FAPESP:
SCIENCE FOR SUSTAINABILITY

FAPESP
SÃO PAULO RESEARCH FOUNDATION

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SCIENCE FOR SUSTENTABILITY

The São Paulo Research Foundation (FAPESP) fosters and supports research on bioenergy, biodiversity and climate change via three specific programs – BIOTA, BIOEN and RPGCC (Research Program on Global Climate Change) – whose results have contributed to sustainable development initiatives and public policies. FAPESP also funds multidisciplinary research on the preservation of the Amazon and its biodiversity.

PHOTOS: Léo Ramos Chaves/Revista *Pesquisa FAPESP*

FAPESP BIOENERGY RESEARCH PROGRAM

BIOEN
FAPESP


Leo Ramos Chaves/FAPESP

https://fapesp.br/en/bioen

The share of clean, renewable sources on Brazil's energy matrix corresponded to 46% in 2020, representing one of the highest percentages worldwide. Bioenergy from sugarcane accounts for almost 18% of the Brazilian energy supply through the use of sugarcane bagasse to generate electrical and thermal energy and bioethanol that accounts for 50% of the light fleet vehicle fuels. Indeed, bioethanol is an important component of the energy that powers Brazilian vehicles. In 2020, 80% of the light vehicle fleet were equipped with flex fuel engines. In 2019, ethanol consumption corresponded to 34,9 billion liters, whilst gasoline's was equivalent to 27,9 billion liters. Furthermore, ethanol is blended to the regular gasoline sold in the country on a 27% ratio. An important result is the avoided emissions of CO_2 that in 20 years amount to the planting of 4 billion trees.

With 8,44 million hectares of sugarcane fields in 2019 – the equivalent to 1% of the national territory – Brazil is the world's top sugarcane producer. In the last few decades, the average ethanol productivity per hectare has been increasing annually due to the incorporation of new technologies. In the harvesting season 2019/2020, the country produced 642,7 million tons of sugarcane, 35,3 billion liters of ethanol and 34.5 million tons of oil equivalent (Mtoe) of biomass (bagasse).

Being an agricultural country, Brazil has a large biomass base to work on that can allow for the substitution of fossil fuels and petrochemicals with new improved bioproducts. Agroforestry-energy systems can be integrated to provide for sustainable development while improving food security and provisioning of ecosystems preservation. Strategies are being developed for carbon neutrality in many sectors that include stimulating the circular economy and the bioeconomy with the use of residues and waste for energy.

The FAPESP Bioenergy Research Program BIOEN seeks to generate fundamental and applied knowledge for bioenergy, biofuels and bioproducts. The results of the program since its creation in 2009 demonstrate a systematic and vigorous performance by the São Paulo scientific community and the ability of FAPESP to articulate many new initiatives in the area.

Among the goals for the next decade BIOEN seeks to foster research on the growth and diversification of the use and sources of biomass, the expansion of conversion platforms and the use of biofuels, the development of biorefineries with the integration of new bioproducts and on studies that define the impacts that these developments may have for the State of São Paulo and the Brazilian bioeconomy. Specific goals of research include to diversify biomass options, increase production and productivity, develop efficient and competitive biomass conversion platforms, improve energy efficiency and the sustainability of the end use of bioenergy and accelerate the transition to a bioeconomy.

BIOEN FAPESP

747 FAPESP FUNDING INSTRUMENTS

Research grants : **70**

Scholarships/Fellowships: **677**

199 RESEARCHERS

137 SCIENTIFIC PUBLICATIONS

65 PARTNERS INSTITUTIONS

9 INTERNATIONAL AGREEMENTS

BRAZIL

SUGARCANE FIELDS

8,44 million hectares (2019)

1% of the National territory

PRODUCTION

SUGARCANE

642,7 million tons in the harvesting season 2019/2020

ETHANOL

35,3 billion liters

BIOMASS

34,5 million tons of oil equivalent (Mtoe)

HIGHLIGHTS – BIOEN FAPESP

Report sees Latin America as offering best potential to expand bioenergy production

Based on efforts of 137 experts from 24 countries and coordinated by researchers in FAPESP's programs, the report will fed into public policy in São Paulo State.

Genes that make sugarcane more drought tolerant are identified

Brazilian and Belgian researchers have discovered five genes that when pemanently activated in transgenic varieties make sugarcane mor tolerant of hydric stress.

New tool facilitates genetic mapping of polyploid plants

Available online for free, polyploid mapping systems developed in Brazil helps breeders of sugarcane, kiwi, blueberry, sweet potato and forages, among other crops.

Most complete comercial sugarcane genome sequence has been assembled

Researchers have succeeded in mapping 99,1% of the plant's gene, providing knowledge that will help improve its resistance to disease and increase its biomass yield for fuel or sugar production.

Novel biotechnological route developed to obtain fine chemicals from agricultural waste

Coniferol obtained from sugarcane and wheat straw. The compound has applications in the food, cosmetics and pharmaceutical industries.

Researchers investigate energy storage solutions for electric vehicles and homes

Study by FAPESP-Shell Engineering Research Center hosted at University of Campinas set out to develop supercapacitors that store more energy and batteries that charge faster.

Study reveals how a hormone increases sucrose accumulation in sugarcane

Researchers have discovered how Chemical ripeners act on the molecular level in sugarcane to increase sucrose storage in the plant.

Novel nitrogen management method helps mitigate GHG emissions of sugarcane fields

Results obtained by Brazilian and Dutch researchers show that separate applications of vinasse and nitrogen fertilizers 30 days apart significantly reduce emissions of nitrous oxide.

Ricardo Pereira Rodrigues da Costa/BIOTA-FAPESP

BIOTA-FAPESP PROGRAM

Brazil is home to 13-15% of all species found on the planet, which live in a broad variety of habitats, along terrestrial, aquatic, coastal and marine environments. This natural treasure can be split into six large continental biomes – the Amazon, Atlantic Rainforest, Caatinga, Cerrado, Pampa and Pantanal biomes – originally distributed over 8.5 million square kilometers of national territory. Just as an example São Paulo State has a rich biodiversity and is also home to one-fifth of the country's population and approximately 7,200 species of higher plants. These ecosystems and their native species ensure important ecological processes and provide ecosystem services that are critical to human well-being The BIOTA-FAPESP Program is intended to study, characterize and, where needed, retore Brazilian biodiversity, promote its sustainable use, establish mechanisms for its conservation, provide information to public and private managers and raise public awareness about these matters.

The BIOTA-FAPESP Program is also known as the Virtual Biodiversity Institute because it integrates researchers, students and public and private institutions with common research objectives and targets through web tools. The research projects developed under the auspices of the program produce data on the characterization of biodiversity, which are simultaneously used for human resources training and to inform the public about conservation policies. Through its network of bioprospection, the Program envisages knowledge transfer for new product development and technology for the private sector.

https://fapesp.br/en/biota

20 anos BIOTA FAPESP

BIOTA-FAPESP

305 FAPESP FUNDING INSTRUMENTS

Research grants : **291**

Scholarships/Fellowships: **13**

238 RESEARCHERS

1.032 SCIENTIFIC PUBLICATIONS

15 PARTNERS INSTITUTIONS

Photo 1: Marcio José de Novaes
Photos 2, 3, 4: Eduardo Cesar/FAPESP

BRAZIL: **13-15%** of all species on the planet


1


2


3


4

HIGHLIGHTS – BIOTA-FAPESP

Large rural properties account for 54% of the environmental deficit in the state of São Paulo

The estimate comes from a research project supported by FAPESP to produce scientific input for implementation of Brazil's new forest code in the state.

Substances with anti-cancer action are identified in Brazilian red propolis

Researchers isolated eight polyphenols from the rarest type of propolis. Two of them found to inhibit tumor cell proliferation in laboratory assays.

An inventory providing information on mor than 200 viruses that infect plants in Brazil

The largest database of plant viroses serves as a tool for researchers, growers in the policymakers.

Study investigates Atlantic Rainforest regeneration in the state of São Paulo

A study conducted at the National Space Research (INPE) in Brazil compared recent high-resolution satellite images with georeferenced aerial photographs taken in 1962 and deployed powerful computational resources to analyze the changes in forest cover using two pioneer tree species as markers.

Scientists set out to understand how regenerated Atlantic rainforest áreas help to protect biodiversity

Researchers-based in São Paulo state and Netherlands are collaborating on four projects that explore how restored forest function. The findings may be used as public policy inputs.

South America is home to more than 2.500 species of frogs and toads

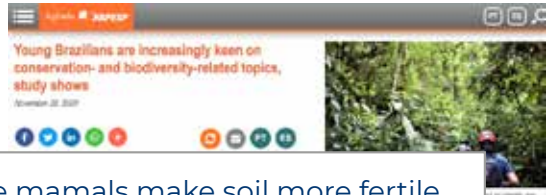
Updated survey of anuran amphibians that live in South America was led by a Brazilian researcher. Results are published in a book with maps of species diversity, ecological functions and endemic species.

Stingless bee species depend on a complex fungal community to survive

A report published in PLOS ONE describes key roles of various microorganisms in the development of the larvae of Scaptotrigona depillis. Researchers warn that this symbiotic relationship is threatned by indiscriminate use of pesticides.

Young Brazilians are increasingly keen on conservation and biodiversity related topics, study shows

An article in Science Advances shows high school students are steadily becoming more sensitive to environmental and scientific ideas. However, interest is uneven in regional terms. It is most intense in the North, less so in the Southeast.



Large mamals make soil more fertile in tropical forests

A study conducted by scientists at São Paulo State University demonstrates that animals like peccaries and tapirs boost soil levels of nitrogen, an essential elemento to plant growth.

FAPESP
CLIMATE
CHANGE

FAPESP RESEARCH PROGRAM ON GLOBAL CLIMATE CHANGE

https://fapesp.br/en/rpgcc

Leo Ramos Chaves/FAPESP

The need for studies on climate change in Brazil is vital on a local, regional and global scale due to the country's vast dimensions and the significant interdependence of its economical base on natural renewable resources. Not to mention the fact that Brazil's vegetation coverage, which is already considerably altered in the Atlantic Forest and Cerrado (savannah) biomes, is in the process of rapid change in the Amazon Forest over the last few decades. Changes in carbon stocks, precipitation patterns, sea-level rise, climate extremes are some of the main issues that Brazil has to face given the ongoing climate change. These changes could have substantial impacts on the socio-economical aspects of Brazilian society.

The FAPESP Climate Change Research Program is a bold and ambitious initiative in this direction. The program supports research projects performed by large and multidisciplinary teams. One of its primary goals is to understand the critical processes that control our climate, how these processes are changing, and develop scientifically based mitigation and adaptation strategies.

The program is developing the knowledge necessary for implementing new science-based policies to achieve sustainable development in some critical areas in our society. Among these areas, we could include agriculture, energy, health impacts, urbanization, biodiversity and ecosystems, and socioeconomic dimensions.

GLOBAL CLIMATE CHANGE

155 FAPESP FUNDING INSTRUMENTS

Research grants : **151**

Scholarships/Fellowships: **4**

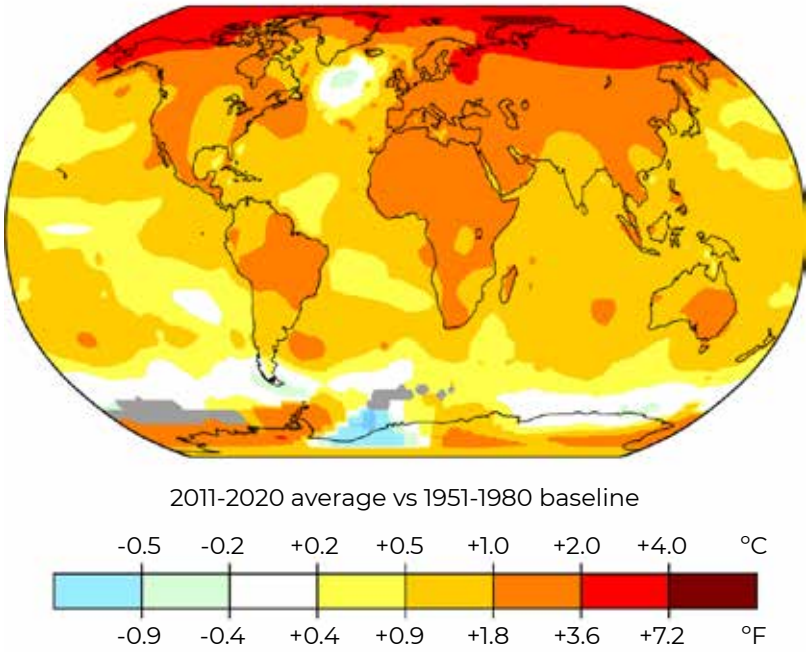
47 RESEARCHERS

302 SCIENTIFIC PUBLICATIONS

14 PARTNERS INSTITUTIONS

6 INTERNATIONAL AGREEMENTS

TEMPERATURE CHANGE IN THE LAST 50 YEARS



https://en.wikipedia.org/wiki/Climate_change#/media/File:Change_in_Average_Temperature.svg

HIGHLIGHTS – GLOBAL CLIMATE CHANGE

FAPESP CLIMATE CHANGE

Climate change may affect second corn crop in Brazil

The so-called safrinha suffer from extreme drought events in the Center-West, Southeast and South caused by global warming, according to a study supported by FAPESP and Belmont Forum

Extreme rainfall days in metropolitan São Paulo have risen fous fold in the last seven decades

Study by researchers at Cemaden also shows a rise in the number of consecutive dry days, suggesting that extreme rainfall events are concentrated in shorter, more widely spaced periods

Destruction of an Atlantic Rainforest fragmente raises the local temperature

Brazilian researchers show that if 25% of a one-hectare forest remnant is cut down, the impact on the local climate will be a temperature increase of 1° C

Experiments to discover how forests respond to rising levels of atmospheric CO_2

Facilities installed in the Amazon Rainforest in Brazil and in an English temperate forest will simulate a 50% rise in atmospheric carbono dioxide to assess the impacto on ecosystems

Drought favors plant pathogenic fungi in pasturelands and release of carbono dioxide from the soil

Scientists have estimated the impact of water stress and rising temperatures on tropical grassland soil used for pasture


Drought favors plant-pathogenic fungi in pasturelands and release of carbon dioxide from the soil

Impact of climate change will be measured in South Atlantic

Equipment anchored at depths of almost 4 km detect variations in salinity, temperature and maritime current velocity


Experiments to discover how forests respond to rising levels of atmospheric CO2

SCIENCE OF THE AMAZON

Covering over five and a half million square kilometers (1.4 billion acres), the Amazon basin hosts the largest tropical rainforest in the world. Given its distribution throughout such a large geographical area, this highly complex biome displays unique characteristics that are of extreme relevance to the planet, attracting the attention and the concern of nations worldwide.

The Amazon basin houses rivers and streams that are responsible for approximately 20% of the world's total river discharges into the oceans, representing one of the most important sources of freshwater in the world. Part of this abundance in fresh water is due to the peculiar structure of the Amazon soil, rich in decomposing organic matter, which soaks up moisture, that is slowly released to the rivers and the atmosphere. The cycle associated with moisture-release into the atmosphere and its return to the ground, as rain, is believed to play a crucial role in regulating climate-systems at both regional and global levels. Thus, deforestation, besides being a source of increase in greenhouse gas emissions, may result in the disruption of this water cycle, contributing to temperature increases and droughts.

The Amazon rainforest contains the largest biodiversity in the world, with more than 2.5 million catalogued species, including invertebrates, birds, mammals, amphibians, reptiles and fish, along with tens of thousands of different plant species. Such diversity is expected to provide new feedstocks and/or become an important source of genes that may be used, for example, to fortify modern plant varieties against current vulnerabilities to pests, diseases, or climate changes.

FAPESP has been providing continuous support to research projects that study the Amazon region under different and complementary perspectives. Many of these research projects are jointly funded with other organizations, as the Amazon Research Foundation (FAPEAM), the United States Department of Energy – Office of Science, the National Science Foundation (NSF), the Belmont Forum, the UK Natural Environment Research Council (NERC), among others, in Brazil and abroad.

Leo Ramos Chaves/FAPESP

SCIENCE OF THE AMAZON

2,507 FAPESP FUNDING INSTRUMENTS

Research grants : **895**

Scholarships/Fellowships: **1,612**

1,821 RESEARCHERS

414 SCIENTIFIC PUBLICATIONS

57 PARTNERS INSTITUTIONS

36 INTERNATIONAL AGREEMENTS

AMAZON BIOME

IN: https://www.bbc.com/portuguese/brasil-51377232


Leo Ramos Chaves/FAPESP

1. Green Ocean Amazon – GOAmazon

In partnership with the US Department of Energy (DOE) and the Amazonas State Research Foundation (FAPEAM), FAPESP sponsored the Green Ocean Amazon (GOAmazon) campaign, addressing tropical ecosystem functioning in the Amazon.

The project, in which the US National Science Foundation (NSF), the Max Planck Institute for Chemistry (Germany) and FINEP, the Brazilian Innovation Agency, also participated, transformed Manaus into a vast laboratory between 2013 and 2015.

The campaign analyzed the effects of pollution on cloud and rain formation processes, and the dynamics of interaction between the Amazonian biosphere and the atmosphere, among other factors.

1. Highlights GOAmazon

Study reveals how particles that seed clouds in the Amazon are produced

GOAmazon researchers describe in Nature the role of clouds as transportes of particles between the ground and the Upper atmosphere. New knowledge will enhance climate models

Scientists take stock of research on the dynamics of the Amazon rainforest

Researchers affiliated with GOAmazon and the Large Scale Biosphere-Atmosphere in Amazonia presented the findings of projects coducted in recente years and dicussed priorities for 2017-21

Pollution from Manaus results in up to 400% higher aerossol formation due to Amazon rainforest

The phenomenon affects cloud production and rainfall, with consequences for the local and global climate, which researchers have warned about in the study published in Nature Communications

Ultrafine aerossol particles intensify rainfall in Amazon region

Study published in Science reveals that pollution particles from cities substantially affect storm cloud formation over tropical forests

2. Highlights Amazon Biodiversity

New Amazonian fish Family discovered for first time in 40 years

Resembling an eel but phylogenetically close to the Wolf fish, Tarumania walkerae spends its life buried in leaf-filter pools. The specimen used for the description was found during the dry season in the Amazon.

Expeditions to Amazonia reveal new species of toads, lizards, birds and plants

Understanding the evolutionary history of Neotropical biota and past relationships between Amazonian and Atlantic Rainforest are the goal of a team led by zoologist Miguel Trefaut Rodrigues.

Deforestation in the Amazon favors an increase in the diversity of antibiotic-resistant soil bacteria

Study suggests that replacing native vegetation with pasture or crops increases competition among microorganisms, favoring those with antimicrobial resistance genes. Brazilian scientists advocate more research to find out whether bactéria can migrate to food and reach humans.

Venoms from Amazon snake and spider have pharmaceutical potential

Mapping of toxins from pit viper and tarântula reveals peptides that could lead in future to the Development of novel drugs for cardiovascular problems and câncer, besides anti-bacterial, anti-fungal, and anti-viral potential.

Conservation planning in Amazon should prioritize aquatic biodiversity, study concludes

Simulations using field data suggest focusing on the protection of species that live in rivers and lakes can be more eficiente than the approach most used now, which focuses on terrestrial biodiversity.

3. Highlights Amazon Rainforest

Regenerated forest offset 12% of carbono emissions due to deforestation in Brazilian Amazon in 33 years

A study quantified the size and age of the forest that grow naturally in degraded and abandoned áreas, creating 131 benchmark maps for Brazil. The Amazon has the most restored and the Atlantic Rainforest biome has the oldest.

Mega-study shows limits to survival of tropical forest

Dozen of scientists from several countries calculated Upper limits to global and local temperatures if tropical forests are to survive

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