International Institute for Applied Systems Analysis
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options

summer 2009

Global threats

Golden opportunities for change

editorial

Detlof von Winterfeldt
Director, IIASA

A connected world

The world in the twenty-first century is more interconnected than at any time in human history, reflecting the globalization of economic relationships, travel, and communication. But this has given rise to new threats—threats that cannot be contained within the borders of a country.

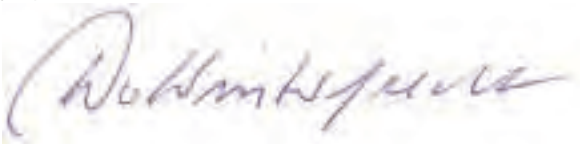
As I write, greenhouse gas emissions from cars in Chicago and power plants in Frankfurt are contributing to melting the ice caps in the Arctic, reducing crop yields in Africa, and bringing drought to farms from Australia to Sudan. In 2008 a housing bubble burst in the USA leading to economic crises worldwide and recessions in countries ranging from England to Iceland to Japan. And as people struggle to cope with the economic downturn, we must not forget the billion people left behind in a globalized world surviving on less than a US$ 1 a day.

Tackling these challenges will not be easy. It requires a thorough understanding of the threats that this world faces and the complex, dynamic, interlinked, economic and social systems that can cause unexpected and extreme, ripple effects throughout the globe. It requires creative and anticipatory thinking as well as smart, robust, and adaptive policies that can buffer the consequences of extreme events. It requires countries to work together. Only then can we be sure of being able to leave to our children a world that is better than the one we inherited.

For over 35 years IIASA has helped the world by researching global problems and encouraging scientific cooperation across nations. Back in the 1970s the Institute's approach of building international and interdisciplinary teams of researchers to investigate real world problems was rare. But it proved successful; for example, thanks to the contribution of an IIASA scientific model, levels of acid rain and air pollution have plummeted in Europe,

IIASA's approach is even more relevant to today's world. This issue of *Options* shows how the Institute's talented researchers are bringing new insights into how to tackle major global threats: climate change (pages 18–21), hunger (pages 14–17), mass immigration (pages 12–13), and the economic crisis (pages 22–23).

These global threats also provide the world with an opportunity and stimulus to build a new future that is more equal and sustainable. It is in response to the prospect of a world in transition that IIASA is developing a new strategy for the second decade of the twenty-first century—a strategy that will focus the Institute's research on the major global problems and on partnering with prestigious organizations in our member countries to translate IIASA's global analysis into locally relevant assessments of policy options. ■



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

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IIASA

About *Options*

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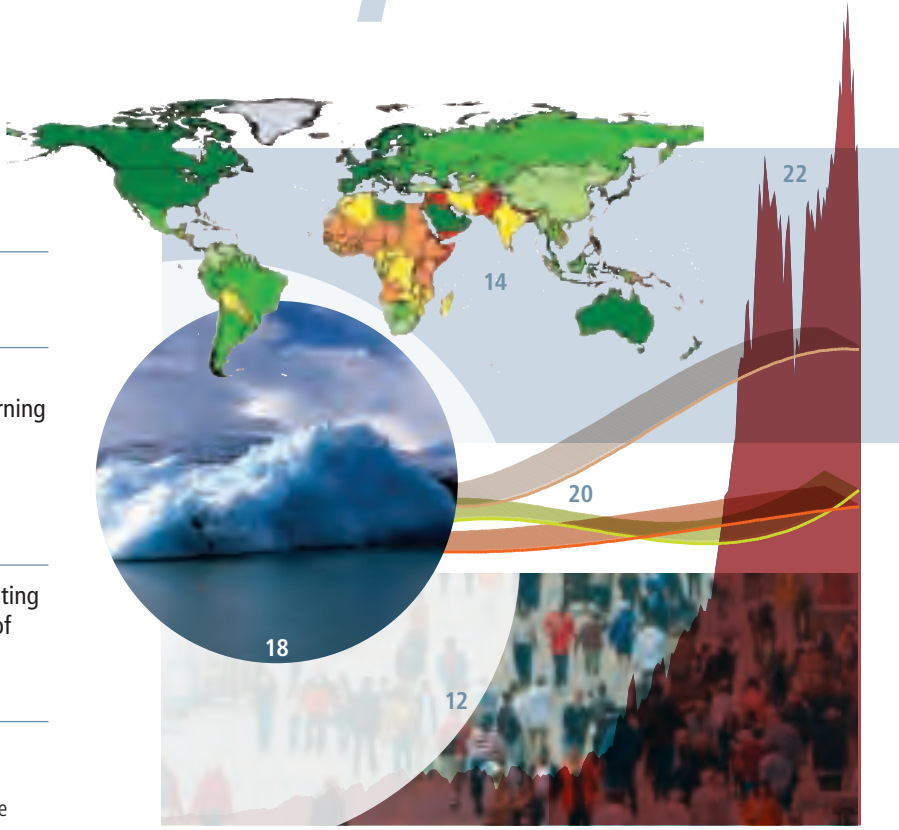


Cover image (front/back):
NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

ENERGY & CLIMATE

IIASA briefs UN Secretary-General

A briefing by IIASA for the United Nations (UN) Secretary-General Ban Ki-Moon was held on 6 May at UN Headquarters, New York. The briefing, from Director Detlof von Winterfeldt and Acting Deputy Director Nebojsa Nakicenovic focused largely on IIASA's energy and climate change research, within the context of the UN initiated 'Global New Green Deal,' which aims to revive the world economy, reduce carbon dependency, minimize environmental degradation, and end extreme poverty.

IIASA highlighted the need for changes in energy policies that support a paradigm shift away from fossil fuel dependency to a carbon-neutral economy. Emphasizing that such a shift requires investment in new technologies and practices that would generate employment, pave the way for a more sustainable future, and help to mitigate climate change.

The meeting was attended by IIASA Special Advisor Chin-Min Lee and senior officials of the United Nations. Another briefing will follow the United Nations Framework Convention on Climate Change COP 15 meeting in Copenhagen in December. ■

RISK AND VULNERABILITY

Avoiding ruin from climate change

An important paper from the methodological and policy perspective has been published by IIASA researchers in the March edition of *Mitigation and Adaptation Strategies for Global Change*. The paper, "Climate change and financial adaptation in Africa: Investigating the impact of climate change on the robustness of index-based microinsurance in Malawi," was produced by IIASA researchers, Stefan Hochrainer, Reinhard Mechler, and Georg Pflug of the Risk and Vulnerability Program.

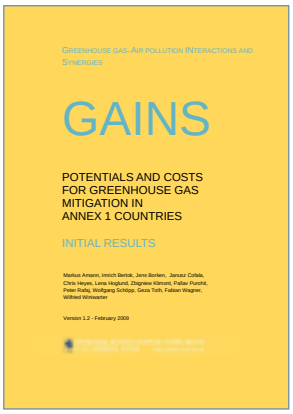
By combining catastrophe insurance modeling with climate modeling, the methodology demonstrates the feasibility, albeit with large uncertainties, of estimating the effects of climate variability and climate change on the near- and long-term future of microinsurance schemes serving the poor, with particular reference to Malawi. The researchers demonstrate the need for financial assistance to protect micro-insurance pools against climate-induced insolvency.

This research addresses an issue of particular concern to donors, NGOs, and others supporting these innovative insurance systems, both those actually at-risk and those providing insurance. ■

The journal, *Mitigation and Adaptation Strategies for Global Change*, is available at www.springerlink.com/content/102962

TOWARD COPENHAGEN

Calculate to negotiate



To help countries prepare for upcoming negotiations at the UN climate change conference in Copenhagen (COP 15) in December 2009, IIASA's Markus Amann presented version 1.2 of the Greenhouse Gas (GHG) Mitigation Efforts Calculator to 800 decision makers and climate negotiators at a high-level workshop on 27 March in Bonn.

Developed by the Atmospheric Pollution and Economic Development Program (APD) of IIASA, and launched at COP 14 in Poznan, Poland, in December 2008, the new Calculator allows users to make an interactive comparison of mitigation efforts and costs among the Annex 1 Parties and their likely effects in 2020.

The Bonn Workshop was the first of three meetings of the "Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol" on issues relating to the scale of emission reductions to be achieved by Annex I countries. According to Markus Amann, leader of the APD Program, use of the Calculator enables countries to gain an impartial, coherent, and transparent overview and comparison of their own and other Annex I countries' GHG mitigation potentials and costs. It will thus considerably ease the negotiation process. ■

The Calculator is freely available online at http://gains.iiasa.ac.at/MEC

CLIMATE CHANGE

Learning from global emissions scenarios

Learning from global emissions scenarios, by B.C. O'Neill and N. Nakicenovic, published in *Environmental Research Letters*, December 2008, was identified by the journal editors as one of the best articles of 2008.

The article evaluates various global emissions scenario comparison exercises, including those that have been used to inform key climate change policy documents,

BEST OF 2008 Environmental Research Letters, the open-access research journal for environmental science, selected the article "Learning from global emissions scenarios," by IIASA's O'Neill and Nakicenovic, as one of the best and most-read articles published in the journal in 2008.

such as the Intergovernmental Panel on Climate Change reports. The authors conclude that while scenario comparisons provide invaluable insights, overall learning from the exercises as a whole can be greatly enhanced by the following: (a) investing resources into assessing the results at the time they are produced; (b) focusing the questions addressed by scenarios to increase their relevance; (c) conducting additional assessments of scenarios and how they are produced separate from the production exercises and; (d) increasing understanding about how scenarios are used outside the research community. ■

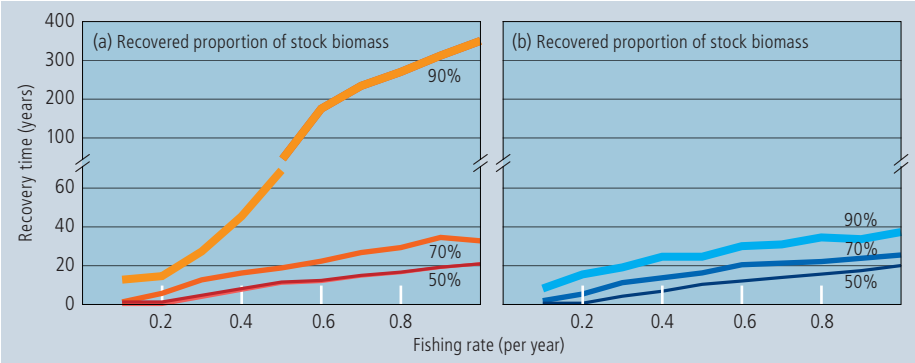
Environmental Research Letters Vol. 3, No. 4 (October–December 2008) 045014 (9 pp.)

EVOLUTION AND ECOLOGY

Slow recovery of over-exploited fish stocks

The worldwide depletion of fish stocks has led fisheries managers to become increasingly concerned about stock rebuilding and recovery planning. To succeed, it is crucial to understand all factors affecting recovery dynamics, including the role of evolutionary changes resulting from fishing. IIASA's Evolution and Ecology Program and the Norwegian Institute of Marine Research therefore have modeled the response of Atlantic cod to fishing followed by a moratorium. The model accounts for evolution of key life-history processes including maturation, reproduction, and growth, and incorporates environmental variability, phenotypic plasticity, and density-dependent feedbacks. Results of this research demonstrate that fisheries-induced evolution seriously delays a stock's recovery (a), and that current management practices, based on non-evolutionary models, underestimate the recovery time (b). These findings strengthen the case for the proactive management of fisheries-induced evolution. ■

Enberg K, Jørgensen C, Dunlop ES, Heino M & Dieckmann U (2009). Implications of fisheries-induced evolution for stock rebuilding and recovery. *Evolutionary Applications*, in press.



CULTURAL THEORY

Beyond boom and bust

"History," as Mark Twain observed, "does not repeat itself; at best it rhymes." So reflects IIASA Scholar Michael Thompson in a recent article "Beyond Boom and Bust", in the Journal of the UK's Royal Society of Arts (Winter 2008). Analyses of the credit crunch and the subsequent global economic turmoil, he points out, are based on the repeating, not the rhyming, model, in that they all invoke just two forms of "solidarity"—markets and hierarchies—with the time-lagged responses of light- or heavy-hand regulation imparting a pendulum-like oscillation: boom and bust.

Such a model assumes just two kinds of goods—*private* (the market) and *public* (the hierarchy)—and ignores the other two kinds: *common-pool* goods and *club* goods, each of which, cultural theorists point out, has its associated solidarity: activist groups and fatalised margins, respectively. Solutions based on the repeating model therefore lack the requisite variety and are doomed to failure. ■

The article draws on the book: Thompson M (2008). *Organising and Disorganising*. Triarchy Press, Axminster, UK.

NITROGEN MANAGEMENT

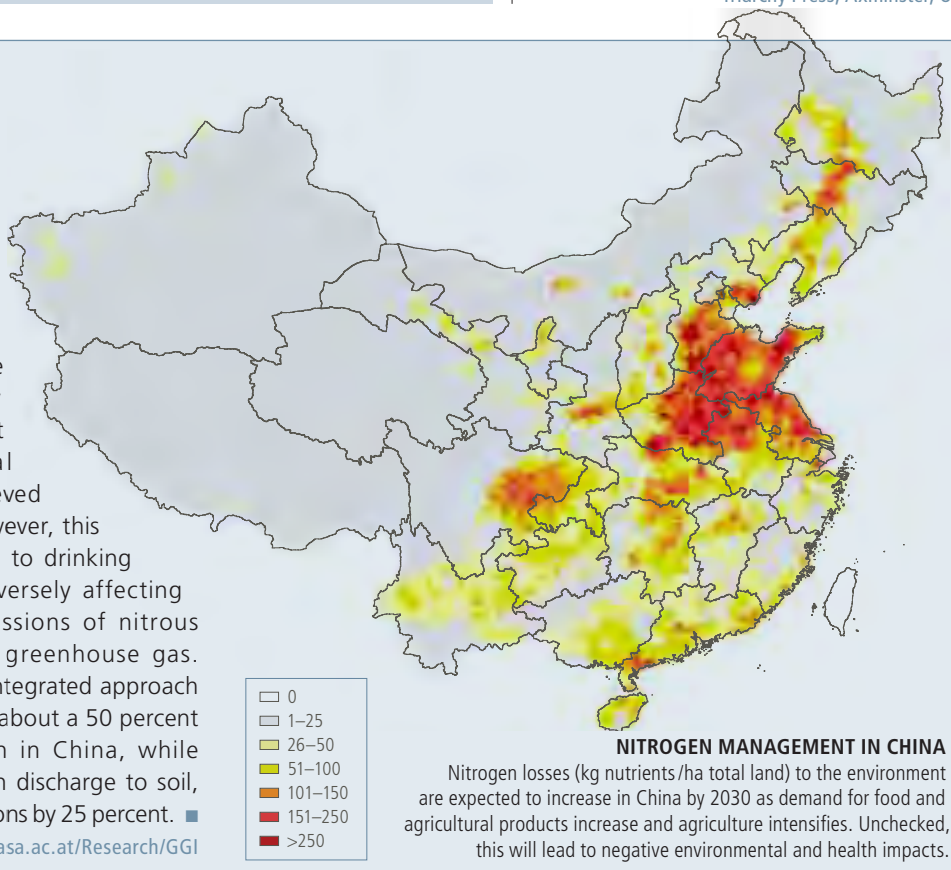
IIASA study will benefit Chinese agriculture

A recent study by IIASA researchers Wilfried Winiwarter and Tatiana Ermolieva addresses ways of upgrading food production in China without harming the environment.

Feeding the growing Chinese population with a higher-quality diet and a larger share of meat involves increasing agricultural productivity, which is usually achieved by enriching soils with nitrogen. However, this process can cause nitrogen to leach to drinking water and to the environment, adversely affecting human health and increasing emissions of nitrous oxide (N_2O), an important global greenhouse gas.

The new study estimates that an integrated approach to nitrogen management could bring about a 50 percent increase in agricultural production in China, while maintaining current levels of nitrogen discharge to soil, water, and air, and reducing N_2O emissions by 25 percent. ■

IIASA's Greenhouse Gas Initiative at www.iiasa.ac.at/Research/GGI



NITROGEN MANAGEMENT IN CHINA
Nitrogen losses (kg nutrients/ha total land) to the environment are expected to increase in China by 2030 as demand for food and agricultural products increase and agriculture intensifies. Unchecked, this will lead to negative environmental and health impacts.

DISASTER RISK MANAGEMENT

The costs of uncertainty

An IIASA Research Report to be published later in 2009 describes an interdisciplinary approach to flood risk analysis and management that was developed by investigating flood risks to the city of Vienna, Austria, caused by the phenomenon of flash flooding of the Vienna River. The research, which showed that flooding on the Vienna River could inundate the Vienna city subway system, provides an assessment of the flood risk to the subway and discusses related management measures, on which research to date has been scarce.

The purpose of the research was to analyze different policy paths, including both flood-prevention measures and risk-sharing financial provisions, in the presence of major uncertainties. Challenging methodological problems needed to be overcome to integrate the different disciplinary concepts of risk within a single analysis and to identify uncertainties fully and consistently across the component disciplines.

The research results suggest alternatives for combining mitigation measures (inspections of flood gates) and risk-transfer measures (municipal catastrophe bonds) in an overall risk management strategy. These, in turn, would decrease total costs of mitigation and reduce the likelihood and the uncertainties of catastrophic financial losses. ■

IIASA's Risk and Vulnerability Program
www.iiasa.ac.at/Research/RAV

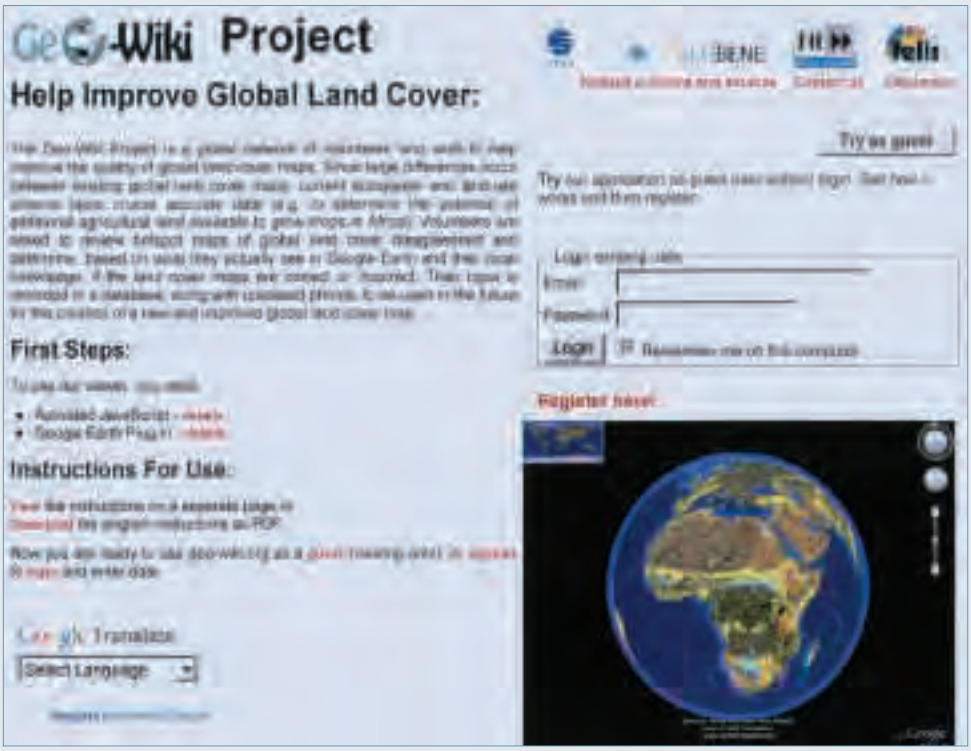
LAND COVER MAPS

Improving the quality of land use information

Global land cover maps are an invaluable tool for informing policy and management decisions in land use, forestry and ecosystem health, in particular the related and hotly debated issues of food and energy security, deforestation, and climate change. However, due to discrepancies in how land is classified and how data is collected and analyzed, the accuracy of the data, and the maps derived from it, are estimated to be only 60–70 percent accurate. Total areas of forest and cropland disagreement alone represent around 5,000 million ha, about one third of the land surface. As demand on land resources and the abovementioned issues grow, data reliability must be improved to ensure that future models produce reliable forecasts

Using internet-based tools, "wiki" and "Google Earth," IIASA forestry researchers have developed the Geo-Wiki Project, a framework for a global network of volunteers who aim to improve the quality of land cover maps. Volunteers review hotspot maps of land cover disagreement and determine, based on what they see in Google Earth and their local knowledge, if the maps are accurate. This information is recorded in a database and used to generate improved global land use maps.

This inexpensive approach allows Internet users from any region of the world to be involved. The data is publicly available and overseen by IIASA's Forestry Program, the public website is hosted by IIASA and partners. ■



More at www.geo-wiki.org

in the pipeline

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FORESTRY

REDD alert

The IIASA Forestry Program's expertise in land use change modeling and its sound knowledge of issues concerning deforestation and reduced emissions from avoided deforestation and degradation (REDD) have won it a place on a European Commission–funded consortium studying the evolution of some of the drivers of deforestation and their potential impacts on the costs of an avoided deforestation scheme.

Deforestation and degradation release up to 20 percent of the greenhouse gas emissions that cause global warming, and a major REDD initiative features in current negotiations under the UN Framework Convention on Climate Change. There are many drivers and pressures causing deforestation. These include conversion of forest to agricultural use, infrastructure development, wood extraction, agricultural product prices, and a complex set of factors that, in certain localities, can be extremely important. As, economically speaking, deforestation is best understood as an investment process, there is an economic cost involved in avoiding deforestation that varies widely across continents, regions, and countries.

The nine-month project is expected to foster greater understanding of the linkages between different drivers and their significance in a global economic and political environment with higher incomes and productivity, increasing energy prices, and increased food demand. The project will also assess the costs and challenges for reducing deforestation in order to limit climate change and preserve biodiversity. ■

IIASA's REDD research
www.iiasa.ac.at/Research/FOR/redd.html

ATMOSPHERIC POLLUTION

Counting the cost of climate change

IIASA and The Energy and Resources Institute (TERI) of New Delhi, are two of the partners in a multi-disciplinary team of leading impact and economic experts working on the new project, "Full Costs of Climate Change" (ClimateCost), funded by the European Commission under the Seventh Framework Programme.

SEVENTH FRAMEWORK PROGRAMME

Although the debate on the costs of climate change is already under way, there is a major research gap in terms of the lack of a detailed cost-benefit analysis of the various strategies currently being considered. There is a thus an urgent policy need to advance knowledge on the full economic effects of climate change, as reflected in the combined costs of inaction, mitigation, and adaptation.

As part of the overall work plan for ClimateCost, the Atmospheric Pollution and Economic Development (APD) Program will link the IIASA DIMA model, which produces forecasts of land-use change, carbon sequestration, impacts of carbon incentives, biomass for bioenergy, and climate policy impacts, to the global energy sector model, POLES. The combination and integration of POLES and DIMA will enable the production of consistent scenarios considering sinks and biomass potential and use.

IIASA's GAINS-Asia model will also be used to estimate air pollution concentrations and key health and environmental changes for India and China, and express all outputs in monetary terms. TERI will conduct a complete qualitative and quantitative assessment of the co-benefits/ancillary benefits of air pollution abatement measures, working closely with IIASA. ■

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

WORLD POPULATION

Building resilient communities

Understanding how societies will be able to adapt to the increasingly severe impacts of climate change is the focus of new research made possible by a prestigious grant awarded to Wolfgang Lutz, leader of IIASA's World Population Program. The grant, totaling approximately €2.5 million over five years is the inaugural Advanced Investigator Grant of the European Research Council. It will fund an ambitious study, "Forecasting societies' adaptive capacity to climate change," and has been granted to address a key knowledge gap concerning the likely impact of climate change on human wellbeing.

Using demographic forecasting techniques and in-depth empirical case studies in Asia, Africa, and Central America, the research will focus on the role of education in determining how different segments of populations in various parts of the world will be able to adapt to the extreme consequences of a changing climate.

According to Professor Lutz, the research will address "perhaps one of the world's most important unanswered questions." While there is quite a good understanding of how population is contributing to greenhouse gas emissions and associated climate change, there is very limited understanding of how future societies will be able to cope with climate change. Says Lutz: "Developing resilient communities must be one of the urgent challenges facing governments and international donors around the world."

The research will be carried out in collaboration with Chulalongkorn University in Bangkok and the Vienna University of Economics, and will include research partners in Asia, Africa and Central America. In-depth case studies will focus on communities affected by the Asian Tsunami, the Sahelian drought and Hurricane Mitch off Central America. ■

IIASA's World Population Program
www.iiasa.ac.at/Research/POP

FRAGILITY OF CRITICAL INFRASTRUCTURES

Fast tracks to the Stone Age

In today's highly-connected world, the possibility for a local event to spiral out of control and become a global catastrophe is much greater than ever before

What's remarkable about the four news stories (*right* and *below*) is that there is *nothing* remarkable about them! Similar events are reported in the media every day. The scary part of these reports is that they are not just examples of events that could turn society upside-down overnight; they are far more than mere curiosities or hypothetical doomsday fantasies dreamed up by the overly active imaginations of thriller writers. Each and every one of them has already happened (including the EMP, which was felt in Hawaii from nuclear tests in the Pacific back in the 1960s) and will almost surely happen again. Moreover, these kinds of "catastrophes" almost never happen because of terrorist attacks or other malign intent. Rather, simple human error and poor judgment, coupled in some cases with just plain bad luck and/or the whim of nature, is quite sufficient to make the house come tumbling down.

While those catastrophes like an EMP or a crash of the Internet grab attention because they can come seemingly out of the blue, there are medium- and long-term events of equal import. For instance, long-range catastrophes such as a new Ice Age or an overall decline in human fertility can wreak havoc on survival prospects for humankind. So can shorter timescale events like the extinction of bees or other animals necessary for agriculture and food production.

Millions Trapped by Power Cuts

6 November 2006—On Saturday night, 5 November 2006, about 10 million people in France, Italy, and Germany were trapped in trains and elevators when the electric power went out for about half an hour. The German energy company E.ON said the problem began in northwestern Germany, where its network became overloaded because a high-voltage transmission line over a river had been shut down to let a ship pass safely. The company said it had carried out similar shutdowns in the past without incident and that it could not understand ''where and why'' the shortfall in electricity began. The German government immediately demanded an explanation from E.ON of what happened—and how it would prevent a recurrence. According to the German economy minister, Michael Glos, ''Power outages of this kind are not only annoying for people, but also represent a considerable risk for the economy.''

Air Traffic Control System Breaks Down

21 September 2004—According to a report in the *Los Angeles Times*, a major breakdown in Southern California's air traffic control system the previous week was partly due to a ''design anomaly'' in the way Microsoft Windows servers were integrated into the system. The radio system shutdown, which lasted more than three hours, left 800 planes in the air without contact with air traffic control and led to at least five cases where planes came too close to one another, remarked the Federal Aviation Administration (FAA). Air traffic controllers were reduced to using personal mobile phones to pass on warnings to controllers at other facilities, and watched close calls without being able to alert pilots.

The failure was ultimately attributed to a combination of human error and a design glitch in the Windows servers installed over the previous three years to replace the radio system's original Unix servers, according to the FAA. The servers are timed to shut down after 49.7 days of use to prevent a data overload, a union official told the *Los Angeles Times*. To avoid this automatic shutdown, technicians are required to restart the system manually every 30 days. An improperly trained employee failed to reset the system, leading it to shut down without warning, the official said. Backup systems failed because of a software failure.

Threat from Electromagnetic Pulse Attack

22 July 2004—A nuclear-generated electromagnetic pulse ''is one of a small number of threats that has the potential to hold our society seriously at risk and might result in defeat of our military forces.'' The Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack announced this startling conclusion today in a report to Congress. This alarming report clears the way for Congress to debate more seriously the most effective measures to meet the threat of an EMP attack.

The report states that in addition to being able to kill thousands of people instantly, nuclear weapons have another, equally crippling capability to destroy or disrupt power grids, electronic systems, and communications in an entire country, while sparing the lives of its people—at least initially. A nuclear bomb detonated above the Earth's atmosphere creates a split-second electromagnetic pulse, similar to an extremely high-energy radio wave. For example, a single nuclear weapon detonated at an altitude of 500 kilometers over Kansas could produce an EMP that would blanket the entire continental United States, potentially damaging or destroying military forces and civilian communications, power, transportation, water, food, and other infrastructure essential to modern society. Recovery could take years. In a congressional hearing on the EMP threat, chaired by Representative Roscoe Bartlett (R-MD), Dr. Lowell Wood of the Lawrence Livermore National Laboratory described the effect of an EMP attack as capable of instantly regressing a country dependent on 21st-century technology by more than 100 years.

Even more ominously, if you're inclined to create an EMP yourself ,you don't even need a nuclear weapon to do it. Plans are available on the Internet for a ''home-brew'' device that will do the job at a cost around US$ 400.

Hackers Attack Estonian Web Sites

17 May 2007—The Estonian Defense Ministry today claimed there was a possibility that the Russian government was behind recent hacker attacks against Estonian Web sites. They said more than one million computers worldwide had been used in recent weeks to attack Estonian sites since a disputed Soviet statue had been removed from downtown Tallinn, Estonia's capital. Defense ministry spokesman, Madis Mikko, stated, "If, let's say, an airport or bank or state infrastructure is attacked by a missile it's clear war. But if the same thing is done by computers, then what do you call it?"

Of course, it's easy to be a doomsayer and write about what might happen. What's not so easy is to identify early-warning signals to anticipate these "deal-breaker" events before they occur. Nor is it easy to give prescriptions for what to do when we actually observe such "weak" signals. But it's clearly not possible to prepare for every class of catastrophe or even mitigate its effects. A collapse of the quantum vacuum, for instance, could gobble up the entire planet in a few milliseconds, and the only way to prevent it would be to stop all research into particle physics. And even that might not be enough if nature steps in to play a malevolent role. So some catastrophes are just that and cannot be anticipated or buffered against. But others are not. What we need to do is to identify those events that are foreseeable and to behave in a proactive rather than simply reactive fashion to that type of natural-born killer.

How communities can increase resilience to extreme events (pp. 20–21)

Societies today are unimaginably complex, having been built up over the span of centuries. This is one of the underlying reasons why many human-generated collapses can (and do) occur. When a society collapses, be it ancient Egypt, Rome, or the USA today, it quickly loses complexity. All institutions, laws, and technologies become simpler, a lot simpler. Moreover, the range of social roles and behaviors open to the population of such a society dramatically shrink. These factors lead to a rapid reduction in living standards, as without complex institutions, infrastructures, technologies, and social roles, large populations cannot be sustained at their previous standard of living. Consequently, people consume far less, stay at home, turn inward, and die much sooner. Only by understanding the ways in which collective social events unfold, together with how infrastructure networks operate, can we hope to identify distant early-warning signals of impending catastrophes and take action to defuse, or at least mitigate, their potentially earth-shattering consequences. ■

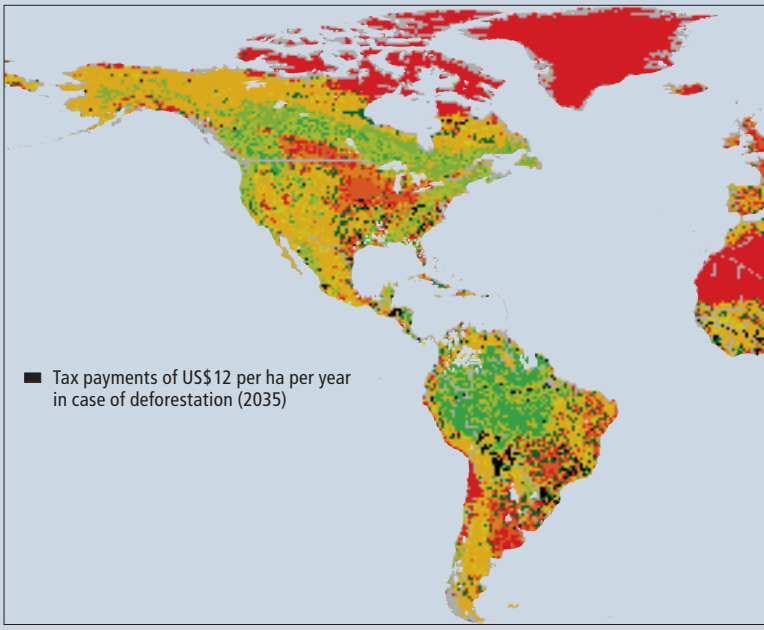
Further information *Fast Tracks to the Stone Age: Thirteen Global Catastrophes Just Waiting to Happen* by John Casti will be published in 2010. IIASA's Fragility of Critical Infrastructures (FCI) initiative at www.iiasa.ac.at/Research/FCI. For information on the closely-related emerging IIASA initiative on Extreme Events in Human Society, contact the author on casti@iiasa.ac.at.

Dr. John Casti is a research scholar with IIASA's Dynamic Systems Program.

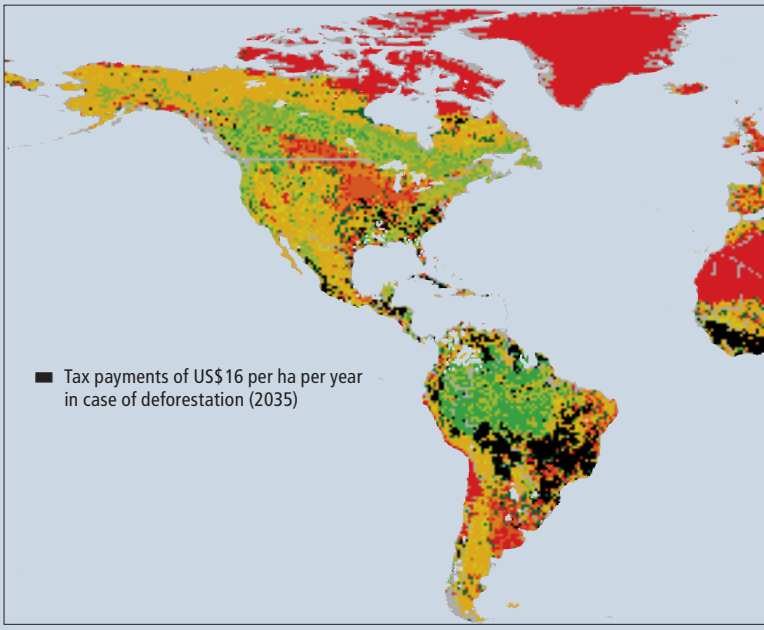
POLICY-RELEVANT RESEARCH

Stopping deforestation and degradation of forests

IIASA foresters advise the UN Framework Convention on Climate Change



SAVING FORESTS AND ECOSYSTEM SERVICES AT THE SAME TIME
The black areas show the forests that will have been protected from deforestation by 2035 through introducing a tax on deforestation of US$ 12 per ha and year (*top map*) or of US$16 per ha and year (*bottom map*). Such policy protects simultaneously some of the areas in the world with the highest ecosystem services values (green area).
Source: See www.iiasa.ac.at/Options/sources



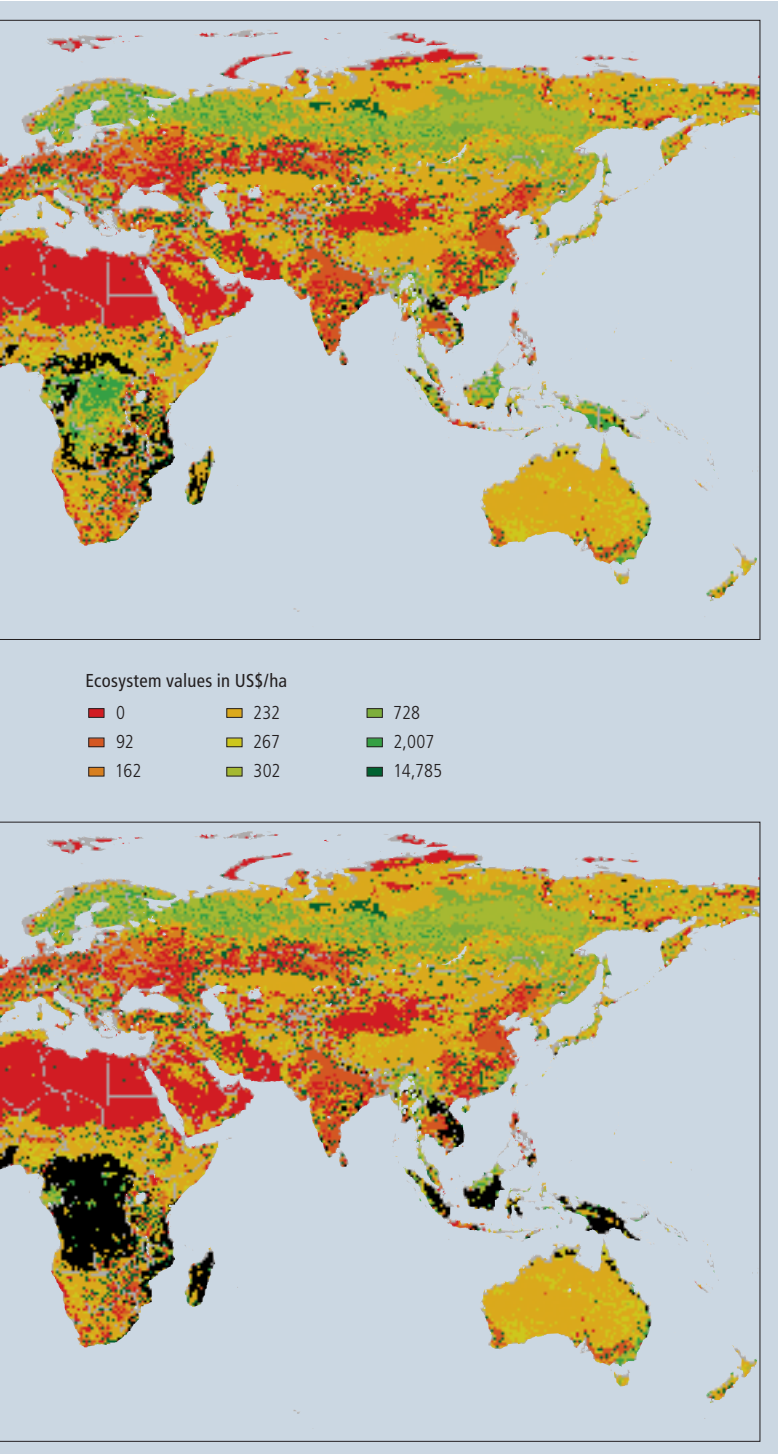
Today, the concept of reducing emissions from deforestation and degradation of forest is central to the debate over how best to limit the global temperature rise to under 2 °C. Moreover, partly thanks to IIASA scientists' efforts in pushing their research in successive fora and publishing their studies, the reduction of emissions from deforestation and the degradation of forests (REDD) has become firmly linked to other important environmental benefits that offer more environmental "bang" for an emissions reduction "buck." It is now recognized that not only can a well-constructed REDD mechanism offer enhanced ecosystems value such as biodiversity and water-security (forests are the source of three-quarters of the world's fresh water supply), but it can help sustain the mostly impoverished, indigenous peoples who inhabit the forests by preserving cultural and social values and developing fresh sources of income for them.

However, the REDD process has not always been seen this way. The critical path from research to policy and eventually on to practice can be tortuous and requires more than scientific expertise. It also demands persistence, energy and a willingness to spend sleepless hours on overnight flights to remote conference locations. Most of the early efforts at halting climate change under the Kyoto Protocol were aimed at cutting CO_2 emissions in the developed (or, in UNFCCC-speak, "Annex I") countries. The principal carbon abatement measures targeted the two largest single sources, transport and industry. At that stage, forestry in developing (non-Annex I) countries was only peripherally involved within the Land Use, Land Use Change and Forestry (LULUCF) sector of the UN Framework Convention on Climate Change (UNFCCC). Under this, developed countries might cooperate with developing countries on voluntary measures in the framework of the "clean development mechanism." However, even this effort was limited to afforestation and reforestation rather than REDD.

It was only in December 2005 that the phrase, "Reducing emissions from deforestation in developing countries and approaches to stimulate action," first appeared as an agenda item in the UNFCCC process, at the 11th session of the Conference of the Parties (COP 11) in Montreal. However, the key event that moved the REDD process up the global agenda was actually COP 13, held in Bali in December 2007. Several IIASA forest experts were invited to attend that enormous 12-day international get-together of politicians and scientists, which not only produced an Action Plan that gave new prominence to the REDD approach, but also a Road Map calling forth various ideas on stimulating action.

The Bali Road Map called for investigation into a long-term, global goal for emission reductions (pp. 18–19)

Partly in response to the challenge thrown down in Bali, in July 2008, a team of scientists, including Georg Kindermann, Michael Obersteiner, and Ewald Rametsteiner, together with co-authors from Brazil and the US, published a study that showed



how paying to reduce tropical deforestation might be a more cost effective way to slash greenhouse gas (GHG) emissions than other methods under consideration. According to their calculations, even a modest program of cutting deforestation by 10 percent over a period from 2005 to 2030 could save 0.3–0.6 billion tonnes of CO_2 at an annual cost of US$ 0.4–1.7 billion. To achieve the same result by another method under serious review, carbon capture and sequestration from a fossil-fuel power plant, would cost up to US$ 30 billion at then-prevalent rates.

The transparency of such studies, and the peer review to which they are subjected, is one important way that IIASA is able to push its research into policy channels. But another more direct way is through important subsidiary bodies that feed into the main UNFCCC process. For the Subsidiary Body for Scientific and Technological Advice (SBSTA) meeting held in Accra, Ghana, in August last year, another IIASA Forestry team traveled down to trail new research linking REDD and global climate change.

By making this effort, they were rewarded with an invitation to hold an event at COP14, held in Poznan, Poland last December. There, they presented a proposal to create an International Emission Reference Scenario Co-ordination Centre (IERSCC), a body to ensure that planned cuts in emissions from avoided deforestation in developing countries would be globally consistent, and thus qualify to take part in a new process that would attract credits in return for storing carbon. The distribution of such credits would be made under another IIASA proposal, adapting an innovative Dutch auction mechanism used in the LULUCF sector of the UNFCCC. Combining the two ideas would avoid creating REDD "hot air", or wasting funds on cuts that were not "real:" i.e. measurable, reportable, and verifiable.

Currently, IIASA scientists continue to refine and support this and other research plans, presenting them in different fora as well as peer-reviewed publications. One especially significant event was held in Copenhagen in mid-March, from which research conclusions will be collated and later fed into the main UN climate change conference which convenes in the city on 7 December. Two IIASA Forestry Program teams presented papers there, one describing a quantitative analysis of GHG mitigation through bio-energy production versus carbon sinks enhancement, and the other a collaborative modeling initiative on the economics of REDD.

Since the mid-March event, Dr. Obersteiner has provided expert input to the SBSTA meeting at the invitation of the UN Climate Change Secretariat in Bonn, and described the outcomes of IIASA Forestry Program's work. Those discussions, which focused on methodological issues relating to reference emission levels specifically related to deforestation and degradation, were scheduled to feed into the 30th SBSTA session.

IIASA's work is based on research and analytical tools such as those developed in the Integrated Sink Enhancement Assessment (INSEA) project. This work, led by IIASA's Forestry Program, assessed the economic and environmental effects of enhancing carbon sink and GHG abatement measures on agricultural and forest lands by combining and integrating the models and data from 14 international partners into three major blocks: bio-physical modeling, forest modeling, and economic modeling. The integrated modeling capacity has been further applied and developed in the European Commission funded projects, GEO-BENE and CC-TAME.

Now IIASA's Forestry Program is applying its research tools to a real world situation in a group of countries that make up the Congo Basin, an important rainforest region of Central Africa. There, for a project sponsored by the World Bank, existing models developed by the IIASA Forestry team (such as GLOBIOM and G4M) will be adapted in order to develop forward-looking REDD scenarios for the Congo Basin in a fully integrated manner. The same group at IIASA is also developing an online tool (see page 6 and www.geo-wiki.org) using Google Earth maps, so that a global network of local volunteers, who wish to help improve the quality of existing land cover maps, can report on deforestation and degradation in their own areas. ■

Further information IIASA's Forestry Program at www.iiasa.ac.at/Research/FOR and a list of references at www.iiasa.ac.at/Options/sources

Mr. Florian Kraxner, **Dr. Michael Obersteiner**, and **Dr. Steffen Fritz** are research scholars in IIASA's Forestry Program.

International Migration Threat or solution?

Managing migration will become harder in a more demographically and economically divided world

Not surprisingly, the apparently contradictory concerns over rapid population growth in some world regions and population aging and shrinking in others, confuse many observers. Obviously, individual solutions must be found for each region; however, the simultaneous occurrence of such contradictions in a rapidly globalizing world does pose a major challenge—which is seen by many as a threat—international migration.

According to conventional wisdom, Europe's graying population and declining labor force will create a huge need for migrants in the coming decades. However, some experts assume that improving educational attainment levels and further technological progress can make native populations more productive and thus reduce the need for migrants. So who is correct?

A DEMOGRAPHICALLY DIVIDED WORLD

Demographically speaking, today's world is deeply divided. Rapid population growth continues to be a major concern in regions, where populations of some countries are likely to triple over this century. In some African countries, if female education and family planning services stall, populations could even more than quadruple in coming decades, with disastrous implications for poverty reduction and health, and a massive growth in urban slums. Climate change is also likely to bring extra hardship to the most vulnerable populations.

Elsewhere, including most of Eastern Europe, very low birth rates and out-migration are causing unprecedented rates of population aging and even decline—Bulgaria's population declined from around 9 million in 1989 to 7.5 million today and is projected to fall to 6 million by 2030. We are also seeing a massive increase in the mean age of the population, with corresponding reductions in the number of children and young adults. Western Europe shows similar aging but life expectancies are typically much higher and population decline is still being offset by significant immigration. The population of Japan, where immigration is negligible, is already on a shrinking trajectory. China still has quite a young population, in spite of its rapid switch from high to very low birth rates, and will thus continue to grow until around 2025–2030, when a rapid decline is likely to start. Meanwhile, the number of over-60s in China will increase from 10 percent in 2000 to 35 percent in 2050. ■

We need to go beyond the simplistic consideration of pure population numbers to include human capital considerations regarding the skill levels of both migrants and the resident population. IIASA's new human capital reconstructions and projections for 120 countries have made it possible to study such long-term trends.

The "Pull" Factor: Does Europe need migrants?

In Figure 1 we see that in the EU27, the projected labor force decline after 2020 (assuming median migration) will be low and gradual; it will also be offset in part by a further increase in the labor force's educational attainment and possibly a gradual increase in retirement ages. It is not clear if this combination of trends will actually result in the frequently mentioned need for migrants for demographic reasons. If labor input into production keeps diminishing because of technological change, this combination of fewer but better-educated workers may be just what the European labor market needs. Note that individual countries such as Italy

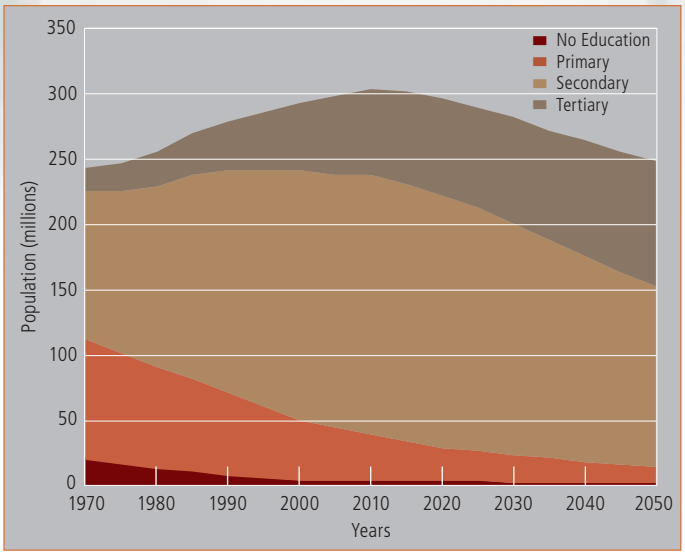


FIGURE 1 Size of the population aged 20–65 in the European Union (plus Norway and Switzerland) by level of educational attainment, 1970–2050.

face much more serious labor force declines, which are unlikely to be compensated for by better education, especially if enrollment rates in tertiary education (which are particularly low among men) do not improve significantly.

Figure 2 shows the projected labor force size declining much more rapidly in the non-EU Eastern European countries where, between 2010 and 2050, the working-age population is likely to decline by over one-third and the number of people with tertiary education remains fairly constant.

For both East and West Europe, we are unsure what kind of worker educational profile is needed in the future and therefore what "pull factors" of migration we can expect. Some experts argue that because of the aging population, the European health-care sector needs unskilled workers. But currently we find that unskilled persons have by far the highest unemployment rates—10.6 percent in the EU27 in 2007, as opposed to 3.9 percent for those with higher education. The perceived labor shortage in the low education sector may thus have less to do with labor supply than with lower salaries in the sector and the unwillingness of the native-born to do such jobs. In industrial production and most services, further increases in worker skill levels will likely be needed.

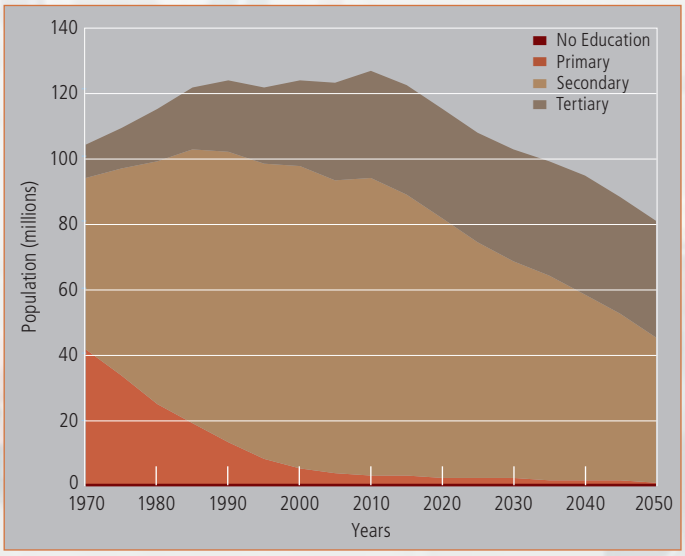


FIGURE 2 Size of the population aged 20–65 in Eastern Europe by level of educational attainment, 1970–2050.

The "Push" Factor: Do migrants need Europe?

In many parts of Africa the combination of rapid population growth, economic stagnation and additional stress due to climate change will likely present serious "push factors" for migrants, mostly in the direction of Europe. Figure 3 shows the growth of the working-age population in sub-Saharan Africa by level of education under an optimistic scenario concerning future education. But even though the educational composition of the population is seen as improving significantly, the sheer increase in human numbers is daunting—tripling from 100 million in 1970 to 300 million today, and probably tripling again to 900 million by 2050. Can job creation keep pace with this rate of population growth, especially under current economic conditions? I believe that only a major reorientation of international development priorities can help achieve this. As IIASA research shows, only massive investments in universal primary and secondary education could help kick-start such growth.

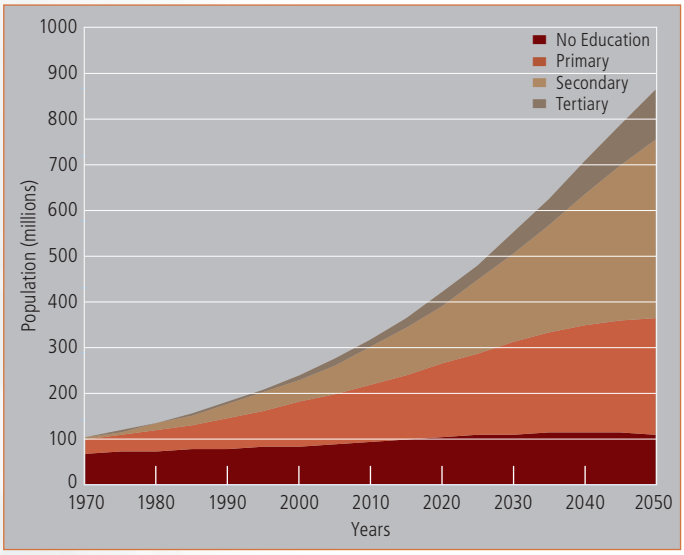


FIGURE 3 Size of the population aged 20–65 in sub-Saharan Africa by level of educational attainment, 1970–2050.

Migration and social conflict

If Africa fails to develop rapidly, we can expect more conflict and more humanitarian crises. These will coincide with the expected negative consequences of climate change for African livelihood and health. This will probably produce more asylum seekers and those desperately seeking a better life in the North. In this context it does not matter whether Europe needs or wants migrants with certain qualifications. Europe must expect that many more will arrive at its gates, many simply trying to survive. But migration could also take new and surprising directions.

Food insecurity is expected to increase in Africa (pp. 14–17)

Consider, for example, the vast and highly fertile agricultural lands of Ukraine and Russia. Here, the native population is shrinking rapidly, while climate change may even increase agricultural productivity and expand the arable land. Compare this to Egypt, not too far away, whose population is likely to double and where worsening water constraints make agricultural expansion impossible. Perhaps these two IIASA member countries should start talking about migration to each other.

However, for political reasons significant migration from Egypt to Russia or Ukraine seems unlikely to happen in the near future. Migrants would come with their own language, culture, and religion, thus making the receiving countries more heterogeneous. If integration does not work well, this carries the risk of declining social cohesion and even social conflict. Hence, the potential problems lie not only at the borders but also within countries.

There will always be migration in a globalizing world. The trick is to establish rational migration regimes early on that ensure planned and orderly migration conditions at both the sending and receiving ends. However, the more demographically and economically divided the world becomes, and the stronger the impact of climate change will be felt, the harder this task will be. And again, investment in education is a good strategy because more educated migrants tend to integrate much better and a more educated receiving population will be more open to this process. ■

Further information IIASA's World Population Program at www.iiasa.ac.at/Research/POP

Professor Wolfgang Lutz is the leader of IIASA's World Population Program.

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Poverty and food insecurity

A threat to billions

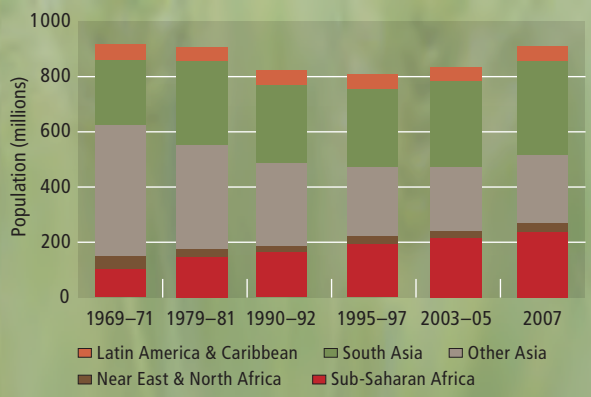
The much-heralded Copenhagen climate change summit in December 2009 offers an opportunity to tackle the plight of two billion of the poorest people who have contributed very little to the causes of climate change but will almost certainly bear the brunt of its impacts. Similarly the burdens from the current financial crisis and the negative side effects of biofuels development and agricultural subsidies all fall disproportionately on the poor. Seventy percent of the poorest two billion rely on agriculture for their livelihoods and wellbeing. Political will and resource commitments are required to tackle the threats of poverty and food insecurity and to help the world achieve the universal right to food for all its inhabitants. But will the ministers and officials meeting in Copenhagen be able to mobilize these? It seems unlikely.

Food, water, and health are recognized as fundamental human rights and yet today, a billion people are undernourished, over 1.2 billion have no access to safe water, and half the worlds population is at risk of infectious diseases. The tragic situation will be further exacerbated in the twenty-first century by global change, including climate change, ecological degradation, economic inequities, and the momentum of demographic processes.

The year 2008 will be remembered as the defining moment when the reality of the interlinkages and interdependencies between food and energy came home to roost. A number of factors, including the adoption of mandatory biofuels targets, the high volatility of crude oil prices, increasing demand for food imports from major developing countries, below-average harvests in some countries, and market speculation—together with the low level of world food stocks—resulted in sudden increases in world food prices. This caused the domestic prices of staple foods in a number of countries to increase by over 50 percent in a matter of weeks. The poorest were, of course, the hardest hit.

The poverty trap

Poverty and hunger eradication is a much more complex process, involving far greater risks and uncertainty, than was imagined in 2000 when the Millennium Development Goal (MDG) of halving, between 1990 and 2015, the proportion of people who suffer from hunger and debilitating poverty, seemed feasible. For a number of reasons, eradicating extreme poverty and hunger, numerically and ethically the first of the MDGs, is now—paradoxically—the least likely to be achieved.



UNDERNOURISHED Changes in the number of undernourished people in developing countries between 1969 and 2007. *Source*: FAO (2008b; 2001b). (*Note*: FAO states the estimate for 2007 is based on partial data for 2006–08 and a simplified methodology and should therefore be regarded as provisional.)

Poverty means lack of livelihood earning opportunities and constant struggle for survival and high susceptibility to illness. The average income of the world population has increased substantially in the last decades, but so too has the number of people falling below the poverty line. The 2.5 billion people with incomes of less than US$ 2 a day lack an estimated US$ 300 billion. This is equivalent to some 0.6 percent of global income, but much less than say annual spending on military, not to mention the more than US$ 1 trillion made available to save broken banks. There has always been a gap between the poor and the rich in the world, but it is currently wider than ever before. In 2000 the top 10 percent of earners in the world received together 85 percent of total earnings, the bottom 10 percent only 0.03 percent, a ratio of nearly 3000 to 1.

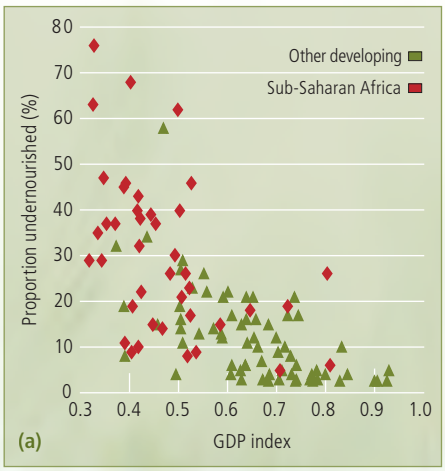
The syndrome of poverty, undernourishment, poor health and illiteracy is governed by multiple mutually reinforcing factors: the lack of socio-economic development; high population growth; insufficient investment in infrastructure and human capital; poor agronomic progress; increasing competition for land and water resources by food production and other sectors; pollution and nutrient mining instead of environmentally sustainable best practices; exposure to natural disasters and extreme events; and insufficient response capacity and adaptation to climate change. These threats are further aggravated by poor governance and civil conflicts.

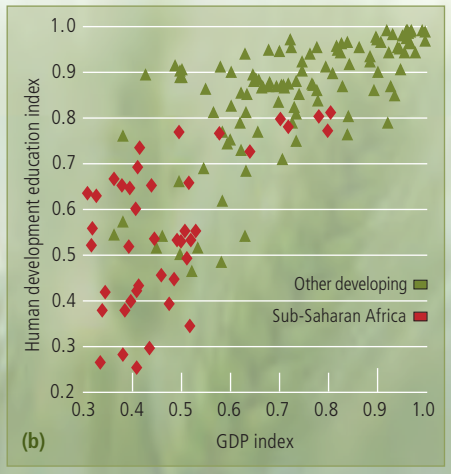
Food insecurity

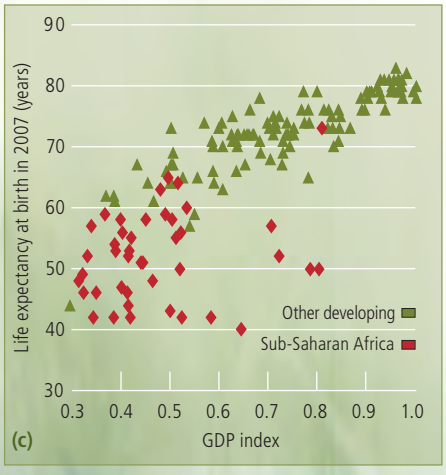
The most widely accepted definition of food security, which captures its inherent complexity, was formulated at the 1996 World Food Summit in Rome: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." There is no easy way of measuring food insecurity. However, it can be broken down into three distinct but interrelated dimensions: food availability, food access, and food utilization.

Chronic food insecurity is a widespread problem and is closely related to structural factors associated with extreme poverty. Vulnerability to food insecurity generally includes those who lack productive assets and depend on irregular income from daily wage labor. Groups such as landless agricultural day laborers, casual fishermen, and beggars fall into this category.

Calamities like floods, cyclones, earthquakes, land slides and erosion, and droughts cause extensive damage to crops, homes, and to household and community assets, decreasing the livelihood opportunities of the poor. At the same time, disasters hamper physical access to food when food stocks and crops are destroyed and markets are temporarily dysfunctional, often causing price spikes for essential food staples.







HUMAN DEVELOPMENT AND WELLBEING
The four figures illustrate the correlation between a country's economic development and its population's (a) undernourishment, (b) level of education, (c) life expectancy, and (d) access to safe drinking water.

In a perfect and equitable world, food availability would be achieved by ensuring that domestic production, net food imports, and national food stocks are, together, sufficient to cover national requirements. However, even with all these factors in place, in reality poor households can be prevented from accessing food for many reasons: they have no land to grow their own food; their income is too low to afford market prices; no public welfare programs are available to enhance their capacity to acquire food.

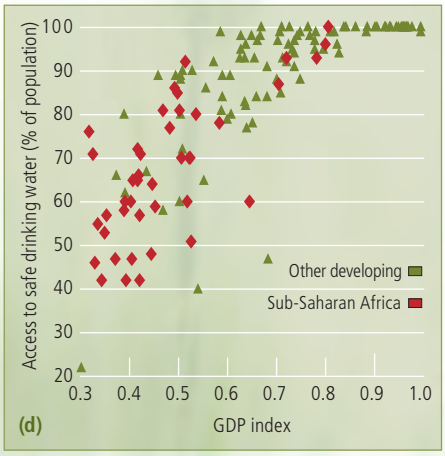
Extreme events can extensively damage crops (pp. 20–21)

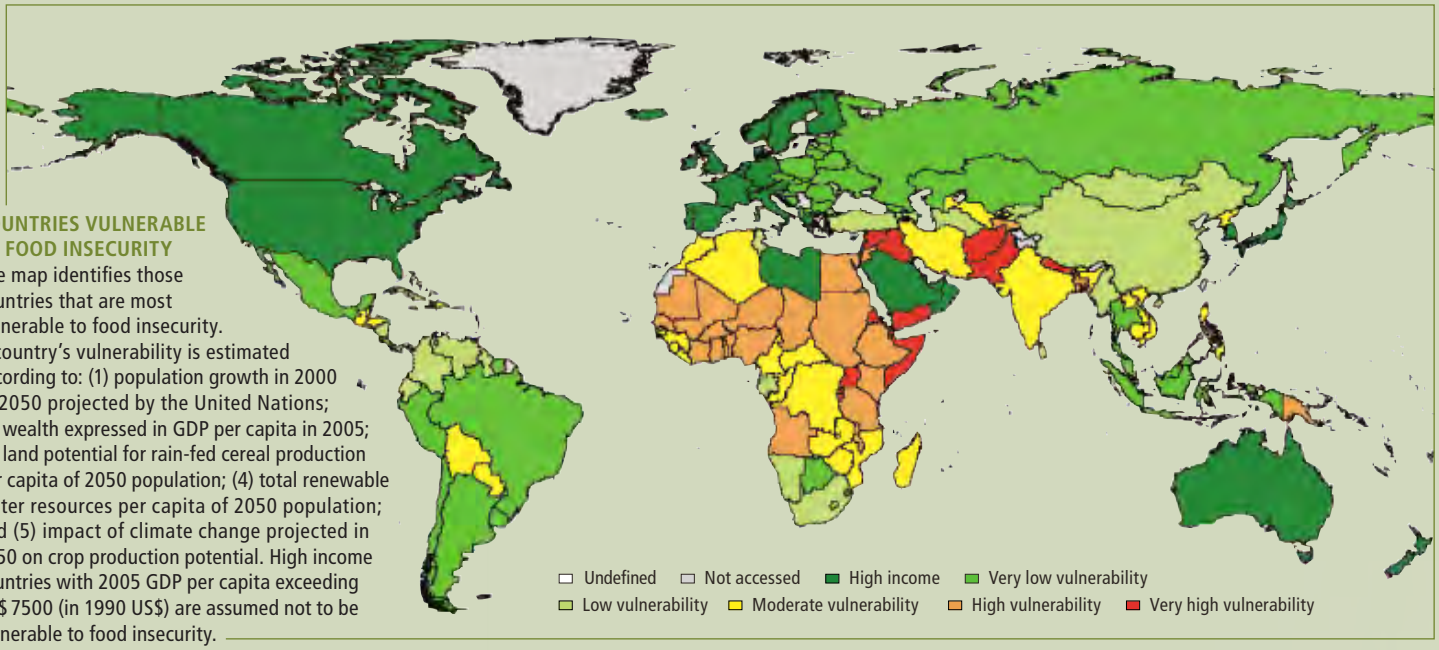
Even if enough food is "acquired," its distribution in the household is often inequitable, with women, children, the elderly, and the disabled often eating last and least. And even when there is enough food available, an individual's capacity to absorb and utilize nutrients may be deficient because other aspects are lacking such as access to proper sanitation and healthcare, education and nutritional awareness, caring practices and social safety nets.

Trends aggravating food insecurity

Demographic pressures Growing population numbers in developing countries stretch the food and water supply more thinly. The developing-country population is projected to increase by some 60 percent to about 8 billion by 2050, clearly indicating that there will be more mouths to feed, which is reflected in land use changes. The amount of new land brought under cultivation over the last 30 years has been around 5 million hectares annually. Some 1.6 billion hectares of land are currently used for crop production, with about 1 billion under cultivation in developing countries.

As people strive to get the most out of land already in production or exploit virgin territory to develop more agricultural land to grow food, the damage inflicted on the





COUNTRIES VULNERABLE TO FOOD INSECURITY
The map identifies those countries that are most vulnerable to food insecurity. A country's vulnerability is estimated according to: (1) population growth in 2000 to 2050 projected by the United Nations; (2) wealth expressed in GDP per capita in 2005; (3) land potential for rain-fed cereal production per capita of 2050 population; (4) total renewable water resources per capita of 2050 population; and (5) impact of climate change projected in 2050 on crop production potential. High income countries with 2005 GDP per capita exceeding US$ 7500 (in 1990 US$) are assumed not to be vulnerable to food insecurity.

environment grows: arable lands lost to erosion, salinity, desertification, and urban spread; disappearing forests and loss of biodiversity. About 40 percent of the world's arable land is degraded to some degree and will be further impacted by climate change, including by expected extreme weather events and climate variability.

Climate change makes a serious situation worse An already difficult food insecurity situation is being exacerbated by the overarching effects of climate change, caused by the atmospheric accumulation of greenhouse gas emissions, particularly carbon dioxide (CO_2). While current research confirms that crops would respond positively to elevated CO_2 in the absence of climate change, human activities—primarily fossil fuel burning and deforestation—are causing massive atmospheric concentrations of greenhouse gas emissions, leading to higher temperatures, altered precipitation patterns, and increased frequency of extreme events, such as drought and floods. This combination of factors will likely depress agricultural yields and increase food production risks in many world regions in the future, particularly in many of the current food-insecure countries.

Improving climate change policy (pp. 18–19)

Water scarcity exacerbates food insecurity Compounding food insecurity is water scarcity in the locations that need it most—water supply does not coincide with regional distribution of the world's population. Water-stressed and water-scarce countries are defined as those with less than 1,700 and 1,000 cubic meters, respectively, of available water per capita. Some 30 countries already face water shortages, and by 2050 this number could increase to over 50 countries, most in the developing world. As around 70 percent of the world's fresh water use goes to agriculture—even 90 percent in countries that rely extensively on irrigation—water scarcity is often a very serious obstacle to achieving food security.

Research from IIASA's Land Use Change and Agriculture Program indicates that both socio-economic development and climate change in this century will significantly impact irrigation water requirements. Simulation results suggest that globally the impacts of climate change on increasing irrigation water requirements could be nearly as large as the changes projected in response to socio-economic development alone: a projected growth of water withdrawals in the order of 25 percent due to socio-economic development as compared to an increase of about 20 percent in global irrigation water needs due to global warming.

Biofuels add to the competition for land and water About 80 percent of current global carbon dioxide emissions originate from fossil fuel burning, making the development of cleaner fuels, the improvement of energy efficiency measures, and adaptation of conservation practices vital. Several developed and developing countries have embraced the apparent win–win opportunity of fostering the development of biofuels to respond to the threats of climate change, lessen their oil dependency, and contribute to agriculture and rural development.

The reality, however, is complex, as biofuel development has social, environmental, and economic impacts, well beyond the national and regional setting of domestic biofuels targets. When important food and animal feed crops, including maize, wheat, and soybean, are redirected toward the production of biofuels, there is competition for land—with serious implications for food security, especially, as demonstrated in 2007/08, when the speed of biofuels development outpaced annual production increases of agriculture.

Ways forward

Commitment to sustainable agricultural development Agriculture is the dominant user of the environment and natural resources; it has the greatest impact on the sustainability of ecosystems and their services, and accounts directly and indirectly for a major share of employment and livelihoods in rural areas in developing countries. The reality for many developing countries is that no progress on reducing rural poverty and hunger can be achieved without political and resource commitment to sustainable agricultural development.

Given that 70 percent of the world's food insecure population live in rural areas, food security cannot be tackled unless the issues of sustainable agriculture and rural development are tackled first. These obviously require the highest policy and resource commitment.

However, trends over the last 30 years show a reduced allocation of national development budgets to agriculture in many developing countries, a setback that has coincided with declining multilateral lending and bilateral aid for the sector. Agriculture, it seems, has been regarded as "backward" and thus of low priority by national governments and their international partners.

The agricultural sector faces a complex challenge: producing more food of better quality while using less water per unit of output; providing rural people with resources and opportunities to live a healthy and productive life; applying clean technologies that ensure environmental sustainability; and contributing in a productive way to local and national social and economic development.

Think globally and act locally The paradox of food insecurity and hunger is that at the global level there is sufficient production to provide food for everyone at a level of nutrition considered satisfactory and yet 1 in 7 people in the world face daily hunger. Notwithstanding the global adequacy of food supplies, at the local level people in countries with persistent food insecurity problems may not have opportunities of access to the actual or potential global plenty. In many countries food security depends fully on the performance of local agricultural production. Investing in the development of agriculture will be particularly effective in those countries with high population growth. However, the natural resource base of some of these countries may not be sufficient to make significant progress. Therefore, serious thought needs to be given to the option that efforts to develop agriculture be supplemented with interventions in other sectors not dependent on agricultural resource constraints.

Focus research and development on the needs of the poor The biological sciences challenge is to combine the best of conventional breeding with safe and ethical molecular and cellular genetics research to develop nutritionally enhanced and productive germplasms. A risk of modern biotechnology for developing countries is that technological development may bypass poor farmers. The rapidly increasing privatization and patenting of agricultural research findings is of concern as its profit priority is unlikely to focus on the needs and crops of the poor. Targeted research has the potential to overcome many environmental constraints such as infertile soils, water limitations, pests and diseases, etc., as well as to increase crop nutritional content.

In many countries, agricultural extension and marketing services have declined due to budgetary constraints and low priority and political support for agriculture. Yet, agricultural extension services will be an essential link to inform and train farmers in the agricultural adaptation to climate change.

Land rights and tenure are indispensible Providing adequate rights of access to land and other natural resources and secure tenure of those rights are essential to fostering sustainable and progressive agricultural development. Secure land tenure empowers and enables development and is a valuable safety net as a source of shelter, food, and income, especially in times of hardship, and leads to greater environmental security. Farmers are quite naturally more inclined to invest in improving their land through soil protection measures, planting trees, and improving pastures if they have secure tenure and can benefit from their investments. Without a land title, the alternative is for farmers to exploit marginal land, abandon it when it becomes unproductive, and then move on clearing forests and other fragile land areas that are available.

Political will and the resources to act are lacking

Safeguarding food, water and energy security requires an enabling environment, which can best be established in a context of good governance, respect for and enforcement of human rights, and a broad-based non-discriminatory economic development. As stated in the Voluntary Guidelines, adopted by the UN Food and Agriculture Organization (FAO) Council in 2004 to support the progressive realization of the right to adequate food in the context of national food security "such an approach entails, *inter alia*, direct and immediate measures to ensure access to adequate food as part of a social safety net; investment in productive activities and projects to improve the livelihoods of the poor and hungry in a sustainable manner; the development of appropriate institutions, functioning markets, a conducive legal and regulatory framework; and access to employment, productive resources and appropriate services."

Until this rhetoric is translated into real policies and actions at the national and international levels, poverty in all its myriad aspects—including chronic debilitating hunger—will remain.

Whether it is climate change, biofuels development, contra-productive subsidies, or the financial crisis, the burden of all these falls on the poor countries and unless the international community rises to these challenges, the future is likely to be bleak, not only for those directly affected but globally in a world that is increasingly interdependent.

The Copenhagen climate change summit should take note and act morally, ethically and practically to ensure worldwide achievement of the universal right to food. ■

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

Günther Fischer is Leader and **Harrij van Velthuizen** Senior Scientist of IIASA's Land Use Change and Agriculture Program. **Mahendra Shah**, Senior Scientist, is Dean of IIASA's Young Scientists Summer Program and Coordinator of UN Science and Policy Relations.

BIOFUELS AND FOOD SECURITY

Based on a global agro-ecological and socioeconomic assessment, IIASA's Land Use Change and Agriculture Program assessed the implications of an accelerated increase in biofuel production. A number of scenarios covering a wide range of possible future demand for transport biofuels for the period 2000 to 2030 were assessed in terms of their impacts on food availability, prices, trade, and worldwide use of agricultural inputs, notably fertilizer and land. Sustainability issues, competition for land use, food insecurity, and greenhouse gas savings were among the aspects addressed by the study.

The global study provided a number of robust policy-relevant research findings:

- Implementing ambitious global biofuel targets for 2020 based on current first-generation technologies is likely to put food security in developing countries at risk and may not achieve any significant reduction in greenhouse gas emissions.
- Meeting ambitious global biofuel targets for 2030 in a sustainable manner requires rapid deployment of second-generation feedstock production and conversion technologies.
- Biofuel policies need to have global scope and be implemented through international development partnerships to avoid potential risks to food security and the environment.
- Biofuels are not all equally "good" or "bad" and knowledge-based policymaking is required to ensure that the right choices are made.

The IIASA study identified the following policy-support measures as being critical for achieving sustainable expansion of biofuels:

- Renewed agricultural investment and research efforts are needed to enhance agricultural productivity.
- The poor must be protected against the impacts of rising agricultural prices.
- Poor rural agricultural communities must be empowered through good governance, participatory development and respect of human rights.
- Equitable partnerships need to be fostered with local communities.
- Second-generation biofuel technologies (i.e., using biomass consisting of the residual non-food parts of crops as well as bio-energy crops) must be promoted.
- Criteria for achieving sustainability and best land use practices as well as environmental certification must be established and adopted.

Even then, liquid transport biofuels are only one among many sources of renewable energy. Their efficiency and societal value needs to be assessed vis-à-vis other current and future energy options within comprehensive national and global energy strategies. ■

Source: "Sustainable Agriculture and Food Security: Implications of an accelerated expansion of biofuels production." Study commissioned by the OPEC Fund for International Development.

Keeping options open

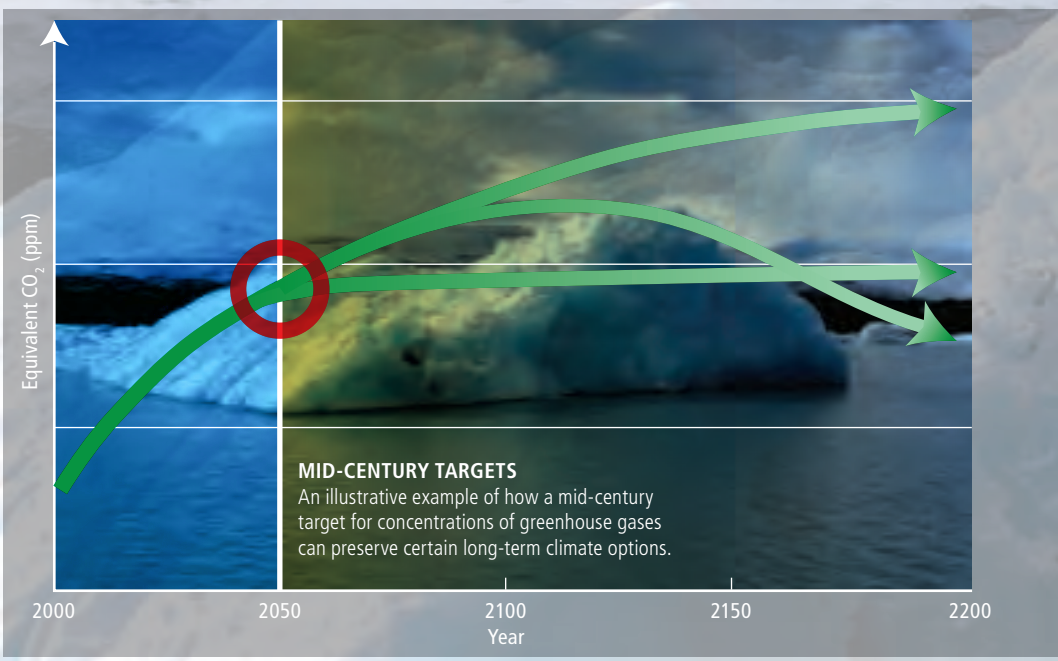
IIASA research suggests mid-century targets could preserve long-term climate options

A nagging fear driving the process to limit anthropogenic climate change is that sometime over the next several decades we may cross a point of no-return. Beyond it, the impact of extreme weather and climate events becomes not only dangerous but also unstoppable. Efforts to keep the global average temperature in a desired maximum range would be overwhelmed by changes already underway, in other words the effort would become too little, too late. As the 2007 Intergovernmental Panel on Climate Change (IPCC) report warns, civilization could then suffer a wide spectrum of impacts, all the way from local economic losses, such as the decline of winter tourism, to major threats to life from greater flooding, heat exhaustion or the spread of tropical diseases.

Most countries now recognize that such a challenge—as with resource scarcities and the flaws of globalization—can only be met by a global rather than a regional, still less a national, solution. However, even as long-term goals for the upper levels of temperature rise are discussed, there remain serious divisions among the scientific community, economists and politicians over the way to reach them. Not only are there well-known scientific uncertainties about how much climate may change in the future and what its impacts will be, but serious political disagreements over long-term climate change policy and short-term measures such as carbon trading combine to block agreement.

But while the global community awaits solutions, a very practical question remains open: Could the world still preserve its longer-term options—options which might allow it eventually to avoid the most dangerous impacts—by establishing and hitting certain interim policy targets (see figure), and even doing so at the least cost?

Several IIASA scientists from the Energy Program and Population and Climate Change Program have collaborated to explore that practical question. Their stepping-off point was the observation that climate change policies have, until quite recently, been viewed from the perspective of two quite different timescales: objectives set for a century or more away, such as ultimate greenhouse gas (GHG) stabilization levels, and short-term targets agreed for mitigation measures over the next decade or so. They had already argued (*IIASA Options*, Winter 2006) that since the atmospheric "life cycles" of some GHGs last a century or more, climate policy demands a long-term perspective at the same time that the international regime to combat climate change is premised on mitigation action beginning in the here-and-now. But between the long term and the short term lies a yawning gap that cannot be effectively bridged by current policy perspectives. Without agreement on a long-term goal, no clear signals are being provided about where emissions should be headed over the next few decades, despite the fact that policy certainty over such a timescale is needed to justify investments in long-lived capital (new or retro-fitted power plants, emitting industries, agribusinesses, etc.).



MID-CENTURY TARGETS
An illustrative example of how a mid-century target for concentrations of greenhouse gases can preserve certain long-term climate options.

Recently, policy proposals that refer to mid-century goals have begun emerging, such as the G8 aim of reducing global emissions by at least 50 percent (without specifying the baseline) and the aspirational targets announced by some individual countries. These may yet prove their importance in providing signals to businesses and government planners that need to take decisions over a horizon of several decades. However, the team was aware that no one had used emissions reduction models to examine the relationship between possible long-term outcomes and the mid-century conditions on which they would presumably be based. The IIASA

Climate change is also expected to lead to more extreme events (pp. 20–21)

scientists reasoned that such an analysis would be especially valuable if they were to asses this relationship between conditions in 2050 and feasible options for long-term climate goals with a model that incorporated factors that determine how much inertia is in the energy system such as rates of capital stock turnover (e.g. new power plants), the penetration of specific technologies, as well as changes to production and distribution systems.

Consequently in the research they employed the IIASA-developed integrated assessment modeling framework. This took into account emissions of multiple GHGs and aerosols from energy, industry, and land-use activities, coupled to models of GHG cycles and climate. They used it to look at a set of scenarios in which demand was met over the first half of the century in order to achieve a specified emissions target by 2050, without knowing what the long-term climate goal would turn out to be. Then with the long-term goal clear, they looked at how demand over the second half of the century could be met in order to reach that goal.

In doing so, they were able to examine the balance between mitigation costs and reducing the risks of dangerous impacts of climate change, exploring the critical trade-off question of whether it is better to make more emissions reductions over the next few decades, or to make fewer now and then ramp up efforts later, when long-term goals become clear. A key factor in this trade-off is identifying how much emissions reduction in the near term is necessary simply to keep long-term options from becoming infeasible.

Results show that for each long-term climate change outcome, there is a "point of no-return," or a critical threshold of mid-century conditions above which the desired long-term goal becomes unattainable. For example, to have at least a 50 percent chance of limiting warming to 2°C over the course of the century, CO_2 emissions in 2050 cannot rise above about 7 billion tons of carbon. In addition the research identified mid-century conditions that would preserve long-term options at the lowest cost. Here, for example, the same probable outcome could be achieved by permitting emissions of about 6 billion tons of carbon in 2050, minimizing mitigation costs.

In some cases, feasibility thresholds identified by the analysis lie considerably above 2050 emissions targets frequently cited as needed to reach long-term goals. For example, thresholds can lie substantially above mid-century emissions levels identified by the EU as necessary for achieving its 2°C target, or by the IPCC Fourth Assessment Report as being associated with various long-term concentration stabilization levels. For example, the IPCC range indicates that stabilization at 490–535 parts per million is consistent with 2050 emissions that are 30 to 60 percent below 2000 levels, while the IIASA analysis found it was feasible to reach the same stabilization level with mid-century emissions that are 20 percent above 2000 levels. This does not necessarily mean, however, that the EU or IPCC targets are not well founded. The feasibility threshold depends on assumptions about the baseline development path, particularly future demand for energy and land. If that demand turns out to be relatively high, then the mid-century emissions threshold is much more in line with the EU and IPCC levels. In addition, policy goals for emissions are probably more sensibly set well below such thresholds, to reduce the risk of crossing them and making long-term targets infeasible.

The study also confirms that these carefully selected interim targets, with regular reviews of progress and of the targets themselves, could play a vital role in anchoring the expectations of GHG emitters. Indeed, industry leaders such as the World Business Council on Sustainable Development, have begun asking for mid-century targets on global emissions. Naturally, the analysis comes with a caveat that all are based on a particular modeling framework and a set of assumptions about future economic and technological development. More analysis with other models and a wider range of assumptions could explore the robustness of the conculsions. However, the study provides clear evidence that mid-century targets could indeed serve as useful policy guideposts, providing a framework for linking uncertain long-term climate goals with the shorter-term actions over the next few decades that may be necessary to achieve them. ■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Further information O'Neill BC, Riahi K & Keppo I (2009). Mitigation implications of mid-century targets that preserve long-term climate policy options. *IOP Conf. Series: Earth and Environmental Science* 6:502001 (2pp).

Professor Keywan Riahi is the acting leader of IIASA's Energy Program.
Dr. Brian O'Neill is the leader of IIASA's Population and Climate Change Program.

NATURAL HAZARDS

Increasing resilience to Extreme events

In collaboration with local partners, an IIASA team assessed the challenges and opportunities for disaster risk management and climate adaptation in India and Pakistan.

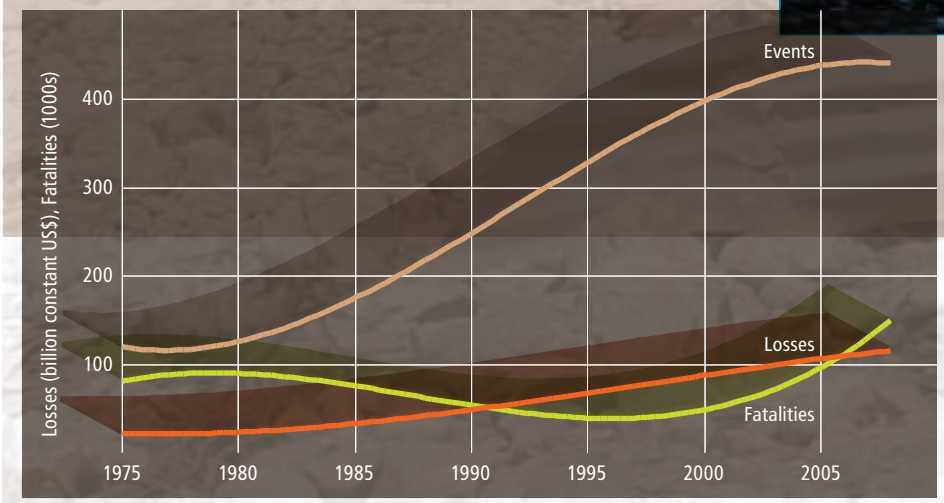
Natural disasters such as floods, droughts, earthquakes, and cyclones have posed a threat to society since the dawn of civilization. However, over recent decades there has been an increase in both the frequency and severity of such disasters worldwide, with associated devastating loss of life and damage to property. Although progress had been made in reducing disaster-related fatalities, over the last years there has been a trend towards increasing loss of life (see chart). The 2004 Asian tsunami, the earthquake in China's Sichuan Provence and Cyclone Nargis in Burma, both in 2008, together accounted for almost half a million deaths, millions of people displaced, and direct damage costs of over US$ 100 billion. Despite extensive relief efforts and large donations from around the world, these impacts will be felt for years to come. In addition, the indirect, often hidden costs on people's livelihoods, the environment, and the economy often exceeds the direct impacts.

Developing countries are most at risk of hunger (pp. 14–17)

These trends, largely driven by socioeconomic factors today, are likely to continue also due to climate change. The latest Intergovernmental Panel on Climate Change (IPCC) report predicts that "some weather events and extremes will become more frequent, more widespread or more intense during the 21st century." Of particular concern is that these impacts are expected to disproportionately affect poorer developing nations across Africa and Asia due to their low adaptive capacity and the costs associated with managing risks.

How can the developmental risks affecting the "bottom billion" be estimated, and how can donors, governments and local communities reduce the risks posed by such disasters given that disaster risk management strategies are often more effective and cheaper than post-disaster relief and reconstruction. Previous research by IIASA scientists has shown that such investments can pay higher dividends in terms of substantially reduced, short- and longer-term, disaster impacts. However, given the competing demands for public and donor funds the question remains as to what type of investments are likely to yield the best and most sustainable results in terms of minimizing risk for those vulnerable to climate variability and change.

A new research methodology developed by IIASA combining economic analysis with risk analysis and climate modeling, and utilizing local disaster-related knowledge as input, may inform the implementation of better solutions as illustrated in the following three case studies. The objective has been to develop a suite of methods and analytical cases that illustrate how the benefits and costs of different risk reduction strategies can be evaluated under different climate scenarios in order to generate analytical results for the risk reduction strategies evaluated. The program takes a comparative multi-hazard case-study approach, with micro- and macro-modeling methodologies used to quantify the costs and benefits of risk reduction for selected risk management interventions. Analytical frameworks are utilized to enable exploration of the role governance and institutional factors play at local and national levels in the functioning of, and anticipated benefits from, investments in risk reduction or risk transfer. Research was undertaken to identify specific opportunities for risk reduction or transfer within the national policy and governance context.



GLOBAL TRENDS IN THE NUMBER OF LARGE DISASTER EVENTS, and associated loss of life and monetary losses. *Data source*: EM-DAT: International Disaster Database, Centre for Research on the Epidemiology of Disasters, Université Catholique de Louvain, Belgium.

UN Photo / Evan Schneider

The cases analyzed (see box, *right*) illustrate that disaster risk reduction can "pay." Whether or not disaster risk management generates returns that justify public investment, however, depends on the details of the specific strategy implemented. In order to generate positive economic returns at a level that competes effectively with other avenues for public investment, risk management strategies need to be tailored to specific contexts. They also need to reflect the best possible knowledge regarding the impacts of climate change on regions. These impacts can fundamentally change the returns to different strategies and their resilience as conditions change. The new methods being developed by IIASA offer the opportunity for policy and decision makers to make robust investment choices for building community resilience to disasters. ■

Further information IIASA's Risk and Vulnerability Program at www.iiasa.ac.at/Research/RAV and the From Risk to Resilience project at http://climate-transitions.org/climate

Dr. Reinhard Mechler, **Dr. Stefan Hochrainer**, and **Mr. Daniel Kull** are research scholars and **Mr. Fawad Khan** and **Mr. Unmesh Patnaik** are associates in IIASA's Risk and Vulnerability Program, of which **Dr. Joanne Linnerooth-Bayer** is the leader.

MINIMIZING DROUGHT RISK IN UTTAR PRADESH, INDIA

Uttar Pradesh is a predominantly agricultural state in northern India with a population of over 190 million. Three quarters of the population are involved in agriculture and almost half of the region's income is derived from farming. Agriculture is heavily dependent on rainfall during the summer monsoons, which often fail resulting in widespread drought. These failures are predicted to increase with climate change. Droughts affect the entire local population, but the extent varies according to location. Farmers with access to limited groundwater or located near canals are usually less affected while those in upland areas with low soil moisture or small and marginal farmers are among the hardest hit. The drought of 2004 resulted in average losses of almost 30 percent of household incomes, with some losses to poorer farmers being almost 100 percent. A key risk reduction strategy has involved surface irrigation from groundwater and canals, both of which are highly limited throughout the area. Given the fact that the proportion of farmers holding crop insurance as of today, as another pre-disaster risk management option, is negligible, ex-post government assistance for drought-affected landholders has been an important response.

The IIASA team modeled the costs, benefits, and economic efficiencies of various risk management options under a variety of climate and rainfall scenarios. The key risk management strategies, actually under discussion in the area, investigated were (i) irrigation via groundwater pumping, (ii) subsidized micro crop insurance (risk sharing), and (iii) an integrated package. Results indicated that all three interventions were economically efficient helping farmers to reduce risk to their livelihoods, however, they depended on both climate variability and a household's access to finance. Integrated packages including both irrigation and insurance were found to return higher benefits at similar costs. ■

FLOOD RISK IN THE ROHINI BASIN, INDIA

The Rohini Basin is located in the northeast region of Uttar Pradesh. The basin is prone to annual monsoon floods, the intensity and frequency of which seem to have increased over the last decade—a trend predicted to increase under climate change. Almost half of the local households have reported at least one family death due to flooding over the past 10 years, 65 percent of which were the prime income earner. The primary flood management strategy has been the construction of embankments, which are often breached. Some local populations have developed their own strategies, including raising houses and grain storage facilities and keeping boats in reserve. These people-centered strategies increase the community's resilience and substantially reduce the impact of floods.

As with the Uttar Pradesh case study, various risk management strategies were modeled under different climate scenarios, both traditional centralized approaches (embankment construction) and more egalitarian people-centered decentralized approaches. The latter included local (e.g., raising of houses and grain storages), community (e.g., village flood shelters, purchasing of community boats), and societal (e.g., promotion of flood adapted agriculture) level interventions. Results showed that past and future construction of embankments were not economically efficient under both current and future climate change scenarios. In contrast, the more people-oriented strategies yielded substantially greater benefits and were economically superior to conventional approaches, with the added advantage of low initial investment costs. ■

URBAN FLOOD DAMAGE IN PAKISTAN

The Rawalpindi/Islamabad urban area in Pakistan is home to over 2 million people. The flood-prone Lai River runs through the area, with most of the city's poor living in the hazardous strip along its bank. A flood in 2001 resulted in 74 deaths and a damage bill of over US$ 1 billion. In addition to the physical damage caused, floods also pose a health risk to local residents through unsafe drinking water and poor sanitation. Past flood management strategies have been primarily structural including the construction of a spillway and retention pond, and tributary diversion.

Four potential flood risk reduction interventions were modeled: (1) deepening and paving a section of the river that runs through the most populated area of Rawalpindi; (2) river improvement through construction of a pond upstream and straightening of a downstream bottleneck; (3) development of an early warning system; and (4) ecological restoration of the floodplain and relocation of people out of the most flood prone areas. All four approaches were found to have favorable benefit/cost ratios indicating that proactive risk reduction among densely populated urban poor can be cost effective. However, there were significant differences among the strategies. The advantage of the modeling approach used is that it allows comparison of similar approaches for cost effectiveness. For example, it was found that one form of river improvement, channel improvement in the lower reaches, was more cost effective than concrete paving in the middle section. The modeling also allows comparison of "softer" people focused approached versus "harder" engineering solutions. ■

The time for restructuring and renewal is *now*

The current economic crisis is a catalyst for structural changes to create a more resilient world, argues IIASA's Sten Nilsson and highlights how to renew the forest sector.

In 2008 the financial bubble that had, in fact, been growing since the early nineties dramatically burst. Most of us are fairly conversant with the issues leading to the crisis and their specialized terminology. We now realize the weaknesses of financial deregulation. We understand about reckless lending by banks and mortgage institutions. We lament human greed and the disproportionate amount of financial influence wielded by the few. We recognize that credit was too cheap and that the banks were effectively giving money away. We can even relate to the unparalleled spending spree embarked upon by US households who never thought about the day of reckoning to come. And we continue to marvel at the estimated US$ 10 trillion pumped into the banks and "The Detroit Three," at the magnitude of financial stimulus packages in general and the recent G20 US$1 trillion giveaway in particular.

Shortly after the financial crisis erupted, Martin Wolf, chief economics commentator at the *Financial Times* summarized it as follows: "The lax monetary policies/regulations facilitated the excess credits and spending, while the housing bubble was the vehicle through which it worked." But this was not a simple subprime crisis—an entire chain of interacting factors led to the crisis. It was an overall systems failure, and as such it will be very difficult to identify the right measures to take to achieve an economic recovery. With system failures taking so long to repair, an extensive string of corrective measures will also be needed. Moreover, I doubt that the current stimulus packages will help mitigate the economic crisis. "No financial stimulus program in the world can stop the crisis," wrote the chief economist of Commerz Bank in the Austrian newspaper *Die Presse* on 6 March." In *The Times* of 7 April 2009, the International Monetary Fund was reported as estimating the amount of toxic paper in the banks alone—and still not written off—to be around US$ 4 trillion.

At an event a few months ago, Britain's Queen Elizabeth asked: "Why did no one see the crisis coming?" The answer is that some did, but no one listened to them. Indeed, there were plenty of signals that an economic crisis was on its way. Simply put, such crises occur roughly in 10-year cycles: the 1973–1974 oil crash, Black Monday 1987, the 1997–1998 Asian crisis (see chart). It was just time for another one. Some scientists are concerned that long-term Schumpeter technological innovation waves have also contributed to the economic crisis. These occur only every 45–50 years and, according to the Vienna University economist E.W. Streissler, the fourth wave appeared from 1995–2000 and was driven by ICT innovations. After the end of this wave, countries failed to find any profitable industrial investments.

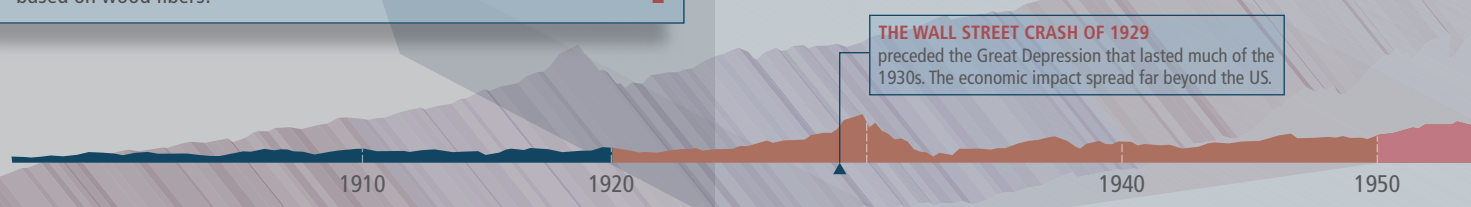
CRISIS AND URGENTLY NEEDED RENEWAL IN THE FOREST SECTOR

Ecosystem services and ecotourism from the forests are options, but they will not save forestry or the forest sector. The market is too limited and the prices needed are not there.

Bioenergy makes an important contribution. Work at IIASA shows that most biomass production for bioenergy production will—for economic reasons—take place in the southern hemisphere. However, this will probably be taken care of by the energy industry, which has huge financial resources available, not by the forest industry. The same goes for biofuel production from cellulose.

The biorefinery approach is currently regarded, as it should be, as an opportunity for the forest industry. However, it will only work if the refineries produce many products based on cellulose fibers using the existing industrial structure and creating synergy effects. This has not yet happened.

This is the right time to really systematically analyze what detailed components are available in wood fibers. We should then try to identify what materials and exciting new value-added commercial products can be produced within the current or restructured forest industry. One possibility is to invite competing proposals for "new commercial material products based on wood fibers." ■



The USA, the entire developed world, and some emerging economies, Streissler believes, were already in a recession in 2000, but this was covered up with artificial policies.

There are still more shocks in the pipeline. As mentioned, massive unknown amounts of so-called toxic paper and assets are still sitting in banks around the world—the result of irresponsible loans that were packaged and sold on to third parties to spread the risk. Some 20 financial institutions in Germany are estimated to have toxic paper with a value of €1 trillion, of which only about 25 percent has been written off to date.

And the financial crisis is no longer just financial. As Robert Zoellick recently recorded in the *Financial Times*, we have gone from a financial crisis to an economic crisis; we are now being hit by an unemployment crisis and heading for a human and social crisis. Dramatically decreased growth is bringing countries such as Estonia, Hungary, Latvia, and Ukraine, to the verge of bankruptcy. Many countries are being forced to increase their budget deficits to levels never seen before. We are in uncharted waters. And as Warren Buffet recently pointed out, the economy will be in a shambles for a long time.

But there is hope. According to former IIASA Director Buzz Holling, though the destruction we face is deep, destruction in its turn generates new, albeit frightening, forces that can produce tremendous creativity. Ernst & Young, in their latest bulletin "Economic Outlook for Business," conclude that the UK will go through detrimental changes because of the crisis, but that "in 5–10 years we will have a completely different country." The message from many sources seems to be that we are in the midst of transition to a new world order. But what kind of new world order?

I believe, essentially, that our values will change. Wealth can no longer be concentrated in just a few hands because, as shown by the present financial crisis, that increases the vulnerability of all. And wealth itself will be defined differently. Pavan Sukhdev of Deutsche Bank believes that in our quest to build financial and human capital, we have forgotten that the natural capital of our environment and the services it provides are the most valuable resource we have.

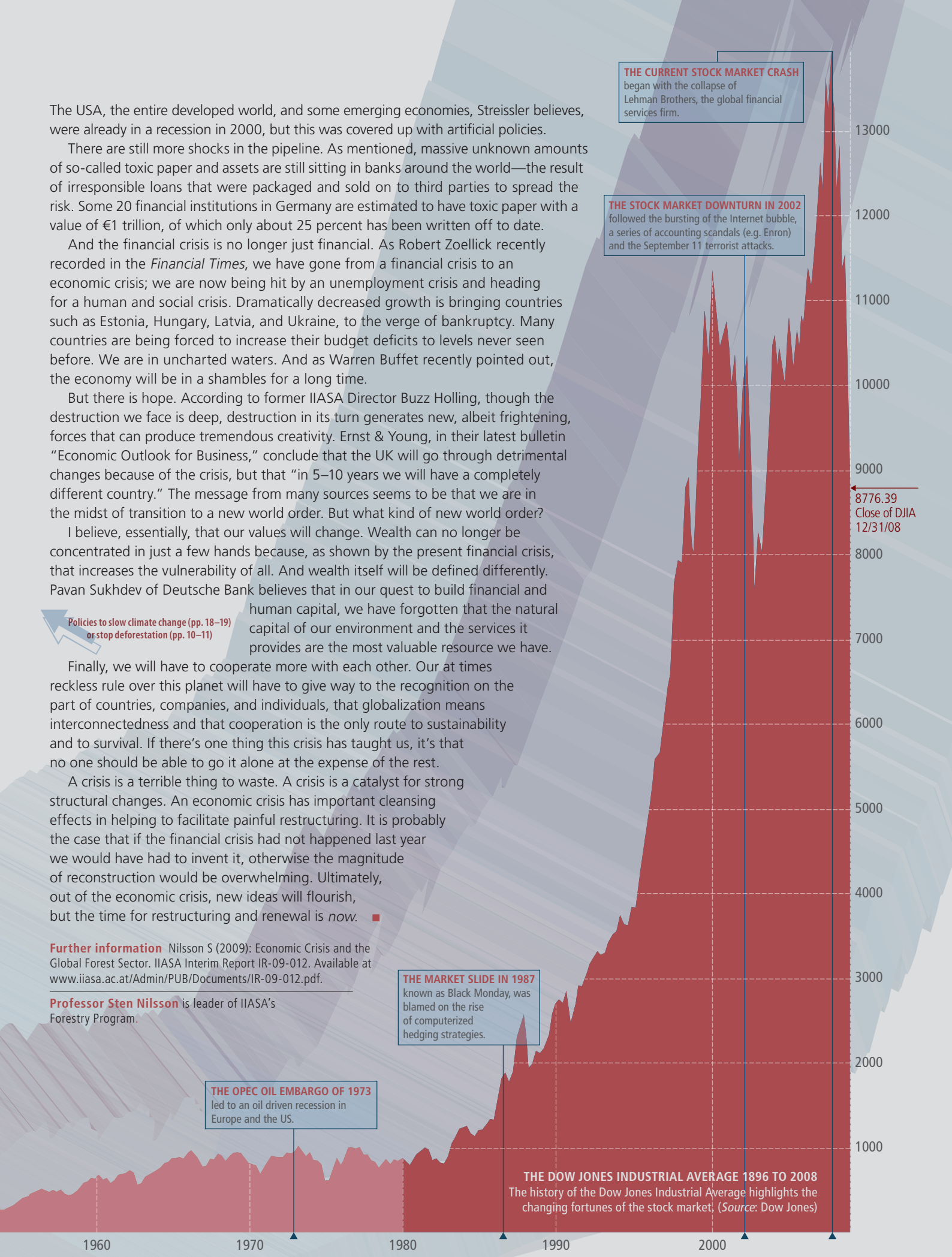
Policies to slow climate change (pp. 18–19) or stop deforestation (pp. 10–11)

Finally, we will have to cooperate more with each other. Our at times reckless rule over this planet will have to give way to the recognition on the part of countries, companies, and individuals, that globalization means interconnectedness and that cooperation is the only route to sustainability and to survival. If there's one thing this crisis has taught us, it's that no one should be able to go it alone at the expense of the rest.

A crisis is a terrible thing to waste. A crisis is a catalyst for strong structural changes. An economic crisis has important cleansing effects in helping to facilitate painful restructuring. It is probably the case that if the financial crisis had not happened last year we would have had to invent it, otherwise the magnitude of reconstruction would be overwhelming. Ultimately, out of the economic crisis, new ideas will flourish, but the time for restructuring and renewal is *now*. ■

Further information Nilsson S (2009): Economic Crisis and the Global Forest Sector. IIASA Interim Report IR-09-012. Available at www.iiasa.ac.at/Admin/PUB/Documents/IR-09-012.pdf.

Professor Sten Nilsson is leader of IIASA's Forestry Program.



THE DOW JONES INDUSTRIAL AVERAGE 1896 TO 2008
The history of the Dow Jones Industrial Average highlights the changing fortunes of the stock market. (*Source*: Dow Jones)

IIASA DIRECTOR AND CHAIRMAN

New leaders for IIASA

Peter Lemke Detlof von Winterfeldt

On 1 January 2009 both Professor Detlof von Winterfeldt and Professor Peter Lemke began work as, respectively, the new IIASA Director and new Chairman of the IIASA Council.

Professor von Winterfeldt joins IIASA following his long-term tenure as a professor at the University of Southern California, where he held many administrative and research positions, most recently as the Director of the National Center for Risk and Economic Analysis of Terrorism Events (CREATE). While at IIASA, he will also serve as Visiting Centennial Professor at the London School of Economics and Political Science (LSE).

One of Professor von Winterfeldt's first priorities has been to work with the IIASA Council and other stakeholders to develop a strategic plan to lead the Institute into the next decade.

Peter Lemke is a professor of physics of atmosphere and ocean at the University of Bremen and head of the Climate Sciences Research Division at the Alfred Wegener Institute of Polar and Marine Research.

He has worked for 30 years in climate, sea ice and atmospheric research and has participated in seven polar expeditions with the German research icebreaker "Polarstern." His special interests are observation and modelling of high-latitude processes, especially the interaction between atmosphere, sea ice, and ocean. In 1991 he received the German Polar Meteorology Award (Georgi-Preis) and in 2005 he became an Honourable Professor of the China Meteorological Administration, Beijing. He was the Coordinating Lead Author for Chapter 4 (Observations: Changes in Snow, Ice and Frozen Ground) of the IPCC Fourth Assessment Report, *The Physical Science Basis*, published in 2007. ■

TOWARD COPENHAGEN

Climate change congress

On 10–12 March 2009 a large contingent of IIASA scientists participated in the International Scientific Congress on Climate Change, hosted by the University of Copenhagen. The main aim of the Congress, "Climate Change: Global Risks, Challenges and Decisions," was to synthesize existing and emerging scientific knowledge, thus allowing the necessary intelligent societal decisions to be made about the application of climate change mitigation and adaptation strategies. Nebojsa Nakicenovic, Acting Deputy Director of IIASA, was a plenary speaker.

The deliberations from this meeting, which was attended by more than 2,500 delegates from nearly 80 countries, will be presented as input to world leaders when they meet to agree on a new global agreement against climate change at the UN climate change conference (COP 15) in December in Copenhagen. ■

Photo: Lizette Kabré

GAINS MODEL

Training for policy advisors

The IIASA GAINS team hosted a hands-on training workshop for 25 policy advisors and national experts from Russia, Belarus, Moldova, China, and nine Western European countries on the use and application of its GAINS model. This online tool informs the development of cost-effective strategies to combat air pollution and climate change simultaneously. ■

INFORMATION EXCHANGE

Finnish policymakers visit

A delegation of senior policymakers from Finland's government visited IIASA on 3–4 February. The delegation, representing Finland's Government Foresight Network and Advisory Board for Sectoral Research, sought analysis from IIASA in the fields of population aging, technological change, forestry, and climate change and energy policy. The Government Foresight Network is an inter-ministerial forum for cooperation and exchange of information in issues relating to the anticipation of the future. ■

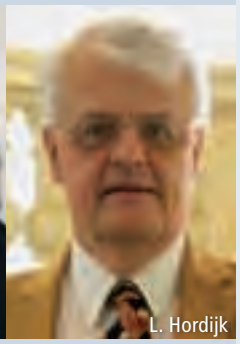
RUSSIAN FORESTS

IIASA sets standards

The Russian Federal Forest Service has recommended that models and patterns, recently published by IIASA and the Russian Academy of Sciences, on the growth and productivity of Northern Eurasian forests, be adopted as guidelines and standards for forest management across Russia. ■

iiasa news


N. Nakicenovic


L. Hordijk


W. Lutz


A. Shvidenko


Flora Piasentin


Jan Ohlberger


J. Alcamo


K. Parikh


B. Fath

GERMAN COUNCIL APPOINTS NAKICENOVIC

IIASA's Acting Deputy Director, **Nebojsa Nakicenovic**, has been appointed by the German Federal Cabinet to the German Advisory Council on Global Change. The Council is an independent scientific advisory body that analyses and reports on global environmental change, provides advice on research needs, and monitors and assesses national and international policies for the achievement of sustainable development.

AUSTRIAN GOVERNMENT AWARDS FORMER IIASA DIRECTOR

Former IIASA Director **Leen Hordijk** has been awarded the Austrian Honorary Cross for Science for his contribution during his term as Director of IIASA. The award, conferred by the Federal Minister for Science and Research is given to individuals who have performed in an extraordinary way in the area of science or arts.

IUSSP AWARD FOR LUTZ

IIASA's **Wolfgang Lutz** has received the 2009 Mattei Dogan Award of the International Union for the Scientific Study of Population (IUSSP). This prestigious recognition for comparative demographic analysis is given once every four years and will be formally awarded at the International Population Conference in Marrakesh in September.

HONORARY MEDAL OF FORESTRY

IIASA's **Anatoly Shvidenko** has been awarded the Honorary Medal of Forestry Society by the Russian Union of Foresters. The Medal, instituted by the Forestry Society of the Russian Empire in the mid-1800s, honors Professor Shvidenko's sustained contributions to the Russian and global forest sector.

PECCEI AND MIKHALEVICH WINNERS

IIASA's 2008 Peccei and Mikhalevich awards for outstanding research by participants in IIASA's Young Scientists Summer Program, have gone to **Flora Piasentin** and **Jan Ohlberger**.

Ms. Piasentin, a PhD student at the Federal University of Brasilia, Brazil, has completed the first known assessment of the potential for improving cacao productivity and sustainability in Bahia State in Northeast Brazil.

Mr. Ohlberger, who just completed his PhD at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Berlin, assessed how fish diversity in Lake Stechlin in Germany might be affected by the inflow of warm water used in cooling a nearby nuclear power plant.

ALCAMO TO BE TOP SCIENTIST AT UNEP

IIASA alumnus Professor Dr. **Joseph Alcamo** has been appointed inaugural Chief Scientist of the United Nations Environment Programme (UNEP), with responsibility for providing scientific direction to the organization. Professor Alcamo served at IIASA from 1982–1992 and was co-founder and Deputy Leader of IIASA's Acid Rain Project (now part of the Atmospheric Pollution and Economic Development Program). The appointment is effective 1 August 2009.

INDIAN GOVERNMENT HONORS PARIKH

The IIASA Council Member for India, **Kirit S. Parikh**, has received the Indian Government's prestigious Padma Bhushan award. Conferred by the President on 26 January, the award acknowledges his exemplary services to the nation on public affairs. Kirit S. Parikh was inaugural Chair when India joined IIASA in 2007 and is currently Chairman, Indian National Committee for the India–IIASA Programme and IIASA Council Member.

FATH TO EDIT *ECOLOGICAL MODELLING*

IIASA's **Brian Fath** is the new Editor-in-Chief of the journal *Ecological Modelling*. This Elsevier journal is one of the oldest and most prestigious in the field of environmental modelling. Dr. Fath will manage the associate editors and editorial board as well as direct the overall activity of the journal. ■

iiasa alumni


Gilbert Ahamer


Joseph Alcamo


Luis Mundaca


Photo: IISD/Earth Negotiations Bulletin

Cynthia Rosenzweig


Robu Sergiu

Where are they now?

Working at IIASA can have a profound impact on a person's career, opening doors to positions in academia, government, industry, and business. These brief notes show five of our alumni who research cllimate change.

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

www.iiasa.ac.at/IIASA_Society

GILBERT AHAMER, a participant in IIASA's 1992 Young Scientist Summer Program (YSSP) subsequently joined IIASA's Environmentally Compatible Energy Strategies Project as a research scholar, was elected Member-at-Large of the IIASA Society in 2006. Dr. Ahamer was pre-Accession Advisor on air pollution to the Slovak Republic in 2000–2001 working on behalf of the European Commission's Enlargement Directorate-General. He currently lectures on Technology Assessment, Systems Analysis, Participation of Citizens, and Future Scenarios and Climate Models at six Austrian universities, and collaborated in setting up the "Global Studies" curriculum at Graz University. His "favorite pastime," he claims, is the "fine art" of scenario writing for interdisciplinary and environmentally oriented global models pertaining both to land use change and energy.

JOSEPH ALCAMO co-founded the Acid Rain Project at IIASA in the 1980s. As the project's deputy leader Prof.Dr. Alcamo played a key role in developing the integrated scientific model of acid rain in Europe. Known as RAINS, the model was used in the negotiations of a major European treaty to control acid deposition. After IIASA, he led a major scientific effort in the Netherlands to build an integrated assessment model, IMAGE 2, of global climate change. He then moved to the University of Kassel, Germany in 1996 to direct the Center for Environmental Systems Research. Professor Dr. Alcamo has recently been appointed inaugural Chief Scientist of the United Nations Environment Program.

LUIS MUNDACA was a YSSP participant in 2006 in IIASA's Environmentally Compatible Energy Strategies Program. Having trained as an environmental economist and policy analyst, Chilean-born Dr. Mundaca is now a Research Fellow at the International Institute for Industrial Environmental Economics (IIIEE), Lund University, Sweden. His research focuses on energy and climate policy design and instrument choice, which aims to effectively inform and support policy-related decision-making processes. In 2008 his research on energy efficiency policy evaluation, which built on his YSSP research, won the Nordic Award Competition in Social Science, conferred by the Energy Forum and the Nordic Energy Research Council. Dr. Mundaca has worked as an international energy–economy–environment consultant for numerous companies, international development agencies, and state ministries of economy and environment across the Americas and in Europe.

CYNTHIA ROSENZWEIG is a Research Scientist at the Goddard Institute for Space Studies, where she is the leader of the Climate Impacts Group. She is also an Adjunct Senior Research Scientist at the Columbia University Earth Institute and an Adjunct Professor at Barnard College. A recipient of a 2001 Guggenheim Fellowship, Dr. Rosenzweig is currently the Co-Chair on the New York City Panel on Climate Change. She was a Coordinating Lead Author of the Intergovernmental Panel on Climate Change Working Group II Fourth Assessment Report and has worked on numerous international assessments of climate change impacts, adaptation, and vulnerability. She has collaborated with IIASA since the 1990s and worked in IIASA's Land Use Change Program in 1997.

ROBU SERGIU was the first scientist from the Republic of Moldova to conduct research at IIASA. He spent summer 2005 as a YSSP participant based within the Environmentally Compatible Energy Strategies Project. At IIASA, Mr. Sergiu studied the effect of learning spillovers between technologies using a cluster approach, with a focus on synthetic fuels production (i.e., hydrogen, ethanol, and methanol). After YSSP, he was appointed Science Secretary of the Institute of Power Engineering of the Academy of Sciences of Moldova. In 2004 he was a national expert for the UN Development Programme's "Climate Change" Project in Moldova; in 2004–2005 he was involved in the implementation of the Project "Stockholm Convention on PCBs in Moldova"; and since 2006 he has been national consultant for the UN Environment Programme in Moldova. ■

Breaking the ice with Peter Lemke

Introducing the new Chairman of the IIASA Council

As you would expect of a Professor of Physics of Atmosphere and Ocean at the University of Bremen and Head of the Climate Sciences Research Division at the Alfred Wegener Institute of Polar and Marine Research, Peter Lemke teaches, improves computer models, and writes scientific articles.

What you might not realize, however, is that Peter is also an intrepid polar explorer and has been on seven grueling two-to-three-month expeditions to the Arctic and Antarctic aboard the German icebreaker *Polarstern*. For five of these expeditions he was Chief Scientist.

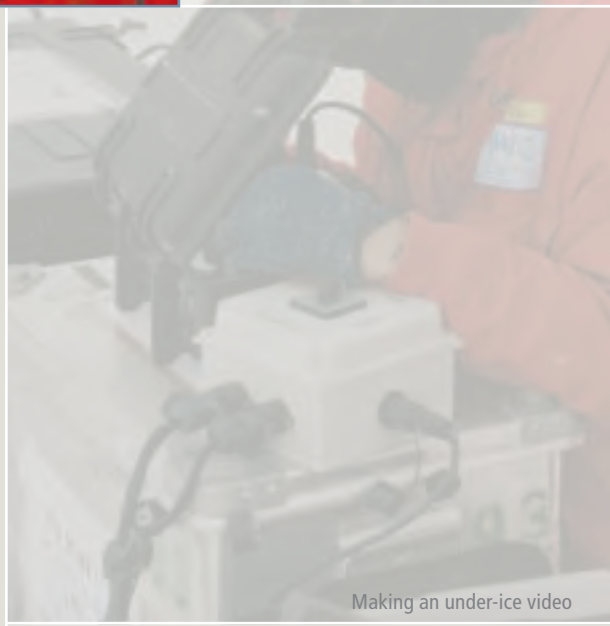
Recently, the main emphasis in polar research has been the pronounced variability of the polar sea ice cover. Sea ice, being porous, is home to a rich and specialized ecosystem of algae and crabs which support the food chain for fish, seals, and polar bears; but although these tiny, fragile creatures have evolved internal anti-freeze mechanisms, they are potentially threatened by diminishing ice cover in the Arctic and interannual variabilities in the Antarctic sea ice.

Understanding the effect of climate on ice cover, and the implications for ecosystems, is Peter Lemke's main research agenda. He has been on four summer expeditions to the Arctic (including the North Pole) and three winter expeditions to the Antarctic. The latter were especially demanding. On its two-week voyage from Cape Town, the *Polarstern* has to navigate the *Roaring Forties*, *Furious Fifties*, and *Screaming Sixties*, before reaching the research area on the ice floes of the Southern Ocean. Depending on the weather, three-to-five major storms with 20 meter high waves are encountered en route.

The *Polarstern* is probably the best research icebreaker available for expeditions to the ice-covered polar oceans. With berths for up to 55 scientists and 43 crew, it is equipped with high-tech laboratories and computers. Expedition planning starts a year before departure to determine which research groups are participating, the equipment required, the cruise track and time schedule, berth allocations, and general logistic requirements, such as use of winches, nets, trawls, helicopters, and lab space. Given the punishing conditions, stringent medical checks are mandatory prior to departure.

Apart from bad weather, the main challenge during a polar expedition, according to Peter Lemke, is achieving cross-disciplinary collaboration among the expedition's meteorologists, oceanographers, ice physicists, biologists, chemists, and geologists Such collaboration is the hallmark of a successful expedition, he says, bringing enormous benefits in terms of understanding the relation between climate and ecosystems.

Cross-disciplinary scientific collaboration, he adds, is something that he will definitely be fostering in his new position at IIASA. ■



Making an under-ice video

A chief scientist's day on the *Polarstern*

7.00	Planning next 48 hours' scientific activities with captain and officers on the bridge
7.30	Breakfast
8.00	Preparation and updating of the cruise track and station schedule
9.00	Meeting with all scientists (and some officers) in the lecture hall to discuss the upcoming day's activities and presentation of new scientific results
10.00 –17.30	Discussion with the scientific groups; participation in station work
11.30	Lunch
17.30	Dinner
18.00	Revising and adjusting the station plan for the remainder of the cruise
20:00	Special lecture
Midnight	Working day ends
Night watch	Occasional wake-up calls from the bridge to discuss problems with execution of scientific program

IIASA

IIASA is an international scientific institute that conducts policy-oriented research into problems that are too large or too complex to be solved by a single country—problems like climate change that have a global reach and can be resolved only by international agreement, or energy security or population aging, which are national issues with international ramifications for every country. As an independent research body, IIASA examines such issues and devises strategies for cooperative action unconstrained by political and national self-interest.

science for global insight

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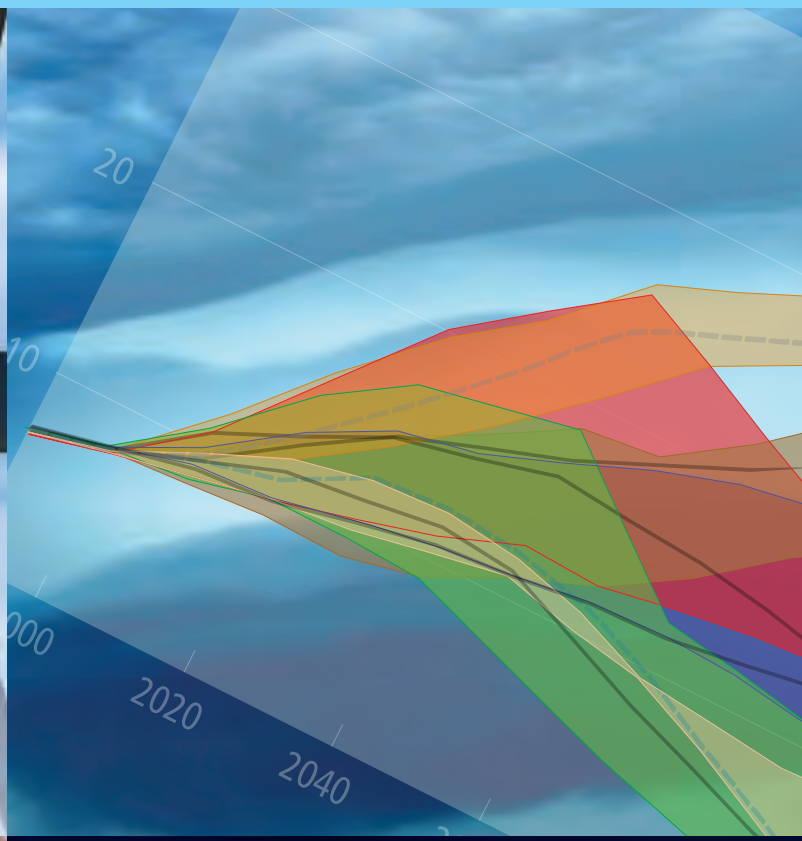

UN Photo/John Isaac