

CLEAN AIR NEEDS MORE THAN CLIMATE POLICY

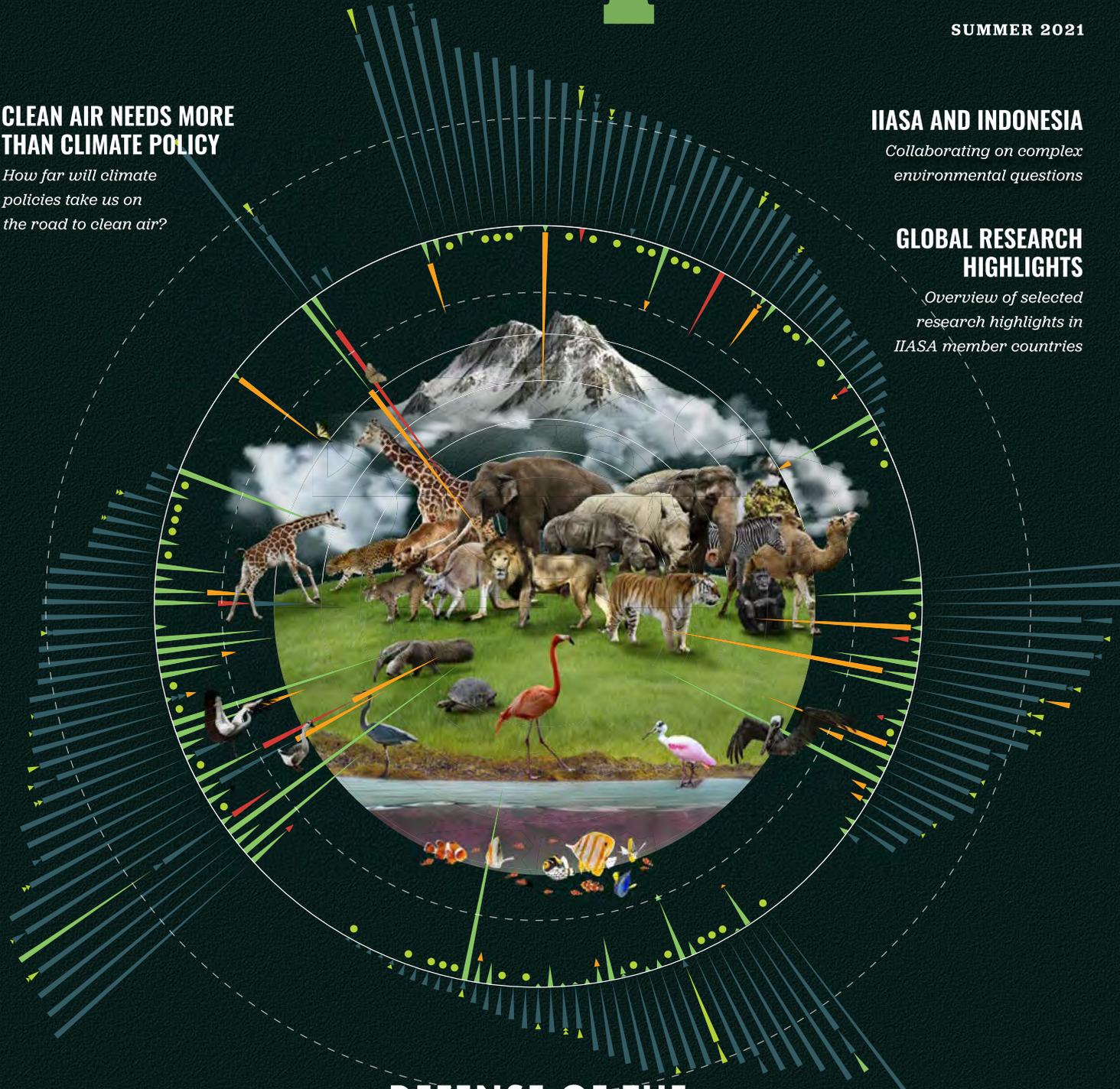
How far will climate policies take us on the road to clean air?

IIASA AND INDONESIA

Collaborating on complex environmental questions

GLOBAL RESEARCH HIGHLIGHTS

Overview of selected research highlights in IIASA member countries



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NATURAL REALM

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FROM THE EDITORIAL TEAM

While life in lockdown continues for the majority of people around the world and vaccine rollouts start to offer a glimmer of hope for a return to normal life, we are delighted to present you with another issue of *Options* magazine.

In our cover feature, we take a look at biodiversity research undertaken at IIASA and how it is contributing to the global conversation around this important issue. We also provide a sneak peek into how different aspects of biodiversity will be studied across the institute as part of the new IIASA strategy (pages 12-15). Our second feature highlights how researchers at the institute continue to apply their expertise to the threat air pollution poses to the climate and global health (pages 10-11), while our national member organization feature celebrates the institute's collaboration with Indonesia over the past decade (pages 16-17).

We hope that you enjoy reading the articles in this issue of *Options*. Please get in touch with us via email if you would like to share your comments or ideas for future articles.

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ABOUT OPTIONS

Options magazine features recent IIASA research and activities.

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News in brief

By Ansa Heyl

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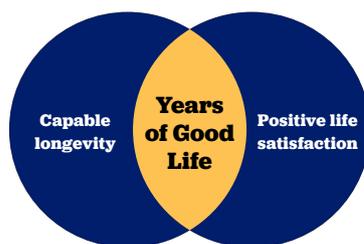
Measuring sustainable wellbeing

Life expectancy has long been used as an extensive indicator of human development, with avoiding premature death being a universally shared aspiration. However, according to a group of researchers led by Senior IIASA Population and Just Societies Program Advisor, Wolfgang Lutz, mere survival is not enough to enjoy life and its qualities.

To overcome the lack of benchmarks of objective and subjective wellbeing in existing indicators, Lutz and his colleagues propose a new, tailor-made metric that measures development based on long-term human wellbeing: The Years of Good Life (YoGL) indicator. YoGL only counts a year as a good year if individuals are simultaneously not living in absolute poverty, are free from cognitive and physical limitations, and report to be generally satisfied with their lives.

The researchers say their work presents a first step in the great challenge to comprehensively assess sustainable human wellbeing that also considers feedbacks from environmental change. Unlike many other indicators, YoGL is not restricted to the national level but can be assessed for flexibly defined sub-populations and over long-time horizons. It also has the potential to become a broadly used “currency” for measuring the benefits of certain actions, thus complementing assessments based on purely monetary units.

The social costs of carbon could, for instance, potentially be evaluated in terms of years of good life lost among future generations, making it a key indicator to measure sustainable progress in an integrated and tangible way. When applied to the COVID-19 pandemic, the researchers note that YoGL represents a major improvement over conventional indicators in assessing the long-term success of intervention measures, as it not only accounts for material losses and lost life years, but also for the losses in physical and cognitive wellbeing and those incurred by younger generations due to lockdown measures like school closures.



Further info: pure.iiasa.ac.at/17111

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A NEW FRAMEWORK TO IMPROVE CLIMATE MITIGATION SCENARIOS

IIASA researchers and colleagues at the RFF-CMCC European Institute on Economics and the Environment have developed a systematic framework that allows identifying the type, timing, and location of feasibility concerns raised by climate mitigation scenarios to help understand what to improve in the next generation of scenarios and explore how to make ambitious emission reductions possible by strengthening enabling conditions.

www.iiasa.ac.at/news/21-pathways

ADVANCING THE SCIENCE OF CITIZEN SCIENCE

A new book featuring contributions by IIASA researchers Dilek Fraisl and Linda See, brings together the views and perspectives of researchers and practitioners from various disciplines spanning the humanities to the natural sciences, to offer practical support for implementing citizen science projects and address important current and emerging topics in fields like citizen science and artificial intelligence.

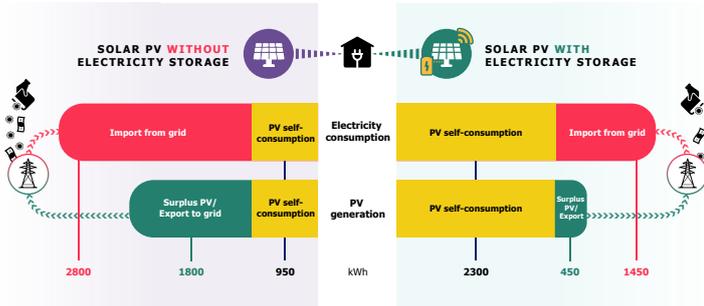
www.iiasa.ac.at/news/21-citizen-science

A SAFE AND JUST FUTURE FOR PEOPLE AND PLANET

IIASA is supporting the Earth Commission through assessment and modeling of safe and just development pathways for people and the planet by integrating complex interlinkages and feedbacks among Earth and human systems. The work answers the clarion call from businesses and cities for putting science behind the setting of targets for the global commons and crucial Earth systems to safeguard Earth’s resilience.

www.iiasa.ac.at/news/21-future

Increasing the value of solar panels for homeowners



The installation of solar panels to offset energy costs and reduce the environmental impact of homes has been gaining popularity with homeowners in recent years. Despite the promising advantages this mode of electricity generation offers, there is a number of hurdles to overcome. An international team of researchers explored some of these challenges.

The study shows that homeowners currently only use 30-40% of the electricity generated by their solar photovoltaic (PV) panels, while the rest of the electricity is exported to the grid with very little to no benefit for the owner. With the addition of a home battery, the self-consumption of solar PV in the building almost doubles, allowing the residents to reduce electricity imports from the grid by up to 84%, which can in turn help the owner to become less dependent on the grid and electricity prices.

This would however require the implementation of slightly different policies and regulations to guarantee return on investment in home batteries for homeowners. These include that national renewable energy policies adopt more innovative incentives to enhance the economic profitability of decentralized green energy solutions based on the contribution of these systems to the grid. The findings indicate that this can be easily achieved by, among others, rewarding consumers for using their solar PV generation onsite instead of encouraging them to export the excess solar energy they produce to the grid.

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Extreme droughts threaten increasing number of people

IIASA researchers contributed to a global research effort, which shows that the global land area and population facing extreme droughts could more than double if a medium-to-high level of global warming continues and water management is maintained at its present state. The study presents the first, comprehensive picture of how global warming and socioeconomic changes will affect land water storage and what that will mean for droughts until the end of the century.

The research team, including IIASA researcher Peter Burek, and Biodiversity and Natural Resources Program Director Yoshihide Wada, projected a large reduction in natural land water storage in two-thirds of the world due to climate change. The results indicate that areas of the Southern Hemisphere, where water scarcity is already a problem, will be disproportionately affected, which could ultimately affect food security and escalate human migration and conflict.

Recent advances in process-based hydrological modeling, combined with future projections from global climate models under wide-ranging scenarios of socioeconomic change, provided a unique foundation for the study's comprehensive analysis of future water availability and droughts, which comprised a set of 27 global climate-hydrological model simulations spanning 125 years.

According to the researchers, their findings highlight why we need climate change mitigation to avoid the adverse impacts on global water supplies and increased droughts. There is a need to commit to improved water resource management and adaptation to avoid the potentially catastrophic socioeconomic consequences of water shortages around the world.

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ADDRESSING INEQUALITIES TO WEATHER THE IMPACTS OF CLIMATE CHANGE

Vulnerability and exposure to the effects of climate change differs significantly across social groups, defined not only by income levels but also by gender, education, and racial and ethnic profiles. According to a recent study, building capacity to adapt to such changes will require eradicating inequalities of many sorts, including gender, to improve overall resilience to climate change impacts.

www.iiasa.ac.at/news/20-women

CLOSING THE GLOBAL SKILLS GAP

While developing countries are rapidly catching up in terms of formal educational attainment, the gap between highly skilled and low skilled populations continues to widen globally. A new demographically consistent indicator for adult literacy skills – the Skills in Literacy Adjusted Mean Years of Schooling (SLAMYS) – will help to determine the differences in the skills of the working-age population between countries and over time, and how this relates to educational attainment in the respective country and year.

www.iiasa.ac.at/news/21-skills

SUPPORTING CHINA'S CARBON NEUTRALITY GOALS

IIASA researchers contributed to a new report that provides an overall picture of the pathways that support China's carbon neutrality goal and its new vision for growth and development, and identifies both long-term sectoral strategies and near-term actions to prepare the help the country realize its goal of achieving carbon neutrality before 2060.

www.iiasa.ac.at/news/20-carbon-China



How grasslands changed our climate

Grasslands are critically important for animal forage, biodiversity, and ecosystem services. They absorb and release carbon dioxide (CO₂), and emit methane (CH₄) from grazing livestock and nitrous oxide (N₂O) from soils, especially when manure or mineral fertilizers are introduced. Little is however known about how the fluxes of these three greenhouse gases from managed and natural grasslands have contributed to climate change in the past, and about the role of managed pastures versus natural or very sparsely grazed grasslands.

To address this knowledge gap, an international research team built and applied a new spatially explicit global grassland model - one of the first to simulate the regional details of land use change and degradation from livestock overload.

The team found that emissions of CH₄ and N₂O from grasslands increased by a factor of 2.5 since 1750 due to increased emissions from livestock. The ability of grasslands to absorb more carbon and pack it in the soil, was estimated to have intensified over the last century, but mainly over sparsely grazed and natural grasslands. On the other hand, over the last decade, grasslands intensively managed by humans have become a net source of greenhouse gas emissions.

“Our findings make it clear that countries should assess not only the greenhouse gas budgets of their managed pastures, but also the sinks and sources of sparsely grazed rangelands, steppes, tundra, and wild grasslands. Full greenhouse gas reporting for each country could facilitate the assessment of progress towards the goals of the Paris Agreement and better link national greenhouse gas budgets to the observed growth rates of emissions in the atmosphere,” concludes Jinfeng Chang who led the study at IIASA and is now based at Zhejiang University in China.

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Healthy enough to retire later?

While many people are now enjoying longer, healthier lives, current retirement ages are posing challenges for both policymakers and retirees, while falling fertility rates, especially in European countries, are leading to a marked increase in the share of older adults.

This situation poses a risk to financial sustainability in several areas of social security systems, one of them being pension systems. It has also prompted discussions around retirement ages and measures to support longer working lives at the country, as well as at the European Union level, and many countries have already initiated

and passed policy changes to gradually increase the official retirement age. One pertinent question that has surfaced in this context, however, is how large the potential is to increase working lives further given the health status of people at that phase of life.

A study led by IIASA researcher Daniela Weber endeavored to answer this question.

The findings indicate that there is indeed potential to increase the expected number of economically active years for both men and women between the ages 60 and 69. An education-specific analysis however revealed large differences between socioeconomic subgroups of the population when it comes to the size of this potential.

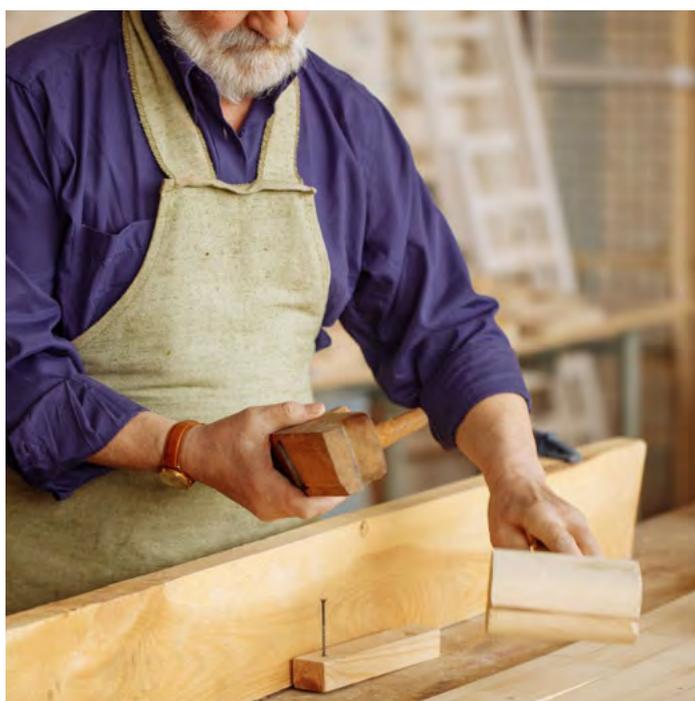
“The heterogeneity between education groups in terms of health and the ability to work beyond currently observed labor market exit ages has to be taken into account when working lives are being extended. This will require policies that account for this heterogeneity,” Weber says.

Further info: pure.iiasa.ac.at/16911

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Bioenergy production requires sound water management

Bioenergy is often considered an option to reduce greenhouse gases, especially if combined with capturing the CO₂ from biomass power plants and storing it underground. In addition to land, growing large-scale bioenergy plantations however also requires considerable amounts of freshwater for irrigation. IIASA researchers and colleagues explored how much additional water stress could result for people worldwide in a scenario of conventional irrigation for bioenergy production compared to one of sustainable freshwater use.

The results indicate that irrigation of future biomass plantations for energy production without sustainable water management, combined with population growth, could double both the global area and the number of people experiencing severe water stress by the end of the century. Sustainable water management on the other hand, could almost halve the additional water stress compared to another analyzed scenario of strong climate change unmitigated by bioenergy production.

“Sustainable water management means both political regulation to reduce the amounts of water taken from rivers, as well as on-farm improvements to make more efficient use of the water,” explains study coauthor Sylvia Tramberend, a researcher in the IIASA Water Security Research Group.

The study confirms that sustainable water management is a challenge to be addressed urgently. Measures currently considered to stabilize the climate, in this case bioenergy plus carbon capture and storage, must take into account a number of further dimensions of the Earth system, including water cycles. Risks and tradeoffs have to be carefully considered before launching large-scale policies that establish biomass markets and infrastructure.

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Investing in a low-carbon future

The financial sector is expected to play a key role in achieving a greener future, but how will climate policies and banks' pricing of climate-related risks influence an orderly transition to a low-carbon economy?

Banks' climate sentiments, that is, their expectations and pricing of climate-financial risks – and especially of climate transition risks – can foster or hinder an orderly low-carbon transition. Nevertheless, they have been neglected by macroeconomic and financial risk analysis so far.

IIASA researchers and colleagues at the Vienna University of Economics and Business (WU) assessed the impact of banks' climate sentiments on climate policy effectiveness, considering two types of climate policies: a carbon tax and a green supporting factor. They considered under which conditions a carbon tax or green supporting factor could foster green capital investments to achieve the EU2030 targets, and the implications for banks' financial instability, focusing on loan contracts.

“Depending on the timing and implementation, a simple carbon tax can reduce the profitability of high-carbon firms, leading to non-performing loans which could, in turn, pose credit-risk for banks. To maintain regulatory capital, banks increase the cost of credit for high-carbon firms, leading to a credit crunch that would also affect green firms negatively, thus putting the success of an orderly low-carbon transition at risk,” explains Irene Monasterolo, a researcher at WU. “In contrast, banks' anticipation of the impact of the carbon tax on high carbon firms would lead to smooth adjustments of prices and greening of the economy.”

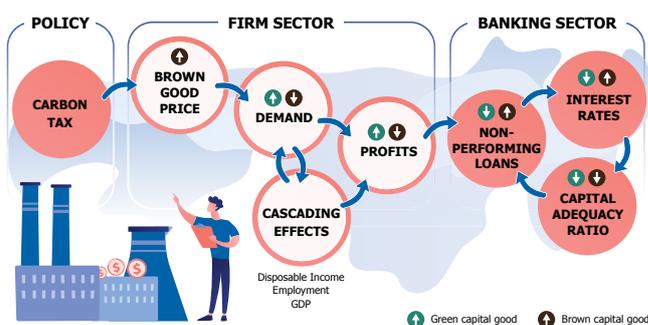
To analyze the macro-financial implications of a carbon tax and a green supporting factor, and the feedbacks effects from banks' climate sentiments, the researchers developed a stock-flow consistent model that embeds a forward-looking approach to the pricing of climate risks in banks' lending contracts and credit risk born by firms, departing from rational expectations.

“We found that a carbon tax would put a cost on carbon-intensive production thus making low-carbon production and investment in such production facilities

more attractive. To prevent unintended effects, a carbon tax should however be complemented with distributive welfare measures,” says IIASA researcher Asjad Naqvi.

“A green supporting factor on the other hand, would lower the capital requirements for loans that banks give out for green investments, thus making green lending for banks more attractive and potentially resulting in better credit conditions for green investment projects,” adds Nepomuk Dunz, an alumnus of the IIASA Young Scientists Summer Program (YSSP) currently affiliated with WU.

According to the researchers, policy credibility is crucial to building trust in the banking sector, whose climate sentiments, in turn, help with successful policy implementation and minimize the negative impacts on economic and financial instability. Stock flow consistent models can help central banks and financial regulators to identify the relation between climate transition risk and financial instability and identify suites of policies (fiscal, monetary, and macroprudential) to foster banks' pricing of climate risks in their lending. The article is part of the special issue on Climate Risks and Financial Stability published in the *Journal of Financial Stability* (2021).



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Science into policy



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A vision for a just and resilient post-pandemic world

IIASA and the International Science Council (ISC) have drawn on the combined strengths and expertise of the two organizations to address emerging issues and provide science-based insights on how to rebuild a post-pandemic world that is more resilient, sustainable, and just.

C **COVID-19 is a warning:** We need to step back from business-as-usual and find new ways to build a future that allows all of humanity to thrive in a resilient, sustainable, and equitable world. The IIASA-ISC Consultative Science Platform “Bouncing Forward Sustainably: Pathways to a post-COVID world”, a global hub for consultation, deliberation, and collaboration among scientists, policymakers, and representatives from civil society, has produced a series of reports with key messages and recommendations for policy- and decision makers, that have the potential to enable the needed systemic transformations and structural changes. The reports provide recommendations around four interconnected themes: Governance for Sustainability, Strengthening Science Systems, Resilient Food Systems, and Rethinking Energy Solutions. Key recommendations from all four themes are presented in a Synthesis Report.

In terms of governance for sustainability, the authors point out that a fragmented approach to governance has hampered responses to the crisis. The initiative’s recommendations include that the ongoing reform process should ensure that separate UN agencies work in a coordinated way, while governments should be empowered to take a systems view. A global dialogue could engage policymakers, civil society, the private sector, and the scientific community to improve understanding of compound and systemic risks; while a science-based tracking mechanism could assess how recovery packages align with the Sustainable Development Goals.

The report on science systems contains a number of recommendations grouped under five interrelated transformative changes aimed at ensuring a more

effective response of the science system to future global crises. These changes address the need to strengthen transdisciplinary research on critical risks; enhance the diffusion of knowledge within the science system; increase the capacity of the science system to respond rapidly with high-quality research; improve the science-policy interface; and enhance public understanding and trust in science.

With regard to future energy solutions, the authors urge that we need to look beyond production and focus on addressing demand, for example, by re-purposing urban spaces to provide for human wellbeing while reducing environmental footprints. This can build on innovations adopted during the COVID crisis.

The pandemic also underlines the entanglement of human and natural systems, especially in the field of food and nutrition. In this regard, there is an urgent need to balance today’s focus on efficiency of supply with a new emphasis on resilience and equity, to ensure that the future food system can deliver universal security and empower the most vulnerable groups.

“COVID-19 could become a catalyst for reform. Governments, businesses, and citizens have been willing to respond constructively to the crisis and take radical action. This is cause for optimism that we can undertake the transformative changes we need for a safe, just, and healthy planet,” concludes IIASA Deputy Director General for Science, Leena Srivastava.

By **Ansa Heyl**

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Pursuing sustainable development in the Indus and Zambezi basins

The Integrated Solutions for Water, Energy, and Land (ISWEL) project has provided a systematic view and policy recommendations to support stakeholders in the Indus and Zambezi basins in achieving a sustainable future through cooperative development.

The ISWEL project, a recently concluded partnership between IIASA, the Global Environment Facility, and the United Nations Industrial Development Organization, set out to develop tools and build capacity to support the sustainable management of water, energy, and land by means of a truly integrated nexus approach. Although the project took a global view, it also zoomed in on two large transboundary river basins facing multiple development and environmental challenges: The Zambezi and the Indus.

According to the researchers, population growth and socioeconomic development will continue to put pressure on natural resources in both these regions in the absence of ambitious investments and joint planning. Transboundary cooperation between basin countries, coupled with innovation, can however help manage water-energy-land tradeoffs and support sustainable development.

In the Indus basin, for instance, overall investment costs could be reduced by up to 9% if riparian countries decided to cooperate and develop joint sustainable investments through strategies like the promotion of internal trade, and assigning energy and food production to the regions with the largest comparative advantages. Development strategies to increase agricultural productivity and lift farmers out of poverty in the Zambezi basin, on the other hand, should include a combination of joint investments in the agricultural sector, as well as the promotion of wider access to local and international markets.

The tools and recommendations developed under the auspices of the ISWEL project will support finding solutions to complex problems in transboundary river basins while also developing local capacities in regions that are in dire need of expanding such integrated approaches.

By **Ansa Heyl** Further info: Zambezi policy brief | Indus policy brief

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ENABLING JUST AND INCLUSIVE ENERGY TRANSITIONS

IIASA Deputy Director General for Science, Leena Srivastava, and Emeritus Scholar Nebojsa Nakicenovic, have been appointed to the UN's Technical Working Group 3. The group aims to offer recommendations and policy options that maximize the positive impacts of inclusive and just energy transitions on the achievement of the Sustainable Development Goals, and strengthen the benefits that such transitions hold for current and future generations.

PARTNERING FOR SUSTAINABLE GROUNDWATER MANAGEMENT

IIASA has joined the Groundwater Solutions Initiative for Policy and Practice (GRIPP), which aims to strengthen, expand, and connect current groundwater research and initiatives. The goal is to advance the agenda of sustainable groundwater management to achieve the Sustainable Development Goals; co-develop, document, and disseminate proven technologies, policies, and approaches; and to provide a platform for attracting, guiding, and implementing actionable research for sustainable groundwater management.

www.iiasa.ac.at/news/GRIPP-21

LINKING CLIMATE CHANGE MITIGATION AND SUSTAINABLE DEVELOPMENT

The recently concluded CD-LINKS project has contributed to filling the gap in available research on the complex interplay between climate and development policies, allowing researchers to reuse successful policy information and tools, exploit consistent national and global scenarios, and provide important guidance for designing future policies aimed at boosting sustainable development and tackling climate change.

www.iiasa.ac.at/CDLINKS

Clean air needs more than climate policy

Actions to curb global warming can have an added benefit—cutting air pollution and saving millions of lives. This bonus however only takes us part of the way to truly clean air. We need ambitious policies focused on pollution – and urgently.



Wind turbines do not belch sulphurous fumes; solar panels emit no choking dust; electric vehicles have no exhaust pipes. It seems obvious that by rolling out these technologies, all aimed at fighting climate change, we will also cut air pollution. But it is far from obvious how powerful an effect that will be. What will climate policies mean for global health? How far can they take us on the road to clean air?

Researchers from the climate and air quality communities have been working together to answer these questions. The Paris Agreement added new momentum, making sustainable development an explicit focus of the climate effort, as air pollution is a particular threat to development in poorer regions.

A recent IIASA study looked at the public health implications of the Paris Agreement across nine countries – including China, India, and the US – which are home to half of the world's population. The research also covers the health impacts of diet and physical activity, but IIASA researchers Gregor Kiesewetter and Peter Rafaj focused on air pollution – specifically $PM_{2.5}$, the fine particulate matter that is damaging to health and responsible for more than 7% of all deaths worldwide – using the IIASA Greenhouse gas Air pollution INteractions and Synergies model (GAINS). GAINS models emissions of pollutants, their chemical interactions, and their path through the atmosphere, and finally calculates the impact on human health and ecosystems.

One scenario portrays a world that meets the Paris goal of staying under 2°C of global warming, and also other Sustainable Development Goals (SDGs), such as access to clean energy. The result of this was 1.2 million fewer annual deaths due to air pollution in the nine countries, compared with a scenario based on existing clean-air policies and climate commitments.

This message was reinforced in a second study led by Rafaj, looking ahead to 2050 and examining health impacts across Asia.

Scenarios that meet the 2°C and 1.5°C targets show great health benefits, averting up to 13% (or 0.5 million) of annual premature deaths seen in the baseline scenario of today's climate and energy policies. In addition, climate action brings cost savings: cutting one tonne of CO_2 means €5 to €12 less spent on abating pollution.

The prospect of these lives and dollars saved should be a spur to policymakers considering more ambitious climate goals at the upcoming UN climate conference, COP26, in Glasgow.

Climate action alone is however not enough. Pollution is a huge and growing problem, largely because an ageing population is increasingly vulnerable to the cardiovascular diseases linked to $PM_{2.5}$. Rafaj and colleagues examined this demographic effect, and found that even if emissions are held steady, premature mortality in Asia rises fast, which suggests that even stricter policies are needed.

The study includes a scenario where a 1.5°C world also pursues aggressive clean-air policies. This means applying the best pollution abatement measures available today. For example, all power plants use desulfurization technology, catalysts to remove nitrogen oxides, and electrostatic precipitators to filter out fine particles.

The impact is huge. According to the GAINS model projections, in 2050 this “maximum feasible reduction” strategy reduces premature deaths across Asia by nearly 45% compared with the baseline.

Another IIASA study gives an idea of what will be needed to bring clean air to a majority of the world population. The World Health Organization air quality guideline is that annual mean PM_{2.5} levels should be no higher than 10 micrograms per cubic meter. In 2015, only about 18% of us were breathing air that conformed to this guideline. The research showed that a clean-air scenario could raise that number to 56% in 2040. This, however, requires policies that deal with all polluting sectors, including energy, agriculture, and waste management.

“To get to these really low levels, you need to use all the options available,”

says Kieseewetter.

Climate and clean-air policies however need to be carefully coordinated, as some measures that cut greenhouse gases actually increase pollution. Biomass burning, for example, can be a strong source of PM_{2.5}. In Europe, this is now being recognized. The EU’s Second Clean Air Outlook, which contains major contributions from IIASA, includes research into the co-benefits of climate and pollution policies to inform the upcoming zero-pollution action plan.

“More needs to be done to provide clean air for all,” concludes IIASA Pollution Management Research Group Leader, Zbigniew Klimont. “Any day with polluted air is a lost day causing suffering that can be avoided.”

By **Stephen Battersby**

www.iiasa.ac.at



Megacity air

Big cities face some of the world’s worst air pollution. A 2020 World Bank report “Clearing the Air – a Tale of Three Cities” examined responses in Beijing, Delhi, and Mexico City. Input from IIASA research included a long-term collaboration with the World Bank to tailor the GAINS model to local conditions in highly polluted regions.

The report recommends a three-pronged approach through information, incentives, and institutions. Accessible information about pollution can galvanize public support, as it did in Mexico City with an analysis of air pollution and children’s health.

“Countries need a strong mechanism to incentivize local air-quality programs and institutions must involve a range of stakeholders addressing all relevant pollution sources, as air pollution does not care about administrative boundaries,” notes Pallav Purohit, a researcher with the Pollution Management research group.

We tend to think of city pollution as a homegrown problem, the noxious consequence of diesel engines and heavy industry. IIASA and the Indian National Environmental Engineering Research Institute however found that 60% of PM_{2.5} in Delhi was actually coming from outside the city, for example, from crop burning. Clean-air policy therefore needs to transcend jurisdictions – as with the Jing-Jin-Ji Regional Air Quality Prevention and Control Coordination Group in the Beijing area, the Megalopolis Environmental Commission in Mexico, and the newly established Commission for Air Quality Management for the area around Delhi.



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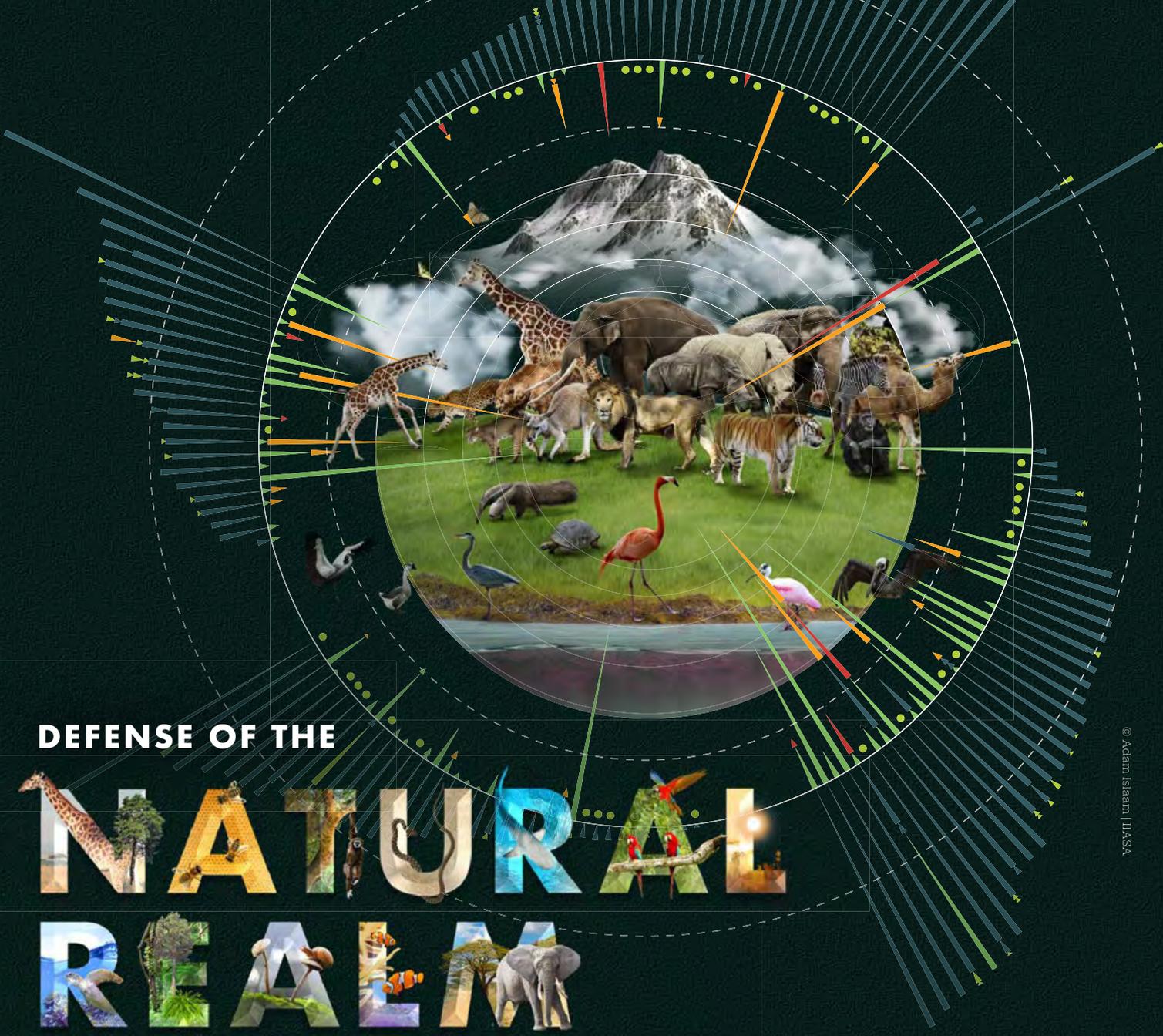
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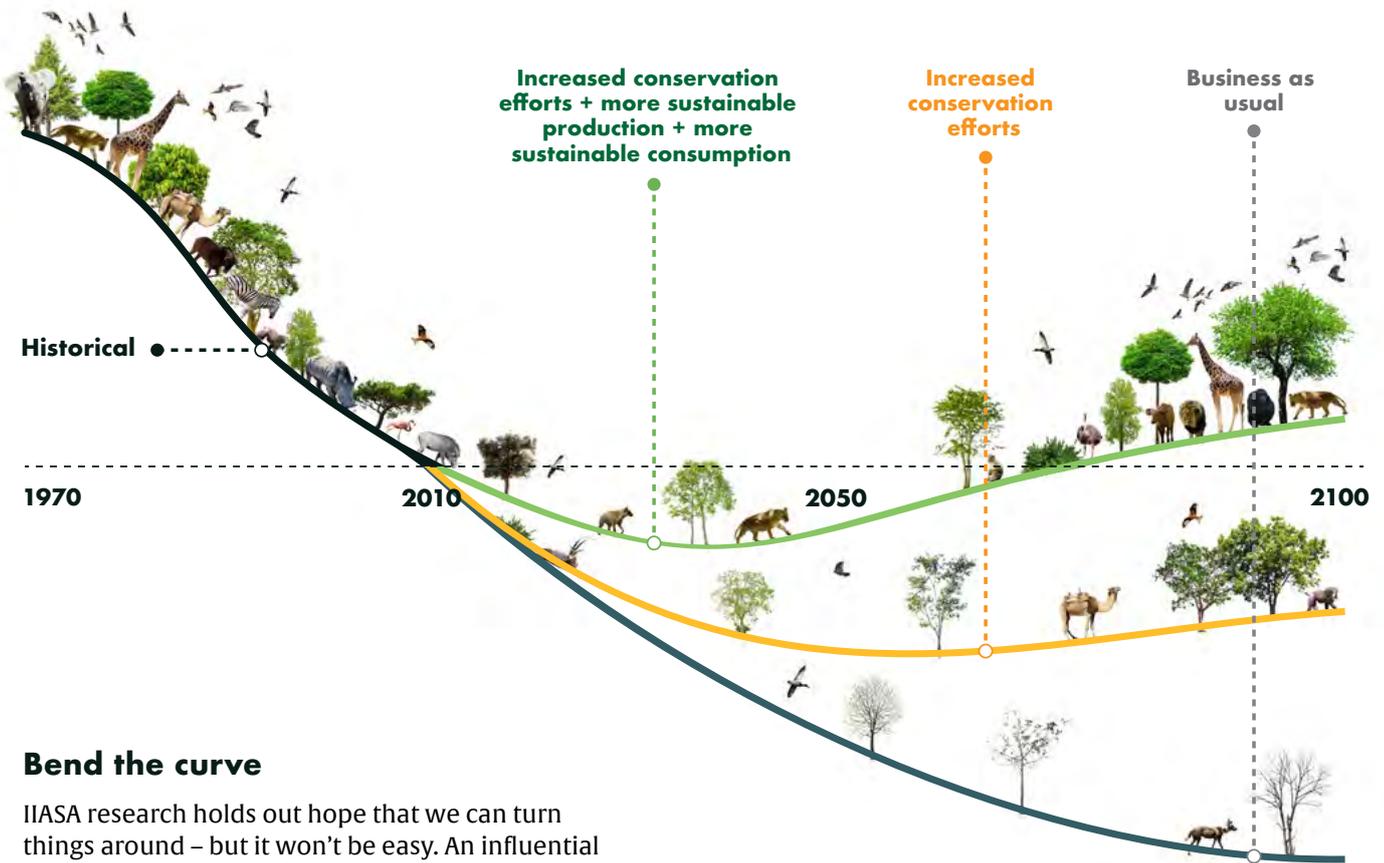
NATURAL REALM

By Stephen Battersby

At a crucial moment for beleaguered nature, IIASA research is showing that we can reverse biodiversity loss. It will need an effort that is grand in scale and focused where rewards are greatest.

Humanity's advance has meant retreat for millions of other species. Habitats are ploughed and paved; pollution chokes ecosystems; overfishing scours the seas; climate change brings drought and scrambled seasons. Even from a cynical, human-centric point of view, this is a looming disaster. Plants and animals feed us, stabilize the climate, filter air and water, and give us fuel and medicines.

Decades of conservation efforts have had limited success. Almost every country is signed up to the Convention on Biological Diversity (CBD), a treaty that set out 20 biodiversity targets in 2010. By the 2020 deadline, however, only six of these targets had been partially achieved. According to the 2019 IPBES Global Assessment Report on Biodiversity and Ecosystem Services: "Biodiversity ... is declining faster than at any time in human history."



Estimated recent and future global biodiversity trends resulting from land-use change, with and without coordinated efforts to reverse trends — Bending the curve of terrestrial biodiversity needs an integrated strategy. Leclère, et al.

Bend the curve

IIASA research holds out hope that we can turn things around – but it won't be easy. An influential study led by IIASA researcher David Leclère modeled how different policies could change land use, and how that would affect various aspects of biodiversity such as species extinctions.

In one scenario protected areas stretch to 40% of the planets' land (from 15% today), and 5 million km² of degraded land is restored. The study projects that biodiversity trends should start to improve around the middle of the century – but many regions still see heavy losses, and food prices rise, undermining the UN's goal to end hunger.

A happier picture emerges if we also tackle food supply and demand: adding sustainable increases to crop yields and agricultural trade, plus a more plant-based diet and less food waste. The study projects that this should turn biodiversity trends positive before 2050, allow more land to be restored, prevent food prices from rising, provide powerful benefits for climate, and cut the use of water and fertilizers.

These messages are amplified in a 2020 article led by Sandra Diaz at the University of Cordoba in Argentina, authored by dozens of leading researchers including Piero Visconti, who leads the IIASA Biodiversity, Ecology, and Conservation research group. Among other things, the authors propose outcome-based goals for species and genetic diversity, along with goals to halt the net loss of natural ecosystem areas and integrity, and ensure that loss of a rare ecosystem cannot be offset by an increase in another ecosystem.

Plan B

The CBD is now devising a strategy for the coming decade. Its draft Global Biodiversity Framework (GBF) embraces some of these ideas, including goals based

on biodiversity outcomes, such as reducing the number of threatened species by a certain percentage, and maintaining genetic diversity. Five GBF action targets for 2030 are broadly consistent with the intervention in Leclère's integrated scenario. The draft GBF also cites Diaz et al. frequently – although its goal statements have not yet changed in accordance with that paper's suggestions, says Visconti. According to Leclère, the final framework, which is due to be ratified in October 2021, needs to ensure that national plans align with the desired global goals and that efforts and benefits are equitably distributed.

The draft may also rely too much on area-based targets, such as expanding protected areas to cover 30% of land and sea. Protected areas are often put where they are least inconvenient, instead of most effective.

"Look at the average elevation and remoteness of National Parks. They tend to be high and far; rock and ice," notes Visconti, adding that for biodiversity impact, quality is more important than quantity.

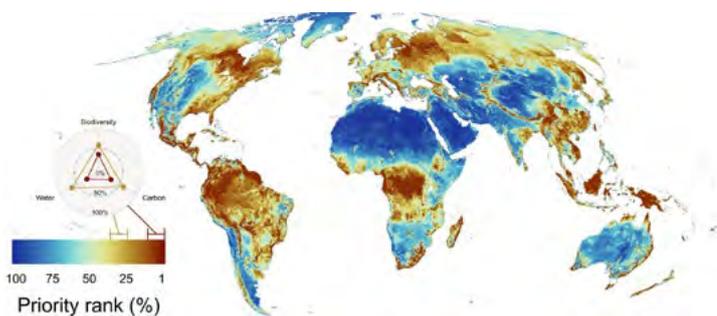
Biodiversity ... is declining faster than at any time in human history

2019 IPBES Global Assessment Report on Biodiversity and Ecosystem Services

Concentrated solutions

These sentiments are confirmed by two recent studies involving IIASA researchers. One looked at restoring cropland and pastureland back into natural habitat. The authors mapped converted land, calculating the local impact of restoration on carbon and species extinction risk based on field data from similar sites. They then modeled global outcomes from restoring 15% of all converted land, amounting to 4.3 million km². A linear programming algorithm found the optimum choice of conversion sites, for various weights given to extinction risk, carbon, and cost. One restoration scenario, designed to optimize carbon and biodiversity, prevents 60% of extinctions that would otherwise be expected, and locks up almost 300 gigatons of CO₂ – about seven years of global emissions at today's rate.

The second study, led by IIASA researcher Martin Jung, looked at conservation, calculating its effect on biodiversity, carbon, and clean water provision. Unlike earlier studies, this included not only animals, but also plants. It concludes that managing just 10% of global land area can improve the conservation status of 46% of species, and conserve 27% of stored carbon and 24% of clean water. A detailed map of local benefits shows where people can get the greatest value for their conservation effort.



Global areas of importance for terrestrial biodiversity, carbon and water. — Areas of global importance for terrestrial biodiversity, carbon, and water. Jung, et al.

State of nature

Data on biodiversity is essential to guide the campaign, but that is often scarce.

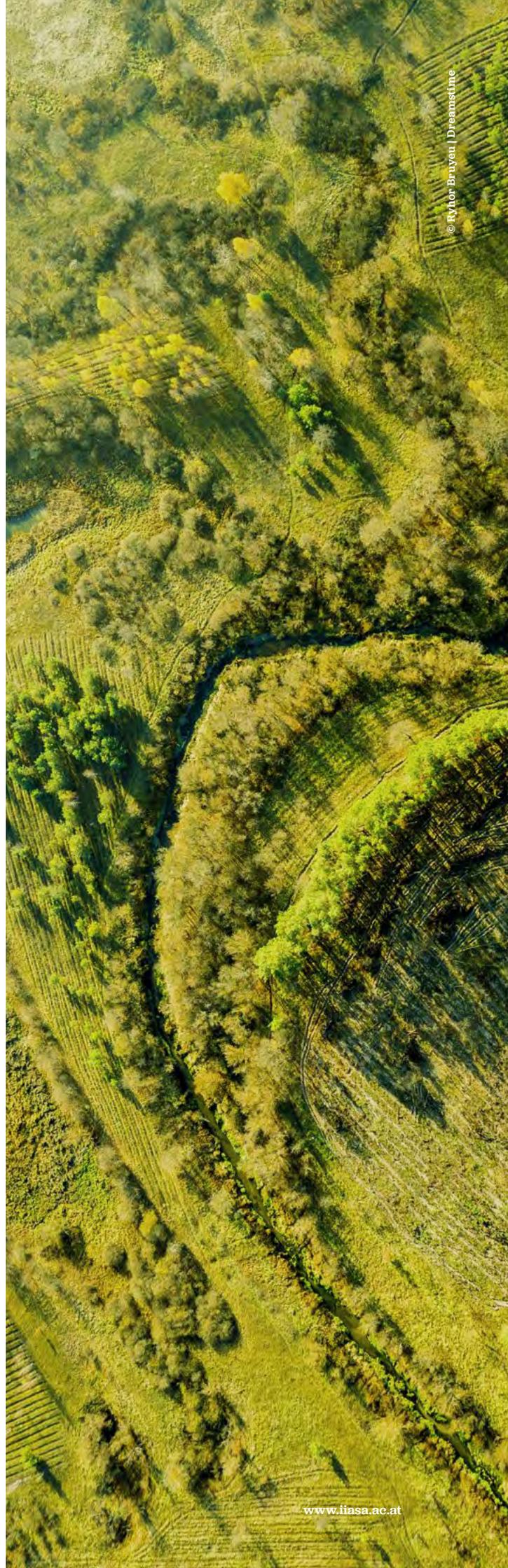
“Africa and South America in particular are missing huge amounts of data,” says Ian McCallum, head of the IIASA Novel Data Ecosystems for Sustainability research group.

The group is aiming to improve this situation, partly through novel data sources such as citizen science, imaging with drones, and lidar from satellites and aircraft.

“We use statistical techniques to harmonize data, in order to put it all together,” says McCallum.

McCallum also leads the stakeholder engagement effort of EuropaBON, the EU's biodiversity observation network project, aiming to identify critical gaps in data. Even though Europe is better covered than much of the world, there are still plenty of weak areas – particularly in aquatic habitats – and this project will help to drive data integration methods.

“In data-rich areas you can develop techniques to then scale up and use globally,” he notes.



Roots of biodiversity

A solid theoretical understanding could fill data gaps, and make policy-facing models more realistic. One aim is to understand why some ecosystems are so rich in species.

“All ‘why’ questions in biology have an evolutionary answer,” explains Ulf Dieckmann, a senior researcher in the IIASA Advancing Systems Analysis Program, who has spent 25 years at IIASA developing adaptive dynamic theory, a form of systems analysis that links ecology and evolution.

A striking success of this approach has been to show how rainforest plants can be so diverse. According to niche theory, each species adapts to fit a unique position in an ecosystem. Animals compete for different foods, which creates many niches; but all plants eat sunlight. Because of this, niche models had predicted that rainforests should have few types of trees, and only one shade-tolerant species. Real forests however have many shade-dwellers, which cast niche theory into doubt.

Dieckmann collaborated on a more realistic model, combining plant physiology, ecology, and evolution. It allows species to have two variable traits (height at maturity and leaf thickness). When tree-fall or fire opens up a new patch of forest, fast-growing colonizers move in, followed by slow-growers. In the model, evolution leads to a large number of shade-tolerant tree species with slightly different traits. It also shows realistic plant diversity in temperate forest, shrubland, and wooded riverbank. This kind of insight could inform conservation work.

“One could ask what ecological processes must be kept intact to preserve biodiversity?” says Dieckmann.

Plants also compete for water, and IIASA research scholar Jaideep Joshi is examining how that affects biodiversity.

“Even more ambitious eco-evolutionary models will take into account topography, soil microbiomes, and other factors,” Dieckmann adds.

Integrated future

As well as being a desirable outcome in itself, biodiversity affects other systems: for example, maintaining forest resilience and so keeping carbon locked up. IIASA is building a new integrated biosphere model, iBIOM, which could capture some of these effects, such as the role of insect pollination on crop yields.

As part of an overall integrated modeling framework now being developed at IIASA, iBIOM will help to explore the complex interplay between climate and biodiversity.

“This is a huge challenge,” says Leclère.

For one thing, models will have to capture land use in great detail, for example the effect of planting different plant species to sequester carbon. But the reward could also be huge, revealing which climate mitigation options are best for biodiversity – helping us fulfil the CBD’s 2050 vision to live in harmony with nature.

Further information:

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Even more ambitious eco-evolutionary models will take into account topography, soil microbiomes, and other factors

Ulf Dieckmann

INDONESIA AND IIASA

A burgeoning collaboration is exploring how to balance complex tensions over land use and other interlinked environmental issues.

As a vast and remarkably diverse archipelago of more than 17,000 islands, and the world's fourth most populous country, Indonesia faces very complex environmental questions.

"The urgency of addressing climate change, sustainable land use, and inclusive development were apparent to the government, but conventional approaches seemed to not be working," says Yos Sunitiyoso of the Bandung Institute of Technology in Jakarta, Secretary of Indonesia's IIASA National Member Organization. "Systems analysis is ideally suited to tackle such interlinked challenges, which led Indonesia to join IIASA in 2012. There were high expectations that IIASA could help us develop solutions to the pressing issues around sustainable development."

Chief among these issues is forest management. Indonesia holds more than 100,000 km² of tropical rainforest, behind only Brazil and the Democratic Republic of Congo; and agriculture is the main source of income for a large and growing population. Inevitably, this creates a clash over land use. Much natural forest has been replaced with palm oil plantations and other farmland, and there are many areas of burned forest and land in various states of abandonment or degradation.

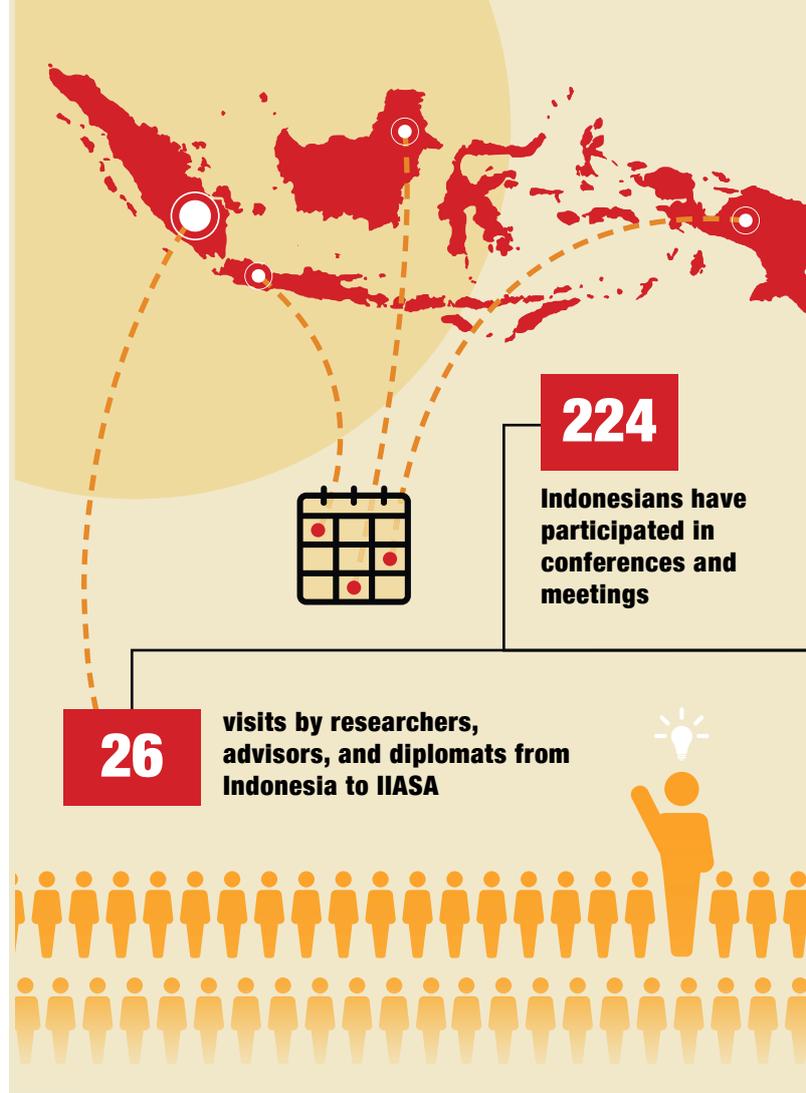
The RESTORE+ project is using systems analysis to reveal the trade-offs between economy and ecology.

"Our aim is to move beyond the simplistic argument: 'conserve forest' vs. 'exploit forest'," says IIASA researcher Ping Yowargana. "We need a higher-quality discussion, acknowledging both economic pressure and value in conservation."

The project is mapping vegetation across the country, then modeling how restoration options could affect crop yields, carbon stocks, and biodiversity, and finally using that to project the outcome of different policy scenarios. When discussions with stakeholders began, it became clear that this process would not be simple.

"It was natural for us to start by saying, let's identify where degraded areas are, then see what we can do," says Yowargana. "But our stakeholders would respond, 'that is an oil plantation generating income for the people, why do you call it degraded?' So we abandoned the concept of degraded land. Instead, we make maps of restoration potential. This involves classifying land cover into 10 categories, such as agroforestry, rubber monoculture, and logged forest (also known as secondary forest)."

The mapping project uses crowdsourcing. A platform called Urundata displays satellite images and asks people to classify land cover. Workshops with Indonesian



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2012**

remote-sensing experts provide insights into more sophisticated image interpretation. Results from both Urundata and the workshops inform an algorithm, which generates detailed land-cover maps of Indonesia.

Stakeholder input has also led to a more inclusive list of restoration options, including commercial options, such as agroforestry with oil palms, as well as reforestation with natural vegetation.

The final stage of the project will be to model various future scenarios. One focuses on conciliatory approaches such as agroforestry, another on strong policy enforcement. Other scenarios explore restoration using market-based mechanisms. The IIASA GLOBIOM model, tailored to Indonesia, will project outcomes for the economy, land cover, and climate.

These policy scenarios result from a back-and-forth dialogue with the Ministry of National Development Planning, part of their close collaboration with IIASA. Early stages of RESTORE+ informed the Ministry's 2017 Low Carbon Development Initiative report, which set a national agenda for green development.

"The challenges the ministry gave us were a great lesson in policy-science interaction: what's important is not only what the scientists think is important," says Florian Kraxner, IIASA Agriculture, Forestry, and Ecosystem Services Research Group Leader.

Areas of research collaboration



Ecosystem restoration



Negative emissions



Low carbon transition



Land use sustainability



Disasters: wildfires and floods



66

publications with research partners in Indonesia, about Indonesia, or by Indonesian IIASA researchers

7

participants of the Young Scientists Summer Program since 2011

12

research partners



“Our mission initially sounded simple – the “science to policy” household mantra of IIASA – but it turned out to be challenging in many ways, in managing the project, engaging people, and ensuring that insights from that engagement inform the different streams of research,” adds Yowargana.

The lessons learned should however keep providing value after the final report, in Indonesia and elsewhere.

“We have developed a suite of methods that can be picked up and improved,” says Kraxner.

Several Indonesian institutions were crucial in the collaboration. World Agroforestry Centre Indonesia provided maps, an agroforestry systems model, and expert knowledge; WWF Indonesia mobilized the crowdsourcing effort; and World Resources Institute Indonesia designed and conducted stakeholder workshops, and built the Urundata platform.

“They took the generic IIASA idea and made it work in a complex and specific national context,” notes Kraxner.

“We have many experiences where international research collaboration is relatively one-sided, with only limited roles for Indonesian researchers,” concludes Sunitiyoso. “RESTORE+ is a good example of how ideas from Indonesia were reciprocated in a joint activity.”

By **Stephen Battersby** Further info: www.iiasa.ac.at/indonesia

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INTERNATIONAL MODELING COLLABORATIONS CENTERED ON INDONESIA

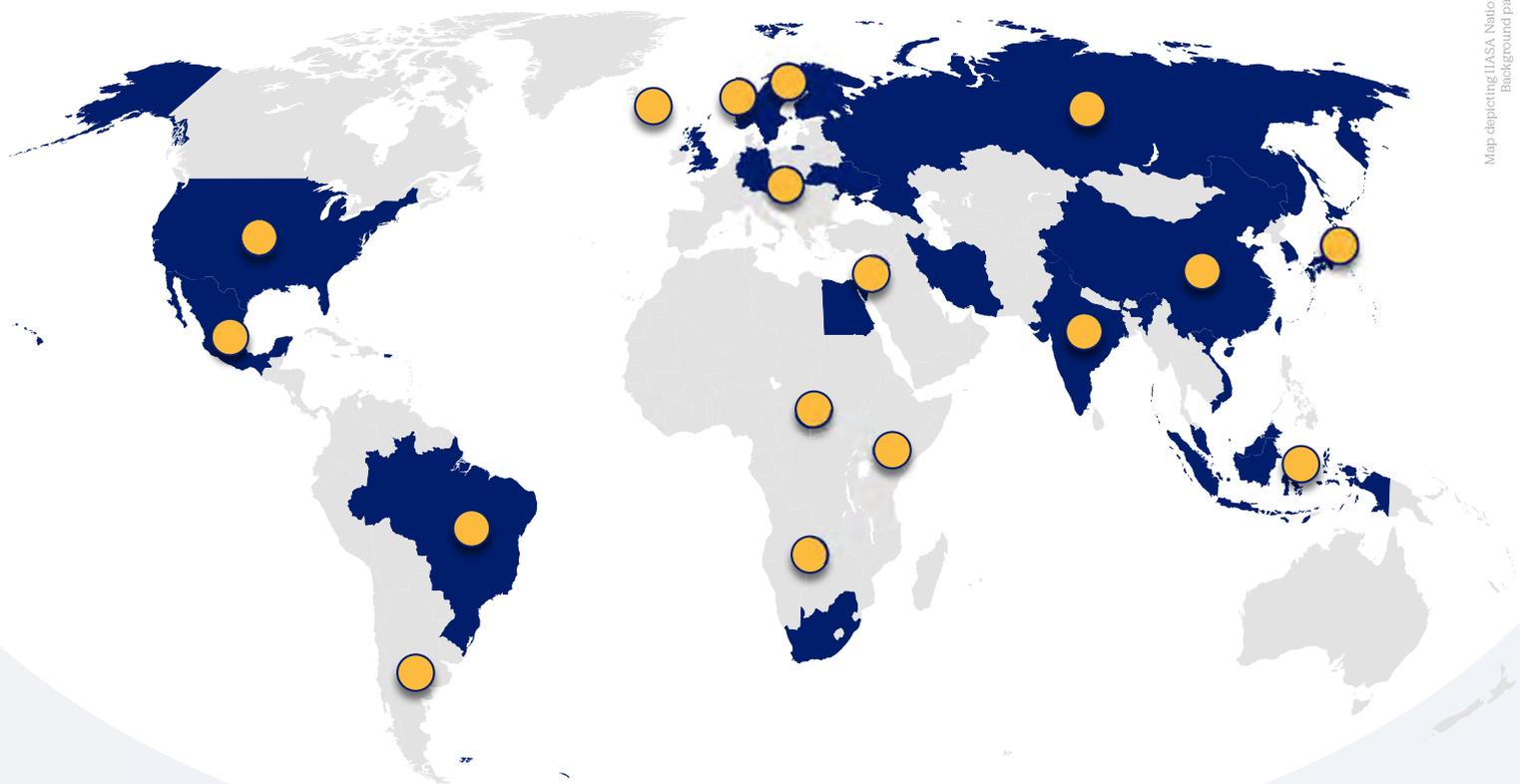
Other collaborations are tackling air quality, sustainable cities, resilience to natural disasters, water and energy issues.

For example, Indonesia has great potential for hydropower. Researchers from China and IIASA collaborated on a study of how climate change could affect hydropower on the island of Sumatra, accounting for the physical effects on river discharge, and the economics of installing and managing infrastructure. The study, performed with the IIASA BeWhere model, found that under a 1.5°C warming scenario, hydropower production increases to the point where it can cut 40 million tonnes of CO₂ from emissions – but under 2°C that drops to only 10 million tonnes. If warming therefore goes too far, it hampers efforts to mitigate climate change.

An IIASA collaboration with the Institute for Global Environmental Strategies (Japan) looked at approaches for treating wastewater from the fish processing industry. Using the GAINS model to assess different technologies and governance options, the study showed that some wastewater treatment approaches would generate considerable methane and carbon dioxide emissions. “By exploring different trade-offs, it is possible to identify the option delivering the maximum benefits for both climate and water,” says IIASA researcher Adriana Gómez-Sanabria.

Global research highlights

IIASA researchers collaborate with colleagues from member countries and partner institutions around the globe to develop holistic, systems-based solutions and provide policy advice for some of the most pressing problems society faces today.



Map depicting IIASA National Member Organizations in 2020
Background pattern: © Statline5588 | Dreamstime

IIASA cohosted an online symposium with the **Russian** Presidential Academy of National Economy and Public Administration to share recent research and discuss challenges that demographers may face in studying demographic consequences of COVID-19.



As part of the Peking University (PKU)-IIASA Postdoctoral Program, IIASA hosted two joint postdoc fellows working on Water-Energy-Land nexus modeling and on regional water security for the countries of the **Chinese** government's Belt and Road Initiative.



Innovative water modeling and scenario assessment tools developed at IIASA are helping policymakers in **East Africa** to identify the principal needs for effective water management policies and improve water management in the region.



In a multi-institute collaborative effort, researchers explored the impact of different combinations of non-pharmaceutical interventions to curb the spread of COVID-19 on reducing deaths, health demands, and lowering healthcare costs in **Sweden**.



IIASA provided essential support in the development of the EU's Second Clean Air Outlook through model calculations carried out with the IIASA GAINS model.



IIASA researchers are assisting with the development of a National Forestry Accounting Plan and Forest Reference Levels for Iceland and Norway.



In Israel, a country suffering from chronic water shortages, IIASA researchers are co-developing a water resources management tool with Israeli colleagues.



Researchers created different scenarios of the effects of economic measures to tackle the COVID-19 crisis in Austria using a novel economic model developed at IIASA.



An IIASA-led study used systems analysis methods to measure trade interdependencies between US states and found that the country's current food supply chain is often not optimized for using available natural resources.



IIASA works with the Ministry of Environment, Forest, and Climate Change in India (MoEFCC) to develop tools to assist Indian government agencies in evaluating targets for the Sustainable Development Goals (SDGs).



IIASA is providing modeling support to Argentina, China, and India to develop their Long-term Climate Targets (LTS) and Nationally Determined Contributions (NDCs) to the Paris Agreement with the objective of strengthening climate related policymaking, while simultaneously strengthening the capacities in local institutions to carry forward this work.



NatureMap, an integrated global map of biodiversity, carbon storage, and other nature services, is now being applied in several countries, including Brazil, Indonesia, and Mexico. The work will contribute to decision making at the Convention on Biological Diversity and the Climate Change COPs taking place in China and the UK respectively.



An IIASA-led study found that to ensure universal access to affordable, reliable, and modern electricity services in sub-Saharan Africa by 2030, the pace of electrification must more than triple.



In 2020, IIASA joined forces with SAS, a global leader in analytics, innovative software, and services, to help fight deforestation and protect the planet using the next generation of crowd-driven artificial intelligence (AI).



Using a new analytical tool capable of simulating an optimal mix of public fund allocations and financial protection instruments for disaster risk reduction, IIASA researchers collaborated with colleagues in Japan to support the systematic analysis of public investment decisions in vulnerable African countries.



The highlights include selected activities only, they are not comprehensive and do not aim at providing an overview of IIASA's regional research and policy activities.

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Adapting to droughts in South Africa

One of the biggest challenges to global food security is drought. This is especially true for smallholder farmers, who often have limited access to resources for responding to droughts. While household resource availability varies, a lack of access to secure and adequate land, as well as water-storage and irrigation infrastructure are persistent problems for many smallholders.

In a recent publication, IIASA researcher Adam French and colleagues presented findings from a study in South Africa's Western Cape Province. The study assessed impacts of the 2015-2018 drought on smallholder farmer livelihoods, as well as the coping and adaptation strategies used.

Collecting and analyzing data from face-to-face interviews and focus groups, the researchers found that both government and private sector support improved smallholder coping strategies. Additionally, the findings indicate that information sharing and social network participation helped some farmers adapt. Formalizing structures for learning and knowledge sharing, as well as refining mechanisms for distributing aid, were also found to be important to enhancing future drought preparation and response.

"Smallholder farmers in the Western Cape of South Africa are particularly vulnerable to the region's recurrent droughts," explains French. "Policymakers should consider the insights of this locally-led research into coping and adaptation strategies employed by smallholders during the country's historic drought of 2015-2018. In particular, the findings related to inter-household diversity in drought response and adaptive capacity have potential to inform more targeted and effective support for building resilience to future droughts."

Further info: pure.iiasa.ac.at/17016

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Improving water security in East Africa

East Africa is the world's fastest growing region, with GDP increasing by 5% or more each year for the last decade. Part of this growth can be attributed to the East Africa Vision 2050, an initiative launched in 2015 by the Head of States of the East African Community to increase development while protecting the environment. A large focus of this effort is achieving water security for the region, even as demand increases from population and economic development.

Through a partnership with the Lake Victoria Basin Commission (LVBC), IIASA researchers are helping to identify pathways to sustainable development. IIASA researcher Sylvia Tramberend and colleagues have developed water scenarios for 2050 that take socioeconomic, climate change, and environmental factors into account.

Because agriculture was shown to be a key driver of water demand, IIASA and other stakeholders focus on scaling up resilient water and agricultural systems (scaleWAYS) in the extended Lake Victoria Basin. Stakeholders have selected rice and livestock-fodder systems for studying up-scaling potentials in the region.

"Co-development is imperative for research and the implementation of potential solutions," says Tramberend. "The Lake Victoria Basin in East Africa is a hotspot of socioeconomic and environmental change. Achieving sustainability goals here can leverage development opportunities beyond just East Africa. The institute's partnership with the LVBC has enriched our research approach and we are committed to following a joint approach to supporting and facilitating science-based decisions about sustainable management of natural resources in the region."

Further info: www.iiasa.ac.at/wfas-eastafrica
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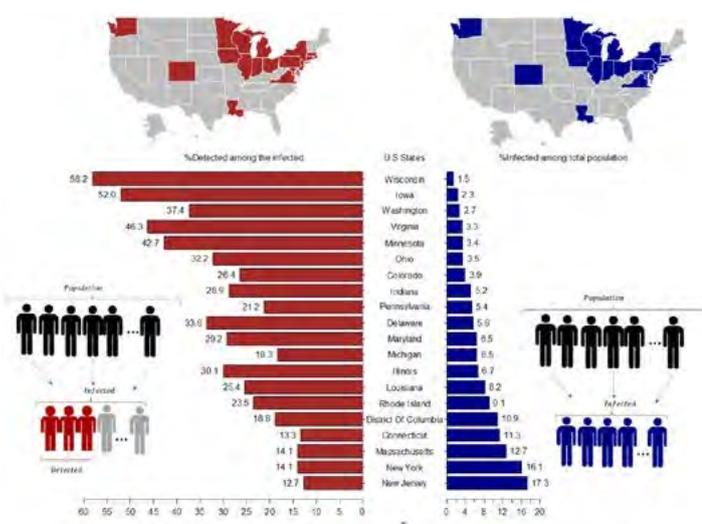


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Regional impacts



Estimated fraction of people ever infected among the total population and fraction of people detected among the ever infected across states with stable case-fatality rates as of September 8, 2020.

Getting a fuller picture of COVID-19 infections

One of the biggest challenges during the COVID-19 pandemic has been accurate testing and detection rates of the virus. In fact, most countries detected only 60% or less of all infected cases by September 2020. IIASA researchers endeavored to bridge this gap.

Led by Alexia Fürnkranz-Prskawetz and coauthors from the Wittgenstein Centre for Demography and Global Human Capital, the study analyzed the results from 3,000 likely parameter sets of an epidemiological model. The technique was applied to the US due to the country's regional diversity and because the US accounted for almost a quarter of all global confirmed cases and deaths by September 2020.

The model depends on the lethality of the virus and not contagiousness, which means more contagious mutations of the virus do not affect the results. The findings suggest that non-pharmaceutical interventions, such as social distancing and masks, have been key to containing the virus and preventing future waves.

"The number of COVID-19 infections is key for accurately monitoring pandemics. A number of challenges, however, such as varied testing policies and availability, prevent accurate detection of all cases," explains Fürnkranz-Prskawetz. "Previous studies aimed at reaching a more accurate number by retroactively assessing infections, but they are lacking in scope and often confined to a specific population subgroup. Our research combines the reported number of COVID-19 deaths with population data and case-fatality rates to indirectly estimate the fraction of people ever infected and the fraction of people detected among the infected."

Further info: pure.iiasa.ac.at/17014

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Understanding the impacts of climate change

The Green Climate Fund was established as part of the Paris Agreement to help developing countries mitigate emissions and adapt to climate change.

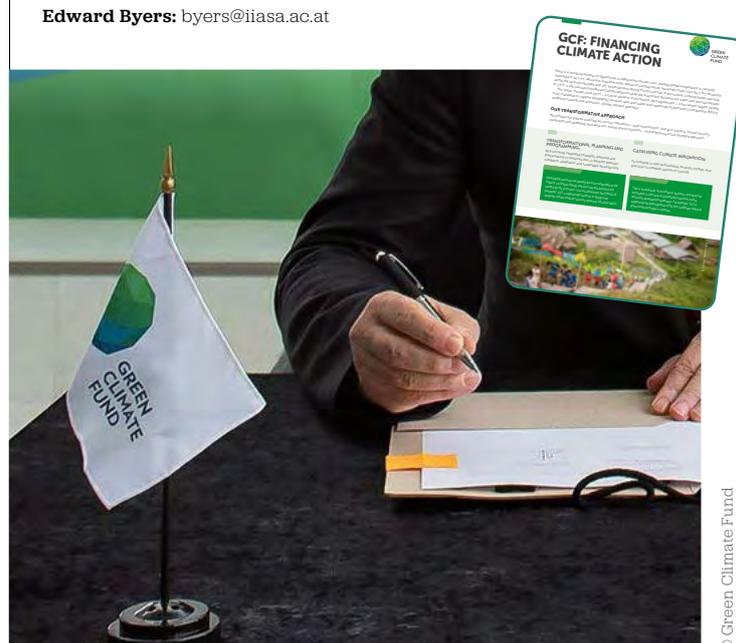
One of the aims of the organization is to develop institutional capacities to deliver climate action agendas, which was the mandate of a recent consortium involving IIASA, Climate Analytics in Germany, and the Center for Clean Air Policy in the US. Together, the group delivered technical assistance to help nine developing countries, including Mexico and Nicaragua, better understand climate mitigation and adaptation issues.

Efforts were focused on helping to build institutional capacity on climate strategies. Services offered by the consortium included climate finance and policy mapping, climate risk profile, macroeconomic impact analysis, and IIASA-led research on vulnerability assessments, greenhouse gas inventories, and energy systems modeling.

Vulnerability assessments combined data from different models to calculate 14 indicators for scenarios of socioeconomic and climate change and to further understand to what extent the population and land area is exposed. The research shows how emissions mitigation and pursuing an agenda to reduce socioeconomic vulnerability would benefit these countries significantly.

"This group has worked diligently to build capacity on mitigation and adaptation to climate change," says IIASA researcher Edward Byers, who was one of five IIASA staff members involved in the project from 2019-2021. "In Mexico and Nicaragua, we worked directly with government agencies to assess climate vulnerabilities. This capacity building will help these countries target action to help the most vulnerable populations."

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Toward better bioenergy efficiency in Malaysia

Malaysia relies heavily on the production of palm oil for cooking and the production of oleochemicals. However, increasing palm oil production has led to the generation of excess agricultural wastes in the country. Effective use of agricultural wastes for bioenergy can potentially improve resource efficiency in the palm oil sector. IIASA research has helped to identify optimal national policy configurations for promoting sustainable bioenergy production in Malaysia.

The study's analysis shows that bioenergy could contribute up to 30%, 27%, 22% and 6% substitutions, respectively, of the country's long-term electricity, industrial heat, diesel, and gasoline demands. This could lead to as much as 58 million tonnes per year of carbon dioxide emission reductions by 2050.

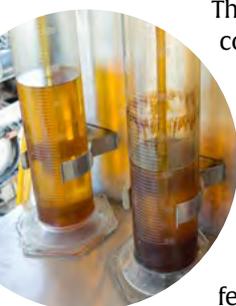
Additionally, the researchers showed that as much as 40% of the country's biomass feedstock would remain available for use in agriculture and other industries.

"We developed a specific BeWhere-Malaysia model and the results were promising in terms of increasing sustainable bioenergy production combined with emission reduction targets," explains study coauthor and IIASA researcher Sylvain Leduc.

"Our study opens new opportunities to develop an assessment for Southeast Asia on improving the sustainable use of oil palm in order to benefit the bioenergy industry and climate targets, as well as afforestation," adds first author Muhammad Nurariffudin Mohd Idris, an alumnus of the IIASA Young Scientists Summer Program (YSSP). "Coordination of policies on the production of bioenergy among the national sectors involved is key to achieving Malaysia's nationally determined contributions at a lower cost."

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Tackling air pollution in India

Air pollution, linked to several million cases of premature deaths each year, is the largest environmental risk to human health worldwide. The problem is especially bad in India, one of the world's most polluted countries.

A recent World Bank report highlighting IIASA research examined the actions and policies of megacities to tackle air pollution. Part of a long-term collaboration between IIASA and the World Bank on identifying cost-effective strategies for air quality management in China, India, South Africa, and Vietnam, the report offers lessons on how governments can tackle the growing challenge of air pollution by examining Delhi, Beijing, and Mexico City.

The research, led by IIASA researcher Pallav Purohit, shows that a large portion of air pollutant emissions in India originates from solid fuel used for cooking, poor waste management practices, and crop residue burning—all of which are associated with poverty and underdevelopment. However, sources of pollution are only partly within large cities. As much as 60% of air pollution in Delhi is caused by fine particulate matter that originates from outside the city.

"There is no silver bullet for solving the problems associated with air pollution and only sustained political commitment will address this very serious issue," explains Purohit. "Achieving clean air, which would save millions of premature deaths annually, needs integration over multiple policy domains, including environmental policies focusing on pollution controls, energy and climate policies, and policies to transform the agricultural production system."

Further info: www.iiasa.ac.at/news/pollution-20

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Co-creating digital tools to address misinformation in the social media age

Misinformation is a problem that long pre-dates current times. However, social media and other digital technologies have made the spread of misinformation nearly universal and its impact far broader.

When people use social media, they are using emotional reasoning, which greatly amplifies the impact of misinformation. This emotional reaction can lead to preconditions and prejudices, which result in discrimination, intolerance of differing viewpoints, and unjust treatment of certain social groups.

Developing digital tools that deal with misinformation in social media may be the solution, according to new research. Co-Inform, an IIASA project funded by the European Commission, develops digital tools such as a browser plugin and a fact-checking dashboard to stimulate critical thinking and the desire for social media users to search for more information.

The goal of these tools is to decrease the influence of instinctive and emotional reactions and activate more rational reasoning. Researchers involved journalists, citizens and decision makers in Austria, Greece, and Sweden to gain diverse perceptions and worldviews to create these tools. One of their primary goals was to preserve freedom of choice while avoiding censorship, and to create a variety of tools to increase their usefulness.

“The co-creation of digital tools is invaluable for addressing misinformation online,” explains IIASA researcher Nadejda Komendantova. “However, journalists, policymakers, and citizens have very different expectations around the features of these tools. These expectations have to be addressed to increase the usability of the tools.”

Further info: pure.iiasa.ac.at/17013

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Analyzing environmentally sustainable diets in the European Union

Malnutrition is growing among European adults, as more than half of the population is overweight or obese, with very low adherence to recommended dietary needs. This also correlates to a recent increase in diet-related cardiovascular deaths. Additionally, the production of unhealthy foods is closely tied to negative environmental impacts. In the European Union, agriculture is responsible for 10% of greenhouse gas emissions and losses in reactive nitrogen, which poses a substantial risk to air, soil, and water quality.

IIASA researchers Stefan Frank and Petr Havlik contributed to research that looked at consumer-side interventions and how effective they may be in helping European adults transition to diets that are both more nutritious and environmentally sustainable. The study combined the implementation of dietary targets derived from nutritional insights of recent literature with modeling that incorporates the overall socioeconomic context, and return food system implications of these diet policies. The models solve for the necessary price changes to reach these dietary shifts at EU population level.

“Recent research clearly shows that unhealthy eating habits impact overall health and the environment,” notes Frank. “A combination of food group taxes, behavioral policies targeting consumer preferences, and supply side measures targeted at producers will help the EU hit its sustainable development goals by 2050. Our research contributes to a body of work that makes it increasingly clear that now is the time to act.”

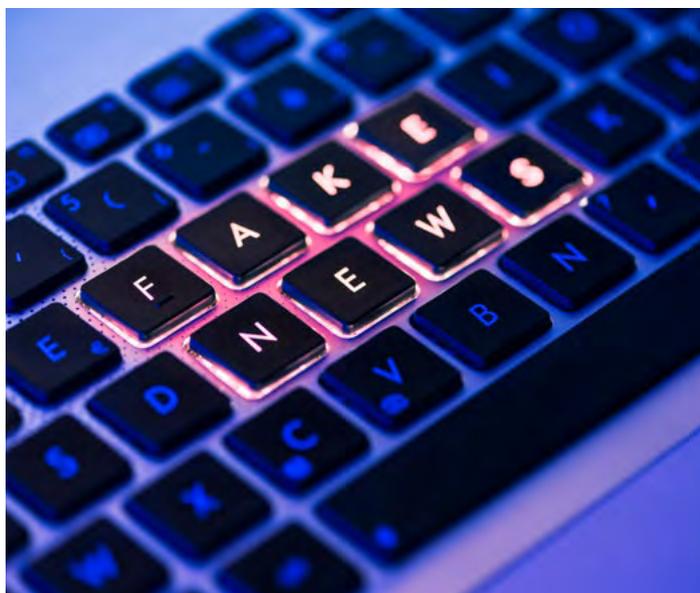
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IIASA alumna and current Director of International Affairs and Science Diplomacy at the American Association for the Advancement of Science (AAAS), **Kim Montgomery**, highlights the role of science diplomacy in successfully addressing global challenges.



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Advancing global scientific collaboration



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The world is facing global challenges ranging from the current COVID-19 pandemic to climate change and food and water insecurity. Science will be central to the progress of solutions and diplomacy will be needed to ensure their development and implementation. Thus, scientists, decision makers, and governments – at the local, national, regional, and global levels – must work together. This will not be an easy task and it will require greater understanding and cooperation between the scientific, policy, and foreign affairs communities.

A framework for science diplomacy was developed through a meeting hosted by the American Association for the Advancement of Science (AAAS) and the Royal Society of London (RS) in 2009. The report, published in 2010, reviews the framework's three dimensions of science diplomacy: (1) science in diplomacy where scientific evidence informs policymaking, (2) diplomacy for science to foster international scientific cooperation, and (3) science for diplomacy to utilize science's soft power to improve relations between countries.

As part of my current role as the Director of International Affairs and Science Diplomacy at AAAS, I have the privilege to direct the Center for Science Diplomacy. Established in 2008, the center provides thought leadership through its *Science & Diplomacy* journal, collaborates with international partners including The World Academy of Sciences (TWAS) to offer science diplomacy trainings, and works to establish and maintain scientific collaborations even when diplomatic relations are strained or severed.

IIASA is an affiliate of AAAS, which is personally exciting for me as an IIASA alumna and member of the IIASA community. The institute is a leading example of a

science diplomacy institution that was founded to promote scientific collaboration between the West and the East. Its charter, signed at the RS headquarters in London in 1972, structures an organization with science diplomacy goals – decades before the RS and AAAS conceptualized the framework of science diplomacy.

Working in external relations at IIASA was instrumental in expanding my science policy experience, which had been developed working at US science agencies and for the US Congress, to include firsthand experience in international science. I had the opportunity to work with national member organizations to highlight and foster member activities, as well as initiate a value proposition for IIASA membership. This experience provided me with insights into the opportunities and potential roadblocks to international scientific collaboration.

With global challenges spanning borders and science and technology driving towards solutions, there is an increasing role for science diplomacy. I am excited to utilize my experiences in academia, policy, and international organizations to help bridge the scientific, policy, and foreign affairs communities. To effectively do that, however, a coalition involving diverse scientific disciplines and policy stakeholders from local, national, regional, and global levels is needed. I look forward to working with AAAS' partners, including IIASA, to strengthen that coalition and meet this pressing need for science diplomacy.



Kim Montgomery: kmontgomery@aaas.org

Kim Montgomery with Leigh Turner (UK Ambassador to Austria and UK Permanent Representative to the United Nations) and Albert van Jaarsveld (Director General and CEO, IIASA). © Markus Rauchenwald | IIASA

Interview

The new IIASA Strategic Initiatives (SI) Program works closely with the IIASA National Member Organizations (NMOs) to identify global and regional initiatives of high strategic impact to continuously push the boundaries of systems analyses in an environment that is relevant to both policy and society at large. Monika Bauer sat down with **Tyseer Aboulnasr**, Chair of the IIASA Committee for Egypt to discuss her participation in a series of workshops that aimed to set the agenda for the new program's research activities.



Charting a course for IIASA strategic initiatives

Q. Tell us about your experience participating in the SI Program workshops and what benefits such consultations hold for Egypt and other IIASA NMOs?

A. Given that this was the first consultation of its kind, I was not sure what to expect. However, we were extremely delighted that IIASA is consulting with the NMOs to understand their priorities and to engage them in choosing the direction of the winning projects that will be pursued under the auspices of the program. In this way, IIASA is ensuring the engagement of its stakeholders from the start, which increases the likelihood of transferring IIASA knowledge and expertise to NMO communities once the project is completed. The workshops were well organized and allowed NMO members to express their views, thus allowing for a broader perspective and better appreciation for common problems. I am looking forward to hearing which projects are chosen and to the opportunities for continued engagement with them. I sincerely hope that such consultations are a general direction IIASA will continue to pursue and not just for the Strategic Initiatives Program.

Q. What would you like to see as an outcome from this initiative in the future?

A. It would be great if we can take this type of collaboration a step further. Once projects are selected by IIASA, the NMOs can, for instance, identify researchers from their countries to engage with IIASA researchers as stakeholders, thus providing better regional context and possibly conducting their own projects related to the institute's work and sharing results regularly rather than just at the end. There would be no transfer of funds, no "required" work, just interested researchers connecting to achieve common goals and produce exceptional scientific work grounded in and connected to realities on the ground.

Q. What was your biggest take away from the experience?

A. My biggest take away was that IIASA regards NMOs as partners and not just as a source of funding. Engaging with NMOs in charting the direction of the SI Program's priorities, really creates a sense of responsibility on the NMO side — that we as NMOs must become actual productive partners in and not just recipients of the institute's work. In other words, IIASA is working with NMOs to provide exceptional scientific outputs that they can use to do good, each in their own region. This enables us to truly work together to fulfil the goals IIASA was founded to achieve — bringing people together from East and West, North and South to collectively make the world a better place.



Message from the director

“ The last year and a half has been extremely disruptive for everyone. The COVID-19 pandemic and consequent lockdown measures fundamentally changed the way we work and live. The crisis has revealed striking gaps in our interconnected world. Despite this, IIASA continued to produce impactful research and to collaborate internationally. In 2020, 439 peer-reviewed articles were published – that’s almost 40 more items than in 2019. The institute – together with the International Science Council (ISC) – also launched the IIASA-ISC Consultative Science Platform “Bouncing Forward Sustainably: Pathways to a post-COVID world”. The platform serves as a global hub for collaboration among scientists, policymakers, and civil society. The outputs of the initiative, which are supported by an advisory board under the patronage of the former Secretary-General of the United Nations, H.E. Ban Ki-moon, include a series of reports with key messages and recommendations for policymakers on how to help find a way forward and apply systemic thinking in a post-COVID world.

The implementation of the new IIASA Strategy 2021-2030 is well underway, as is the development of the new IIASA Research Plan 2021-2024. The plan aims to position IIASA as the primary destination for integrated systems solutions and policy insights into the emergent challenges and threats to global sustainability through increased innovation, integration, and agility. Next year, the institute will celebrate its 50th anniversary. I am excited to take the opportunity to both look back at 50 years of IIASA and look forward to the next 10 years of strategic IIASA research.

ALBERT VAN JAARVELD

INSTITUTE NEWS

By Bettina Greenwell

Awards for outstanding young scientists



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Four researchers from the 2020 virtual Young Scientists Summer Program (YSSP) have been recognized for their papers. Setu Pelz from the Europa Universität Flensburg, Germany, and Johns Hopkins University, USA, won the IIASA Peccei Award for his analysis on the impacts of grid electricity access on rural non-farm entrepreneurship and employment in Ethiopia and Nigeria. Bernardo Buarque from University College Dublin, Ireland, received the IIASA Mikhalevich Award for his study: “Evolving the knowledge space: Towards a selection dynamics model of patent classes”.

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

Fellow YSSP participants Janet Molina Maturano from Ghent University, Belgium, and Simon Plakolb from the Technical University and the University of Graz in Austria received honorable mentions for their work. In her paper, Maturano developed a SDGs-guided toolkit taking into account responsible scaling of citizen science projects for farmers. Plakolb’s study investigated “Using the Future State Maximization paradigm to analyze the emergence of socially sub-optimal mobility behavior”.

“There were some exciting moments due to the inspiring research we got to know during the virtual presentations and discussions, but also times of wishing I could get to know people at IIASA and other YSSPers in person. Overall, it has however been a really worthwhile and interesting experience. I highly recommend it,” says Maturano.

Further info: www.iiasa.ac.at/yssp/awards



European Research Council funding news

Five IIASA researchers have won grants from the European Research Council (ERC) to lead groundbreaking projects looking into the dynamics of global change.

ASSESSING POPULATION TRENDS

IIASA Population and Just Societies Program Director, Raya Muttarak, was awarded an ERC Consolidator Grant for the Population Dynamics under Global Climate Change (POPCLIMA) project. She and her team will investigate how the changing climate has affected, and will affect, future population trends. The aim is to gain insight into the socioeconomic costs of climate change and provide more realistic population projections.

“The new projections take into account the impact of climate change and help the design of policies that protect vulnerable subgroups of the population,” says Muttarak.

The ERC also awarded Sergei Scherbov, senior researcher in the Population and Just Societies Program, a 2020 Proof of Concept grant to develop research as part of the ReAging project.

“With this research we present an innovative methodology that produces scenarios of equitable normal pension ages using the details of a specific pension system. The project shows how fairness can enter public policy discussions of aging,” notes Scherbov.

CLIMATE CHANGE AND NEW TECHNOLOGIES

Energy, Climate and Environment Program Director, Keywan Riahi, was awarded the GENIE project (GeoEngineering and Negative Emissions pathways in Europe). Funded by an ERC Synergy Grant and working with colleagues from MCC (Germany) and Aarhus University (Denmark), Riahi aims to identify if, how, where, and when to use negative emissions technologies effectively. The project will provide an urgently needed interdisciplinary perspective of risks and opportunities of these technologies.

“The aim is to bring social science into energy system models. We want to understand and include soft factors, such as public perception and social learning, which

are underrepresented in current integrated assessment models,” explains Riahi.

In addition, IIASA researcher Charlie Wilson has been awarded an ERC Consolidator Grant to study how the digitalization of our everyday lives impacts climate change and to explore how it can be steered to help, rather than hinder climate action.

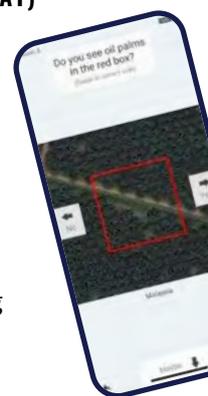
The Impacts of Digitalized Daily Life on Climate Change (iDODDLE) project aims to develop an evidence-based program of action to support policymaking aimed at ensuring that digitalized daily life helps tackle climate change, including the quantitative systems analysis of energy and material flows.

CROWD-DRIVEN ARTIFICIAL INTELLIGENCE (AI)

The development of the crowdsourcing game Picture Pile, which is funded by an ERC Proof of Concept Grant, aims to provide users with the opportunity to run their own crowd-sourced image classification campaigns, which can then train AI algorithms.

“The new platform will address the current gap in the market for a platform that allows users to build their own quality controlled crowdsourcing campaigns to collect image classifications in an efficient and fair way, and then make the data collected openly and freely available. Once the platform has been built, the running costs will be low, and the overall benefit for society will be tremendous,” explains IIASA Strategic Initiatives Program Director, Steffen Fritz, who is developing the platform within the Advancing Systems Analysis Program as part of the Novel Data Ecosystems for Sustainability Research Group.

Further info: www.iiasa.ac.at/erc





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IIASA regional conference: Systems Analysis in Eurasia

Systems analysis is a problem-solving process in which many people participate: scientists of relevant disciplines, stakeholders, and decision makers. To foster dialogue between the research and policy community, IIASA cohosted the Systems Analysis in Eurasia conference in Moscow from 13-15 April 2021 in a hybrid format – combining online and in-person attendance.

The conference, co-hosted by the Russian Academy of Sciences (RAS), the Russian Foundation for Basic Research (RFBR), the National University of Science and Technology MISIS (NUST MISIS), the Austrian IIASA Committee at the Austrian Academy of Sciences, the Finnish Committee for IIASA, and the Committee on Data of the International Science Council (CODATA), supported by the Systems Analysis Committee of the RAS and the Geophysical Center of the RAS, explored how the multilateral application of systems analysis can be used to address societal challenges.

The conference built on existing expertise in the systems analysis communities in countries across the Eurasian region to discuss and analyze transformative approaches to achieving sustainability across multiple sectors and regions. It attracted 27 high profile speakers from 13 countries, along with a physical and virtual audience of over 700 viewers.

It was the third meeting in a series of IIASA regional conferences to foster dialogue between research and policy communities. The first of these conferences was the Americas regional conference co-hosted by IIASA, CAPES, the US National Academies of Sciences, and the Getulio Vargas Foundation, which took place in Rio de Janeiro, Brazil, in September 2019. The second conference was the African regional conference, co-hosted by IIASA, the National Research Foundation (NRF) South Africa, and the Egyptian Academy of Scientific Research and Technology (ASRT), which took place in Pretoria, South Africa, in December 2019. The next regional conference will be in Asia in collaboration with the National Natural Science Foundation of China.

By **Bettina Greenwell** Further info: www.iiasa.ac.at/eurasia21

NEW APPOINTMENT FOR NAKICENOVIC

IIASA Emeritus Research Scholar Nebojsa Nakicenovic was one of three new members appointed to the Group of Chief Scientific Advisors to the European Commission. The group of seven eminent scientists are appointed in their personal capacities to provide independent scientific advice to the European Commission to inform policymaking and provide recommendations to improve the interaction between policymaking and scientific advice. The Prestigious Earth and space science award for Wadation, Research, Culture, Education and Youth.

www.iiasa.ac.at/news/20-scientific-advisor

PRESTIGIOUS EARTH AND SPACE SCIENCE AWARD FOR WADA

IIASA Biodiversity and Natural Resources Program Director, Yoshihide Wada, was awarded the American Geophysical Union's James B. Macelwane Medal 2020, widely considered as the highest honor for early career scientists in the fields of Earth and space science. The medal is given annually to three to five early career researchers for significant contributions to the geophysical sciences.

www.iiasa.ac.at/news/AGU-medal

ALL-WOMEN AUTHORED PAPER ON COVID-19 PANDEMIC

IIASA researchers Benigna Boza-Kiss and Caroline Zimm, and Transformative Institutional and Social Solutions Research Group Leader, Shonali Pachauri, have combined their expertise in the fields of energy, social, and sustainability science to analyze how the COVID-19 pandemic and related containment measures have exacerbated urban inequalities. Their efforts have culminated in a paper on deprivations and inequities in cities viewed through a pandemic lens.

pure.iiasa.ac.at/17121



Ayelet Davidovitch

As a postdoc in the IIASA-Israel Program from 2018 to 2019, Ayelet Davidovitch developed policy-relevant scenarios to support identifying trade-offs and synergies related to the Israeli energy system transition that is expected to take place in the coming decades. The research was conducted in the former IIASA Energy Program in cooperation with the Israeli Ministry of Energy, the Israeli Ministry of Environmental Protection, and the National Economic Council, and aimed to support Israeli decision makers in answering questions related to energy policy and environmental protection. It directly addressed the vision of the Government of Israel to transition to renewable energy.

Davidovitch is currently a research scholar in the Porter School of Environmental Sciences at Tel Aviv University, where she focuses on the

integrated assessment of energy economics, energy modeling, and climate change. More specifically, she is continuing the research she was involved in during her IIASA postdoc by exploring the interplay between consumer preferences for alternative fuel vehicles and energy supply, using the IIASA Message-Transport model (MTix) with modifications to country-level. The research team includes senior researchers from the IIASA Energy, Climate, and Environment Program and Tel Aviv University. The project will support the readiness of the transportation sector for new, upgraded energy technologies and facilitate the formulation of policies to encourage the use of alternative fuel vehicles.

“My time at IIASA significantly impacted my career. The unique atmosphere and international cooperation allowed me to develop my research and academic capabilities during my postdoc. My on-going collaboration with the IIASA Energy, Climate, and Environment Program is special. Everyone shares the same vision and is dedicated to the mission. This truly creates a family environment where everybody is there for each other,” she concludes.

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By **Monika Bauer**

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BRINGING TOGETHER THE GLOBAL SYSTEMS ANALYSIS NETWORK

Develop or join relevant groups to promote your research, share best practice, and share other targeted information.

Build and Coordinate your virtual events, workshops, and activities as part of your research activities.

Cocreate, and build communities of practice to bring information together into a shared, closed workspace.



People profiles

Bridging science and policy

Marie Franquin is a neuroscientist striving to find new ways to bridge the divide between science and policy and communicate their impact on our lives.

Franquin joined IIASA in September 2020 as External Relations Officer in the Communications and External Relations Department. Her journey has taken her from Paris to London to Montreal to Vienna, which necessitated relocating during the pandemic. While her background is in neuroscience, Franquin discovered her passion for science policy in Canada when she joined the Science and Policy Exchange, of which she is currently Internal Director.

“While I am familiar with the science to policy interface, I have never been so close to systems analysis research in the past. Here at IIASA, I am learning how this research can directly influence policies and how to maximize its impact. I have also started building relationships with our National Member Organizations (NMOs). The cultural and scientific background of our NMOs and collaborators represent a unique strength for the institute and I hope to be able to support the continuation of an open and dynamic dialogue with our stakeholders around the world,” notes Franquin.

Her science to policy work in Canada focused on giving a voice to the next generation of scientists, in particular on topics such as redefining excellence and promoting equity, diversity, and inclusion in academia. At IIASA, she hopes to keep applying these skills and knowledge in support of the institute's strategy for the next decade.

By **Monika Bauer**

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Working on water

Taher Kahil studies the growing challenges to water security and investigates innovative solutions.

Kahil grew up in Tunisia, in a village famous for its copious water supplies.

“We have the remains of a sacred fountain there called the Water Temple, where the Romans took water to send through an aqueduct to Carthage,” he says.

Due to rising demand, the mountain springs have however begun to dry up, and people now have to pay for water that was once free.

Kahil came to IIASA in 2015, after completing a PhD at the University of Zaragoza in Spain during which he developed hydro-economic models.

“My perspective is to bring economic thinking into water management problems – how water can be allocated in a more economically efficient way,” says Kahil.

To do this, he has developed the Extended Continental-scale Hydro-economic Optimization model (ECHO). This calculates the most cost-effective ways to supply water for agriculture, industry and homes while preserving aquatic ecosystems. The model has been used to look at Africa as a whole, and to zoom in on the Ebro, Jucar, Lake Victoria, Yangtze, and Zambezi basins. Kahil also uses cooperative game theory to ensure that water allocation is equitable as well as efficient.

“We have had significant impact with the Lake Victoria basin – influencing plans for development and sustainable investment.”

In January 2021, Kahil was appointed Research Group Leader of the new IIASA Water Security Research Group.

“We are now setting up a global version of ECHO, linked to other in-house models,” he says. “I think that will be unique.”

By **Stephen Battersby**

Taher Kahil: kahil@iiasa.ac.at

Crossing frontiers towards sustainability

Michael Kuhn was appointed program director of the newly established IIASA Economic Frontiers Program in January 2021.

Q What is your area of research?

A As a young and idealistic student, I discovered that economic thinking – if applied in the right way – may be a powerful tool in changing the world for the better. In my research, I use economic theory to study policy issues at the interface of health, population, and economic development. The fundamental question is: How can we transform towards a sustainable society when placing human wellbeing at the center?

Q What are the big issues in your field?

A Human capital modeling looks at economic growth as a result of individuals' efforts to improve themselves. A good education and good health are regarded as investments that lead to economic returns for both the individual and society. In other words, if I invest in better education and better health, I can get a better job, earn more money, and live and work longer, but by working more productively and being more informed in my private choices, I also contribute to the economy and society as a whole.

There are two large challenges to these beneficial processes. First, there has been vast, and in some places rising inequality in the opportunity for people to undertake investments in their human capital. Too many are disadvantaged from early on and never have the chance to set their lives on a good trajectory, but this also leaves their own communities and local economies trapped without access to the virtuous cycle. Second, climate change is a threat to human capital. For example, severe weather such as extreme heat can impact personal productivity and lower life expectancy. With bleak prospects caused by climate change, what is the incentive to invest in education or health? The Friday4Futures movement shares the same sentiment: Why bother about education, if there is no world to live in? This issue needs to be addressed in a scientifically more rigorous way.

Q This year, IIASA is embarking on a new strategy, which will apply systems science to support transformations to sustainability. The Economic Frontiers Program is a new research program established as part of this strategy. What are your research objectives as program director?

A Economic behaviors lie at the heart of current unsustainable development and therefore need to be transformed. The Economic Frontiers Program aspires to explore how economic policies and institutions need to be changed to bring forth such transformation. What needs to be done to achieve an equitable distribution of economic outcomes and opportunity? How do economies need to be shaped when it comes to the overdue acceptance that we are living in a finite and interlinked world? These are some of the research questions we will be addressing.

Q What do you enjoy about working at IIASA?

A It is still early days, but I have been hugely impressed by the diversity and depth of the research undertaken at IIASA, by the welcoming openness of my colleagues, and the interest the research I envisage for the program has been met with.

By Bettina Greenwell

Michael Kuhn: kuhn@iiasa.ac.at

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** Indonesian National Committee for IIASA
- IRAN** 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)
- MALAYSIA** (Observer) Academy of Sciences Malaysia (ASM)
- MEXICO** (Observer) Mexican National Committee for IIASA
- NORWAY** The Research Council of Norway (RCN)
- RUSSIA** The Russian Academy of Sciences (RAS)
- SLOVAKIA** Ministry of Education, Science, Research and Sport
- SOUTH AFRICA** The National Research Foundation (NRF)
- SWEDEN** The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS)
- UKRAINE** The National Academy of Sciences of Ukraine (NASU)
- UNITED KINGDOM** UK Research and Innovation (UKRI)
- USA** The National Academy of Sciences (NAS)
- VIETNAM** Vietnam Academy of Science and Technology (VAST)



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