The health benefits of systems analysis:
IIASA is poised to take a leading role in global health research

also in this issue

The balancing act of sustainability
What happens when work towards one sustainability goal prevents progress in another?

Breaking the habit
New research sheds light on how to drive people to make more environmental choices

#YSSP40
The Young Scientists Summer Program celebrates 40 years
Celebrating the old and the new

The world is constantly changing, and as it does some challenges fade and new ones come to light. Here at IIASA we change in response, continually adapting our work to help humanity live well, within the limits set by the planet. Yet we also retain our core values, building on the successes that have been with us from the start.

In this issue we celebrate a well-established success that is nearly as old as the institute itself: the Young Scientists Summer Program. The program marks its 40th anniversary this year and although it has expanded and become more diverse, in its essence the idea has not changed since it was first launched in 1977. Every summer, keen young scientists come from around the world and many different disciplines to work with IIASA researchers. As a launching pad to many successful careers in science, policy, and business, the program also plays an important part in the IIASA network, which spans the globe (page 20).

We also discuss a potential new development at IIASA: a global health initiative, which will allow IIASA to apply systems analysis to the increasingly complex and interconnected health issues of today. IIASA research can have a meaningful impact across many fields relevant to health, from air pollution to the evolution of new pathogens to food and lifestyle (page 14).

To ensure that the institute grows even more robust in response to its current growth and the challenges of the future, a comprehensive international independent review of IIASA was carried out this spring. We look forward to reporting on the results, the recommendations for IIASA, and our response.

About IIASA
IIASA uses systems analysis to research the critical issues of environmental, economic, and technological change we face today. Many of the most pressing problems of our times—climate change, food and water security, and biodiversity decline, to name just a few—are too complex to be solved by a single country or discipline. IIASA produces world-class research that integrates problems, drivers, and impacts, helping countries around the world to produce effective, evidence-based policies to tackle these challenges.

IIASA produces
◼ data, models, and research tools;
◼ peer-reviewed scientific papers; and
◼ policy-relevant information.

IIASA helps
◼ countries produce effective policy;
◼ develop international research networks; and
◼ support the next generation of scientists.

IIASA is represented by its National Member Organizations in the following countries:
Australia, Austria, Brazil, China, Egypt, Finland, Germany, India, Indonesia, Iran, Japan, Malaysia, Mexico, Netherlands, Norway, Pakistan, Republic of Korea, Russia, South Africa, Sweden, Ukraine, United Kingdom, United States of America, Vietnam.

About Options
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40 years of YSSP: A life-changing experience for young scientists

Cover photo
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Risk analysis for common ground on climate loss and damage

How to deal with loss and damage from climate impacts has been a fundamental issue in international climate negotiations. “Impacts of climate change have been observed for all continents and oceans,” says IIASA researcher Reinhard Mechler. Developing countries in particular are in need of assistance in responding, particularly for unavoidable risks that exceed adaptation capacities. There has been contentious debate between vulnerable countries and developed nations about the rationale, extent, and form of such assistance.

This debate on impacts “beyond adaptation” was institutionalized in 2013 via the Warsaw Mechanism on Loss and Damage and further endorsed by the Paris Agreement in 2015, yet the exact remit of loss and damage has not been clarified. In an article published in Science, Mechler and colleague Thomas Schinko show how recent advances in climate risk science can be aligned to a principled approach for identifying a proper policy space, in terms of distinct action beyond support for adaptation.

The research, which was also presented at the 2016 climate negotiations in Morocco, suggests the policy space for loss and damage is composed of two sets of options for dealing with impacts. The first set includes curative measures for unavoided and unavoidable risks, such as upgrading coastal protection because of increasing sea levels caused by climate change. The second set of transformative options focus on building resilience against climate-related impacts while also realizing that people and communities will need support to learn new skills and develop alternative livelihoods as well as seek assistance for voluntary migration.

Droughts may travel along predictable pathways

Some intense droughts move across continents in predictable patterns, according to recent IIASA research. The study, published in the journal Geophysical Research Letters, enriches our understanding of droughts and could improve projections of future drought, allowing for more effective planning.

“Most people think of a drought as a local or regional problem, but some intense droughts actually migrate, like a slow-motion hurricane on a timescale of months to years instead of days to weeks,“ says Julio Herrera-Estrada, a graduate student in civil and environmental engineering at Princeton, who worked on the study in collaboration with IIASA researcher Yusuke Satoh, as part of the Young Scientists Summer Program.

While most droughts tend to stay put near where they started, approximately 10% travel between 1,400 to 3,100 kilometers, the study found. These traveling droughts also tend to be the largest and most severe ones, with the highest potential for damage to the agriculture, energy, water, and humanitarian aid sectors.

The researchers analyzed drought data from 1979 to 2009, identifying 1,420 droughts worldwide. They found hotspots on each continent where a number of droughts had followed similar tracks. For example, in the southwestern USA, droughts tend to move from south to north. In Australia, the researchers found two drought hotspots and common directions of movement, one from the east coast in a northwest direction, the other from the central plains in a northeast direction.

What causes some droughts to travel remains unclear, but the data suggest that feedback between precipitation and evaporation in the atmosphere and land may play a role.

Further info
- www.iiasa.ac.at/news/loss-damage-16
- www.iiasa.ac.at/news/drought-17

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IIASA at EGU
Over 20 IIASA researchers participated in this year’s European Geosciences Union
General Assembly, one of the largest international research conferences focused on
Earth sciences. IIASA scientists from five of the institute’s nine research programs
presented new work at the meeting, which takes place in Vienna every spring.

Win-wins on climate and food
Efforts to reduce greenhouse gas emissions from the agriculture and forestry sectors
could lead to increased food prices. In a new study presented at EGU, IIASA
researcher Stefan Frank found several strategies that could help mitigate climate
change while avoiding steep hikes in food prices. In particular, the study found that
reducing deforestation and increasing soil carbon sequestration through
agricultural practices could significantly reduce greenhouse gas emissions
without jeopardizing food security.

Citizen science
for disaster response
At EGU, researchers launched a test run for a new citizen science campaign that links
volunteers around the world with a way to help communities after major disasters.
The campaign relies on the IIASA-developed app Picture Pile, which asks users to
compare sets of before and after images to identify damage to buildings. During
the test phase, the campaign is sorting through data from Hurricane Matthew,
which devastated Haiti in 2016.

Ancient groundwater
A new study presented at EGU, and published in the journal Nature Geoscience,
found that fossil groundwater makes up a significantly higher proportion of the
Earth’s groundwater than previously thought. It also found that this ancient
water—which has been stored underground for over 12,000 years—is not immune to
modern contamination, as had been widely assumed. Groundwater used for irrigation
is particularly worrying, since it is often untested before being applied to crops,
says IIASA Water Program Deputy Director Yoshihide Wada, who contributed to
the study.

How nature creates forest diversity
Traditional ecological theory holds that each species on this planet occupies its
own niche, or environment, where it can uniquely thrive. But forests, especially
tropical forests, are home to thousands of species of trees—sometimes tens to
hundreds of tree species in the same forest—a level of biodiversity ecologists have
struggled to explain.

In particular, ecological models have been unable to account for the unexpectedly large
number of varieties of shade-tolerant tropical trees and shrubs, which appear to occupy
the same niche and yet coexist. This raises the fundamental question: are separate niches
really always needed for species coexistence?

In a recent study, IIASA Evolution and Ecology Program Director Ulf Dieckmann and
colleagues provide a new model that elucidates the ecological and evolutionary mechanisms
underlying these natural patterns.

The researchers combined tree physiology, ecology, and evolution to construct a new
model in which tree species and their niches coevolve in mutual dependence. While previous
models had not been able to predict a high biodiversity of shade-tolerant species to coexist
over long periods of time, the new model demonstrates how physiological differences and
competition for light naturally lead to a large number of species, just as in nature. At the
same time, the new model shows that fast-growing shade-intolerant tree species evolve
to occupy narrow and well-separated niches, whereas slow-growing shade-tolerant tree
species have evolved to occupy a very broad niche that offers enough room for a whole
continuum of different species to coexist—again, just as observed in nature.

Until now, a different framework—called neutral theory—had to be invoked for explaining
tropical tree diversity. “Our model shows how neutral theory follows from niche theory,”
Dieckmann says. “We hope this work will result in a better understanding of human impacts on
forests, including timber extraction, fire control, habitat fragmentation, and climate change.”

Further info
Falster DS, Brännström A, Westoby M, & Dieckmann U (2017). Multitrait successional forest
dynamics enable diverse competitive coexistence. Proceedings of the National Academy of Sciences 114
(13): 2719-2728. [pure.iiasa.ac.at/14354]

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The new model allows researchers to predict how natural variation of forest structure depends on environmental conditions. When
the model is run for different environmental conditions, it returns results that mirror the variation observed in natural environments.
Living standards lag behind economic growth

As incomes rise in developing countries, access to basic amenities such as electricity, clean cooking energy, water, and sanitation, also improves—but not uniformly, and not as quickly as income growth, according to IIASA research. The study looked at historical rates of energy access compared to other living standards and GDP.

“What we found is that income growth alone isn’t enough to get these basic necessities to all people in society,” explains IIASA researcher Narasimha D. Rao, who led the study. The researchers also found that access to clean cooking energy and sanitation lagged behind access to electricity and water, a finding which has an outsize impact on the poorest members of society, and especially on women.

“In women bear the brunt of health risks that come from cooking with solid fuels, as well as from lack of sanitation, because women are predominantly responsible for cooking and household work,” explains IIASA researcher Shonali Pachauri, who also worked on the study.

In order to achieve the Sustainable Development Goals of universal access to clean energy, water, and sanitation by 2030, the study shows, sub-Saharan Africa in particular would have to see unprecedented rates of improvement compared to historical trends in the region.

There is room for optimism, however: the study shows that historically, some countries that have more recently improved access have done so faster than those that did so earlier. For instance, most countries that embarked on electrification prior to 1970 took from 19 to 27 years to increase access from 20 to 80% of their population, and up to 40 more years to get to universal access. However, Vietnam and Thailand, which embarked on electrification after 1970, took only 15 years to increase access coverage from 20 to 80%, and a further 11 to 20 years to reach full electrification.

Further info
www.iiasa.ac.at/news/living-standards-17

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How to make decisions under uncertainty?
Advanced methodology delivers robust solutions for improving energy efficiency in large buildings

Constructing or operating the energy system of a public building like a hospital or university campus involves making many complicated decisions. In order to achieve a robust energy supply, maximize energy efficiency, and minimize environmental impact, the stakeholders—including representatives of central and local governments, building managers and users, consultants, and decision-support system developers—need to agree on which technologies to invest in, decommission, or refurbish.

The recent global deregulation of energy sectors and new efficiency targets in Europe mean that stakeholders are more exposed to energy and financial market risks, which can be further exacerbated by extreme weather events. However, stakeholders also gained the opportunity to play a more active role in energy security and managing demand and risk. For example, building managers now have more flexibility in decisions about energy sources, with incentives to invest in renewable energy technologies such as wind, solar, geothermal, and the possibility of participating in the energy market. However this flexibility can lead to new systemic risks and potentially irreversible problems if the decisions are inappropriate for the situation that occurs.

In the face of these rising uncertainties and risks, IIASA researchers have developed a strategic Decision Support System (DSS) for energy-efficient technology investments, in collaboration with nine other research institutes and energy companies. This system can help design decisions that are robust, ensuring stable system performance no matter what the future may bring.

“The key methodological advance of the new DSS is its underlying model, which has a random horizon defined by a ‘stopping time,’” says IIASA researcher Yurii Yermoliev. “The stopping time represents new conditions such as a natural disaster, a market shock, or new policies, which can lead to a system failure. The time horizons of the model can also be determined by the possible outcomes of stakeholder discussion.”

The design of robust solutions has to be based on analysis of complex systemic interactions and risk exposure, evaluated with respect to the goals and constraints of the people involved. That requires a method called stochastic optimization, incorporating probabilistic constraints for safety and security, which guarantee that stakeholders’ requirements could be met under all circumstances.

“Most existing DSSs are based on a deterministic optimization approach that is unable to provide decisions robust against uncertainties and risks. The deterministic approach performs analysis of ‘what-if’ cases and derives scenario-specific solutions. This can lead to system failure if something unexpected happens,” says IIASA researcher Tatiana Ermolieva, who also worked on the project. “Contrary to the deterministic approach, this DSS allows stakeholders to analyze a portfolio of interdependent, strategic long-term, and operational short-term decisions involving standard technological as well as market-oriented financial options, which ensures robust performance of energy systems.”

In today’s world, stakeholders often have conflicting goals and have to make decisions with incomplete and uncertain information. The principles behind this DSS can also be applied to other problems in which people want to evaluate the long-term performance of systems in such a way that the negative impacts of policy alterations like removal of subsidies, or external events like weather or market conditions, are minimized.

Further info

Energy Efficiency and Risk Management in Public Buildings (EnRiMa) EU FP7 project
* [www.iiasa.ac.at/Enrima](http://www.iiasa.ac.at/Enrima)

[www.iiasa.ac.at/13386](http://www.iiasa.ac.at/13386)

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The DSS can be used to plan robust energy portfolios for buildings, districts or countries, and has been applied at several test sites in Europe, including the University of Applied Sciences Burgenland in Austria (pictured), and at the experimental KUBIK building in Spain.
What is disaster resilience?

True disaster resilience is not just about reducing risk, it must also have sustainable development at its core

In July last year a flood hit the Indian state of Assam, affecting 1.6 million people as they fled, abandoning homes and livestock. In October, a hurricane struck Haiti, affecting 2.1 million people and leaving 806,000 in urgent need of food. In Peru, February this year saw the worst floods in two decades, killing over 100 people and displacing nearly 158,000. Hospitals, roads, and schools were all severely affected.

Whatever their origin, disasters hit the poorest and most vulnerable communities the hardest. The loss of property and infrastructure is often just the start of a vicious cycle of poverty. “Let’s say your town is hit by a hurricane,” says IIASA researcher Adriana Keating. “The school is damaged, and your kids’ education suffers. Your house was blown down too, and you have to take out a high-interest loan to rebuild it. It’s hard to recover from that: people struggle along in debt, children never get that education back. And what happens when the next storm comes along?”

Keating and colleagues in the IIASA Risk and Resilience program are exploring how to break this cycle, how communities can not only face disasters but continue to work towards their sustainable development goals despite them. This process starts, says Keating, with understanding what disaster resilience is, and what it isn’t.

In a recent study the team found that traditional definitions of disaster resilience focus on reducing risks. That is important, but it needs to be extended. The risks are always going to be there, and in many cases will even worsen under climate change. “Resilience is not just disaster risk management done well,” says Keating. “It’s living in harmony with disasters, it’s thriving in the face of them.”

Developing real disaster resilience means linking it with sustainable development and shifting the focus to community wellbeing. “We must also accept that risk is constructed by humans,” adds Keating. “If a typhoon hits a deserted island it’s not a disaster; it’s only ever a disaster if people and their property are in the way. That also means we have some power to prevent new risks—by avoiding construction on flood plains, for instance.”

Making disaster resilience a part of sustainable development and vice versa ensures that the two reinforce rather than undermine each other. Building homes on a fault line or flood plain might look like the best option for economic development—and it could be, in the short term—but risk and resilience analysis will show that it puts communities into harm’s way. Getting schools running in the aftermath of a disaster is not only an important part of sustainable development, it also improves disaster resilience for the future.

Putting these principles into action in Peru, IIASA researchers and the non-governmental organization Practical Action brought together members of vulnerable communities and other stakeholders to explore the links between sustainable development and flooding. “A greater focus on long-term flood risk management in land-use planning and governance is vital to breaking the cycle of disaster impacts that undermines development in the region,” says IIASA researcher Adam French, who spearheaded the Peru collaboration.

Further info

- blog.iiasa.ac.at/tag/resilience17

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A tale of two countries: Why is Germany not Japan a leader in renewable energy?

Today, Germany and Japan look very different in terms of energy policies, but this wasn’t always the case. “In 1990, Germany and Japan had very similar electricity systems, with similar numbers of nuclear power plants,” says IIASA researcher Jessica Jewell. “We wanted to investigate how they ended up so different—with Germany leading the way in renewables and Japan going down a nuclear path.”

One common assumption is that political will in Germany was greater, whereas in Japan the strong nuclear lobby quashed any move towards renewables. But a recent study by researchers at IIASA and the Central European University found that it’s not as simple as that.

“A key difference between the countries was in electricity demand,” says Jewell, a coauthor on the paper. “In Japan, demand rose rapidly in the 1990s, but in Germany it stagnated.” That gave Germany room to maneuver: it could keep relying on its massive coal reserves and did not need to build new nuclear power plants. It was also aided by new wind turbines developed in Denmark. Japan didn’t have those choices; it had no domestic coal, and at the time Danish wind turbines were not suitable for the geographic conditions in the country.

“There are three main policy lessons we can take from this,” says Jewell. “First, political will is not the be all and end all—there is a window where it can make a difference, certainly, but it is far from the sole factor. Second, when translating energy policies between countries we have to be sensitive to demand. China, for example, has rapidly growing demand and can’t be expected to follow Germany’s route of nuclear phase-out. Finally, beware simplistic narratives about international policy lessons. Energy policy learning must be supported by an analysis of the underlying energy systems dynamics, not only of the policies themselves.”

Further info
- www.cd-links.org
- blog.iiasa.ac.at/jewell-17

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New EU air pollution directive becomes law

The new National Emissions Ceilings Directive, which introduces new rules for EU countries to drastically cut air pollution, was created with substantial input from the IIASA Air Quality and Greenhouse Gases Program (AIR). AIR’s Greenhouse Gas - Air Pollution Interactions and Synergies model and its forerunner have provided vital input to European air pollution policy since the 1970s, and the latest directive will reduce the negative health impacts of air pollution by almost half by 2030.

Policy to combat environmental market failure

Neither the damage caused by CO2 emissions nor the benefits of developing renewable energy technology are properly reflected by economic markets. The best policy to deal with these ‘market failures’ is an aggressive renewables subsidy and a carbon tax, an IIASA study found. However, given that policymakers often prefer the carrot to the stick they may rely on the second-best option of subsidy only. If policymakers could fully commit to these policies the best option will lead to a peak warming of 2.1–2.3°C, and without commitment under the second best option, warming would reach 3.5°C, the study showed.

Japan’s changing disaster risk management

In Japan, the failure to foresee the catastrophic earthquakes, tsunamis, and nuclear accident of 2011 has been seen by many in the country as a fundamental shortcoming of disaster risk science. The use of scientific knowledge came under renewed scrutiny in light of this, an IIASA study has found. There is now recognition of an overreliance on well-documented hazard risks and more attention paid to less documented but known risks. However, debates continue over the appropriate role of “evidence-based policy” in earthquake and tsunami risk reduction.
Despite 193 countries adopting the Paris Agreement on climate change in 2015, and its entrance into force in November 2016, the issue of climate change is still hotly debated. People question the realism of both the targets—limiting global temperature rise this century to “well below 2°C above pre-industrial levels”—and the pace of a transformation of the global energy system to low-carbon options. In addition, the new US administration brings the issue of uncertainty in measuring the impact of human activity on climate as a reason to continue the debate on climate change. In some cases, framing the issue as a question of uncertainty leads to an argument that we should wait to act. Maybe we should wait and see if the impacts are indeed as bad as some researchers describe? Maybe we should wait and see if technological invention (like cheap energy storage or biomass with carbon capture) will solve the issue of reliance on fossil fuels? Maybe we should wait until the next election cycle and leave this problem to the next policymakers?

A more productive way is to frame the issue of global change as a risk problem. It is true that we still cannot provide exact numbers or specific forecasts for a certain impact in a certain region, but nevertheless, decisions have to be made. When you frame it as a risk problem, then you need to be prepared for bad outcomes, whatever they are. We constantly make these kinds of decisions: Should we let our teenager drive a car? Should we buy travel insurance? Formulating the issue as a risk assessment calls for a preparation for potentially bad outcomes and finding ways to mitigate them. Our research at the MIT Joint Program on the Science and Policy of Global Change shows that even limited actions towards reducing greenhouse gas emissions results in a substantial reduction in the risk of exceeding a certain temperature threshold. Even if we cannot predict the climate and its impacts with precision, especially at regional and local levels, that does not mean that the best strategy is to do nothing.

The world is already making progress towards addressing climate change: in particular there has been tremendous progress in bringing the costs of renewable energy down. But there are still many challenges in making low-carbon energy competitive with traditional energy sources. Policymakers face the issue that the results of emission reduction activities will be far in the future, while the changes in energy choices have to be made today. In many parts of the world, these energy choices have to be made simultaneously with choices about combating hunger and poverty. In many cases, policymakers prioritize providing power to homes, hospitals, schools, and new industries, while delaying the issue of emission reductions. Policymakers are in urgent need of a reliable assessment of how their economic development goals can be combined with environmental and climate change mitigation goals: What are the trade-offs in meeting these goals? How will the local conditions affect the choice of the policy instruments and the magnitude of action? The IIASA World in 2050 project provides a great opportunity for a science-based discussion of the viability of these multiple goals of sustainable development. This is a great undertaking as we need to improve our communication to policymakers about how to pursue social development goals and reap the benefits of economic growth and a better environment.
Q. What does the concept of “from Lisbon to Vladivostok,” which is being studied at IIASA, mean?

A. The concept of a common space “from Lisbon to Vladivostok” potentially encompasses the EU, the Eurasian Economic Union, as well as a number of states in this territory that are not part of any of those unions. We perceive it not as a supranational organization, but rather as an economic space, in which economic relations between the players are defined jointly, taking into account each other’s economic interests.

Q. As you know, the relationship between the EU and Russia is going through some rough times. What is the probability for creating a common economic space from Lisbon to Vladivostok?

A. The idea of this common economic space is quite old, already more than a decade. In the 2000s, the EU and the Russian Federation actually moved quite close to the implementation of this idea. Nearly two dozen sectoral dialogues were launched: on technical regulation, macroeconomics, industry, competition, and so on. However, they unfortunately came to a halt.

Since there is no direct dialogue between the two commissions at the moment, the work carried out by IIASA is very important. It is necessary to move away from existing political problems and to explore the benefits of a common economic space at a professional level, and to identify the most promising and effective areas of cooperation.

Q. And what are the advantages of creating this common space?

A. The advantages lie in the fact that we complement each other very well. IIASA analysis shows this. We complement each other in transport and energy, as well as in the development of industry and agriculture.

Energy is a good example. Traditionally the EAEU countries are energy suppliers to Europe (gas and oil from Russia and Kazakhstan, petroleum products from Belarus). A stable energy supply is the interest of the EU.

It is not just these traditional resources. We can conduct joint research, create large integrated production chains, and together go to markets of third countries, including the Asia-Pacific market, in which we are all very interested.

To move the conversation on this topic forward, one ought to begin with the specific topics that business is interested in: technical regulation, standardization, logistics, transport, energy, and cooperation in industry.

Q. In November last year we saw the completion of the pilot phase of the IIASA research project Challenges and Opportunities for Economic Integration within the Wider European and Eurasian Space. What are your thoughts on the next steps in this project?

A. IIASA is a unique organization, the only one currently exploring the opportunities and benefits from creating a common economic space between the EU and the EAEU. This project could bring specific proposals on where to start: whether in transport, technical regulation, energy, or something else.

I believe that the EU-EAEU economic cooperation should not be only about free trade in goods. We need to think bigger! We also need to consider services, technical regulations, and investment. Such a tight relationship will indeed lead to a very different quality of economic cooperation in our common space.

Further info

- [www.iiasa.ac.at/economicintegration]
- [www.iiasa.ac.at/news/eurasia-16]

Interview translated from Russian by IIASA researcher Jurij Kofner.
Despite rising carbon emissions, pressing food shortages, dwindling water supplies, and other environmental problems, some people don’t bother to conserve. Airports are bustling with travelers even though flying is a major source of greenhouse gas emissions. The habit of hopping on planes is a growing concern because the industry is expanding. By 2050, aviation may account for 15 to 40% of the world’s CO2 emissions. In the UK, passenger traffic is expected to surge from 219 million in 2011 to 445 million in 2050. A recent study in the country found that even though UK citizens were environmentally conscious in other areas of their lives, they didn’t cut back on flying.

When we’re united in our efforts to tackle global problems, we’re far better able to manage limited resources and reduce carbon emissions, but ingrained habits are tough to break. New research suggests some possible strategies.

**Education empowers**

Can we change behavior by simply increasing time people spend in school? Recent work by IIASA researcher Raya Muttarak explored whether formal schooling promotes the adoption of better environmental habits. Muttarak and Thanyaporn Chankrajang from Chulalongkorn University, Thailand examined two national surveys conducted in Thailand in 2010 and 2013. Residents aged 15 and over, answered questions about the environment, global warming, and natural disasters.

“We found that highly educated people had better environmental habits,” says Muttarak. “When people learned about the risks or dangers of climate change, it increased their awareness and gave them the means and ability to make a change.”

Education doesn’t just change individual behavior—it also causes societies to evolve. It affects fertility, mortality, and migration. The highly educated have better health, live longer, and have fewer children. And the effect lasts a lifetime: “Education is human capital which people can take with them when they grow up or move,” says Muttarak.

In a recent article, Muttarak and IIASA World Population Program Director Wolfgang Lutz proposed that climate change research should include the “demographic metabolism” of a population. The term refers to the changing characteristics of the people, from generation to generation. As more educated generations replace less educated ones, the world may see a shift towards more awareness of environmental change and higher adaptive capacity to already unavoidable change.

**Keeping an eye on the pie**

Education isn’t the only way of influencing people—if we could see how others behaved, we might change our own behavior. In fact, open exchanges of information about the amount of a resource and its consumption could help prevent the squandering of that resource, according to a recent study by IIASA researchers Elena Rovenskaya, Talha Manzoor, and Abubakr Muhammad. They incorporated psychology in a model of how consumers use a resource. “It models mathematically how people may change their behavior,” says Rovenskaya, IIASA Advanced Systems Analysis program director.

Before deciding how much of a resource to consume, people look at two things: the amount of the resource and how much other people are harvesting. “Some people pay a lot of attention to what other consumers are doing and they adjust their own behavior,” says Rovenskaya. “Others do not.”

In order to achieve environmental and sustainability goals, individuals around the world will need to change their behavior, to consume fewer resources and make less waste. But how can we break out of long-established patterns?
In the theoretical model, people who didn't care about a scarce resource, or about the actions of others, took as much as they wanted. “People would conserve more if they coordinated among themselves and exchanged information,” says Rovenskaya. “If they learned more about consumer behavior and the amount of a resource, it would reduce or even prevent free-riding.”

**Spreading green innovation**

Another benefit of exchanging information is that we learn about new products and discover new ways of doing things. Innovation can radically transform our habits. But what causes these behavior changes to go viral?

Charlie Wilson, a researcher at IIASA and the Tyndall Centre for Climate Change Research in the UK, is studying the spread of disruptive innovations through social media, face-to-face communications, and neighborhood interactions. “If they’re adopted, they shake up the way mainstream behavior, practices, or markets function. The classic example is what the microcomputer did to mainframe computing. I’m interested in disruptive innovations that can potentially reduce carbon emissions if they become popular.” Wilson points to things like sharing a car or zipping along on an electric bike or golf cart as examples of disruptive innovations.

“I’m interested in measuring the strength of all these different kinds of influences,” says Wilson. “We plan to study this by working with early adopters—people who are already using the technology.” During the four-year study, Wilson and his team will track the social networks of early adopters in Canada, Holland, Ireland, and the UK.

**Kicking the habit**

Although old habits can be tough to budge, new research is giving us the tools to pry them loose. By promoting education, we can increase awareness about our environmental footprints and alter behavior for the benefit of society. While giving up something as ingrained as a frequent flying habit may seem impossible, research is raising hope that by exchanging information or spreading innovations, we can turn people off autopilot and onto a more sustainable course.

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**Further info**


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The health benefits of systems analysis
Health is likely to rate well above wealth when people are asked what’s important in life. And in striving for “good health” the world’s largest science community has been created. Health journals and health professionals regularly make headlines, and with a four billion dollar annual budget, the World Health Organization is a giant among international institutions.

IIASA scientists engage with health issues at many levels, including through studies of air pollution, climate change, ecology, evolution, land use, and water. The relevance to human health of these core research areas is often direct and sometimes indirect; but as the scientists make clear, understanding the linkages of planetary systems to health has never been more important, and IIASA is well-positioned to take a leading role on the topic.

Injecting IIASA science into health research

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Know your networks

“How complex system is composed of elements and their interactions, and the health care system is no exception,” says IIASA researcher Stefan Thurner. In any health care system “it’s the patients, it’s the pharmaceutical industry, it’s the psychotherapists—you name it.” His point is that they are all interacting with each other but not always achieving the best possible outcome.

Thurner and colleagues set out to untangle the genetic and environmental risk factors for individual diseases in cases where patients who have one disease are likely to have another related disease—known as comorbidity networks.
The health initiative will strengthen links between IIASA research, the international global health research community, and policymakers. Researchers will collaborate across IIASA programs to promote interdisciplinary links involving health issues. Because the health research field is so large, IIASA will carefully identify its own niche aided by recognized scientists from around the world.

Taking data from almost two million Austrian patients who had the same disease at around the same time, the team produced comorbidity networks with startling results. “We find that most diseases are dominated by genetic risk factors, not by a combination of genetic and environmental factors,” says Thurner.

He believes this type of modeling provides a completely new way of looking at the health of a population. “If I can spot myself in this comorbidity network as my life goes on I can predict my (disease) trajectory pretty well.” An example is diabetes, a disease where patients are likely to have other complications such as kidney and retina problems. Knowing the patient’s position in the comorbidity network can provide a promising start to predicting the expected complications and then rationally optimizing the combination of treatments and medications.

The implications for interventions and public health programs are significant. “If policymakers know disease A causes disease B with a likelihood of 70%, and they know the costs associated with treating both A and B, they can compute the economic benefit of an intervention scheme.”

“The essence of sustainable development is lasting improvement of human wellbeing.”

Wolfgang Lutz

Sustainable health

IIASA has become deeply involved in integrated research supporting the UN Sustainable Development Goals (SDGs), particularly those focused on climate, energy, and education. For IIASA World Population Program Director Wolfgang Lutz, health is not only a SDG in its own right but is intimately linked to many other SDGs. “The essence of sustainable development is improving human wellbeing,” he says, but stresses that the focus should be on “sustainable wellbeing” with health as a key dimension and perhaps the most important factor.

With respect to health there is both good news and bad. The good news includes increases in life expectancy in most countries and progress in the reduction of some infectious diseases. The bad news includes increasing environmental and climate-related threats such as air and water pollution along with new infectious diseases to which the elderly are particularly vulnerable. IIASA research can really have a meaningful impact across many fields relevant to health, from air pollution to food and lifestyle; disease adaptation, transmission, and new pathogens; and health systems.

Lutz says research on air pollution and its cumulative effect in the course of a lifetime is a perfect example of where IIASA programs should work together. “We know for sure that children in particular absorb this into their bodies but they don’t immediately become ill—that would only happen in cases of very severe pollution—so you need to consider the history of air pollution.” Lutz wants to see demographic life-cycle analysis combined with air pollution analysis, something very few people have done. “A perfect niche for IIASA,” he says.

Another field where IIASA expertise can give powerful health-related insights is in food and nutrition. Internationally recognized research in land-use and food production modeling could be expanded to more

IIASA makes the case for its global health initiative

Five areas have been identified where IIASA research could make a meaningful contribution to health research.

1. Air pollution and its cumulative effects over the life cycle
2. Food, water, and undernutrition
3. Lifestyle, unhealthy nutrition, and obesity in the context of aging
4. New dimensions of infectious disease spread: emerging pathogens, altered transmission, and disease adaptation
5. Health systems and public health

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directly address health issues. “When planning work in this field we can combine established IIASA work with that of invited scholars who are better linked within the health community—and so define a niche where we can have an impact,” says Lutz.

The obesity pandemic is a case in point. Lifestyle, unhealthy nutrition, and obesity are big health challenges and Lutz says these are related to the population factors, such as education, which IIASA is currently studying. He gives the example of Austria, where there is a difference of seven or more years in life expectancy between the highest and the lowest education groups. This is partly related to lifestyle and behaviors like smoking. “In the past, infectious diseases killed the poor as well as the wealthy,” says Lutz, but today, education and behavior are now strong determining factors in life expectancy.

IIASA research is also well positioned to integrate existing insights into disease emergence, transmission, and adaptation, with research not only on climate and land use, but also human demography and behavior.

Then there is the broader question of systems analysis and its application to health systems. “A full and comprehensive systems view on public health is required where we not only look at singular risks but all risks in combination,” says Lutz, who believes that IIASA is in a position to develop its role in studying these health dimensions in a systemic way.

**Eradication meets evolution – how disease fights back**

Health science must tackle the disease as well as treat the diseased populations. However, the history of disease eradication is a brief one. In only two cases have scientists found success; with smallpox and rinderpest. For many others, including malaria and polio, success has sometimes seemed near but in the end has proven elusive. Now, a new study could reinvigorate eradication campaigns by showing how evolution, population factors, and economics can interact to hamper eradication efforts.

“It’s a model-based perspective of disease eradication which can provide useful information for public health institutions aiming to eradicate diseases,” says IIASA Evolution and Ecology Program Director and coauthor Ulf Dieckmann.

Quite often an eradication campaign will meet with initial encouraging success and then encounter what Dieckmann and colleagues call the “eradication tail” where returns diminish and the disease persists. It’s then that scientists and policymakers have to be prepared for the long haul, perhaps involving decades of financial commitment.

“The disease itself can evolve, the pathogens can become resistant to treatment; the patients can evolve, changing their immune system, changing their resistance; and the carriers such as insects, can evolve.” This adaptive capacity has to be taken into account, says Dieckmann and cites integrative modeling as a way to achieve this when assessing the timescales and resources required for eradication campaigns. In fact it’s the “eradication tail” of the campaign which can bite, as Dieckmann and colleagues discovered when factoring costs into their modeling. “So you keep investing but there is no strong pressure from the society anymore because the disease is almost gone, but it’s not quite gone, and if you release the pressure it jumps back,” he says.

“**When we consider the spectrum of research areas covered at IIASA that are relevant to the Sustainable Development Goals—then health really comes up as the one field where IIASA must strengthen its standing.**”  

Wolfgang Lutz

While the study shows that a model-based perspective can be useful for public health institutions aiming to eradicate diseases, Dieckmann is hoping that a sharper focus on health will bring other benefits. In particular IIASA can help develop data-driven integrated models, “that would enable us to look at multiple diseases, regions, transmission routes, environmental drivers, and intervention options. In this way, we can better understand and manage the synergies, trade-offs, and complex relationships among these components.” In the long term it’s the perfect challenge for an institute like IIASA to tackle.

Further info


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Imagine pumping air into a party balloon. As it fills, you can press your fingers against any weak spots to alleviate the strain. The balloon swells and you save the weak spots from catastrophic failure—but of course, you have simply shifted the pressure somewhere else.

“All of our various demands on the land system, from mining to agriculture and forestry, are like pumping air into that balloon,” says IIASA researcher Brian Walsh. “Conservation,” he adds, “is like putting your finger over the weak spot—it can put pressure on the system elsewhere.”

IIASA has been working on these trade-offs for some time, constructing models to see how our interconnected planet copes with various challenges (see box). One such model, the Global Biosphere Management Model (GLOBIOM) examines the tension between safeguarding the environment and producing vastly more food than we do now.

Go vegetarian
Walsh and his colleagues are searching for the interventions that minimize the trade-offs and, hopefully, create synergies too. Surprisingly, one intervention has emerged that is “an order of magnitude more positive than any other intervention in conservation,” says Walsh. This measure led to a reduction in deforestation, irrigation, fertilizer use, and biodiversity loss—as well as greenhouse gas emissions.

This intervention was giving up meat. Meat consumption is predicted to rise by 50% by 2050. In a recent study, the researchers held consumption constant instead—reflecting a reduction in meat consumption in the developed world and an increase in poorer countries to satisfy nutritional goals.

“All of this land that the model thinks will be needed for pasture and animal feed is freed and so there’s less deforestation, less irrigation, less fertilizer use, and less biodiversity loss—and fewer greenhouse gas emissions,” says Walsh.

Put another way, it’s like letting air out of the balloon, and Walsh is now convinced that eating less meat “is the single largest thing that anyone can do to care for the planet”.

Coal or clean fuels?
Another area that may cause clashes between conservation and development is the quest to bring modern energy to all by 2030—UN Sustainable Development Goal 7—which can seem in opposition to the Paris Agreement to keep global temperature rise at less than 2°C above pre-industrial levels.

The balancing act of sustainability
What happens when work towards one sustainability goal prevents progress in another? Do we have to choose between universal energy access and climate change mitigation, or biodiversity and food security?
IIASA researchers have been modeling these tensions in different regions: In South Asia Shonali Pachauri has been working on the problem as part of the IIASA project Linking Climate and Development Policies—Leveraging International Networks and Knowledge Sharing, and Peter Rafaj has been examining similar issues in South Africa.

In South Asia many of the poor burn biomass, such as dung or wood, and in South Africa, a lot of slum households burn coal. Both of these produce noxious indoor pollution. Switching to stoves that use bottled gas, or tapping into the electricity grid, are solutions. But policies to cut carbon and pollutant emissions are likely to increase the price of these.

In South Africa a host of measures aimed at tackling climate change and air pollution—such as investments in renewable energy, retrofitting coal power plants to scrub out pollutants, and putting a higher price on carbon—are all pushing up the price of electricity. Many people who have been hooked up to the electricity supply nevertheless find it cheaper to use coal.

In South Asia, Pachauri has quantified the tensions using an extension of the Model for Energy Supply Strategy Alternatives and their General Environmental Impact called MESSAGE-Access. If things go on as they are, she says, there will likely be 700 million South Asians without access to clean cooking fuels even in 2030.

The cost of bringing modern energy to these 700 million people would be US$29 billion, but that’s without the effect of carbon reduction policies, which could push that cost up by 44%—or mean that another 430 million people (20% of South Asia’s population) were abandoned to dirty fuels.

“We’re not saying don’t do climate policy, but we have to be very careful in designing those policies,” says Pachauri.

**Climate policy must be smart**

For both South Asia and South Africa, the researchers found that the poor must be shielded against fuel price rises to help them move to modern energy. In South Africa, Rafaj and other authors, including Harold Annegarn of the Energy Institute in Cape Town, South Africa, used the Greenhouse Gas and Air Pollution Interaction Synergies (GAINS) model which has informed policy in Europe and South Asia. They found that the money intended for retrofitting coal stations to remove air pollutants would be more effectively spent eliminating air pollution on the ground—by upgrading stoves, subsidizing electricity use, insulating homes, and suppressing dust.

“You’re talking about a very large expenditure on very old plants for marginal benefit versus a direct and significant reduction in domestic exposure,” says Annegarn.

One consequence of the energy policy debate in South Africa was that the government has allowed coal stations to postpone their retrofits, provided they fund on-the-ground interventions. If fully implemented, the GAINS analysis might become a centerpiece for the future local decision making.

New policies in India too are more aligned with results from the MESSAGE-Access analysis. A new Indian scheme provides free stoves and gas cylinders to women from poor households in addition to subsidizing the fuel (for everyone).

“Our analysis shows that for poor households the upfront cost of the stove and cylinder is a bigger hurdle than the fuel costs,” says Pachauri.

Meanwhile, Pachauri is also expanding analysis to consider how the energy access Sustainable Development Goal interacts with others. The good news is that it seems to support them more than it undermines them. Another way of letting air out of the balloon? AI

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**Further info**


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A life-changing experience for young scientists

This summer the IIASA Young Scientists Summer Program celebrates 40 years. Although much has changed since its first year in 1977, the basic idea that launched the program has ensured its success: bringing together an international, interdisciplinary group of young scientists to work together at IIASA.

At many academic institutions in Europe, summer is sleepy. Offices are empty, doors are closed, and emails bounce back with vacation messages. At IIASA, it's the opposite. Each June to August brings an injection of life into the castle, as over 50 young scientists join the institute for the annual Young Scientists Summer Program (YSSP). The young scientists, usually PhD students, come from around the world and many different disciplines to work with IIASA researchers. The aim is to publish a scientific paper. For many it is the first time doing independent research, working with scientists outside of their discipline, or applying research to policy. The program has been the launching pad to many successful careers in science, policy, and business. And it is the seed of many fruitful collaborations and connections.

“The international and interdisciplinary cohort experience is the most unique and important aspect of the YSSP. Participants leave with a global network of 50+ friends and colleagues for life,” says Brian Fath, the scientific coordinator of the program, who also participated in the program in 1997.

The program was started in 1977 under the leadership of then director Roger Levien. He came up with the idea based on his own experience working as a summer student at the RAND Corporation in 1956.

“That summer experience, at the right point in my career—it transformed my entire career,” says Levien. “When I came to IIASA in 1975, I thought it would be wonderful if we could provide a similar experience at the institute, for young scientists from many nations.”

Back then the groups were smaller, and like science itself in those days, mostly men. They came from the two sides of the Cold War divide—USA, Russia, Canada, Japan, and countries in Eastern and Western Europe. At the time, it was unusual for researchers to work across this divide.

Today’s young scientists come from not just east and west, but around the world—in 2017 there will be 52 students from 28 countries. And the groups are now evenly mixed between men and women. In 2016 for the first time, women outnumbered men in the program.

While the program has expanded and become more diverse, in its essence the idea has not changed since it was first launched 40 years ago. “We’ve made some adjustments over the years, but the fact is that the original formula works really well: People come here to do research,” says IIASA Risk and Resilience Program Director JoAnne Linnerooth-Bayer, who has served as dean of the program since 1990.

Further info
- Young Scientists Summer Program www.iiasa.ac.at/yssp
- Young Scientists 40th Anniversary Event www.iiasa.ac.at/events/40yssp
- Blog post: Interview with Roger Levien Blog iiasa.ac.at/Levien-17
- Options 2002: A New Generation of Scientists www.iiasa.ac.at/options/yssp25

Petra Aven (Russia)
“My involvement in the IIASA summer program was my first experience working with foreign scientists, who I found to be a rich source of new knowledge and expertise. Today, many years after my YSSP experience, I am still aware of the influence my participation in the program had on my life.”

Erkki Ormala (Finland)
“The YSSP program provided me with support and ideal working conditions in an area where there was no tradition in my home country, Finland. The degree and knowledge associated with it were very helpful in my future career as a scientist, policy adviser and, finally, as a business leader.”

Abdel-Hamid El-Kassass (Egypt)
“The YSSP program was one of the most remarkable events in my life, which I remember until today because it helped me while I was working on my PhD thesis on population-economy-environment integrated modeling.”
40 years of YSSP
This map shows the geographical diversity of YSSP participants since 1977. All countries with at least one citizen who participated in the YSSP are highlighted. For those countries with over 10 participants, the number is shown in a bubble.

1,870 YSSP participants from 89 countries
5,610 months of individual research

Eri Saikawa (Japan)
"After the YSSP, I studied atmospheric chemistry, international relations, Chinese, and Korean, and conducted very interdisciplinary research that was policy-oriented. All of this became possible because the breadth and the depth of research I got engaged in at IIASA made me motivated that such interdisciplinary work was possible."

Talha Manzoor (Pakistan)
"My PhD research required me to link extremely disparate disciplines in a manner that was also relevant to the global issues being faced by society on a daily basis. This would not have been possible for me without the experience I gained at IIASA during the YSSP."

Yue Qin (China)
"This was indeed the best summer I could have ever expected, with all the resources that helped me to pursue my research interests, and all the YSSPers that shared the summer experiences together."
Higher education connects sub-Saharan Africa to the world

Expanded higher education in sub-Saharan Africa is leading to a new generation of mobile, highly educated Africans. Yet experiences vary wildly across countries in the region, according to a new book edited by IIASA researcher Anne Goujon. The book explores current trends and future prospects for education in the region, as well as the outlook for the growing number of well-educated people.

Adapting to climate change in West Africa

Climate change will likely have negative impacts on food production in West Africa: projections for the region show that crop yields and grass for livestock grazing are likely to decline in the future. But a new study led by IIASA researcher Amanda Palazzo shows that strategic planning by decision makers in the region could be the key to ensuring future food supply. If ineffective institutions and political instability limit investment in agriculture and economic growth, the researchers found, climate change would have even greater impacts on regional food security.

The new study is the result of an intense process where researchers worked closely with local experts to develop plausible futures for the region. Then they linked the regional scenarios with global socioeconomic projections developed for climate change research—the Shared Socioeconomic Pathways—and adapted them to provide specific information for West Africa.

The study showed that investments in agriculture, specifically to improve crop yields, could lead to greater food production but also to an expansion of agricultural area into forest and other natural land within West Africa. However, the region’s productivity gains in the agriculture sector could help to reduce the global need for land for agricultural production: in some cases sparing three times as much land outside West Africa for each hectare of land converted to agriculture within the region.

“Food security in the region could improve even under the threat of climate change if the region takes a coordinated and long-term approach to investment and development,” says Palazzo.

Further info

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“The development of higher education could push forward change and innovation, building capacity in sub-Saharan Africa where it is direly needed,” says Goujon.

The book provides a timely summary given current trends. Today, less than 6% of the working age population has a post-secondary education in sub-Saharan Africa, but the potential for growth in higher education is tremendous: the number of people of university age—18-23 years—is projected to double from its 2015 level by 2050, to 235 million people.

The book addresses many questions currently facing the region. For one thing, the development of higher education should go hand in hand with the development of opportunities for the highly educated. This also applies to graduates returning from studying abroad. Yet studies in the book show that some African countries provide far more opportunities for graduates to return home to well-paying jobs than others.

 Universities in sub-Saharan Africa also vary in quality, but harmonization strategies at the African level and new linkages between European and African universities are paving the way for more consistent standards, improving compatibility between programs and therefore mobility for students and graduates.

Further info

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High temperatures adversely affect US crops

Rising temperatures around the globe pose numerous threats to our environment. The endangerment of animal species, rising sea levels, and increasingly powerful storms are some of the effects most covered in the media.

But perhaps the biggest threat from high temperatures is the devastation of crops which contribute to the global food supply, such as corn, wheat, and soybeans. These three crops are particularly vulnerable to rising temperatures, which have been steadily increasing for decades.

In a study published in the journal Nature Communications, IIASA researcher Christian Folberth and his team showed that even with normal rain, crops in the USA are underperforming, and in some cases failing, because of high temperatures. The study analyzed nine crop models as they reproduced average temperature responses of maize, soybean, and wheat yields in the USA.

Researchers observed that for each day temperatures exceeded 30°C, maize and soybean yields declined by up to 6% under rainfed conditions. The findings support the notion that crops decline when high temperatures restrict the water available to these plants.

“The study shows that global crop models are well capable of reproducing crop yield decreases at high temperatures in the USA, which are likely to occur more frequently in the future,” explains Folberth, a coauthor of the new study. “These impacts on crop yields are predominantly caused by an increase in water deficit and could hence be alleviated by irrigation, provided that sufficient water is available.”

Analyzing the success of Uber and the ride-share revolution

Information and communication technology has progressed so rapidly in recent years that it has fundamentally changed the way we go about our daily lives.

One of these changes has been the rise of Uber and the resulting ride-share revolution. Whereas people once looked to taxis or public transportation to get around town or while traveling, they can now take Uber for greater convenience and often at a lower cost.

Uber is an excellent example of how a business with the right business model for our modern times can become wildly successful very quickly. Of course, that business model must be built upon technology that performs well, especially if it is to be scaled to a global level. When these pieces are in place, technology can have a significant impact on society.

In a study published in the journal Technology and Society, IIASA researcher Chihiro Watanabe showed that Uber’s disruptive business model, coupled with its well-functioning technological architecture, has driven the societal change. The architecture, in particular, Watanabe showed, allowed Uber to have a tremendous impact in their business space.

“The contrast of Uber’s rapid global expansion and legal battles in some cities proves that a technology-driven business model behind a product that caters to social demand succeeds, if it is based on trust,” explains Watanabe, a coauthor of the new study. “The advancement of information and communication technology has allowed Uber to be successful in ways that traditional business-to-consumer models are not.”

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Further info


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Separating economic growth from environmental impact

Cities undergoing rapid economic growth often face the challenge of balancing continued growth with their environmental impact. In traditional growth models, the more a city has grown, the greater its environmental impact has been, particularly in carbon emissions.

But in today’s world, that no longer has to be the case. The municipality of Chongqing in China has seen rapid economic growth in the past two decades. Yet Chongqing has not done so at the expense of the environment. In fact, the municipality has even managed to reduce emissions of some pollutants during this rapid growth.

In a study published in the journal Ecological Indicators, IIASA researcher Bing Zhu showed that between 1999 and 2010, the decoupling of Chongqing’s economic growth from its environmental pressure was absolute for emissions of sulphur dioxide, soot, and waste water, while total energy consumption remained the same, as did CO₂ emissions and solid waste.

Chongqing’s emissions rate is now below average emissions for all municipalities across China and has had significant impact on economic development. Chongqing even improved its emissions output in the last half of that period, demonstrating that responsible economic growth for global sustainable development is possible.

“Our findings show that you don’t have to contribute more to carbon-based emissions in order to undergo economic growth on a city level,” explains Zhu, coauthor of the new study. “We believe that these findings provide a model for policymakers to use to separate the idea of rapid growth from adverse environmental impact.”

Hasegawa showed that Indonesia’s plan has been effective. The study showed that Indonesia achieved a 58% total reduction in emissions from agriculture, forestry, and other land-use sectors. Although rising carbon prices may prevent Indonesia from fully realizing the 2020 goal, the country is still on track to meet its goal for 2030.

“It is imperative that countries around the globe act on reducing their carbon emission outputs. The future of our planet depends on it,” explains Hasegawa, author of the new study. “Indonesia is an excellent example of how measured action, particularly in non-energy sectors such as forestry and agriculture, can achieve the desired results.”

Reducing CO₂ emissions in Indonesia

Most nations agree that reducing CO₂ emissions worldwide is the best way to address climate change. Solutions for addressing this fact, however, are not so simple.

Indonesia, a country that relies heavily on its agriculture and forestry industries, has been a leader in self-directed emissions reductions. It has served as an example of how even countries that depend heavily on these industries change their way of thinking and reduce their carbon footprint.

In 2009, Indonesia pledged a 26% reduction in CO₂ emissions by 2020 and a further 29% by 2030. To achieve its goal, Indonesia implemented policies protecting existing forests as well as establishing enough plants to create new forests and plantations.

In a study published in the journal Sustainability, IIASA researcher Tomoko Hasegawa showed that Indonesia’s plan has been effective. The study showed that Indonesia achieved a 58% total reduction in emissions from agriculture, forestry, and other land-use sectors. Although rising carbon prices may prevent Indonesia from fully realizing the 2020 goal, the country is still on track to meet its goal for 2030.

“It is imperative that countries around the globe act on reducing their carbon emission outputs. The future of our planet depends on it,” explains Hasegawa, author of the new study. “Indonesia is an excellent example of how measured action, particularly in non-energy sectors such as forestry and agriculture, can achieve the desired results.”

Further info

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Changing rainfall patterns linked to water security in India

Changing monsoon patterns in India—which are tied to higher temperatures in the Indian Ocean—are an even greater driver of change in groundwater storage than the pumping of groundwater for agriculture, according to new research from IIASA and the Indian Institute of Technology.

Satellite measurements have shown major declines in groundwater storage in some parts of the country, particularly in northern India in recent years. And groundwater withdrawals in the country have increased over tenfold since the 1950s, from 10-20 cubic kilometers per year in 1950, to 240-260 in 2009.

The issue of groundwater depletion has been a topic of much discussion in India, but most planning has focused on pumping, or the demand side, rather than the deposit side, or how much water is going into the ground. By looking at water levels in wells around the country, the researchers could track groundwater replenishment following the monsoons. They found that in fact, variability in the monsoons is the key factor driving the changing groundwater storage levels across the country, even as withdrawals increase.

“Weather is uncertain by nature, and the impacts of climate change are extremely difficult to predict at a regional level,” says IIASA researcher Yoshihide Wada, who contributed to the study. “But our research suggests that we must focus more attention on this side of the equation if we want to sustainably manage water resources for the future.”

How much do disasters cost Australia?

Floods, fires, earthquakes, and storms: Australia is one of the countries most frequently hit by disasters. But estimates of annual disaster cost range widely—from 1.75 to 3.26 billion AU$, according to recent research.

“The concept of disaster cost initially seems fairly straightforward. However, when we look at estimates we find a huge amount of variety. Even questions such as ‘which disaster type does the most damage’ are very difficult to answer because of the confounding variety of estimates, born of different data sources and methodologies,” explains IIASA researcher Adriana Keating, who worked on the new study. The study examined disaster-cost estimates and the data from which they were generated, aiming to explain the differences.

The confusion in large part comes from cataloging different types of damage. Costs can be direct, such as the destruction of a house or road, or indirect, such as lost profits when a business is forced to close. And while some costs have a clear monetary value, others such as environmental and cultural losses are more difficult to put a number on. Even the loss of life can be difficult to value.

“We know that investing in risk reduction is often more cost-effective than waiting for disaster to strike and cleaning up the mess afterwards. In order to support arguments for investment in risk reduction, and estimate the most cost-effective investments, policymakers need information about how much disasters cost, where they strike, and which types require the most urgent attention,” says Keating.
Russia’s population will decline slightly in the next 20 years, even with the assumption that immigration will exceed emigration by around 250,000 people per year. Without this migration, the population would have declined by more than 5 million people by 2035, according to new population projections from IIASA in collaboration with the Russian Presidential Academy of National Economy and Public Administration and the Russian Federal State Statistics Service.

Population projections are vital for policymaking, particularly in the area of social security, since the number of people drawing pensions must be supported by those paying into the system. In Russia, the aging population has led to recent calls to increase the retirement age. “This need can be well observed from our projections,” says IIASA researcher Sergei Scherbov, who worked on the new projections. Scherbov and colleagues have recently developed new methods of categorizing aging which take into account people’s characteristics, such as health and education level—these factors are also included in the new projections.

The new projections also show huge regional differences among demographic indicators across the vast country, particularly in the area of life expectancy. “Regions with highest life expectancy may be not so far from West European countries according to this indicator. But there are regions where life expectancy is at the level of a least developed country. For example, life expectancy for men varies from 58 to 76 years,” says Scherbov.

The new assumptions about fertility, mortality, migration, resulted in the projected population age composition and characteristics of aging. The data sheet is freely available online in both English and Russian.

Further info Russian Presidential Academy of National Economy and Public Administration (RANEPA), Russian Federal State Statistics Service (Rosstat), and International Institute for Applied Systems Analysis (IIASA). 2016. Russian Demographic Data Sheet 2016. RANEPA, Rosstat, and IIASA: Moscow, Russia and Laxenburg, Austria. [pure.iiasa.ac.at/14482]

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Energy is at the heart of sustainable development

Discussions at the Vienna Energy Forum 2017 contributed to implementation of the Sustainable Development Goals and Paris Agreement

In May 2017, Vienna’s Hofburg Palace once again opened its doors to a unique international meeting—the Vienna Energy Forum, co-organized by IIASA, the UN Industrial Development Organization (UNIDO), the Austrian government, and Sustainable Energy for All. High-level government officials from around the world interacted with top experts in the fields of energy, development, and environment, exchanging knowledge on how energy fits into the broader context of global development and climate targets.

Central to this year’s discussions were the two major international agreements of 2015: the Paris Agreement on climate change, and the UN Sustainable Development Goals (SDGs). As UN Deputy Secretary-General Amina Mohammed said at the meeting, “The 2030 Agenda and the Paris Agreement are mutually reinforcing and inseparable. And it is why member states have overwhelmingly endorsed both. Implementing the 2030 Agenda and addressing climate change must go hand-in-hand.”

Also clear was that policymakers need more analysis on the interactions between the targets. “The SDGs provide us with the destination for where we would like the world to go by 2030. But to arrive at that point, we need a roadmap that shows the pathways and their potential pitfalls, the trade-offs and synergies between policies,” said IIASA Director General and CEO Pavel Kabat, who spoke at the opening session and moderated a panel on the Energy, Food Security, Land, Water, and Health Nexus. He also took part in a high-level discussion co-hosted by IIASA, UNIDO, and the Financial Times entitled Moving SDGs & the Paris Agreement Forward: Clean energy’s role in addressing implementation challenges.

IIASA researchers came to the meeting with early results from three major projects focused on SDG interactions. At a side event, they presented recent research and upcoming projects looking at linkages between energy and other SDGs. IIASA Deputy Director General Nebojsa Nakicenovic introduced The World in 2050 initiative, which employs a backcasting method to assess feasible pathways for achieving all SDGs by 2030 and beyond into 2050. Shonali Pachauri described her recent research looking at how climate policies could affect energy access. Simon Langan, IIASA Water Program director, presented the new Integrated Solutions for Water, Energy, and Land project. And Keywan Riahi, IIASA Energy Program director, showed first results from a new IIASA-led project, Linking Climate and Development Policies - Leveraging International Networks and Knowledge Sharing (CD-LINKS). Members of the CD-LINKS project also joined Riahi for a second side session highlighting case study results for India and China.

IIASA researcher Luis Gomez-Echeverri co-led organization of the event and took part in a high-level panel on innovation and technology in the implementation of the SDGs and Paris Agreement. He said, "This year was the most successful Vienna Energy Forum yet, with more public interest, more media coverage, and more sponsors. Important side events provided key contributions to the discussions, and a greater focus on gender mainstreaming, which reflects the key role of women in energy development, innovation, and impacts."
Major project to empower tropical forest restoration

In order to limit climate change, protect the environment, and provide food for a growing world population, sustainable land use is critical. The new RESTORE+ project, launched in April 2017, takes aim at the issue in Indonesia and Brazil, two IIASA member countries where the issue of land-use change is of critical policy importance. The project, which will be funded for five years by the German International Climate Initiative, will also extend to the Congo basin, encompassing all three major tropical forests in the world.

Restoration of marginal and degraded land can bring multiple benefits, such as reducing greenhouse gas emissions from deforestation, protecting and increasing biodiversity, as well as economic benefits for local areas. Yet the issue is multifaceted and complex, and even the definitions of marginal and degraded land, as well as restoration, are seen very differently by different interest groups and in different regions. The IIASA-led project brings together 10 partners from around the world, creating a new network of expertise in modeling as well as community engagement.

“Assessing restoration potential of tropical degraded areas is a major two-fold challenge at the moment. Degraded areas have yet to be identified and agreed upon. Moreover, we need more knowledge on the implication of restoring these areas, not just from the environmental perspective but also what it means to the surrounding people, the food-land-energy nexus, or the broader economy,” says IIASA Ecosystems Services and Management Program Deputy Director Florian Kraxner, who leads the project.

IIASA researchers launch women in science club

Back in the 1970s when IIASA was founded, women made up only a tiny proportion of the scientific staff. Since then, the institute has grown much more diverse and in recent years the number of female scientists has been increasing rapidly. Yet both within and outside IIASA, women still face unique challenges in scientific careers. The new Women in Science Club, launched in spring 2017, is a scientist-led effort to help women at IIASA rise to those challenges and succeed in their careers.

Inspired by discussions with former Finnish president Tarja Halonen who visited IIASA in summer 2016, the club grew out of an ongoing conversation at the institute on gender balance and diversity. It was founded by two researchers in the Ecosystems Services and Management Program, Olga Turkovska and Amanda Palazzo, in collaboration with Anni Reissell, who leads the Arctic Futures Initiative.

“Initially the club started as a platform to bring more female speakers to the institute, but it has grown into something bigger,” says Turkovska.

“The goals of the club are to promote, support, and offer encouragement for women connected to science at IIASA,” says Palazzo.

While we also aim to amplify the scientific contributions of women, our club is open to all genders and backgrounds. We want to host discussions, lectures, and seminars that will highlight scientific insights by female researchers, as well as provide career development opportunities and trainings, and a support network to discuss challenges facing women in science.”
ERC grant to explore human wellbeing as criterion for sustainable development

IAISA World Population Program Director Wolfgang Lutz has been awarded a 2017 Advanced Grant from the European Research Council (ERC). The new research project will explore the viability and acceptability of a new holistic indicator—Empowered Life Years—as an ultimate end measure for sustainable development. The new indicator is based on the fact that being alive is a fundamental prerequisite for enjoying any quality of life. But since mere survival does not say much about quality of life, this project proposes to combine life expectancy with empowerment indicators such as health, literacy, freedom from poverty, and happiness. If the world achieves sustainable development the new indicator would not decline over time, even if feedbacks from socioeconomic and environmental changes, including climate change, are factored into the model.

"There has been much discussion recently about complementing the still widely used GDP per person with other indicators of quality of life that consider more than just the economic dimension. The tendency has been to go for large sets of indicators. But there is the danger that one does not see the forest for the trees," says Lutz. "This project tries to go in the other direction and look for one comprehensive indicator that reflects many of these dimensions and has a direct substantive meaning: the number of years a person is alive and empowered to enjoy life."

Such a comprehensive indicator could also be used for forecasting future trends. In order to more realistically address complex socioeconomic and environmental feedbacks, the study includes forward-looking case studies on Costa Rica, Namibia, Nepal, and South Africa, and a historical study on Finland to better understand the interactions under differing conditions.

The new grant is the 9th ERC grant awarded to IIASA researchers and Wolfgang Lutz’s third. Lutz was also recently appointed to join an independent group of scientists that have been charged by the UN Secretary-General to draft the Global Sustainable Development Report 2019, which will be presented to the heads of state and government at the 2019 UN General Assembly.

Recent awards

Five IIASA research studies were selected as part of Environmental Research Letters Highlights of 2016. The collection highlights the journal’s “most innovative groundbreaking articles published in 2016,” as selected by the journal’s editorial board. Among the thirty articles selected by the journal, five articles with IIASA lead or coauthors made the cut.

The Risk and Resilience Program received an international award for its long-standing collaborations with the Disaster Prevention Research Institute (DPRI) in organizing annual conferences on integrated disaster risk management. In addition to IIASA’s collaborations with DPRI, the award also seeks to recognize IIASA’s role as a founding member of the Society for Integrated Disaster Risk Management (IDRM).

IIASA researcher Daniela Weber has received the Allianz Young Talent Prize from Deutsche Gesellschaft für Demographie (DGD), the third award honoring her work on the international perspective on aging and cognitive decline. The World Population Program researcher is one of four awardees based on her international comparison of the cognition decline of elderly people.

Once every three years the Dutch Hydrological Society awards its prestigious Hydrology Prize (NHV Hydrologieprijs) to recognize exceptional contribution to hydrological science. IIASA Water Program Deputy Director Yoshihide Wada, who has published over 50 articles in the field of hydrology over the last decade, won the prize due to his groundbreaking work which revealed the impact of human water consumption on drought.

Systems analysis applied to environment and health

In collaboration with the UK national member organization – the Natural Environment Research Council (NERC), IIASA cohosted a conference at the Royal Society in London. On 2 December leading academics and practitioners came together to discuss the latest developments in systems analysis and modelling, specifically to talk about the opportunities and pitfalls of engaging decision makers with systems analysis.
Resilience is a slippery term. Resilience might refer to a person or community’s ability to adapt and rebuild after a disaster, but the term is also used more technically to describe the properties of a system to recover from collapse or catastrophe. These multiple definitions of resilience mean that there are also many approaches to study it. In a recent study, University of Tokyo researcher Ali Kharrazi and IIASA researcher Brian Fath bring some clarity to the concept of resilience and the empirical—or evidence-based—approaches used to study it in social environmental systems.

“Resilience is the ability of a system to survive and adapt in the wake of a disturbance.” says Kharrazi, an alumnus of the 2012 Young Scientists Summer Program (YSSP). However, he says, “there are few empirical approaches to the concept of resilience. This makes measuring, quantifying, communicating, and applying the concept to sustainability challenges difficult.”

The study found that in fact, none of the current methods can handle all aspects of the concept of resilience. What’s needed, Kharrazi says, is to apply different empirical approaches towards real-world sustainability challenges, using real data from cities and countries.

Kharrazi credits the YSSP with strengthening his passion, and giving him the research skills to make a positive impact on humanity and sustainable development. “When I first started my PhD I became interested in the concept of resilience, its relationship to common sustainability challenges, and our inability to measure and quantify this importance concept. Since my PhD I have continued to do research in this area and apply it to various domains, including energy, water, and trade.”

Driving the sustainability bus

A 2016 YSSP project was put to use in Sweden’s first wireless bus-charging system

When Sweden launched their first wireless electric bus system last year, Maria Xylia had just the tool that city planners needed. Xylia, a PhD student at KTH Royal Institute of Technology in Sweden, spent the summer of 2016 at IIASA working on a new model to optimize the bus charging system. Xylia’s model shows the optimal locations for charging stations, potentially cutting CO₂ emissions in half and lowering energy consumption by 34%. The model is used for optimizing energy or cost savings.

The new bus charging system relies on electric buses that can be charged wirelessly at bus stops, instead of having to be plugged in. While the buses can also run on a backup biodiesel engine, placing the charging stations in the right spots can keep the buses charged, and reduces local emissions and noise.

The model Xylia developed for Stockholm was based on the IIASA BeWhere model, a tool that can be used for energy system optimization at the local, regional, and national scale.

The researchers say that the model could be used for any city hoping to build such a system. “As long as you have a detailed map of the bus network and a reliable bus schedule, then you can do this for any city,” Xylia says. “London, for example, is much bigger than Stockholm, but if they have this data we can generate optimized energy and cost scenarios for that system.”
Water for life

Q&A with IIASA researcher Yoshihide Wada

Q: What interests you about water supply and demand around the world?
A: When I started my career, researchers were looking at the natural water cycle without considering how humans use and manage water. My background is in social and political science and I wanted to bring in this human dimension. I had to develop my own approach to calculate industrial, domestic, and agricultural water use. Once I had created a global map of water demand I could overlay this with a map of water supply to see where the two are mismatched and water scarcity will occur.

Another very important facet is groundwater. Data on groundwater resources are very scarce, so my team and I collected data on groundwater pumping rates around the world and assessed whether that was balanced by ‘recharging’ from rainfall. We discovered several regions where the rate of groundwater use was unsustainable, and they were not yet aware.

Q: How does your research help countries create policies to prevent water stress?
A: These global assessments have identified areas that suffer from water scarcity, and where groundwater is being depleted. That’s good progress scientifically but it is not enough for policy development. At IIASA we go beyond the assessment to look at measures that can be used on the ground. Part of my work, for example, has been looking at which management options are available and realistic for different regions. These might include improving irrigation efficiency, or building new storage infrastructure and desalination plants.

Q: How are you working with policymakers to apply these options?
A: As part of the IIASA Water Futures and Solutions Initiative we are working to help reduce water stress and improve water quality in Uganda and the areas around Lake Victoria. Under the Integrated Solutions for Water, Energy, and Land project we are developing sustainable solutions that work not only for water, but also the food and energy sectors. We are currently focusing on the Zambezi and Indus basins, working closely with local stakeholders who can provide us with important local knowledge.

Q: Much of your work is at a global scale, why is that so important?
A: Sometimes people assume that global assessments are too broad to be of real use, but our world is increasingly international and understanding large-scale patterns can be vital. In a recent study we examined how local groundwater depletion is ‘transported’ to other countries via the international food trade. In Japan, for instance, consumers are buying food from countries that are depleting their groundwater at an unsustainable rate, in order to grow those same crops for export. When it is international trade driving demand, you need to look at management options that are not just local but also at larger scales.

Q: You are a relatively young deputy director of a program at IIASA. What is that like?
A: As a deputy director I have to look at the wider scientific agenda, and how the program can grow and move forward. Sometimes I miss the days when I was doing the modeling, but these new challenges also give me a chance to develop as a scientist.


Just a few examples include

Globally IIASA researchers assessed countries’ climate pledges in light of the Paris Agreement.

Regionally input from IIASA provided an important basis to the revised EU Renewable Energy Directive.

Nationally the institute has developed a blueprint for managing air pollution in fast-growing megacities.

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