

**CITIZEN SCIENCE: CO-
CREATING A BETTER FUTURE**

*How can societal participation
in research contribute to a
more sustainable world?*

**SYSTEMS ANALYSIS FOR
REDUCING FOOTPRINTS AND
ENHANCING RESILIENCE**

*Reflections on the 2022
IIASA-ÖAW Conference*

JAPAN AND IIASA

*Tackling complex issues
on a global scale*



INTO THE GREAT WIDE OPEN

**By opening up access to science, IIASA is sparking
new insights into our planet's health.**



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CO-CREATING A BETTER FUTURE



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FROM THE EDITOR

It is our pleasure to introduce the latest installment of *Options*, the summer 2023 edition. Within these pages, we proudly showcase the ongoing endeavors of IIASA researchers across various domains and disciplines, as they persistently strive to address the pressing challenges confronting society today.

Our cover feature highlights how opening up access to science can spark new insights into our planet's health and how IIASA is opening doors to science by encouraging open access to publications and making data, tools, and models more accessible (pages 16-19). We also take a look at how IIASA is harnessing the power of citizen science and co-production processes to strengthen societal participation in research and sustainability issues (pages 8-9). In addition, we explore the fruitful collaboration between Japan and IIASA, which has yielded numerous research endeavors, workshops, and conferences addressing intricate global challenges since the institute's founding in 1972. This enduring partnership continues to thrive today (pages 20-21).

We sincerely hope that you find the articles in this edition of *Options* enjoyable. We warmly encourage you to reach out to us via email and let us know your thoughts about the content in this edition or provide us with your ideas for topics to be featured in upcoming issues.

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News in brief

A novel use for decommissioned mines

Renewable energy sources are central to the energy transition toward a more sustainable future. However, as sources like sunshine and wind are inherently variable and inconsistent, finding ways to store energy in an accessible and efficient way is crucial. While there are many effective solutions for daily energy storage, a cost-effective long-term storage solution is still lacking.

According to IIASA-led research, a novel technique called Underground Gravity Energy Storage (UGES) could fill this gap while also making use of now-defunct mining sites, which likely number in the millions globally.

UGES generates electricity by lowering sand into an underground mine and converting the potential energy of the sand into electricity via regenerative braking. The sand is then lifted from the mine to an upper reservoir using electric motors to store energy. The fact that sand is used as an energy storage medium means that no energy is lost to self-discharge over long periods, as is the case with other energy storage methods like batteries. This enables ultra-long time energy storage ranging from weeks to several years.

The deeper and broader the mineshaft, the more power can be extracted from the plant, and the larger the mine, the higher the plant's energy storage capacity. Mines also have the added benefit that they already have the basic infrastructure and are connected to the power grid, which significantly reduces the cost and facilitates the implementation of UGES plants.

The authors emphasize that to decarbonize the economy, we need to rethink the energy system based on innovative solutions using existing resources. Turning abandoned mines into energy storage is one example of many solutions that exist around us, and we only need to change the way we deploy them.

By **Ansa Heyl**

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INNOVATING FOR CLIMATE RESILIENCE

IIASA researchers are collaborating on the Youth Agency Marketplace Operational Research (Yoma OR) project – an ambitious initiative aimed at helping African young people grow their digital skills as a first step on a journey from learning to earning using AI, blockchain, and crowdsourcing. Launched in June 2022 for a two-year period, the project uses citizen science methodologies to help local youth find concrete answers to the climate resilience challenges their communities face and rewards them for their participation.

www.iiasa.ac.at/news/resilience-23

SECURING A LIVABLE FUTURE FOR ALL

IIASA researchers contributed to the latest Intergovernmental Panel on Climate Change (IPCC) synthesis report released in March 2023. The report urges action on deep and sustained emissions reductions and highlights feasible and effective options for achieving this in a fair and equitable way. According to the authors, the solution lies in climate resilient development, which involves integrating measures to adapt to climate change with actions to reduce or avoid greenhouse gas emissions in ways that provide wider benefits. Examples are access to clean energy and technologies, and improvements in public transport which enhance air quality, improve health, provide employment opportunities, and deliver equity.

www.iiasa.ac.at/news/futureforall-23



Equitably sharing the burden of CO₂ removal

Discussions and studies on how countries should share the burden of carbon dioxide (CO₂) removal are limited, and so far, mostly only concerned developed countries and major emitters. To achieve the Paris Agreement's goal of limiting global warming to 1.5–2°C, we however need to extend analysis and discussions to developing economies as well.

An IIASA-led study analyzed CO₂ removal quotas for developing countries, while considering issues of equity and fairness. The authors distilled the global climate targets into national quotas and assessed the implications for developing countries.

Given the large potential for natural climate solutions such as conservation, restoration, and improved land management for CO₂ removal in tropical developing countries, the study focused on Brazil, Colombia, Democratic Republic of Congo, India, Indonesia, Malaysia, and Mexico, which together cover ~35% of global cost-effective natural climate solutions potential.

The potential for CO₂ removal quotas for these seven countries ranged between 0.1–29 gigatons of CO₂ across the allocation scenarios, but also revealed inherent bias and strong heterogeneity of quotas between the allocation methods, making agreement on an 'equitable' quota unlikely.

The researchers caution that if ambitious quotas are implemented in countries with vast forest areas, competition between natural and non-nature-based solutions might ensue to the detriment of emissions reduction, biodiversity, and the benefits that people can derive from nature. Therefore, it is important to not use these quotas to inform climate targets, but instead use the results to foster higher ambition in voluntary cooperation mechanisms.

By **Ansa Heyl**

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The effect of COVID-19 on global migration flows

COVID-19 has undeniably affected international migration flows in most countries. To shed light on this phenomenon, IIASA researchers looked into the varying impact of the pandemic on immigration to different high-income countries. As part of their study, the researchers forecasted immigration counts in the absence of COVID-19 and compared them to the actual immigration counts in 15 high-income countries. Potential driving forces behind the changes in immigration counts were determined as travel and mobility restrictions, lockdowns, work and school closures, and unemployment.

The results show that international travel and mobility restrictions, along with stay-at-home requirements were strongly associated with immigration declines, whereas work and school closures and unemployment showed no effect. The largest drop in immigration was seen in Australia, with a staggering 59.9% decrease, while Spain and Sweden recorded drops of 45.4% and 36.4%, respectively. Finland was the only nation to experience an influx of new migrants.

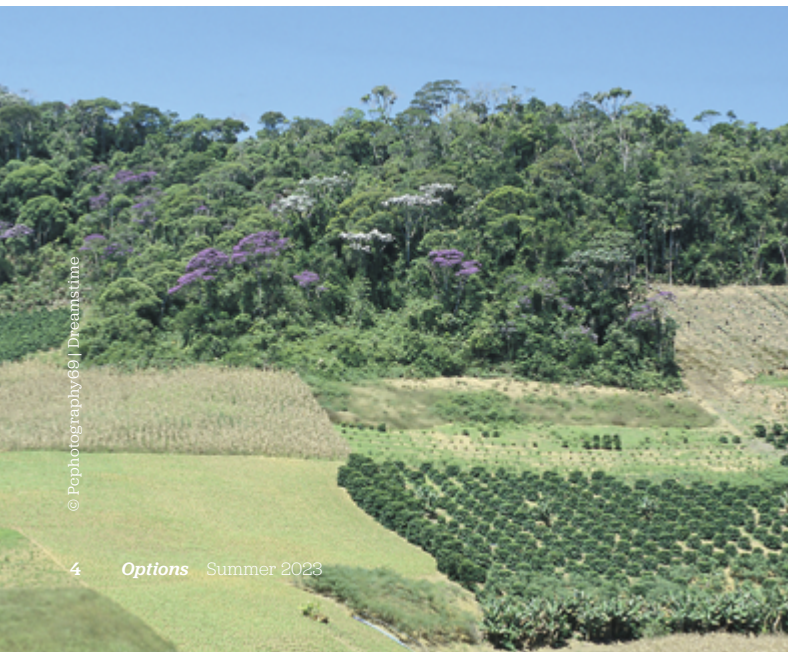
Lead author of the study, Miguel González-Leonardo, a researcher in the IIASA Population and Just Societies Program, emphasized that while previous studies have speculated on how the pandemic may have impacted migration, this study is the first to provide empirical evidence of its effects. Understanding changes in the global network of international migration is crucial to ensure appropriate policies are put in place, especially in aging societies. It underscores the need to implement appropriate policies to address the changes in international migration flows and ensure social and economic stability.

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Calculating the price of cancer

IIASA Economic Frontiers Program Director Michael Kuhn contributed to a recent study published in the *Journal of the American Medical Association (JAMA)* - Oncology, which used a comprehensive modeling framework estimating the macroeconomic cost of cancer in terms of lost GDP. The work was pioneering in the sense that it estimated the macroeconomic cost of cancer using a model that embraces many of the economic adjustment mechanisms, incorporating changes in labor supply due to cancer mortality and morbidity, as well as the loss in capital investments related to treatment costs.

The authors estimated the global economic cost of cancers from 2020–2050 to fall around \$25.2 trillion in international dollars (INT\$, at constant 2017 prices), which is equivalent to an annual tax of 0.55% on global gross domestic product.

The research focused on 29 types of cancers in 204 countries and territories. Lung cancer emerged as the cancer type inflicting the largest financial burden, followed by colon and rectum cancer, breast cancer, liver cancer, and leukemia. The findings show that the health and economic costs of cancers are distributed unevenly across countries and regions, with China and the US accounting for 24.1% and 20.8% of the total global burden respectively. Although countries with lower or middle income face most cancer cases, their share of economic burden is only about half.

“The four economically most damaging cancers are all amenable to primary and secondary preventions, such as smoking, diet and alcohol interventions, and increased screening,” notes Kuhn. “This reveals the large potential for policy interventions world-wide, which will help to curb the trade-off between the high disease burden and the high economic burden.”

The study emphasized the urgent need to invest in effective public health interventions to reduce the burden of cancer and protect global health and economic wellbeing.

By **Cherry Edwards**

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EDUCATION PLAYS A KEY ROLE IN REDUCING UNDER FIVE MORTALITY

An IIASA study explored the relationship between maternal education and children’s health in the rural-urban context in India. The authors explored whether mothers’ educational attainment influences the under-five mortality rate between rural and urban areas, and how this has changed over the last three decades. The results show that increased maternal education, and particularly secondary education, reduced the risk of under-five deaths in both contexts. The authors urge decision makers to secure educational opportunities, especially secondary education for girls, to keep up the declining trend in the under-five mortality rate in India.

www.iiasa.ac.at/news/child-deaths-23

IIASA RECEIVES CONSULTATIVE STATUS WITH UNIDO

IIASA has a long history of productive collaborations with the United Nations Industrial Development Organization (UNIDO) in a diverse range of areas, focusing on important issues like poverty reduction, inclusive globalization, and environmental sustainability, among others. Earlier this year, IIASA was granted consultative status with UNIDO on recommendation of the UNIDO Director General. This status allows IIASA delegates to participate in the meetings of UNIDO’s main policymaking organs and to contribute scientific insight to their deliberations. In this way, IIASA can enhance the impact of its research on shaping evidence-based decision-making processes by UNIDO Member States.

www.iiasa.ac.at/news/UNIDO-23

Seaweed farming could help address global challenges

A study led by IIASA Young Scientists Summer Program alumnus, Scott Spillias, shows that expanding global seaweed farming could go a long way to addressing the planet's food security, biodiversity loss, and climate change challenges.

The researchers mapped the potential of farming commercially important seaweed species using the IIASA Global Biosphere Management Model (GLOBIOM). They estimated the environmental benefits of a range of scenarios based on land-use changes, GHG emissions, water and fertilizer use, and projected changes in species presence by 2050.

“Seaweed has great commercial and environmental potential as a nutritious food and a building block for commercial products including animal feed, plastics, and fuel,” he explains. “We found that expanding seaweed farming could help reduce demand for crops on land and reduce global agricultural greenhouse gas emissions (GHGs) by up to 2.6 billion tonnes of CO₂-equivalent per year.”

The study identified millions of available hectares of ocean where farming could be developed, with Australia and Indonesia showing the greatest potential with respectively 75 million and 114 million hectares of ocean estimated to be suitable for seaweed farming. The study further highlights that many native species of seaweed in Australian waters has not been studied from a commercial production perspective, which could hold further opportunities.

“This study uniquely highlights the need for integrated strategies bringing together terrestrial and marine ecosystems management to address some of the mounting problems of global sustainability facing us,” concludes IIASA Biodiversity and Natural Resources Program Director, Petr Havlík.

By **Ansa Heyl**

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What bolsters support for climate action among Europeans?

While the effects of climate change are becoming more visible every day, most Europeans do not consider climate change, the environment, and energy among the most pressing issues for national policymaking. The successful implementation of stringent and sustainable environmental policies, however, relies heavily on public support for the needed measures.

Jonas Peisker, a researcher in the IIASA Population and Just Societies Program, set out to understand the factors that drive concern for the climate and the environment to raise the motivation for climate action. To do this, he analyzed how environmental preferences in 206 European regions are shaped by socioeconomic, geographical, and meteorological circumstances.

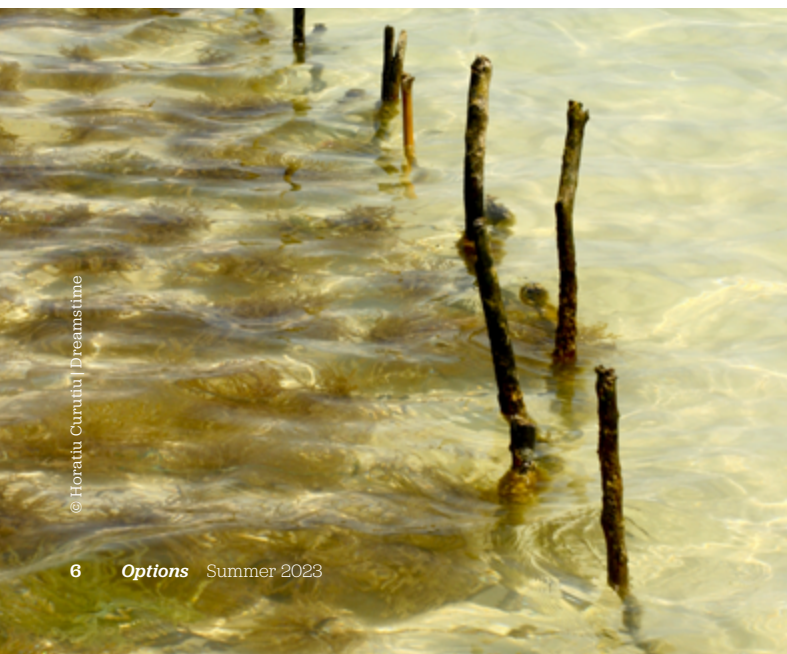
His findings included that favorable economic contexts, such as a relatively high income level and low inflation, foster environmental concern, whereas rising energy prices lowered environmental concerns up to a point, after which environmental concerns started to rise as well. At this point, energy supply could become an issue that actually raises environmental concerns. A more equal distribution of income and wealth also had a positive impact on the prioritization of environmental issues, suggesting that social cohesion is beneficial for green concerns.

“The results of this study show that climate policy and environmental protection are likely to be unpopular if they increase income and wealth inequality, inflation, and unemployment. Therefore, a way to support climate action could be to emphasize the co-benefits of environmental policy, for instance, positive employment effects of the transition to renewable energy sources,” Peisker concludes.


By **Ansa Heyl**

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ADVANCING SYSTEMS ANALYSIS FOR INFORMED AND AGILE DECISION MAKING

Continuing innovation and developing new tools is crucial to effectively address problems, adapt to changing circumstances, and drive progress in an ever-evolving world. To bolster the institute's analytical toolkit, IIASA is continuously developing new systems models and methods incorporating state-of-the-art technology.

By Ansa Heyl

The IIASA Advancing Systems Analysis (ASA) Program is the institute's laboratory for innovative systems analysis and has a strong focus on producing new data, developing innovative methods, and creating new insights for use in other programs and the broader research community, while acting as a hub to promote transdisciplinary research for informed decision making.

Decision makers often need to make trade-offs between multiple conflicting objectives. In this context, the ASA program developed a novel way to reduce a very large set of potential policies to a handful of alternative diverse solutions that optimize the multiple objectives of the decision maker. Applying their framework to a case study of epidemic control, a small set of candidate policies were identified that balance health impacts with economic or societal costs, while being robust with respect to uncertainties of the underlying processes. During the COVID-19 pandemic, for instance, decision makers strived to minimize deaths, while simultaneously minimizing the cumulative impact on the economy. According to the model, alternative control strategies would consist of mass testing, lockdowns, or a combination thereof.

As another example of out-of-the-box thinking, ASA researchers developed a new type of computer model – known as an agent-based model or ABM – representing an innovative approach to economic forecasting. It focuses on small open economies and incorporates both micro and macro data from various sources, enabling a detailed picture of the economy.

What makes the model unique is that it considers all economic activities as defined by the European System of Accounts and includes millions of individual agents representing different sectors of the economy. This enables the model to make predictions at the sector level and to analyze and forecast the economic performance of specific economic sectors, which could provide valuable insights into the economy and can be applied to real-world situations to inform decision-making processes.

IIASA has a long history of contributing to climate science and hosts the Scenario Explorer and databases underlying the work of the Intergovernmental Panel on Climate Change (IPCC). One of the latest innovative developments in the institute's climate science toolshed is the Pathfinder model. Pathfinder is open-source and merges multiple state-of-the-art sources of information via a statistical technique called Bayesian inference. The model thus combines established formulations that describe climate and carbon cycle systems and incorporates the latest data from complex Earth system models and the IPCC sixth assessment reports. Despite its simplicity, it can accurately replicate the behaviors and outcomes of complex models.

While these are just a few examples of the work done at IIASA, they clearly illustrate the institute's commitment to innovation in systems analysis models, methods, and tools with the aim to inform decision-making processes in an agile manner and pave the way to a better future.

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CITIZEN SCIENCE: CO-CREATING A BETTER FUTURE

Citizen science is the new buzzword. Science is no longer confined to ivory towers, it is something that anyone and everyone can participate in. With numerous citizen science initiatives around the world, you can be anything from an astronomer for a day, counting stars in the night sky, to a marine biologist decoding whale sounds.

IIASA has long been a champion of involving the public in science, recognizing it as a vehicle for strengthening societal participation in research and sustainability issues. However, some institutions remain hesitant about using citizen science data, citing concerns about quality and access. To address these issues, IIASA researchers are working to streamline the scientific process, including defining what citizen science entails, ensuring data quality, and finding ways of better engaging citizens.

“One key area that we study is the quality of data,

where we compare citizen data to what we call controls, where the answers are already known,” says Linda See, a researcher in the Novel Data Ecosystems for Sustainability (NODES) Research Group of the IIASA Advancing Systems Analysis Program. “We also conduct surveys to study citizen engagement, and interestingly, we find that people are primarily motivated by participating in science but monetary incentives, prizes, and coauthorship also help.”

Beyond advancing scientific research, citizen science could also play a crucial role in monitoring progress toward the UN Sustainable Development Goals (SDGs). Currently, 41% of SDG indicators lack data, highlighting the need for innovative data sources. IIASA researchers are working with various statistical offices and UN agencies, and have released several papers and a policy brief to offer advice on how to effectively fill these data gaps.

“We provide important recommendations on how to build trusted partnerships around citizen science data, not only to address the data gaps in the SDG framework but also to build data ecosystems that support inclusive decision making by empowering citizens and communities,” says Dilek Fraisl, who is also associated with NODES.

CITIZEN SCIENCE IN ACTION

To lead by example, several research projects at IIASA depend heavily on citizen science data. The Geo-Wiki platform offers citizens the opportunity to engage in monitoring of the Earth’s surface by classifying satellite, aerial, or ground-level imagery, while the CAMALIOT project aims to improve weather forecasting models using citizen-science data collected from the global positioning systems (GPS) in smartphones.

“The CAMALIOT project has been really successful with around 12,000 people participating from all parts of the world, creating a dense, global coverage of data,” says See, who led the project at IIASA. “One person even collected data on Antarctica, so we had every continent covered.”

Through the Urban ReLeaf project that kicked off earlier this year, researchers will use a variety of citizen science data streams, such as wearable devices and citizen observations, to support urban design planning, green infrastructure, and climate change adaptation in cities.

“We are excited to work with urban authorities, opening a new chapter for citizen participation,” says Gerid Hager, a researcher in the IIASA Advancing Systems Analysis Program who is one of the coordinators of the project. “Through Urban ReLeaf, citizens can collaborate alongside authorities to share knowledge and drive targeted and evidence-based decision making.”

THE POWER OF CO-CREATION

As much of the research at IIASA focuses on issues like climate adaptation and sustainability, it is only fair to involve the people whose lives will be affected by the decisions. Many projects at IIASA are taking a step further from solely collecting data and actively involve stakeholders in scientific co-creation processes.

One such project is ALFAwetlands, which aims to map wetlands across the EU and evaluate which restoration methods will provide the greatest benefit for the climate and biological diversity. The project uses an approach of co-creation to find ways for integrating multiple targets, supporting more inclusive, community-based approaches to wetland restoration.

Another initiative is the fairSTREAM project, which aims to create visibility for the importance of co-production processes in applied systems analysis. Its main co-production effort is currently taking place in the Bhima basin in India, where the team is working with local experts and the public to understand the issues related to fairness within the food-water-biodiversity nexus.

“Co-production is crucial for creating actionable results,” says Susanne Hanger-Kopp, the project lead and a researcher in the IIASA Population and Just Societies Program. “However, as it is also resource intensive and unpredictable, it is important to define a framework of when and where co-production methods work the best.”

A GLOBAL VOICE FOR CITIZEN SCIENCE

While citizen science is gaining popularity, it is still lacking a united voice. Recognizing this, in October 2022 citizen science networks and practitioners from around the world came together to form the Citizen Science Global Partnership, seeking to promote and advance citizen science for a sustainable world.

The partnership’s mission is to coordinate the collaboration of citizen science practitioners with international organizations and governments and support the use of citizen science data and tools toward sustainable development. As a founding member and the current host of the partnership, IIASA is playing a key role in bringing its mission to life.

“What we really want to achieve is to bring citizen science into the mainstream,” says Fraisl, who is the managing director. “I’m passionate about advancing citizen science because we know its importance doesn’t only lie in providing useful data, but also in making people more aware of the issues that our world is facing by directly involving them in the scientific research processes.”

Citizen science isn’t just a passing trend; it has the potential to revolutionize the way we approach scientific research and sustainability issues. As more people become involved in the scientific process, we can expect to see more innovative ideas and discoveries emerge, and ultimately, a more informed and engaged society.

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SUSTAINABILITY ISSUES**

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Historic breakthrough in addressing climate losses and damages

With the development of a comprehensive policy framework for loss and damage finance, IIASA research helped pave the way for the breakthrough agreement at the 2022 United Nations Climate Change Conference (COP27), to provide loss and damage funding for vulnerable countries affected by climate disasters.

As the climate crisis intensifies, vulnerable communities around the world are experiencing significant losses and damages to their lives, livelihoods, and futures. Communities in the Global South are often the hardest hit by these challenges, and provisions for managing the costs of increasing disasters are lacking. In 2013, the United Nations Framework Convention on Climate Change established the Warsaw International Mechanism to avert, minimize, and address losses and damages associated with the impacts of climate change. However, despite ongoing dialogue and heated debate, concrete action and policy development have been lacking until now.

Loss and damage funding was added to the official agenda and adopted for the first time at COP27, marking an important point of progress in climate mitigation and justice. Governments also agreed to form a transitional committee that will provide suggestions on how to put the newly established funding arrangements into operation during COP28 this year.

Over the years, IIASA research has been instrumental in reaching this historic milestone. In 2021, IIASA researchers published a comprehensive policy framework for loss and damage finance presented at COP26. The framework uses a layering approach, leading to two lines of action on risks and loss and damage. The first aims to minimize risk through direct funding to support adaptation, risk reduction, and resilience building, while the second addresses the unavoidable losses and damages that cannot be further reduced or insured for which financial and social protection mechanisms are required.

Ahead of the breakthrough at COP27, IIASA also coauthored a policy brief followed by a report together with the Zurich Flood Resilience Alliance, discussing the realities of the climate crisis in vulnerable communities in Bangladesh, Indonesia, and Nepal. The researchers found that many adaptation costs have to be borne by households, and that other than conventional disaster risk management approaches, there are little or no rehabilitation mechanisms for losses and damages. The brief urges governments to take a holistic rather than an incremental approach, and calls for investments to reduce greenhouse gas emissions, prevent avoidable losses and damages, and particularly consider creating and upgrading social protection programs to provide safety nets to the most vulnerable in times of distress.

“In its latest synthesis report, the Intergovernmental Panel on Climate Change strongly warns of the escalation of the climate crisis. There is no time to waste,” says Reinhard Mechler, who leads the Systemic Risk and Resilience Research Group in the IIASA Advancing Systems Analysis Program. “As the negotiations on loss and damage will be continuing over the next few years, the framework and evidence presented in the report and brief has the potential to further inform the process and ensure that the support reaches those who need it the most.”



By **Fanni Daniella Szakal**

Further info: www.iiasa.ac.at/news/losses-damages-23 | www.iiasa.ac.at/pb32

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Informing policy in The Gambia

The recently concluded FACE-Africa project co-developed country-specific information and tools with Gambian food system stakeholders to evaluate possible strategies for adapting to climate change and ensuring sufficient healthy food for The Gambia. Their recommendations and key findings have been made available in an IIASA policy brief.

The scenarios developed as part of the project focused on climate change impacts on agricultural productivity, agricultural trade flows, land use, and national climate, as well as nutritional and agricultural policies including adopting climate-smart agricultural practices and shifting toward nutritional and sustainable diets.

According to the project team, achieving nutritional security through policies that promote healthy and sustainable diets is possible in The Gambia, but would require a significant increase in either domestic agricultural production through improved yields or expanding agricultural land, or increased imports.

In addition, policies that enable farmers to reduce nutrient deficiency and water stress and adopt climate-smart agricultural practices, will significantly improve crop yields and local production in the country, while also improving the agricultural sector's resilience and reducing import dependency, thus ensuring sustainable and healthy diets. The team however cautions that, in the absence of adopting resilience options, adverse climate conditions will continue to widen yield gaps, exacerbate crop losses, and increase dependency on imports.

As part of the project, researchers also developed or adapted a number of tools and other products to provide decision makers in agriculture and food systems with the information needed to make evidence-based decisions going forward. The Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Calculator, for example, was adapted for The Gambia and used to assess the impact of multiple possible future scenarios on key food security indicators to show the achievability of healthy and sustainable diets.

By **Ansa Heyl** Further info: www.iiasa.ac.at/pb36

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TOWARD MORE EFFECTIVE BIODIVERSITY MONITORING IN EUROPE

A recent IIASA policy brief highlights solutions proposed by the Europa Biodiversity Observation Network (EuropaBON) to improve the collection and uptake of policy-relevant biodiversity data in Europe. These include, among others, enhancing the coordination and collaboration of monitoring efforts, increasing data standardization with dedicated data sharing and exchange mechanisms, and enabling additional, consistent, and long-term financial resources for monitoring efforts. The creation of a European Biodiversity Monitoring Coordination Centre to implement lasting improvements in the collection, analysis, reporting, and political uptake of biodiversity data in all European countries will bring further benefits.

www.iiasa.ac.at/pb37

QUANTIFYING THE COST OF INACTION ON AIR POLLUTION

Despite policies that have improved air quality, the populations of the Association of Southeast Asian Nations (ASEAN) continue to experience a large health burden due to air pollution exposure. New work by IIASA under a 2021-2023 United Nations Environment Programme (UNEP) project aims to show that quantifying the cost of inaction on air pollution can help ASEAN countries build stronger investment cases for action and support the development of more integrated, science-based policy measures. The team's first set of recommendations has been published in an IIASA policy brief.

www.iiasa.ac.at/pb40

SYSTEMS ANALYSIS FOR REDUCING FOOTPRINTS AND ENHANCING RESILIENCE: REFLECTIONS ON THE 2022 IIASA-ÖAW CONFERENCE

IIASA Advancing Systems Analysis Program Director, **Elena Rovenskaya**, and **Viktor J. Bruckman**, National Member Organization Secretary for Austria, reflect on the main topics discussed at this jointly organized hybrid event that formed part of the IIASA 50th anniversary celebrations.



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The institute's 50th anniversary was celebrated with a range of events worldwide. From 16 to 17 November 2022, IIASA and the Austrian Academy of Sciences (ÖAW) – the IIASA National Member Organization for Austria – organized a hybrid conference in Vienna that brought together more than 550 participants. The event demonstrated how systems analysis has evolved and how it can contribute to solving many of today's global challenges, while also exploring emergent trends in this transdisciplinary field.

A WORLD-LEADING INSTITUTE FOR ANALYZING COMPLEX SOCIO-ENVIRONMENTAL SYSTEMS

IIASA was founded in 1972 amid the cold war with the aim to foster collaboration between East and West. Its founding principles were to employ multilateralism and science as a common language to bridge ideological divides and to address challenges arising from economic and technological development. Over the years, the world's geopolitical landscape may have transformed, but it has not become less complex. The demand for science diplomacy remains high as it has proven effective for addressing “wicked” policy problems characterized by incomplete information, uncertainty, high stakes, ambiguity of responsibilities among stakeholders, conflicts, and different problem framings.

Frequently, our solutions to past problems ended up being the underlying causes of new problems. Climate change, biodiversity loss, growing socioeconomic, health, and environmental inequalities, demographic

change, and disruptive events such as large-scale natural disasters or pandemics and geopolitical conflicts, are impacting essential domains that sustain our society. Our continued wellbeing is becoming increasingly precarious, which requires more effective ways to govern common goods, and take advantage of new advanced technologies, data, models, and theories. By putting systems thinking into practice, systems analysis can deliver integrated solutions and demonstrate the value of cooperation and multilateral action, thus providing a framework to address global challenges.

Building on fifty years of international and interdisciplinary collaboration and experience, IIASA has become a trusted platform for science, policy, and societal exchange to inform and support the transformation of our society to sustainability.

TRANSFORMATION TO A SUSTAINABLE, EQUITABLE, AND RESILIENT WORLD

Given the growing frequency, severity, and propagation capacity of both natural and man-made disruptive events leading to their global impacts, the resilience of socio-environmental systems is becoming increasingly important, alongside sustainability and equity. The resilience of socio-environmental systems, a concept rooted in the theory of complex adaptive systems, was pioneered by C.S. Holling, who served as the third Director of IIASA in the early 1980s. Today, resilience is understood as the ability of individuals and communities to respond to and navigate change;



including the ability to absorb and adapt to change, but also to transform with change. Discussions during the event explored how resilience considerations nuance our understanding of sustainable development, and how this can in turn lead to shifts in the focus of decision makers and experts to promote a transformation to a more sustainable and equitable society.

While the transformation to a sustainable, equitable, and resilient world is a global challenge, decisions are often taken and implemented locally and are driven by individuals. Several critical aspects were highlighted by conference participants:

At the global and universal scale

- the challenge of finding balanced economic policies to ensure that human needs are universally satisfied;
- the nexus of culture, science, and technology, which, if directed appropriately, can provide significant leverage for achieving sustainability transformation;
- the special role of transdisciplinary science and science diplomacy as catalysts of transformation; and
- the need to advance effective science translation and communication.

At the local scale

- the incorporation of the local context, including the knowledge, expectations, and demands of indigenous communities to make research truly policy-relevant;
- citizens' expectations that governments become more interventionist; and
- resilience and stability objectives that need to be institutionalized.

At the individual scale

- the powers and limitations of the human brain, which combines emotional and rational responses;
- the power of positive incentives and co-benefits for stimulating pro-environmental behavior; and
- the ability of people to imagine different futures.

NOVEL SYSTEMS-ANALYSIS METHODS, APPROACHES, AND DATA TO ADDRESS GLOBAL CHALLENGES

Advancing the methodology of systems analysis is an indispensable facet of IIASA research. Prompted by rapidly developing computing capabilities in the second half of the 20th century, systems analysis emerged as a techno-social science, seeking to improve policy development by detaching decision making from fallible humans, relying instead on computer-enabled systems modeling and simulation. Through advances in operations research and other methods, systems-analysis modeling revolutionized our ability to optimize decisions in settings where perfect information and the rational behavior of agents were acceptable approximations of reality.

Today, systems analysis strives to enhance relevance by integrating pertinent human and institutional factors into research and models. The lack of social factors and feedback might have been one reason why some technocratic models, such as some state-of-the-

art models predicting the pace of energy transitions, did not perform well in forecasting. The conference underscored the power of several methodologies and approaches to incorporate people into research including:

- Evolutionary game theory that models bounded rationality with recent insights regarding new mechanisms for upscaling cooperation based on reciprocity and democratic decision making.
- “Rough” systems analysis that provides tools to quickly solicit and integrate expert knowledge and harness systems thinking.
- Fuzzy sets theory, random set theory, and imprecise probability theory to encode qualitative uncertainty and ambiguous information.
- Theory of plural rationality that allows the structuring of different worldviews by various stakeholders.

The event also showcased recent progress, including:

- Advancements in foresight methodology to optimize the use of scenarios to embrace future uncertainty.
- Case studies combining the strengths of conventional expert modeling and participatory research to address complex problems of environmental governance.
- Novel approaches to link together individual country models to test the consistency of national development plans with planetary boundaries.
- The first-ever incorporation of political and institutional factors into climate change scenarios informed by Integrated Assessment Models (IAMs).

Presently, innovation in systems analysis often takes place in the realm of data and data analysis. In this context, the conference showcased a number of studies utilizing new data sources including Earth observation, citizen science, mobile phone data, digital platforms (e.g., Google), and social media. For example, using the experience of COVID-19, participants highlighted that geolocation data from mobile phones can provide information on people’s mobility, which can be useful to anticipate the patterns of an epidemic’s spread and the economic impacts of mobility restrictions. As another example, how citizen science provides missing data for the Sustainable Development Goals indicators was discussed. The conference also emphasized the power of modern dynamic and interactive visualization techniques in conveying the intricate narratives presented by socioeconomic data, while underscoring the challenge of communicating uncertainty.

ADVANCES IN SCIENCE-FOR-POLICY

Policymakers tasked with protecting human health and wellbeing, as well as environmental resources must develop policies and decide on investments that can best prepare our systems for an uncertain future, given multiple interconnectivities and tradeoffs. The

sustainable management of the water-energy-food-land-ecosystem nexus, together with adjacent sectors including mobility, finances, and conflicts is a prime example of a policy challenge that requires a systems approach. Siloed approaches, which are still prevalent in many parts of the world, lead to unwanted cross-sectoral impacts and inefficiencies. Policymakers are increasingly becoming aware of the need to approach “wicked” policy problems through a systems view, which creates a demand for transdisciplinary science that is able and willing to cooperate with policymakers with input that is timely, agile, robust, and modest, while respecting confidentiality. Policy decisions on “wicked” problems are often unpopular hence communication and framing are crucial.

The conference underscored that IIASA has been successful in facilitating science-informed policies utilizing its models and participatory research. The IIASA GAINS model, for instance, has been used to support air pollution regulation in the EU. Multiple partnerships with policymakers through participatory research have helped to inform policies at the local and national levels to deal with “wicked” problems. Experience demonstrated that several factors make a crucial contribution to the success of science-for-policy work. This includes:

- Long term partnerships and trust between scientists and policymakers.
- A good understanding of policy processes and their characteristics including timing, political economy, and governance aspects.
- The diversity of stakeholders in the policy co-production process and recognizing and respecting the different worldviews of stakeholders.
- Focusing on compromise rather than consensus.

The conference participants discussed that transdisciplinary research is a combination of science, art, and craft. The main challenges are that policymakers, stakeholders, and scientists speak different languages and operate under very different incentives. Experimentation is crucial for policy innovation. There is a demand for honest brokers and boundary spanners who work across science and policy to facilitate science-informed policies.

With the rise of social media and political populism, science is losing its “monopoly on the truth”. In the coming years, the institute’s mission will be to strengthen transformative science towards the establishment of a post-Agenda 2030 program with a stronger focus on interconnections between objectives, as IIASA successfully did in the past during the drafting of the UN Sustainable Development Goals.

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AT THE INTERSECTION OF SUSTAINABILITY AND ECONOMIC GROWTH

IIASA research collaborations with India stretch back to the 1970s. **Prof. Kirit Parikh** is Chairman at the Integrated Research and Action for Development (IRADe), Former Member at the Government of India's Planning Commission, Chairman of the Kirit Parikh Committee on gas pricing, and an IIASA Honorary Scholar. Together with his wife, Prof. Jyoti Parikh (IIASA Alumna, Executive Director of IRADe, and Nobel Peace Prize laureate 2007), they established the Prof. Jyoti and Prof. Kirit Parikh Fellowship, which aims to support talented researchers from India and other developing countries.



Q What are the key recommendations of the Kirit Parikh Committee on gas pricing for India?

A Currently, natural gas consumption in India constitutes around 6.5% of the country's total energy basket, which the government wants to raise to 15% by 2030. Also, 45-50% of gas is imported as liquefied natural gas (LNG). Given the large volatility in the international gas price, domestic production has to be increased if the target is to be reached. Some 14 different price regimes are present, depending on how the gas field was allotted, involving cost-sharing, profit-sharing, or revenue-sharing. The fields allotted to public sector firms were not competitively bid, and the government sets the price for their gas. This gas, called Administered Price Mechanism (APM) gas, is given for certain uses that the government wants to promote, such as piped natural gas (PNG) for households as a clean cooking fuel and compressed natural gas (CNG) for transport vehicles. These are desirable uses as they reduce indoor and urban air pollution.

We recommended that the APM gas price should be set relative to the cost of imported crude oil so that PNG and CNG users will find the gas cheaper than alternatives and other producers should have pricing and marketing freedom by 1 January 2027.

Q How should sustainable economic growth be realized?

A The path to sustainable development has to be sensitive to the impact on all sections of society, particularly the poorest. Almost all economic

activities have environmental consequences, and the burden of environmental degradation must be assessed and accounted for. For example, phasing down coal can disrupt the livelihoods of millions of people employed in the coal industry in India. Policies should recognize the impact on the poor and take appropriate measures to protect them.

Q What is the aim of the Parikh fellowship?

A IIASA plays a very important role in exploring pathways to net zero. Collaboration with Indian modelers can help bring in the viewpoints and concerns of developing countries. Also, case studies in India can help assess the effectiveness of policies in different environments. More visiting scholars from India to IIASA and vice-versa for periods of around three months can make them sensitive to larger concerns and aware of the benefits of system analysis.

Q What do you think of youth-organized global climate strike movements?

A It is a most encouraging sign. Many countries that need to take action for climate change seem to be stuck in denial and do not show the necessary resolve. I see great awareness among young people worldwide, and I think they will lead us to more determined action.

By **Bettina Greenwell**



INTO THE GREAT WIDE OPEN

**By opening up access to science, IIASA is sparking
new insights into our planet's health.**

By Stephen Battersby



“OUR MANTRA IS ‘AS OPEN AS POSSIBLE, AS CLOSED AS NECESSARY’”

Luke Kirwan

IIASA Open Science Coordinator

Science can sometimes seem cloistered. Hedged about by obscurity and jargon; accessible only to those in the club. Even established researchers can face serious barriers, from opaque models and baffling data formats, to the high costs of subscription journals and publication fees. Over the past few years IIASA has been opening a series of doors to science, encouraging open access to publications and making data, tools, and models more accessible.

There are moral motivations. Results, data, and models should be open to those who need them; and publicly funded research should be open to the public who funded it. But open science also brings practical benefits, enabling ideas to be more widely and rapidly shared so they can make more impact. In the early days of the COVID-19 pandemic, researchers increased their use of preprints to communicate new science rapidly and freely, and traditional publishers followed. “Suddenly journals were dropping their paywalls to allow everyone to read the latest research on the virus,” says Luke Kirwan, Open Science Coordinator at IIASA.

OPEN BOOK

Back in the early 2000s, people recognized that the internet had brought a new opportunity for open access science. According to the 2003 Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, users should have “a license to copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works”. The movement began to build up steam around 2014, when funders such as the European Commission’s Horizon 2020 program began to mandate open access to publications – and it is still gathering pace. Starting in 2026, all research receiving US government funds will have to be open access immediately.

There are many degrees of openness. Some journals offer the “diamond standard” of open access, free to all, with peer review and author copyright, but they account for only a small fraction of published research.

“Everything else puts barriers on one side or the other,” says Advancing Systems Analysis Program Director, Elena Rovenskaya.

Researchers still want to publish in established, high-impact journals, which generally impose high charges to make a paper open access. So IIASA has created an internal fund to cover these costs. It is also plugged into the Austrian Academic Library Consortium, which has negotiated lower charges. As a result, around 80% of the papers in the IIASA PURE repository are openly accessible.

“Our mantra is ‘as open as possible, as closed as necessary,’” says Kirwan.

MINES OF INFORMATION

Ideally, data should be open too. Last year IIASA appointed a data steward for each of the six research programs, to help researchers find the right way to make their data more accessible. But an open door is no use if you don't know how to find it or use the tools and information inside – the institute also follows the principles of “FAIR” (findable, accessible, interoperable, reusable), which ensure that data can be accessed and manipulated with standard procedures and software.

A new global database on mining land use is already reaping results.

“The lack of information on mining land use had been long known,” says Victor Maus, a researcher in the Novel Data Ecosystems for Sustainability Research Group.

Maus and his colleagues at IIASA and the Vienna University of Economics and Business (WU) were trying to build a study on tropical mining and deforestation, and realized it would be impossible without a proper database – so they set out to create one.

Manually gathering and harmonizing the data took a huge effort.

“My team and I worked for at least three years on this project, visually inspecting and tracing polygons over thousands of satellite images. It was exhausting, but we learned a lot about what was happening on the ground – and it was exciting to virtually visit a vast range of mining sites across the globe and realize the wide variety of ecosystems that they affect,” he says.

Launched in 2020, the database covers more than 34,000 mines worldwide. Data is available in GeoPackage and GeoTIFF formats, which are straightforward to handle using any open Geographic Information System (GIS) software.

Researchers outside IIASA have used the data to investigate the ecological footprint of global metal production, identify hotspots of mining biodiversity loss, and map sources of methane emission. Maus's team returned to their original research question, identifying the direct and indirect deforestation driven by mining in the tropics.

“This is important because mining is expanding fast in tropical regions, which are key for biodiversity conservation and global climate stability,” he says.

UNLOCKING THE TOOL-SHED

Some IIASA models and tools are now freely available to download. Other models have a contact who can give permission, or decide to withhold access if there's a risk of misuse, or where a model uses an old dataset under strict copyright.

The IIASA Community Water Model (CWatM) was designed to be open access from the start. The model and its discussion forum are freely available on GitHub. Interactions with the community of users have helped in developing online tutorials, says Mikhail Smilovic, a researcher in the Water Security Research Group. CWatM's accessibility has enabled the scaleWAYS project to run workshops investigating sustainable rice and fodder production; while the FUSE consortium has used the model to explore issues of urban food, water, and energy in three living labs, involving a wide range of stakeholders. CWatM is among several IIASA models that are opening up by building an international community of users.

EYES ON EARTH

An even wider collaboration is the IIASA Geo-Wiki, which since 2010 has been welcoming people to analyze their home planet. Experts and the members of the public can classify images from satellites, drones, and other sources, which are sometimes used to train deep-learning algorithms. The wiki has illuminated issues such as land use and food security, and recently helped to identify drivers of deforestation. On images of random locations within the tropics, users tagged the presence of tell-tale features such as roads, buildings, and pastures, which could then be correlated with forest loss. Participants were given training, and even offered prizes for the best contributions. A 2022 study based on this work found crucial differences between drivers of deforestation in different continents; and revealed that deforestation rates in protected areas can sometimes be higher than outside them.

“We are also working on a tree biomass app,” says Steffen Fritz, principal researcher in the Novel Data Ecosystems for Sustainability Research Group. “This will allow citizens to collect information on trees, which should give us a much better picture of the spatial distribution of tree biomass and species.”

AN OPEN DOOR IS NO USE IF YOU DON'T KNOW HOW TO FIND IT OR USE THE TOOLS AND INFORMATION INSIDE





“THE CHALLENGE IS HOW TO BRING BIG EARTH OBSERVATION DATA TO DECISION MAKERS EFFICIENTLY, AND WITHOUT EXPOSING THEM TO OVERWHELMING COMPLEXITY”

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Citizen and space science meet again in the Open Earth Monitor Cyberinfrastructure (OEMC) project. OEMC grapples with the petabytes of data stored in NASA and the European Space Agency’s satellite archives, with the aim of using this data to inform policy – especially to support implementation of the European Green Deal.

“The challenge is how to bring big Earth observation data to decision makers efficiently, and without exposing them to overwhelming complexity,” says Milutin Milenković, a researcher in the Novel Data Ecosystems for Sustainability Research Group.

The project is creating a set of open-source tools to generate maps and other visualizations of environmental change, revealing the effects of different strategies, and where best to concentrate efforts on forests, biodiversity, flooding, and pollution. These tools are developed in collaboration with users from the start, to ensure they meet people’s needs – and IIASA is central to this process, as it leads stakeholder engagement for OEMC. In October, IIASA will be hosting a workshop at an OEMC meeting to find out how in-situ citizen-science data can be used to train and validate machine learning models exploring deforestation, forest management, and crop mapping.

A SLEW OF SCENARIOS

In 2022, the Intergovernmental Panel on Climate Change (IPCC)’s Working Group III report on climate mitigation pointed out our rapidly narrowing options to limit warming to 1.5°C. It drew on thousands of modelled scenarios, exploring emissions from industry, land use, and other sectors, on national to global scales. To navigate this multiverse of possible futures, IIASA developed the AR6 Scenario Explorer – a database and website where researchers could upload scenarios for assessment by the report authors. The Scenario Explorer includes open-source analysis software that researchers and policymakers can use to focus on exactly what they want to know – be it pathways for land use in South America, or near-term global investment needed to meet 1.5°C – and to plot the results in clear graphs and images.

“This community data resource underpins key findings from the AR6 report, including the calculation of carbon budgets that inform climate policy across the world,” says Edward Byers, a senior researcher in the Integrated Assessment and Climate Change Research Group.

Are there any other avenues of open science to explore in future? Kirwan says that IIASA could do more in the field of science communication.

“This is far more valuable than people give it credit for,” he says. “Open science is not just about open data and publications, it is also about providing insight into the scientific process.”



JAPAN AND IIASA:

Japan and IIASA have a long history of collaboration, dating back to the institute's foundation in 1972. Over the years, the partnership has resulted in a multitude of research projects, workshops, and conferences, tackling complex issues on a global scale.

By Fanni Daniela Szakal

“While we are located in Asia, we are also in the position to address global issues such as climate change, biodiversity, and others,” says Kazuhiko Takemoto, IIASA Council Vice-Chair and Council Member for Japan. “Although we have individual collaboration with research institutes around the world, the collaboration with IIASA has given us a window into global research.”

In turn, as the sole Asian member organization for the first few decades after the foundation of the institute, the Japan Committee for IIASA has helped IIASA establish its research connections throughout the region. The institute has been working with the Japanese Ministry of the Environment (which also funds the country's annual membership fee), as well as several Japanese research institutes on research projects around issues such as air pollution, climate change, and sustainable development, both in Asia and globally.

CLEANING UP THE AIR

The IIASA-Japan collaboration is especially significant in addressing the issue of air pollution in Asia. Nearly 85% of the population in the Association of Southeast Asian Nations (ASEAN) – a political and economic union of 10 member states in Southeast Asia – is exposed

to pollution levels that exceed the World Health Organization's air quality guidelines.

“In many countries in South Asia, there are existing policies and legislations, but there are delays in implementation,” says IIASA Pollution Management Research Group Leader, Zbigniew Klimont. “It is the people who suffer the consequences, by breathing polluted air for extended periods of time.”

IIASA collaborated with the Institute for Global Environmental Strategies (IGES) in Japan to identify measures that would increase the number of people in ASEAN countries breathing clean air from approximately 100 million to over 250 million. The project is supported by the United Nations Environment Programme and the Climate and Clean Air Coalition, and the resulting report on *Clean Air and Climate Solutions for ASEAN* will be launched in June at the Climate and Clean Air Conference: Air Quality Action Week in Bangkok, Thailand.

Strong economic development in Asia resulted in the growth of megacities where air pollution became even worse. Measures to improve air quality often weren't successful, as a lot of pollution comes from outside the cities. In response, researchers from IIASA, IGES, the National Institute for Environmental Studies (NIES), and the Asia Center for Air Pollution Research (ACAP) in Japan have been working on determining the sources



of air pollution in major cities in Asia and analyzing how these sources may change in the future under different policies.

In another initiative focusing specifically on Northeast Asia called AQNEA, researchers are developing a regional database with principal data and scenarios necessary to model the evolution of air pollution. The project is building on the IIASA GAINS and MESSAGE models, the AIM-JAPAN model from NIES and Kyoto University, and other models developed by research groups at Konkuk University in Korea and Tsinghua University and Beihang University in China. The first results will be presented this year at the Community Modeling and Analysis System conference in Saitama, Japan.

SUPPORTING SUSTAINABLE DEVELOPMENT AND CLIMATE MITIGATION

Achieving the Sustainable Development Goals (SDGs) and the targets outlined in the Paris Agreement simultaneously requires measures that maximize synergies of different climate mitigation policies. IIASA has been working with IGES, NIES, and Kyoto University to study how various climate policies will impact the SDGs, including the impacts on air quality, human health, and biodiversity.

The project links several Japanese models such as the AIM-BIO and AIM-Hub with the IIASA MESSAGE-GLOBIOM model. To visualize the multitude of projects and scenarios, a new platform is currently under development to show the implications of different policies in different countries.

The collaboration in modeling has not only been influential in climate policy, such as informing the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, but IIASA and NIES were also founding members of the Integrated Assessment Modeling Consortium, connecting the global energy and emissions modeling community.

“We have developed several future scenarios which have been widely used by the climate research community. Many of the articles using these scenarios end up being cited in IPCC reports,” says Shinichiro Fujimori, associate professor at Kyoto University and a guest researcher in the IIASA Energy, Climate, and Environment Program.

As reducing energy use is a key component of progress towards the SDGs and the Paris Agreement, IIASA and the Research Institute of Innovative Technology for the Earth (RITE) in Japan are collaborating on the EDITS project, which aims to enhance modeling, analyzing, and communicating solutions for climate mitigation and the SDGs with the goal to reduce global energy use by 40% by 2050. The project was presented at both COP26 and COP27 and has also been working to engage citizens through webinars and the EDITS-ARTS Competition; the latter calling for submissions to imagine “life in 2050 with much less energy” into art.

Toyota Japan has been supporting the collaboration between the Japanese research community and IIASA as well, with research affiliates from the company currently stationed at IIASA for a second time to collaborate on transport projections, energy demand, and greenhouse gas emission reductions.

SEALING THE FUTURE OF A SUCCESSFUL COLLABORATION

“My collaboration with IIASA started back in 2006 when I visited the institute for the Young Scientists Summer Program,” says Fujimori, who has been working closely with IIASA ever since. “Now, some PhD candidates in our group have also been selected for the program. Engaging the young generation can be a great way to keep the relationship between our research groups and IIASA going in the long-term.”

As the world faces unprecedented challenges, international research collaboration is becoming increasingly crucial. Through its partnership, Japan and IIASA have made significant strides towards addressing some of the world's most pressing challenges and through continued collaboration, will help shape a better future for the planet and its people.

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By **Jeremy Summers**

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Applying a methodological framework for COVID-19 management in Botswana

When COVID-19 hit in the spring of 2020, no country was prepared. However, Botswana took swift and decisive action in the early days of the pandemic by creating a national COVID-19 strategy and policy, which helped it mitigate the spread of the coronavirus.

In a recent study, Nadejda Komendantova and her coauthors developed a methodological framework for policy formation in situations with high uncertainty and heterogeneity of opinions among involved stakeholders. They then applied this framework to Botswana’s management of the pandemic, which informed the national COVID-19 strategy.

The framework considers a combination of various epidemiological risk assessments and evaluation of socioeconomic costs of risk management measures. It also utilizes a multi-criteria decision analysis support model to weigh various policy options.

The authors describe how Botswana’s formulation of a national strategy and policy was aided by ICT decision support models. Their results show that this framework can be further developed to optimize hazard management options for COVID-19 and other pandemic scenarios.

“Risk governance of the COVID-19 pandemic was a contested policy issue when heterogeneity of opinion among stakeholders about possible risk mitigation strategies and their costs existed,” explains Komendantova, who leads the Cooperation and Transformative Governance Research Group in the IIASA Advancing Systems Analysis Program. “The methodological framework we developed (based on multi-criteria decision analysis) allows for accounting of this heterogeneity of voices, but also for developing policy solutions that benefit from the integration of various positions and different stakeholders’ views.”

Further info: pure.iiasa.ac.at/18615

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Promoting sustainable rural development in sub-Saharan Africa

IIASA has joined LEAP-RE, a joint initiative of the European Union and the African Union, which seeks to advance climate-water-energy-land-food-environment nexus modeling in sub-Saharan Africa through the RE4AFAGRI project.

Roughly 40% of sub-Saharan Africans live in poverty, 50% lack access to electricity, and nearly 25% face food insecurity. By promoting the uptake of renewables-based standalone systems and mini-grids, project leaders are hoping to promote agricultural productivity and profitability, and foster community-wide rural development.

While lack of electricity poses several problems for the agricultural sector, the inability to irrigate is among the gravest. Today, only 5% of sub-Saharan agricultural land is irrigated. Additionally, a lack of electricity prevents local crop processing and cold storage, which are crucial to guarantee access to profitable value chains.

There is reason for optimism, however. The technology behind climate-friendly fossil-fuel alternatives is both mature and increasingly competitive. The region simply needs valid, quantified data showing that the positive impact of adopting these technologies will far outweigh the costs needed to develop and deploy innovative business models. In essence, the project is seeking to empower the region to overcome financial barriers and mitigate risks for private investors.

“Eight out of ten poor people in Africa live in rural areas,” explains Giacomo Falchetta, a researcher in the IIASA Energy, Climate, and Environment Program. “Therefore, promoting a sustainable transformation of the agricultural sector bears huge potential to improve human wellbeing while safeguarding the environment. Promoting renewable energy uptake is a key priority to achieve such transformation.”

Further info: www.iiasa.ac.at/projects/leap-re

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Proving health insurance coverage can extend lifespan in the United States

Health insurance has been a divisive topic in the US for several decades. Some argue that more healthcare means healthier citizens. Others argue increased expansion causes excessive consumption and a waste of resources.

In one of the first studies of this kind, IIASA Economic Frontiers Program Director Michael Kuhn and his coauthor used a rigorous analytical model to examine the impact of health insurance expansion on medical progress, longevity, and wellbeing. Their research includes key features of economic and healthcare developments in the US, including the introduction of Medicare in 1965 and, importantly, takes account of an expanding market-size effect of health care provision on the returns to medical innovation.

Results of the study show that public health insurance has increased lifespan in the US, predominantly by spurring medical innovation. The study also shows that increased coverage tends to subsidize consumption of healthcare, particularly for the elderly, who may overconsume, to the detriment of the younger generation. However, the innovations that are induced by current health care spending provide the foundation for the longevity gains by future generations.

“Generally, our analysis demonstrates the importance of taking a broader, wellbeing oriented, and systemic stance when evaluating healthcare policies,” explains Kuhn. “Health insurance is one possible vehicle for an intergenerational ‘trade’ between current and future generations. Stakeholder and public awareness of the broader ramifications of such intergenerational ‘contracts’ is important for leading an informed debate.”

Further info: pure.iiasa.ac.at/18568

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Analyzing the impact of ecosystem services in coastal Brazil

Ecosystem services are the contributions of natural ecosystems to human wellbeing. Examples of these services include plants that provide and filter air and water, natural resources like wood and biofuels, and greenhouse gases that regulate our climate.

In recent years, an increasing number of global studies has proven just how valuable these services are to human health. In the wake of these new studies, there is a need to measure the undesired drivers that impact nature’s ability to provide these benefits.

In their study (the third in a series), researchers Bruno Meirelles De Oliveira and Brian Fath, both associated with the Systemic Risk and Resilience Research Group of the IIASA Advancing Systems Analysis Program, developed a new model to measure the economic valuation of a social-ecological system in Ubatuba, a Brazilian coastal city. Their results show that ecosystem services provide an economic value of US\$ 622 million in this century, and the city must preserve the natural area from overcrowding and other threats.

“Our results show that the city needs to control the population visiting the area, which can lead to positive effects on the ecosystem services provision,” explains Meirelles De Oliveira. “While we cannot say whether it was influenced by our research, the good news is that the city did implement measures to reduce the number of visitors through strategic taxation. Hopefully, this will serve as an example for other cities in how to protect ecosystem services.”

Further info: pure.iiasa.ac.at/18180

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Using multi-sector transformation to replenish the Indus River Basin

The Indus River Basin is home to more than 250 million people in South Asia—a figure that is expected to vastly increase in the near future due to rapid development. In fact, just an acute deficit of environmental flows in the basin's delta has been shown to negatively impact the surrounding ecosystem.

In a new study, Muhammad Awais, a researcher in the Integrated Assessment and Climate Change Research Group of the IIASA Energy, Climate, and Environment Program, and his coauthors, used a sub-national model of the basin's integrated water-energy-land system to analyze costs associated with multi-sector transformations aimed at enhancing environmental flows to the delta.

Their results show that increasing average outflows from the basin (relative to historical policy levels) by 2.5 and 5 times respectively, would increase sectoral costs for upstream water users between 17-32% for low, and 68-72% for high ecological potential targets.

Enhancing environmental flows, the study shows, would also increase energy available for pumping and treating water upstream from the delta. This would provide a net increase in both irrigation and energy investments.

"The recent floods in Pakistan are yet another indication of the overall vulnerability of the Indus River Basin to climate change," notes Awais. "It is crucial that policymakers prioritize ecosystem adaptation in the context of environmental flows. Doing so will greatly help mitigate the negative impacts on the delta and its surrounding ecosystems. It will also, just as importantly, ensure the socioeconomic wellbeing of the inhabitants downstream from the delta."

Further info: pure.iiasa.ac.at/18487

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Improving air pollution and public health in South Asia

South Asia is home to nearly two billion people. It is also home to the most polluted air on the planet, with nine of the world's 10 most air polluted cities. Some of the more densely populated and poorer areas have air quality 20 times worse than what the World Health Organization considers to be healthy.

In addition to negative environmental and economic impacts, air pollution in South Asia is also deadly to residents. It is estimated that roughly two million premature deaths occur annually as a direct result of air pollution.

In a new report from The World Bank, with collaboration from IIASA, Pollution Management Research Group Leader in the IIASA Energy, Climate, and Environment Program, Zbigniew Klimont and colleagues, identified local and regional pollution sources in this region in airsheds shaped by meteorology and topography. Additionally, the researchers analyzed scenarios for reducing air pollution and offered a roadmap for air quality management.

"Air pollution has been a major issue in South Asia, contributing to severe health impacts and economic costs. The research clearly shows that direct economic gains of better air quality far exceed the cost of measures needed to reduce air pollution," says Klimont. "The most cost-effective scenario to reduce air pollution, with varying degrees of policy implementation and cooperation among countries, calls for full coordination between airsheds. This scenario would cost US\$278 million but save more than 750,000 lives annually."

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Addressing population decline in Ukraine after the Russian invasion

Russia's war against Ukraine began in February 2022. Since then, many Ukrainians have fled their homeland, kicking off a mass exodus that has become the fastest and largest population displacement in Europe since World War II.

Compounding the tragedy of war is the fact that this displacement has hit a nation already reeling from a rapidly shrinking population, due to low birth rates as well as high mortality and emigration rates.

In a new report from the Joint Research Centre (JRC), with collaboration from IIASA, IIASA Population and Just Societies Program Director Anne Goujon and her coauthors, Saroja Adhikari and Samir KC, show that this population decline is likely to continue over the next decade. In fact, even the most optimistic projections show a decline of 21% by 2050. This research underscores the need for strong and decisive leadership on long-term care and learning, citizen engagement, and migrant reintegration to address both rapid aging of the population and loss from the war.

"The Russian invasion of Ukraine has led to the displacement of millions of Ukrainians, which will have consequences on the longer-term future of Ukraine's population size and structure," explains Goujon. "Exploring potential futures using "what-if" scenarios with varying assumptions is necessary to provide policymakers with a nuanced picture of how migration could impact the future of the Ukrainian population. More importantly, this research can help to make informed decisions about the allocation of support in line with the country's needs."

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Utilizing forest management practices to counteract EU species loss

EU forests provide numerous ecosystem services and are home to a diverse array of plant and animal species. Regional forest conservation policies, such as the EU Biodiversity Strategy for 2030, are designed to protect biodiversity within a certain region, but such policies seldom fully consider potential leakages to other regions.

In a recent study, Fulvio Di Fulvio, a researcher in the Integrated Biosphere Futures Research Group of the IIASA Biodiversity and Natural Resources Program, and his coauthors, modeled the potential global species extinction risk in scenarios considering increasing woody biomass demands for climate mitigation. They found that expanding set-aside areas to more than 20% of EU forest land would decrease biodiversity at the global level.

On the other hand, it would be possible to apply closer-to-nature forest management within the EU for up to 50% of forest land, without decreasing biodiversity on the global level. This is because closer-to-nature management allows a combination of wood provisioning and biodiversity protection, which tends to keep the leakage effects of EU forest policies relatively low.

"When planning climate change mitigation policies, it is crucial to define land-management strategies using a regional perspective to preserve local species while simultaneously considering the potential global leakage of impacts," Di Fulvio explains. "It is imperative for EU policymakers to identify forest management pathways that help to mitigate climate change and the loss of species, both within and outside the EU. Properly defining integrated climate-biodiversity scenarios and policies will greatly impact this effort."

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Message from the director

“ After celebrating 50 years of systems analysis last year, it is now imperative to focus on the future. The ongoing war in Ukraine has not only caused limitless personal heartache for many, but also generated multiple global socioeconomic pressures. With the cost of living and doing business increasing dramatically, many research institutions have found it challenging to maintain their activities and reach. Despite these times, IIASA continues to position itself as a primary destination for integrated systems solutions and policy insights to current and emerging global challenges. Now, more than ever, science diplomacy is crucial to help steer the global trajectory, and build trust, understanding, and a common cause between nations.

Facing the worst refugee crisis in Europe since the Second World War, the disruption of global supply chains, and increased food, energy, and essential supply prices, the scale of the challenges is enormous. We at IIASA, along with our supporters of multilateral engagement, must ensure that we maintain the pace of reform, despite continuous distractions from a multipolar world. A stronger emphasis on multilateral cooperation is needed to collectively achieve the goals of Agenda 2030. IIASA aims to be at the forefront of strengthening this multilateral system. As an example, IIASA is proud to be making key inputs into India’s first G20 presidency – a watershed moment in a series of upcoming developing nations’ G20 presidencies (Brazil and South Africa) that can collectively shape the global narrative over the coming years.

ALBERT VAN JAARVELD



New systems analysis research center in Israel

IIASA collaborated with Tel Aviv University and the Ministry of Innovation, Science and Technology in Israel, to set up a new research center focusing on sustainability in several scientific fields. The newly established Israeli Applied Systems Analysis Center of Excellence (IASACE) provides a platform for strengthening and accelerating collaboration between IIASA and Israeli researchers. The center also acts as an interface for relevant government ministries and policymakers.

IASACE covers themes that are closely aligned with the interdisciplinary systems research carried out at IIASA. Researchers focus on various topics, such as energy, water, transportation systems, climate change, demography, biodiversity, food systems and agriculture, and health. The center builds on existing research frameworks and integrated assessment models developed at IIASA and localizes them in accordance with the economy of Israel.

Israel became a member of IIASA in 2017 through the Israeli Committee for IIASA, which is made up of representatives from Israeli universities, government ministries, and the public. Since 2010, there have been nine publications resulting from IIASA-Israeli collaborations, two Israelis have gained international and interdisciplinary research experience from participating in the IIASA Young Scientists Summer Program, 25 researchers, advisors, and diplomats from Israel have visited IIASA and participated in IIASA events, and IIASA scientists have visited Israel over 18 times. It is foreseen that research collaborations between Israel and IIASA will intensify further through IASACE.

The Ministry of Innovation, Science and Technology’s director general, Hilla Haddad Chmelnik, noted that the establishment of the new research center was of the utmost importance for Israel.

By **Bettina Greenwell**

The new IIASA Gender Equality Plan: Promoting fairness and addressing disparities

The IIASA Diversity Policy aims to ensure that diversity is welcomed, respected, supported, and valued and that social equity is upheld in its research and staff. To support these aims, the institute developed a Gender Equality Plan (GEP). Through a participatory process, employees representing various functions and levels shared their views on topics such as work-life balance, gender balance in leadership, gender equality in recruitment, the integration of the gender dimension into research, and measures against gender-based violence. The insights have been translated and incorporated in areas for action and goals and initiatives in the GEP and published on the IIASA website.

“Research has shown that companies that are more diverse in terms of gender and ethnicity outperform their peers. It is therefore of particular importance to promote a working environment in which all genders can contribute and develop equally. Some good gender initiatives have already been introduced at IIASA. With the new GEP we step up to the next level by introducing a structural and continuous approach,” says Lion Huijers, Head of Human Resources.

The framework for the IIASA GEP – endorsed by the IIASA Executive Team – is the European Commission’s Gender Equality in Academia and Research tool. IIASA will commit dedicated resources to the GEP and plans to implement gender-related training for staff.

By **Bettina Greenwell**



High school students visit IIASA

Last year, 50 students from the Bundesgymnasium Zehnergasse in Wiener Neustadt, Austria, visited IIASA for a day to learn about the institute’s research activities related to the 17 Sustainable Development Goals of Agenda 2030 – the blueprint for peace and prosperity for both people and the planet.

As part of their Sustainable Economics class, the students had the opportunity to meet with Thomas Schinko, who leads the Equity and Justice Research Group in the IIASA Population and Just Societies Program. Schinko provided an introduction to systems analysis and makingAchange – a collaborative project involving Austrian-based schools and scientists. This was followed by a lively discussion on several topics including current world events, the climate crisis, biodiversity loss, and the COVID-19 pandemic. The students shared some of their concerns and discussed how the young generation can deal with challenges caused by environmental change. The students were also introduced to the concept of so-called stability zones and encouraged to create such spaces for their own mental wellbeing.

Following the meeting, Executive Assistant to the Director General, Katherine Ivanschits, provided a tour of Schloss Laxenburg – a Habsburg castle now home to IIASA – to the enthusiastic young visitors. The students were accompanied by their teachers Simone Göstl, Markus Reiter, and Ingrid Schwarz.

This visit marks the beginning of a joint initiative of the IIASA Capacity Development and Training Unit and the Communications and External Relations Department, which aims to open the institute’s doors more frequently to schools in Austria and engage with students on important topics like climate change and sustainability. Watch this space!

By **Nina Cabala**





AWARDS FOR OUTSTANDING YOUNG SCIENTISTS

Three participants of the 2022 Young Scientists Summer Program (YSSP) have been recognized for their work. Melissa Chapman from the University of Berkeley, USA, won the IIASA Peccei Award for her analysis on meeting the 2030 biodiversity targets under land use constraints in the EU. Xander Huggins from the University of Victoria and the Global Institute of Water Security in Canada, received the Mikhalevich Award for his study: Global archetypes of groundwater interactions in social-ecological systems.

The Peccei award is named in honor of IIASA alumnus Aurelio Peccei and recognizes policy-related research, while the Mikhalevich Award, named after IIASA alumnus Vladimir S. Mikhalevich, acknowledges mathematically oriented research.

The winner of the newly established IIASA Special YSSP Award is Romain Clercq-Roques from the London School of Hygiene and Tropical Medicine, UK, for his study: Coupled dynamics of biodiversity loss and undernutrition in eastern Madagascar: a participatory agent-based model.

The winning projects were selected by a committee comprised of one member from each IIASA program based on their outstanding quality, originality, and relevance.

In addition to the three award winners, Dipesh Chapagain from the University of Bonn, Germany, and Hyun-Woo Jo from Korea University, received honorable mentions for their research. In his project, Chapagain looked at the role of climate change in disaster mortality in Nepal, while Jo was recognized for his study on the optimization of the IIASA FLAM model to represent forest fires in South Korea.

“The YSSP pushes each one of the participants to produce substantial research that helps them achieve their PhD objectives,” says Fabian Wagner, Dean of the IIASA Capacity Development and Academic Training Unit. “The work of the award winners stands out in quality and maturity. Congratulations on this fine achievement.”

By **Bettina Greenwell**

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Nicole Arbour

Nicole Arbour is the current Director of the Belmont Forum, an international partnership that mobilizes funding for environmental change research and accelerates its delivery to remove critical barriers to sustainability.

“I feel that the work of the Belmont Forum can really have an impact,” says Arbour. “I work with the organization’s members to create spaces for societally relevant transdisciplinary research to be taken forward, to ultimately assist with skill development and community building towards goals and values I truly believe in.”

While she may have left IIASA where she previously worked as External Relations Manager, Arbour’s collaborations with IIASA and former colleagues continue.

“I learned a lot about how an international, member-based research organization functions, about systems analysis, and why it is pivotal to

By **Monika Bauer**

the global environmental change research currently being done. I also met many fantastic people, and I still carry all of that with me, bringing systems thinking into many aspects of my work and life,” she notes.

Some of the initiatives she is involved with include finding opportunities to train colleagues and future leaders in systems analysis, and to incorporate systems approaches in the Sustainability, Research, and Innovation Congress that Belmont Forum hosts with Future Earth.

Arbour finds the international research space a challenging and rewarding area to work and engage in.

“Finding ways to empower the research community to work together across geopolitical borders and to engage equitably on peer, community, and organizational levels is what keeps me moving forward. The global challenges we face will require the community to come together towards shared goals. If the work I do can help make that happen, to maybe make the future a little safer and brighter for my daughters, then I will be happy,” she concludes.

[CONNECT.IIASA.AC.AT](https://connect.iiasa.ac.at)



BRINGING TOGETHER THE IIASA NETWORK

Engage with IIASA alumni, staff, and National/Regional Member Organizations by sharing updates, events, job opportunities, and joining groups via the IIASA Connect App.



PEOPLE PROFILES

Driving change from the ground up

Felicity Addo joined IIASA 2021. She is a key contributor to the FACE Africa project, bringing together local actors to co-design strategies to ensure food security in The Gambia.

If science was in an ivory tower, Felicity Addo would be the one demolishing its walls, stepping out into the world to empower communities with knowledge and dedication to solving real-world challenges.

“I believe in rolling up my sleeves and actively engaging with stakeholders. This is when science truly comes to life. The FACE Africa project was an opportunity to work closely with policymakers, researchers, technical experts, farmers, and consumers,” Addo notes.

The cornerstones of the FACE Africa project – Food Systems Adaptations in Changing Environments Africa – align with Addo’s scientific interests, focusing on tools for sustainable agricultural development, food and nutritional security, and sustainable rural development. Addo, who is currently completing her PhD at the University of Natural Resources of Life Sciences in Vienna, is driven by an unwavering passion for the betterment of developing countries.

“By coming from Ghana to Germany, where I studied Agricultural Economics at the University of Hohenheim, and then to Austria, I have made it my mission and passion to learn about agricultural and natural resource management: understanding what works, how it works, and how to apply this knowledge to emergent nations,” she explains.

She continues to explore these topics across several projects at IIASA.

“It is a positive signal when stakeholders holding varying perspectives, gather in a single space and engage in lively discussions. This is an applied grassroots systems approach: working together to drive sustainable change from the ground up,” she concludes.

By **Bettina Greenwell** **Felicity Addo:** addo@iiasa.ac.at



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Creating feasible and sustainable solutions

How could implementing renewable energy solutions help lift more than 600 million rural Africans out of poverty? How could this simultaneously provide one fifth of the regional population with the sufficient, nutritious, and reliable food sources they lack? How are water, energy, food, and environment systems impacting each other, and how should policy leverage the co-benefits of these interactions?

These are just some of the questions Giacomo Falchetta is working on in the Long-Term Joint European Union–African Union Research and Innovation Partnership on Renewable Energy (LEAP-RE) in which the Energy, Climate, and Environment Program is a partner.

“IIASA brings global perspectives to policymakers so that regional policies consider global challenges, and vice versa. The work I do at IIASA allows me to take local perspectives into account when identifying global trends,” explains Falchetta.

Falchetta is a systems modeler who is passionate about analyzing global trends that were created from many local inputs and utilizes the Google Earth Engine for completing geographical analysis of satellite images. For example, household surveys can obtain local perspectives and combing these from many local areas enables him to identify trends. Using this approach, he has analyzed changes in land cover, measured pollutant concentrations, and identified the potential for solar and wind energy.

When describing the impact he hopes to make, he says, “I want to create a positive impact in the world by creating feasible and sustainable solutions that policymakers can implement as they take a systems approach.”

By **Monika Bauer** **Giacomo Falchetta:** falchetta@iiasa.ac.at

Q & A

CREATING IMPACTFUL CONNECTIONS IN AND BEYOND IIASA

IIASA Network and Alumni Officer Monika Bauer brings together the global network of IIASA staff, alumni, and National and Regional Member Organizations. She is responsible for the online community platform IIASA Connect and is also the co-president of the IIASA Women in Science Club (WISC).



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Q How do you manage, follow, and speak with a research network of more than 400 scientists, representatives from 22 National and Regional Member Organizations, and over 700 collaborating institutions?

A Creating meaningful connections has always been at the core of my role. There is so much amazing scientific work being done, and as the IIASA network and alumni officer, I try to build on that to determine how I can make a purposeful impact, and how colleagues can benefit from being part of the IIASA network.

Establishing professional connections, bringing together regional communities, and creating opportunities for mid- and early-career researchers are some of my key aims. I follow my colleagues' work, sit down and talk to them – not only in person, but also on social media platforms like LinkedIn or Twitter. I strive to build connections that make sense strategically and where all parties benefit, for example, finding speakers for events or referring colleagues to open calls. It is about creating opportunities for people on all levels. As co-president of WISC, I am also conscious about being inclusive in terms of diversity – not just gender, but also diversity of nationality, research area, and age.

Q How did your role evolve, considering the increase of new technologies and communication channels such as social media?

A My role has changed significantly since I started in 2009. Back then, there was no electronic database of IIASA alumni. I started building Excel lists by talking to different departments, research programs, and other

stakeholders within the IIASA network. This led to an electronic catalogue of alumni. Platforms such as Facebook, LinkedIn, and Twitter were – and still are – great tools to connect, however, these platforms are limited. Also, an electronic list of alumni saved somewhere does not provide the opportunity for members to directly connect with others. After looking at various alumni software options, I developed IIASA Connect through the community management and engagement platform, Hivebrite. It gives users full and direct access to alumni, staff, member collaborators, diplomatic partners, policymakers, and visiting fellows. IIASA Connect members can look up and search for collaborators on a virtual map. This allowed us to visualize the IIASA network and for the first time make it tangible to those who are part of it, including the IIASA National and Regional Member Organizations.

Q What do you enjoy most about working at IIASA?

A I enjoy supporting the incredible work our colleagues are doing, connecting people in meaningful ways, and building partnerships. It goes back to the quote “science is not finished until it is communicated” – and as part of the Communications and External Relations Department, I find this to be a motivational work mantra.

By Bettina Greenwell


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The International Institute for Applied Systems Analysis (IIASA) is an independent, international research institute with National Member Organizations in Africa, the Americas, Asia, and Europe. Through its research programs and initiatives, the institute conducts policy-oriented research into issues that are too large or complex to be solved by a single country or academic discipline. This includes pressing concerns that affect the future of all of humanity, such as climate change, energy security, population aging, and sustainable development. The results of IIASA research and the expertise of its researchers are made available to policymakers in countries around the world to help them produce effective, science-based policies that will enable them to face these challenges.

National Member Organizations:

AUSTRIA The Austrian Academy of Sciences
BRAZIL The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) **CHINA** The National Natural Science Foundation of China (NSFC)
EGYPT Academy of Scientific Research and Technology (ASRT) **FINLAND** The Finnish Committee for IIASA **GERMANY** Association for the Advancement of IIASA **INDIA** The Technology Information, Forecasting and Assessment Council (TIFAC) **INDONESIA** (Observer) Indonesia National Committee for Applied Systems Analysis (INCASA)
IRAN, ISLAMIC REPUBLIC OF Iran National Science Foundation (INSF) **ISRAEL** The Israel Committee for IIASA **JAPAN** The Japan Committee for IIASA **JORDAN** (Prospective) The Royal Scientific Society (RSS) of Jordan
KOREA, REPUBLIC OF National Research Foundation of Korea (NRF) **NORWAY** The Research Council of Norway (RCN) **RUSSIAN FEDERATION** The Russian Academy of Sciences (RAS) **SLOVAKIA** Ministry of Education, Science, Research and Sport
SUB-SAHARAN AFRICA REGIONAL MEMBER ORGANISATION (SSARMO) The National Research Foundation (NRF) **SWEDEN** FORMAS - a Swedish Research Council for Sustainable Development **UKRAINE** The National Academy of Sciences of Ukraine (NASU) **UK** UK Research and Innovation (UKRI) **USA** The National Academy of Sciences (NAS) **VIETNAM** Vietnam Academy of Science and Technology (VAST)

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