International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

options

winter 2008/2009

Scientific bridge building

- connecting countries
- building knowledge
- bridging disciplines

editorial

Sten Nilsson
Acting Director, IIASA

Bridge over troubled waters

Throwing a fallen branch across a river to explore the terrain beyond one's immediate environment probably goes back to the early days of human evolution—the first tentative step toward world exploration. Bridges have always intrigued us: the Romans built viable bridges before they understood the full engineering implications behind them. Though the bridge symbol is not new, I would like to use it in the context of IIASA's place in the global change community as, for us, it is a very apt metaphor indeed.

At the time of its foundation in 1972, IIASA was considered a bridge between East and West in a time of Cold War. Today, we are scientific bridge builders at a global level, dedicated to knowledge transfer, data sharing, and distribution of methodologies, often via the Internet. Not everyone has IIASA's will—or the freedom—to do this. Yet sharing the results of research is a fast track to solving some of the toughest challenges our planet has to offer, from climate change to poverty eradication.

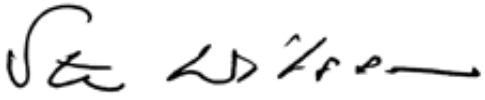
Traffic across the IIASA bridge is thus growing beyond the original planned scope and now links to countries from the South. Egypt became a full member in 2003, and India, Pakistan, South Africa, and South Korea have recently joined us in 2007. Our scientific bridge building is vibrant, smooth-running, and successful and we hope to encourage more countries to join the stream of new members in the near future.

It is also very much a two-way bridge, with IIASA scientists exchanging vital knowledge with scientists in the national member countries. IIASA bridges are designed to address real-world problems: they are not just "friendship bridges" built for show or the "bridge to nowhere" of recent U.S. election campaign fame. They bring noticeable improvements to the lives of ordinary people in terms of better air quality, improved disaster recovery, and preservation of species vital to the well-being and survival of all, as well as greater energy and food security.

In fact, we have a duty to build scientific bridges. As former UN Secretary-General Kofi Annan said in 2007, "industrialized countries are chiefly responsible for carbon emissions and global warming," and he added—famously—that developing countries should be able to "leapfrog" to catch up technologically. However, as scientific advances and advantages represent prosperity, industrial or technological superiority, and heightened political power, many who could build scientific bridges are equivocal, or even negative, about doing so.

IIASA is fortunate in being independent of governments and individual national interests. Fortunate, too, in that the very cornerstone of our approach to problem solving, systems analysis, is itself based on bridging different scientific disciplines to find the most appropriate integrated solutions.

In this issue of *Options* you will read about the ways in which IIASA is bridge building between countries, regions, and local communities. You will see that beneath the many IIASA bridges, the waters are frequently troubled. I believe, however, that human ingenuity has always found ways to cross the floods and torrents in our way—and this will continue to be the goal of our work at IIASA. ■



About IIASA

IIASA is an international scientific institute that conducts policy-orientated research into problems that are too large or complex to be solved by a single country or academic discipline.

IIASA's scientists research
- energy and technology;
- environment and natural resources; and
- population and society.

IIASA produces
- data, models, and research tools;
- refereed scientific literature; and
- policy-relevant information.

IIASA helps
- countries make better-informed policy;
- develop international research networks; and
- support the next generation of scientists.

IIASA is funded and supported by scientific institutions and organizations in the following countries:

Austria, China, Egypt, Estonia, Finland, Germany, India, Japan, Netherlands, Norway, Pakistan, Poland, Republic of Korea, Russian Federation, South Africa, Sweden, Ukraine, United States of America.

International Institute for Applied Systems Analysis
A-2361 Laxenburg, Austria
Phone +43 2236 807 0
Fax +43 2236 71313
E-mail inf@iiasa.ac.at
Web www.iiasa.ac.at

About *Options*

Options magazine features the activities of IIASA, the International Institute for Applied Systems Analysis, located in Austria.

Editor Iain Stewart
Writer Kathryn Platzer
Contributors Markus Amann, Christoph Bals, Thomas Büttner, Ulf Dieckmann, Yuri Ermoliev, Tatiana Ermolieva, Günther Fischer, Keith Jinks, Florian Kraxner, Zbigniew Klimont, Petro Lakyda, Chin Min Lee, Joanne Linnerooth-Bayer, Ariel Macaspac Penetrante, Landis MacKellar, Marek Makowski, Reinhard Mechler, Akira Nagamatsu, Sten Nilsson, Anatoly Shvidenko, Karan Deo Singh, Michael A Stoto, Kwang-Il Tak, Fabian Wagner, Christine Wamsler, Wilfried Winiwarter

Prepared by the IIASA Communications Department
Printed by *Rema*print, Vienna

Options is sent to over 6,500 policymakers, diplomats, and scientists. If you would like a free subscription, please send your name, address, and profession to publications@iiasa.ac.at.

Copyright © 2008
International Institute for Applied Systems Analysis
ZVR: 524808900

Sections of *Options* may be reproduced with acknowledgment to IIASA. Please send a copy of any reproduced material to the editor.

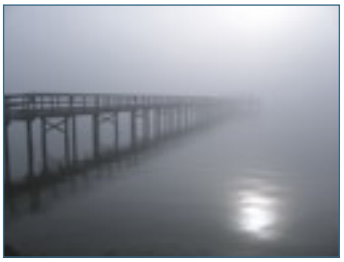
The views and opinions expressed herein do not necessarily represent the positions of IIASA or its supporting organizations.

options

United Nations

IIASA

4



Cover photo
by Gary Bidlo

FORESTRY

Barking up the right tree

Getting the biggest ecosystem service bang for every avoided deforestation buck is one of the main goals of current studies by IIASA's Forestry Program on Reducing Emissions from Deforestation and Ecosystem Degradation (REDD). Their research on how to build "ecosystem services" into the carbon economy was presented at the IIASA Side Event of the UNFCCC Climate Change Talks in Accra on 23 August.

Accra Climate Change Talks 2008

At the meeting, held 21–27 August, Yvo de Boer, Executive Secretary of the United Nations Framework Convention on Climate Change, stressed the growing urgency to improve understanding of how to protect forests. "We cannot come to a meaningful solution on climate change without coming to grips with deforestation," he said. "Plants soak up carbon dioxide, the main greenhouse gas, as they grow and release it when burnt down or when they rot."

IIASA foresters led a team of scientists from Austria, Brazil, and the USA publishing a study in late July 2008 showing that paying land-owners to reduce tropical deforestation is a cost-effective way of cutting greenhouse gas emissions compared to other current options, such as carbon capture and storage from coal power plants. Here the REDD approach helped protect biodiversity, regulate rivers, maintain the environment of some of the world's poorest people, and bring other important environmental benefits.

REDD is thus not only contributing to mitigating climate change, but also emerging as a major tool to conserve ecosystem value. The research was published in the *Proceedings of the U.S. National Academy of Sciences* (*PNAS*). ■

The complete article is available in *PNAS* 105(30):10302–10307
www.pnas.org

GLOBAL CHANGE

UN–IIASA cooperation

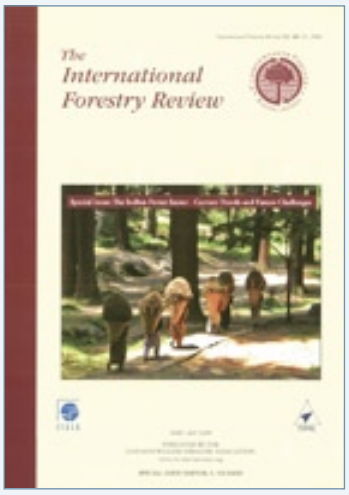
The United Nations Secretary-General Ban Ki-moon met with IIASA's Acting Director Sten Nilsson and his Special Advisor Chin Min Lee on 13 October at the UN Headquarters in New York to discuss possible future cooperation on systems oriented policy advice on global change issues. The UN Secretary-General agreed to IIASA assisting him regularly on issues of his concern. The next meeting is expected to be held in mid-2009.

Before the meeting, Nilsson presented recent IIASA research to the Fourth Committee of the UN General Assembly. He explained how space technology could provide a wide array of tools to identify the man-made activities currently affecting climate and how to mitigate their effects. In the following panel discussion on space technology and food security, Nilsson emphasized that such remote-sensing data had to be supplied to decision makers in timeframes that ensured that reasonable action could be taken in order to deal with the food crisis and make it possible to increase food production and agricultural production. Policy innovations covering property rights, institutions, subsidies and tariffs, and trade bans would also be needed. ■

INDIAN FORESTRY SECTOR

Root and branch

A major impact of India's accession to IIASA in 2007 was the research conducted for the publication in October 2008 of a Special Issue of the *International Forestry Review*. Entitled "The Indian Forestry Sector—Current Trends and Future Challenges," the Special Issue will be presented to the Indian government in support of forest sector policymaking. This comprehensive piece of research not only highlights the important economic, societal, and environmental benefits provided by the Indian forestry sector, but also assesses the dynamics of the escalating demands being made on it. It thus brings to light where urgent remedial actions are required to assure the sector's future viability.



Based on 25 papers, which were written by Indian experts, IIASA scientists, and international researchers, four interlinked issues/components were identified as priorities in terms of promoting sustainable development of the Indian forestry sector: (1) more reliable data and inventories, feeding into (2) systems-based integrated assessments of the causes of the degradation of Indian forestry resources, like sustenance and livelihood pressures. These would, in turn, foster (3) the introduction of ongoing strategic planning for the forest sector, thus bringing about (4) new governance and institutional structures for Indian forestry. These institutional structures would be designed by the strategic planning process, rather than vice versa.

It was recommended that the implementation of a limited package of important actions should begin immediately, to be driven by the "critical mass" of Indian experts who came together to contribute to the Special Issue. ■

The International Forestry Review
www.cfa-international.org

WORLD POPULATION PROGRAM

Education proves key

A four-page IIASA Policy Brief, "Economic Growth in Developing Countries: Education Proves Key," has been published by IIASA. It synopsizes research carried out by IIASA's World Population (POP) Program in collaboration with the Vienna Institute of Demography (VID) of the Austrian Academy of Sciences. It shows unambiguously that

education is a fundamental determinant not only of health, demographic trends, and individual income, but also of a country's aggregate level of economic growth. This is based on the article "The demography of educational attainment and economic growth" by W. Lutz, J. Crespo Cuaresma, and W. Sanderson of POP, published in *Science* 319(5866):1047–1048 . ■

IIASA Policy Briefs
www.iiasa.ac.at/Publications/policy-briefs

AIR POLLUTION

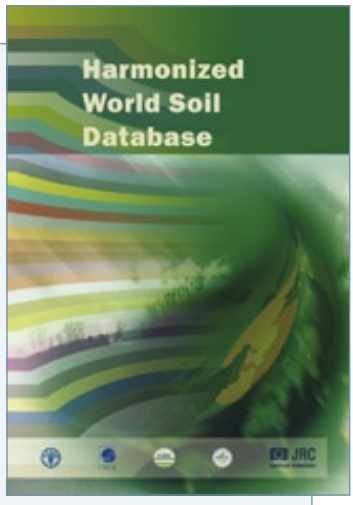
Ozone controls failing

IIASA's Markus Amann and co-authors of a new report by the UK's Royal Society claim that control efforts in many parts of the world have failed to reduce ground-level ozone, a pervasive air pollutant, and that human health and environment remain at risk. The authors warn that climate change is expected to make the challenge of controlling ozone pollution even harder. ■

The report, "Ground-level ozone in the 21st century," is available at:
www.royalsociety.org/ozone

LAND-USE CHANGE & AGRICULTURE

World soil resources



The absence of globally systematic soil data has added to the uncertainties of predicting the potential for, and constraints to, food and fiber production as well as the capacity of soils to hold carbon and to act as a sink.

Recognizing the urgent need for improved soil information worldwide, the Food and Agriculture Organization of the United Nations and the Land Use Change and Agriculture Program of IIASA spearheaded a powerful consortium of organizations dealing with applied soil science. They took the initiative of combining the recently collected vast volumes of regional and national updates of soil information with the information already contained within the 1:5,000,000 scale FAO–UNESCO Digital Soil Map of the World to create a new comprehensive Harmonized World Soil Database (HWSD).

This comprehensive harmonized soil information is of critical importance for rational natural resource management and making progress towards achieving food security and sustainable agricultural development. ■

The HWSD database is available on DVD from the FAO and can also be downloaded at:
www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HTML

IIASA RESEARCHER CO-EDITS

Encyclopedia of ecology

Brian Fath of IIASA's Dynamic Systems Program is Associate Editor-in-Chief, with Danish ecologist and chemist Sven Erik Jørgensen, of Elsevier's recently published *Encyclopedia of Ecology*, a five-volume major reference work including over 500 detailed entries on the complete field of ecology, from general to applied. Several IIASA staff members contributed entries to this work: Mahendra Shah (sustainability), Anatoly Shvidenko (deforestation), John Casti (ecological complexity) and Brian Fath (network environmental analysis and ecosystem ecology).

The encyclopedia is the first-ever complete reference in ecology and forms the foundation for the interdisciplinary knowledge required to meet the challenges of sustainability. With its international coverage, it provides the most comprehensive review of the state-of-the-art in ecology and will be a valuable resource to researchers, teachers, students, environmental managers and planners, engineers, and economists. The encyclopedia covers the field of ecology with over 500 concise, stand-alone articles. ■

Available in both hard-copy and digital form:
www.elsevierdirect.com/brochures/ecology

NEW PIN BOOK

Negotiated risks

Negotiated Risks: International Talks on Hazardous Issues, edited by Rudolf Avenhaus and Gunnar Sjöstedt of IIASA's Processes of International Negotiation (PIN) Program, will soon be published by Springer. The book will fill a major gap in risk literature, bringing together two research strands: *risks*, to which IIASA's research programs have contributed significantly over the years; and *international negotiations*, on which there is an abundance of published work, much resulting from IIASA's PIN work.

Throughout the book, it is pointed out that there are actor-driven risks, namely, those posed by international negotiations themselves, and issue-driven risks which are caused by large-scale human activities. In fact, *Negotiated Risks* deals with some of the most serious risks facing humanity: climate change, nuclear activities, and weapons of mass destruction.

The volume contains scientific analyses on the nature of internationally negotiated risks and analyses of concrete risks, both of practical relevance in international negotiations. ■

IIASA's Processes of International Negotiation Program
www.iiasa.ac.at/Research/PIN

The following new research projects have all been funded by the Seventh Framework Programme for Research and Technological Development (FP7). The programme is the European Commission's main instrument for funding research in Europe between 2007 and 2013 with a budget of over €50 billion.

Part of IIASA's success in raising funds from FP7 stems from the Institute's expertise in researching complex issues that cross both national and disciplinary boundaries—a research priority for the European Union. IIASA's large network of collaborators across the world also facilitates building the research consortiums necessary to investigate such multifaceted challenges.

AIR POLLUTION HOTSPOTS

CityZen for environment

IIASA is one of 16 organizations participating in CityZen, a three-year project that uses extensive satellite and in situ observations to investigate air pollution in and around various hotspots. IIASA's Atmospheric Pollution and Economic Development (APD) Program will produce emission scenarios and propose mitigation strategies for CityZen, which aims to determine the distribution of and changes in air pollution over the last decade.

The focus of CityZen (megaCITY—Zoom for the ENvironment) is on ozone and particulate matter and their precursors and will include particularly intensive case studies on the Eastern Mediterranean (Istanbul, Athens, Cairo), the Po Valley, the BeNeLux region, the Pearl River Delta in China (with megacities Guangzhou and Hong Kong), and the hot and polluted European summer of 2003.

IIASA will help develop a set of models at urban, regional, and global scales to quantify how the observed air pollution arises. Feedbacks on how climate change may be causing changes in air pollution in and around hotspots, and how hotspot pollution can change precipitation and temperature/albedo will be studied using global climate model scenarios coupled with a high resolution chemistry–climate model. The models will also be used to analyze options to reduce greenhouse gas emissions in and around hotspots. ■

IIASA's Atmospheric Pollution and Economic Development Program
www.iiasa.ac.at/Research/APD

LAND USE CHANGE AND AGRICULTURE

IN-STREAM on stream now

IIASA's Land Use Change and Agriculture (LUC) Program is one of eight partners in IN-STREAM, a collaborative research project to better integrate mainstream economic indicators with sustainable development objectives. It is scheduled to run until mid-2011.

Mainstream economic measures, like GDP, though influencing public and private decisions in Europe, are flawed as measures of human welfare. They also give little information as to whether the market is helping Europe make progress on its environmental goals and its commitment to sustainable development.

Mainstream economic measures are still the dominant indicators of human progress, despite the significant work undertaken on sustainability indicators and green accounting measures in the last two decades. However, there is now a renewed interest and momentum on the part of policymakers and researchers in developing headline indicators that go beyond economics to more comprehensively assess societal progress.

The IN-STREAM project will undertake the qualitative and quantitative assessments necessary for linking mainstream economic indicators with key well-being and sustainability indicators. It will thus provide insight into the synergies and trade-offs implicit in Europe's simultaneous pursuit of economic growth and environmental sustainability.

LUC will improve quantitative models linking indicators and build on previous modeling and statistical work that has attempted to bridge the gap between macroeconomic indicators and sustainability measures. Based on these analyses, recommendations for new indicator approaches will be proposed and strategies for implementing these approaches will be identified and developed in consultation with stakeholders. ■

IIASA's Land Use Change and Agriculture Program
www.iiasa.ac.at/Research/LUC

FORESTRY

Busy bee

IIASA's Forestry (FOR) Program is a partner in Biomass Energy Europe (BEE), a 33-month project focusing on the availability of biomass for energy in Europe and its neighboring countries. The aim of the BEE project is to harmonize biomass resource assessments to improve their consistency, accuracy, and reliability as part of planning a transition to renewable energy in the European Union.

The project activities include (i) analysis of recently conducted biomass resource assessments; (ii) analysis of policy backgrounds, sustainability criteria, and user requirements; (iii) analysis of currently applied methodologies; (iv) inventory of data sources and ongoing activities

aimed at improved data quality and accessibility; (v) elaboration of a proposal for a harmonized biomass potential assessment methodology; and (vi) illustration and validation of the approach developed in case studies at the EU27, Pan-European, and selected country levels (e.g., Finland, Ukraine, Croatia, and Macedonia). IIASA's FOR will play a central role in leading the work on case studies.

BEE explicitly focuses on methods using earth observation and terrestrial data for biomass assessments and the integration of multiple data sources. The

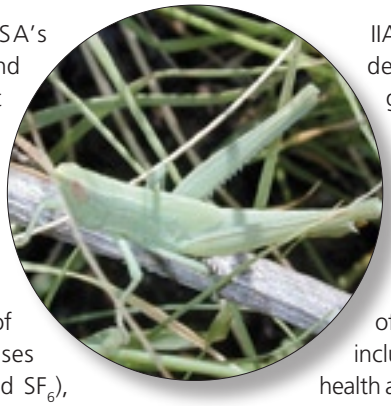
Biomass Energy Europe

relevant sectors being investigated are forestry, energy crops, and residues from traditional agriculture and waste. There will be intensive scientific cooperation and discussions with stakeholders, including the European Commission's Directorate Generals, European Environment Agency, Eurostat, United Nations Economic Commission for Europe, United Nations Food and Agriculture Organization, national ministries, and research organizations, on the objectives, and the interim and final results, and distribution of these. ■

Biomass Energy Europe (BEE) project
www.eu-bee.com

ATMOSPHERIC POLLUTION

Costing climate change



Researchers from IIASA's Atmospheric Pollution and Economic Development (APD) Program are participating in a new project, funded by the European Commission, to assess emissions of air pollutants (SO_2, NO_x, PM, NH_3, VOC) and emissions of non-CO_2 greenhouse gases (CH_4, N_2O, HFC, PFC, and SF_6), and to calculate the costs of controlling these emissions.

The new project, Energy and Climate System Modelling, uses IIASA's Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model to project future emissions for the current EU27 countries, the accession countries (Turkey, Croatia), Norway, Switzerland, and possibly other countries of the former Yugoslavia.

IIASA scientists will study the development of pollution-generating activities across Europe from 2000–2030 and the control measures required for the enforcement of EU-wide and national emission and fuel standards. An investigation of the effects of pollution, including impacts on human health and acidification and eutrophication of ecosystems is also included in the study, as is an analysis of the effects of policies to reduce air pollution from shipping on environmental impact indicators.

The IIASA team will work to determine costs of mitigation of air pollutants and greenhouse gases for the 2000–2030 period. ■

IIASA's Atmospheric Pollution and Economic Development Program
www.iiasa.ac.at/Research/APD

EVOLUTION AND ECOLOGY

Cooperation benefits

Photo: Yummifruitbat

Ulf Dieckmann of IIASA's Evolution and Ecology Program (EEP) is one of eight principal researchers to elucidate mechanisms fostering cooperation between species. Selected by the European Science Foundation and funded by agencies in Austria, France, Hungary, Portugal, and the USA, the research project BIOCONTRACT brings together empiricists and theoreticians for a three-year period of collaboration until mid-2011.

In biology, mutualisms are interactions between species that result in net benefits for both partners. BIOCONTRACT takes a cross-disciplinary approach and applies contract theory from economics to investigate how the evolution of "natural contracts" between partner species secures the mutually advantageous exchange of benefits between them. The research draws and expands upon the economic theory of self-enforcing contracts to investigate how mutualisms persist in the face of potential exploitation by cheaters, that is, by organisms that reap the benefits of mutualism without reciprocation. Mutualisms, just as all other systems of cooperation, are threatened by the well-known "tragedy of the commons"—when benefits can be obtained (or costs avoided) by cheaters, cooperation is likely to dwindle and cooperative systems are bound to collapse. BIOCONTRACT will parameterize cooperation models with data from a suite of empirical systems and will analyze these models to reveal general mechanisms that promote and maintain cooperation in diverse systems. ■

IIASA's Evolution and Ecology Program
www.iiasa.ac.at/Research/EEP

CASPIAN DIALOG

Bridge building in the Caspian Sea

Caspilog 3 takes place in Kazakhstan

When the Tehran Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention) was signed in 2003, a spokesman for the then UN Secretary-General Kofi Annan praised the message it sent to the region's people and to the world that "multilateral cooperation for sustainable development is not only essential but possible."

At the signing, Iran's Special Envoy for Caspian Sea Affairs, Mehdi Safari, announced that the Tehran Convention would prepare ground for cooperation between the Caspian Sea littoral states in various fields: a tall order, given the contentious nature of political relations between some of the five states that existed at the time. Privately, however, Iranian scientists and government officials were consulting with members of IIASA's Processes of International Negotiation (PIN) Steering Committee—then in Tehran to conduct a PIN Roadshow—about ways of affecting such a rapprochement.

The Tehran Convention requires the five countries—Azerbaijan, the Islamic Republic of Iran, Kazakhstan, the Russian Federation, and Turkmenistan—to prevent and cut pollution, restore the environment, use resources sustainably, and cooperate more to protect the environment. Bringing all Caspian parties together to discuss these issues was a delicate diplomatic balancing act, but PIN managed to do this through the Caspian Dialog (Caspilog), the third session of which took place on 3–4 October 2008 in Almaty, Kazakhstan, co-organized by PIN and the Institute for World Economy and Politics (IWEP).

Altogether, 80 delegates from the five countries came together in the magnificent setting of the Presidential Palace in Almaty to discuss fisheries, land use, energy, terrorism, and security. It is a measure of the success of the two previous Caspilog meetings (in 2006 in Istanbul, shortly before the entry into force of the Tehran Convention, and in 2007 in Baku) that this mixed grouping of state officials, environmentalists, academics, and non-governmental organizations in Almaty was able to reach consensus on a resolution: their very first as a body. The resolution (see box, *right*), which draws attention to imminent environmental threats to the region and calls for greater cooperation in the wake of political tensions, has since been forwarded to the relevant government ministries in the five countries.

So what has been PIN's role in the Caspilog series and how has PIN members' negotiation expertise helped representatives of the five Caspian Sea states reach consensus at only their

The Caspian crisis

The Caspian is the largest inland body of water in the world, with a surface area of 384,400 km^2 and a coastline nearly 7,000 km long. The Caspian is known for two key natural resources: oil and natural gas reserves, and caviar-producing fish sturgeons. Five countries border the Caspian Sea—Azerbaijan, the Islamic Republic of Iran, Kazakhstan, the Russian Federation, and Turkmenistan.

The conflicts in the Caspian region are intertwined in the sense that political, legal, economic, and environmental considerations cannot always be separated from each other. The recent developments in Georgia have strained relations between the Caspian littoral states, further reducing their capability and willingness to address common problems in the region. Moreover, the Caspian Sea littoral states are involved in several conflicts not only among themselves but also with other neighboring countries such as Turkey, Armenia, Uzbekistan, and Georgia. Continuing uncertainty over the status of Iran's nuclear capability only adds to the tensions.

The Caspilog 3 resolution

The Caspilog 3 resolution calls for the establishment of a joint international commission of technical experts from each of the five countries to oversee the management of pollution, radioactive waste, crude oil contamination, endangered biodiversity, desertification, rising sea level, and the near extinction of sturgeon species, which are prized for Beluga caviar. The commission, which would coordinate its activities outside the contentious political realm, would conduct independent fact-finding missions on fisheries, coastal development, and aquatic and bio-resources. Notably, delegates called for a reduction in fishing within the sturgeon fisheries in the Caspian Sea until a multilateral stock assessment and management framework has been established and implemented, and they also wanted better enforcement of the ban on fishing in the Sea itself.

It was also vital, the resolution stated, to integrate all the industrial aspects of Caspian regional development with measures on the protection of Caspian biodiversity and natural resources (rare species of sturgeon, seals, and birds). The Caspian Basin itself, delegates said, should be demilitarized to promote security and stability in the region and enable confidence-building measures to be pursued. Moreover, a Caspian Fund should be established to support humanitarian projects in the five states. ■

Photo: NASA

Environmental problems are causing internal conflicts, with the rising sea level forcing the resettlement of populations from 50 small cities and settlements, as well as hundreds of small villages, away from the Caspian shores—and this in Azerbaijan alone. Over 10,000 houses in the coastal cities of Iran have been damaged and destroyed as a result of rising sea levels. If the sea levels rise by 0.25 m, Russia will lose 16,500 km^2 of land and will be forced to evacuate 100,000 people.

More than 1,400 oil wells and industrial areas are currently contaminating Caspian waters. The rising sea level threatens to flood hundreds more oil wells, as well as industrial areas, causing further contamination. Biodiversity in the Caspian Sea is decreasing, as indicated by the near extinction of several sturgeon species and other species that support human needs.

As mistrust allows only limited space for interaction, these tensions and the instability in the region are at the root of the failure to comprehensively address the imminent environmental collapse threatening the Caspian Sea and the Caspian region in general. ■

third meeting? Crucially, PIN invited IIASA scientists working on fisheries, water, air pollution, and other Caspian-related issues, to make presentations and provide expertise at each Caspilog. It was a "back-to-basics" approach. There was no point in beginning discussions before the objective facts of the issues affecting the shared environment were known: substance was needed. The shared knowledge could then be built up over time, encouraging a problem-solving approach, and thus, ultimately, the formulation of consensual decisions.

Perhaps one of the most important aspects of Caspilog 3 was its symbolism, in the sense that it represented the point at which those involved in the Dialog began to take ownership of it.

"Problems related to security, energy, terrorism, forestry, and water management affect all states in the region and can be best addressed through cooperation and partnership.... IIASA's role in Caspilog is to help create an environment where all parties can be heard, and their views understood."

—I. William Zartman

Around 50 percent of the experts invited to advise the discussants were local, with PIN's Kazakh partners inviting many of their own scientists and experts. This was a very important development as, from the beginning, the organizers had stressed the importance of "Cooperation—Partnership—Ownership."

As I. William Zartman of the PIN steering group states: "Problems related to security, energy, terrorism, forestry, and water management affect all states in the region and can be best addressed through cooperation and partnership. The problems faced in the Caspian Region, require sound science. Using this science to help people agree on how they want to resolve an issue, has proved very beneficial. IIASA's role in Caspilog is to help create an environment where all parties can be heard, and their views understood."

Kazakhstan's coming chairmanship of the Organization for Security and Co-operation in Europe (OSCE) in 2009 was seen by delegates to Caspilog 3 as a chance to address environmental issues and put the Caspian Sea on the international agenda.

The next Caspilog—Caspilog 4—will focus on transportation, migration, and energy. It will be held either in Astrakhan, Russia, or in Turkmenbashi, Turkmenistan. The PIN network is looking for possible co-organizers, preferably local institutions. ■

Further information IIASA's Processes of International Negotiation Program at www.iiasa.ac.at/Research/PIN

Ariel Macaspac Penetrante is Coordinator of IIASA's Processes of International Negotiation Program.

THE NITROGEN PROBLEM

100 years of ammonia synthesis

How a single patent changed the world

As a result of the Haber–Bosch process for the synthesis of ammonia from atmospheric nitrogen, billions of people have been fed, millions have died in armed conflict, and a cascade of environmental changes has been set in motion—suggests a feature article by scientists from four of the world's leading environmental research centres that was published 30 September in *Nature Geoscience*. The feature appears 100 years after Fritz Haber filed his patent on the "synthesis of ammonia from its elements," for which he was awarded the 1918 Nobel Prize in Chemistry.

The article explains that we now live in a world transformed by, and highly dependent upon, Haber–Bosch nitrogen. This extra nitrogen has allowed large scale production of explosives with the result of millions of casualties. On the other hand, it has created an enormous chemical industry producing materials and goods for society. The major impact, however, has been the large scale production of fertilizers supporting almost half of the world's population through increased food production.

While the use of nitrogen as a fertilizer has brought enormous benefits, losses of fertilizer nitrogen to the environment continue to cause many harmful effects. These include reduced biodiversity and the formation of marine algal blooms. Furthermore, nitrogen compounds endanger the quality of drinking water, and contribute to air pollution as well as climate change, affecting life quality and the health of large parts of the population.

Future scenarios

Future scenarios suggest that such problems will become more extreme, with a potential doubling of fertilizer use predicted over the coming century (see figure). This demand is partly driven by the growing requirement for "nitrogen hungry" biofuels. These environmental challenges highlight the need for a new invention, as transforming as the Haber–Bosch process that would benefit both society and the global environment.

The future scenarios of global nitrogen fertilizer consumption were developed at IIASA and, while based on the four storylines developed for the Intergovernmental Panel on Climate Change's *Special Report on Emission Scenarios* (see *Options*, Winter 2006, page 10), they include additional drivers affecting the projections.

"Population growth is the main driver behind the increase in nitrogen fertilizer use," explains Zbigniew Klimont, who developed the future scenarios with Wilfried Winiwarter. "Changes in diet will also increase nitrogen usage." The researchers expect meat consumption to increase in developing countries to the level observed in developed countries. Increased meat production will increase nitrogen usage because of the additional nitrogen required to produce animal feed and the inefficiency of nitrogen use in meat-based diets relative to plant-based diets.

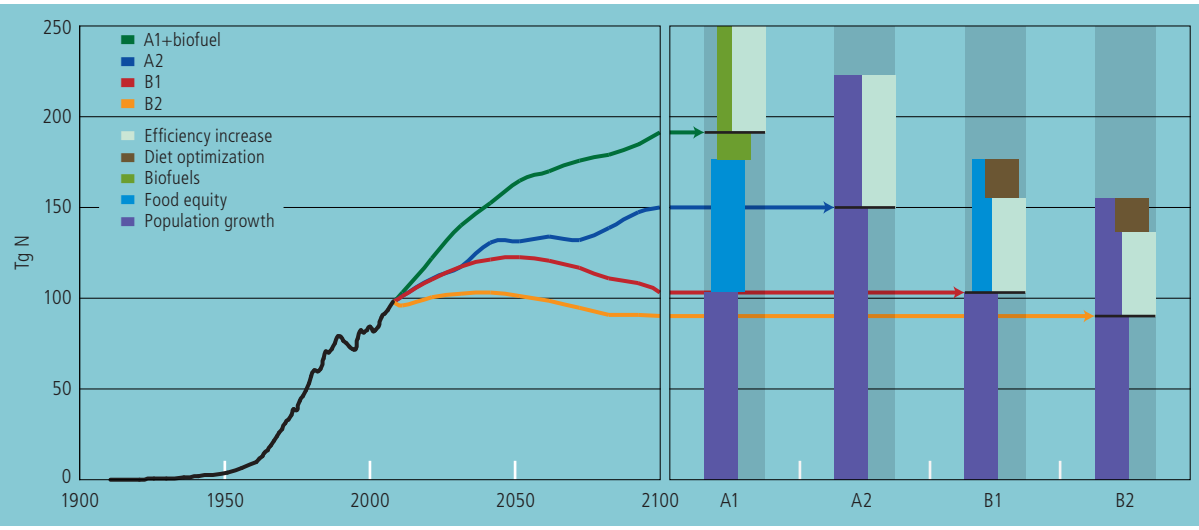
"Fortunately, an expected increase in nitrogen-use efficiency will alleviate part of the problem of growing nitrogen use," says Dr. Winiwarter. "Only when bioenergy calls for a large increase in crop production is the demand for nitrogen fertilizer projected to double to nearly 200 Tg N per year. Unfortunately, even if the overall increase in the scenarios will remain moderate, the nitrogen problem is going to stay with us for decades to come."

The feature concludes by arguing that today's society is dependent on a nitrogen-based economy and discusses some of the challenges we are likely to face in the next 100 years.

The global nitrogen challenge is an issue that is set to receive more attention in the future. For example, the European Commission is funding the NitroEurope project, a consortium of over 60 research institutions, including IIASA, which is investigating the effect of nitrogen on global warming. Its results will feed into the work of the "Task Force on Reactive Nitrogen," recently established by the United Nations Economic Commission for Europe (UN-ECE). ■

Further information Erisman JW, Sutton MA, Galloway J, Klimont Z & Winiwarter W (2008). How a century of ammonia synthesis changed the world. *Nature Geoscience,* 1:636–639 (01 Oct 2008). www.nature.com/naturegeoscience

Zbigniew Klimont and **Wilfried Winiwarter** are Research Scholars in IIASA's Atmospheric Pollution and Economic Development Program. Dr. Winiwarter is also a Research Scientist at the Austrian Research Centers.



FUTURE DEMAND FOR NITROGEN FERTILIZER Global nitrogen fertilizer consumption scenarios (*left*) and the impact of individual drivers on 2100 consumption (*right*). This resulting consumption is always the sum (denoted at the end points of the respective arrows) of elements increasing as well as decreasing nitrogen consumption. The A1, B1, A2, and B2 scenarios draw from the assumptions of the IPCC emissions scenario storylines.

UN CLIMATE CHANGE CONFERENCE

Insuring against climate change

Insurance instruments for adapting to climate risks

Negotiators that are party to the United Nations Framework Convention on Climate Change (UNFCCC) are discussing how to help countries adapt to climate change. Work from IIASA is feeding into these discussions by showing how insurance mechanisms have a promising and legitimate role in an adaptation regime. It also identifies practical options to include insurance mechanisms in the post-Kyoto adaptation strategy.

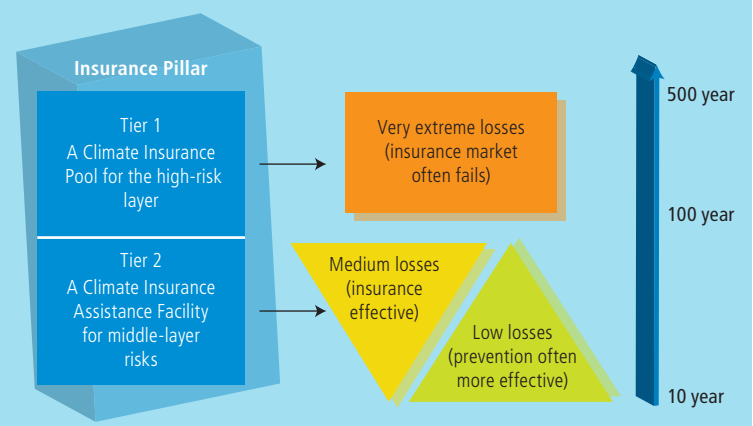
There is now broad scientific consensus that climate change will be contributing to worsening climate variability and extremes, which impose disproportionately large human and economic burdens on developing countries. The cost of recovering from extreme events, such as flooding or hurricanes, is often amplified by the inability of households, businesses, and governments to raise sufficient post-disaster capital for the recovery process. In many cases, insurance can help meet this liquidity gap.

There are large potential benefits for insurance in the developing world: providing security against the wholesale loss of assets, livelihoods, and even lives in the post-disaster period; changing the way development organizations provide disaster assistance and, at the same time, engaging the private sector in vast markets; ensuring reliable and dignified post-disaster relief; setting powerful incentives for prevention; and not least, spurring economic development. There are also many challenges: assuring sustainability and affordability in light of covariate risks; defining an appropriate role of donors in light of the inefficiencies of subsidies; and assuring that systems avoid moral hazard and contribute to "good" investments.

While the benefits and challenges of catastrophe safety nets are uncontested, the role of outside assistance for insurance instruments is highly controversial. Opponents rightly argue that support in the form of subsidies can distort the price signal and encourage mal-adaptation; support in the form of reinsurance can crowd out the role of the private market. Yet, most experts agree that even subsidized insurance systems are in this regard preferred to post-disaster aid, and the reinsurance market is not yet prepared to commit sufficient and affordable capital to markets serving the poor. Experts also agree that outside support should be closely coupled with a risk management program including a vulnerability assessment. Pilot programs are offering a testing ground for the efficacy of international assistance, and these programs should be carefully monitored and built upon by governments, international development organizations, NGOs, private insurers, and the climate-adaptation community.

The case for intervention as part of an adaptation regime is legitimized by the failure of the market, and greatly strengthened by recent evidence that greenhouse gas emissions are contributing to increased weather variability and risks of extreme events. According to the climate convention's principle of *common but differentiated responsibilities and respective capabilities*, industrialized countries are obligated to absorb a portion of this burden.

The Munich Climate Insurance Initiative (MCII), which includes IIASA staff as members, has proposed a two-pillar international risk-management program as part of a post-Copenhagen adaptation regime—financed fully by Annex 1 countries. A *risk prevention* pillar would directly support risk-reduction measures. A two-tiered *insurance* pillar would address high and medium layers of risk (see figure). The first tier takes the form of a Climate Insurance Pool (CIP) that indemnifies victims of extreme catastrophes in non-Annex 1 countries by a percentage of their losses. A second tier takes the form of a Climate Insurance Assistance Facility and provides support to enable micro and national insurance systems to offer cover for middle-layer risks in vulnerable developing countries. The support includes providing technical assistance, capacity building, and possibly absorbing a portion of the insurance costs. Low-level risks would continue to be absorbed fully by respective governments and the private sector.



TWO-TIERED INSURANCE PILLAR AS PART OF AN ADAPTATION FUND

The MCII two-pillar proposal meets the challenge of providing support to promote sustainable, affordable, and incentive-compatible insurance programs for vulnerable households, small and medium businesses, and governments in the developing world, and at the same time enabling private sector involvement. Because of the substantial economies of pooling public and private sector risks, there are strong arguments for creating facilities, like the CIP, at the global or regional scale.

It is hoped that this proposal contributes to the opportunities facing negotiators at the Climate Change Conference (COP 15) in Copenhagen in adopting a comprehensive adaptation strategy that enables risk management and insurance through the funding of a global adaptation strategy. This work was also presented to negotiators at the UNFCCC Climate Change Talks in Accra in August 2008 and at COP 14 in Poznan in December 2008. ■

Further information Munich Climate Insurance Initiative (MCII) (2008). "Insurance Instruments for Adapting to Climate Risks: A proposal for the Bali Action Plan, Version 2.0," MCII Submission to the 4th session of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA 3), Poznan 1–13 December, 2008. Available at www.climate-insurance.org

Dr. Joanne Linnerooth-Bayer is the Leader of IIASA's Risk and Vulnerability Program. **Dr. Reinhard Mechler** is a Research Scholar in IIASA's Risk and Vulnerability Program. **Dr. Christoph Bals** is Executive Director of Germanwatch.

A scientific model aims to help China and India combat air pollution and climate change simultaneously

Clean air in Asia

THE GAINS-ASIA MODEL integrates a number of established economic and environmental models developed by experts at the following institutions:

- IIASA – International Institute for Applied Systems Analysis, Laxenburg, Austria
- ERI – Energy Research Institute, Beijing, China
- TERI – The Energy and Resources Institute, Delhi, India
- JRC-IES – Institute for Environment and Sustainability of the Joint Research Centre of the European Union, Ispra, Italy
- UBERN – The University of Bern, Switzerland

The research was funded by the Sixth Framework Programme (FP6) of the European Commission.

Close collaboration between scientists in China, India, Italy, Switzerland, and IIASA has resulted in a tool to help policymakers in China and India make sense of the complexities of air pollutant controls and greenhouse gas mitigation. Together, the policymakers and scientists hope to identify and implement activities that reduce both air pollution and greenhouse gases in China and India without compromising economic development.

Air pollution is a far more visible and imminent problem for China and India than climate change. Current and future economic growth will cause serious air quality problems in Asia, worsening human health and crop production, unless further air pollution policies are implemented. Statistical life expectancy in India is expected to shorten by over three years by 2030 compared with 2005 because of outdoor exposure to just one air pollutant—fine particulate matter. Another air pollutant, higher ground ozone, is likely to at least triple crop losses of wheat, corn, and rice by 2030.

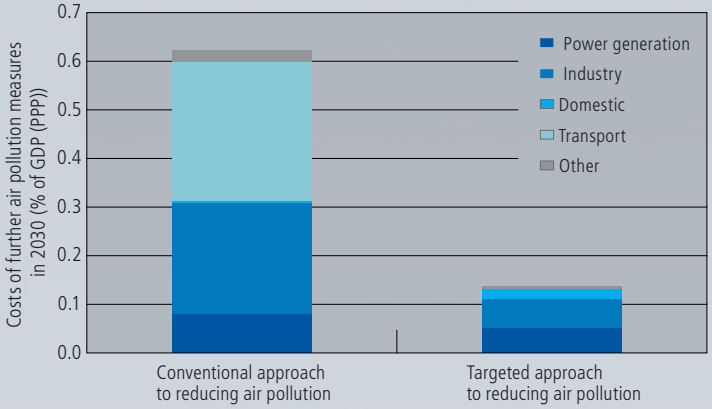
At the same time, increased economic activity will also lead to more greenhouse gas emissions and subsequent climate change. Emissions are expected to grow by a factor of four in China and India by 2030. Yet most of the global warming that will result from the world's greenhouse gas emissions is still in the future. Consequently, governments around the world are postponing taking difficult measures today to reduce emissions.

But what if policies to tackle air pollution could also tackle greenhouse gas emissions at little additional cost? In theory it is possible. Both often come from the same sources. Yet setting the right policies is not easy and needs to resolve complex scientific and political issues, as well as ensure costs are kept to a minimum.

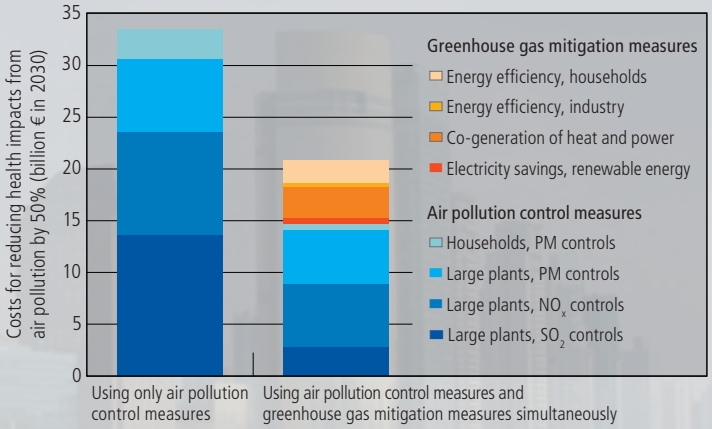
An effective policy must consider all the numerous sources of air pollution and greenhouse gases, ranging from agriculture through industry to transport. Measures to reduce air pollution and greenhouse gases must therefore also be equally numerous. A successful policy must understand the range of air pollutants and greenhouse gas emissions which, individually and in combination, have multiple effects on the environment.

In China and India, different regions generate distinct amounts of air pollution and greenhouse gas emissions; they also feel the effects unequally. The governments must therefore ensure there is a fair division of the clean up costs between regions.

An international team of researchers (see "The GAINS-Asia Model" above) has developed a scientific tool to guide policymakers



REDUCING THE COSTS OF AIR POLLUTION CONTROL Air pollution in China can be reduced far more economically by carefully selecting the most cost-effective portfolio of measures. The left column shows the costs of a conventional, across-the-board approach to reducing air pollutants in 2030. The resulting cleaner air will reduce losses in statistical life expectancy from air pollution by 43%. It will also reduce crop losses by around 50%. The right column shows how China could achieve these same benefits at a far lower cost by using GAINS to carefully identify the most effective and efficient portfolio of emission control measures.



BENEFITS OF TACKLING AIR POLLUTION AND CLIMATE CHANGE SIMULTANEOUSLY To achieve a given target in ambient air quality, China can dramatically save costs by adopting a smart mix of measures to reduce air pollution and greenhouse gas emissions. The left column shows the most cost effective way for halving negative health impacts from air pollution using only air pollution control measures. The right column shows how much more cheaply the same target can be reached using measures to lower air pollution and greenhouse gas emissions simultaneously. This cost savings also results in a 9% reduction in greenhouse gas emissions.

Photo © Phillip Gray | Dreamstime.com

LESSONS LEARNED IN EUROPE

Twenty years ago, acid rain ravaged Europe, turning trees yellow and killing populations of fish. Caused by air pollution, acid rain is now under control in Europe, thanks, in part, to the role played by IIASA.

Today, air pollution remains harmful, but its effects, such as causing respiratory diseases, are often less visible. Fortunately, plans now in place will clean Europe's air over the coming 15 years adding, on average, three months to the lives of people living in Europe through improved health. Once again, IIASA's research has played a vital role.

Cleaning up Europe's air has not been easy. It has required an effective environmental policy to reduce air pollution in over 30 European countries, and making the policy has required resolving complex scientific and political issues.

IIASA's scientific model RAINS (Regional Air Pollution Information and Simulation) has helped European countries resolve such issues by showing various strategic options to achieve long-term environmental goals at the lowest possible cost. Europe's nations used this scientific tool to help negotiate the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe. Since the 1980s, the Convention has dramatically reduced emissions, first for sulfur dioxide and then for many air pollutants simultaneously.

GAINS Asia (see main text) enables China and India not only to follow this successful approach, but also, thanks to advances in the model, to leapfrog European practices and tackle both air pollutants and greenhouse gas emissions together. GAINS Asia is the result of three years' work by an international, multidisciplinary team of researchers to develop and expand RAINS to offer an integrated analysis of air pollution and greenhouse gas emissions in China and India. ■

through this complex process of air pollutant control and greenhouse gas mitigation in China and India. Known as GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies), this state-of-the-art interdisciplinary model builds on a scientific tool that has already helped European governments slash air pollution across the continent without compromising economic development (see "Lessons learned in Europe" below).

There are two broad methods to cut air pollution: either reducing the levels of activities that emit the pollutants; or not changing production and consumption levels but controlling the waste they produce. The latter method is known as end-of-pipe emission control technology and, by fully applying existing technical measures, Asia can avoid serious deterioration in air quality. However, such an undifferentiated across-the-board approach would impose significant burdens on the economy.

An optimized emission control strategy, which selectively allocates specific reduction measures across economic sectors, pollutants, and regions, could achieve equal air quality improvements at only 20% of the costs of a conventional across-the-board approach (*top chart*). The GAINS optimization tool allows a systematic search for those measures that ensure total emission control costs are minimized. For Asia, an integral element of such an air pollution control strategy will be measures to eliminate indoor pollution from the combustion of solid fuels.

Well-designed air pollution control strategies can also reduce emissions of greenhouse gases and vice versa. Climate-friendly measures such as energy efficiency improvements, cogeneration of heat and power, fuel substitution, and integrated coal gasification combined cycle plants, reduce, simultaneously, air pollution and greenhouse gas emissions. For example, for China, India, and Europe, GAINS estimates that each percent of CO_2 reduction will typically reduce health impacts from fine particulate air pollution by 1%.

Indeed, a smart mix of measures to simultaneously cut air pollution and greenhouse gas emissions will help combat climate change and air pollution more cheaply than tackling either issue separately. GAINS demonstrates that China, by selecting such a smart mix of measures, can almost halve air pollution control costs as well as lower greenhouse gas emissions by 9% (*bottom chart*).

GAINS helps policymakers identify the best strategy to tackle air pollution and greenhouse gas emissions by acting as a scenario-generating device. It helps users understand the impacts of future actions—or inaction—and design strategies to achieve long-term environmental goals at the lowest possible cost. With a few days of training, scientists, civil servants, politicians, and other non-technical users can pose any number of "what-if" questions to GAINS: How much would it cost to reduce air pollution levels to a given standard for all of India? For the worst-affected areas only? What is the cheapest way to reduce the health impacts of air pollution on China's population? What air pollution controls maximize the reduction of greenhouse gases? Fed with the relevant data for China and India, GAINS gives answers to such questions within minutes. ■

Further information IIASA's GAINS model is freely accessible on the Internet at http://gains.iiasa.ac.at

Dr. Markus Amann is the Leader of IIASA's Atmospheric Pollution and Economic Development Program. **Dr. Fabian Wagner** is a Senior Research Scholar in IIASA's Atmospheric Pollution and Economic Development Program.

The exceptional role of the global forest in human life is well known. But there are not enough forests in the world, and those that exist are facing dramatic challenges. Over the past 15 years, in the tropics alone, deforestation has accounted for 13 million hectares annually.

Bridging science – policy – practice

Poor forest governance in many countries has resulted in over-exploitation of forests for fiber and fuel, as well as a growth in illegal logging. Add to that the negative impacts caused by global warming and increasing climate instability, and one sees very clear threats to the vitality and survival of forests in many regions, particularly where forest cover is limited. For example, although many countries declare that they are in transition to sustainable forest management, we are far from its practical implementation in most regions of the world.

If we are to understand the current and future functioning of the Earth system and make appropriate decisions concerning its future, then knowledge of the condition of global forests—the way they are developing, their protective role for other land uses (particularly agriculture), and their response to changing environmental, social, and economic processes—is vital.

Original tree cover

Current tree cover

DEFORESTATION
The spread of agriculture and animal husbandry, the harvesting of forests for timber and fuel, and the expansion of populated areas have all taken their toll on forests. About half of the forest that was present under modern (i.e. post-Pleistocene) climatic conditions, and before the spread of human influence, has disappeared, largely through the impact of man's activities.

The complexity of the world forest's problems is accelerating. Understanding this complexity requires new methodologies and new approaches. At IIASA's Forestry (FOR) Program, we use *system integration* as a basic philosophical background—combining diverse information sources, particularly remote sensing and models of different nature, and accounting for the input and interests of all stakeholders. *Integrated modeling* is then used to explain the functioning of complex and heterogeneous systems. This allows us to project, among other things, how changing environment, ecology, management needs, market pressures, and social processes may affect forests. Using these methods, FOR explores the interaction and integration between the many diverse areas of the world and their overall combined impacts and then presents various options of potential use to policymakers.

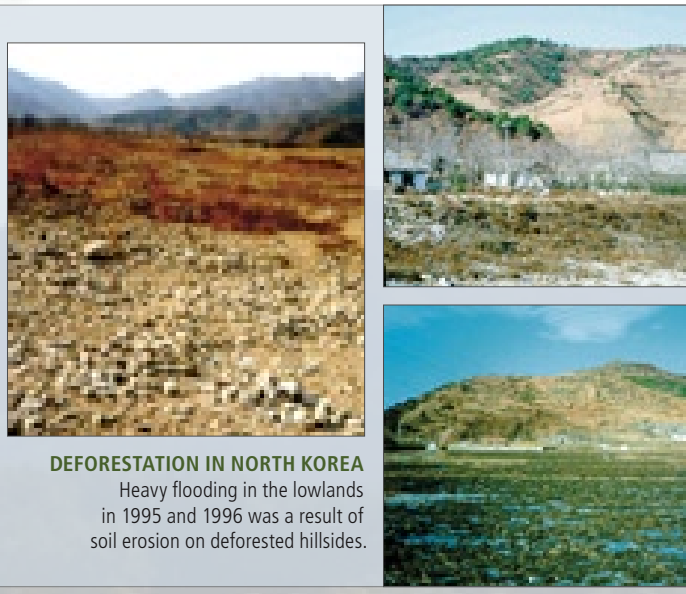
As in any complex fuzzy system, "absolute certainty" is impossible, but this methodology is valuable in that it allows us to evaluate the reliability of our responses to the scenarios and questions posed. This means that decisions to deal with acute environmental problems that could cause large or irreversible losses to forests in the future need not be postponed by policymakers.

IIASA's interdisciplinary and interactive approach to understanding complex systems enables our scientists to develop solutions to otherwise intractable problems. Indeed, IIASA's forest experts are building bridges worldwide (see "A forest tale of two Koreas," page 16), not only through scientific research, but also through expert input to numerous international activities, including the Intergovernmental Panel on Climate Change. Here, however, I will confine myself to giving three examples of the ways in which FOR research has recently been able to build bridges between science and policymakers. ▶

A forest tale of two Koreas

The 952 sq km demilitarized zone (DMZ), established across the middle of the Korean Peninsula in 1953, is a bleak reminder of the Cold War and East–West tensions. North and South Korea have pursued completely different development paths during the years of division. At the end of the Korean War, the two countries were the poorest in Asia: even in 1961, South Korea's per capita gross domestic product (GDP) was about US$ 79. But while South Korea successfully undertook 20 years of industrialization and is now the 13th largest economy in the world, with a per capita GDP of US$ 24,700, North Korea is still among the world's poorest countries, with a per capita GDP of about US$ 1,900 in 2007.

One of the most popular explanations for this disparity is the closed and centrally planned economy in the North versus the open and free market economy in the South. However, a more interesting and controversial reason for such different development paths might be seen in the context of the condition of the forests in the two Koreas.



DEFORESTATION IN NORTH KOREA
Heavy flooding in the lowlands in 1995 and 1996 was a result of soil erosion on deforested hillsides.

South Korea

South Korea was traditionally a rice-growing country, while North Korea was forested. After 40 years of Japanese occupation and three years of Korean War, the entire Korean Peninsula was severely depleted of natural resources and heavily deforested, with just 10 m^3 standing timber per hectare (ha) in the South and 15 m^3 per ha in the North.

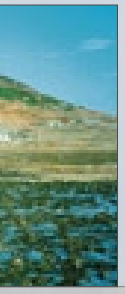
South Korea began a massive government-led reforestation campaign in the early 1970s to halt further soil erosion and generate jobs for thousands of families in the rural areas. Through a tremendous national and human effort, South Korea reforested its entire country within just one decade. In no other part of the world has reforestation on such a large scale ever been seen. Since the reforestation measures, South Korea's forest land has decreased only by 3 percent, mainly because of urban and industrial development. South Korea now boasts 98 m^3 of growing stock per ha, a nearly tenfold increase over the 1960s. Forests in South Korea provide valuable environmental and recreational functions, especially to people living in heavily industrialized and urbanized areas. Stabilizing the ecosystem by reforestation has also proved a solid foundation for economic development in South Korea.

REFORESTATION IN SOUTH KOREA
South Korea began a government-led reforestation campaign in the 1970s. The area of land depicted in the photos to the right—at Tap-dong of Kosung-gun, Kangwon Province—was reforested in 1979. The photos show the area before reforestation (*top*), one year after reforestation (*middle*), and five years after reforestation (*bottom*).

The first example is IIASA's continuing insistence that countries must improve how they monitor progress towards meeting their commitments to lower greenhouse gas (GHG) emissions under the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). For instance, the Protocol and subsequent decisions have introduced into wide international practice within the domain of land use, land use change, and forestry (LULUCF) only a partial accounting of major GHGs, limited to the so-called managed biosphere. It thus presents only a partial picture of human intervention in the atmosphere. To give one short example, direct carbon emissions from wild vegetation fires in the "unmanaged biosphere" in Russia in 2003 were higher than the overall target of the entire Kyoto Protocol. Moreover, partial accounting does not allow solid analysis of uncertainties because evaluating impacts on only part of a system is insufficient in terms of assessing the responses and feedbacks of the entire system.

In recent years, FOR has developed new methods, known as full greenhouse gas accounting (FGGA), to more effectively verify a country's GHG emissions. Based on the experiences from Austria, Russia, and Ukraine, FOR has demonstrated the possibility of elaborating national and macro-regional FGGA with uncertainties acceptable for policymakers. The FGGA approach would clearly need specialized background information and accounting systems, but because of FOR, the FGGA approach is gaining greater currency in the global change community in discussions about the future development of the Kyoto Process after 2012. This is an important step forward in efforts to curb global emissions.

A second example is FOR's contribution to the European Commission–funded Integrated Sink Enhancement Assessment (INSEA) project. Forests store carbon, and they act as carbon dioxide sinks when the forest increases in density or area. Sink enhancement measures are seen as instrumental in attaining climate mitigation goals, and could simultaneously become a major driver of how our natural environment is managed. The overall objective of INSEA was to develop an analytical tool to assess, in a geographically explicit fashion, the economic and environmental effects of LULUCF measures in the short and long term. The European Commission is using the information generated by FOR and its partners to support the formulation and implementation of European Community policies, coherent across the various regions and sensitive to changes in policies as



North Korea

Since the 1970s, North Korea has increased deforestation by 33 percent to 6.7 million ha. There are many reasons for this. North Korea started building its economy under a Communist regime with inefficient central planning and collective farming. It logged heavily, not only to satisfy domestic timber and energy demands, but also to generate foreign currency income by exporting logs to China. It began experiencing food and energy shortages in the 1970s, although it did receive aid and subsidies from China and the former Soviet Union to help fill the food and energy gaps.

After the former Soviet Union collapsed in the early 1990s, North Korea experienced increasingly serious food shortages. With the former Communist allies no longer sending food, fertilizer, and fossil-fuel subsidies, North Korea started clearing forest to create more farmland and supply fuelwood. The price of deforestation was huge. One result was intensive soil erosion on cleared hillsides, causing heavy flooding in the lowlands in 1995 and 1996 and ruining crops. A chain reaction of crop failure—famine—economic crisis created social and political instability, which contributed to a buildup of tensions on the Korean Peninsula and in the world.

Bridging the two Koreas through forestry projects

Today, North Korea is where South Korea was some 40 yeas ago. Reforestation would be an excellent way of stabilizing and driving the economy, providing jobs, protecting against soil erosion and flooding, and providing further related ecosystem services that could strengthen the food and (bio)energy sectors.

Knowledge transfer from South Korea could form the foundations of a stable bridge between the separated countries in that it would not be a politically based project, but would include North Korea in the transboundary problem of climate change, rather than further excluding it. Considering that South Korea is the 10th biggest CO_2-emitting country in the world, helping reforest its neighbor would be an excellent project for South Korea in terms of meeting its responsibility for reducing carbon emissions under the Clean Development Mechanism of the Kyoto Protocol, likely to be imposed on South Korea after 2012.

South Korean nongovernmental institutions (NGOs) have made humanitarian efforts to help North Korean reforestation efforts, but these were small-scale and usually one-off events. While the South Korean government is in a unique position to transfer its know-how to help North Korea, it has claimed unique responsibility for improving the forest situation in the North and has prevented the involvement of the international community. It is thus important to draw attention to the reforestation issue in North Korea and promote it as a meaningful project for ecological restoration and peace in Northeast Asia.

With South Korea having become a member of IIASA in 2007, it is hoped that the Institute, as a nongovernmental and international research institute originally established as a scientific bridge between East and West, can contribute to initiating such an integrative reforestation project in North Korea. ■

Professor Kwang-Il Tak researches at the Forest Science College at Kookmin University, Seoul, Korea and in IIASA's Forestry Program. **Florian Kraxner** is a Research Scholar in IIASA's Forestry Program.

Photos: National Forestry Cooperatives Federation, South Korea

they take place. Within the European Union itself, the findings of this project are supporting implementation of Kyoto Protocol commitments and providing consistent, fair, and neutral background information for negotiations within and outside the EU, notably as guiding information for post-Kyoto negotiations.

The third example is a successor of INSEA, the CC-TAME project (Climate Change—Terrestrial Adaptation and Mitigation in Europe), which touches upon new layers of understanding of global change in Europe. The project aims to provide consistent policy analysis across sectors within the entire land-use sector based on the data–model–policy fusion concept. This approach guarantees efficient and effective mitigation and adaptation in the land-use sector and maximizes benefits from coordination of the EU climate mitigation and adaptation policy with other EU policies like the Common Agricultural Policy (CAP), Rural Development Strategy, EU Forestry Strategy, and Clean Air and Water Policies.

CC-TAME demonstrates a new step in bridging science and policy: not only does it display the traditionally important "policy relevance," but it also builds a strong science–policy interface by delivering timely, relevant, and understandable information from state-of-the-art policy impact assessments provided to the policy community.

Understanding the processes of transition of the world forest sector to sustainable development requires the development of policies able to foster this transition. In fact, a "meta-integration" of even more complicated and poorly organized systems should be considered, and a corresponding methodology is needed that takes into account the rapid changes in, and new challenges to, the contemporary world within the context of globalization. This is particularly important for FOR's ongoing research in, for example, the forest sector in the global economy, international governance of the global forests, and other forestry-related issues.

The world's forests stand at the junction of environmental, economic, social, and political problems, placing new responsibilities on and challenges to forest scientists. Providing a sound contribution to this process is among the most important of FOR's tasks today. ■

Further information IIASA's Forestry Program at www.iiasa.ac.at/Research/FOR; the INSEA project at www.insea-eu.info; and the CC-TAME project at www.cctame.eu

Professor Anatoly Shvidenko is Acting Leader of IIASA's Forestry Program.

EVOLUTION AND ECOLOGY

When fish adapt to fishing

Building a scientific consensus about the evolutionary consequences of commercial fishing

Commercial fishing is a major industry that has been hard-hit by falling catches in many regions of the world. As a result, fisheries bodies have welcomed research into ways of maximizing sustainable catches. But one area of research, long neglected by international organizations, suggests that commercial fishing on the present scale is causing dramatic evolutionary changes in fish species. This research, developed and extended by IIASA scientists, has recently been recognized by the International Council for the Exploration of the Sea (ICES), the organization that coordinates and promotes marine research in the North Atlantic.

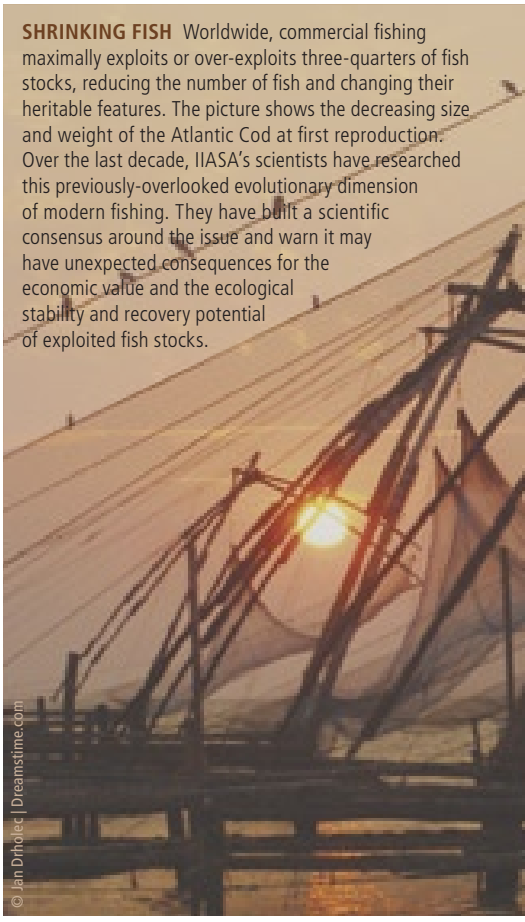
Further recognition came with the publication of an article in the *Policy Forum* section of the prestigious American magazine *Science* (23 November 2007). Under the title "Managing evolving fish stocks," 17 authors from 11 different institutions—with IIASA serving as coordinator of the underlying network—describe how current fishing practices appear to alter the genetic make-up of exploited stocks with unexpected consequences for economic yields, as well as for the ecological stability and recovery potential of exploited fish stocks.

According to one author, Ulf Dieckmann, Leader of IIASA's Evolution and Ecology Program, the research that started at the Institute in 1999 followed pioneering work carried out a decade earlier that had raised pertinent questions about the evolutionary consequences of fishing without, however, engaging a broad basis of scientists or practitioners.

"Monitoring the size of fish catches was something that national agencies had been undertaking for many years, but their chief role was to support their country's fishing economy," says Dieckmann. "Observation and analysis of the collected catch data revealed that over several decades, not only were overall fish populations in decline, but also the body size at which fish started to reproduce dropped. For example, a typical cod caught off the Norwegian coast that used to take up to 10 years to mature was now maturing at the age of only six years."

"As a result, these fish are smaller and thus produce far fewer eggs at their first reproduction. This is just as expected from evolutionary theory: fish that postpone reproduction for too long are caught before they can contribute to the next generation, which is thus made up of fish that are genetically predisposed to mature earlier."

Those early observations pointing to the evolutionary impact of fishing had been published in the late 1980s by Richard Law of York University and Adriaan Rijnsdorp of the Netherlands Institute for Fisheries Research. This was a radical hypothesis for fisheries science because discernible evolution was then still thought of as requiring centuries or even millennia. There were also competing explanations of the observed maturation trends. As a result of these varying opinions, coupled with some institutional inertia, by the late 1990s the pioneering work had been put aside or was treated in a cursory way by national fishery bodies and by scientists working in the field. The question of what was really happening in the oceans stayed open.



SHRINKING FISH Worldwide, commercial fishing maximally exploits or over-exploits three-quarters of fish stocks, reducing the number of fish and changing their heritable features. The picture shows the decreasing size and weight of the Atlantic Cod at first reproduction. Over the last decade, IIASA's scientists have researched this previously-overlooked evolutionary dimension of modern fishing. They have built a scientific consensus around the issue and warn it may have unexpected consequences for the economic value and the ecological stability and recovery potential of exploited fish stocks.

© Jan Drholec | Dreamstime.com

It was then that IIASA came into the picture. The Institute supports several bridge-building initiatives, visitor programs, and schemes inviting scientists to broaden the research base at IIASA by developing new ideas. In 1997, a recently-graduated Finnish ecologist, Mikko Heino, joined one of these: IIASA's Young Scientists Summer Program.

Heino picked up on the neglected work of Law and Rijnsdorp and, when he won a scholarship to return to IIASA the following year, he applied himself to developing it further in the form of a paper on the management of evolving fish stocks. This coincided with a sabbatical visit by Richard Law to IIASA. There, Law met up with a former student of his, Ulf Dieckmann, and, after various discussions, the three scientists set out to initiate IIASA's research on the evolutionary implications of fishing.

"Specifically," says Dieckmann, "two innovations were needed. First, new statistical techniques had to be devised to analyze existing data for signals of fisheries-induced evolution, taking other hypotheses into account. Second, new simulation models had to be developed that could do better justice to the real-world complexities of stock dynamics."

systems analysis, develop the necessary methodological tools, and then cooperate with its wide constituency on practical applications."

The early results of the IIASA work were described in 2002 in two publications. In an article entitled "Measuring probabilistic reaction norms for age and size and maturation," Heino and Dieckmann, together with their colleague Olav Rune Godø from Norway, laid the groundwork for a new statistical approach to detecting trends in the maturation schedules of exploited stocks. Another article entitled "Fisheries-induced changes in age and size at maturation and understanding the potential for selection-induced stock collapse," by IIASA's Bruno Ernande, Dieckmann, and Heino, introduced a modeling framework for understanding and predicting fisheries-induced evolution of maturation schedules.

Dieckmann believes these developments could not have come together so readily anywhere other than at IIASA: "At the national level, governmental fisheries bodies have little capacity for developing new methodology and might interact little with the academic world. Fortunately, IIASA has this willingness to take on such a challenge, scrutinize it from the perspective of applied

The latter article was published in a 2002 conference proceedings by ICES, and in 2006 ICES instigated a new Expert Group on Fisheries-induced Adaptive Change, jointly chaired by Heino, Dieckmann, and Rijnsdorp. Such endorsement by one of the foremost international agencies for fisheries research would have been inconceivable only a decade before, believes Dieckmann. Or, as he puts it more succinctly: "Gradually, research on fisheries-induced evolution could no longer be disparaged and dismissed as the work of just a bunch of cranks with an outlandish theory."

Research in the field has now broadened under IIASA's auspices. It has spawned the European Marie Curie Research Training Network FishACE (Fisheries-induced adaptive change in exploited stocks), which involves 11 research teams from eight countries. It has also attracted the involvement of the European Union in the form of the European research network FinE (Fisheries-induced evolution), which is designed to contribute to the sustainable management of Europe's fisheries and brings together 18 research teams from 15 countries.

This element of IIASA's profile, serving as a bridge between national and international, commercial and academic quarters, deserves further mention. Based on its broad international constituency and political impartiality, IIASA is well-positioned to offer impartial advice that is not affected by national interests.

Ulf Dieckmann's view of this is diplomatic: "One certainly hears of incidents within national fisheries research agencies, where certain results are not welcome if they contradict government positions. But these things are rarely documented. The other and perhaps even more important problem is that innovative research work may simply never get done at all, since national research priorities are occasionally myopic, national research agencies are typically overburdened with routine tasks, and the temptation to play it safe is not uncommon."

From his experience with the project Mikko Heino agrees, adding: "I would say it helps to enter a field with a fresh mind. National institutions have a tendency to become stagnant, so somebody coming in from the outside has a better chance with an innovative approach."

Until now, research on fisheries-induced evolution has focused on fisheries in the developed world. New member countries of IIASA will benefit from the enormous potential for modernizing and improving their fishing practices, to ensure the sustainability of their catches, and to avoid the many mistakes that developed countries have committed in the past. ■

Further information IIASA's Evolution and Ecology Program at www.iiasa.ac.at/Research/EEP

Keith Jinks is a freelance writer based in Vienna.

Science partnerships for change

What the world needs now…

It's 28th August at the 2008 Awards Ceremony of IIASA's Young Scientists Summer Program (YSSP). Suddenly, there's uproarious laughter as the YSSP Dean, Mahendra Shah, shows "before" and "after" photographs of the soon-to-go-home YSSPers.

For some YSSP participants, the time spent at IIASA represents their first major stay outside their home country. The "before" photos are a series of glum-looking individual student "mug shots" taken on 1 June on the YSSPers' arrival in Austria for the summer program. The "after" or, more accurately, "during" photos are of young scientists in multinational groups, at work and at leisure, visibly confident, and having the time of their lives. As intended, for the 49 PhD researchers from some 20 countries, the three months spent at IIASA have been transformational.

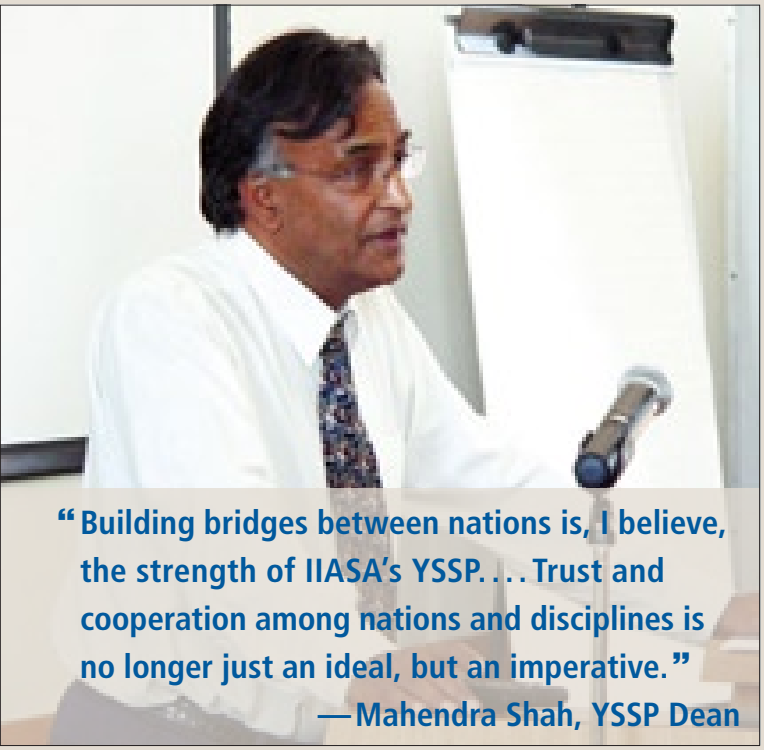
The YSSP epitomizes, indeed enhances, IIASA's reputation for multinational and inter-disciplinary research. The participants find the international atmosphere stimulating, and they quickly accept the multidisciplinary approach to tackle "real world" problems as well as interacting and networking with each other and with IIASA resident scientists.

Science diplomacy towards bridge building

"Working in the IIASA environment entails being tolerant of each other's viewpoints and open to a diversity of ideas," says Shah. In fact, Dr. Shah believes strongly in the concept of science as a form of diplomacy to build international collaborative partnerships. He mentions Karen Hughes, recently retired U.S. presidential adviser on public diplomacy, who has publicly proclaimed the unifying power of science.

Says Shah: "Although we live and work within nations, our impact is far wider—regional, if not global. What are we to do if we can't cooperate with each other? How will we save this world of ours? Building bridges between nations is, I believe, the strength of IIASA's YSSP."

Indeed, the establishment of IIASA some 35 years ago was proposed to break down Cold War barriers; the YSSP followed four years later with its dual emphasis on bringing young researchers with fresh ideas to IIASA while developing a new generation of scientists to carry forward the unique IIASA approach. New antagonisms have replaced the Cold War—as have new priorities for IIASA—but it is heartening to witness "science as diplomacy" in action during the summer months at IIASA, as friendships and networking form among individual young scientists that are not necessarily reflected in the dealings between their governments.



"Building bridges between nations is, I believe, the strength of IIASA's YSSP. . . . Trust and cooperation among nations and disciplines is no longer just an ideal, but an imperative."
—Mahendra Shah, YSSP Dean

The relationship between India and Pakistan, for instance, has been troubled for many years. However, the accession of the two countries to IIASA on 1 January 2007 has given practical reasons for extended cooperation, with the YSSP serving as one of the avenues to improved relations. In 2007, Indian and Pakistani YSSPers worked together in their "spare time" to survey and document a wide variety of the botanical specimens to be found in and around Laxenburg, particularly the 280 hectare imperial park. Another 2007 YSSPer, Dorothy Dankel from Bergen, Norway, blogged her impressions of her international colleagues: "Everything's going really well here in Austria. I'm settled in both in the hostel with my roommate Heidi from England and with my 50 new colleagues at the Institute. We're all in a castle, the former summer castle for hunting for the Austrian Royal Family. . . . Pretty cool." She later adds, along with a smiley emoticon: "All the YSSPers are so nice and it's fun being amidst so many smart people."

In 2008, two Pakistanis and one Indian participated in the YSSP. Pushpendra Rana of the Indian Forestry Service researched ways of improving the social and economic benefits of forestry through better forestry governance procedures. Tahira Munir from Islamabad and Syed Zaidi from Lahore both studied aspects of climate change: Munir looked at pollution and greenhouse gas emissions, including ways of reducing negative health impacts from indoor air pollution; Zaidi focused on how future climate variables could affect management of water resources in the Jhelum River Basin of Pakistan.

It is not just in formal research sessions that the paths of young scientists from different countries and cultures cross. The living arrangements, hiking, excursions to tourist attractions, and social events organized at IIASA also provide opportunities for "bonding." YSSP participants organize their own off-duty experiences—and not just expeditions to the local *Heuriger*.

Partnership imperatives for an interdependent world

According to Mahendra Shah, one of the YSSP's most important aspects is that YSSP participants come to IIASA with a project proposal closely related to research at their home institutions and take home their summer research results, along with the new interdisciplinary scientific skills and policy-relevant research methods they have learned at IIASA. "This is particularly important for developing countries," says Shah, "where inter-disciplinary and policy-relevant scientific capacity building is critical to find home-grown solutions. This is probably why many YSSP participants tend to gravitate back to IIASA, either as postdoctoral students or as researchers. IIASA allows people to work in an international setting to do hands-on research that benefits their home country or region. The IIASA experience contrasts with the risk of brain drain when developing country research students go to centres of excellence in developed countries, often researching on issues that have little relevance to pressing problems in their home countries."

Former YSSPers also come back or continue to participate with IIASA projects in other ways. At the time of this writing, among the latest additions to the Institute from the YSSP "gene pool" are: in the Dynamic Systems Program, Russian Denis Pivovarchuk (2007) researching optimal control systems; and in the Forestry Program, Ukrainian Mykola Gusti (2000) looking at greenhouse gas cycling and terrestrial ecosystems.

Science, diplomacy, and international negotiations

That science can facilitate diplomacy has been known for decades. IIASA's own RAINS model—the first computer model to be at the center of major international environmental negotiations—led to the Convention on the Long-range Transboundary Air Pollution, the success of which was due to the close collaboration that took place between the scientists and policymakers who negotiated it. The RAINS model was chosen as the standard because of the political neutrality of IIASA. It was this aspect that fostered trust among the countries that would develop policies based on its findings.

Mahendra Shah believes that part of the mission of the YSSP is to bring home to young scientists that the world's problems are now so complex that they cannot be solved by individual countries working in isolation or via one stand-alone scientific discipline. Mutual trust is thus vital. "The countries of the world are interdependent," he says, adding: "According to projections, the tipping point after which climate change will be irrevocable will come in approximately 40 years. It is up to the current generation of scientists not only to find solutions to the problems of global change but to work with policymakers to ensure that that the right measures are implemented. Trust and cooperation among nations and disciplines is no longer just an ideal," he adds, "but an imperative." ■

Further information IIASA's Young Scientists Summer Program at www.iiasa.ac.at/yssp

Kathryn Platzer is a writer and editor in IIASA's Communications Department.

Today, decision makers are faced by diverse complex and interlinked challenges ranging from climate change to food shortages. The complexity of such issues often means that only scientists can provide rational and objective support for decision making. However, the role of science is not to "solve" the problem, but rather to help decision makers analyze the possible solutions taking into account trade-offs between often conflicting goals (such as cost, environmental and social impacts, risks, etc.), which are often impossible to evaluate precisely.

Given the complexity of the problem, experts from a variety of disciplines need to work together to build a common understanding of the issues they address, and then contribute relevant elements of their disciplinary knowledge to come up with an effective solution. For example, climate change is not simply a question of predicting rises in global temperatures or sea level that can be "solved" by climate scientists. In reality it is far more complex involving a set of interactions between agriculture, industry, land use, energy utilization, social and economic issues, and related public policy. Therefore, it requires an integrated multidisciplinary approach to both understand and address the issue. IIASA has established an international reputation in these types of studies across a variety of fields, including land-use and agriculture, atmospheric pollution, population, and climate.

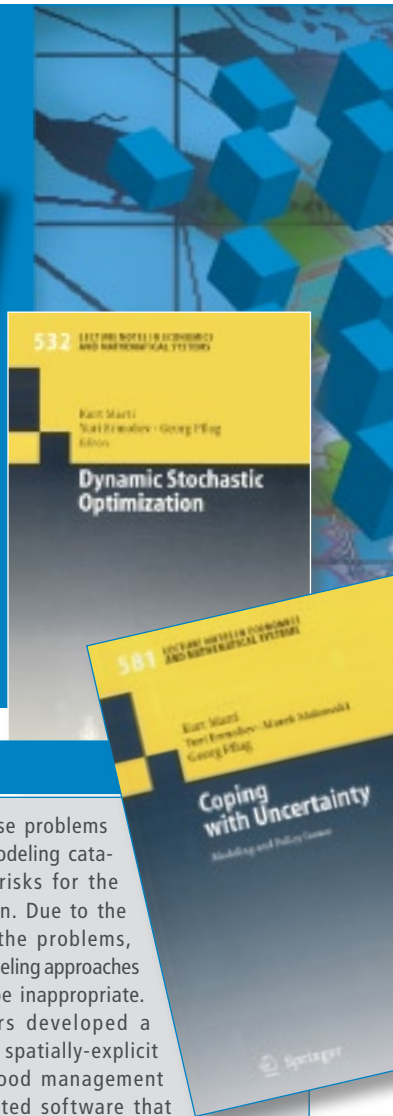
In this article we illustrate IIASA's strengths in international and interdisciplinary collaboration aimed at effectively dealing with the basic problems of uncertainties, risks, and interdependencies.

Uncertainty and potential global risks are the prevailing characteristics of the on-going, often controversial, technological, environmental, and socio-economic global changes affecting large territories and communities. As these changes occur across traditional international borders, they create unprecedented opportunities for cooperation among

INTEGRATED MODELING

Scientific bridge building under Uncertainty

The major issues facing the world today, such as climate change, catastrophes, food shortages, and even the current global economic crisis, are undoubtedly complex. Many of them are characterized by an intricate interplay of often poorly understood underlying social, environmental, and economic issues, and inherent uncertainties. As such, there are no simple or single solutions.



CASE STUDIES: COPING WITH CATASTROPHES

Integrated modeling approaches for designing robust policies developed at IIASA have been applied in a number of case studies on catastrophic risks, e.g., floods, windstorms, earthquakes, and outbreaks of livestock diseases, covering countries such as Russia, Japan, China, Italy, Ukraine, Poland, and Egypt. All these case studies have similar methodological challenges, which we illustrate by outlining the case study of catastrophic floods on the Tisza River in the Ukraine and Hungary.

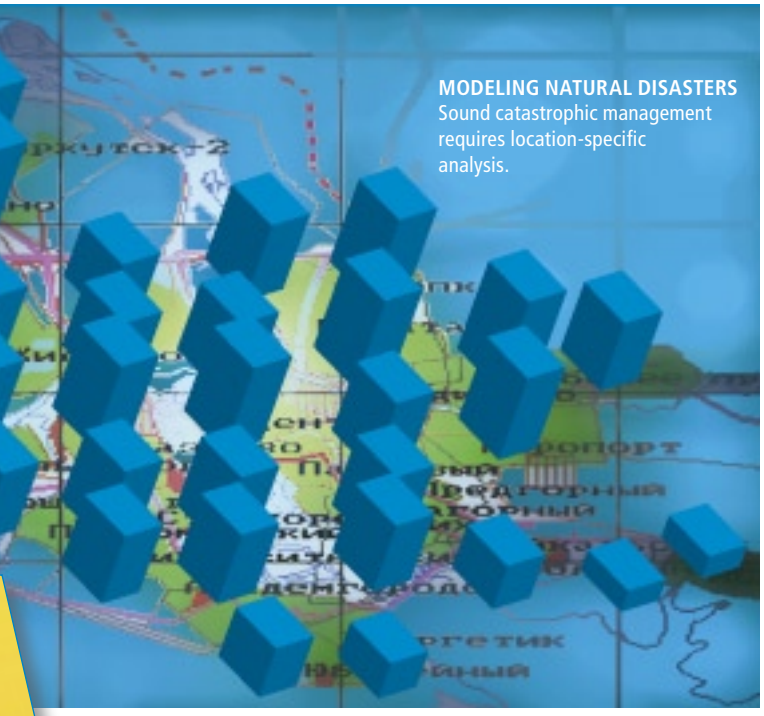
The Tisza River rises in the Carpathian Mountains in the Ukraine and flows through Romania, Hungary, and Serbia. Recently, a number of catastrophic floods have caused massive structural and agricultural damage in both the Ukraine and Hungary. Previously, national governments have covered the costs of losses; however, in the new economic system introduced recently, the governments need to partially shift the responsibility to local authorities and individuals. The key problem is how to manage the risks of catastrophes in areas characterized by poor infrastructure, governmental subsidies, low incomes, and little or no previous insurance coverage.

Protection against catastrophic events, such as floods, is a complex issue: catastrophes, by their nature, are rare events (although may occur at any time) and affect large areas (although are location-specific); moreover, the same catastrophe never strikes twice, thus historical data is often lacking or irrelevant. Additionally, the desired outcomes of mitigation or management options can differ (and often conflict) among various stakeholders, e.g., farmers, governments, insurers, financiers, etc. Spatial patterns of the losses depend on various factors, such as patterns of rainfalls and runoff, land use practices, reliability of flood defense systems, patterns of inundation, etc. Therefore, managing catastrophic risks is a complex multidisciplinary problem that requires an integrated modeling approach.

Scientists from IIASA, together with colleagues from the Ukraine, Hungary, and Sweden, have been working on these problems in relation to modeling catastrophic flood risks for the Tisza River basin. Due to the complexity of the problems, conventional modeling approaches were found to be inappropriate. The researchers developed a new integrated spatially-explicit catastrophic flood management model and related software that combined natural, engineering, agricultural, financial, and socio-economic systems to address the issue. Using these models, the interdisciplinary teams of researchers were able to assess various policy options for flood management in terms of potential losses, enabling decision makers to make better informed decisions in relation to both mitigation and insurance. The developed collaborative networks, as well as methodology and tools, provide capacity for scientific support of rational catastrophe management. ■

more and more countries in efforts to find solutions. However, they may also increase the interdependency among countries, thus reducing their diversity and safety margins, and possibly creating conditions for world-wide instability. Interdependencies among various global change processes are too complex to allow for good measurements and traditional "cause and effect" (deterministic) predictions may be dramatically misleading. A more sophisticated approach that takes into account inherent uncertainties associated with particular processes is now required.

For example, the projected global temperature change is the main indicator of climate change; its value (say, 5°C) is roughly within the difference between the average temperature of cities and surrounding rural areas. Using such a simple indicator in existing climate assessment models demonstrates that climate change impacts are not significant. However, the main issue in assessments of climate change impacts and other global changes is an appropriate modeling of increasing



MODELING NATURAL DISASTERS
Sound catastrophic management requires location-specific analysis.

variability and intensity of climate-related extreme events. Events such as hurricanes and floods occur as spikes at different moments in time and location; this may destabilize both the local and other interdependent regions, for example through impacts on financial markets.

The widely accepted deterministic view that extreme events occur once in 100, 200, 500, etc. years leads directly to their being regarded as events irrelevant to current and future generations. In fact, the time of occurrence of such events is highly uncertain, e.g., a 100-year flood may occur next year, and a 500-year earthquake even tomorrow. The Chernobyl disaster of 1986 was quantified as a 1,000,000-year event, yet it occurred 9 years after the power plant was commissioned.

Such ignorance of these underlying uncertainties can be seen in the risk management industry, where, typically, the standard deterministic annualization of losses caused by an extreme event simply spreads the damages, with a discount factor, over their respective time horizon, e.g., 500 years, and determines premiums accordingly. However, a realistic assessment of global change impacts calls for explicit spatio-temporal representation and modeling of uncertainties, as well as related extreme events and risks, which can subsequently expose areas of inappropriate or inadequate land-use planning and policies, infrastructure, communications, production, and so on.

There are no simple solutions for effectively dealing with the problems outlined above. This requires collaboration of scientists with experience in developing new approaches and applying them to real-world problems in different fields. The power of mathematics is that the same equations can be applied to different problems. To facilitate building bridges between mathematicians and practitioners aimed at developing novel approaches to treatment of such uncertainties, scientists from IIASA's Integrated Modeling Environment (IME) Project have hosted a series of workshops on "Coping with Uncertainty," organized jointly with the International Federation for Information Processing (IFIP) and the International Association of Applied Mathematics and Mechanics (GAMM). These workshops provided researchers and practitioners with a forum for discussing various ways of dealing with uncertainties, across a number of areas including environmental and social sciences, economics, policymaking, management, and engineering.

These workshops have contributed to a better understanding between practitioners dealing with the management of uncertainty and scientists using different modeling approaches that can be applied to improve our understanding of the management of uncertainty.

The main focus of the workshops was on the development of new methods for designing robust decisions in the presence of interdependent and inherent variabilities, extreme events, and other uncertainties. The design of such robust policies is fundamental for coping with the uncertainty posed by global change. Traditional scientific approaches usually rely on real observations and experiments. However, insufficient observations exist for new problems, and "pure" experiments and "learning by doing" may be very expensive, dangerous, or simply impossible. In addition, available historical observations are often "contaminated" by our previous actions and policies. It's not simply a question of increasing the resolution or complexity of existing models, but rather explicitly treating uncertainties using both available "hard" data, e.g., historical observations, experiments, and scientific facts, as well as "soft" data, such as expert opinion, scenario generators, and simulations.

Such methods for designing robust solutions and related issues of coping with uncertainties have been at the center of methodological developments in stochastic programming over the last 20 years and have become the key modeling tool in the research community. Now they are also becoming an important modeling tool for quantitative finance, energy, telecommunications, and many industrial fields.

In the future, science will increasingly deviate from traditional "deterministic predictions" to the design of robust strategies aimed at tackling the issues of uncertainty, safety, and flexibility. This will increasingly require the bringing together not only of scientists from different disciplines, from mathematics to ecology, but also economists, social researchers, and policy and decision makers. A number of case studies organized by IIASA on designing robust policies for dealing with catastrophic risks clearly shows the value of such interdisciplinary and international collaboration. With its reputation for international interdisciplinary research, IIASA will undoubtedly continue to play a vital role in such bridge building into the future. ■

Further information Outcomes from the workshops can be found in: *Dynamic Stochastic Optimization* (2003), *Coping with Uncertainty: Modeling and Policy Issues* (2006), *Coping with Uncertainty: Robust Decisions* (forthcoming), published by Springer Verlag. IIASA's Integrated Modeling Environment Project at www.iiasa.ac.at/Research/IME and IIASA's Land Use Change Program at www.iiasa.ac.at/Research/LUC

Professor Yuri Ermoliev is an IIASA Institute Scholar, **Dr. Tatiana Ermolieva** is a Research Scholar in IIASA's Land Use Change Program, and **Dr. Marek Makowski** is Leader of IIASA's Integrated Modeling Environment Project.

"FISHERIES IN FLUX"

Experts hook up

Mikko Heino of IIASA's Evolution and Ecology Program, together with colleagues from the University of Bergen, Norway, convened a symposium entitled "Evolving Fish, Changing Fisheries" at "Fisheries in Flux," the 138th American Fisheries Society annual meeting, held 17–21 August 2008 in Ottawa, Canada.

Over thirty experts gave presentations at the symposium, the overall objective of which was to promote discussions and debate on the topic of contemporary evolution in fish populations and its importance to fisheries management. Mikko Heino and IIASA Evolution and Ecology Program Leader Ulf Dieckmann gave keynote speeches. ■

www.fisheries.org/afs08

MEETING PLACE

IIASA hosts diplomats

Ambassadors from the 27 member states of the European Union met at IIASA on 3 July. The French Ambassador to the International Organizations in Vienna, Mr. Francois-Xavier Deniau, hosted the event to consult with his counterparts at the start of France's Presidency of the European Union.

On 4–5 September, IIASA welcomed a high-level Finnish delegation to discuss international forestry, the forest industry, and the energy sector. The delegation, established by the Finnish Prime Minister and chaired by the former Prime Minister Esko Aho, has been tasked with making policy recommendations for the future of the Finnish forest sector. ■

NEW STRATEGIC PLAN

Stakeholder engagement

Sten Nilsson, IIASA's Acting Director, and Detlof von Winterfeldt, IIASA's Director Designate, have, in consultation with the Chairs of the Council, the Program Committee, and the Scientific Advisory Committee, started the process of developing a possible strategic plan on how to position IIASA for the future. During autumn 2008, they have consulted a wide range of internal and external stakeholders, to inform the development of this strategy.

This process will be further discussed at IIASA's Council meeting in November 2008. ■

IIASA CONFERENCE 2010

Science for global change: Responding to problems and opportunities

Global change poses enormous challenges, but presents opportunities as well. Science can help us not only to identify the problems we face, now and in the future, but also to design solutions. Scientific approaches, once tightly constrained by the need for simplification and the paucity of data, have evolved to incorporate complexity and heterogeneity. Deterministic models have been replaced by models addressing uncertainty. Stakeholder views, once accorded little importance, are increasingly taken into account. The roles of institutions, governance structures, and incentives receive growing recognition. Scientific research itself is becoming ever more multidisciplinary, interdisciplinary, and international.

For nearly 40 years, the International Institute for Applied Systems Analysis, located outside Vienna, Austria, has been a world-renowned center for the application of systems approaches to global challenges. The IIASA Conference 2010, "Science for Global Change: Responding to Problems and Opportunities," is expected to attract over 500 eminent scientists, members of the global policy and decision making communities, industry experts, and representatives of civil society. Held in the Hofburg Palace in the center of Vienna, the IIASA Conference is your opportunity to participate in setting the global change research and policy agenda for years to come.

The conference will take place on 1 and 2 June 2010 followed by a post-conference interactive scientific event at IIASA on the morning of 3 June. ■

www.iiasa.ac.at/conference2010

WORLD WATER CONGRESS

Urban H_2O

IIASA Institute Scholar Bruce Beck chaired a workshop at the World Water Congress and Exhibition of the International Water Association (IWA), which attracted 3,000 water professionals to the Austria Center, Vienna, from 8–11 September, to advance their common goal of sustainable water management.

The workshop, "Providing Livelihoods and Water for a Growing Planet," focused on water, climate, and energy at the level of the urban environment, where most IWA professionals work. In the discussions, the key themes were treated in light of both the congress focus on the frontiers of science and technology and the strategic global change research being carried out at IIASA. Landis McKellar, Leader of IIASA's Health and Global Change Project, was one of four speakers at the workshop on the topic "Water, Nutrition, and Nutrients." ■

GLOBAL CHANGE TALKS

IIASA at Tällberg

IIASA scientists presented the Institute's work on systems analysis and global change, demographic development, energy development, forestry development, and deforestation at the Tällberg Forum 2008 that took place in the small Swedish village of Tällberg from 26–29 June.

The Forum, "How on earth can we live together? In search of the common sense," gathered thinkers and leaders from 70 nations for four days of conversations and workshops related to the opportunities and challenges of global interdependence. Speakers included former UN Secretary-General Kofi Annan.

The 2008 Forum illustrated that Tällberg conversations are increasingly focused on the systems problems emerging from the growing imbalance between nature and human activity. It generated many concrete ideas and proposals for policy, strategy, and institutional development that work in the interests of the whole. ■

www.tallbergfoundation.org

WORLD JUSTICE FORUM

IIASA co-sponsors forum

IIASA was co-sponsor of the World Justice Forum in Vienna in July 2008, at which Archbishop Desmond Tutu and Mary Robinson, the former President of Ireland, were among the prestigious speakers. Over 800 delegates from around the world participated in the Forum, which aims to strengthen the principles and application of the rule of law. The rule of law is a vital prerequisite for countries working to meet the challenges of global change, which is a major focus of IIASA research activities. ■

Sten Nilsson, IIASA's Acting Director, has been selected as a Rights and Resources Fellow for the Rights and Resources Initiative in Washington, DC. The Initiative is a coalition of international organizations engaged in forestry issues.

The Lithuanian Academy of Sciences has elected Sten Nilsson as a Foreign Member.

Professor Nilsson has also been appointed to the Advisory Board of the World Resources Forum, an independent, international platform which brings together natural scientists and engineers, economists and policymakers to identify realistic policy options for sustainable growth. The first meeting of the Forum will take place in Davos, Switzerland, on 16 September 2009.

Economist **W. Brian Arthur**, a former IIASA Institute Scholar, and mathematician Yakov Sinai of Princeton University are the inaugural winners of the Lagrange Prize for research on the science of complexity.

Sergey Aseev of IIASA's Dynamic Systems Program has been elected Correspondent Member of the Russian Academy of Sciences (RAS) at their Annual Meeting which took place in Moscow from 26 May to 2 June.

Chairman of IIASA's Council **Simon Levin**, who has made major contributions in the areas of biological conservation and ecosystem management, has been selected as a foreign member of the Istituto Veneto di Scienze, Lettere ed Arti, a venerable Italian academic institute.

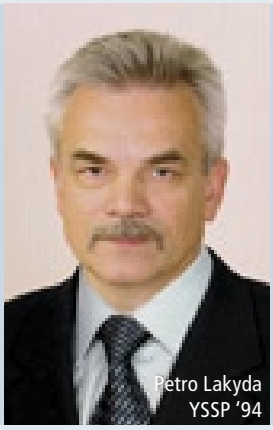
José Goldemberg, IIASA Associate Research Scholar and Co-President of the Council of the Global Energy Assessment, has been awarded the 2008 Blue Planet Prize for making major contributions in formulating and implementing policies associated with improvements on energy use and conservation.

Alexander Tarasiev of IIASA's Dynamic Systems Program has been elected Chair of the Technical Committee Optimal Control by the International Federation of Automatic Control (IFAC). IFAC's aims are to promote the science and technology of control in the broadest sense in all systems, whether engineering, physical, biological, social, or economic, in both theory and application.

Canadian ecologist and scientist **Crawford "Buzz" Holling**, Director of IIASA from 1981 to 1984 and long-time supporter of the Institute, has been awarded this year's Volvo Environment Prize. The Jury of the Volvo Environment Prize says in its citation: "Crawford (Buzz) Holling is one of the most creative and influential ecologists of our times. His integrative thinking has shed new light on the growth, collapse and regeneration of coupled human–ecological systems."

Chihiro Watanabe, Senior Advisor to the Director on Technology, IIASA, received the Japan Society's "most significant contributor" award for science policy and research management. The prize is for the macro dynamic analysis of innovation and subsequent insightful empirical suggestions to help countries and companies manage their technologies. ■


Thomas Büttner
YSSP '86


Petro Lakyda
YSSP '94


Akira Nagamatsu
YSSP '00


Michael A. Stoto
YSSP '77


Christine Wamsler
YSSP '06

Where are they now?

The number of applications for IIASA's Young Scientists Summer Program (YSSP) is always high: it's not often that Ph.D. level researchers get the chance to work alongside established scientists in an international, multidisciplinary setting like IIASA. Here, we look at what five former YSSPers have been doing with their working lives since their stay with us.

Keep in touch with fellow IIASA alumni/ae by joining the IIASA Society.

www.iiasa.ac.at/IIASA_Society
www.iiasa.ac.at/yssp

THOMAS BÜTTNER, a 1986 YSSP participant, was named Assistant Director and Chief of the Population Studies Branch of the Population Division of the United Nations in November 2007. He joined the UN Population Division in 1992 and has worked on a range of population issues including mortality, migration, and population estimates. Prior to his assignment with the Department of Social and Economic Affairs, he provided consulting services on population affairs to the Economic Commission for Europe in Geneva, and was head of a research group on demographic forecasting at the Academy of Sciences of Berlin. Born in the German Democratic Republic, Dr. Büttner was a research scholar at IIASA from 1988 to 1991. His research focus is aging, mortality, population estimates and projections, and demographic software development.

PETRO LAKYDA Just 14 years after coming to IIASA as a YSSPer, Petro Lakyda is Director of the Institute of Forestry and Landscape Architecture of the National Agricultural University of his home country, Ukraine. Professor Lakyda is now one of Ukraine's leading experts in multifunctional forestry, the focus of his work being the assessment of carbon deposition in forest biomass.

IIASA's YSSP was his first experience with an international research organization and it greatly influenced his future work. Building on his YSSP research, he returned to IIASA's Forestry Program several times. He has recently worked on the internationally recognized projects "Preparation and Design of Ukraine Reforestation Biocarbon" with Tuscia University and Agrotec (2005–2007) and a five-year EC project "Biomass Energy Europe" coordinated by Freiburg University and currently partnering with IIASA.

AKIRA NAGAMATSU graduated from the Yokohama City University with a Master's Degree in business administration in 1998 and received his Ph.D. from the Tokyo Institute of Technology in 2002. He was a YSSP participant in 2000 in IIASA's Dynamic Systems Program. In 2002 he contributed, with three co-authors, a chapter "Inter-Firm Technology Spillover and the 'Virtuous Cycle' of Photovoltaic Development in Japan," to the book *Technological Change and the Environment*, edited by Grübler and Nakicenovic of IIASA and Nordhaus of Yale. Dr. Nagamatsu now works in the Production Engineering Research Laboratory of Hitachi. He began his affiliation with Hitachi in 2002 and has carried out wide-ranging research in the field of business administration, quality management, and project management.

MICHAEL A. STOTO was a participant in IIASA's very first YSSP in 1977. With a distinguished career as an epidemiologist, statistician, and health policy analyst, Dr. Stoto is currently the co-principal investigator for the Harvard Center for Public Health Preparedness Research.

Dr. Stoto has served on a number of prestigious faculties, for example, the John F. Kennedy School of Government at Harvard, the George Washington University School of Public Health and Health Services, the Georgetown Public Policy Institute, and the RAND Graduate School. He also led numerous high-profile projects in public health practice at the U.S. National Academy of Sciences and the RAND Corporation. He is currently Professor of Health Systems Administration and Population Health at Georgetown University.

CHRISTINE WAMSLER attended IIASA's YSSP in 2006, after field studies in disaster-prone slum areas in El Salvador for her Ph.D. thesis on Urban Disaster Risk Management. A trained architect, urban planner, and humanitarian aid worker, Dr. Wamsler is now Visiting Professor of Disaster Management and Recovery at Lund University, Sweden, and Lecturer on Urban Climate Change Adaptation at the Global Urban Research Centre of the Institute for Development Policy and Management, University of Manchester, UK. She has worked for various development and relief programs in Togo, India, Chile, El Salvador, Guatemala, Nicaragua, and Peru, and for international agencies such as the Austrian and Belgian Red Cross, the German Development Service, the Swedish Organisation for Individual Relief, and local NGOs. ■

Peacocks and roses

Karan Deo Singh is an Indian forester and IIASA collaborator. He recently worked closely with forest experts in both India and IIASA to produce a special journal issue on the current trends and future challenges of the Indian forest sector (see page 4).

I have been a forester by profession and still enjoy remaining involved in forestry. I spent half of my active career with the Indian Forest Service in the Himalayan Region, which is similar to the Alps in Austria, and the other half with the Forestry Department at the UN Food and Agriculture Organization in Rome, responsible for Global Forest Resources Assessments.

After Rome, we spent five years in an academic environment in Boston, USA, and finally, as destiny would have it, we returned to live in New Delhi, India. I still conduct some research related to forestry, in particular, on empowering the local communities to take over a major share of responsibilities of forest protection and management from the Forest Department. In the meantime, I have also become associated with IIASA activities in India, as I feel that the Institute has a meaningful role in building capacity in India to analyze policies and strategic plans for the forest sector, which we need.

As a retiree, I feel free to plan my time as I like it. My typical day begins at 6.00 a.m., with 15 minutes of yoga and a 45 minute walk in the nearby Rose Garden and Deer Park complex. On a lucky day, I might see a peacock, and on a more lucky day, a pair of them. But what I enjoy most is the rising sun against the blue background of a clear sky above the tree line. Then I look inwards and recite the *Gayatri Mantra*, composed some 5,000 years ago, to invoke "Earth, Heaven and Ether" to jointly contemplate the glory of the Divine and to arouse our intellect. The proximity to nature reminds me of IIASA's most natural surroundings, which has left a lasting impression in my mind.

After half an hour of newspaper reading and breakfast, it is time to check e-mails, make quick replies, and get ready for meetings. The road journey in Delhi is a serious undertaking, calling for good patience and nerves, getting worse and worse on account of never-ending road improvements and new metro construction for the 2010 Commonwealth Games in India. Travel to and fro might easily take one to two hours and I am usually late for lunch.

My afternoons are generally without any engagement and provide two to three hours for serious writing or thinking. By five o'clock, it is time for an evening walk, in the same park, but less inspiring, as evenings in the forested part of the park get sombre and dark with more insects and mosquitoes; but it is still interesting enough to break the day's monotony. After a shower, dinner, and a bit of light reading, it is time to go to bed by 10 p.m. I do not find TV very entertaining or informative, as it generally contains a lot of crime and violence. We have enough of that in daily newspapers. Terror and crime seem to spread all over the world, and Delhi is no exception. We need more peace and non-violence. ■

A typical day for Karan Deo Singh

6 a.m.	Rise; 15 minutes of yoga
Until 7 a.m.	Walk in the park and recite *Gayatri Mantra*
8 a.m.–10.30 a.m.	Read newspapers and answer e-mails
11 a.m.	Travel to meetings in central Delhi by car
Lunch	Usually late, because of the heavy traffic
Afternoons	Serious reading and study
6 p.m.	Walk in the park, shower, dinner, light reading
10 p.m.	Lights out

International Institute for
Applied Systems Analysis
Schlossplatz 1
A-2361 Laxenburg, Austria
Tel: +43 2236 807
Fax: +43 2236 71313
www.iiasa.ac.at

IIASA Postdocs

Postdoctoral Program for Young Researchers

IIASA, the International Institute for Applied Systems Analysis, invites recent recipients of a doctoral degree to apply for postdoctoral scholarships of 12 to 24 months' duration to conduct research on a theme related to IIASA's current research agenda. A competitive package is offered, along with research-related support services.

For details visit www.iiasa.ac.at/postdocs

be a part of a new generation of scientists

ZVR-Nr: 524808900