

Activities with Member Countries

Brazil

Research collaborations between Brazil and IIASA have intensified since Brazil became a member of IIASA in 2011. Research projects have used the tools of systems analysis to find the smartest ways for Brazil to achieve sustainable agriculture and land management strategies that reduce deforestation. Other projects have focused on energy: Ranging from long-term energy planning, to learning from Brazil's leadership in the use of ethanol fuel, to advancing understanding of the complex global energy system and its multiple connections with Brazil's economy, environment, and society. IIASA is also working with Brazilian agencies to build capacity in systems approaches to national and international policy issues, including support for Brazilian participation in IIASA Young Scientists Summer Program, specialized training in model development and application, and a partnership with the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) to bring Brazilian postdoctoral scholars to IIASA.

Beyond continuing these research collaborations, there is significant opportunity to grow the relationship between IIASA and Brazil through further joint research projects, scientific exchange and collaborative capacity building activities. Opportunities for such activities will be facilitated through the forthcoming IIASA strategic plan 2021-2030 and new IIASA membership strategy, which CAPES are helping to shape via their role on the IIASA governing council. This IIASA Info Sheet provides a summary of this expanding and mutually beneficial relationship since 2010.

Highlights of Interactions Between IIASA and Brazil (since 2010)

National Member Organization	The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES)
Membership start date	2011
Selected research partners	<ul style="list-style-type: none"> ■ Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) ■ Brazilian Reference Center on Biomass (CENBIO) ■ Brazilian Corporation of Agricultural Research (EMBRAPA) ■ Federal Universities of Rio de Janeiro, of Mato Grosso, and of Minas Gerais ■ Institute of Applied Economic Research (IPEA) ■ Ministry of Science, Technology, Innovation and Communication (MCTIC)
Areas of research collaboration	<ul style="list-style-type: none"> ■ Balancing the needs of agriculture and the environment in Brazil ■ Supporting Brazil's changing energy landscape ■ Co-benefits: Improving air quality and tackling climate change ■ Projecting demographic change in Brazil ■ Advancing the modeling of complex systems
Capacity building	16 doctoral students from Brazil have taken part in IIASA Young Scientists Summer Program. A Brazil-IIASA Doctoral Sandwich and Postdoctoral Fellowship Program, that funds up to four Brazilian PhD students and up to four Brazilian Postdocs at IIASA has run since 2016.
Publication output	Over 140 publications have resulted from collaborations between IIASA and researchers at Brazilian institutions since 2010.
Other interactions	<ul style="list-style-type: none"> ■ Researchers, advisors, and diplomats from Brazil have visited IIASA over 55 times, while IIASA scientists have visited Brazil over 115 times. ■ Over 150 Brazilian nationals have participated in IIASA events since 2010.

Activities with Member Countries: Brazil

IIASA Info Sheet 2019/08

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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 recent interactions with Brazil.
It includes highlights with links to further information but is
not meant 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 Brazil

The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) has been the National Member Organization (NMO) representing Brazilian membership of IIASA since 2016.

Professor Mauro Luiz Rabelo, CAPES's Director of International Affairs is the IIASA Council Member for Brazil and along with representatives of each of the IIASA member countries governs the institute.

The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) Foundation represents Brazil and its scholarly community on the IIASA Governing Council.

Web: www.capes.gov.br

Professor Paulo Artaxo, Professor of Environmental Physics at the University of São Paulo, chairs the regional Latin American assessment of short-lived climate pollutants, in which IIASA plays a key role as part of the international Climate and Clean Air Coalition.

Professor Eduardo Delgado Assad, Embrapa Informática Agropecuária, member of the Scientific Committee of the Brazilian Panel on Climate Change, researches with IIASA on land-use and a member of the RESTORE+ Advisory Board.

Dr Mateus Batistella, Director, Brazilian Corporation of Agricultural Research's (EMBRAPA) Satellite Monitoring, collaborates with IIASA on research into sustaining ecosystem services.

Professor Gilberto Camara, former Director General of the National Institute for Space Research (INPE), researches with IIASA on a major project to develop policies to reduce emissions from deforestation and forest degradation.

Professor Suaní T. Coelho is the Executive Secretary of the Brazilian Reference Center on Biomass and was a member of the executive committee of the IIASA Global Energy Assessment.

Professor José Goldemberg of the University of São Paulo where he was the rector from 1986-1990, has served in various capacities in the Brazilian government including as the Secretary of State for Science and Technology; interim Secretary of the Environment; and Minister of Education. He was Co-President of the IIASA Global Energy Assessment Council and has been a long-term collaborator of IIASA's on issues associated with energy and sustainable development.

Professor Carlos Nobre is the former IIASA Council member representing Brazil, former President of CAPES and former National Secretary for R&D Policies at the Ministry of Science, Technology & Innovation of Brazil.

Professor Adilson de Oliveira, Federal University of Rio de Janeiro, was responsible for creating the University's first research group on energy economics and was a Lead Author on the IIASA Global Energy Assessment.

Professor Jacob Palis, President, Brazilian Academy of Sciences discussed scientific collaborations between Brazil and IIASA during a visit by IIASA Director General to Brazil in November 2013.

Professor Suzana Kahn Ribeiro, Federal University of Rio de Janeiro and Vice Chair of Working Group III of the Intergovernmental Panel on Climate Change was a member of the executive committee of the IIASA Global Energy Assessment.

Professor Roberto Schaeffer, Federal University of Rio de Janeiro, is a member of IIASA's Science Advisory Committee (2014-2020), was a member of the IIASA visiting evaluation committee in 2013, and has been a long-term collaborator with IIASA energy experts.

Dr. Bernardo Strassburg, is the Founder and Executive Director of the International Institute for Sustainability in Rio de Janeiro and Assistant Professor at the Pontific Catholic University of Rio de Janeiro and collaborates with IIASA on land use, sustainability, and biodiversity projects.

Dr Alexandre Ywata Carvalho is head of the econometrics group at the Institute for Applied Economic Research (IPEA) and collaborates with IIASA on forestry and ecosystem services research.

Some leading Brazilian personalities in academia, business, and government who are associated with IIASA

Research Partners in Brazil

IIASA is continually developing collaborations with Brazil and has recently been working with 38 organizations in Brazil via formal and informal connections

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

- Amazon Environmental Research Institute (IPAM)
- Brazilian Corporation of Agricultural Research (EMBRAPA)
- Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES)
- Brazilian National Institute for Space Research (INPE)
- Brazilian Reference Center on Biomass (CENBIO)
- Center for Development and Regional Planning (Cedeplar)
- Center for International Forestry Research (CIFOR), Brazil office in Rio de Janeiro
- Center for Strategic Studies and Management (CGEE)
- Federal University of Acre
- Federal University of Mato Grosso
- Federal University of Minas Gerais
- Federal University of Rio Grande do Norte
- Federal University of Rio de Janeiro (UFRJ)
- Federal University of Pernambuco (UFPE)
- Federal University of Southern Bahia
- Federal University of Viçosa (UFV)
- Institute for Sustainability (IIS)
- Institute of Applied Economic Research (IPEA)
- National Institute of Amazonian Research (INPA)
- Luiz de Queiroz College of Agriculture
- Ministry of Mines and Energy (MME)
- Ministry of Science, Technology and Innovation (MCTI)
- Museum of Tomorrow
- National Center for Natural Disaster Monitoring and Alarms (Cemaden)
- National Council for Scientific and Technological Development (CNPq)
- National Institute of Energy Efficiency
- Pontifical Catholic University of Rio de Janeiro
- Regional University of Blumenau
- Rio Conservation and Sustainability Science Centre
- São Paulo School of Economics
- São Paulo State Environment Agency
- São Paulo State University
- State University of Campinas
- Universidade do Estado de Mato Grosso
- Universidade Estadual de Maringá (UEM)
- University of Brasilia
- University of São Paulo
- World Resources Institute Brazil

Recent Research Collaborations

Balancing the needs of agriculture and the environment in Brazil

Around sixty percent of Brazil is covered in forests and is home to one of the largest natural forests on the planet. Although Brazil was facing significant deforestation rates, they have made substantial progress in reducing deforestation in recent years. However, further progress both in Brazil and worldwide requires tackling a range of complex issues simultaneously, including: reforming agricultural practices, increasing the use of agroforestry systems, conserving natural capital and the sustainable development of forest-dependent communities. The holistic approach of systems analysis can help identify strategies that reap multiple benefits across sectors and regions, as well as avoid policies that lead to negative side effects in remotely connected activities. Numerous joint studies between IIASA and Brazilian researchers have adopted this approach.

Brazilian-IIASA researchers are studying ways to achieve sustainable agriculture and land management strategies that reduce deforestation

The 2015 Paris climate talks yielded an unprecedented agreement, pledging to keep global warming well below 2 degrees celsius and endeavoring to limit it to 1.5 degrees celsius. This ambitious target must be backed up by clear action from all countries. Brazilian policy makers had an important but complex task to produce ambitious but feasible climate policies that would also allow the Brazilian economy to flourish. To aid Brazil, Researchers from INPE and IIASA along with the IPEA and other international partners developed the technical know-how and capacity in designing efficient, effective and environmentally relevant policy strategies for REDD.

The REDD-PAC project (2011-2015) had a strong focus on Brazil including analyses on whether REDD policies could act as an incentive to reach Brazil's 80% deforestation reduction target for the period 2006-2020; and on the impact REDD policies have on the recovery of areas already de-forested. In addition, the researchers developed a Brazilian version of IIASA GLOBIOM model to assess the competition between Brazil's goals for reducing deforestation, increasing production of cash crops and biofuels, and intensifying cattle-raising. Various workshops took place in Brazil as part of the project and to strengthen collaborations between IIASA, INPE, IPEA as well as the Brazilian Corporation of Agricultural Research (EMBRAPA). This project provided the land use, agriculture, and forestry background for Brazil's proposed Intended Nationally Determined Contribution (INDC), the country's commitment to greenhouse gas reductions until 2050.

IIASA's work is underpinned by high-quality science, which is regularly published in high impact publications. A selection of current publications is presented here and full list can be found in appendix 4:

- Steidinger BS, Crowther TW, Liang J, et al. (2019) Climatic controls of decomposition drive the global biogeography of forest-tree symbioses. *Nature* 569(7756):404-408 DOI:10.1038/s41586-019-1128-0.
- Coelho ST, Sanches-Pereira A, Tudeschini L, & Goldemberg J (2018). The energy transition history of fuelwood replacement for liquefied petroleum gas in Brazilian households from 1920 to 2016. *Energy Policy* 123: 41-52. DOI:10.1016/j.enpol.2018.08.041.
- Rao ND, Ummel K. (2017). White goods for white people? Drivers of electric appliance growth in emerging economies. *Energy Research & Social Science*, 27, 106-116.
- Moreira, JR, Romeiro V, Fuss S, Kraxner F, Pacca SA (2016). BECCS potential in Brazil: Achieving negative emissions in ethanol and electricity production based on sugar cane bagasse and other residues. *Applied Energy*, 179, 55-63.
- Rogelj J, Den Elzen M, Höhne N, Fransen T, Fekete H, Winkler H, et al. (2016). Paris Agreement climate proposals need a boost to keep warming well below 2 °C. *Nature* 534(7609):631-9.
- Smith P, Davis SJ, Creutzig F, Fuss S, Minx J, Gabrielle B, et al. (2016). Biophysical and economic limits to negative CO₂ emissions. *Nature Climate Change* 6(1):42-50.

Selected publications resulting from IIASA-Brazilian collaborations

IIASA continues to support Brazil towards its Intended Nationally Determined Contribution (INDC) and one key aspect of this is implementing the country's Forest Code. Although this code sets a minimum percentage of native vegetation to be preserved or restored and gives environmentally sensitive areas permanent protection, it has previously been seen too restrictive to agriculture. In 2018 IIASA researchers and researchers from INPE, conducted research using the developed GLOBIOM-Brazil model to foresee the implications of fully enforcing the Forest Code of both the environment and agriculture to the year 2050. Findings showed that by fully implementing the Forest Code cropland will only be reduced by 4% while cattle herds only need to be reduced by 8%. The successful implementation of the code, with a combination of forest regrowth and reduced deforestation, means Brazil can adequately reach zero forest-related emissions after 2030. Findings were published in *Environmental Research Letters*.

The RESTORE+ project, launched in 2017, is a five-year partnership that aims at enhancing land use planning capacity related to restoration or utilization of degraded/marginal land in Brazil and Indonesia, providing policy support for major players in global land-sector emissions. The project will focus on degraded land, first mapping its availability using a combination of innovative methods, such as simple games that citizen scientists can use to help validate satellite imagery. Second, the project will assess the implications—for emissions, biodiversity, and the economy—of different uses of this degraded land. The importance of ecosystem restoration, combined with sustainable food and energy production, will be a central theme. At every stage IIASA researchers will work closely with local stakeholders, from policymakers, to non-governmental organizations, to the general public. Ultimately, RESTORE+ will build on the successful techniques that were employed in Brazil, using systems analysis and national collaborations to create clear, robust policies that deliver vital progress towards a sustainable future.

The Tropical Futures Initiative is a multiyear project developed and coordinated by IIASA to focus on tropical deforestation, greenhouse gas emissions, air pollution, agriculture, and water. The project will use GLOBIOM and the Global Forestry Model, G4M, as a basis for developing tailored national and regional models that help to identify REDD+ (Reducing Emissions from Deforestation and Forest Degradation) and other development policies that are economically efficient, socially fair, safeguard and enhance ecosystem values, and help meet the goals of the

IIASA's global contribution

Many of today's most pressing challenges do not stop at 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 National Member Organizations recognize this need and that their investment in IIASA is a contribution to a global public good. And the benefit of this contribution is paid back to global researchers, policymakers, and citizens in multiple ways as the following examples show:

1. 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 IPCC's (Intergovernmental Panel on Climate Change) Fifth Assessment Report.
2. 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 policymakers 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.

Convention on Biological Diversity. The Tropical Futures Initiative's partners include the Brazilian Institute for Applied Economic Research (IPEA) and the Brazilian Institute for Space Research (INPE).

Additional Brazilian-IIASA collaborations in this area since 2010 include:

- The 2019 AmazonFACE project conducted by an international team including researchers from IIASA, who studied part of the Amazon forest in Manaus, Brazil. They monitored how trees are growing and leaves are developing aboveground, while also tracking root growth and what is happening in the soil below ground. In their paper, which was published in *Nature Geoscience*, the authors showed the extent to which soil nutrient supply might limit the production of biomass in tropical forests.
- As part of the Unlocking Forest Finance (2013-17) project, IIASA is working with the Amazon Environmental Research Institute (IPAM), INPE, and other international partners to design financial mechanisms that enable integrated investments in halting deforestation.
- A collaborative project with the National Center for Natural Disaster Monitoring and Alarms (CEMADEN), the National Institute of Science and Technology for Climate Change (INCT) and IIASA to develop an early warning system for crop condition monitoring which could include dispatch warnings for threats of new pests and diseases.
- An international collaboration involving researchers from IIASA, INPE, and IPEA using GLOBIOM to model the Brazilian soy moratorium to evaluate the past impacts the moratorium, including avoided deforestation and indirect effects such as displacements

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:

Brazil may be able to curb up to 26% of global greenhouse gas emissions from deforestation by encouraging the intensification of its cattle production. The study, published in the journal *Proceedings of the National Academy of Sciences*, showed that by subsidizing semi-intensive pasture-based cattle production or taxing conventional pastures Brazil may be able to deliver a substantial cut in global greenhouse gas emissions, even in the absence of a global agreement to prevent deforestation. The two policies would both reduce deforestation in the Brazilian Amazon by about 50% between 2010 and 2030. This would lead to a 25% reduction in global greenhouse gas emissions from deforestation during that time. Combining the two policies could provide a revenue-neutral way for the Brazilian government to reduce greenhouse gas emissions. (Source: IIASA GLOBIOM model. Research published in: Cohn AS, Mosnier A, Havlik P, Valin H, Herrero M, Schmid E, O'Hare M & Obersteiner M (2014). Cattle ranching intensification in Brazil can reduce global greenhouse gas emissions by sparing land from deforestation. *PNAS*, 111(20):7236-7241.).

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

- Planning sustainable energy systems (MESSAGE model, Global Energy Assessment Scenario Database).
- Improving food security through identifying yield gaps (GAEZ model), assessing competition for land use between agriculture, bioenergy, and forestry (GLOBIOM model), and looking at social, economic, and environmental earth systems (FeliX).
- Financial disaster risk management (CATSIM model).
- Projecting future population (Demographic multistate modeling).
- Reducing energy poverty (Energy Access Interactive Tool [ENACT]).

IIASA's models, tools, and data

and leakages. The research will also assess the benefits of keeping this zero-deforestation agreement in the Amazon and of extending it to the Cerrado biome.

- Researchers from INPE and IIASA along with the IPEA and other international partners developed the technical know-how and capacity in designing efficient, effective and environmentally relevant policy strategies for REDD. The REDD-PAC project (2011-2015) had a strong focus on Brazil including analyses on whether REDD policies could act as an incentive to reach Brazil's 80% deforestation reduction target for the period 2006-2020; and on the impact REDD policies have on the recovery of areas already deforested. In addition, the researchers developed a Brazilian version of IIASA GLOBIOM model to assess the competition between Brazil's goals for reducing deforestation, increasing production of cash crops and biofuels, and intensifying cattle-raising. Various workshops took place in Brazil as part of the project and to strengthen collaborations between IIASA, INPE, IPEA as well as the Brazilian Corporation of Agricultural Research (EMBRAPA). This project provided the land use, agriculture, and forestry background for Brazil's proposed Intended Nationally Determined Contribution (INDC), the country's commitment to greenhouse gas reductions until 2050.
- A study by researchers at the Institute for Sustainability (IIS) in Rio de Janeiro and IIASA, among others, showed that while the current rate of deforestation threatens to cause massive species extinctions worldwide, prompt implementation of an effective carbon payment system to avoid deforestation could reduce extinctions by more than three-quarters. The research, published in *Nature Climate Change*, used an advanced global land-use model cluster and comprehensive biodiversity data to predict the impacts of deforestation on biodiversity.
- The Food, Agriculture, Biodiversity, Land Use and Energy Pathways (FABLE) Consortium, which has been initiated by IIASA and the UN Sustainable Development Solutions Network (SDSN) and implemented with partners around the world, mobilizes top knowledge institutions from G20 and other countries, including Brazil, to support the development of data and modeling infrastructure to produce long-term pathways towards sustainable food and land-use systems. The aim of FABLE is to promote more ambitious, integrated national strategies, and to ensure alignment with the global objectives under Agenda 2030 and the Paris Agreement. The FABLE Consortium offers training, technical support, and sharing of lessons for the use of Excel-based tools and sophisticated geospatial economic models.

Supporting Brazil's changing energy landscape

A range of collaborations between Brazilian and IIASA researchers are investigating how to manage the transition toward a sustainable energy system

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 such as through integrative assessments of the future for the Arctic or of the economic integration of 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 negotiated membership with Iran and Israel.

Ministry of Mines and Energy, the company in charge of producing long-term energy scenarios for Brazil, has continued to use MESSAGE as one of its official modeling tools ever since. The model helps energy planners to design long-term strategies by analyzing cost-optimal energy mixes, investment needs, and other costs, as well as technical, financial or policy constraints such as energy supply security or the rate at which new technologies can be introduced.

Developing a sustainable energy system in Brazil also requires a thorough understanding of the complex global energy system and its multiple connections with Brazil's economy, environment, and society. Integrated, international assessments are one of the few research approaches that have the breadth and depth to explore such complex problems across multiple sectors, regions, and time frames. IIASA has developed substantial expertise in international energy assessments, in the Global Energy Assessment (GEA), which involved significant collaboration with Brazil (see: Global Energy Assessment and Brazil: page 9).

Collaborations between researchers at the Federal University of Mato Grosso and IIASA have explored what could be learnt from Brazil's leadership in the use of ethanol fuel. This work fed into the GEA chapter on policies for energy technology innovation and a subsequent book dedicated to learning from the successes and failures of energy technology innovation. IIASA agricultural experts have also explored ethanol production in terms of the land it uses in Brazil. Joint studies include:

- From 2010-2012 this biofuel research has been further extended in partnership with the car maker Daimler to explore the potential for growing biofuel on residual land in Brazil.
- IIASA and Swedish partners have developed a Brazilian version of IIASA BeWhere model. This analyzes the alternative uses of sugarcane biomass for second generation ethanol and/or bio-electricity production in Brazil.

Other recent energy collaborations include the following:

- An international research collaboration including researchers from IIASA and Universidade Federal do Rio de Janeiro assessed countries' Intended Nationally Determined Contributions (INDCs), which outline their future climate action plans. The analysis found that the INDCs lower greenhouse gas emissions, but would still achieve a warming of 2.6 to 3.1 degree Celsius by 2100. The research was published in *Nature* in 2016.
- IIASA researchers in collaboration with the University of São Paulo and the World Resources Institute explored a biofuels combined with carbon capture and storage (BECCS) scheme from the joint production of ethanol and electricity based on sugar, bagasse, and other residues in Brazil. The researchers found that it could supply more than 75 percent of private car fuel and more than 15 percent of all electricity in Brazil with only small increases in prices for the consumer. The results were published in *Applied Energy* in 2016.
- Researchers at IIASA examined the drivers of appliance ownership and uptake of technologies in Brazil, India, and South Africa. The researchers found that income is the predominant driver of technology ownership, but non-income factors including race and region are influential and help explain the heterogeneity in ownership especially at the lower income levels. The research was published in *Energy Research & Social Science* in 2017.

IIASA is coordinating the Linking Climate and Development Policies – Leveraging International Networks and Knowledge Sharing (CD-LINKS), a consortium of 19 international research organizations, exploring national and global transformation strategies for climate change and their linkages to a range of sustainable development objectives. CD-LINKS will advance the state-of-the-art of climate-development policy analysis and modelling and it aims to have a pronounced impact on the policy dialogue, both nationally and internationally. The Energy Planning Program at the Universidade Federal do Rio de Janeiro is one of the partners of CD-LINKS.

Global Energy Assessment and Brazil

Brazil was a significant partner and contributor to the Global Energy Assessment

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.

- The Brazilian multinational energy corporation, Petrobras, was a sponsor of the GEA.
- Brazilians played important leadership roles in the GEA; notably, Professor José Goldemberg of the University of São Paulo was Co-President of the GEA; and Celso Fernando Lucchesi, a former Managing Director of Petrobras, was a GEA Council Member. Professors Suaní T. Coelho and Suzana Kahn Ribeiro were members of the GEA executive committee.
- Brazilian researchers made a significant contribution to the GEA with two Convening Lead Authors, six Lead Authors and one Contributing Author.
- The final assessment was launched at a high-level side event during the Rio+20 United Nations Conference.

Outcomes from the GEA include the adoption of GEA 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. Several senior Brazilian officials are involved in SE4ALL, including Edison Lobão, a former Brazilian Minister of Mines and Energy and Luciano Coutinho, President of the Brazilian Development Bank.

Co-benefits: Improving air quality and tackling climate change

Brazilian and IIASA researchers are jointly investigating how to simultaneously reduce air pollution and greenhouse gas emissions in Brazil and Latin America

IIASA GAINS model is a scientific tool that helps policymakers select a smart mix of measures to simultaneously cut air pollution and greenhouse gas emissions in the most cost-effective way. It has been applied successfully in international negotiations of the Convention on Long-range Transboundary Air Pollution and the European Union to curb air pollution; and it has been used to analyze mitigation efforts for the climate negotiations under the UN Framework Convention on Climate Change.

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, **Petrolero Brasileiro**, 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 agricultural experts from 2008-10 to analyze yields and land suitability of key agricultural crops under a changing climate.

In addition, IIASA works with the Austrian industrial company, **OMV** via IIASA Deputy Director General serving on OMV's Advisory Group on Sustainability and being Chair of the Advisory Board of OMV Future Energy Fund from 2006-11.

Researchers from the University of São Paulo, IIASA and other Latin American countries have developed the GAINS model to identify measures to curb the release of short-lived climate pollutants such as black carbon and methane in Latin America. By implementing an integrated approach to reducing these pollutants, there is potential to simultaneously increase human wellbeing through reduced local air pollution, improve local environmental quality, increase security of food and energy supply, and lower water demand as well as reducing greenhouse gas emissions.

The work started in 2014 as part of a regional assessment of short-lived climate pollutants in Latin America for the Climate and Clean Air Coalition to Reduce Short Lived Climate Pollutants—the first international effort to treat these pollutants as a collective challenge. IIASA and international partners provided the intellectual underpinnings for this coalition via an article in *Science* in 2012.

Another greenhouse gas, nitrous oxide, contributes to global warming and stratospheric ozone depletion. Researchers from the Ministry of Science, Technology and Innovation, INPE, the University of Brasilia, and IIASA are part of the International Nitrogen Initiative which aims to optimize nitrogen's beneficial role in sustainable food production and minimize nitrogen's negative effects on human health and the environment resulting from food and energy production.

Projecting demographic change in Brazil

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.

IIASA's demographers are providing independent analysis and projections of Brazil's future population

The Institute's interdisciplinary approach has encouraged its demographers to reach 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 a book with *Oxford University Press* that offered the first projections of educational attainment by age and sex for 171 countries. Findings for Brazil show how different policies over the next few decades could lead to the country's 2010 population of 194.9 million declining to 148 million by 2100 or increasing to around 279 million.

IIASA demographers also collaborate with researchers from the Center for Development and Regional Planning (Cedeplar) at the Federal University of Minas Gerais on demographic methods to analyze the formation of human capital.

Between 2009 and 2011, IIASA social scientists explored the factors that determine people's capacity to cope with and adapt to adverse climatic conditions through case studies of two low income settlements, one of which is 'Rocinha' in Rio de Janeiro. In both case studies the research found that formal education had a direct effect on reducing risk as well as a mitigating effect on issues that increase risk.

Advancing the modeling of complex systems

New frameworks and new models are being developed via joint studies between Brazilian and IIASA researchers, these include:

IIASA and Brazilian researchers are exploring new ways to understand complex environmental and social systems

- CGEE, INPE and IIASA co-organized a land-use change vision workshop in Rio de Janeiro in 2012. Resulting papers from the workshop argue for a new globally consistent and expandable systems-analytical framework to guide and facilitate decision making on sustainability from the planetary through to the local level, and vice versa. This framework

would strive to link a multitude of Earth-system processes to the local level and so allow countries like Brazil, a case study in this article, to understand domestic or even local sustainability measures within a global perspective and to optimize them accordingly. Other authors on this journal article were also from EMBRAPA, São Paulo State University, Federal University of Minas Gerais, and Brazil's Ministry of Science, Technology and Innovation. Collaborations continue between these partners in the area of uncertainty in environmental services.

- Researchers from INPE, IIASA and collaborators in Ukraine and Poland worked together on reducing uncertainties in greenhouse gas inventories at a workshop in 2010 in Ukraine.
- Collaboration with the University of São Paulo is developing a model of plant growth that analyzes how vegetation in the past has responded to changes in climatic conditions in order to project how vegetation may be affected by future changes in temperature and precipitation.
- In collaboration with INPE and other international partners, IIASA has developed plausible scenarios of Eastern African food security for stakeholder groups and policymakers using its GLOBIOM model as part of the CGIAR Climate Change, Agriculture, and Food Security Program.

Capacity Building

Young Scientists Summer Program

Since 2010, 16 Brazilian students have developed research skills and networks by taking part in the IIASA 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 Brazilian National Member Organization (NMO) unless otherwise stated. Since 2008 the following 12 Brazilian students have participated in this program:

YSSP '19

Talita Borges Cruz (Federal University of Rio de Janeiro) analyzed how introducing social stratification in intergrated assesment models might affect the analysis of mitigation scenarios.

Bruno Meirelles De Oliveira (University of São Paulo) developed a prototype of social ecological systems resilience using system dynamics modelling.

YSSP '18

Camila Thiemy Dias Numazawa (University of São Paulo) assesed the economic and environmental performance of the Brazilian Forest Code in the Amazon rainforest - using primary data and G4M modelling method.

Fabio Amendola Diuana (Federal University of Rio de Janeiro) enhanced an integrated basin-scale modelling tool developed at IIASA over the past few years by automating and testing its transferability to other case-study basins.

YSSP '17

Esperanza Gonzalez Mahecha (Federal University of Rio de Janeiro) assesed the technical and economic feasibility of nearly Zero Energy Buildings in the Brazilian buildings sector.

YSSP '16

Eveline Vasquez Arroyo (Rio de Janeiro Federal University) examined optimization of the Brazilian energy system expansion under water availability restrictions. (Funded by IIASA).

Alexandre Koberle (Rio de Janeiro Federal University) downscaled the shared socioeconomic pathways (SSPs) to Brazil using the MESSAGE modelling framework. (Funded by the Brazilian NMO).

Victor Manabe (University of Campinas – Unicamp) mapped integrated crop-livestock systems in Brazilian agricultural frontier. (Funded by the Brazilian NMO).

YSSP '15

Luis Tudeschini (University of São Paulo) investigated the characteristics of the direct and embedded energy consumption of Brazilian households and its carbon footprint. (Funded by the Brazilian NMO).

YSSP '14

Minella Martins (National Institute for Space Research) evaluated the vulnerability of agricultural production in major cities in the semi-arid region of Brazil in order to suggest priority sectors (economic, social and/or environmental) for investments and improvements. (Funded by IIASA).

Guilherme de Paula (Yale University), a Brazilian national, analyzed and explained the significant cost reductions in sugarcane ethanol production in Brazil since 1975. (Funded by the US NMO).

YSSP '13

Juliana Gil (University of Hohenheim), a Brazilian national, explored the land use change dynamics in Mato Grosso, Brazil, to improve our understanding of the extent to which anti-deforestation measures and high grain prices may lead to livestock farming intensification. (Funded by the German NMO).

Victor Maus (National Institute for Space Research) developed a new methodology for satellite time series analysis in order to use it to produce accurate land use and land cover data.

Pedro Rochedo (Federal University of Rio de Janeiro) further developed the Brazilian version of IIASA's energy planning tool, MESSAGE, by introducing carbon, capture and storage in association with biomass or bioenergy development as one of the many low-carbon technologies.

YSSP '11

Gustavo Burin Ferreira (University of São Paulo) extended a model of plant growth in order to study how salient aggregate properties of vegetation such as net primary productivity and total biomass are likely to change under future changes in temperature and precipitation. (Funded by IIASA).

YSSP '10

Aline Soterroni (National Institute for Space Research) developed a methodology to calibrate the inputs to the EPIC (Environmental Policy Integrated Climate) model and validate its outputs based on remotely sensed data. (Funded by IIASA).

Regional Young Scientists Summer Program

In 2012 IIASA launched its first regional YSSP called the Southern African Young Scientists Summer Program (SA-YSSP). The Program is organized jointly by the South African National Research Foundation, the South African Department of Science and Technology, the University of the Free State in Bloemfontein, South Africa, and IIASA. The following Brazilian national has participated in the program:

One Brazilian national has taken part in the IIASA regional Young Scientists Summer Program in South Africa

Alan de Barros (SA-YSSP 2014-15 & University of São Paulo) conducted statistical analysis of jaguar movements in order to enhance the conservation of a critically endangered population of jaguars in the Atlantic Forest, Brazil.

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. Two postdoctoral fellow from Brazil have participated in the program since 2010:

Two postdoctoral fellows from Brazil have developed their careers through joint research and publications at IIASA since 2010

Luciano Barreto Mendes (2015-2017) worked in the Air Quality and Greenhouse Gases & Ecosystem Services and Management Programs on two projects linked to reducing agricultural pollution and optimizing resource use on farms.

Edmar Teixeira (2007-2011) worked in the Ecosystems Services and Management Program and focused on the enhancement of the FAO/IIASA Agro-ecological Zones (AEZ) methodology.

IIASA-CAPES Postdoctoral Fellowship Program

A bilateral doctoral student and postdoctoral fellowship program to support Brazilian doctorate students and postdoctoral researchers at IIASA

IIASA is developing the research base for systems analysis in Brazil through the IIASA-CAPES Postdoctoral Fellowship Program offering Brazilian early-career scientists the opportunity to work at IIASA on a variety of research areas from energy and water management to risk prevention. The program will support up to four Brazilian Ph.D. students for a doctorate-sandwich program and up to four Brazilian researchers for the postdoctoral program at IIASA:

IIASA - CAPES Postdoctoral Fellows

Cláudio Cristina (2017-2018) worked with the Advanced Systems Analysis Program to study probabilistic models of time between events to develop risk prevention and reduction actions.

Raquel Guimaraes (2019-present) working with the World Population Program to imobility, vulnerability and floods through a case study of the Rio Doce valley in Brazil.

Julian Hunt (2017-2018) worked with the Water Program to research the implementation of seasonal-pumped-storage plants to improve energy and water management.

Alessandra Kortz (2019-present) working with the Evolution and Ecology Program to study global diversity and directional impacts of non-native species in natural diversity over time.

Andreas Nascimento (2018-present) working with the Advanced Systems Analysis Program on real-time data streaming and analysis.

IIASA - CAPES Doctorate Sandwich Program Fellows

Camila Callegari (2018-2019) developed a global travel demand simulator through the implementation of a multinomial logit model to assess different pathways towards a less carbon intensive transport system.

Rafael Cancella Moraes (2017) researched electric integration challenges of renewable energy forms in Latin America.

Vágna da Costa Pereira (2017-2018) studied differences in soil organic carbon dynamics in Crop-Livestock Integration Systems and under Cerrado vegetation in Brazil, using the CENTURY model.

Luis Gustavo Tedeschini (2017-2018) researched regional development, inequalities, household consumption patterns and their relationship with energy and carbon footprint.

Other Capacity-Building Activities

Brazilians have developed their forestry research, modeling techniques and foresight skills at IIASA

IIASA participates in the European Forestry Masters Program, a training initiative for advanced university students. As part of the EU sponsored program, candidates work for a 3-month period at IIASA to further their studies. Two Brazilian students have participated in the program since 2010:

- In 2011 **Mariah Pereira Vargas** worked on a database of traditional wood fuels in tropical countries (Brazil, Congo Basin, Indonesia and India). And in 2012 **Abel Alain Marcarino** applied, validated and further developed IIASA ecosystem services modeling tools.
- In October 2012, eight Brazilian researchers from INPE and IPEA were trained to use the General Algebraic Modeling System (GAMS) software and IIASA's GLOBIOM model at IIASA.
- In September 2013, three Brazilians from CGEE took part in a summer school at IIASA on future studies and foresight as an instrument for public engagement in policymaking for a complex and uncertain world.
- In March 2014, IIASA became a partner of Rio de Janeiro's new Museum of Tomorrow. This partnership will see IIASA research being displayed in the museum's Observatory of Tomorrow.

Selected presentations in Brazil

IIASA researchers regularly make presentations in Brazil, a recent selection follows:

Albert van Jaarsveld on "The Power of Systems Analysis" at the IIASA Systems Analysis and the Americas Conference, Rio De Janeiro in 2019.

Fulvio di Fulvio on "Benchmarking Harvesting Systems Costs in Industrial Forest Plantations Across Different Global Regions" at the Brazilian Agricultural Research Corporation (EMBRAPA) in 2019.

Narasimha Rao on "Decent Living Emissions Pathways: Using Input-Output to Quantify Human Well-Being" at the 26th International Input-Output Conference, Juiza de Fora in 2018.

Aline Mosnier and Johannes Pirker discussed and evaluated the results of the REDD-PAC Brazil with the Ministry of Environment of Brazil in Brasilia in 2015.

Susanne Hanger on "Risk Financing and Risk Reduction – a Comparison National Arrangements Across Developed Countries and Specific Lessons from Austria 2002-2013" at the 6th International Conference on Flood Management in São Paulo in 2014.

Florian Kraxner on "The REDD+BECCS connection, assessing global potentials and sustainability" at the IEA-IIASA-USP workshop on 'Bioenergy and carbon capture and storage (BECCS): Options for Brazil' in São Paulo in 2013.

Keywan Riahi on "Integrated assessment scenarios, the multiple co-benefits of an integrated approach to energy transformation" at Rio+20 in Rio de Janeiro in 2012.

Michael Obersteiner on "Land use transitions in South America: Framing the present, preparing the future towards regional sustainability" at a Global Land Project workshop in Ilhabela in 2011.

Shonali Pachauri on "Estimating the inconvenience costs of traditional fuels to assess non-monetary drivers of household fuel choices in developing countries" at the International Association for Energy Economics Annual Conference in Rio de Janeiro in 2010.

Other examples of scientific exchange include:

- Over 150 Brazilians have participated in IIASA events since 2010.
- Over 140 publications have resulted from IIASA-Brazilian collaborations
- Since 2010, 16 Brazilians have gained international and interdisciplinary research experience from participating in IIASA's Young Scientists Summer Program.
- Researchers, advisors, and diplomats from Brazil have visited IIASA over 55 times, while IIASA scientists have visited Brazil over 115 times.

Appendices

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

Prospects for Future IIASA-Brazilian Activities

Enhancing the IIASA-Brazil relationship offers benefits for Brazilian research, government policy, and international relations

This Info Sheet summarizes recent research collaborations between IIASA and Brazil. Significant potential remains to further intensify the IIASA-Brazilian relationship through developing a range of new joint activities including:

- **Enhancing Brazilian expertise in applying system analysis to national problems:** Developing bespoke Brazilian versions of IIASA global models would allow researchers and policymakers to look at complex global problems and their impact on Brazil in a holistic and integrated way. For example, the Dutch government worked with IIASA to develop a Dutch version of the IIASA GAINS model. The new model helps ministries to identify cost-effective measures to improve air quality and reduce greenhouse gas emissions in the Netherlands at the same time as complying with the country's obligations under international air quality agreements.
- **Conducting international assessments in areas of Brazilian strategic interest:** Brazil was a significant contributor to IIASA Global Energy Assessment which brought together over 500 specialists to transform the way society thinks about, uses, and delivers energy. IIASA is embarking on two new assessments, at the request of its member countries that will focus on issues of strategic interest to Brazil. These are holistic, integrative assessments of global water challenges and tropical deforestation.
- **New partnerships between IIASA and Brazilian 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 2017, this additional funding reached €52 million. This was part of a total funding portfolio of €265 million, the total awarded to external projects featuring collaboration between IIASA and member countries.
- **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's 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 box: 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 young Brazilian scientists:** There is significant potential to enhance participation by young Brazilian postdoctoral scholars in IIASA programs to develop their international and interdisciplinary research skills (see page 11: Capacity Building). Additionally, in 2016, IIASA and CAPES established fellowships for Brazilian postdoctoral fellows and Ph.D. students to bring Brazilian research conducting research on topics closely related to IIASA research agenda to IIASA.

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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