

Research collaborations between IIASA and the People’s Republic of China have been highly productive since China became a national member of IIASA in 2002 through the National Natural Science Foundation of China (NSFC). Since 2010, research collaborations between IIASA and China have focused on reducing greenhouse gas emissions, sustainable agriculture, water resources, disaster preparedness, demography, and the transition to a sustainable energy system in China. Underpinning the joint work is systems analysis – one of the few research tools with the breadth and depth to explore these complex problems across multiple sectors, countries, and timeframes. Moreover, the next generation of systems analysts are profiting from Chinese involvement in IIASA capacity building activities. Since 2010, 4 postdoctoral research fellows from China have developed their research skills at IIASA and 68 doctoral students have participated in IIASA programs for young scientists. Scientific exchange between IIASA and China is bolstered by over 170 visits to IIASA and over 290 visits by IIASA researchers to China. All these activities have contributed to producing over 360 peer reviewed publications since 2010. This Info Sheet summarizes activities between IIASA and China since 2010.

Highlights of Interactions Between IIASA and China (since 2010)	
IIASA National Member Organization (NMO)	National Natural Science Foundation of China (NSFC)
Membership start date	2002
Key research partners	43 Chinese organizations collaborate with IIASA including: <ul style="list-style-type: none"> ■ Beijing Forestry University ■ Beijing Normal University ■ Chinese Academy of Agricultural Sciences (CAAS) ■ Chinese Academy of Sciences (CAS) and many of its institutions ■ Energy Research Institute, National Development and Reform Commission ■ Peking University ■ Shanghai Meteorological Bureau ■ Shanghai University ■ The State Forestry Administration of the People’s Republic of China (SFC) ■ Tianjin University ■ Tsinghua University
Areas of research collaboration	<ul style="list-style-type: none"> ■ Sustainable agriculture and food security ■ Smart ways to clean up China’s air ■ Sustainable energy future and climate change ■ Global Energy Assessment and China ■ Water scarcity in China ■ Projecting changing population and human capital in China ■ Enhancing disaster preparedness in China ■ Terrestrial carbon management in China ■ Evolution of cooperation ■ Advanced systems analysis
Capacity building	<ul style="list-style-type: none"> ■ 89 doctoral students from China have participated in IIASA Young Scientists Summer Program ■ 4 young scientists from China have received IIASA Postdoctoral Fellowships ■ 5 doctoral students from China have taken part in the Southern African Young Scientists Summer Program
Publication output	<ul style="list-style-type: none"> ■ 366 publications have resulted from research collaborations between IIASA and Chinese scientists
Other interactions	<ul style="list-style-type: none"> ■ Researchers, advisors, and diplomats from China have visited IIASA over 220 times, and over 320 have participated in IIASA events, while IIASA scientists have visited China over 290 times

Activities with Member Countries: China

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IIASA Info Sheets provide succinct summaries of IIASA activities. They do not necessarily reflect the views of IIASA staff, visitors, or National Member Organizations.

This Info Sheet summarizes IIASA interactions with China during 2010–2019. It includes highlights, with links to further information, but is not intended to be a comprehensive report on all interactions.

Feedback and updates are encouraged and should be sent to the External Relations Department.

IIASA National Member Organization in China

In 2002 China formally joined the Institute, with the National Natural Science Foundation of China (NSFC) as the National Member Organization (NMO) of IIASA. NSFC is directly under the jurisdiction of China's State Council and is responsible for administering the Central Government's National Natural Science Fund which has been approved by the National People's Congress.

Professor Xie Xincheng, Vice President of the NSFC, is the IIASA Council Member for China and along with representatives of each of the IIASA member countries governs the Institute. Professor Xie is also a member of the Program Committee, which advises IIASA on research activities and overseeing approval of the IIASA Research Plan and the external review processes. **Mr. Chuang Zhao**, Program Officer for the Division for Asia, Africa and International Organizations, Bureau of International Cooperation, the NSFC, is the NMO Secretary for China.

NSFC has established a NSFC Advisory Expert Group on Cooperation with IIASA, the Belmont Forum, and other International Organizations. The Group has the following members:

Professor Xie Xincheng (Chair), Member of CAS (Chinese Academy of Sciences); Vice President, NSFC

Dr. Bojie Fu, Member of CAS; Professor, Research Center for Eco-Environmental Sciences, CAS; President, The Geographical Society of China

Dr. Zhengtang Guo, Member of CAS; Professor, Institute of Geology and Geophysics, CAS; Vice President, University of Chinese Academy of Sciences

Dr. Huijun Wang, Member of CAS; Professor, Institute of Atmospheric Physics, CAS; President, The Meteorological Society of China

Dr. Peng Cui, Member of CAS; Professor of Institute of Mountain Hazards and Environment, CAS; Vice President, The Geographical Society of China

Dr. Xiangzheng Deng, Professor, Institute of Geographic Sciences and Natural Resources Research, CAS

Dr. Jikun Huang, Professor, School of Advanced Agriculture Sciences, Peking University; Founder and Director, Center for Chinese Agricultural Policy, CAS

The National Natural Science Foundation of China represents China and its scholarly community on IIASA governing Council

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Professor Bojie Fu, Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences. Dr. Fu is a member of the Chinese Academy of Sciences, President of Chinese Geographical Society, and is a member of IIASA Scientific Advisory Committee.

H.E. Liangyu Hui, former Vice Premier of the State Council of the People's Republic of China from 2003 to 2012, promoted findings from IIASA research to agricultural policymakers in China.

Professor Zheng-hua Jiang, former Vice-Chairman of the Standing Committee of the National People's Congress of the People's Republic of China, has collaborated with IIASA for many years.

Professor Jianhua Lin, Former President, Peking University

Professor Yi-fu Lin (Justin Lin), Professor and Honorary Dean, National School of Development, Peking University and Former Senior Vice President and Chief Economist, The World Bank

Dr. Xu Tang, former Director General of the Shanghai Meteorological Service, now at the World Meteorological Organization, collaborated with IIASA on research into China's agro-ecosystem.

Professor Jie Wang, Vice President of Peking University, was IIASA Council Member for China from 2002 until 2013 when he served as Vice President of NSFC.

Professor Jinghai Li, President, NSFC

Professor Linxiu Zhang, Deputy Director, Center for Chinese Agricultural Policy; Director, Rural Education Action Program China, Chinese Academy of Sciences. Professor Zhang was a Panel Member for IIASA Institutional Review.

Professor Dadi Zhou worked closely with IIASA energy researchers when he was Vice Chairman of the State Expert Advisory Committee to the National Energy Leading Group of China and Director of the Energy Research Institute, among other affiliations.

Some leading personalities from academia and government in China associated with IIASA

Dr. Xiubin Li, Professor, Deputy Director, Institute of Geographic Sciences and Natural Resources Research, CAS

Dr. Xizhe Peng, Professor, Fudan University; Director, State Innovative Institute for Public Management and Public Policy Studies

Dr. Peijun Shi, Professor and Executive Vice-President, Beijing Normal University

Dr. YU Guirui, Professor and Deputy Director, Institute of Geographic Sciences and Natural Resources Research, CAS; Vice President, The Ecological Society of China

Dr. ZHANG Wei, Professor and Dean, College of Management and Economics, Tianjin University

Dr. ZHANG Xiliang, Professor and Director, Institute of Energy, Environment, and Economics, Tsinghua University

Dr. ZHOU Tianjun (Secretary for Belmont Forum affairs in the Committee), Professor and Deputy Director, State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, CAS

Dr. ZHU Bing, (Secretary for IIASA affairs in the Committee), Professor and Executive Deputy Director, Institute of Circular Economy, Tsinghua University; Guest Research Scholar, IIASA

Research Partners in China

IIASA is continually developing collaborations with China and has recently been working with 43 organizations in China via formal and informal connections

IIASA works with research funders, academic institutions, policymakers and individual researchers in China. The following list includes the names of the organizations or the individual's affiliated institutions that have all recently collaborated with IIASA.

- Beihang University
- Beijing Forestry University
- Beijing Normal University
- China Conservation and Research Center for the Giant Pandas, State Forestry Administration of the People's Republic of China (SFC)
- China Council for International Cooperation on Environment and Development (CCICED)
- China University of Mining and Technology
- Chinese Academy of Agricultural Sciences (CAAS)
- Chinese Academy of Sciences (CAS), including:
 - Coal Liquefaction Research Center
 - Institute for Atmospheric Physics
 - Institute of Geographic Sciences and Natural Resources Research (IGSNRR)
 - Institute of Soil Science
 - Institute of Zoology
- Chinese Research Academy of Environmental Sciences (CRAES)
- China National Environmental Monitoring Center
- Chongqing Normal University
- Clean Air Alliance of China (CAAC)
- Development Research Center of the State Council of the People's Republic of China (DRC)
- East China Normal University (ECNU)
- East China University of Science and Technology (ECUST)
- Energy Research Institute National Development and Reform Commission (ERI)
- Fudan University
- Huazhong Agricultural University (HZAU)
- Lanzhou University
- Nanjing University (NJU)
- National Center for Climate Change Strategy and International Cooperation
- National Geomatics Center of China (NGCC)
- National Natural Science Foundation of China (NSFC)
- North China Electric Power University
- Peking University (PKU)
- Renmin University of China
- Shanghai Jiao Tong University
- Shanghai Institute of Technology
- Shanghai Meteorological Bureau
- Shanghai Ocean University (SHOU)

- Shanghai University (SHU)
- Shenhua Coal Liquefaction Research Center
- Sichuan Academy of Forestry
- Sichuan University (SCU)
- South China University of Technology (SCUT)
- South University of Science and Technology of China (SUSTC)
- Southwest University
- State Energy Administration of the People's Republic of China
- State Forestry Administration of the People's Republic of China (SFA)
- Tianjin University (TJU)
- Tsinghua University (TH)
- Wuhan University
- Xinjiang University (XJU)

Recent Research Collaborations

Sustainable agriculture and food security

China's agricultural sector is changing. Driving this transformation is rising food demand due to a growing population, that is expected to reach 1,436 million by 2030, increasing urbanization of up to 60 percent by 2030, and rising incomes as the country's economic growth benefits more and more people. At the same time, industrialization and climate change are expected to lead to a loss of crop land of some 6.5 million ha and trade liberalization and technical progress will continue to drive further change.

IIASA researchers are collaborating with Chinese institutions to develop models and research tools that identify ways to improve agricultural production in China

Understanding the impacts of these driving forces on farmers and consumers across the diverse 2,885 counties that make up China is not easy. Setting the right agricultural policies is even harder. In a number of collaborations with partners in China, IIASA has developed a range of research tools to help identify the right policies as part of on-going cooperation with China since 1995. Recent Chinese-IIASA Collaborations in this area include:

- An international collaboration including researchers from IIASA, the South University of Science and Technology of China, and the Beijing Forestry University investigated the suitable areas to implement photovoltaic water pumping systems for irrigation. The researchers found significant potential for photovoltaic water pumping systems for both grassland conservation and carbon emissions reduction. The study was published in *Applied Energy* in 2017.
- A study by researchers from IIASA, South University of Science and Technology of China analyzed multiple Sustainable Development Goals policies for the management of land-based resources. Using a comprehensive modeling approach, the researchers examined how policies can manage trade-offs among the environmental conservation initiatives and food prices. This framework could help policymakers understand and negotiate potential trade-offs when constructing sustainable development strategies. This research was published in *Science Advances* in 2016.
- Climate change and intensive human activities are also affecting China's agro-ecosystem and its supply potentials. Shanghai Meteorological Bureau (SMB), IGSNRR, Chinese Academy of Agricultural Sciences (CAAS), and IIASA assessed this impact as part of a NSFC-IIASA funded project from 2010 to 2012. Results from the project were presented at a workshop in 2013 in Shanghai entitled Opportunities and Challenges of China's Agriculture Under Climate Change.
- The Global Agro-Ecological Zones (GAEZ) model has been developed by the Food and Agriculture Organisation (FAO) of the United Nations and IIASA to help identify areas for increased food production, while maintaining the natural resource base and facing the challenge of climate change. GAEZ underpins many of the following studies. Feeding into GAEZ, is a database of world soil resources (HWSD) developed by FAO, IIASA, ISRIC – World Soil Information, Institute of Soil Science at the Chinese Academy of Sciences (ISSCAS), and the Joint Research Centre of the European Commission.

- IIASA with the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) at the Chinese Academy of Sciences, and Center for Chinese Agricultural Policy Center (CCAP) among others developed Chinagro II—a highly detailed model of Chinese agriculture—in a series of projects starting in 2001.
- The CATSEI-project extended the Chinagro study to explore the impacts of China's vigorous agricultural transition, on the country itself, as well on its trading partners, the EU in particular. This EU-funded project ran from 2007 to 2010 and was an international collaboration including IIASA, CCAP, and several European institutions.
- The trade-offs between intensifying agricultural production and harming the environment is the focus of several recent studies into nitrogen management. With Beijing Forestry University IIASA assessed global nitrogen flows in croplands and concluded that globally, two-fifths of nitrogen used in agriculture is lost to ecosystems with harmful environmental effects. Southern China, Western Europe, and eastern United States were particularly vulnerable due to the prevalence of wet soils that encourage nitrate leaching. IIASA researchers also explored nitrogen management in China through combining results from the CATSEI project and greenhouse gas emissions from IIASA GAINS model. The resulting spatial modeling framework has since been adopted by Chinese scientists, with the results serving as a basis for further national work.
- Further models and research tools are being developed in a collaboration between IIASA, IGSNRR, and Chongqing Normal University. From 2012 to 2017 the NSFC–IIASA funded project is conducting an integrated analysis and modeling of land use efficiency and security under rapid agricultural transformation due to urban–rural dynamics in China.

These studies have resulted in numerous peer-reviewed publications (see Appendix 4, Publications Relevant to IIASA–China Collaborations). They are also contributing to national reports. For instance, studies with the Chinese Academy of Agricultural Sciences on the impacts of climate change on the agricultural production and crop yields in China have been cited by both the Chinese Third National Climate Change Assessment Report and the Second National Communication for Climate Change.

IIASA's models, tools, and data

Through intense data gathering, computer modeling, and other advanced research methods, IIASA provides a country's researchers and their policymakers with the essential numbers and tools to select the most effective policies. For example:

- Nitrogen oxides (NO_x) are air pollutants that help form acid rain, contribute to global warming, hamper the growth of plants, and have adverse impacts on human health. A research collaboration between IIASA and Tsinghua University explored historical trends and future perspectives of NO_x emissions in China. The study calculated that NO_x emissions increased rapidly in China from 11.0Mt in 1995 to 26.1Mt in 2010 driven by the fast growth of energy consumption. Exploring six future scenarios, the researchers projected that NO_x emissions would increase by 36% by 2030 under business as usual conditions. However, implementing stringent end-of-pipe pollution control measures in power plants, industry, and transport sectors could reduce up to 61% of emissions by 2030. *Source: Zhao B, Wang SX, Liu H, Xu JY, Fu K, Klimont Z, Hao JM, He KB, Cofala J, Amann M (2013). NO_x emissions in China: Historical trends and future perspectives. *Atmospheric Chemistry and Physics* 13(19):9869–9897.*

Many of the research projects summarized in this Info Sheet draw on analyses from IIASA's models, tools, and data including:

- Reducing air pollution and greenhouse gas emissions simultaneously (GAINS model)
- Planning a sustainable energy system (MESSAGE model, Global Energy Assessment Scenario Database)
- Reducing energy poverty (Energy Access Interactive Tool—ENACT)
- Improving food security through identifying yield gaps (GAEZ model) and assessing competition for land use between agriculture, bioenergy, and forestry (GLOBIOM model)
- Financial disaster risk management (CATSIM model)
- Projecting future population (Demographic multistate modeling)

IIASA research has also influenced Chinese agricultural policy on regulating the quality of livestock feed and the excessive application of fertilizers.

Smart ways to clean up China's air

IIASA GAINS model is a scientific tool that has been helping policy makers and researchers across the globe to select a smart mix of measures to simultaneously cut multiple air pollutants and greenhouse gas emissions. Experience from Europe, whose policy makers use GAINS, show this multiple pollutant approach is the most cost-effective.

IIASA has worked closely with Tsinghua University, the Energy Research Institute (ERI) of the National Development and Reform Commission in Beijing, and other international partners to implement the GAINS model for Asia and for China. Additionally, GAINS has been extended to cover short-lived climate pollutants such as ozone and aerosols. IIASA and Tsinghua University researchers are using this capability to assess emission abatement strategies for these pollutants as part of the EU-funded ECLIPSE project. Over the last five years, these versions of GAINS have underpinned various policy analyses, including:

- Two NSFC-funded projects exploring (1) controls of emissions from the Chinese energy sector, and (2) technologies to control greenhouse gas emissions in China.
- An ongoing collaboration with Tsinghua University and funded by Toyota has projected tropospheric ozone concentrations across South and East Asia and so inform efforts to limit the air pollutant ozone in the region.
- A joint project with ERI studied the greenhouse gases mitigation potentials for China and was funded by the Climate Works Foundation.
- A current study into strategies to control multiple air pollutants in China with the Chinese Research Activity for Environmental Sciences (CRAES) and funded by the Norwegian Ministry of Environment.
- A project with Peking University, since 2014, on coal, natural gas, and clean air in China.

Findings from these policy analyses have been communicated to the Chinese government through a variety of channels. Recent interactions include:

- IIASA researchers delivered a session on the GAINS model at the China Clean Air Training seminar for local air quality managers, organized by the Clean Air Alliance China (CAAC) in Beijing in 2013.
- In 2012 **Markus Amann** contributed to the report of the China Council for International Cooperation on Environment and Development (CCICED) to the Chinese government on "Full Implementation of Action Plan on Prevention and Control of Air Pollution."
- Lessons learned from GAINS-China on the co-benefits of low-carbon strategies on local air quality informed the development of the 12th Five Year Plan.

In addition, a city-scale implementation of the GAINS model has been developed by researchers from IIASA and Tsinghua University to help urban planners assess practical policy options for controlling urban air pollution that simultaneously maximize reductions in greenhouse gas emissions. GAINS-City has been implemented for Beijing and Tianjin with funding from the Energy Foundation.

Since 1998 IIASA has been organizing annual workshops to compare results from atmospheric dispersion models for Asia and published the results. Researchers from the Institute for Atmospheric Physics of the Chinese Academy of Sciences and Tsinghua University have taken part.

Further, IIASA researchers in international collaboration including researchers from Peking University, Tsinghua University, and the Chinese Academy of Meteorological Sciences studied how residential emissions contribute to regional air pollution. The researchers found that reducing residential sector emissions would lead to significant air quality improvements in the Beijing region. This study was published in *PNAS* in 2016.

Chinese researchers are working with IIASA to use its GAINS model to identify the most efficient and effective measures to tackle the country's air pollution

Sustainable energy future and climate change

Chinese national interests are integrally connected to complex global systems that impinge on the country's economy, energy systems, and climate among others. The latest Chinese national energy plan demonstrates the Chinese government's commitment to increasing its share of renewable energy sources. IIASA recent collaborations with Chinese researchers and institutions are improving energy and integrated assessment modeling and thereby contributing to China's strategic research base through enhancing modeling knowledge and skills. In addition, the research improves understanding of how today's energy and climate policies, both global and national, may impact China's development.

Recent Chinese-IIASA collaborations in this area include:

- An international research collaboration including researchers from IIASA, Chinese Academy of Sciences, Tsinghua University, Peking University, Beijing Forestry University, and South University of Science and Technology of China re-evaluated China's carbon emissions and found that total energy consumption was 10 percent higher, coal emissions were 40 percent lower, and emissions from cement production were 45 percent less than recent estimates. This study indicates a probable overestimate of China's emissions from 2000 to 2013. This study was published in *Nature* in 2015.
- A global model comparison of 23 energy–economy and integrated assessment models has helped better articulate Asia's role in mitigating climate change—crucial, given the growing economic relevance of Asia in the world and its energy and environmental impacts. This Asian modeling study was a global collaboration between multiple modeling teams including ERI and Renmin University, and ran from 2009 to 2012.
- ERI and Tsinghua University are also members of the Integrated Assessment Modeling Consortium (IAMC), which IIASA and partners in Japan and the US coordinate. IAMC is a consortium of scientific research organizations that facilitates and fosters the development of integrated assessment models. Recent work for the climate change research community involved in the IPCC Fifth Assessment Report includes: (1) the Representative Concentration Pathways (RCP) database that provides greenhouse gas emission and other projections (see IIASA's global contribution, page 13); and (2) the Shared Socioeconomic Pathways that facilitate the integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation.
- Multiple collaborations between IIASA, ERI, and/or Tsinghua University are researching:
 - Development of a Chinese version of IIASA MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impact) model to help energy planners develop a sustainable energy system (ERI and Tsinghua University).
 - Strategies for investing in carbon capture and storage technologies in China and the impact of climate policy on these investments (Tsinghua University).

Research to support science diplomacy

IIASA was established in 1972 to use scientific cooperation to build bridges across the Cold War divide and research growing global problems on a truly international scale. Today the soft power of science diplomacy continues to help IIASA member countries through using scientific cooperation to improve international relations, and through international teams jointly researching controversial issues to find consensus. For example, researchers and policymakers from Austria (Vienna Institute for International Economic Studies), the European Commission, Finland, Germany, Russia, and Ukraine are jointly analyzing the challenges and opportunities for greater economic integration in Eurasia.

In addition, IIASA also maintains its original bridge-building objective through attracting member countries that represent a range of geo-political interests (see full list of members: Back page). For instance, both Russia and the US are members; as are Brazil, China, India, and South Africa. Several key factors also unite all IIASA member countries: their interest in systems analysis, scientific and academic infrastructure, economic stability and the geopolitical role in future global transitions. With this in mind, IIASA recently negotiated membership with Iran and with Israel.

- The co-benefits of climate policy for air pollution, energy security, and economic growth as part of the EU-funded project, LIMITS (ERI).
- Climate change mitigation pathways and associated mitigation costs as part of the EU-funded project, AMPERE (ERI). And the potential for technology to reduce China's carbon dioxide emissions as part of the UK-funded project, AVOID.

In addition, China is a key region in IIASA's MESSAGE-Access model which assists national and regional policymakers in their strategies to improve energy access for the rural poor in developing countries.

Global Energy Assessment and China

The Global Energy Assessment (GEA), published in 2012, defines a new global energy policy agenda—one that transforms the way society thinks about, uses, and delivers energy. Coordinated by IIASA and involving over 500 specialists from a range of disciplines, industry groups, and policy areas, GEA research aims to facilitate equitable and sustainable energy services for all, in particular for around three billion people who currently lack access to clean, modern energy.

Dr. Fei Feng, Director of the Industrial Economics Research Department and Research Fellow, Development Research Centre of the State Council of China, was a co-chair of GEA. **Dr. Kebin He** and **Zheng Li** were Convening Lead Analysts. **Professor Dadi Zhou** was a council member of the GEA. Additionally, twelve researchers from Chinese institutions, including the Energy Research Institute, Tsinghua University, North China Electric Power University, Shenhua Cola Liquefaction Research Center, and Renmin University of China were lead or contributing authors to the GEA

Findings relevant to China were outlined at the China launch of the GEA by IIASA in Beijing in 2012. Areas of particular interest were the implications of a rapid shift to urbanization and increasing energy densities; along with the key issues of energy access and the associated health and development issues associated with poor levels of access to clean energy.

Outcomes from the GEA include the adoption of GEA's findings as the three key objectives of the UN Secretary-General's Sustainable Energy For All (SE4All) initiative on energy access, energy efficiency, and renewable energy, which in turn have informed the targets of the Sustainable Development Goal on energy.

Water scarcity in China

IIASA, Beijing Forestry University, and other partners were involved in a global assessment of "green" and "blue" water (withdrawn for irrigation from rivers, lakes, and aquifers) availability. The study looked at the need to improve understanding and management of "green water" (precipitation to the soil) as this may prove an important resource as water scarcity escalates. China was one of the six countries identified in the study as of high significance given it has one of the highest rates of blue water consumption in the world supporting agriculture.

Related research, also involving NSFC, Beijing Forestry University, and IIASA was launched in April 2012 on "Grey water footprint and water scarcity assessment." The project aims to quantify pollution-induced water scarcity (PIWS) based on an assessment of the grey water footprint for the Heihe River Basin, in China.

Geo-Wiki, a crowdsourcing tool developed by IIASA and partners, has established a global network of volunteers who help improve the quality of land cover maps and data.

China was a significant contributor to the Global Energy Assessment

Collaborations between IIASA and Chinese researchers are assessing the quantity and quality of water in China

IIASA demographers are providing independent analysis and projections of China's future population including the impact that education and urbanization may have on China's future demographics

Projecting changing population and human capital in China

IIASA demographers study and project the changing composition of population for all countries of the world. They produce one of the few independent alternatives to the demographic projections of the UN Population Division. As a testament to the quality of IIASA demography, the IPCC in 2011 adopted IIASA population projections as its source data in all modeling for the Fifth Assessment Report; and UNESCO has adopted IIASA demographic methods as part of its literacy forecasting.

The Institute's interdisciplinary setting has encouraged its demographers to research beyond the traditional boundaries of demography and to explore how changes in society, economy, and the natural environment influence the health and mortality, migratory patterns, and reproductive behavior of human society.

A recent innovative example of this broader approach has been the development of research methods to project population by level of education. This equips researchers with the tools to explore the implications of different education policies on a country's future fertility, life expectancy, migration, and population level as well as economic growth and ability to adapt to climate change. In 2014 IIASA published the first projections of educational attainment by age and sex for 195 countries in the Oxford University Press volume *World Population and Human Capital in the Twenty-First Century*. Findings for China show how different policies over the next few decades could lead to the country's 2010 population of 1,341 million falling to between 550 million and 1,046 million by the end of the century. Additionally, in 2016, *Who Survives? Education decides the future of humanity*, a book summarizing scientific research conducted at IIASA was published detailing the importance of education for societal and

Selected publications resulting from IIASA–China collaborations

IIASA work is underpinned by high-quality science, which is regularly published in high impact publications. A selection of recent publications is presented here; a complete list can be found in Appendix 4.

- Campana PE, Leduc S, Kim M, Olsson A, Zhang J, Liu J, Kraxner F, McCallum I, Li H, Yan J (2017) Suitable and optimal locations for implementing photovoltaic water pumping systems for grassland irrigation in China. *Applied Energy*, 185, 1879-1889.
- Liu J, Mauzerall DL, Chen Q, Zhang Q, Song Y, Peng W, Klimont Z, Qiu X, Zhang S, Hu M, Lin W, Smith KR, Zhu T (2016). Air pollutant emissions from Chinese households: A major and underappreciated ambient pollution source. *PNAS*, 113(28), 7756-7761.
- Obersteiner M, Walsh B, Frank S, Havlik P, Cantele M, Liu J, Palazzo A, Herrero M, Lu Y, Mosnier A, Valin H, Riahi K, Kraxner F, Fritz S, & van Vuuren D. (2016). Assessing the land resource-food price nexus of the Sustainable Development Goals. *Science Advances*, 2, e1501499.
- Liu Z, Guan D, Wei W, Davis SJ, Ciais P, Bai J, Peng S, Zhang Q, Hubacek K, Marland G, Andres RJ, Crawford-Brown D, Lin J, Zhao H, Hong C, Boden TA, Feng K, Peters GP, Xi F, Liu J, Li Y, Zhao Y, Zeng N, He K (2015). Reduced carbon emission estimates from fossil fuel combustion and cement production in China. *Nature*, 524, 335-338.
- Lu Y, Nakicenovic N, Visbeck M, Stevance A-S (2015). Policy: Five priorities for the UN Sustainable Development Goals. *Nature* 520(7548):432–433 [doi:10.1038/520432a].
- Feng K, Davis SJ, Sun L, Li X, Guan D, Liu W, Liu Z, Hubacek K (2013). Outsourcing CO2 within China. *PNAS* 110(28):11654–11659 [doi:10.1073/pnas.1219918110].
- Garcia SM, Kolding J, Rice J, Rochet M-J, Zhou S, Arimoto T, Beyer JE, Borges L, Bundy A, Dunn D, Fulton EA, Hall MA, Heino M, Law R, Makino M, Rijnsdorp AD, Simard F, Smith ADM (2012). Reconsidering the consequences of selective fisheries. *Science* 335(6072):1045–1047 [doi:10.1126/science.1214594].
- Rogelj J, Hare W, Lowe J, Van Vuuren DP, Riahi K, Matthews B, Hanaoka T, Jiang K, Meinshausen M (2011). Emission pathways consistent with a 2°C global temperature limit. *Nature Climate Change* 1(8):413–418 [doi:10.1038/nclimate1258].

economic development. The researchers found that education is often more important than income when looking at health, resilience, and wellbeing.

Other population studies related to China include:

- A collaboration with the newly established Asian Demographic Research Institute (ADRI) at Shanghai University, which will use advanced demographic methods and the best available data to study a wide range of policy relevant topics in population research and population–economy–environment interactions. The new institute will also create a platform for regional collaboration in demographic research and training through close collaborations with institutions in Asia and beyond.
- A collaboration between IIASA and the Institute of Population Research at Peking University (PKU) resulted in a special volume of *Population and Environment* in 2012 that used models to explore the complex relationships between urbanization, demographic change, economic growth, and natural resources and the environment in China.
- A 2011 *Science* article used China as one of its case studies to demonstrate that the level of education among a country’s population has a clear positive effect on the country’s economic growth.
- In 2011 IIASA demographers assembled a global panel of experts, including **Peng Xizhe** of the School of Social Development and Public Policy at Fudan University. Together they issued the Laxenburg Declaration, which outlined the demographic challenges for sustainable development.
- In 2010 IIASA and partners published a study in *PNAS* exploring the links between the major demographic trends of aging, urbanization, and changes in living arrangements on the one hand, and energy consumption, land use, and associated emissions on the other. The key results for China indicate that by factoring in urbanization, emissions projections could be nearly 50% higher than projections made without considering urbanization.
- In 2009 IIASA completed a study on global and regional population aging and subsequently made a regional analysis for China which was published in the *China Economist* and warned of China’s grave demographic challenges in coming decades.

Enhancing disaster preparedness in China

Through Beijing Normal University (BNU), IIASA is a collaborator on activities such as:

- Establishing the Integrated Disaster Risk Management Society and organizing associated conferences.
- The Integrated Risk Governance Project of the International Human Dimensions Programme (IHDP) which is exploring mechanisms, trends, impacts and the predictability of risks in the context of global change, and developing risk assessment models and methods for integrated risk simulation.

Researchers from IIASA and China are jointly researching activities to make communities more resilient to the impacts of natural disasters

A project examining mega-disasters and socioecological transition in Sichuan Giant Panda Sanctuary World Heritage is seeing IIASA researchers collaborating with researchers at multiple Chinese institutions, including the Sichuan Academy of Forestry, the Institute of Zoology of the Chinese Academy of Sciences, the Research Center for Eco-Environmental Sciences, Sichuan University, and the China Conservation and Research Center for the Giant Pandas. The project is having an impact through enhancing disaster preparedness in world heritage management and promoting reform in protected area legislation to the National People’s Congress and the Chinese People’s Political Consultative Conference.

Terrestrial carbon management in China

On-going modeling work with collaborators at IGSNRR has been calculating the contributions of China’s forests and land-use practices to the country’s national carbon inventories.

Recent studies have also explored:

- The impact of forest management practices on the carbon dynamics in woody biomass of forest ecosystems in China.

Joint research into carbon sinks and sources from China’s land

- The extent of the carbon sink across the world's forests in a study with international collaborators including Peking University, as part of the Global Forest Carbon Budget Group, which was published in *Science*.
- The optimal grassland location for sustainable photovoltaic water pumping systems in China in collaboration with researchers from the South University of Science and Technology of China, Beijing Forestry University among others and as part of the NSFC collaborative project on water and ecology.

Evolution of cooperation

A conference to compare different research approaches to the evolution of cooperation provides a special emphasis on contributions by the rapidly growing community of Chinese game theorists

Building on the success of the Evolution of Cooperation conference held at IIASA in 2009, NSFC and IIASA organized another conference to bring together leading cooperation researchers from China, IIASA, and elsewhere to discuss empirical insights and theoretical methods underlying the evolutionary theory of cooperation. The conference took place in Beijing in April 2014 and showcased complementary approaches to evolutionary problems dealing with the social dilemmas surrounding human cooperation. Eighteen speakers from Chinese institutions, ranging from Beijing Normal University to the Chinese Academy of Sciences, presented their latest theories via model-based lectures.

Other collaborations in the field of ecology and evolution include:

- Exploring financial market stability in the presence of heterogeneous adaptive agents with a researcher from Tianjin University.
- A study on evolutionary community assembly with size-structured populations with a Chinese researcher based at Umea University in Sweden.

Advanced systems analysis

Collaborations that are advancing the methods of systems analysis

The NSFC–IIASA-funded project Optimization of Resource Productivity for Sustainable Economic Development is exploring the dynamic mechanism of resource productivity to characterize the optimal strategy for improving resource productivity on a macro-level, with a specific focus on mid-term economic development in China. The project, which runs from 2012 to 2015 and brings together researchers from IIASA, Tsinghua University, and Renmin University, has already published early findings.

An on-going collaboration since 2010 between researchers from IIASA and Beijing Normal University is applying network analysis to study urban metabolism in Chinese cities. Nearly 20 peer-reviewed journal articles have resulted including a new model for analyzing Beijing's water resources and a spatially explicit network model of urban metabolism.

Researchers from the China University of Mining and Technology and IIASA have collaborated to develop a three-dimensional model to analyze the sustainable development of energy and agricultural industries in China under competition for land and water resources and implications for policy.

Capacity Building

Young Scientists Summer Program

The Young Scientists Summer Program (YSSP) develops the research skills and networks of talented PhD students. Program participants conduct independent research within the Institute's research programs under the guidance of IIASA scientific staff. Funding is provided through IIASA Chinese National Member Organization unless otherwise indicated. Since 2010 the following 68 Chinese students have participated in this program:

Since 2010, 89 Chinese students have developed research skills and networks by taking part in IIASA Young Scientists Summer Program

YSSP'19

Minghao Qiu (Massachusetts Institute of Technology) is analyzing on-road vehicle emissions from remote sensing in the Jing-Jin-Ji (JJJ) region of China.

Muye Ru (Duke University) proposes a generalized set of functions linked to GAINS that estimate cause-specific morbidity burdens and the associated economic costs.

Xu Wang (School of Economics and Management of the Beihang University) is assessing energy efficiency co-benefits for air pollution and greenhouse gas abatement in China's building sector.

Chenling Fu (Northwest Normal University) is proposing flow-stock network model of urban metabolism – an application in the global megacity Beijing.

Xikun Hu (Royal Institute of Technology) is working on modelling burned areas based on flam using deep learning-based methods.

Zitong Liu (China Agricultural University) is proposing model based approach for managing nitrogen for sustainable wheat-maize rotation.

Huan Liu (Kyoto University) is making estimation of business lifeline resilience factors to disaster.

Wu Chen (University of Southern Denmark) is researching unlocking the transportation-energy nexus: case study for China's passenger vehicles transition.

Many of today's most pressing challenges extend beyond international borders. IIASA research areas such as climate change, water scarcity, and poverty are affected by multiple factors across the globe. In turn, these global problems have impacts on nations, regions, and continents. Finding long-lasting solutions to these challenges requires scientific expertise that is free from the interests of a single nation. IIASA's National Member Organizations recognize this need and their investment in IIASA is a contribution to a global public good. The benefit of this contribution is paid back to global researchers, policymakers, and citizens in multiple ways, as the following examples show:

- IIASA supports the climate change research community by hosting the Representative Concentration Pathways (RCP) database. The database provides data on greenhouse gas emissions for four different future scenarios that underpin the analysis of thousands of climate change researchers. IIASA also calculated the data for one of the scenarios, all of which have been developed for the world's most comprehensive analysis of climate change—the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report.
- IIASA research provides scientific guidance to the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe. This international environmental treaty between 33 countries has slashed air pollution in Europe, improving people's health and countries' crop production. IIASA GAINS model guided negotiators and policy makers as they worked on the treaty to identify the most cost-effective approach to cleaning Europe's air. The negotiators chose the GAINS model not only because of its accuracy and usability but also because it had been developed by an international team with funding from multiple countries, which assured them that the model was nationally unbiased.

IIASA's global contribution

Xingrong Zhao (East China University of Science and Technology) is analyzing electric vehicle adoption in Shanghai based on empirical data and agent-based simulation

Wenting Yang (Tsinghua University) is evaluating groundwater recovery in the North China Plain using the high-resolution Community Water Model.

YSSP'18

Boshu Li (Peking University) is exploring decapacity policy solutions for air quality and public health improvement in the Jing-Jin-Ji region of China.

Jiamin Ou (University of East Anglia) is analyzing demand-driven ground-level ozone pollution in the Guangdong province, South China.

Yi Huang (Xiamen University) is researching reform of China's marine fisheries management using output control.

Meng Cai (Chinese University of Hong Kong) is generating WUDAPT level 1 data from Google Maps.

Ying Meng (Southern University of Science and Technology in Shenzhen) is conducting modeling and visualization of optimal locations for hydropower in the context of global change.

Hao Zhao (Institute of Genetics and Developmental Biology of the Chinese Academy of Sciences) is exploring past changes and sustainable pathways of future land use in agricultural systems in China.

Yuping Bai (Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences) is investigating climate adaptation in semi-arid regions as complex adaptive social-ecological systems.

Jie Liu (East China University of Science and Technology) is identifying knowledge depreciation rate at industry level by calibrating agent-based model on patent application.

Xiaoyu Liu (Peking University) is conducting modelling of the water-energy-economy nexus at provincial scale across China.

Jiayue Wang (Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences) is estimating transaction cost of farmland transfer in China.

Mengru Wang (Wageningen University) is conducting modelling of river export of nutrients from land to sea by Yangtze and Indus Rivers

YSSP'17

Nannan Zhang (Chinese Academy of Sciences) is analyzing the costs and benefits of options to reduce NH₃ emission from dairy production.

Ming Ren (China University of Mining and Technology) is researching technology development paths of the iron and steel industry in the Beijing-Tianjin-Hebei Region of China under resources and environmental constraints.

Saige Wang (Beijing Normal University) is researching regional energy-water nexus within China.

Malan Huang (Huazhong Agricultural University) is exploring rural labor and the evolution of cropping systems in China.

Meng Jiang (Tsinghua University) is assessing energy and natural resource footprints under China's sustainable economic transformation.

Ziyun Zhu (Peking University) is conducting a global analysis of wildlife damage insurance.

Yaru Zhang (East China University of Science and Technology) is proposing a multi-regional energy transportation strategy for China's electricity system using the MESSAGE model.

Hanqing Xu (Shanghai Institute of Technology and Climate Change Center) is analyzing drought risk, irrigation demand, and maize yield under climate change in the northeast farming region of China.

YSSP'16

Meng Li (Tsinghua University) evaluated emission inventories for atmospheric modeling over Asia from bottom-up and top-down perspectives.

Li Cheng (South China University of Technology) focused on the prediction and cost-benefit assessment of control policies from non-road mobile sources in China.

Zhanqing Zhao (Chinese Academy of Sciences) explored sustainable pathways for greenhouse gases and NH₃ mitigation from crop and livestock production in the North China Plan.

Wei Qi (Chinese Academy of Sciences) developed a model to calculate carbon footprint of inter-regional population migration in China.

Kejia Hu (Zhejiang University) conducted an urban heat health risk assessment using a multi-hazard approach.

Jiangjiang Zhao (East China University of Science and Technology) focused on the calibration of a model on the diffusion on environmental friendly products with the case of electric vehicles.

Yinghao Ji (Shanghai Institute of Technology and Climate Change) assessed the potential of planting rapeseed in winter fallow fields in the Yangtze River Basin of China.

YSSP'15

Chuchu Chen (Tsinghua University) modeled ammonia emissions to identify the best agricultural management for reducing air pollution.

Jiayi Fang (Beijing Normal University) demonstrated that although marine disaster reduction measures by the Chinese government have been effective, they will face new challenges under climate change.

Markus Amann "Science-based Air Quality Management Systems" at 12th Annual China City Air Quality Management Workshop in Chengdu (2016).

Aline Mosnier "Disentangling the effects of local and global drivers of deforestation with the GLOBIOM model" at the Global Land Project third Open Science Meeting in Beijing (2016).

Linda See "Identifying gaps and improvements in Global Agriculture Monitoring" at the Global Land Project Third Open Science Meeting in Beijing (2016).

Samir KC "Modeling Human Capital Formation" at Shanghai University (2015).

Wei Liu "Landscape as An Emergence of Social-Ecological Interactions Department of Landscape Architecture" at Tsinghua University (2015).

Anna Shchiptsova "Assessing the Reliability of an Agent-Based Model of the Global Energy System" at the Integration of Modeling, Optimization, Data Analysis and Knowledge Management for Solving Real World Problems in Shanghai (2015).

Gui-Ying Cao "Is Europe a paradigm of consumer behavior for urban Chinese? An aspect of residential energy consumption" at the International Conference on Consumer Research on Challenges for Consumer Research and Consumer Policy in Europe in Germany (2014).

Zbigniew Klimont "Recent updates in GAINS for Asia (and World) including time series back to 1990 and new projections until 2050" at the 5th International Workshop on Atmospheric Modelling Research in Xiamen (2014).

Florian Kraxner "From Sustainable Bioenergy to Negative Emissions – BECCS" at the Applied Energy Innovation Institute and the University of Nottingham China international workshop on Sustainable Energy in Ningbo (2014).

Nebojsa Nakicenovic "Transformational Pathways Toward Mitigating Anthropogenic Climate Change and the Future of the Carbon Cycle: From Decarbonization to 'Negative' Emissions" at the 9th International Carbon Dioxide Conference (ICDC9) in Beijing (2013).

Selected presentations
in or about China
by IIASA researchers

Zhaomiao Guo (University of California, USA), a Chinese citizen, used a stochastic game-theoretic model to study energy security and energy capacity issues in the USA, China, and Organization of the Petroleum Exporting Countries (OPEC). (Funded by US NMO)

Rui Hu (Imperial College London), a Chinese citizen, conducted an international comparative study to examine China's wind energy knowledge and technology accumulation, showing that China is making rapid progress. (Self-funded)

Wenfeng Liu (Swiss Federal Institute of Technology Zurich and the Swiss Federal Institute of Aquatic Science and Technology), a Chinese citizen, used a biophysical crop model to identify hotspots of global nitrogen and phosphorus pollution. (Self-funded)

Zhimin Mao (Pardee RAND Graduate School, USA), a Chinese citizen, analyzed a proposed action plan to cut air pollution in China, showing that enable rapid reduction of air pollution can be achieved. (Funded by the Roger Levien Fellowship)

Yilong Niu (Shanghai Institute of Technology and Climate Change) coupled three agricultural models together to give an accurate picture of greenhouse gas emissions from rice cultivation.

Cuiqing Sun (China University of Mining & Technology), applied integrated modeling to tackle interconnected environmental and socioeconomic issues for the robust energy, food, and water provision in coal-rich areas of China, using Shanxi, China, as a case study.

Siyuan Yang (Beijing Normal University) used input-output analysis to investigate particulate matter pollution, showing that the petroleum, coking, and chemicals sector was the main source of direct PM2.5 emission.

Zihan Zhai (Peking University) studied the actions needed to reduce hydrofluorocarbon (HFC) emissions in China, showing that there is substantial potential for minimizing China's HFC emissions by using alternatives.

Jie Zhang (Tsinghua University) investigated ways of improving agricultural management to maintain crop yields while reducing phosphorus pollution.

IIASA working with business

Business can benefit from science through the analysis and knowledge it provides. In turn, science can benefit from business through its experience on the ground and in implementation. IIASA also recognizes that closer collaboration between business and its researchers can increase the impact of the Institute's work. Not surprisingly, IIASA is seeing a growing number of contracts with commercial partners, including:

- The global insurer, **Zurich Insurance Group**, began working with IIASA in 2013 to identify and address research gaps on flood resilience and community based disaster risk reduction, demonstrate the benefits of pre-event risk reduction over post-event disaster relief and to improve public dialogue around disaster resilience.
- The German carmaker, **Daimler AG**, has collaborated with IIASA researchers to assess biofuel potential from marginal and degraded lands in India and Brazil.
- The Brazilian energy company, **Petrobrás**, was one of nineteen sponsors of IIASA's Global Energy Assessment.
- The research institute of the Japanese carmaker, **Toyota**, has an ongoing collaboration with IIASA to research measures to reduce ozone emissions in Asia.
- The multinational consumer goods company, **Unilever**, funded IIASA's agricultural experts from 2008-10 to analyze yields and land suitability of key agricultural crops under a changing climate.

In addition, IIASA is exploring ways that it can work more closely with multinational corporations, including through input to the development of their global sustainable business plans.

YSSP'14

Qiuying Ding (Shanghai Climate Center) looked at the coupling of crop models across different spatial scales and the multi-scale evaluation of adaptive technologies locally, for different cropping regions, and China as a whole.

Shengfa Li (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences) estimated the amount of abandoned croplands in 2000–2010 and the future changes expected in China's mountainous areas.

Jun Liu (Peking University) explored the potential benefits in terms of air pollutant reduction through natural gas substitution strategies in power plants, residential combustion, and industrial boilers in the Jing-Jin-Ji region.

Kun Ma (Beijing Forestry University) used the EPIC model to estimate soil organic carbon stocks in the Roige wetland in western China.

Haochen Wang (Peking University) projected how human capital will change in Beijing to 2050 from the education and health perspectives in different policy scenarios.

Tao Wang (Tsinghua University) constructed an aggregate model of China's economy for 1980–2010 to retrospectively analyze the sensitivity of resource productivity to variations in investment scenarios.

Jie Zhang (University of Maryland, USA) examined the sensitivity of different MODIS-derived indicators for agricultural drought and investigated their effectiveness agricultural drought monitoring during the growing season on the Southern Great Plains of the USA. (Funded by the US NMO)

Hongmei Zheng (Beijing Normal University) analyzed how the three regions within the Jing-Jin-Ji agglomeration interact with each other and their roles in its development.

YSSP'13

Long Ji (Huazhong Agricultural University) measured the geographic concentration and regional localization of vegetable production in China with newly developed indicators. (Funded by IIASA)

Xi Pang (KTH Royal Institute of Technology) connected existing models for calculating timber, pulp, and bioenergy production, with new methods for biodiversity, carbon stock, and recreation evaluation to conduct a sustainability assessment of forest bioenergy options. (Funded by the Swedish NMO)

Wei Wang (Tsinghua University) analyzed how to improve resource productivity using optimal control models under the supervision of IIASA system analysts.

Xue Wang (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences) explored how different land use change and climate change scenarios would impact the sowing of winter wheat and its associated agriculture water footprint in the North China Plain.

Shasha Yin (South China University of Technology) explored potential control measures for ammonium in the Pearl River Delta area of China.

Xinxin Zhang (Beijing Forestry University) conducted a spatially explicit downscaling of future land use change from IIASA GLOBIOM model for a regional case study of the Heihe River Basin in China.

Bo Zheng (Tsinghua University) projected future energy use and emissions in the transportation sector at a provincial level in China, taking account of the different growth patterns of vehicles between provinces.

YSSP'12

Shaoqing Chen (Beijing Normal University) examined a new system technique, information-based network analysis, and applied it to ecological risk assessment

Yuche Chen (University of California Davis, US) re-analyzed emission measurement data again to identify the amount and contribution of high emitting vehicles, and explored possible policies to reduce the emissions. (Co-funded by US NMO and IIASA)

Zhuoran Liang (Shanghai Climate Center) assessed climate change impacts on the potential productivity of major crops in China using a fusion model system.

Fangyi Li (Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences) studied how China can meet its energy intensity targets by 2020 considering the country's rapid increase in consumption and GDP.

Xiaopeng Song (University of Maryland, US) used satellite observation, FAO statistics, and socioeconomic parameters to project global deforestation. (Co-funded by US NMO and IIASA)

Yadong Yu (Tsinghua University) used optimal control theory combined with an economic growth model to explore raising resource productivity by substituting old raw materials with new, more technologically-advanced materials.

Yuanyuan Zhao (Tsinghua University) assessed the accuracy of global volunteers who are categorizing land cover for the online crowdsourcing tool, Geo-Wiki, using local knowledge and satellite data.

YSSP'11

Jing Dai (Beijing Normal University) conducted a network analysis of a socioeconomic consumption system based on ecological thermodynamic theory via a case study of China.

Yang Li (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences) focused on the determinants and spatial structure of interprovincial migration in China, and how they have changed over the period 1985–2005.

Huayi Lin (Uppsala University, Sweden) built a model involving the multiple socioecological factors influencing sustainable management of the Swedish wolf population.

Fei Liu (Tsinghua University) developed and applied the GAINS-City Model for Chinese Cities.

Xilei Pang (Beijing Normal University) analyzed typhoon-flood risk from a dynamic perspective and applied it to a case study of Guang Zhou, China.

Zhiqiang Wu (Tianjin University) analyzed the interplay between investor types and financial market dynamics by modifying the agent-based Santa Fe Institute artificial stock market model.

Fang Yan (University of Illinois-Urbana and Champaign, US) studied the role of superemitters in transport emissions and what policies would be effective at eliminating these air pollutants. (Partially funded by IIASA)

Chuanfu Zang (Beijing Forestry University) assessed the trade-offs between green and blue water uses with ecosystem services and humans in the Heihe River Basins in China.

Honglin Zhong (East China Normal University) studied—through a quantitative approach involving data and model analysis—future crop management and land use patterns that minimize negative risks to food production.

Lei Zhou (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences) used IIASA G4M model to help estimate the carbon sink/source of China's forests under a range of scenarios. (Self-funded)

YSSP'10

Wenfang Chen (Beijing Normal University) developed a typhoon disaster risk assessment model to assess the typhoon wind intensity using the Yangtze River Delta as a case study.

Yang Cheng (Queen's University, Canada) used a systems modeling approach to develop a healthy and successful aging model for the elderly population in Beijing, China. (Funded by IIASA)

Siyi Feng (Texas A&M University, US) assessed the international leakage of the U.S. climate policy. (Funded by IIASA) on issues related to challenges in rural education.

Haiguang Hao, (Chinese Academy of Sciences) assessed the interactions of farmer's household and agricultural land use changes in ecologically-vulnerable areas of China.

Linke Hou (Chinese Academy of Sciences) investigated the impacts of climate change on China's agriculture with consideration of farmers' adaptation.

Ling Liu (Shandong Audit Office) assessed urban demography and economic growth impacts on land use in the Yangtze River Delta City Cluster.

Wei-Shiuen Ng, University of California, Berkeley, US (Funded by US NMO)

Chen Wang (University of Wisconsin-Madison, US) modeled uncertainty of threats from group judgments for designing efficient response strategies.

Rui Xing (Uppsala University, Sweden) evaluated energy saving effect of different measure and find an optimum energy consumption reduction plan for public buildings in Shanghai, China. (Funded by Swedish NMO)

Xuchao Yang (Shanghai Typhoon Institute of China Meteorological Administration) assessed the potential impacts of climate change on China's agriculture production based on a spatially explicit crop suitability and productivity assessment model.

Regional Young Scientists Summer Program

In 2012 IIASA launched the first expansion of its successful YSSP with the Southern African Young Scientists Summer Program (SA-YSSP) at the University of the Free State in Bloemfontein, South Africa. The program was organized jointly by IIASA and three South African partners: the National Research Foundation (NRF), the Department of Science and Technology, and the University of the Free State. The following Chinese nationals have participated in the program:

Liu Haoqi (SA-YSSP'13/14 & Xinjiang University) explored habitat loss and biodiversity impacts as part of the stability and complexity of adaptive ecological networks theme.

Zhang Hui (SA-YSSP'13/14 & Nanjing University) explored air pollution controls for coal-fired power plants in South Africa.

Delin Fang (SA-YSSP'13/14 & Beijing Normal University) conducted a socioeconomic analysis of a socioeconomic water system.

F Le Feng (SA-YSSP'12/13 & Beijing Normal University) used network analysis to develop robust measures for river ecological systems.

Yinghui Yang (SA-YSSP'13/14 & Lanzhou University) studied commonness and rarity in ecological communities as part of the stability and complexity of adaptive ecological networks theme.

Five Chinese nationals took part in the first two sessions of the regional Young Scientists Summer Program in South Africa

Postdoctoral Program

Postdoctoral researchers at IIASA work in a rich international scientific environment alongside scientists from many different countries and disciplines. The Institute's research community helps its postdoctoral researchers to develop their research from fresh angles, to publish widely in journal articles, and to establish their own global network of collaborators. Four postdoctoral fellows from China have participated in the program since 2010:

Fei Guo (2016-2018), a Chinese national, explored socioeconomic heterogeneity and non-cost factors influencing consumer energy and appliance choices and demand in China, as understanding consumer decisions is a crucial component for bottom-up type energy policy modeling. (PhD in Energy and Environmental Policy from University of Delaware, US)

Shaohui Zhang (2016-2018), a Chinese national, studied the co-benefits of energy efficiency measures and air pollution control options in China's industrial sectors at national and provincial scales. (PhD in Science, Technology, and Environmental Policy from Utrecht University, Netherlands)

Four postdoctoral fellows from China have developed their research and published widely at IIASA

Wei Liu (2012–2014), originally from China, is developing models and scenarios to investigate integrated adaptive management of complex socioecological systems, with a focus on how changing land use affects ecosystem service provision and natural hazard vulnerability in Wolong Nature Reserve in China. His research topics include spatiotemporal dynamics of ecosystem service trade-off and synergy, multi-scale disaster resilience in complex socioecological systems, and integrated assessment of conservation policies. (PhD in wildlife conservation and wildland management from Michigan State University)

Xiaojie Chen (2010–2012), focused on evolutionary dynamics in biological and social systems, especially the emergence and stability of cooperation in social networks, using evolutionary game theory and adaptive dynamics. (PhD in Dynamics and Control of Complex Systems [2011] from Peking University, China)

In addition **Dr. Dan Zhao**, from Northwest A&F University in Yangling, received a scholarship from the Eurasia-Pacific Uninet (EPU), funded by the Republic of Austria, to work for six months in 2013 with IIASA demographers Bilal Barakat and William Butz on issues related to challenges in rural education.

Other capacity-building activities

Several other activities have helped develop the system analytical skills of young Chinese researchers

IIASA participates in the European Forestry Masters program, a training program for advanced university students. As part of the EU sponsored program successful candidates work for a three-month period with IIASA researchers to further their studies. Two Chinese students have participated in the program since 2005.

IIASA air pollution experts regularly host students from Tsinghua University to train them in the use of IIASA GAINS model in order to foster cooperation with the Chinese science community in controlling air pollution. In addition, **Professor Allen Zheng** of South China University spent six months researching at IIASA in 2012 and 2013, and subsequently implemented the GAINS model for the Pearl River Delta.

Several IIASA research programs are co-supervising PhD students at Chinese universities as part of these universities' training programs. These include:

Haoqi Liu, of Xinjiang University, carries out research with IIASA Evolution and Ecology Program.

Junlian Gao, of the China University of Mining and Technology, researches with IIASA's Advanced Systems Analysis Program and Exploratory and Special Projects.

Yibo Luan, of the Academy of Disaster Reduction and Emergency Management at the Ministry of Civil Affairs & Ministry of Education and Beijing Normal University, studies with IIASA Water Program.

IIASA–China scientific exchange through people

Several IIASA research scholars hold positions at universities and research centers in China. These include:

Joanne Bayer Beijing Normal University and the Science Committee of the Chinese Academy of Disaster Reduction and Emergency Management

Gui-Ying Cao Adjunct Professor, Peking University and Scientific Advisory Committee Member, Shanghai Climate Research Center

Qionglin Dai Associate Professor, Beijing University of Posts and Communications

Brian Fath Deputy Director, Low Carbon Research Center, Beijing Development Area

Luis Gomez-Echeverri Member, China Council – Task Force on Rural Development and its Energy, Environment and Climate Change Adaptation Policy

Pavel Kabat Visiting Professor, Peking University

Junguo Liu Professor, Beijing Forestry University

Tieju Ma Professor, School of Business, East China University of Science and Technology

Laixiang Sun Visiting Professor, Institute of Geographic Sciences and Natural Resources Research (IGSNRR); China Center for Agricultural Policy (CCAP), Chinese Academy of Sciences; and Senior Research Fellow, Guanghua School of Management, Peking University

Bing Zhu Professor, Department of Chemical Engineering, and Executive Deputy Director, Institute of Circular Economy, both at Tsinghua University and Member of the Inter-Ministerial Panel of the People's Republic of China on Circular Economy

Other examples of scientific exchange include:

- Over 320 Chinese nationals have participated in IIASA events since 2010.
- Since 2010, 89 doctoral students from China have participated in IIASA Young Scientists Summer Program, five have taken part in the Southern African Young Scientists Summer Program, and three IIASA Postdoctoral Fellowships have been awarded to young scientists from China.
- Over 220 researchers, advisors, and diplomats from China have visited IIASA since 2010, while IIASA scientists have visited China over 290 times.
- 366 publications have resulted from collaborations between IIASA and Chinese nationals since 2010.

Appendices

Summaries detailing the presented information can be requested by contacting the External Relations Department (externalrelations@iiasa.ac.at).

Prospects for Future IIASA–China Activities

Enhancing IIASA–China collaboration offers benefits for Chinese research, government policy, and international relations

This Info Sheet summarizes recent research collaborations between IIASA and China (see Recent Research Collaborations, page <?>). Significant potential remains to further intensify IIASA interactions with China through developing a range of new joint activities, including:

- **Enhancing Chinese expertise in applying system analysis to national problems**

Developing bespoke Chinese versions of IIASA global models would allow researchers and policymakers to look at complex global problems and their impact on China in a holistic and integrated way. For example, there is a national version of the IIASA GAINS model for China, which identifies cost-effective measures to improve air quality and reduce greenhouse gas emissions in China.

- **Conducting international assessments in areas of Chinese strategic interest**

China contributed to IIASA Global Energy Assessment which brought together over 500 specialists to transform the way society thinks about, uses, and delivers energy. At the request of its member countries, IIASA is currently embarking on four new assessments, whose focus will be on issues of strategic interest also to China: holistic, integrative assessments of plausible futures for the Arctic, global water challenges, Eurasian economic integration, and tropical forests. In addition, IIASA is exploring the development of a quantitative foresight capability for Asia to explore future resource security (materials, energy, land, and water) for nations in the region.

- **New partnerships between IIASA and Chinese institutions to win grants from international research funders**

IIASA high-quality research and international research network makes it highly competitive in its applications for international research funds. Between 2012 and 2016 this additional funding reached €45 million. This is part of a funding portfolio of €360 million — The total awarded to external partner and consortia projects featuring collaborations with IIASA.

- **Using international scientific cooperation to support diplomacy**

IIASA was established in 1972 to use scientific cooperation to build bridges across the Cold War divide and research growing global problems on a truly international scale. Today the soft power of science diplomacy continues to help IIASA member countries through using scientific cooperation to improve international relations, and through international teams jointly researching controversial issues to find consensus, free from the constraints of national self-interest (see research to support science diplomacy, page 8). IIASA recently launched a new global project to evaluate issues arising at the nexus of food, water, energy, and climate change.”

- **Academic training opportunities for early-career Chinese scientists**

There is potential to further enhance participation by young Chinese doctoral and post-doctoral students in IIASA programs to develop international and interdisciplinary research skills (see Capacity Building, page 13). Becoming a partner in IIASA forthcoming International Postgraduate School of Excellence will be another fine opportunity.

About IIASA

Founded in 1972, the International Institute for Applied Systems Analysis (IIASA) conducts policy-oriented research into problems of a global nature that are too large or too complex to be solved by a single country or academic discipline. IIASA research is across and at the intersection of natural, human, social, knowledge and technology systems to support the development of integrated solutions to global sustainability challenges.

IIASA is at the center of a global research network of around 3,500 scholars and over 830 partner institutions in over 65 countries. It is funded and supported by its National Member Organizations which represent the scholarly community in the following countries:

Austria, Brazil, China, Egypt, Finland, Germany, India (Observer), Indonesia, Iran, Israel, Japan, Malaysia, Mexico, Norway, Republic of Korea, Russia, South Africa, Sweden, Ukraine, United Kingdom, United States of America, Vietnam.

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