Collaboration between Wageningen University & Research and Brazil

WAGENINGEN
UNIVERSITY & RESEARCH

Preface

As President of Wageningen University & Research (WUR), I am proud that for over 50 years we have received Brazilian students at our university and have implemented research projects and programmes together with our Brazilian partners. Brazil's potential for food production, climate mitigation and biodiversity protection makes it a key player in the international arena.

This booklet gives an overview of the work we have been doing in Brazil and with Brazilian partners on a diversity of topics. We look forward to strengthening our present ties with strategic national and global partners in Brazil like EMBRAPA, the agriculture faculty of the University of Sao Paulo, the University of Viçosa as well as (associations of) small, medium and large farmers and agribusiness companies. We are eager to establish new partnerships to support sustainable rural and urban development and solid and sustainable food systems.

Dr ir Sjoukje Heimovaara
President Executive Board
Wageningen University & Research

Introduction

This publication gives you an overview of research projects of Wageningen University & Research in Brazil and/or with Brazilian partners in the past 5 years. We have included PhD research projects, mainly of Brazilian PhD candidates carrying out their research at Wageningen University.

The overview is far from complete, as the relationship between WUR and Brazil dates from 1951 (see chapter History of Wageningen University and Research in Brazil).

The current research and other work of Wageningen University & Research in and with Brazil is in the disciplines of food sciences, environment and climate change, nature and biodiversity as well as application of big data and sensor technology in agriculture (precision agriculture).

Over the past decade WUR has been able to focus on fundamental research with Brazilian partners thanks to the funding of the European Commission and the Netherlands Science Foundation (NWO) in collaboration with science foundations such as FAPESP in Brazil. Applied research has been performed in collaboration with private sector and public agencies.

Content

Preface	3
Introduction	5
History of WUR in Brazil	9
Brazilian students	11
Nowaste	12
Sustainable Forest Management in Caatinga	13
Mixed metal carbides for biomass upgrading	14
Controlling eutrophication in fresh and brackish water	15
Cyanobacterial blooms in a changing world	16
Managing eutrophication and cyanobacteria nuisance	17
Urban risk and disaster cultures	18
Conservation in times of crisis	19
Advancing environmental policies	20
Youth engagement in agro-ecological farming	21
Small scale, great opportunity	22
Fouling and process design in reverse electrodialysis	23
Diagnosing drought fordrought management in 3D	24
Contextualized indicators for drought	25
Solar energy and the water, energy and food nexus	26
Multifunctional landscapes in the Amazon	27
Global Network of Lighthouse Farms	28
Nature’s benefits in agro-forest frontiers	29
Terra Preta de Indio	30
Public policies for resilient food systems	31
Sustainable, integrated virus management	32
Linking biodiversity and ecosystem services	33
Microbiota against Streptococcus suis in pigs	34
Understanding the resilience ofAmazonian forests	35
Cellular and molecular basis of floral organs	36
Complete chloroplast genome of Lafoensia	37
Lined Seedeater Project	38
Photosynthesis, high temperatures and tree species acclimation	39
Fire in neotropical savannas revisited	40
Nordeste Caatinga canopy response to climate change	41
Anthropogenic & environmental effects on wild fruits	42

New Forests (NewFor)	43
Imaging detection of food fraud practices	44
Impact of elevated CO_2 on the Amazon rainforest	45
Critical feedbacks in and from the Amazon	46
Smart technology for soybean production	47
Biodiversity for Food	48
Post-mining forest restoration in the Amazon	49
Uncovering the quality of forest regeneration in the Amazon	50
Scalable sustainability insights of agri commodity imports	51
Absolutely Amazonian	52
CloudRoots	53
Airborne Stable Isotopes of Carbon from Amazonia	54
Synergies in integrated systems	55
Epilogue	57

You can view the digital version in our catalogue:
https://wur.on.worldcat.org:443/list/17090021

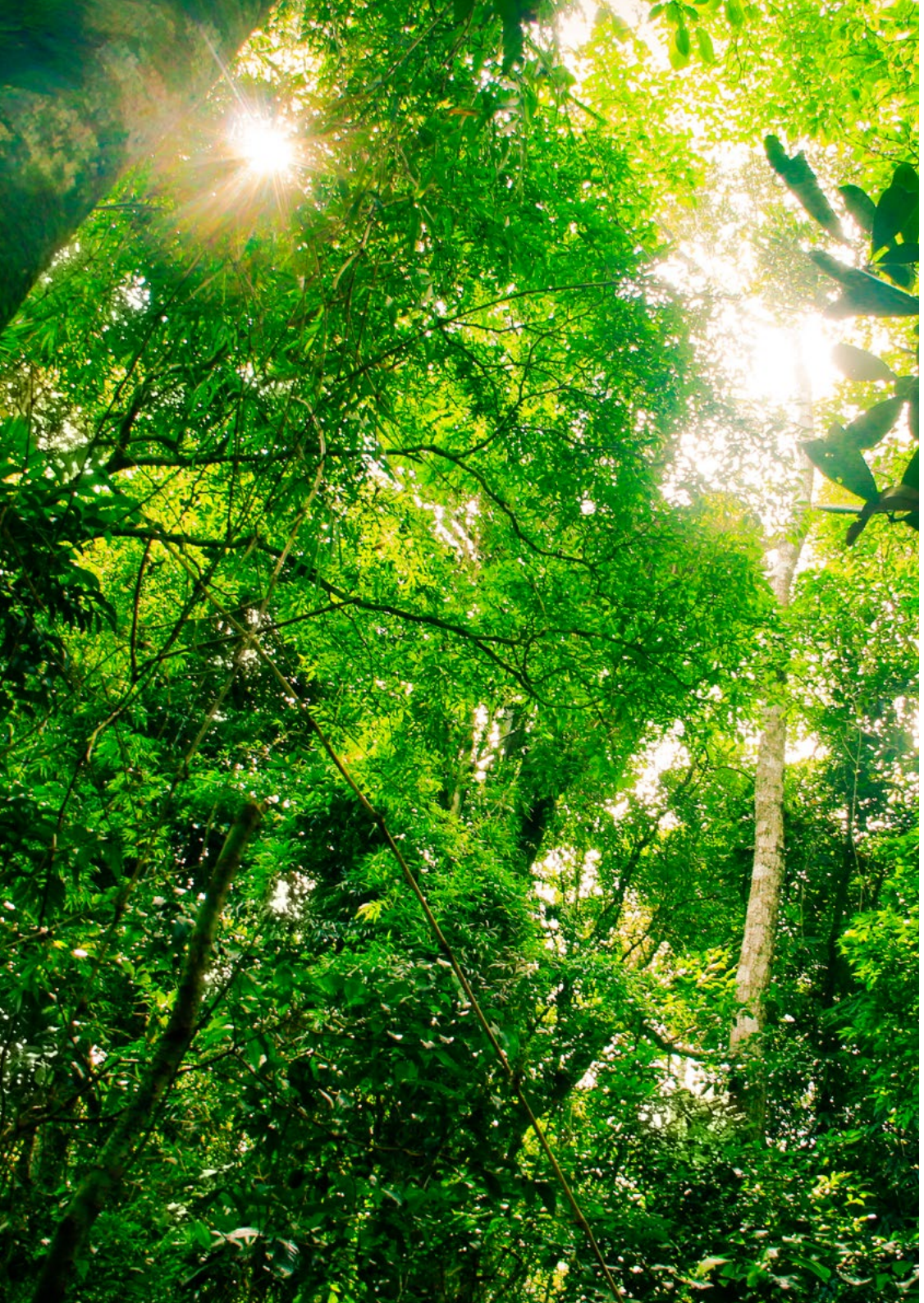
History of WUR in Brazil

From its early history the Netherlands has attached importance to Brazil. In 1630 the Dutch West India Company conquered parts of the Brazilian coastline from the Portuguese. The Dutch established their headquarters in Recife. John Maurice, Prince of Nassau-Siegen, was appointed as the governor of the Dutch possession in Brazil from 1636 until 1644. He was called 'the Brazilian" for his -at that time considered- 'successful' period as governor of Dutch-Brazil ensuring religious freedom, representation and legislation. In his expedition Maurice took with him scientists and explorers such as Willem Piso (Guilherme Piso in Portuguese), physician and naturalist, and Georg Markgraf, naturalist and astronomer. Their posthumously published Historia Naturalis Brasiliae was a major contribution to early modern science, and the first description of the nature and culture of Brazil.

Since the start of Wageningen University in 1876, at that time an Agricultural School in Wageningen, the director of the Agricultural School in Wageningen was involved in the registration of the states of emigrants from the province of Groningen to North America, Brazil and other regions in the period 1888 and 1904. The involvement can be found in the accompanying letters from the governor of Groningen and the commissioner to the Ministry of Interior and also in the minutes of the director of the National Agricultural School in Wageningen (States of emigrants 1888 – 1904, Regionaal Historisch Centrum Groninger Archieven).

One of the first study reports by WUR on Brazil dates from 1951 "Rural Brazil at the cross-roads" written by Hendrik Meijer to obtain the degree of doctor of Agriculture. Mr. Meijer was at that time agriculture counsellor in Rio de Janeiro and his study attempts to detect and discuss the most urgently needed changes, as to resource distribution, production methods and supporting services in Brazilian agriculture around the middle of the twentieth century.

The WUR library shows in its Special Collections Wageningen's interest in historic works; these include the book by Piso and Markgraf entitled Historia naturalis Brasiliae published in 1648 and the book Neerlants Brasil from 1682 by Johan Nieuhof who explored Brazil from 1640 until 1649. The monumental work on the palm trees in Brazil by Martius is also included in the collection, as well as the multi-volume publication Flora Brasiliensis published between 1840 and 1906 by the editors Carls Friedrich and Philipp von Martius.



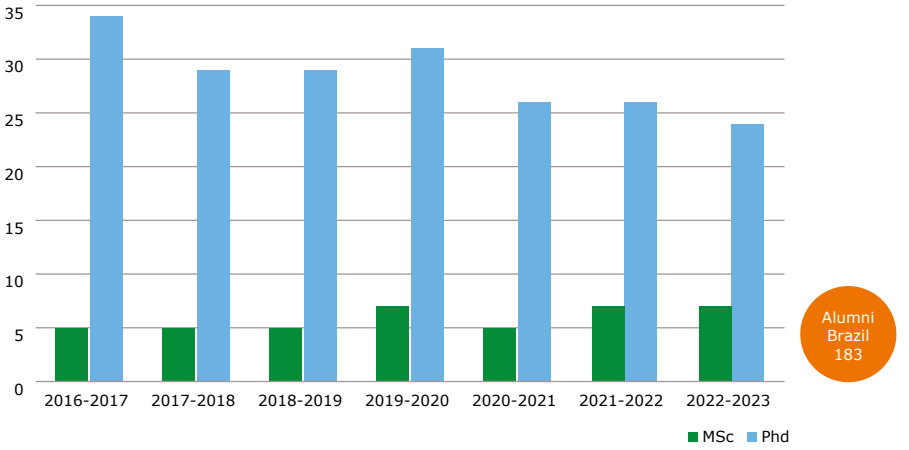
Brazilian students

"I am very grateful to the multicultural experience I was given by WUR professors and colleagues. In my Master's programme (tropical forest) there were more than 10 nationalities.

Later on in my career this experience helped me considerably to make my way in an international not-for-profit network, but also supported me in the cultural and environmental challenges I encountered in Brazil. This was fundamental to enlarging my view and deepening my knowledge of multiple forestry products, natural resources ownership and economic valuation."

Luciana Simões, alumna MSc management and conservation of tropical forestry, now independent consultant Sustainability, Ecosystem Services, Biodiversity and Forestry

In this academic year 2022-2023, Wageningen University & Research has 34 students from Brazil: 3 BSc students, 7 MSc students and 24 PhD candidates. This makes Brazil the third country of Latin America in Wageningen, after Mexico (57 students) and Colombia (53 students). In 2021 we count 183 alumni from Brazil who have graduated from Wageningen University. 99 Wageningen alumni do live in Brazil.



Brazil - total amount of students (MSc and PhD)

Nowaste

From 2014-2019 | Total budget € 300,000

Over the past decades the aquaculture sector has seen a tremendous growth and intensification in order to meet the growing global demand for animal proteins. This intensification came with a cost as it resulted in an increase in disease incidences due to several factors. A common countermeasure for the increased disease incidence is the use of antibiotics. β-glucans are a waste product from bio-ethanol industries and can be used to improve immune functioning in aquaculture fish. Optimal use of β-glucans might reduce the need for antibiotic usage in aquaculture and improve the sustainable use of waste products from the bio-ethanol industry.

This project combined the laboratory expertise of Cell Biology and Immunology group of WUR, with the field experience of the Centro de Aquicultura da Unesp (Caunesp, Brazil) from Sao Paulo and practical experience from the industrial partner Biorigin (Zilor, Lençóis Paulista, Brazil). The project resulted in several elucidating insights in the fundamental mechanisms controlling the immuno-modulatory effects of β-glucans and innovative new methods to administer the β-glucans. Taken together, this project resulted in a better understanding of the use of a bio-ethanol waste product, possibly leading to improvement of fish health and welfare and reduction of the need for antibiotic usage.

More information:
https://bv.fapesp.br/en/auxilios/84126/use-of-branched-1316-glucan-macrogard-a-waste-production-of-sugar-and-ethanol-from-bakers-ye/

Contact:
Geert Wiegertjes | geert.wiegertjes@wur.nl

Sustainable Forest Management in Caatinga

From 2014-2018 | Total budget € 90,000

Sustainable Forest Management (SFM) strategies aim at the use of forest resources maintaining forest-related ecosystem services. SFM is a central concept in international debates on forest governance and when it 'moves' from these debates to implementation on the ground, translations of the concept result in different outcomes. The research focused on investigating how SFM-linked institutions – rules, norms, and beliefs – are translated from international policy arenas, to domestic and sub-national policy and governance frameworks, and further down the line to their implementation in a specific locality, Caatinga biome in Brazil. The overall findings demonstrate that it is essential to explore how SFM institutions are translated, involving study of the interactions amongst actors, resources use, and governance systems within different social-ecological settings. The research also shows that different groups of local actors, isolated or together, reject, adapt, and/or integrate SFM institutions through their local practices in order to cope with SFM implementation challenges. As such, the global-local nexus of SFM embodies a complex set of vertical and horizontal interactions amongst actors, forest resources, and governance systems. This PhD research was developed within the Forest and Nature Conservation Policy Group (FNP) and was financially supported by the CAPES Foundation, Brazil.

More information:
http://edepot.wur.nl/456852

Contact:
Joana Mattei Faggin | joana.faggin@gmail.com
Jelle Behagel | jelle.behagel@wur.nl

Mixed metal carbides for biomass upgrading

From 2018-2022 | Total budget € 300,000

Noble metals such as platinum and palladium are commonly used catalysts for (de) hydrogenation and hydrogenolysis. However, the high cost and limited availability of those metals have motivated a search for new types of catalyst. Promising results have been obtained using tungsten and molybdenum (W & Mo) carbides. In this study, we will use these carbides as a replacement for noble metal catalysts for the deoxygenation of fatty acid which are renewable biobased organic acids.

However, up to now it is not known what the active site in these catalysts is. Therefore, increasing the performance of these catalysts is still a matter of trial and error. We are aiming to identify the structural properties of these catalysts, inter alia by X-ray techniques, and relate those properties to catalytic performance. This will make a rational catalyst design possible.

These X-ray experiments will be performed in cooperation and at the Brazilian synchrotron Laboratório Nacional de Luz Síncrotron (LNLS) in Campinas Brazil. We will perform in situ and operando characterization using XRD and X-ray absorption spectroscopy as well as X-ray photoelectron spectroscopy (XPS).

Contact:
Marlene Führer | marlene.fuhrer@wur.nl
Harry Bitter | harry.bitter@wur.nl

Controlling eutrophication in fresh and brackish water

From 2014-2017 | Total budget € 124,000

Toxic cyanobacteria pose a serious threat to the environment and public health. As blooms of cyanobacteria are spreading, controlling eutrophication and mitigating cyanobacteria nuisance is considered a key challenge to water quality managers. Within the Science without Borders Programme a Visiting Scientist Grant was awarded to Miquel Lurling (SWB 400408/2014-7). The project yielded valuable knowledge on the efficacy and applicability of several combinations of coagulant and solid phase phosphate-sorbents in controlling eutrophication and cyanobacteria blooms in different surface waters in Brazil. Laboratory and field scale experiments were conducted aimed at removing an existing bloom and hampering phosphate release from the sediment. The eco-friendly coagulant chitosan was found not to be a good alternative for traditional coagulants as it caused toxin leakage from cyanobacteria and was ineffective in water from the brackish lagoon Jacarepaguá. Lanthanum-modified bentonite was found to be an excellent phosphate binder under all conditions tested. A local red soil also showed phosphate binding properties and is promising as a cheap alternative. Moreover, the project enhanced the scientific capacities and experiences of Brazilian researchers in the field of aquatic ecosystem restoration.

More information:
www.wur.eu/rainfall

Contact:
Miquel Lurling | miquel.lurling@wur.nl

Cyanobacterial blooms in a changing world

From 2012-2017 | Total budget € 200,000

This CAPES-NUFFIC project (no. 045/12) focussed on understanding the mechanisms of expansion of cyanobacterial blooms, cyanotoxin production, the consequences under different climate scenarios and the best ways to mitigate harmful blooms.

The project was a cooperation between Wageningen University, Radboud University, Universidade Federal do Rio de Janeiro (UFRJ), Universidade Federal do Rio Grande do Norte (UFRN), Universidade Federal de Juiz de Fora (UFJF), Universidade do Estado do Rio de Janeiro (UERJ) and Universidade Federal do Rio Grande do Sul (UFRGS). It involved eight study missions, seven work missions, three workshops, two courses and resulted in more than 30 scientific articles and 46 contributions to conferences.

The project produced insight in cyanobacterial bloom development under different climate scenarios, toxicity of cyanobacteria, revealed links with greenhouse gas emissions and proposed management strategies to reduce the likelihood of cyanobacteria blooming events. It provided a solid foundation for intensified joint research

More information:
www.wur.eu/rainfall

Contact:
Miquel Lurling | miquel.lurling@wur.nl

Managing eutrophication and cyanobacteria nuisance

From 2015-2019 | Total budget € 150,000

This project was a Science Without Borders Grant (2013-2014) for a full PhD research project to study potential materials and in-situ techniques for managing eutrophication and controlling cyanobacterial blooms. Controlled laboratory experiments were performed and a whole-lake intervention was monitored.

Ten possible clays/soils were evaluated on their ability to adsorb phosphate. A lanthanum modified clay (LMB) was further tested under different salinities and also used in core experiments with sediment from Jacarepaguá lagoon (Rio de Janeiro). The potential of using organic coagulants as an alternative to inorganic coagulants to remove cyanobacteria from the water column was studied. The eco-friendly coagulant, chitosan may, however, damage cell membranes of cyanobacteria, resulting in the release of cyanotoxins. A whole-lake intervention with an aluminium-based coagulant together with LMB was prepared and tested on lab scale. It was then performed on full scale and monitored closely to shed light on the efficacy of the treatment in managing eutrophication and eliminating cyanobacterial blooms.

Contact:
Miquel Lurling | miquel.lurling@wur.nl

Urban risk and disaster cultures

From 2015-2018 | Total budget € 50,000

With numerous Brazilian cities facing serious flood and landslide risks alongside periodic water scarcity crises, Crisis and Disaster Studies staff at the Sociology of Development and Change (SDC) group worked with the University of São Paulo (USP) and the Federal University of ABC in São Paulo on urban disaster, notably how to foster a 'disaster culture' in a socioeconomically deeply divided country that tends to respond to rather than prepare for entirely predictable disasters. The project resulted in large public and academic workshops in São Paulo and Blumenau, student exchange, as well as a book and published articles. The work was funded via a special visiting professorship under the CAPES 'Science without borders/Ciencia sem fronteiras' programme. Additional fieldwork was undertaken on disaster education, socio-environmental vulnerability, and the politics of (peri-)urban development in Nova Friburgo, within the Atlantic Forest biome.

More information:
www.scielo.br/scielo.php?pid=S1414-753X2019000100501&script=sci_arttext&tlng=pt

Contact:
Jeroen Warner | jeroen.warner@wur.nl
Robert Coates | robert.coates@wur.nl

Conservation in times of crisis

From 2015-2021 | Total budget € 2,100,000

Biodiversity loss is a crisis in process and is one of many indicators that human actions are irrevocably pushing planetary limits. Towards Convivial Conservation: Governing Human-Wildlife Interactions in the Anthropocene (CON-VIVA) is a research project that offers a new approach to understanding and practising environmental conservation at a time when the failure to reconcile economic development and species diversity is becoming increasingly apparent. The project addresses human-wildlife conflict and moves beyond protected areas and faith in markets to compare and propose best landscape, governance and funding practices to integrate conservation and poverty reduction. The project works with academic and NGO partners to study declining jaguar populations in the remaining Atlantic Forest in Brazil.
The CONVIVA project builds on and complements another project that studies crisis conservation situations in Brazil, South Africa and Indonesia. Crisis Conservation: Saving Nature in Times and Spaces of Exception, is a five-year project that in Brazil focuses on three aspects related to the conservation of the Atlantic Forest. The first aspect investigates how processes of extinction unfold in relation to conservation efforts and theorizes their ecological and social dynamics. The second aspect aims to understand and theorize the tactical shifts and outcomes of conservation organizations under increasingly inhospitable political conditions. Finally, the project analyses the dynamics of responses by different actors to the fragmentation and defaunation of the Atlantic Forest, as well as alternatives to mainstream conservation.

More information:
www.wur.eu/crisisconservation

Contact:
Bram Buscher | bram.buscher@wur.nl
Thomas Kiggell | thomas.kiggell@wur.nl
Sierra Deutsch | sierra.deutsch@wur.nl
Robert Coates | robert.coates@wur.nl

Advancing environmental policies

From 2015-2019 | Total budget € 95,000

Indigenous people and local communities (IPLC) significantly contribute to the conservation of biodiversity and ecosystem services that are crucial for human well-being via indigenous and local knowledge systems.
Environmental policies have addressed biodiversity and climate change by assessing community contexts and planning management with IPLC. This research investigates the challenges and alternatives for achieving legitimate and effective policy, by the integration of IPLC and scientific knowledge systems, worldviews, and practices in policy assessment and planning to address the needs of diverse stakeholders. We rely on two in-depth case studies: the Malhada Grande Maroom Community (in the Minas Gerais state) and the Kaxinawá de Nova Olinda Indigenous Land and the System of Incentives for Environmental Services REDD+ policy - SISA, acronym in Portuguese (in Acre-Brazil). This inter and transdisciplinary research involves a partnership with the Brazilian Embrapa-Acre and bridges Southern (ethnoecological) and global frameworks such as the International Platform on Biodiversity and Ecosystem Services. The WUR supervision ensured leading-edge, engaged research and we intend to maintain collaboration in the future. Our contributions to advance debate on and implementation of policies with IPLC have been shared in WUR events and scientific publications.

Contact:
Fernanda Ayaviri Matuk van Maurik | ernandamatuk@yahoo.com.br
Jelle Behagel | jelle.behagel@wur.nl

Youth engagement in agro-ecological farming

From 2016-2019 | Total budget € 18,750

This PhD research is part of FOREFRONT, an interdisciplinary research programme in Brazil and Mexico on complex social-ecological systems in agro-forest frontier areas. In Brazil the research is taking place in the region Zona da Mata Mineira (part of the Atlantic Forest biome) in three municipalities that can potentially form part of an ecological corridor between the Carapaó National Park and the Serra do Brigadeiro State Park. The research is part of an ongoing, long-term action research between researchers of the Federal University of Viçosa (UFV) and local peasants.

This PhD research shows how rural youth in Zona da Mata become political actors by following diverse critical, place-based education initiatives. As a result of this transformative and transgressive learning, young peasants are strengthening agroecological practices on their fields, while at the same time re-signifying agroecology as a movement for cultural diversity and biodiversity. Research is based on two years of fieldwork and ethnographic filmmaking (see, for example, the link to YouTube).

More information:
www.youtube.com/watch?v=uJD5zPzoJbw

Contact:
Margriet Goris | margriet.goris@wur.nl
Jelle Behagel | jelle.behagel@wur.nl

Small scale, great opportunity

From 2018-2019 | Total budget € 40,000

Towards sustainable young livestock farming in the Amazon and the potential of the Innovation and Learning Hubs (ILHs)

Livestock farming is considered a key activity for food security, representing 34% of the protein consumed globally and about 14.5% of global anthropogenic greenhouse gas emissions (GHG), of which 2/3 are attributed to cattle production. Brazil, the second largest beef producer and one of the 10 largest GHG emitters in the world, plays a key role in this scenario. The Amazon biome was prioritized, since almost a third of the Brazilian cattle herd is located on it and the expansion of this herd has been directly associated with deforestation, especially in the international scenario.

The present study analysed the operational, technical, and institutional feasibilities of scale replication of low-carbon, good agricultural practices in the context of family livestock farming with the objective of proposing a scale-up intervention strategy focused on the adoption of these practices and the mitigation of deforestation in the Amazon biome. The Innovation and Learning Hubs (ILHs) strategy is based on three central pillars of intervention:1) implementation of field actions; 2) use of online platforms and applications for family agriculture; and, 3) the establishment of partnerships and the strengthening of local institutional arrangements.
Replicating the ILHs is expected to have an impact on GHG emissions mitigation, increase life quality and income of small-scale farmers, and contribute to the network expansion of new low-carbon businesses.

More information:
www.wur.eu/cattlefarming

Contact:
Adolfo Alvarez Aranguiz | adolfo.alvarezaranguiz@wur.nl

Fouling and process design in reverse electrodialysis

From 2018-2022 | Total budget € 80,000

A case study with real waters

Reverse electrodialysis (RED) is a technology for electrical energy harvesting by controlled mixing of fresh and sea water using a membrane stack with alternating anion and cation exchange membranes. It is a renewable source of energy, free of harmful emissions such as CO_2. Fouling is a severe problem for RED using natural waters. Fouling decreases the effective power density output. This project aims to obtain a better understanding and control of fouling, by understanding the behaviour of the main foulants found in natural water. The overall goal is to implement economically attractive pre-treatments and a process design that enables a sustainable energy production. This technology could be relevant in the Brazilian context as an alternative to hydropower sources, by taking advantage of the great potential for controlled mixing of fresh and sea water available in Brazil's coastal area and river mouths.

More information:
https://www.wetsus.nl/app/uploads/2019/12/44-blue-en-BVital-web.pdf

Contact:
Contact: Barbara Vital | barbara.vital@wur.nl

Diagnosing drought for drought management in 3D

From 2019-2023 | Total budget € 500,000*

This project is a joint effort of Brazilian and Dutch organizations including: Wageningen University (WRM, HWM and PAP chair groups); the Research Institute of Meteorology and Water Resources (FUNCEME); the Federal University of Ceará (UFC) and the Brazilian Research Agricultural Corporation, National Research Tropical Agroindustry Center (EMBRAPA).

To improve drought management, human influences on drought must be better understood. Current frameworks for drought monitoring and water accounting offer little help in distilling human influences on drought. We combine insights from socio-hydrology and water management to produce an entirely new approach, incorporating the study of water-related human dimensions (D1), socio-hydrological dynamics (D2), and the structuring of dialogues (D3) among actors. The project will develop and test the integrated, participatory 3D Drought Diagnosis (3DDD) toolbox. The test case is the drought-affected Northeast Brazil. Finally, the 3DDD toolbox can be used to enable existing drought monitors to provide contextualized information in drought-affected regions worldwide. We will demonstrate how proposed drought management solutions perform with regard to cross-scale synergies and trade-offs in relation to the UN SDG 2, 6, 10, and 13.

* partly INREF. INREF: Interdisciplinary Research and Education Fund of WUR

More information:
www.wur.eu/diagnosingdrought

Contact:
Pieter van Oel |pieter.vanoel@wur.nl

Contextualized indicators for drought

PhD From 2019-2023 | Total budget € 75,000

In Northeast Brazil, droughts have affected water resources and the human activities depending on them. The mainly agricultural water uses reciprocally affected the water balance and increased vulnerability to drought. Their influence is however difficult to quantify as the existing monitoring systems are not equipped to inform the stakeholders about the impacts of their actions.

As the majority of studies focus on the physical impacts of droughts and the overexploitation of natural resources, we propose a novel approach based on the explicit inclusion of two-way feedback between human and water systems, a key aspect of socio-hydrology. The aim of this PhD is to determine (i) the influence of human activities at specific locations and times on droughts and reciprocally (ii) how droughts affect them.

The objective is to link these results, based on water accounting data, to water and drought management tools for decision making and makers. It is aimed to build feasibility indicators of practices taking into account three human-related water dimensions: water use, water management and virtual-water transfer. This approach and its replicable pattern could benefit other semiarid regions affected by droughts.

More information:
www.wur.eu/diagnosingdrought

Contact:
Sarra Kchouk | sarra.kchouk@wur.nl
Pieter van Oel | pieter.vanoel@wur.nl

Solar energy and the water, energy and food nexus

From 2017-2021 | Total budget € 30,000

Petrolina-Juazeiro case study

Water, energy and food are essential resources for society. Their integrated management, based on synergies and trade-offs, is determinant to meet the demand in the long term. Petrolina and Juazeiro are cities in the Brazilian semiarid where the Sobradinho hydropower (4,214 km² reservoir) and a fruit production centre (for Brazilian and international markets) coexist. Both activities depend on the São Francisco River and Sobradinho reservoir. Although the water demand for irrigation is intense, hydropower generation was given priority during the dry period 2012-2016. The water scarcity during these years caused conflicts as it reduced hydroelectricity generation and put fruit production at risk. Since solar irradiation is abundant, solar power plants may be used as a renewable energy alternative. Therefore, the research analyses scenarios of water management where floating solar panels are adopted in complementarity to hydroelectricity. The software Water Evaluation and Planning (WEAP) is used to model the scenarios. Results are represented in water, energy and food safety indicators to identify the strategies of integrated resource management to target SDGs 6, 7 and 12.

More information:
This PhD research is being developed with INPE (Brazilian National Institute for Space Research) – CCST (Earth System Science Center) The research integrates the Fapesp Thematic Project "Transition to sustainability and agriculture-energy-water nexus".

Contact:
Érica Ferraz de Campo | erica.ferrazdecampos@wur.nl | erica.campos@inpe.br
Pieter van Oel (supervisor) | pieter.vanoel@wur.nl

Multifunctional landscapes in the Amazon

From 2015-2020 | Total budget € 130,000

Multi-functionality along an Amazonian post-forest frontier

Since the implementation of zero-deforestation policies in the Brazilian Amazon in the early 2000s, a demand for new land-use spatial criteria and agricultural intensification strategies has emerged to recover degraded areas that underwent deforestation in the past. In the Paragominas municipality in Pará state, soil and forest degradation results in the sub- optimal utilization of the land to supply the ecosystem services carbon storage, agricultural production and habitat for biodiversity. Therefore, there is a need for landscape designs that better integrate conservation and production goals in such a way that natural and economic resources are used in a more efficient and sustainable way. By applying the Functional Land Management framework, this project aims to generate integrative landscape and farm transition pathways with the potential to enhance landscape multifunctionality. Ultimately, it will deliver technical and policy recommendations that can be used to inform land-use planning initiatives that reconcile agricultural production and nature conservation in the eastern Amazon region.

More information:
http://landmark2020.eu

Contact:
Felix Bianchi | felix.bianchi@wur.nl
Daniel Pinillos Cifuentes | danielalfredopinillos@gmail.com

Global Network of Lighthouse Farms

Part of an ongoing international network

Wageningen University & Research is working on the Global Network of Lighthouse Farms: an international network of individual farms which are stable and resilient without being a strain on the environment. Together these exemplar farms, which are 'already in 2050', form a mosaic of agricultural systems and solutions which take differences in e.g. climate and culture into account.

Rizoma is one of these exemplar farms and a spin-off from Fazenda da Toca. It aims to regenerate 1 million hectares of land by 2030 in Brazil through regenerative organic agriculture, by implementing integrated farming systems on a large scale. These systems (agroforestry, silvopasture and grain crops) allow nature to recover degraded land, sequester carbon from the atmosphere, infiltrate and retain more water, and restore soil biodiversity, while being productive and profitable.

Wageningen students stayed at Rizoma Agro to gather data for their PhD thesis and internships, creating diverse outputs such as a bioeconomy model for the agroforestry and a regeneration measurement protocol for all crops. The aim of this cooperation is to exchange information and learn from a real-life example farm and to serve as a classroom for the development of sustainable food systems.

More information:
www.lighthousefarmnetwork.com

Contact:
Annemiek Pas Schrijver | annemiek.schrijver@wur.nl

Nature's benefits in agro-forest frontiers

From 2015-2020 | Total budget € 2,300,000*

Throughout the tropics forested landscapes are being converted into agricultural landscapes. Current landscapes reflect the continuous changes in interactions between people and the environment. Understanding the mechanisms that underlie these social-ecological systems is crucial for designing, in close collaboration with local actors, strategies for land use that maintains biodiversity, supplies a wide portfolio of ecosystem services, and meets the needs of local actors. This programme focuses on agro-forest frontier areas, the dynamic border between forested and agricultural land, in Brazil and Mexico. The programme has three objectives: (1) identify and understand ecological and social drivers that shape agro-forest frontier landscapes and their ecosystem services; (2) explain changes in the social-ecological system and their consequences for landscape configurations; (3) design adaptive strategies to balance and optimize the supply of ecosystem services in changing landscapes.

Brazil (Zona da Mata, Minas Gerais state) represents a diversity of important drivers shaping land use change. FOREFRONT uses a comparative approach between sites in Brazil and Mexico that builds on the complementary expertise among the participating institutes and facilitates cross-country learning. Both countries face large land use challenges, are role models for other Latin American countries and have long-standing collaboration with Wageningen University.

* INREF: Interdisciplinary Research and Education Fund of WUR

More information:
www.wur.eu/forefront

Contact:
Thom Kuyper | thom.kuyper@wur.nl
Frans Bongers | frans.bongers@wur.nl

Terra Preta de Indio

From 2010-2017 | Total budget € 1,500,000

Fertile and climate-smart soils in the Amazon region

Anthropogenic soils that combine high fertility and substantial carbon storage in the Amazon (Terra Preta de Índio; also known as Amazonian Dark Earth) challenge conventional theories on environmental limitation of cultural development of pre-Colombian Amerindian people in tropical South America. These improved soils offer a major inspiration for creating and recreating soils for climate-smart sustainable agriculture. This Wageningen University-funded interdisciplinary programme aimed to (1) understand conditions under which Terra Preta originated, both from the biophysical and socio-economic side; (2) understand the institutional and policy dimensions related to actual use and potential future use of these fertile soils; (3) link actual perception and use of these soils for various agricultural purposes, ranging from annual and biannual cropping systems to forestry and agroforestry, to biophysical properties and socio-economic conditions (markets); (4) contribute to the creation of soils that allow sustainable and productive agriculture in the Amazon, using Terra Preta (5) contribute to and maintain the functioning of a network of Latin American Terra Preta researchers; (6) use the conceptualisation of Terra Preta as socially constructed soils to reflect on (and change) actual scientific discourses and practices. Research took place in three countries: Brazil, Bolivia and Colombia. Results: recreation of these soils depends on more than addition of biochar. Interaction between carbon, phosphorus and calcium (and possibly other nutrients) is crucial. Together with soil life, which drives nutrient and carbon transformation, these soils are best considered as living soils.

More information:
www.wur.eu/terrapreta

Contact:
Thom Kuyper | thom.kuyper@wur.nl;
terrapreta.inref@wur.nl

Public policies for resilient food systems

2015-present | 2021: € 25,000 (INREF)*

Diversified farming systems have received considerable attention for their potential to contribute to environmentally sustainable, resilient, and socially-just food systems. Identifying mechanisms by which policies and interventions in agriculture may support diversified farming systems, while also addressing issues such as gender inequality, is of paramount importance. This project investigates how targeted public food procurement, a promising policy instrument, may support both farm diversification and women's empowerment. The project builds on an earlier project conducted with the University of Michigan and its next phase is supported by an INREF Seed Grant. Results show that public procurement programmes in Brazil, such as the School Meal Programme (Portuguese acronym PNAE) have driven diversification of agricultural systems and increased production of diversified, healthy agricultural products. Programmes such as PNAE create a market that allows small-scale farmers to switch from commodity crops, such as soy or corn, to food crops (Valencia et al., 2019), while also supporting women's empowerment (Valencia et al. under review). The next phase of this project expands to a larger collaboration and includes the Andean region to learn by comparison from other public procurement programmes.

* INREF: Interdisciplinary Research and Education Fund of WUR

More information:
http://link.springer.com/10.1007/s13593-019-0572-4

Contact:
Vivian Valencia | vivian.valencia@wur.nl

Sustainable, integrated virus management

From 2018-2022 | Total budget € 280,000

Pathogens present one of the major constraints on production yields and with nearly 50% of all newly emerging diseases caused by viruses, stresses the importance for continuing development of integrated virus management (IVM) strategies. This NWO-FAPESP-funded project aims to strengthen joint efforts of a Dutch-Brazilian virology research consortium to study a small set of very important plant viruses (geminiviruses, tospoviruses and citrus infecting viruses) to the Dutch and Brazilian Agri-Food sector in different vegetable and fruit crops and transmitted by various arthropods (whiteflies, thrips and mites). This project builds on an earlier Dutch-Brazilian NWO-CPNq supported project and expands towards the establishment of a larger collaborating research network that will not only accelerate the implementation of newly gained knowledge into sustainable IVM approaches for the viruses under investigation, but is likely to be of use to other virus pathosystems as well. In the meantime it presents an international research platform to maintain plant virology expertise needed for exchange and training plant virology students.

Contact:
Richard Kormelink | richard.kormelink@wur.nl

Linking biodiversity and ecosystem services

From 2016-2020 | Budget € 17,749 (INREF)*

Towards more sustainable agro-ecosystems

Complex agroecosystems can play a key role in maintaining and enhancing the provision of multiple nature benefits, also known as Ecosystem Services. The development of these systems requires a systemic approach, taking into account social and ecological dimensions. The present study was conducted in Zona da Mata, where an ongoing process of agroecological transition started more than 30 years ago. I used a combination of social and ecological methods (i) to assess farm diversity and its implications for management and for promoting agroecological transitions; (ii) to understand and contrast farmers' perceptions of ecosystem services and their management; (iii) to evaluate the direct and indirect impact of management on biodiversity and soil-based ecosystem services in coffee and pastures; and (iv) to determine the relationship between biodiversity and soil functions during secondary forest succession. The main results show that changes in the cognitive perception of farmers on ES led to changes in management strategies, that in turn, influenced biodiversity and the provision of ES. Agroecological farmers had a more complex perception of ES than other farm types, which was associated with greater access to public policies and participation in social organisations, as well as higher biodiversity in their agroecosystems. Thus, the transition to agroecology in Zona da Mata was successful in helping a group of farmers to enhance biodiversity-based ecological processes in their production areas, therefore moving away from dependence on industrial inputs without compromising soil and water quality and plant health.

* INREF: Interdisciplinary Research and Education Fund of WUR

More information:
www.wur.eu/sustainableagroecosystems

Contact:
Heitor M. Teixeira | heitor.manciniteixeira@wur.nl

Microbiota against Streptococcus suis in pigs

From 2018-2022 | Total budget € 80,000

New antimicrobials and colonization resistence against S. suis infections

Currently, one global concern is the upsurge of disease-causing bacteria that are resistant to antibiotics. European efforts have been initiated to reduce preventative use of antibiotics in livestock farming, notably in pigs. The upper respiratory tract microbiota of pigs are of particular interest because of their association with common swine infectious diseases. Streptococcus suis are Gram-positive pathobionts which are naturally present in the upper respiratory tract of pigs. In early life, S. suis can cause highly invasive infections leading to meningitis, sepsis and endocarditis. Unfortunately, no effective vaccines that protect piglets against S. suis infections exist.

Colonisation of the piglet palatine tonsils by common bacteria may lower the establishment of S. suis and risk of invasive disease. To identify bacterial taxa correlated with S. suis abundance, we are collecting microbiological samples from the tonsils of piglets around weaning and have identified bacterial taxa with strong co- and anti-occurrences with S. suis. A culturomics approach in combination with whole genome sequencing is being used to identify commensals that produce antimicrobial molecules inhibiting growth of S. suis. Key abundant bacterial species present in the oropharyngeal biofilms of healthy animals on farms without a recent history of problems with S. suis will be tested for their contribution to colonisation resistance against S. suis around weaning.

More information:
www.wur.eu/microbiota

Contact:
Isabela Isabela M. Fernandes de Oliveira | isabela.fernandesdeoliveira@wur.nl
Jerry Wells | jerry.wells@wur.nl

Understanding the resilience of Amazonian forests

From 2017-2023 | Total budget € 407,000

Climate warming is increasing the frequency and severity of droughts and fires. We use a combination of methodological approaches to assess and understand the capacity of Amazonian forests to cope and recover from these disturbances. Amazonian floodplain forests have been called the 'Achilles heel' of the Amazon Basin because they can fail to recover after fire and remain in an open savanna-like vegetation state. The ecological mechanisms that explain this low forest resilience is now being revealed. Our research is starting to show that the recovery capacity of floodplain forests relies on strong feedbacks between the aquatic and terrestrial systems. These feedbacks include seed dispersal limitation and increased soil nutrient erosion. We hypothesize that loss of fruit-eating fishes in burned forests may be one of the main underlying causes preventing forest regeneration. The research has been carried out together with Instituto Nacional de Pesquisas da Amazônia (INPA) of Brazil.

More Information:
www.wur.eu/amazonianforests

Contact:
Milena Holmgren | milena.holmgren@wur.nl
Peter van der Sleen | peter.vandersleen@wur.nl

Cellular and molecular basis of floral organs

From 2011-present | Budget € 300,000

The major challenge of modern agriculture is to produce increasing amounts of high-quality biomass for food, feed, and bio-based products, with a minimal ecological footprint. Final yield and quality of crops strongly depends on plant architecture, organ growth, and tissue longevity. Therefore, it is of utmost importance to identify and characterize the key regulatory genes involved in these yield and quality-determining biological processes. In several 'CAPES-NUFFIC & FAPESP'-financed projects, the Brazilian research groups of Professor Marcelo Dornelas (University of Campinas), Professor Adriana Pinheiro Martinelli (USP), and the WUR research group of Professor Gerco Angenent (including Prof. Richard Immink and dr. Ruud de Maagd) have joined forces to address this challenging goal. The expertise of the groups is perfectly complementary, with state-of-the-art microscopy, cell biology and knowledge of passiflora in Brazil, and 'omics', gene editing (CRISPR), and expertise with tomato and the model species Arabidopsis thaliana in the Netherlands. Over recent years there has been fruitful exchange of staff and training of young Brazilian academics. The success of this is shown by the appointment of several visiting Brazilian PhDs as professor and various successful careers in the agricultural business.

Contact:
Plant Breeding Group
Gerco C. Angenent | gerco.angenent@wur.nl
Ruud de Maagd | ruud.demaagd@wur.nl
Richard G.H. Immink | richard.immink@wur.nl

Complete chloroplast genome of Lafoensia

From 2019-2020 | Total budget € 30,000

For phylogenetic and biogeographic reconstruction of Lafoensia V and (Lythraceae)

Lafoensia is a comprehensive component of the forests and savannas of South America. The lack of knowledge of the genus presents difficulties for the exploration of its species that have been recognized for containing active principles to the pharmacological industry. *Lafoensia* is widely distributed across different biomes and biodiversity hotspots in the Neotropics.
Distribution areas of some of the species are non-overlapping, resulting in a patchy pattern with species confined to distinctive habitats, such as the cerrado, campos rupestres, and the submontane forests of the eastern Andes. Using a genome-skimming approach, the extranuclear genetic data of chloroplast genomes will be used in phylogenetic analysis of Lafoensia, and the use of molecular clock models will help explain the evolutionary and biogeographic patterns observed. This project is a collaboration between the Brazilian botanist from Embrapa and Dr. Freek Bakker from WUR. The permanence of the Brazilian researcher in The Netherlands was supported by a grant from National Council for Scientific and Technological Development (CNPq - Ministry of Science and Technology) and the sequencing services by the National Institutes of Science and Technology (INCT-Biosyn/CNPq) and Embrapa. WUR ensured access to the most advanced knowledge and tools on chloroplast genome analysis. The approach is innovative and represents a breakthrough for botanical research in Brazil.

Contact:
Biosystematics Group
Taciana Barbosa Cavalcanti | taciana.cavalcanti@embrapa.br
Freek Bakker | freek.bakker@wur.nl

Lined Seedeater Project

Long-term study | Budget: ongoing with small projects

The Lined Seedeater Project is dedicated to exploring long-standing puzzles in evolutionary biology and behavioural ecology using a small migratory neotropical passerine as a model species: the Lined Seedeater. This long- term study is taking place in Florestal, Minas Gerais, in Southeast Brazil.

There we are conducting several projects with a wild population of Lined Seedeaters, ranging from understanding the evolution of sexually selected traits to the impact of climate change and human activities on migratory behaviour of tropical birds. The project is coordinated by Dr. Filipe Cunha from the Behavioural Ecology Group at Wageningen University & Research, and Prof. Dr. Leonardo Lopes from the Animal Sciences Lab at Federal University of Viçosa (campus Florestal), Brazil. The project receives students and researchers from all over the world and is committed to producing high- quality and responsible science. The Lined Seedeater Project also promotes cultural and intellectual exchange among students and researchers from diverse backgrounds. The Lined Seedeater Project has existed since 2015 and many new projects are in development for the coming years. Participants in the project can count on a good infrastructure in the field and in the office when collecting their data, and on the extensive network built up by the project over the years. The Lined Seedeater Project is a long-term study with no foreseeable end point. We aim to continue exploring deeper questions in biology and bringing new insights to the fields of evolutionary biology, animal behaviour, and behavioural ecology.

Contact:
Filipe Cunha | filipe.cunha@wur.nl

Photosynthesis, high temperatures and tree species acclimation

From 2019-2022 | Total budget € 100,000

In the Cerrado (neotropical savanna)

Global climate change coupled with anthropogenic changes in land use has been modifying local and regional environmental conditions. In the tropics, understanding how these environmental conditions will interfere with plant function plays a key role in understanding how highly structured plant communities will be affected by ongoing climatic change. This project is a collaboration between the University of Sao Paulo (Prof. Tomas Domingues) and Wageningen University. This project studies how leaf-level photosynthesis of woody species across neotropical savanna (Cerrado) deals with increases in temperature. We will be testing approaches that can optimize the photosynthetic model parameters and assess the degree of plasticity of these parameters in both field and greenhouse, thus providing a solid base for eco-physiological information of tropical plant functioning as well as across biome transitions in Ecotone areas in South America. Better insight in how tropical trees deal with high leaf temperatures and how to measure this may have a direct spin-off in horticulture and provide a novel methodology for the selection of climate-proof tropical tree crop varieties.

Contact:
Tony de Oliveira | tony.desoussaoliveira@wur.nl
Elmar Veenendaal | elmar.veenendaal@wur.nl

Fire in neotropical savannas revisited

From 2017 onwards | Total budget € 30,000

Neotropical savannas (e.g. Cerrado, Campo Sujo, Campo Limpo) are hotspots of biodiversity, but are also highly threatened by land use change. Management and conservation of remaining savannas and in particular fire management have become the focus of attention as protected areas have become increasingly isolated. Fire co-shapes neotropical savanna structure, but the extent to which fire is needed for biodiversity conservation is currently hotly debated. Implementing regular fire regimes in protected areas is also costly, difficult to organise and, if wrongly applied, can result in habitat and species loss. In this project we focus on the most typical dystrophic neotropical savanna types of Central Brazil. Wageningen University and Research Centre and the University of Brasilia (Prof. Heloisa Miranda, Prof. Augusto Franco) collaborate through exchange of staff and students and joint research and publications. Activities so far have included training of students from both universities and re-assessment of the effect of fire on vegetation structure and biodiversity using data sets from the long-term fire experiment (Projeto Fogo) in the IBGE ecological reserve (Distrito Federal, Brasilia).
Output will include advice on the regularity and seasonal application of fire as a management tool for biodiversity conservation.

Contact:
Dr. Elmar Veenendaal | elmar.veenendaal@wur.nl
Prof. Heloisa Miranda | hmiranda@unb.br

Nordeste Caatinga canopy response to climate change

From 2017-2020 | Total budget € 1,000,000

The northeast region of Brazil is dry with unusually irregular rainfall patterns and associated droughts. The soils tend to be relatively fertile and therefore the area is reasonably densely populated with about 15% of Brazil's population living there. The area is dominated by shrub vegetation (Caatinga). This vegetation type has been largely neglected to date both in terms of conservation programmes and scientific enquiry. An integrated research programme (Nordeste) involving mainly Brazilian and UK researchers and coordinated by the University of Sao Paulo (Ribeiro Preto campus Prof. Tomas Domingues) and Imperial College London (Prof. Jon Lloyd) is establishing a permanent plot network similar to that existing in moist tropical forests. This will enable measurements of Caatinga canopy structure and dynamics and short and long-term responses to climate change. Outcomes will include Climate-smart regeneration strategies and recommendations for forest regeneration projects at local and regional level. Details on the role species play in biogeochemical cycles will be listed based on project results, as well as shifts in plant species' distributions under future climate change scenarios, published as a policy brief in English and Portuguese. Wageningen University has been involved from the outset, lending its expertise on survey techniques for shrub and savanna vegetation to this international network.

Contact:
Elmar Veenendaal | elmar.veenendaal@wur.nl

Anthropogenic & environmental effects on wild fruits

From 2019-2020 | Total budget € 55,000

Biodiversity and fruit production of the Cerrado

The Cerrado, a biodiversity hotspot, which covers 24% of Brazil, suffers the highest deforestation rates in Brazil, thus reducing opportunities for conservation and sustainable use of its biodiversity. In this biome, sustainable harvesting of non-timber forest products can contribute to biodiversity conservation and maintenance of ecosystem services, as well as to food security, income generation and livelihoods of rural communities. Therefore, knowing how the productive capacity of harvested plant populations is affected by environmental gradients and anthropogenic gradients, such as land use, fire, and livestock grazing, is crucial for defining use and conservation strategies. This project aims to understand the environmental and anthropogenic factors affecting the fruit production of the main wild fruit species of the Cerrado over time and space. To this end, with the support of Embrapa, CNPq-MCT, Funbio and GEF, a network of sites has been established in a large geographical area where fruit production from the main wild plants harvested by farmers, traditional communities and indigenous peoples are being studied.

Contact:
Aldicir Osni Scariot | aldicir.scariot@embrapa.br
Frans Bongers | frans.bongers@wur.nl

New Forests (NewFor)

From 2019-2023| Total budget € 609,500

Understanding restored forests to benefit people and nature

Large-scale restoration in the Atlantic Forest region of Brazil calls for a novel approach to upscale from thousands to millions of hectares. This project evaluates how upscaling is possible, taking into account the potential of restored forests to benefit people and nature in the Atlantic forest. Here we consider all new forests, encompassing young restoration plantations, natural regeneration, agroforests, and abandoned monoculture tree plantations. We will determine characteristics of new forests and their drivers for regeneration and deforestation, assess their aboveground diversity, evaluate key forest functions using a functional trait approach, and predict new forests' potential contributions to ecosystem services. We will also develop a method based on remote sensing to identify areas with the highest forest restoration potential to promote ecosystem services. Our results will inform the development of novel policies and market instruments to foster and stimulate new forests. In an era of ambitious restoration commitments and societal demands for ecosystem services, we will provide alternative landscape developments and promote a sustainable future of the Atlantic forest region.

This project is a collaboration between the USP-ESALQ and WUR. NewFor is funded by FAPESP in Brazil and NWO in the Netherlands.

More information:
www.wur.eu/atlanticforest

Contact:
Frans Bongers | frans.bongers@wur.nl
Marielos Peña-Claros | marielos.penaclaros@wur.nl
Rens Brouwer | rens.brouwer@wur.nl

Imaging detection of food fraud practices

From 2017-2020 | Total budget € 80,000

Food fraud is a problem worldwide, both in scientific and industrial fields, because of its impact on human health and economic reasons. Thus, new technologies based on imaging stand out due to their simplicity, cost-effectiveness, and ability to supply a lot of information.

In Brazil, we have developed new methods to detect milk fraud combining spot test analysis to digital imaging acquired with smartphones or even visual inspection. We have demonstrated that it is possible to determine milk fraud and also classify this product as conforming or non-conforming according to the current standards for milk quality.
At WUR, the objective is to develop a strategy to identify fraud in ground spices, mainly cinnamon, as well as to define a standard pattern (fingerprint), in order to make the identification of fraud easier and faster. Portable hyperspectral imaging technology will be used for this.

This work is being developed together with an interdisciplinary team in Brazil (Prof. Fábio Rocha, Dr. Liz Bueno, Bianca Godoy, Isabela Gonçalves, and Luís Cláudio Martins) and this is the first collaboration of our group with WUR researchers Prof. Saskia van Ruth and Dr. Sara Erasmus.

Credits: Anna Flaxia de Souza SIlva
Gemaakt in: Laboratory of Analytical Chemistry "Prof. Henrique Bergamin Filho" CENA/USP, Piracicaba, Brazil.

Contact:
Anna Flavia S. Silva | anna.desouzasilva@wur.nl
Prof. Saskia van Ruth | saskia.vanruth@wur.nl@wur.nl
Prof. Fábio Rocha | frprocha@wur.nl

Impact of elevated CO_2 on the Amazon rainforest

Period: 2015-2030 | Budget open-ended*

Whether or not the forests of Amazonia will suffer from climate change is crucial for the future of Amazonian society, South-American rainfall regimes and global climate. Amazon-FACE is a large, long-term initiative to study the direct impact of future elevated CO_2 concentrations on the forests of Amazonia, with partners in Brazil, USA, UK, Germany and the Netherlands. The overarching question is whether increasing CO_2 concentrations will increase forest resilience against detrimental effects of climate change, as a result of its stimulating effects on photosynthesis and water use efficiency. The most important scientific challenge is to determine the degree to which poor soils, in particular those with extremely low phosphorus, will limit these stimulating effects.

The experiment, located in an undisturbed forest reserve north of the city of Manaus (Amazonas state, Brazil), consists of a total of four replicate planned plot pairs of 30 m diameter, where CO_2 will be artificially elevated by 200 ppm above ambient. The forest, trees and soils, and their dynamic physiology will be monitored in detail during the experiment. After installation of CO_2 fumigation, the experiment is planned to last for about 10 years.
In addition to the direct effects of CO_2, we will study the impacts of and possible adaptation to climate change in society of the wider Amazonia.

* To be identified for WUR

More information:
www.wur.eu/amazon-face
https://amazonface.inpa.gov.br

Contact:
Bart Kruijt | bart.kruijt@wur.nl

Critical feedbacks in and from the Amazon

Period: 2011-2014 | Budget € 4,700,000

Raising the alert about critical feedback between climate, society, change in land use and vegetation, water availability and policies in Amazonia

The EU-FP7 project AMAZALERT (2011-2014) aimed at raising the alert about critical feedback between climate, society, land-use change, vegetation change, water availability and policies in Amazonia.
This project:

1 analyzed and improved coupled models of global climate and Amazon, land use, vegetation and socio-economic drivers to quantify anthropogenic and climate-induced land use and land cover change and non-linear, irreversible feedbacks among these components
2 assessed the role of regional and global policies and societal responses in the Amazon region for altering the trajectory of land-use change in the face of climate change and other anthropogenic factors
3 proposed i) design of an Early Warning System for detecting any imminent irreversible loss of Amazon ecosystem services, ii) policy response priorities to prevent such loss.

AMAZALERT integrated the multidisciplinary knowledge and research of world-renowned, highly influential climate, land cover, land use change scientists and also policy analysts from 14 European and South-American
institutions that have been collaborating for 10 to 30 years. This project therefore achieved impact on EU (2020 climate goals), international and South-American strategies.

More information:
www.eu-amazalert.org

Contact:
Bart Kruijt | bart.kruijt@wur.nl

Smart technology for soybean production

Period: 2021-2024 | Total budget: € 660,000

In this public-private research project funded by Dutch Topsector AgriFood and in-kind contributions, eleven Brazilian and Dutch partners work together on the development and implementation of technologies and know-how to develop smarter soybean production. The private partners are Bioscope, GDM Seeds, Hiber, Oro Agri, Rometron, Stara and Syngenta companies. The public research partners are Embrapa, Fundaçao ABC, UFSM and WUR. Together, these partners have the knowledge and technology of sensors, IoT, decision support, new varieties, biological control agents, connectivity and actuation (robotics) for precise application of crop protection products and fertilisers, in order to make soybean production more sustainable.
The partners will work on innovations in the coming four years (2021-2024) and deliver results on the following four smart farming topics:

- Innovative weed control in soybean using chlorophyll-sensing technology in combination with decision support and accurate application technology to enable precise, site specific and variable rate herbicide treatment of weeds with low environmental impact;
- Innovative disease control in soybean using field-specific data in combination with decision support and accurate application technology to enable sustainable disease management, including resistance management;
- Innovative pest and disease control by combining different control methods such as natural products, resistant varieties and indirect methods;
- Innovative algorithms to re-use past and in-season data produced by sensors and machinery of the project partners.

More information:
www.wur.eu/precision-agriculture

Contact:
Corné Kempenaar | corne.kempenaar@wur.nl

Biodiversity for Food

From 2020-2021 | Total budget € 25,000 (INREF)*

Cultivating resilience for planetary health

The unprecedented rate of current human-induced environmental change poses a novel challenge to all social-ecological systems on earth. Understanding the main hurdles to planetary health is paramount to designing sustainable solutions that balance the needs of human and natural systems. Recent interdisciplinary work on the concept of Planetary Health emphasizes the interconnectedness of natural systems and human health outcomes, such as food security. This project makes a novel contribution to this emerging field through an analysis of the interlinkages between food production, biodiversity, and society in Brazil. Sustainable and environmentally-friendly farming tools and techniques are being developed at an unprecedented rate, and local communities often use traditional technology that is in line with current agroecological models, although compromising its production and distribution. Biodiversity is crucial for food production, either directly (e.g. honey, crops variety) or indirectly (e.g. pollination, plague control). This project establishes a unique collaboration among experts to develop strategies that permit continuous societal adaptation to the needs of healthy biological systems. The outcomes of this project will make an important contribution to emerging global scholarship on planetary health and ongoing efforts to achieve the UN's Sustainable Development Goals.

* INREF: Interdisciplinary Research and Education Fund of WUR

Contact:
Filipe Cunha | filipe.cunha@wur.nl

Post-mining forest restoration in the Amazon

From 2018-ongoing | Total budget no specific budget

Mining drastically transforms landscapes worldwide and is an expanding activity in the Amazon. The impact of mining goes beyond the loss of vegetation cover and includes topographic and edaphic transformations that require intensive restoration efforts. Legal obligations and the increasing demand for sustainable mining call for the development of efficient restoration measures to compensate for the environmental impacts.

In the southern Brazilian Amazon, a partnership between a mining company and Brazilian ecologists and soil scientists has been promoting and monitoring the restoration of more than 80 hectares of mined lands since 1999. Since 2018, Wageningen University has been collaborating to evaluate how restoration success is affected by mining techniques, edaphic conditions, the planted species pool, the presence of exotic species and the characteristics of the surrounding landscape. One Master's thesis has been finalized and the other two are ongoing. The results of 10 years of monitoring show that the rates of vegetation growth and plant species accumulation are strongly affected by the edaphic characteristics of the different mining zones, being slower at the top and the bottom of mining tailings where soils have a very high sand or clay content, respectively.

Contact:
Catarina Jakovac | catarina.jakovac@wur.nl
Pieter Zuidema | pieter.zuidema@wur.nl

Uncovering the quality of forest regeneration in the Amazon

From 2020-2022 | Total budget € 112,000

Naturally regenerating forests are the solution for restoring large expanses of tropical forests at low costs. The rates of recovery and the levels of biodiversity attained by such forests vary widely. For example, in landscapes severely fragmented or subject to repeated burning, regenerating forests have limited capacity to restore ecosystem services. In the Brazilian Amazon, 21% of previously deforested land is now covered by regenerating forests of unknown ecological integrity.

This project synthesises the scientific knowledge and translates it into guidelines for classifying and monitoring the ecological quality of regenerating forests in the Amazon. Protocols for field and remote sensing assessments will be designed by an international group of 20 experts from 12 institutions. The results of this synthesis will enable mapping and monitoring of the quality of regenerating forests in the Amazon and will hopefully contribute to the implementation of public policies on forest restoration.

The project is supported by the Brazilian Center of Synthesis in Biodiversity and Ecosystem Services – SINBIOSE, and is coordinated by the National Institute for Amazon Research- INPA based in Manaus, Brazil and the Forest Ecology and Forest Management Group from Wageningen University & Research.

Contact:
Catarina Jakovac | catarina.jakovac@wur.nl
Lourens Poorter | lourens.poorter@wur.nl

Scalable sustainability insights of agri commodity imports

Period 2021 | Budget € 40,000

The Netherlands plays a central role in imports and re-exports of key agri commodities such as cocoa, palm oil, coffee, soy and many others. For many years, public and private sector organisations have worked on improving the transparency of the sustainability profile for these agri commodities (e.g. using certification schemes), but still many gaps exist in terms of sustainability risk and impact insights. The objective of this SMP is to explore options for generating scalable sustainability insights of agri commodity imports. We will use soy flows from Brazil as an example to better understand the options to develop a scalable tool or platform. These learnings will be used to examine the options for other crops and countries. Ultimately, this SMP should provide an answer to how we can close the gap in terms of sustainability profiling of agri flows. In addition to the port of Amsterdam (lead partner), we will involve other stakeholders in soy and with a general interest in sustainability profiling of agri commodities (i.e. retail, agri traders, NL Embassy and Agri Council in Brazil and local producers and suppliers of farm inputs).

Contact:
Willem Ruster | willem.ruster@wur.nl

Absolutely Amazonian

From 2022-2023 | Total budget € 38,000

To address deforestation in the Amazon, calls have been made to develop a 'green (bio) economy' that harnesses the value of a permanent productive forest by establishing a new model of socially inclusive economic development with the help of new or emerging technologies. A wide range of bio-products based on the full range of the forest's own wealth has been established and their production/trade is flourishing. Examples are açai, cupuaçu, and cocoa.
The agroforestry production is now getting to a stage that it is also becoming important to protect the reputation of these products from biodiverse environments, i.e. protect them from being illegally replaced by products from other less sustainable systems, including those from monoculture productions. This is feasible with adaptable Synergistic Technology Fusion traceability/authentication support systems that are currently under development in the EU. These systems allow fusion of various data sources, e.g., unique lot identifiers, analytical fingerprint data ,satellite data, etc. The data are subsequently uploaded onto a data platform to track, trace and authenticate products along the chain, to identify anomalies in these patterns with artificial intelligence, and provide feedback to supply chain actors for decision support.
The Absolutely Amazonian project is a WUR wildcard project and involves a consortium of WUR and Brazilian scientists. It aims is to develop a roadmap for the development and implementation of a Synergistic Technology Fusion system that is modifiable to the local situation in the Amazon to support fair competition and social inclusiveness, and enhance biodiversity in the Amazon food production systems.

Contact:
Saskia van Ruth | saskia.vanruth@wur.nl

CloudRoots

Period 2020-2024 | Budget € 750,000

Clouds rooted in a heterogenous biosphere

How are carbon dioxide assimilation by photosynthesis and cumulus clouds connected? What is the local interaction between rainforest evapotranspiration and cloud formation modulated by incoming regional air masses? These interrelated questions were the main drivers of the experimental campaign CloudRoots-Amazonia22 that took place at the ATTO/Campina supersites in the pristine Amazon rainforest during August 2022 (dry season). CloudRoots-Amazonia22 collected observational data to derive relationships between leaf level processes to canopy scales and connected them to the diurnal evolution of the clear to cloudy atmospheric boundary layer.

CloudRoots is a joint research between Wageningen University and Utrecht University financially supported by the Dutch Research Council (NWO) and with a very strong support from the following Brazilian Institutes and Universities: Instituto Nacional de Pesquisas da Amazônia (INPA) in collaboration with the Universidade do Estado do Amazonas (UEA) both in Manaus, Institute of Physics in University of São Paulo and the Federal Institute of Pará (IFPA) in Belém, Pará state as well as Max Planck Institute (Germany).

In addition to the research CloudRoots has organized PhD courses in Manaus and is facilitating the interchange between Brazilian and European researchers.

More information:
cloudroots.wur.nl

Contact:
Jordi Vila | jordi.vila@wur.nl

Airborne Stable Isotopes of Carbon from Amazonia

From 2015-2020 | Total budget € 2,300,000

The carbon balance of the Amazon is undergoing rapid changes due to deforestation and climate change. Severe droughts that used to occur only once in a few decades have hit the region multiple times in the past 15 years. This project tries to estimate the total annual carbon uptake of the Amazon forest, and its changes during severe droughts.

The ASICA project is executed in collaboration with the Brazilian Space Agency INPE, where the state-of-the-art greenhouse gas analysis laboratory of co-PI Luciana Gatti was extended to measure carbon isotopes in air. Collection of air samples takes place from light aircraft using untrained pilots that carry computer-automated suitcases with sampling equipment on-board. Flights occur twice per month across seven airfields throughout the Amazon. The measurements and interpretation of oxygen isotopes in CO_2 now covers 2+ years, and required a newly developed optical instrument and a new numerical modeling framework developed at WUR. With the project nearing its end date, it was able to monitor the increased deforestation that the region saw in 2019.

More information:
issuu.com/euresearcher/docs/eu_research_16_digital_magazine_fin/43

Contact:
Wouter Peters | Wouter.Peters@wur.nl

Synergies in integrated systems

Period 2022-2025 | Budget € 1,300,000

Improving resource use efficiency while mitigation GHG emissions through well-informed decisions about circularity (SENSE)

The SENSE project will develop a matrix of indicators, as well as the status of circularity quantification within various case studies involved in integrated crop-livestock-forestry systems in European (Italy, Germany, the Netherlands, and the United Kingdom) and South America (Argentina, Brazil and Uruguay). Contrasting scenarios of carbon, nutrients, water, and biomass flows will be simulated through process-based models such as manure-DeNitrification-DeComposition (DNDC). We will test a novel digital Monitoring, Reporting and Verification (MVR) system developed by the James Hutton Institute (project leader) and its application in quantifying and mitigating GHG emissions. This analysis will lead to potential scenarios at farm level to redesign systems towards more complete local circularity. We will evaluate and compare the circularity scenarios according to (i) their potential for mitigating GHG emissions, (ii) their resilience, using a probabilistic risk analysis approach, and (iii) their side effects on other societal goals based on multidimensional sustainability assessment tools. We will compare and discuss our cases with the participation of farmers, through circularity, ecological functioning and socio-economic indicators to discover general lessons for enhancing effective circularity at farm level.

More information:
bit.ly/3w7HziA

Contact:
Marianna Siegmund-Schultze | marianna.siegmund-schultze@wur.nl

Epilogue

Wageningen University is a public university in Wageningen, the Netherlands, specialized in life sciences and social sciences with a focus on food, agriculture, nature & environment and engineering subjects.

Wageningen Research consists of 9 specialized research institutes that carry out application-oriented and field-based research commissioned by governments, commercial businesses, non-profit organisations and civil society to help them face their challenges.

The collaboration between Wageningen University and Wageningen Research creates synergy by combining education with fundamental and applied research.

The WUR mission is *"To explore the potential of nature to improve the quality of life".*

Please visit our website where you will find extensive information on the numerous topics WUR is working on: www.wur.eu. If you would like to collaborate, a commission research or advice on a specific topic within our domain, you can approach our regional manager for Latin America & the Caribbean:

Contact
Ria Hulsman, regional manager
Latin America & the Caribbean @ WUR
(Spanish and Portuguese speaking)

E: ria.hulsman@wur.nl
T: +32 317 482 383
M: +31 6 127 974 48

Colophon

Design

Wageningen University & Research, Communication Services

Photography

Guy Ackermans (p.4, 7, 8, 52), Rizoma Agro (p.20), Harry Bitter (p. 14),
Frans Bongers (p.42, 43), Jean Dalmo (p.45, 46), Tomas Domingues (p.39), Duncan de Fey (p.3)
Jeroen Hofman (p.3), Juliana Oliveira (p.24), REDStack, www.redstack.nl (p.13),
Shutterstock.com (p.10, 48), Peter van der Sleen (p.35), Heitor M. Teixeira (p.33),
Elmar Veenendaal (p.40, 41)

Copyright

© 2021 Wageningen University & Research

Postbus 338, 6700 AH Wageningen, www.wur.nl