nations Organizations, on 3–4 November 1988, and 16–17 January 1989. The first was to report on the IIASA/UNEP Study on "The Impact of Climatic Variations on Agriculture," and the second focused on IIASA's research on acid rain and natural gas. Both events were widely covered by the international media.

PUBLICATIONS

A recently produced, informal report providing précis of the papers delivered at IIASA's 15th Anniversary Conference, "Perspectives and Futures," is now available.



In addition, a new Institute brochure is currently on-press, along with the 1988 Annual Report.



Books

Two new IIASA books, both published by Springer-Verlag, are now off press. The first, on stochastic optimization, is a product of IIASA's System and Decision Sciences (SDS) Program. The second, which investigates economic trends, is an output of the Technology, Economy and Society (TES) Program.

Numerical Techniques for Stochastic Optimization. Y.M. Ermoliev and R.J.-B. Wets, editors. Springer-Verlag: Berlin, Heidelberg, New York, 1988. ISBN 3-540-18677-8.

The Future of the World Economy. W. Krelle, editor. Springer-Verlag: Berlin, Heidelberg, New York, 1988. ISBN 3-540-50467-2.

Both books are available from your regular book supplier or from the publisher.

Reports

In addition, the following IIASA reports are now available:

Technology and the Prospects for Natural Gas. H.-H. Rogner. Reprinted from *Energy Policy*, February 1988. RR-88-4, 21 pp, US $5.

Changes in Valued "Capacities" of Soils and Sediments as Indicators of Nonlinear and Time-Delayed Environmental Effects. W.M. Stigliani. Reprinted from *Environmental Monitoring and Assessment* **10** (1988). RR-88-5, 66 pp, US $7.

International Energy Workshop: A Progress Report. A.S. Manne and L. Schrattenholzer. Reprinted from *OPEC Review*, Spring (1988). RR-88-6, 17 pp, US $5.

Carbon Dioxide Emissions in a Methane Economy. J.H. Ausubel, A. Grübler, and N. Nakicenovic. Reprinted from *Climatic Change* **12** (1988). RR-88-7, 22 pp, US $5.

All of the above can be obtained from IIASA's Publications Department at the price indicated. For further details contact Robert McInnes.

◆ Capital Cities of NMO Countries

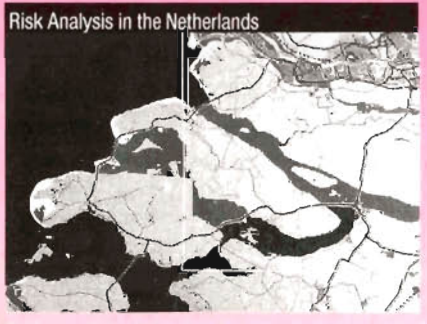
IIASA

International Institute
for Applied Systems Analysis

IIASA's ROLE

The International Institute for Applied Systems Analysis is a non-governmental research institute sponsored by scientific organizations from East and West. It brings together scientists from more than 20 nations and a variety of disciplines. Its purpose is to develop practical options to deal with issues of international importance through the application of system sciences. The Institute's effectiveness is rooted in its international sponsorship and focus, its nonpolitical status, its freedom to choose its research agenda from a variety of pressing international issues, its interdisciplinary base, and its worldwide network of collaborating organizations.

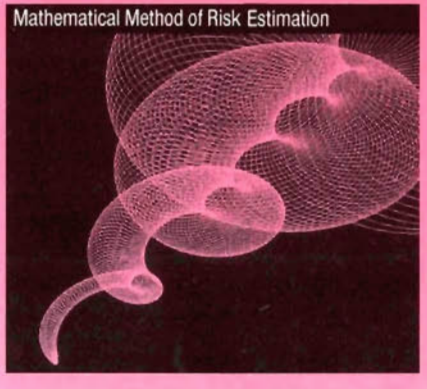
Risk Analysis in the Netherlands



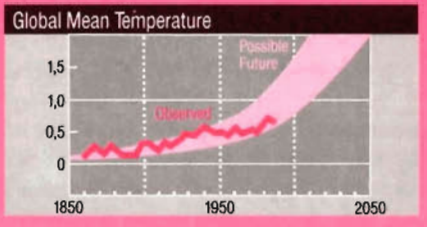
RESEARCH

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

Mathematical Method of Risk Estimation



Global Mean Temperature



MEMBERSHIP

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

FURTHER INFORMATION

Further information about IIASA and its work is available from: The Office of Communications, International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria. Telephone: (0 22 36) 71 5 21-0.