



Activities with Member Countries

South Africa

iiasa info sheet

Since South Africa's membership of IIASA began in 2007, a range of research collaborations and capacity building activities have been developed by IIASA and over 30 South African research partners. Growing the research base in systems analysis has been a particular focus. The Southern African Young Scientists Summer Program (SA-YSSP) which has developed system analytical research skills among over 80 doctoral students from 30 countries including 35 students from South Africa, which led to the development and establishment of the Southern African Systems Analysis Centre (SASAC) in 2015. Joint research studies have also explored how South Africa can make the transition to a low-carbon economy; smart ways to increase crop yields in South Africa; and the impact of different education policies on South Africa's future population.

These activities are complemented by scientific exchange with over 320 researchers either visiting South Africa from IIASA or visiting IIASA from South Africa. Beyond continuing these research collaborations, there is significant opportunity to grow the relationship between IIASA and the South African scholarly community, through 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 the National Research Foundation (NRF) are helping to shape via their role on the IIASA governing council. This IIASA Info Sheet provides a summary of this expanding relationship since 2010.

Highlights of Interactions Between IIASA and South Africa (since 2010)

National Member Organization	National Research Foundation
Membership start date	2007
Key research partners	30 South African organizations collaborate with IIASA including: <ul style="list-style-type: none"> ■ Central University of Technology (CUT) ■ Council for Scientific and Industrial Research (CSIR) ■ Department of Science and Innovation (DSI) ■ National Research Foundation (NRF) ■ Nelson Mandela Metropolitan University (NMMU) ■ Southern African Systems Analysis Centre (SASAC) ■ Stellenbosch University (SU) ■ University of Cape Town (UCT) ■ University of Johannesburg (UJ) ■ University of KwaZulu-Natal (UKZN) ■ University of the Free State (UFS) ■ University of the Witwatersrand (WITS)
Areas of research collaboration	<ul style="list-style-type: none"> ■ Overcoming challenges to sustainable renewable energy in South Africa ■ Projecting demographic change in South Africa ■ Improving water and food security in South Africa and the wider region ■ Advancing the methods of systems analysis
Capacity building	<ul style="list-style-type: none"> ■ 35 doctoral students from or studying in South Africa and 14 doctoral students from other African nations have taken part in the Southern African Young Scientists Summer Program ■ 12 South African doctoral students have also developed research skills and networks by taking part in the Young Scientists Summer Program
Publication output	74 publications have resulted from IIASA-South African collaborations
Other interactions	Researchers, advisors, and diplomats from South Africa have visited IIASA 167 times, while IIASA scientists have visited South Africa over 150 times.

Activities with Member Countries: South Africa

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

This Info Sheet summarizes IIASA interactions with South Africa during 2010–2019.

It includes highlights with links to further information, but it is not 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 South Africa

The National Research Foundation (NRF) is the National Member Organization (NMO) representing South Africa's membership of IIASA. NRF is an independent government agency that promotes and supports research in all fields of knowledge in order to help improve the quality of life of all the people of South Africa. NRF pays IIASA membership fees with funding provided by the South African Department of Science and Innovation.

Dr. Dorsamy (Gansen) Pillay, Deputy CEO (RISA: Research and Innovation Support and Advancement) at NRF, is the IIASA Council Member for South Africa. Dr. Pillay is also Vice Chair of the IIASA Council.

The IIASA Council consists of one representative of each of the IIASA National Member Organizations and is responsible for setting the overall strategic direction of the Institute as well as governing IIASA.

Dr. Aldo Stroebe, Executive Director, International Relations & Cooperation at NRF is the NMO Secretary for South Africa.

NRF has established an IIASA-South African NMO Committee to strengthen communication between IIASA and the broader science and technology environment in South Africa; to work toward establishing systems analysis as a focus in South Africa; to contribute to developing capacity in systems analysis in South Africa; and to ensure South Africa's full participation in IIASA global activities within the broader NRF mandate.

The committee is comprised of members from South African government, government parastatals, funding agencies, research institutions, and universities. The current members are:

IIASA-South African NMO Committee Members

Dr. Ursula Scharler, University of KwaZulu-Natal (Chair)

Professor Priscilla Baker, University of the Western Cape

Dr. Brilliant Petja, Water Research Commission

Professor Frans Swanepoel, University of Pretoria

Dr. Happy Sithole, Centre for High performance Computing

Professor Colleen Vogel, University of the Witwatersrand

Professor Mary Scholes, University of the Witwatersrand

Ex-officio members:

Dr. Sepo Hachigonta, NRF

Dr. Priscilla Mensah, NRF

Dr. Gansen Pillay, NRF

Dr. Aldo Stroebe, NRF

Mr. Daan du Toit, Department of Science and Innovation

South Africa's National Research Foundation represents South Africa and its scholarly community on the IIASA governing Council



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Research Partners in South Africa

IIASA is continually developing collaborations with South Africa and has recently worked with 30 organizations in South Africa via formal and informal connections

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

African Institute for Mathematical Sciences (AIMS)
BirdLife South Africa
Cape Peninsula University of Technology
Central University of Technology (CUT)
Council for Geoscience
Council for Scientific and Industrial Research (CSIR)
Department of Science and Innovation (DSI)
Eskom
Human Sciences Research Council (HSRC)
International Water Management Institute, Pretoria
National Research Foundation (NRF)
Nelson Mandela Metropolitan University (NMMU)
North-West University (NWU)
Rhodes University
South African National Energy Development Institute (SANEDI)
Southern African Systems Analysis Center (SASAC)
Stellenbosch Institute for Advanced Study (STIAS)
Stellenbosch University (SU)
Tshwane University of Technology (TUT)
University of Cape Town (UCT)
University of Fort Hare (UFH)
University of Limpopo (UL)
University of Johannesburg (UJ)
University of KwaZulu-Natal (UKZN)
University of Pretoria (UP)
University of South Africa (UNISA)
University of the Free State (UFS)
University of the Western Cape (UWC)
University of the Witwatersrand (WITS)
Water Research Commission (WRC)

Recent Research Collaborations

Overcoming challenges to sustainable renewable energy in South Africa

The South African economy is highly energy and (mineral) resource intensive, yet the South African government is committed to contributing its fair share of global greenhouse gas mitigation efforts in order to keep the global temperature increase to below 2°C. Achieving this vision of a low-carbon economy requires a thorough understanding of the complex global energy system and its multiple connections with South Africa's economy, environment, and society.

South Africa faces the triple challenge of fueling its economic development by meeting the rapidly growing energy demand; increasing the reliability of its power system; and letting domestic greenhouse gas emissions peak between 2020 and 2025 in line with its pledge to the UNFCCC under the Paris agreement. Recently discovered domestic shale gas reserves are currently under evaluation as a potential new energy source, to provide clean, reliable and cheap electricity while mitigating greenhouse gas emissions. But, the impact of shale gas on greenhouse gas emissions is far from settled.

IIASA researchers recently undertook a study using the MESSAGE model to analyze and quantify the interdependence between shale gas extraction and climate change mitigation effort regarding the South African energy pathways and its domestic greenhouse gas emissions. The results illustrated, that low cost shale gas can lower the overall energy system costs compared to the no-shale-gas counterfactual. At the same time, a system with abundant low cost natural gas from shale sources requires a stronger carbon price signal compared to the no-shale-gas scenarios in order to achieve the same desired mitigation goals. The results were published in *Frontiers in Energy Research* 7 in 2019.

A recent study lead by a South African participant of the 2018 YSSP program from the University of South Africa, IIASA and other partners explored factors preventing the successful implementation of sustainable renewable energy into South Africa's national energy mix. The study focused on legislation which had been passed, to seek to increase South Africa's share of renewable energy resources, reduce carbon emissions and create jobs and economic

A range of collaborations between South African and IIASA researchers are investigating how South Africa can transition to a low-carbon economy and reduce energy poverty

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

Choruma D, Balkovic J, Odume ON (2019) Calibration and validation of the EPIC model for maize production in the Eastern Cape, South Africa. *Agronomy* 9(9) DOI:10.3390/agronomy9090494

Orthofer C, Huppmann, & Krey V(2019). South Africa After Paris—Fracking Its Way to the NDCs? *Frontiers in Energy Research* 7: art.20. DOI:10.3389/fenrg.2019.00020

Jarbandhan VDB, Komendantova N, Xavier R, & Nkoana E (2018). Chapter 8. Transformation of the South African Energy System: Towards Participatory Governance. In: *Systems Analysis Approach for Complex Global Challenges*. Eds. Mensah, P., Katerere, D., Hachigonta, S. & Roodt, A., pp. 139-158 Heidelberg: Springer. ISBN 978-3-319-71485-110.1007/978-3-319-71486-8_8

Flatø M, Muttarak R, & Pelser A (2017). Women, Weather, and Woes: The Triangular Dynamics of Female-Headed Households, Economic Vulnerability, and Climate Variability in South Africa. *World Development* 90: 41-62. DOI:10.1016/j.worlddev.2016.08.015

Gwate O, Woyessa YE, & Wiberg D (2015). Dynamics of land cover and impact on stream flow in the Modder River Basin of South Africa: case study of a quarternary catchment. *International Journal of Environmental Protection and Policy* 3 (2): 31-38. DOI:10.11648/j.ijepp.20150302.12

Ebi KL, Hallegatte S, Riahi K et al. A new scenario framework for climate change research: Background, process, and future directions (2014) *Climatic Change*, 122 (3), pp. 363-372.

Selected publications
resulting from IIASA-South
African collaborations

empowerment for communities. The study showed that while the aims of the program are admirable the execution and approach is limiting the ability for it to succeed. The results were published in the *Journal of Energy in Southern Africa* in 2018.

Researchers from IIASA and the Energy Research Centre at the University of Cape Town collaborated in 2014 to identify technically feasible pathways to achieve deep decarbonization both in South Africa and globally. The resulting report was part of the Deep Decarbonization Pathways Project which is convened under the auspices of the United Nation's Sustainable Development Solutions Network (SDSN).

Other energy studies on South Africa or with South African partners include:

- IIASA has collaborated with the University of Cape Town among other partners to develop the Shared Socioeconomic Pathways (SSPs)—part of a new framework of scenarios that the climate change research community has adopted to facilitate the integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation.
- IIASA researchers developed a new method to evaluate the status and progress of rural household energy sustainability. The analysis, published in 2014, suggested that South Africa's rural energy sustainability index was the highest among the countries studied: Bangladesh, China, Ghana, India, and Sri Lanka.
- IIASA researchers in collaboration with a Kenyan participant in the SA-YSSP analyzed the relationship between energy poverty and the risks of burns, scalds and poisonings from household energy use in South Africa and found that the risks of burn incidents and fires initially rise with income only to decrease at higher income levels.
- Researchers from IIASA and Stellenbosch University among others demonstrated the potential for concentrating solar power to provide baseload and dispatchable power—key to allowing greater flexibility in planning a balanced energy system.
- An investigation into the critical success factors for the environmental leadership necessary to transform the South African energy sector was carried out by researchers at the University of Johannesburg and IIASA.

IIASA 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. 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 IPCC's (Intergovernmental Panel on Climate Change) 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 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.

Global Energy Assessment

Systems analysis helps 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. Integrated, international assessments are one systems analytical approach that has the breadth and depth to explore complex energy problems across multiple sectors, regions, and timeframes. From 2006-12, IIASA led the Global Energy Assessment (GEA), in which a new global energy policy agenda was defined—one that transforms the way society thinks about, uses, and delivers energy. GEA involved over 500 specialists from a range of disciplines, industry groups, and policy areas, to identify pathways and policies to facilitate equitable and sustainable energy services for all:

- Five South African scientists contributed to the GEA with analysis and research on developing policies to (1) increase energy access; (2) transform energy systems; and (3) build capacity.
- Outcomes from the GEA included 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, as well as shaping Sustainable Development Goal #7 (ensure access to affordable, reliable, sustainable and modern energy for all).

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:

- Global food demand could increase by more than 59% by the year 2050, according to an unprecedented comparison of 10 agricultural economic models by researchers from ABARES, IIASA and eight other countries. The study found that demand is likely to increase by 59-98% between 2005 and 2050, more than the 54% projected by the UN Food and Agricultural Organization's most recent analysis. The study compared food demand projections for 2050, based on different population and wealth projections, as well as for different regions and products. It found that uncertainties related to population, income, and consumption, often factors which are set as assumptions in agricultural models, are even greater than uncertainties related to climate change. For example, when considering a world with a higher population and lower economic growth (SSP3), consumption per capita drops on average by 9% for crops and 18% for livestock. The maximum effect of climate change on calorie availability is -6% at the global level. (Source: Valin H, Sands RD, van der Mensbrugge D, Nelson GC, Ahammad H, Blanc E, Bodirsky B, Fujimori S, Hasegawa T, Havlik P, Heyhoe E, Kyle P et al. (2014) The future of food demand: Understanding differences in global economic models, *Agricultural Economics*, 45(1):51-67).

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 models, tools,
and data

IIASA demographers are providing independent analysis and projections of the future South African population

Projecting demographic change in South Africa

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's demographic methods as part of its literacy forecasting.

In addition, 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 with *Oxford University Press*. Findings for South Africa show how different policies over the next few decades could lead to the country's 2010 population of 50.1 million increasing to 70.5 million by 2100 or falling to around 39.3 million.

Other joint studies with South African collaborators include:

- Research between IIASA researchers, the University of the Free State and other partners looked at how existing gender inequality is believed to be heightened as a result of weather events and climate-related disasters that are becoming more common, the results were published in *World Development* in 2017.
- Research with the Centre for Actuarial Research at the University of Cape Town among others analyzed the future of mortality in high-mortality countries.
- A project with the University of Cape Town on estimating AIDS mortality in Africa.
- A collaboration with the Stellenbosch Institute for Advanced Study on a book examining education and development.

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.

Improving water and food security in South Africa

IIASA collaborates with researchers in South Africa and other African nations to develop and apply the Institute's sophisticated models to issues of food and water security as well as land management.

Groundwater maintains vital ecosystems and strongly influences water and energy budgets. Although at least 400 million people in Sub-Saharan Africa (SSA) depend on this valuable resource for their domestic water needs, often the processes that sustain it and their sensitivity to climatic variability, are poorly understood.

IIASA and other researchers recently conducted a study that looked into climate impacts on groundwater in light of changing climatic patterns in Africa. Findings indicated that higher rainfall does not necessarily equate to higher recharge values for groundwater and that aridity and episodicity play an important role in determining the amount of groundwater replenishment. The findings were published in *Nature* in 2019.

Other activities in the field of water and food security since 2010 include:

- The Worldwide Fund for Nature South Africa (WWF-SA) commissioned researchers from the IIASA Water Program to assess pathways towards large-scale, sustainable biofuel deployment in SSA. The IIASA GAEZ model was used to estimate the production potential of bio-energy feedstocks across Sub-Saharan Africa. The findings were published in *Sustainable aviation biofuel potential in sub-Saharan Africa* in 2019.
- Several other studies have explored the impact of climate change on agriculture in SSA. An analysis using found that while some 200 million hectares could be used to expand food and energy production, the key to enhancing food security in SSA will be achieving yield increases on current cultivated land. A further study considered potential impacts to 2100 and identified regional hotspots where early intervention using adaptive measures may avert future hunger and improve food security.
- A case study of South Africa identified options for improving crop yields in the rain-fed systems of the semi-arid tropics, again using the IIASA GAEZ model.

IIASA researchers are collaborating with South African organizations to identify smarter ways to manage Sub-Saharan Africa's land, soil, and water resources

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 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.

IIASA working with business

- A study conducted by IIASA, Rhodes University and other partners evaluated the IIASA EPIC model and its potential to simulate maize yield using limited data from field trials on two maize cultivars. The results were published in the journal *Agronomy* in 2019.
- IIASA and partners have developed a more accurate map of cropland in Africa through IIASA Geo-wiki tool that uses Google Earth and information provided by a global network of volunteers to fill in 'data gaps' and to verify existing land cover information.
- The ground-breaking study, Integrated Solutions for Water, Energy, and Land (ISWEL), (2016-19) has identified sustainable solutions to jointly meet water, energy and land demands at the global level and with a very high degree of spatial detail for two large transboundary basins facing multiple development and environmental challenges: The Zambezi and the Indus river basins. The research is helping to shape the strategic plan of the Zambezi River Basin Commission and informing the Intergovernmental Panel on Climate Change on the systemic changes required to tackle climate change. It has identified the 'hot spots' across the world where water, energy and land challenges collide.
- The Food, Agriculture, Biodiversity, Land, and Energy Project (FABLE), launched in 2017, is identifying pathways for countries to transform their food and land use systems so that they simultaneously create new economic value, protect and regenerate precious natural resources and complex biophysical systems, manage increasing demands on the land, become a carbon sink, providing a more prosperous and resilient lifestyle for farmers, and find a healthier, less wasteful way to feed over nine billion people by 2050.

Advancing the methods of systems analysis

Ongoing collaborations with South African researchers are developing new research methods and applying them to ecological challenges

Researchers at Stellenbosch University, the African Institute for Mathematical Sciences, and IIASA have collaborated in the past to develop novel approaches to the study of complex adaptive systems in ecology and evolution, and to understand the stability and complexity of adaptive ecological networks. The joint activities have included the joint supervision of young scientists in the SA-YSSP capacity building partnership. Studies include:

- An assessment of how the interplay between natural and artificial selection, in the simplest setting in which a fishery and a target stock co-evolve, can lead to disruptive selection, which in turn may cause trait diversification.
- An investigation into the conditions for evolutionary branching and trapping in multidimensional adaptive dynamics.

Joint studies between researchers at the University of KwaZulu-Natal, Stellenbosch University, and IIASA have developed and applied new frameworks to analyze ecological networks representing socio-economic environments and highly productive estuarine/marine environments, in order to better understand their stability, robustness and organizational properties.

Capacity Building

Young Scientists Summer Program (YSSP)

Since 2010, 12 South African 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 National Member Organizations. Since 2010 the following 12 South African doctoral students have participated in this program:

YSSP' 19

Simone Pretorius (Stellenbosch University) worked with the IIASA Water Program to analyze the Western Cape's agricultural sectors adaption to climate change response in order to seek to understand agricultural producer's perspectives on climate change and adaptation in the region.

YSSP' 18

Luckson Muyemeki (North-West University) worked with the IIASA Air Quality and Greenhouse Gases Program and used the IIASA GAINS model to research the air quality management challenges currently facing South Africa. His study focused on better mitigation options for the Gauteng City-Region.

YSSP' 17

Lavinia Perumal (University of KwaZulu-Natal) worked with the IIASA Advanced Systems Analysis Program to understand the complex interactions that exist between social-ecological systems, with a particular focus on the impact of extensive transport infrastructure development in Africa.

YSSP' 15

Mavhungu Muthige (University of Venda) worked with the IIASA Risk and Resilience Program to develop a model that would help investigate potential future changes in tropical cyclone activity within the Southwest Indian Ocean Basin.

YSSP' 14

Gbenga Abiodun (University of the Western Cape) analyzed the impacts of temperature, rainfall, and land-use changes on the distribution, activities, and life histories of the three Anopheles species that are mainly responsible for malaria transmission in Africa. From this, he predicted malaria incidence over the coming decades in three provinces of South Africa.

YSSP' 12

Morag Ayers (University of KwaZulu-Natal) explored the robustness of marine ecosystems to climate change and anthropogenic activities such as fishing, freshwater abstraction from rivers, and eutrophication.

Danielle Nell (University of Johannesburg) conducted a systematic risk assessment of the BRICS countries in order to identify impediments to developing green infrastructure for a green economy.

YSSP' 11

Taufeeq Dhansay (Nelson Mandela Metropolitan University) studied the possibilities of harnessing geothermal energy in South Africa by producing geothermal and hydrogeological models using available heat-flow and groundwater data.

Nimi Hoffmann (Rhodes University) developed a strategy to form a partnership between villagers and universities in South Africa to engage local and provincial government in order to foster the participatory management of their water and climate risks.

Donald Iponga (University of Stellenbosch) studied the forces that drive future invasion of alien plants in the African Savannah.

Prestige Makanga (University of Cape Town) investigated how volunteered geographic information can be used to generate meaningful injury data and data on the socio-economic determinants of injury to inform and equip policy and decision makers to adequately respond to the burden of injury in low and middle income countries.

YSSP' 10

Hayley McIntosh (University of Cape Town) researched the application of Bayesian networks for the analysis of large amounts of seasonal rainfall data, in particular for supporting decision making in agriculture in South Africa.

The Southern African Young Scientists Summer Program (SA-YSSP) developed international and interdisciplinary research skills among doctoral students between 2012 & 2015

Southern African Young Scientists Summer Program (SA-YSSP)

In 2012 IIASA, NRF, and the South African Department of Science and Innovation launched the Southern African Young Scientists Summer Program (SA-YSSP)—the first regional YSSP. The program ran for three consecutive years, between November and February in 2012/13, 2013/14 and 2014/15. During this time, 83 doctoral students from 30 countries participated, including 35 students from or studying in South Africa and 14 students from other African nations. Each SA-YSSP participant was co-supervised by one senior researcher from IIASA and one from South Africa, which lead to further research collaborations with South Africa.

The following 35 doctoral students studying in South Africa participated in the program:

SA-YSSP' 14/15

Anette Alleman (University of the Free State, Bloemfontein) researched the effect of herbicide formulations and soybean genotype on the relationship between beneficial organisms and root pathogens.

Hung-Yu Chaun (University of the Free State, Bloemfontein) studied the influence of sorghum root physiology on rhizosphere interactions and their effect on the incidence of root disease.

Aleksandra Falkiewicz (University of KwaZulu-Natal) explored asymptotic behaviour of dynamical systems in complex networks.

Alois Katiti (University of Fort Hare) conducted a satellite-based estimation of evapotranspiration in the green scheme irrigation (projects) of Namibia.

Serge Kubanza (University of the Witwatersrand) researched the social and environmental injustice in solid waste management in Kinshasa, the Democratic Republic of Congo.

Mantsebo Letsie (University of the Witwatersrand) examined the vulnerability to climate change and variability on crop yields and implications on household welfare in Lesotho.

Decide Mabumbo (University of Pretoria) studied the political, economic, social and ecological implications of large scale biofuel investments in South Africa.

Shingirirai Mutanga (University of Pretoria) modeled an effective energy mix for developing economics using spatial system dynamics: The case of Biofuels in the SADC Region.

Emmanuel Vellem (Rhodes University) explored acid mine drainage and salinity catchment systems.

Marcele Vermuelen (University of the Free State, Bloemfontein) studied the biotic and abiotic interactions of above and below ground parts of an allelopathic plant, using *Amaranthus cruentus* as a model.

Ganzamungu Zihindula (University of KwaZulu-Natal) investigated the access to health care services by refugees in South Africa: A case study of the Congolese community living in the city of Durban.

SA-YSSP' 13/14

Abraham Alemayehu (University of South Africa) reviewed the integration of gender and indigenous decision making power in reproductive health policies.

Everardt Burger (Central University of Technology) researched the re-engineering of public transportation systems to develop greener cities in central South Africa.

Witness Chirinda (University of the Western Cape) estimated healthy life-expectancy in South Africa.

Stephan Eromobor (Central University of Technology) dynamically modeled the feasibility of sustainably built infrastructure in South Africa.

Takunda Mambo (University of Cape Town) researched multidimensional energy poverty in Zimbabwe.

Tafadzwa Makonese (University of Johannesburg) conducted a systems analysis of residential coal combustion and ambient air quality in the South African coal-burning region.

Given Mutimudye (University of the Witwatersrand) researched strategic concerns for South Africa of integrating the greenhouse effect in economic growth.

Thakane Ntholi (Nelson Mandela Metropolitan University) investigated the geothermal power potential of deep gold mines.

Savannah Nuwagaba (Stellenbosch University) studied the role of adaptive foraging behavior in food-web emergence and biodiversity maintenance.

Kgothatso Shai (University of Limpopo) analyzed whether there is a shared or competing interest between the use of oil for Africa's development or US energy security.

Mercy Shoko (University of the Witwatersrand) researched the universality of aging in different population groups in South Africa.

Blessing Silaigwana (University of KwaZulu-Natal) reviewed the efficacy of medicinal plants for the treatment of soil-transmitted helminthic parasites.

Milaine Tchamga (University of Cape Town) analyzed dynamical systems in ecology using models and simulations.

Romeo Xavier (University of the Witwatersrand) explored the factors needed to implement participatory governance in the transformation of the South African energy sector.

SA-YSSP' 12/13

Emile Goufo (North West University) conducted a mathematical analysis of the dynamics of social groups.

Sunday Hosu (University of Fort Hare) analyzed the vulnerability to climate change of smallholder farmers in the Eastern Cape Province in South Africa.

Frederic Isingizwe (University of KwaZulu-Natal) used experimental data to explore the effectiveness of a flow model of aquatic ecosystems.

John Kandala (University of Johannesburg) studied criminal engagement by identifying the demographic aspects, including education, that might contribute to this phenomenon.

David Kimemia (University of Johannesburg) investigated the interface between energy poverty and energy incidents such as shack fires and paraffin poisoning using quantitative analyses of energy access and injuries data.

Omowunmi Longe (University of Johannesburg) researched the feasibility of a standalone microgrid to supply electricity to the Ntabankulu Local Municipality in Eastern Cape.

Brian Mandikiana (University of Pretoria) assessed the potential of extracting bio-gas from organic waste generated in South Africa.

Henintsoa Minoarivelo (University of Stellenbosch) explored the adaptive dynamics of trait diversification in mutualistic networks.

Shakespeare Mudombi (Tshwane University of Technology) examined social learning in the climate change adaptation initiatives in South Africa.

Verena van Zyl-Bulitta (University of Stellenbosch) investigated negative externalities of measures to adapt to climate change in Africa through in-depth interviews with stakeholders.

Building on the successes of SA-YSSP, came the development of the Southern African Systems Analysis Centre (SASAC). Created as a dedicated resource for building capacity in Systems Analysis in South Africa and the wider region

Southern African Systems Analysis Centre (SASAC)

Building on the successes of the SA-YSSP, the NRF and the Department of Science and Innovation of South Africa in cooperation with IIASA, decided to evolve and expand its activities to develop capacity for systems analysis in South Africa and the wider region by launching the Southern African Systems Analysis Centre (SASAC). A consortium of four universities, namely the University of the Western Cape, the Universities' of Limpopo and the Witwatersrand, and Stellenbosch University have been competitively selected to host SASAC.

The SASAC program takes cognizance of a wider framework of engagement, additional and multi-level systems analysis capacity interventions, and a comprehensive approach to policy related activities in South and Southern Africa. The centre will help South Africa and the wider region to work towards its sustainable development plans by building a cohort of system thinkers who will be able to contribute to attaining targets through scientific interdisciplinary research and capacity development.

IIASA-South African scientific exchange through people

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

Albert van Jaarsveld on "The Power of Systems Analysis" at the conference Systems Analysis and Africa in 2019

Barbara Willaarts on "Integrated Solutions for Water, Energy, and Land (ISWEL)" at the conference Systems Analysis and Africa in 2019

Stefan Fritz on "Improving Land Cover and Land Use Maps through Crowdsourcing as a Reference Database" at the South African National Space Agency (SANSA) in 2017

Zbigniew Klimont on "Dialogue on Integrated Local and Regional Scale Air Quality Modelling using the GAINS Model" at a CSIR policy workshop in Pretoria in 2014.

Brian Fath on "The Craft of Systems Analysis" at the SA-YSSP in the University of Free State, Bloemfontein in 2013.

Kaarle Kupiainen on "Emissions of Black Carbon in Europe" at the 16th International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA) in South Africa in 2013.

Elena Rovenskaya on "Bridging the gap between agents' aims in socio-environmental models" at the SA-YSSP in the University of Free State, Bloemfontein in 2013.

Sabine Fuss on "Bioenergy in mitigation portfolios: the role of uncertainty" at the International Energy Workshop in Cape Town in 2012.

Alessandra Garbero on "Survival Differentials by Level of Education" at the experts workshop on the 'Likely Future Trajectory of Mortality in High Mortality Countries' in Cape Town in 2012.

Other examples of scientific exchange since 2010 include:

- 47 South Africans have gained international and interdisciplinary research experience from participating in either the Young Scientists Summer Program or Southern African version.
- Researchers, advisors, and diplomats from South Africa have visited IIASA or participated in IIASA events over 167 times, and IIASA scientists have visited South Africa over 150 times.
- 74 publications have resulted from collaborations between IIASA-South African collaborations.
- 167 South African researchers, advisors, and diplomats have visited IIASA or have participated in IIASA events since 2010
- 74 publications have resulted from collaborations between IIASA and researchers at South African institutions since 2010
- IIASA scientists have visited South Africa over 150 times 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-South African Activities

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

Enhancing the IIASA-South African relationship offers benefits for South African research, government policy, and international relations

- **Enhancing South African expertise in applying system analysis to national problems:** Developing bespoke South African versions of IIASA global models would allow researchers and policymakers to look at complex global problems and their impact on South Africa in a holistic and integrated way.
- **Conducting international assessments in areas of South African strategic interest:** South African researchers contributed to IIASA Global Energy Assessment which brought together over 500 specialists to transform the way society thinks about, uses, and delivers energy. The new IIASA Strategy for 2021-30 will empower its members to collectively initiate large-scale interdisciplinary projects of high relevance to the regions where its members are located.
- **Academic training opportunities for young South African scientists:** Numerous doctoral students have developed research skills in systems analysis by participating in the Young Scientists Summer Program and the Southern African version (see page 10: Capacity Building). Significant scope remains to develop future capacity development activities for early career researchers in the region.
- **New partnerships between IIASA and South African 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. About half of IIASA income comes from additional funds through contracts, grants and donations. This is growing and has increased by up to 25% from €8.4 million in 2017 to €10.5 million in 2018.
- **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).

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, Indonesia, Iran, Israel, Japan, Mexico, Malaysia, Norway, Republic of Korea, Russia, South Africa, Sweden, Ukraine, United Kingdom, United States of America, Vietnam.

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