New research provides important insight on the causes and likely scale of a potential water scarcity problem in large parts of Asia in coming decades.

Is Asia facing a coming water crisis?

also in this issue

What drives migration?
The quest for migration policies that will benefit Europe and meet humanitarian needs

South Africa – A model for systems analysis development?
The Southern African Systems Analysis Centre strengthens links between researchers in South Africa and IIASA

Researcher voices
Sir Peter Gluckman – Challenges to science diplomacy
Angel Gurría – Systems thinking for global challenges
Julian Hunt – Water and energy security
Building bridges to a sustainable future

As my term as Director General and CEO of IIASA is nearing its end, I am honored to have had the opportunity to lead the institute in building bridges across political divides through science for the past six and a half years. My thanks go to the IIASA Council, colleagues at the institute, and our global network for their continued support, hard work, and dedication.

In this issue of Options, we highlight IIASA’s work in analyzing and addressing some of the challenges that society face in multiple domains. Groundbreaking collaborative work undertaken by the IIASA Water Program for example, is looking at how inter-related issues such as climate change, population growth, and urbanization are adding to uncertainties about future water supply in Asia. The research aims to find sustainable solutions to address these challenges at the local, national, and global level (pages 14-17). Migration has also become an increasingly divisive issue across Europe, and continues to be fueled by socioeconomic considerations and armed conflicts. To address this, IIASA researchers are working with EU policymakers to provide a scientific basis for migration policies that will benefit Europe, while simultaneously ensuring that humanitarian needs are met (pages 18-19).

Achieving the Sustainable Development Goals is inextricably linked to how we understand the challenges we are facing with, and how we connect the scientific knowledge needed to do this with policy-making processes. Systems analysis is critical to achieving the necessary understanding in this regard. Through its National Member Organizations, IIASA has made great strides in advancing the discipline of systems analysis in its member countries. The Southern African Systems Analysis Centre (SASAC) for instance, is currently enabling a whole new generation of scientists to use systems analysis and linking with IIASA to solve complex challenges in their country and on the African continent (pages 12-13). The institute also welcomed Israel as its newest member country in December 2017 (page 25). This new partnership will contribute to the development of international research collaborations, and help to build a research base for systems analysis in the country.

I would like to again thank everyone who has contributed to helping IIASA fulfill its mandate and making it the stimulating, productive environment it is today. I look forward to bringing my experiences from IIASA to my new position as first Chief Scientist of the UN World Meteorological Organization (WMO) and hope to foster new collaborations between the two institutions in the future.
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Gender discrimination results in the deaths of an extra 239,000 girls per year in India

Annually, there is an average of 239,000 excess deaths of girls under the age of five in India—2.4 million in a decade—and excess female child mortality is found in 90% of districts in the country, according to a new study.

The research, led by IIASA postdoctoral research scholar Nandita Saikia, shows that 22% of the overall mortality burden of females under five in India is due to gender bias. 29 out of 35 states in the country had overall excess mortality in girls under five. In parts of western Rajasthan and northern Bihar, gender bias accounts for 30-50% of deaths in females under five. The worst affected areas are all rural with lower levels of education, high population densities, low socioeconomic development, and high levels of fertility.

The results do not coincide with areas with known skewed sex ratios at birth. Coauthor Christophe Guilmoto from the Université Paris Descartes, France, says that gender-based discrimination doesn't simply prevent girls from being born, it may also precipitate the death of those who are born.

“Discrimination towards the girl child is not justified. There is a need to change mentality. Rather than discriminating against them it is necessary to raise their value through education and self-dependence,” says Saikia.


Nandita Saikia saikia@iiasa.ac.at

Removing fossil fuel subsidies will not reduce CO₂ emissions as much as hoped

Fossil fuel subsidies amount to hundreds of billions of dollars worldwide, but removing them would have only a small effect on CO₂ emissions, new IIASA-led research has shown.

Removing fossil fuel subsidies would lower growth in CO₂ emissions by just 1-5% by 2030, compared to maintaining subsidies. This equates to 0.5-2 Gt/year, significantly less than the 4-8 Gt/year pledges made under the Paris Agreement, which are themselves not enough to limit warming to 2°C.

Although the global effect on emissions is low, the impact varies by region. The largest effects of removing subsidies were found in regions that export oil and gas. Developing economies that do not export oil and gas would generally experience much smaller effects.

These regional differences connect to important policy considerations in subsidy reform. Many fossil fuel subsidies were put in place to help those living in poverty. Fortunately, the highest numbers of poor people are concentrated in the regions where removal of subsidies will have the weakest effect on CO₂ emissions.

Removing subsidies in richer oil and gas exporting regions would therefore provide significantly greater emissions reductions and have a less detrimental impact on those in poverty. This is facilitated by today’s lower oil prices.

“These governments are already under pressure to reduce spending on subsidies due to lower revenues,” says Jessica Jewell lead author of a paper on this issue published in Nature. “This provides a unique political opportunity to remove subsidies in countries where it will have the largest effect on emissions and the smallest impact on the poor.”


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Thinking outside the box on climate mitigation

According to IIASA researchers, international policymakers need a broader range of scenarios as they seek to limit climate change to below 2°C above pre-industrial levels, and to avoid the potential negative environmental and social consequences of negative emissions technologies.

Ecosystems Services and Management Program Director Michael Obersteiner, led research to develop alternative scenarios that place less reliance on negative emissions technologies.

"Many currently used emissions pathways assume that we can slowly decrease fossil fuel emissions today and make up for it later with heavy implementation of negative emissions technologies," says Obersteiner. “This is a problem because it assumes that we can put the burden on future generations, which is neither a realistic assumption, nor morally acceptable.”

The largest share of scenarios achieving a 2°C target in the Intergovernmental Panel on Climate Change 5th Assessment Report, rely on late deployment of a single negative emission technology, namely bioenergy with carbon capture and storage (BECCS). Given the highly uncertain nature of technological progress, or the responses of the earth system, this is a more than risky strategy, says coauthor Johannes Bednar.

The researchers present four scenarios incorporating a broader range of mitigation options, such as:
- Major reliance on future carbon dioxide removal
- Rapid decarbonization starting immediately, and halving every decade
- Earlier implementation of carbon dioxide removal technologies, and phasing out by the end of the century
- Consistent implementation of carbon dioxide removal from now until the end of the century

Coauthor Fabian Wagner says: “As scientists we need to be careful when we communicate to policymakers about how realistic different scenarios might be. When we present scenarios that require the world to convert an amount of land equivalent to all of today’s cropland to energy plantations, alarm bells should go off.”


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'Modest' climate benefits from LPG cooking

Switching from wood to liquefied petroleum gas (LPG) cooking, could provide modest climate benefits, but these vary based on the extent of sustainable wood use, according to a new analysis focused on India. Young Scientist Summer Program researcher Devyani Singh found that switching to LPG would reduce net emissions by up to 6.73 metric tons of CO₂ equivalent, if 30% wood is assumed non-renewably sourced. Switching would also reduce pressure on woodlands.

Climate change policy and future wellbeing

What is the best mix of mitigation and adaptation when it comes to climate change? Fabian Wagner and his team found that the answer depends on whether we care about the aggregate wellbeing of humanity or the average wellbeing. They also suggest that lowering population growth could save tens of billions of dollars annually and improve overall wellbeing, while a larger population will leave future generations at greater risk from climate-related damage.

Who pays for climate loss and damage?

There is increasing emphasis on adaptation to climate change and the need to address the 'loss and damage' that occurs despite mitigation efforts. Reinhard Mechler looked at the debate around who should pay for such costs and found that practical action is needed, rather than just the current political debates. Adaptation limits are already being breached in some areas, highlighting the urgency of fulfilling the Paris Agreement and tackling the problem.

Sea level rises with peak emission delays

Ensuring that global CO₂ emissions peak as soon as possible is crucial for limiting sea level rise, even if global warming is limited to well below 2°C. A new study involving IIASA researcher Joeri Rogelj, has now shown that each five-year delay in peak global CO₂ emissions will likely increase the median sea-level rise for 2300 by 20cm. Emissions reductions must therefore be implemented as quickly as possible.
Ethane and propane emissions have been underestimated

Emissions of ethane and propane have been underestimated by more than 50% in community-based emission inventories, according to new research coauthored by Lena Höglund Isaksson. For the first time, researchers have found explanations for ‘missing’ emissions, such as venting of waste gas during oil production and misrepresentation of gas composition. The databases created also show geographical emissions distributions and trends in atmospheric concentrations.

www.iiasa.ac.at/news/Ethane-18

2°C rise doubles the population exposed to multiple climate risks

The number of people affected by multiple climate change risks could double if the global temperature rises by 2°C by 2050, compared to a rise of 1.5°C. At 1.5°C of warming, 16% of the population of the world, 1.5 billion people, will have moderate-to-high levels of multisector risk. At 2°C of warming, this almost doubles to 29%, or 2.7 billion people, with those in poverty most at risk. The researchers say this underlines the need to minimize warming and target socioeconomic development in the hotspot regions.

www.iiasa.ac.at/news/Multiple-climate-risks-18

Achieving healthy, climate-friendly, affordable diets in India

New research led by IIASA researcher Narasimha Rao has shown that it might be possible to reduce micronutrient deficiencies in India in an affordable way, while also reducing greenhouse gas emissions. Switching from white rice to coarse cereals, and increasing the share of pulses and dark green vegetables could reduce deficiencies in protein, iron, zinc, and vitamin A, which can be as high as 90%.

www.iiasa.ac.at/news/India-diet-18

Education, not income, the best predictor of a long life

Rising income and the subsequent improved standards of living, have long been thought to be the most important factors contributing to a long and healthy life. However, new research from Wolfgang Lutz and Endale Kebede, from IIASA and the Vienna University of Economics and Business (WU) has shown that instead, the level of education a person has is a much better predictor of life expectancy.

www.iiasa.ac.at/news/Education-life-18

Models show how to limit global temperature rise to 1.5°C

There are several ways to limit global temperature rise to 1.5°C by 2100, and new research led by IIASA researcher Joeri Rogelj shows under what conditions this could happen. The paper is the first to look at how socioeconomic conditions such as inequalities, energy demand, and international cooperation might affect the feasibility of achieving these goals.

“One of the goals of the Paris Agreement is to limit warming to 1.5°C, but scientific studies mainly looked at the question of limiting warming to 2°C. This study fills this gap and explores how climate change by the end of the 21st century can be brought in line with 1.5°C of warming,” says Rogelj.

The researchers modeled scenarios to limit warming under five Shared Socioeconomic Pathways (SSPs), including one in which the world pursues sustainability, one in which economic and population growth continue as they have done historically, and another in which the world embraces fossil fuels to fuel economic growth.

Strong social and economic inequalities, continued high fossil-fuel use, and poor short-term climate policies emerged as key barriers to achieving the 1.5°C goal.

In successful scenarios, zero net greenhouse gas emissions are reached between 2055 and 2075. Energy demand is limited by improving energy efficiency. Bioenergy and other renewable energy technologies make up at least 60% of electricity generation by the middle of the century. Traditional coal use falls to less than 20% of its current levels by 2040 and oil is phased out by 2060.

The 1.5°C pathways created as part of the study, will be used by the wider climate change research community to run the most complex coupled climate models to better understand the climatic consequences.

Further info


www.iiasa.ac.at/news/15153

Joeri Rogelj
Armed conflicts are widespread and yet their dynamics are poorly understood. A simple model can enable insights into the potential for stalemates and a conflict’s ultimate outcome.

The “fog of war” and Donald Rumsfeld’s “unknown unknowns” in Iraq in 2002, are quotes often used by military strategists and authors to convey the uncertainty surrounding military operations. It is perhaps understandable that those seeking to end conflict, or indeed pursue it, might turn to mathematical modeling for clarity.

In the recent paper, “Conflicts among $N$ armed groups: Scenarios from a new descriptive model,” Sergio Rinaldi and Fabio Della Rossa propose and analyze a model that describes armed conflict between a government group and one or two rebel groups. Rinaldi, a researcher at IIASA, says that a scarcity of reliable data has led to the belief that the outcome of such complex conflicts cannot be predicted. But what happens if the data is comprehensive and trustworthy?

The model reveals that the dynamics among fighting groups can be extremely sensitive to the conflict’s initial conditions and parameter values. “This suggests that a conflict’s outcome may be practically unpredictable, even if very rich data sets were available,” says Rinaldi. He adds that this might be an uncomfortable truth for strategists who are increasingly turning to dynamic modeling to disperse some of that “fog of war.”

“Rebels cannot be eradicated if they are highly fanatical” – Sergio Rinaldi

For the modeled conflict, some interesting properties emerged. Government groups, if highly defensive, cannot go extinct, while their rebel opponents cannot be eradicated if they are highly fanatical. Instead, stalemates arise and when a conflict is caught in a turbulent stalemate, “the model allows one to determine when a short military intervention of an allied country should be performed to have the highest chances of eradicating the enemies,” conclude the researchers.

Rinaldi and Della Rossa caution that their results are preliminary and that more subtle considerations—such as the existence of chaotic regimes and the systematic evaluation of the role of strategic factors like power, intelligence, and fanaticism—remain open and require further research. The many failed attempts to resolve drawn-out contemporary conflicts would seem to support their conclusions.
Food, energy, water, and land are interconnected aspects that together form a nexus within the complex system in which the various sectors of a country’s economy operate. Because these aspects are so closely linked, policies that affect one sector in a region can have consequences for others, which means that the integrated management of the nexus is critical to secure sustainable development and the efficient and viable use of resources.

Ukraine, the second largest country in Europe in terms of land area, has been described as the region’s breadbasket thanks to its rich, fertile soil. A lack of integrated policies in the country, however, has led to uncontrolled agricultural intensification and imbalanced land utilization, which has in turn been the cause of increased soil, water, and air pollution. Furthermore, it has created a dualization of the agricultural sector between small household farms—which play a central role in national food security—and large market-oriented agricultural enterprises producing industrial crops that are in high demand on international markets. The introduction of new technologies and policies, or climate change, weather variability, and natural disasters, may also significantly affect systemic instabilities.

IIASA and the National Academy of Sciences of Ukraine (NASU), along with a network of other institutes and policymakers, have been working together on a project devoted to finding robust solutions to these problems since 2012. This work has informed national policy in the country and has led to real improvements in sustainable management. The results of the project are now being used in the preparation of strategically important documents, such as the country’s sustainable agriculture and rural development strategy, national demographic strategy, and sustainable energy sector development strategies.

The team’s conclusions and recommendations on the need for proper financial support for family and small-scale agricultural businesses, for example, were implemented in the Ukrainian Common Cross-cutting Strategy of Agriculture Development for the period until 2020. The results of research investigating sustainable energy sector development and reform towards renewable energy use, also emphasized that robust emissions taxation and trading can act as important mechanisms for creating economic and social stimulus for the improvement of energy efficiency and the implementation of a low-carbon economy in the country.

Towards the end of 2017, a new phase of the project focusing on the robust management of the food-water-energy-environment-social nexus for sustainable development was launched. “During this phase, which will run until 2021, researchers will further develop and implement novel systems analysis approaches addressing problems of common interest for Ukraine and the world, providing solutions for robust and sustainable nexus management,” says Yuri Ermoliev, principal investigator on the project.

To do this, the project concentrates on novel linkage methods enabling consistent multi-sectorial modeling and integrated decision support. Global models, including IIASA models such as GLOBIO, GAINS and MESSAGE, are used in combination with non-Bayesian robust downscaling procedures and national models to produce scenarios and recommendations in support of robust integrated policies.

Further info
www.iiasa.ac.at/impacts/integratedmodeling
Zagorodny AG, Ermoliev YM, & Bogdanov VL (Eds.) (2014). Integrated Management, Security and Robustness. NASU
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Shaping the future of public transport in Sweden

In 2015, Sweden announced an ambitious aim to become one of the first nations to end its dependence on fossil fuels. Work done by IIASA researchers in collaboration with Swedish partners, is now contributing to discussions to make this goal a reality.

Electric buses could contribute significantly to lowering emissions, less noise from traffic, and a more efficient use of energy in public transport, and several cities in Sweden have already started to introduce them as part of their public transport systems. These buses however, need to recharge to continue operating, which requires a significant investment in infrastructure that can be both expensive and complicated.

The Stockholm city council is currently investigating the possibility of switching to electric bus transport in the city within the next 10 years. An important part of the investigation involves the evaluation of various business models to look at the economics of such an ambitious project and to evaluate possible risks.

As part of a project initiated with 2016 Young Scientists Summer Program participant, Maria Xylia from the KTH Royal Institute of Technology in Sweden, researchers from the IIASA Ecosystems Services and Management Program worked on the development and testing of a model based on the IIASA BeWhere model approach. The aim was to help determine the optimal distribution of charging infrastructure for electric buses in Stockholm. The project concluded in December 2017 and the results were reported to the Swedish Energy Agency who was funding the project.

The city council’s investigation on whether electric buses are the way to go for Stockholm will continue in 2018.

“I have been part of the discussions around the ongoing investigation of the potential for implementing electric busses. The results we produced on the charging time analysis and inner city electrification are of particular interest and this is what we have mostly contributed to the discussion,” says Xylia, who is also one of the authors of a paper on this work published in the journal Transportation Research Part C: Emerging Technologies.
Science diplomacy and international science cooperation overlap, but do not necessarily have the same objectives. Joint scientific ventures like IIASA produce important knowledge and to some extent overlap with the world of international diplomacy. While the goal of international science is to produce knowledge, science diplomacy however, is more about how countries use science to advance their interests—or how countries use science to advance their national interests on the international stage.

These national interests can be advanced at different levels using science. Most directly, a country can project influence through science or build a bridge to a country of interest. It can for instance, use science to advance its security or trade interests, or to gain access to needed technologies. It can be about better managing shared resources with another country, for example cross-boundary water issues. It can also be where the global interest is at stake, such as climate change or ocean pollution. Every country, whether developed or developing, has relationships with other countries, and increasingly these relationships have technological and scientific components.

If we go beyond that and look at the global interest, science is critical to every one of the Sustainable Development Goals. Given the centrality of science to addressing international challenges, it is surprising that we do not have better mechanisms to integrate science into international diplomacy. Very few foreign ministries have science advisors. The UN has no integrated system for bringing science advice into its decisions. In general, policy decisions are made in individual countries, not by international organizations—hence the need for more vertical integration between international agencies and domestic science advisory systems, which is perhaps best achieved through science advisors linked to their diplomatic service. Even today, there is often a need for countries to be convinced that it is in their national interest to work together and use science for global advancement.

If we want to achieve the Sustainable Development Goals, we will have to think a lot more about how we connect scientific knowledge, decision making, the international community, UN agencies, and domestic policy. First, the United Nations and international organizations must better integrate their scientific advisory networks. As we think about the goals and the knowledge gaps that need to be filled, we also need to think about the system of science that will support this effort. The UN system does not currently have a coordinated system of science. This is sorely needed, and must reach beyond the heavily siloed system of UN agencies.

Secondly, foreign ministries need to better integrate science into their processes. This is already happening in a number of countries as we are seeing through two organizations, the International Network for Government Science Advice and the Foreign Ministers’ Science and Technology Advisors Network—both of which I chair—that are working together to promote and link the professions of science advice and science diplomacy. The latter has grown from four countries when it started two years ago, to over 25 countries today. What we are seeing is that a growing number of countries are taking an interest in being part of a forum where these topics can be discussed by people who are deeply engaged in them.

Ultimately, the success of these efforts will come from the demonstrated advantages it provides to countries. When one country sees other countries receiving benefits or advantages because it is using the tools of science diplomacy better or more effectively, they will take note.

Further info In November 2017, Gluckman delivered an IIASA 45th Anniversary Lecture on this topic. The full text is available online: www.iiasa.ac.at/events/Gluckman-18

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Sir Peter Gluckman is the chief science advisor to the Prime Minister of New Zealand, and an IIASA Distinguished Visiting Fellow.
Q  What are the most pressing economic challenges facing OECD member countries?
A  One of the main economic challenges that OECD member countries are facing today, is how to consolidate the economic recovery process, while making it inclusive, resilient, and sustainable—both in terms of environmental issues and making the recovery last. Perhaps the most pressing challenge for our generation is how to achieve productivity and inclusivity simultaneously. We need to make these aspects work together to avoid the increasing backlash that will occur if governments only focus on economic growth, which typically leaves many people behind. Similarly, if governments only focus on redistribution, there will not be enough impetus for economies to grow. Finding approaches that achieve both productivity and inclusivity is key to ensuring our sustainable future.

Q  Why do countries need to incorporate systems thinking when setting their economic policies?
A  The global economy now has an unprecedented number of links. For example, we live in a world where workers in Kenya lose their jobs when a volcano erupts in Iceland, because planes cannot fly the flowers they grow to the Netherlands for distribution to other countries. Therefore, I would argue that unless we adopt a systems approach, unless we employ systems thinking, we will fail to understand the complex world we are living in.

Q  How can countries adopt a systems approach to policymaking?
A  At the OECD, we promote evidence-based decision making, but of course there is no evidence about the future. We also know from experience that simply extrapolating from the past can be misguided. In the 1970s for instance, Ken Olsen, the President of Digital Equipment Corporation, famously stated that he could see no reason why anybody would ever want a computer in their home. A systems or complexity approach helps us to avoid such errors. A complex world is nonlinear—anticipation is not extrapolation. We are dealing with a world characterized by nonlinearities, tipping points, and asymmetrical relations where a small cause can have a big effect. To be able to tackle these issues, governments must change the ways in which they make and implement policies. An acceptance of complexity shifts governments from a top-down, siloed culture, to an enabling culture where evidence, experimentation, and modeling help to inform and develop stakeholder engagement and buy-in.

Q  What does the new OECD-IIASA strategic partnership entail, and what do you hope it will achieve?
A  The OECD and IIASA have been working together for many years, but it is now time to strengthen this partnership as both organizations can benefit from the others' expertise. The economy is not just about growth. It does not exist in a bubble isolated from the hopes, stories, desires, and frustrations of the people it is supposed to serve. The economy is political. It is social, historical, and cultural. That is why we need systems thinking to understand the issues, anticipate the consequences of our decisions, and build resilience. Together we can shape a brighter future, for our economies, our societies, and all of our citizens.
SOUTH AFRICA –
A model for systems analysis development?

In 2015, South Africa stepped up its commitment to systems analysis by creating the Southern African Systems Analysis Centre–SASAC. Led by a consortium of four universities—the universities of the Western Cape, Limpopo, the Witwatersrand, and Stellenbosch—SASAC aims to strengthen systems analysis activities by supporting Honours students, PhD students, and postdoctoral researchers.

HOW SYSTEMS ANALYSIS HELPED MY CAREER

South African scholar Elvis M. Nkoana won his SA-YSSP scholarship for research on “Impacts of Environmental Education on Perceptions of Climate Change Risks in Rural and Township Communities in Limpopo Province, South Africa.” He tells Options: “Participation in the SA-YSSP and taking up a short-term vacancy at IIASA accelerated the completion of my doctoral degree with the University of Antwerp in Belgium. The topic of “climate change adaptation” features much systems analysis and holistic/whole-systems thinking. My participation in the SA-YSSP and IIASA has instilled a systems approach in my professional career. Having both on my CV will bring benefits.”

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While addressing the future of science in a speech at the inauguration of South Africa’s Academy of Sciences in March 1995, President Nelson Mandela said “its health in this era of globalization depends critically on the exchange of ideas and collaboration in research across national and cultural boundaries.” That speech now seems prescient about the challenges South Africa’s scientists would face. That many of those scientists, including a new generation of PhD students, are using systems analysis and linking with IIASA to solve complex challenges in their country and on the African continent, would no doubt have pleased the much honoured Mandela.

South Africa joined IIASA in 2007, but the genesis of the country’s current engagement with systems analysis lies in the Southern African Young Scientists Summer Program (SA-YSSP), which ran for three years and saw close mentorship between IIASA and 80 scientists from the region, including 35 studying in South Africa. A review of the SA-YSSP in 2015 identified “a lack of in-depth training and capacity development for the students,” says Sepo Hachigonta, director for strategic partnerships at the National Research Foundation (NRF), the government agency funding SASAC. Where the SA-YSSP offered a three-month program for PhD students, SASAC offers an honours module in global change and systems analysis, and scholarships for a three-year PhD in systems analysis or related disciplines. Two-month courses in systems analysis methods are also available for PhD students, as well as three-week systems analysis courses for supervisors, postdocs, and researchers. “SASAC takes advantage of its partnership with IIASA while localising systems analysis from the South African and regional perspective,” says Hachigonta.

STRENGTHENING THE LINKS

According to Priscilla Mensah, director of human and infrastructure capacity development at the NRF, this perspective includes “focussing on students at the doctoral level and strengthening links between researchers in South Africa and at IIASA.” Mensah describes the three years of the SA-YSSP as a “critical experiment” and says SASAC is “an improved model with a lot of momentum.” The NRF funds South African researchers to travel to IIASA, but the hosting of IIASA researchers is limited by resources—a situation Mensah would like to change. She is keen to point to the issues students and researchers will be tackling, such as energy, water, and acid mine drainage. “These challenges are relevant to South Africa, the region, and the continent,” she says.

South Africa’s dramatic cultural, social, and environmental diversity, combined with democratic youthfulness, provides plenty of scope for systems analysis. No wonder PhD student Sandile Ngcamphalala is fired up about the potential. With a SASAC research scholarship, his PhD focuses on “water policy monitoring and evaluation to improve water policy performance in the face of uncertainty.” He believes systems research is “central to the future of South African policymaking and strategic thinking on sustainable development.” Sandile wants “bigger picture thinking” and is excited by the opportunity of his SASAC scholarship. He would like to see the SASAC-IIASA partnership strengthened through exchange visits, information sharing, and training. Also on his wish list: “A greater focus on systems research.”

At the University of the Witwatersrand in Johannesburg, Mary Scholes holds a research chair in systems analysis and teaches postgraduate students in systems analysis and global change. As director of postgraduate studies, she has worked closely on the transition from the SA-YSSP to the now three-year-old SASAC. She describes some of the thinking behind its creation: “It had to overlap with South Africa’s national priorities and actively address the legacy of apartheid.” A selection system ensures that students chosen for SASAC programs reflect South Africa’s diversity. Selection is carried out by the NRF, while scholars like Scholes deliver what she calls “a pipeline of competence” in systems analysis. The program is in its third year and currently has 60 PhD students. “Not only do we have the students, but we have the supervisors who also benefit by being part of the program,” says Scholes. South African and international experts participate in different elements of the course.

IS THE SOUTH AFRICAN MODEL SUSTAINABLE AND TRANSFERABLE?

For Mary Scholes the answer is a definite yes. She believes the key criteria are intellectual rigour and administrative efficiency combined with links to IIASA. “There’s a real benefit as IIASA scientists are research oriented and not as torn and distracted as South Africans who have to teach, do community service, and research,” says Scholes. Priscilla Mensah from the NRF is also confident that other countries could copy the model: “I think there was some nervousness at the beginning, but after three years (under the SA-YSSP) it was evident that this model can be replicated elsewhere.”

As South Africa’s model of systems analysis capacity development has changed, so has its relationship with IIASA. Ulf Dieckmann co-chairs capacity development and academic training for IIASA and closely accompanied the transition from the SA-YSSP to SASAC. “Ideally, the holistic and cross-sectoral systems approach at IIASA can enable South Africa’s young democracy to home in on sustainable technological, environmental, and institutional solutions that took much longer to emerge elsewhere,” says Dieckmann. He describes the persistent commitment from the South African government as “exceptional” and is looking forward to “an even better dovetailing of IIASA contributions and the needs of South Africa and southern African institutions.”

Further info: www.iiasa.ac.at
Is Asia facing a coming water crisis?

Water scarcity in Asia is likely to get worse over the coming decades, and new research from the IIASA Water Program has shown that increased water demand due to socioeconomic development is likely to be the main cause in large parts of the continent.
Asia is currently home to 4.5 billion people, who use around 65% of the world’s water supply. Around 30% of the Asian population is already facing water scarcity. India and China have experienced close to double-digit GDP growth in recent years, as well as a population boom. Many river basins already cannot cope with the demands placed upon them.

As the effects of climate change really become visible and a continued improvement of socioeconomic conditions cause population numbers to rise still further—with wealthier societies on average requiring more water anyway—what will happen to water supply and demand? Will the problems be worse in some areas than in others? What will exacerbate the situation? Can the problem be reduced?

These are just some of the issues faced by policymakers in Asia today. IIASA Water Program researchers are coming to their aid using multiple hydrological models together with the latest global climate change and socioeconomic scenarios.

Yusuke Satoh and a team of other IIASA researchers were tasked by the Asian Development Bank to evaluate the risks and find out which areas of the continent might be most vulnerable. Understanding potential risks are vital to developing management and adaptation strategies. Although there are studies on future water scarcity under climate change, they are all missing something essential.

“Most existing studies discuss the impact of climate change on water scarcity, but because there were no water use scenarios, they couldn’t assess the impact of changing water demand,” says Satoh.

This is groundbreaking work undertaken by the Water Futures and Solutions (WFaS) initiative as part of the IIASA Water Program.

**New scenarios**

WFaS was set up six years ago by IIASA, with partners including UNESCO, the International Water Association, and the World Water Council, to look at sustainable solutions to local, national, and global water challenges. It aims to include a wide range of stakeholders, rather than just scientific researchers.

“The biggest feature of WFaS, I think, is stakeholder engagement,” says Satoh. “In order to include as many potential futures as possible we need more, broader perspectives, and we need stakeholder opinions.”

One of the major achievements of WFaS has been to develop water use scenarios. The scenarios were developed at a WFaS stakeholder meeting and were based on the five existing Shared Socioeconomic Pathways (SSPs) and the four Representative Concentration Pathways (RCPs). The SSP scenarios were originally developed by IIASA researchers to suggest different ways in which the world and society could progress, depending on decisions made by policymakers and society, while the RCPs are the four greenhouse gas concentration trajectories used by the Intergovernmental Panel on Climate Change in compiling its Fifth Assessment Report. IIASA was also involved in the development of the RCPs.

“The SSP and RCP scenarios do not include information on water use, because their interest is emissions,” explains Satoh. “What we did, is develop water use scenarios to make projections for water security.” Each scenario is a combination of an SSP and an RCP.

“For each combination of SSP and RCP, we assumed water use change according to socioeconomic change. In SSP1, society will
make an effort to improve water use and regulation, and there will be rapid technology change. Depending on socioeconomic growth, water demand is likely to increase. On the other hand, we assume water use efficiency will improve, thus alleviating rapid water demand growth. We created storylines for each scenario with the stakeholders,” says Satoh.

They selected three comparable combinations as water use scenarios, dubbed ‘sustainability’, ‘middle of the road’, and ‘regional rivalry’. Each of these narratives was translated into quantitative measures and used to build the scenarios into the modeling framework. In the scenario development process, a unique method, called hydro-economic classification, was applied. Countries and regions were categorized into four groups, based on their likely water scarcity problems and their ability to cope. Then, what the researchers considered to be reasonable assumptions were made. For example, a rich country with high levels of water scarcity will be better placed to cope than a poor one.

“Using three global hydrological models we projected water consumption and demand. The models also project the available water resources (supply). Using the framework, we assessed water scarcity for each scenario, using a number of indicators,” says Satoh. “We projected how many people might be affected and how the hydro-economic classification for each country might change over time.”

Not a pretty picture

Overall, three scenarios project that the population under severe water scarcity in Asia will increase by 38–68% compared to today’s levels. As a whole, water scarcity will increase in 74–86% of regions in Asia depending on the scenario, with some 40% of the continent’s population facing severe water scarcity in the 2050s. Under the middle of the road scenario, by 2050, 20% of the land area of Asia, with a population of 1.6–2 billion people, is expected to be facing severe water scarcity.

Climate change has long been accepted as the major cause of water scarcity, but some of the results surprised the researchers.

“One of the biggest findings in this study is that demand change can be more significant than climate change over many parts of Asia,” says Satoh.

This is the first time that socioeconomic changes have been identified as the main driver of water scarcity. Water demand for agriculture, industry, and households will increase by 30–40% by 2050 compared to 2010. By the 2050s, water demand in Asia is projected to be larger than all the other continents of the world put together.

As a result of socioeconomic development in Asia, industrial water demand will rise by at least 136% depending on the scenario, while municipal water demands will rise by a minimum of 176% and up to 245%.

Agriculture remains the largest user of water. Seasonal variations, such as extra irrigation in the dry season, further exacerbate the problem of water scarcity in Asia. However, even under the middle of the road scenario, a fifth of Asia will experience severe water scarcity in every season.

Regional variations

Of course, not all regions will be equally affected. According to the model projection, the areas with the most pronounced water scarcity in 2050 will be the same as now—Afghanistan, China, India, and Pakistan. The impacts of water demand increase are particularly pronounced in areas with megacities, such as northern-, coastal-, and southern China.

East and South Asia will see the largest growth in water demand by 2050, accounting for 80% of water use. Growing incomes, increased per capita water use, population growth, and urbanization, will particularly cause a rise in China, India, Indonesia, and Pakistan.

In contrast, under the sustainability scenario, areas including eastern Australia, Malaysia, and Myanmar will see lowered water scarcity.

According to the hydro-economic classification used by the researchers, the most vulnerable countries will be Afghanistan, Azerbaijan, and Pakistan due to their lower economic ability to cope with the challenges of water scarcity.

What now?

The researchers designed their scenario-based approach to provide important insights to policymakers on the scale of the potential problem of water scarcity. The initial target of the study was decision makers and investors in Asia, but Satoh says that the findings of the study will be of interest and relevance to any decision makers looking at water use on a global scale. He believes the projections relating to water demand will be particularly useful to decision makers and investors who currently only have supply projections. The results, the researchers say, highlight the clear need for more work on water demand and its management.

While water availability is to a certain extent determined by weather patterns, as technology advances, we would be able to do more. Desalination and water transfer are two options...
to artificially enrich local water supply. Desalination becomes ever cheaper and more efficient, and already supplies water to some water-stressed areas of the world, although it is only useful in coastal regions and is dependent on socioeconomic conditions. Water recycling technologies and schemes are also important. Improving water management, such as better planning in reservoir operations and adjusting irrigation periods in agriculture, play an important role in regions that have significant seasonal variability.

Managing demand is still the most important tool available to reduce scarcity, as well as the imbalance between water supply and demand. All sectors will need to reduce losses and improve water use efficiency. For example, agriculture uses most of its water in irrigation, of which there are three main forms—flood, sprinkler, and drip. Drip irrigation is the most efficient, but also the most expensive. Satoh and his colleagues assume that due to economic growth in Asia, it will become more affordable, and they expect that the higher efficiency system will eventually become dominant.

The socioeconomic changes, which lead to increased water demand and are the main driver of water scarcity, will need better management and policy interventions through, for instance, better governance and investment in technology and facilities.

The answer to the question posed in the headline then is—not necessarily.

“The message of this study is that we need to change our water use practices, as it has huge impacts on water scarcity. Although climate change is going to affect or intensify water problems, we may be able to adapt or change the situation by changing ourselves. A good recent and topical example was Cape Town in South Africa, which avoided “Day Zero” when water would have been cut off, by people and the city significantly reducing their daily use and demand,” says Satoh.


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WHAT DRIVES MIGRATION?

IIASA research is providing a scientific basis to help design evidence-based migration policies that will benefit Europe while ensuring humanitarian needs are met.

In the summer of 2015, IIASA researchers living in Vienna had a front-row seat to a wave of refugees entering Europe from war-torn Syria and other regions including Africa and the Middle East. The train station where IIASA scientists catch the bus to work, was packed with people in transit. People stood in long ticket lines wrapping through the central hall for hours on end. Families slept on cots in a makeshift shelter and shared meals sitting on the station floor.

For IIASA demographers, migration is one of the key variables in their work. Yet, for researchers who often work on a highly theoretical plane, the scene at the Vienna train station was a reminder of just how relevant their work can be—and a harbinger of how great the demand would soon become for science-based models of future migration.

“Migration is one of the three basic components of demographic change,” explains IIASA World Population Program director Wolfgang Lutz, who is also the founding director of the Wittgenstein Centre for Demography and Global Human Capital. “Other than fertility—birth rates, and mortality—death rates, migration is the only way the size of a country’s population can change.”

AN URGENT NEED FROM EU POLICYMAKERS

Since the summer of 2015, migration has become an increasingly divisive issue across Europe. Some argue that refugees bring problems such as crime and terrorism, or that they can’t integrate well because of their different religions, languages, or education levels. Others argue that Europe actually needs more migration in order to shore up its social system, as declining fertility and longer lifespans have led to a greater proportion of older people in the population.

Despite these popular but contradictory narratives, there is actually very little systematic analysis for projecting how migration will develop and what its impacts will be on Europe’s labor force and society, says Lutz. That is why in 2016, EU policymakers turned to IIASA to launch a new partnership for migration research. The Center of Expertise on Population and Human Migration (CEPAM) includes five researchers at IIASA and five at the European Union’s Joint Research Centre (JRC), who are conducting applied research that provides timely answers for policymakers’ urgent questions.

“What we’re trying to do is look at the big picture and the long term. We are looking at the drivers of migration—what we call pull factors that entice people towards a new country, and push factors that drive people to leave their homes,” says Lutz, who is leading the partnership. The plan is to produce a set of scenarios that can show the potential impacts of different immigration policies, allowing policymakers to make educated decisions and smarter plans.

Although only in its second year, the partnership has already produced several insights and new methods that could provide a more scientific basis for policymaking. At the core of these efforts...
are IIASA’s population projections, which were updated this year to include data up to 2015 and published in a new book in the context of CESAM. These multidimensional projections include not only age and sex, but also education levels, labor participation, and other factors that play a huge role in migration dynamics. In April 2018, Lutz and colleagues presented the updated projections to policymakers in Brussels, along with initial findings from the initiative.

Estimated global migration flows by gender 2010-15

While global migration flows have been assumed to increase over time, a recent study by IIASA researcher Guy Abel estimates that in fact, the proportion of the global population that migrates has remained steady at 0.65% of the global population over each five-year period since the 1960s. (Abel G, 2017)

A GLOBAL VIEW

While the project focuses on Europe-specific scenarios, the research takes into account the broader context of worldwide drivers of migration. For example, Lutz notes that population growth in Africa will be a key driver defining how strong future migration will be from the continent. Climate change, which can contribute to conflicts, food insecurity, or other challenges, may be another indirect driver of migration, and IIASA researchers are exploring this aspect as well.

Lutz says, “You can’t model migration in Europe without understanding the global demographic drivers.”

This big-picture view is a key reason that the IIASA World Population Program was perfectly placed to step in when the EU needed assistance. As their models become more detailed, IIASA demographers hope their research will help policymakers gain a better understanding of the people they are working to help.

DOES THE EU NEED MIGRANTS?

Initial migration scenarios developed through the partnership highlight that the EU’s future labor force depends not only on migration, but also on the proportion of people working. While it is true that Europe’s population is growing older on average, women and people over the age of 65 have been becoming increasingly active in the European labor market in recent years, coinciding with higher rates of education. The research finds that at current rates of labor force participation, the labor force size would indeed decline substantially until 2060. However, if women were to work across the EU at rates common in Sweden, the decline would be much smaller, and could be shored up by a moderate rate of migration.

Lutz notes that other factors could also drive changes in labor force participation, for example increasing automation that could reduce the need for unskilled workers, while potentially increasing the need for more educated workers.

ASSESSING INTEGRATION

Another unique research project focuses on individuals, modeling not just the broad population using three or four attributes, but individuals with a large variety of characteristics including demographic (age and sex, education), ethno-cultural (place of birth, ethnicity, language, religion), and economic (labor activity, employment).

Such a detailed view of a subset of the population—a method known as microsimulation—could help answer trickier questions, such as how well immigrants might be able to adjust to their new countries, learn the language, find jobs, and effectively integrate into society. It could also be used to help assess the effectiveness of such policies.

Alain Bélanger—a former participant in the IIASA Young Scientists Summer Program—rejoined IIASA in 2016 to develop a microsimulation model that could take into account more of the complexities and dynamics of multiple, highly diverse population groups. He says, “The macro-level approach cannot be used to model the complexities and dynamics of super-diverse populations because it has practical limits in the number of events, states, and groups that it can model.”

REFERENCES


FURTHER INFORMATION:

More in-depth highlights of this research can be found in the latest issue of POPNET: www.iiasa.ac.at/popnet/49

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UPDATED PROJECTIONS:

www.iiasa.ac.at/news/migration-book-18
Finding a reason for increased fertility among Egyptian women

Over the last two decades, scientists have observed an upturn in fertility in several Arab countries. As this trend is in direct contradiction to the demographic transition model, researchers are seeking answers to this puzzling question.

Egypt in particular has seen a notable fertility increase. At the onset of the new millennium, Egyptian women had three children each on average. Between 2008 and 2014, this rate rose to 3.5 children. While many point to increased religious freedom in the wake of the Arab Spring, it is becoming clear that this does not provide a comprehensive explanation for the upturn.

In a study published in the journal Population and Societies, IIASA researchers Anne Goujon and Zakarya Al Zalak suggest another reason for increased fertility among Egyptian women. According to their research, Egyptian women are facing an increasing lack of opportunities in the workforce.

This is particularly true for highly educated women. Egyptian women often choose fields of study that leave them with few options after they graduate. It is therefore evident that it is not only access to education, but rather access to adequate types of education that should be improved.

"Whether the fertility of Egyptian women stays above three children or starts declining again in the near future will have huge implications for the country, which is currently both environmentally and economically constrained," explains Goujon, a researcher in the World Population Program at IIASA. "The evidence suggests that there is a necessity to lower the labor market barriers faced by women and increase their employability."

Prototype land cover map of Africa: Great start but more accuracy needed

The latest land cover map of Africa, which can pick out features at 20m, is the first produced for a whole continent at such an exceptionally high resolution. IIASA researchers have however found that its accuracy stands at just 65%.

Land cover maps show land cover changes and give vital food security information. Accurate land cover maps for Africa are especially crucial for monitoring progress towards the UN Sustainable Development Goals. The new map, published by the European Space Agency Climate Change Initiative in September 2017, was created using images from the Copernicus satellite.

The researchers discovered that accuracy is especially low in southern countries and in a band from the horn of Africa to Senegal.

"While the resolution is there, the accuracy is not. That however does not mean that this is the final product; it is the first of its kind and it will advance over the coming years," says Steffen Fritz, IIASA Ecosystems Services and Management Program deputy director.

More high-quality data is needed to “train” the algorithm to categorize the images more accurately. Researchers can collect more data on the ground or use visual interpretations of high-resolution imagery, such as the IIASA Geo-Wiki project. After being trained on how to identify different types of land cover in the images, the team were able to categorize 23,264 sample sites with a high level of confidence.
Crowdsourcing information to help farmers in Mexico increase crop yields

Crowdsourcing has become a popular method for politicians, social groups, and private businesses to engage people. In the social media age, businesses and other groups can quickly, effectively, and inexpensively collect information, opinions, and even money from a wide audience that was previously inaccessible.

Now, scientists have utilized the power of crowdsourcing in a new app that aims to empower farmers in Mexico with comprehensive, real-time data that will hopefully lead to increased crop yields. The Agrotur app allows farmers to register parcels of land and log relevant agronomic information such as crop management practices and yield performance to share with others.

Collaboratively produced by IIASA and the International Wheat and Maize Improvement Center (CIMMYT) in Mexico, the Agrotur app relies on user-supplied data. Once basic information is entered, the app provides users with crop- and location-specific information on weather, yields, income, utilities, and costs. The app features both historical data and forecasts, which will help farmers to better prepare for planting and fertilizing crops. By allowing users to contribute detailed information on soil characteristics and agricultural management, the app’s creators hope that the app’s future recommendations will become even smarter.

“Sustainable intensification of agricultural production is key to achieving food security while avoiding environmental damage due to excessive use of fertilizers and pesticides,” explains Juan Carlos Laso Bayas, a researcher in the IIASA Earth Observation and Citizen Science Center. “The Agrotutor app aims to disseminate best agricultural practices to farmers in a tailored and timely manner, with specific recommendations suitable for geo-located parcels and crops.”

Further info www.iiasa.ac.at/projects/Agri-Support
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Mitigating risks from crude-by-rail transportation

As crude oil production from shale in North America has increased, so too have spills from rail accidents as the railways bear the extra burden from an insufficient pipeline network. A new model developed at IIASA with collaborators at Johns Hopkins University, can help determine the best crude oil transport policies to reduce the risk.

Unlike previous analyses of domestic oil supply and demand, the North American Crude Oil Model (NACOM) is a multimodal partial-equilibrium model that can look at the interplay between available transport modes including pipelines, rail networks, river-going barges, and ships.

The researchers compared four scenarios using NACOM: one in which rail flows from some areas are restricted, one with increased pipeline capacity, one in which the crude export ban is lifted (the analysis was started before the ban was lifted in 2016), and one in which all three measures are implemented. Removing the export ban increases rail flows, while pipeline investment reduces them. It was however the combination of methods that resulted in the lowest rail flows, the lowest environmental and safety risks, and the greatest revenues for operators.

“Looking at one mode only when assessing risks and regional price effects for crude oil and products may be misleading, because efficient markets will just divert production and flows to other regions or modes of transport in response to new policies and regulations. The work is a good illustration that a mix of policies often yields the best outcome in complex and interdependent systems,” says Daniel Huppmann, one of the researchers who worked on the project.

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Finding opportunities for change in disaster

In 2011, an earthquake off the coast of Japan led to a tsunami that decimated the area of Tohoku. Even worse, the event triggered a nuclear disaster from which Japan is still recovering. As is the case in many disasters however, this event created a window of opportunity for positive social and environmental change.

The potential for improvement in the wake of tragedy is known as “building back better”—a phrase that was popularized after the Indian Ocean Tsunami of 2004. Most simply, it means that when faced with devastation, towns or countries have the opportunity to improve upon the social, civil, and environmental infrastructures that were previously in place.

In a study published in the International Journal of Disaster Risk Reduction, Junko Mochizuki measured how the area of Tohoku responded to this tragedy. While many people assume that countries build back better after tragedies, very few studies quantify this change. The study found that 30 coastal communities affected by the disaster adopted photovoltaic solar power at a significantly higher rate than the rest of the country.

“Very few studies have empirically investigated the complex dynamics of the post-disaster reconstruction process,” explains Mochizuki, a researcher in the Risk and Resilience Program at IIASA. “Our study sheds light on potential trade-offs between reducing risk and improving other aspects of community in post-disaster reconstruction. Our overall conclusion is that disaster may serve as an opportunity for positive community change when immediate impact is high enough, but not overwhelming.”


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Accommodating growth without increasing environmental pressure

Rapid economic growth often comes at a steep price, with positive effects of change regularly being balanced out by negative environmental effects. In traditional growth models, greater growth has led to greater carbon emissions output, raising questions about construction practices and expansion in general. With new growth models however, adverse environmental effects do not necessarily have to be part of the equation.

China’s Chongqing municipality has seen rapid economic growth in the last 20 years. Most impressive however, is the fact that they have managed to grow without increasing their emissions. In fact, they have even managed to reduce some of the more harmful emissions during this period.

In a study published in the journal Ecological Indicators, IIASA researcher Wenji Zhou and his peers demonstrated substantial decoupling of environmental pressure from economic growth in Chongqing. Between 1999 and 2010, emissions of Sulphur dioxide, soot, and water waste showed zero growth. Over the same period, the growth rate of total energy consumption, carbon dioxide emissions, and solid waste remained relative to the population. These results were far above the national average, showing that responsible growth can be achieved.

“The results of our study demonstrate the ability to accommodate rapid economic growth on a city level without contributing to carbon-based emissions,” explains Zhou, a researcher in the IIASA Energy Program. “We firmly believe that the case of Chongqing can serve as a model for other cities and policymakers around the world on how to grow a city without harming the environment.”


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Predicting likely outcomes for effective strategic planning

In today’s world, companies must be able to respond quickly to shifts in their operational markets. The most successful companies often try to predict potential changes so that they can be ready to adjust should one of those changes ever come about. Traditional strategic planning is however largely built on the concept of taking current trends and extrapolating from them.

More and more, companies are beginning to utilize scenario-based planning methods. While traditional strategic planning focuses on what is perceived to be the single most likely future, scenario-based planning considers numerous plausible futures. This improved model enables companies to recognize uncertainties that might have otherwise gone unnoticed.

In a study published in the European Journal of Operational Research, Leena Ilmola-Sheppard and her peers present a scenario-based portfolio model that helps companies build more robust and proactive strategies for continued success. This is especially useful in the face of increasing uncertainties.

“We are living in a systemic world, dominated by uncertainty. Even if we are not able to predict the future, it is important to understand the potential impacts of our decisions,” explains Ilmola-Sheppard, a researcher in the IIASA Advanced Systems Analysis Program.

“Previously, we did not have a simple way to take this feedback into consideration. The new extension of Robust Portfolio Modeling is providing us with tools to do just that. In addition to the identification of the most robust portfolio of actions, decision-makers can also use this approach for the simulation of potential decision options.”

Analyzing the impact of climate change on European agriculture

Climate change is one of the gravest threats to our environment. Rising sea levels, extinction of animal species, and stronger storm systems are some of the most well-known consequences. Perhaps the most serious issue however, is the devastating effect that climate change may have on the global food supply. One reason this threat is not well known is that current crop yield projections are not very accurate, in part because they do not take into account soil degradation processes.

In a study published in the journal Earth’s Future, Juraj Balkovic shows that even a 2°C increase in average temperature will likely impact food supply in Europe. With higher atmospheric temperature and increased weather variability, crop-based calorie supply becomes sensitive to soil degradation, particularly in the form of decreased organic matter and erosion. This means that affected crops will have fewer calories than before. Areas like Eastern Europe and the Baltic lack the capacity to manage this nutrient loss and the effects on crop production could be severe.

“Recent projections indicate that Europe will warm at a faster rate than the global average, and a 2°C increase of global warming may significantly impact European agriculture,” explains Balkovic, a researcher in the Ecosystems Services and Management Program at IIASA. “Healthy soils help crops to cope better with future climate and increased weather variability. We must guide our actions to avoid soil degradation in the face of climate change if we hope to keep our soils healthy for future generations.”
A harmonious partnership continues

Music and science have a lot in common. In both, practitioners use mathematical principles and logic, in combination with passion and creativity to produce an end-result that ultimately strives to make the world a better place. A partnership between IIASA and the Vienna Philharmonic has been bringing music and science together to do just that since 2012.

One of the Vienna Philharmonic’s stated missions is to communicate the humanitarian message of music into the daily lives and consciousness of its listeners. One of the ways in which it does this, is by acting as a Goodwill Ambassador for IIASA and raising awareness of the institute’s efforts in finding solutions to some of the critical issues of environmental, economic, technological, and social change that society faces in the twenty-first century.

A summer dedicated to science

The IIASA Young Scientists Summer Program (YSSP) has been providing talented young researchers with opportunities to collaborate with some of the leading minds in the world on important issues of global relevance, since 1977.

This summer, 52 talented young researchers, from 27 countries will once again come to Austria from June to September, to spend time pursuing independent research projects under the direct supervision of experienced IIASA scientists. The institute will also host two science communication fellows who will work in the communications team to gain hands on experience in various aspects of communication and help communicate the work of the YSSP participants. Through the many social and other activities offered during the summer, participants often build lasting friendships and contacts for future collaboration within the institute’s worldwide network.

In addition to all the YSSPers who will be visiting IIASA for the first time, three outstanding young scientists from the 2017 YSSP have received scholarship funding to return to IIASA in 2018 to continue with their research projects for another three months. They are Pablo Ortiz Partida who received the Mikhailovich Award, and Hana Mandova and Yaoping Wang, who each received a Peccei Award.

The scholarships are awarded annually for outstanding papers from the previous year’s YSSP cohort. Candidates are nominated by the program director of the relevant IIASA research program and assessed by a committee comprised of one member from each program. Each candidate’s paper is evaluated based on its quality, originality, and relevance.
Israel joins IIASA

In December 2017, Israel became IIASA’s newest member country with the Israel Committee for IIASA—made up of representatives from Israeli universities and government ministries—representing the Israeli membership of the institute.

Together, IIASA, the Israel Committee for IIASA, Israeli researchers, and public planning authorities will develop international research collaborations to find solutions to the complex global challenges that impact Israel, the broader region, and the world. These include projects to support a long-term sustainable energy strategy for Israel, a package of measures to reduce air pollution in the wider region, and scientific support for national socioeconomic strategic planning.

“We are delighted to become the newest IIASA member country,” said Moti Herskovitz, head of the Israel Committee for IIASA and former vice-president and dean for research and development at Ben-Gurion University of the Negev. “Israel is grappling with multiple challenges, from water and energy security issues, to air pollution and demography that will benefit from the integrated and international perspective that IIASA can provide.”

The Israeli Ministry of Science and Technology, and the Israeli National Economic Council will coordinate the activities of the Israel committee for IIASA.

Systems analysis is one of the few research tools with the breadth and depth to explore complex problems across multiple sectors, countries, and timeframes, which are typical of many of the challenges facing countries in the Middle East. IIASA membership will help develop the research base for systems analysis in the country through early-career Israeli scientists taking part in IIASA programs for young scientists, and a range of opportunities for mid-career researchers.

IIASA Director General and CEO Pavel Kabat welcomed Israel, saying: “The quality of Israeli science and its scientists brings great value to IIASA research, and will further enhance the excellence of the international research projects conducted by the institute and its member countries, along with its expertise and collaboration in the Middle East.”

www.iiasa.ac.at/news/Israel-17

IIASA researcher appointed to prestigious position in Finland

Leena Ilmola- Sheppard, a researcher with the IIASA Advanced Systems Analysis Program, has been appointed as special advisor to the Finnish Prime Minister’s Office as part of the country’s Toimi project, which aims to identify reform strategies for public services.

She will specifically advise on the future wellbeing and health of Finnish citizens using qualitative systems analysis tools developed as part of her work at IIASA.

EGU honors Yoshihide Wada

IIASA Water Program Deputy Director, Yoshihide Wada, received the 2018 Arne Richter Award for Outstanding Early Career Scientists at the 2018 European Geosciences Union (EGU) General Assembly, which took place in Vienna in April.

He was selected for the award due to the pioneering nature and scope of his work on the effects of the human footprint on the global hydrological cycle. Wada is spearheading this new and growing body of work in hydrology.

Kabat accepts a new challenge

After leading the institute for almost seven years, IIASA Director General and CEO Pavel Kabat, has accepted the position of first Chief Scientist and Research Director of the World Meteorological Organization (WMO).

In his new role, Kabat will lead the overall strategic direction of WMO science and its underlying research activities. He hopes to bring his extensive experience in systems thinking to this new position and looks forward to greater collaboration between IIASA and the WMO in the future.

Recognition for excellence in geosciences

Keywan Riahi, IIASA Energy Program director, and Zbigniew Klimont, a researcher with the Air Quality and Greenhouse Gases Program, were included on a list of the most highly cited researchers worldwide for a second consecutive year.

Both scientists were specifically recognized for their outstanding contribution to scientific literature in geosciences.
Having been encouraged to apply by her academic advisor, Jeffrey Bielicki, Wang came to IIASA for the summer from Ohio State University in the USA. Her project titled “Hydro climate impacts on current and planned coal-fired power plants in Asia” was selected as one of the three best from the 2017 YSSP-cohort and she subsequently received a Peccei Award for outstanding policy-based research. Wang and her supervisors identified some interesting extensions to her work, which she is now looking forward to exploring when she returns to IIASA in 2018.

“It is rare to spend such a long time with people from other institutions and countries. It helped me to put my research into a much broader perspective,” says Wang. “I also learned a lot about other research areas from both the seminars and other YSSPers, which helped me to identify some research projects I want to do in the future,” she adds.

According to Wang, some of the benefits were more specific. Her skills in energy modeling, input-output modeling, network analysis, and in using Python, particularly improved. She believes that her time at IIASA made her a better researcher, because of the interdisciplinarity, international connections, and new perspectives.

“My time in the YSSP was the happiest three months of my life. It is a great professional experience, but also great fun. You get to know around 50 people who you can ask for help or collaborate with in the future,” she says.

Jose Pablo Ortiz Partida is a graduate researcher at the University of California, Davis in the USA. He is originally from Mexico and is sponsored by the National Council of Science and Technology of Mexico (CONACYT), and the University of California Institute for Mexico and the United States (UC MEXUS). Ortiz’s 2017 project received a Mikhalevich Award for outstanding mathematical and methodological research.

“The research I started last summer is related to the use of optimization models for reducing water allocation thresholds between human and environmental water use along rivers while maximizing the economic benefits. There is still work to do in terms of refining the model and analysis, as well as outreach,” he says. Ortiz’s supervisors Taher Kahlil, Tatiana Ermolieva, and Yuriy Yermoliev were very helpful in teaching him about optimization methodologies, software, programming languages, and improving his writing.

“These are all skills I am taking back and applying towards my degree and my career. The people and the projects developed at IIASA are so diverse, that I was introduced to many different ways of thinking, and problems and solutions that I never imagined,” says Ortiz.

Ortiz describes the YSSP as a unique opportunity to interact with researchers from all over the world, to make friends, and become part of an international family. The best part of the YSSP is the people.
Seasonal pumped-storage – the answer to water and energy security?

Q&A with Brazilian IIASA postdoc Julian Hunt

Q What is seasonal pumped-storage?
A Pumped-storage is a form of hydropower used for storing energy to guarantee that electricity supply meets demand, especially during peak hours. It is normally used in daily cycles to store energy from inflexible power plants—such as coal and nuclear—at night, and to generate power during the day. The future of this type of short-term storage is uncertain as batteries become more efficient and less expensive.

Seasonal pumped-storage (SPS) on the other hand can be used for the short, medium, and long-term storage of intermittent renewable sources of energy like wind and solar that have hourly, daily, weekly, and seasonal variations.

Q What exactly do you research?
A I published a paper comparing SPS with conventional dams. The main finding is that SPS requires considerably less land to store energy and water. This is because the reservoir level can vary markedly more than in conventional dams. It also involves fewer social and environmental impacts as the reservoirs are built in mountain ranges rather than in the main river.

Seasonal pumped-storage (SPS) on the other hand can be used for the short, medium, and long-term storage of intermittent renewable sources of energy like wind and solar that have hourly, daily, weekly, and seasonal variations.

Q How did you get interested in such plants?
A During my D.Phil. at Oxford, I developed a decision support system to find the best alternatives for energy in the UK looking at a water perspective. I found that wind power is a good solution, but it requires storage. I looked at possible sites for large-scale pumped-storage plants in Scotland and found that if the deep lochs were used as a lower reservoir, and surrounding mountains as upper reservoirs, they could store huge amounts of energy and make wind power a viable solution. During my postdoctoral research in Brazil, I thought of combining large-scale pumped-storage plants with the operation of the existing hydropower plants. It proved to be a very good combination that I later named seasonal pumped-storage.

Q Why is seasonal pumped-storage important to Brazil?
A Most electricity in Brazil is generated by hydropower and the country suffers an energy crisis every 10 to 15 years due to countrywide droughts. SPS is a possible solution for this issue. During years with abundant hydropower generation, some of the wasted hydropower potential can be stored and then used in dry years to guarantee the supply of electricity. HT

Julian Hunt is a postdoc research scholar at IIASA where he works with the Energy and Water programs in collaboration with the CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Education Ministry) Brazilian Foundation for support researchers. His research interests include analysis of energy systems, water-energy-land interfaces, climate change risks, and energy security.