### ACTIVITY REPORT

VALE INSTITUTE OF TECHNOLOGY – SUSTAINABLE DEVELOPMENT

2023



#### Dados Internacionais de Catalogação na Publicação (CIP)

A188 Activity report: Vale Institute of Technology for Sustainable Development -2023 / Project Management and Institutional Relations. Belém: ITV, Matildas Comunicação, 2024. 33 p. : il. color.

> ISBN (impresso) 978-85-94365-22-4 ISBN (eletrônico) 978-85-94365-23-1 DOI 10.29223/REL.PROJ.ITV.DS.2024.03.Projetos

 Research - Activity Report. 2. Research - Environmental Sciences. 3. Sustainable Development. 4. Biological Sciences. I. Vale Institute of Technology (Belém, PA). II. Project Management and Institutional Relations. III. Title.

CDD 23. ed. 570.9811

Eddie Saraiva - Bibliotecário - CRB 2/1843

### INTRODUCTION

The Vale Institute of Technology – Sustainable Development (ITV DS) aims to develop research that fills existing knowledge gaps in supporting Vale's operations. The Institute also seeks to develop studies connected to the company's strategic stance in generating value for society.

The research carried out by the Institute's scientists aims to leverage science and its tools to keep the Amazon healthy and, therefore, our planet. To this end, six different areas of knowledge are involved in the research, namely: Environmental Geochemistry and Water Resources; Biodiversity and Ecosystem Services, Environmental Genomics, Environmental Technology, Socioeconomics and Sustainability, and Data Science.

The year of 2023 was an extremely important one in the quest to consolidate ITV DS as a recognized research institute for the Amazon region. After ten years of operation, the Institute identified the need for a strategy review and the building of a meaningful vision for the future. To this end, our staff, partners, experts, and Vale leaders were assembled to compile the knowledge and lessons learned over a decade's journey to discuss future trends for a corporate research institute. In a collective effort coordinated by Move Social, the ITV DS 2030 Theory of Change was created: a set of premises, strategies, results, and desired outcomes that will guide how the organization's efforts and resources will be allocated in the coming years.



The ITV DS Theory of Change is based on a set of five core strategies, which outline the main options for realizing the desired changes. These include: production of high quality, impactful scientific knowledge; training and qualification of human resources in the Amazon: distribution of knowledge aimed at expanding and diversifying access to varied audiences; development of innovative social and environmental technologies and solutions; and promotion of partnerships and strategic national and international networks aimed at collaborative production of knowledge and technology.

This report summarizes the main activities performed by the Institute in 2023. Our mission thereinafter is to advance the consolidation of ITV as a benchmark institute at the service of the Amazon, striving to contribute to the feasibility of responsible human industrial activity and upholding nature and people. Together with the Theory of Change, ITV DS reaffirms its scientific role and is committed to building bridges so that the knowledge it produces may translate into practical and innovative actions in the Amazonian territory.

Have a nice read!

**Guilherme Oliveira** Scientific Director at ITV DS



About us ITV in numbers ITV in the press ITV Partnerships Technical and scientific production ITV Infrastructure Research Groups Master's Degree Research highlights Looking ahead



Vale created the Vale Institute of Technology - Sustainable Development to discover new approaches for the sustainable use of natural resources. The three pillars of research, education and entrepreneurship have guided the actions of the Institute. In an interdisciplinary and collaborative manner, the goal of ITV DS is to produce knowledge for sustainable development of the Amazon rainforest and other Brazilian biomes, both in economic, social and environmental terms.

Based in Belém (PA), ITV DS innovates in training focused on developing local talents, aimed towards discovering solutions to the challenges of increasingly sustainable production. The Institute is, therefore, an initiative that adds value to Vale's outstanding technical portfolio, exploring scientific and social technologies for mining with respect to nature and people.

#### Science in ITV

ITV DS activities involve research and teaching in the fields of biodiversity, environmental services, water resources, socioeconomics, environmental genomics, reforestation with native species, recuperation of degraded areas, land occupation and use, climate changes and data science, among others.

The research agenda is dynamic and often undergoes adjustments depending on the project's maturity and the strategic guidelines and specific demands of the company. The structuring themes of the research agenda are built in accordance with Vale's guidelines and policies, with sustainability as the core pillar of the unit's work. It should be highlighted that ITV's primary objective is to generate research for the Amazon. We contribute to Vale's strategic plan and mission by conducting research in Vale's operational territory and expected regional implications of the research output. In this process, ITV consolidates its role as a vehicle for promoting Vale's actions. Scientific research and education are, therefore, part of the company's legacy to the region.



#### ITV DS 2030 Theory of Change

Science produced by ITV DS must be at the service of developing solutions that generate value to society, combining basic and applied science to innovation.

Assumptions

- The development of scientific research of excellence entails long-term perspective, impartiality, proper governance and cooperation between institutions.
- The themes of ITV DS's scientific research are in line with the sponsor's purposes and commitments to make a greater contribution to the scientific, social, environmental and innovation fields.
- ITV DS produces open science, aimed towards visibility and sharing of the knowledge produced.

- The work of ITV DS is based on augmenting data science, with attention to the systematic and appropriate treatment of the information generated.
- ITV DS values the traditional and ancestral knowledge in its scientific production.
- ITV DS's knowledge production is enhanced by adopting a multidisciplinary approach to its topics.
- The work at ITV DS is guided by an understanding of sustainability based on the indissociability of the social, economic and environmental scopes.
- The Amazonian territory is the focus of the sustainable development expected by ITV DS, with the territorial perspective as the basis for its work.



#### Outcomes

#### Sustainable mining chain

- Social and economic development of the Amazonian region combined with environmental conservation and recuperation
- Protected ecosystems and contributing to climate resilience
- The Amazon as a global reference in production of knowledge and innovation for sustainable development and local communities

Developed by Move Social





### **Executive Board**

Chief Executive Officer Hugo Guimarães Barreto Filho

Vice-President Director Patricia Fagundes Daros

Executive Director Edson dos Santos Correa Ribeiro

Executive Director Patrice Kassai Moreira Mazzoni

Scientific Director ITV DS Guilherme Oliveira



#### Timeline





### **ITV IN THE PRESS**

During 2023, ITV was prevalent in the media. There were 116 insertions distributed in different regional and national media.

These include:

### Amazonian mangrove forests are the largest and most preserved in the world, study shows

July/2023 | Folha de S.Paulo

https://www1.folha.uol.com.br/ambiente/2023/07/manguezais-da-amazoniasao-os-mais-extensos-e-preservados-do-mundo-mostra-estudo.shtml

# Amazon Summit calls for joint efforts gainst climate change and increased protection of tropical forests

August/2023 | Paper People

http://paper.people.com.cn/rmrb/html/2023-08/11/ nw.D110000renmrb\_20230811\_1-15.htm

# Brazilian Biodiversity Genomics Project propels Brazil to the forefront of scientific research on species conservation

September/2023 | ICMBio website

https://www.gov.br/icmbio/pt-br/assuntos/noticias/ultimas-noticias/projetogenomica-da-biodiversidade-brasileira-coloca-brasil-no-protagonismo-dapesquisa-cientifica-para-conservacao-de-especies

# Vale publication reveals relationship between Carajás Forests and communities

October/2023 | O Liberal Online

https://www.oliberal.com/para/publicacao-da-vale-revela-relacao-entre-as-florestas-de-carajas-e-as-comunidades-1.743311

### Consortium with ICMBio to produce 5,000 genomes for species preservation

#### October/2023 Agência Brasil

https://agenciabrasil.ebc.com.br/geral/noticia/2023-10/consorcio-com-icmbio-produzira-5-mil-genomas-para-preservar-especies

#### Route to genomic mapping of Brazilian biodiversity

#### October/2023 | Valor Econômico

https://valor.globo.com/conteudo-de-marca/projeto-especial-esg/ noticia/2023/10/23/rota-para-o-mapeamento-genomico-da-biodiversidadebrasileira.ghtml

#### Vale mining company presents biodiversity conservation programs in Carajás during CGBio

November/2023 | Portal Canaã

https://portalcanaa.com.br/ mineracao/mineradora-valeapresenta-programas-deconservacao-da-biodiversidadeem-carajas-durante-cgbio/



### **ITV PARTNERSHIPS**

The production of interdisciplinary and collaborative knowledge is one of the core pillars of ITV DS activities. Partnerships for scientific production are encouraged both in and out of the Institute.

Research groups are organized internally by area of knowledge for strategic and structural organization. However, modern research requires collaboration, which makes interdisciplinary efforts invaluable to knowledge. At ITV DS, the same study may involve researchers from biology, computer sciences and geology, among many other fields.

External partnerships are necessary when the required expertise or qualification for a given project is not available. At ITV DS, the demand for external partnerships is met through partnerships with professionals, companies and other institutions, prioritizing those located in northern Brazil.



#### ITV partnerships in 2023

# UNIVERSITIES

Federal University of Alagoas

Federal University of Maranhão

Federal University of Pará

Federal University of Espírito Santo

University of São Paulo

Federal University of Goiás

Federal Rural University of Amazonia

State University of Campinas

University of Copenhagen

Rockefeller University

Technical University of Denmark

University of Oslo

# ICTS

mbrapa	5
Dresden	15
Aicrosoft Philantropic	С
ИРEG	С
Senai Innovation Institute	E
	В



Instituto Mamirauá



# COMMUNICATION

Agência Bori

Ciborga

Inpartec

Lab 37°

Matildas Comunicação

# AGENCIES, FOUNDATIONS AND COMPANIES

ICMBio

FIOCRUZ

FUNDAÇÃO GUAMÁ

FUNDEP

FUNAPE

FADESP

Fundação Sousândrade

**GINKGO BIOWORKS, INC** 

#### CENTROFLORA

BRAZBIO

BIOMAS SERVIÇOS AMBIENTAIS RESTAURAÇÃO E CARBONO S.A

**Conservation Science Partners** 

Microsoft

European Molecular Biology

Sarvision

# VALE'S PARTNERED AREAS WITH ITV DS

Carajás Environmental Management

Porto Ponta Madeira–MA and Carajás Railroad Environmental Management

Corporate Environmental Management

Innovation and Technology Directorate of Ferrous Materials

Environmental Management of Base Metals

Management of Ferrous Environmental Studies

Speleology Management

Fundo Vale

Vale Nature Reserve

Directorate of Nature-Based Solutions

Climate Change Management

Land Management and Removal

Sustainability Board

Serra Sul Environment

### TECHNICAL AND SCIENTIFIC PRODUCTION

The relevance of the studies carried out at a research institute is proven by the publications presented and attest to the quality of the scientific output. Over the years, ITV's expansion of technical and scientific production has increased in significance, which favors the fulfillment of the institute's knowledge generation role.



#### Scientific production at ITV DS over the years





Overall, the publications aim at reporting relevant outcomes of projects to the scientific community. ITV has accumulated 995 scientific publications, including books, articles and book chapters since 2009.

There were 52 articles in 2023, with the following highlights:

#### Mapping soil organic carbon stock through remote sensing tools for monitoring iron minelands under rehabilitation in the Amazon

Signed by Ediu Carlos da Silva Junior, Paula Godinho Ribeiro, Gabriel Caixeta Martins, Diogo Corrêa Santos, Markus Gastauer, Rafael Borges da Silva Valadares, Cecílio Frois Caldeira Júnior, Pedro Walfir Martins de Souza-Filho, Guilherme Oliveira, Wilson da Rocha Nascimento Júnior and Silvio Junio Ramos, the article published in Springer Nature aimed at evaluating the carbon stock in the rehabilitation of mining areas using remote sensing tools.

#### Mangrove Swamps of Brazil: current status and Impact of Sea-Level Changes

Signed by Pedro Walfir Martins e Souza- Filho, Cesar Guerreiro Diniz, Pedro Walfir Martins e Souza-Neto, João Paulo Nobre Lopes, Wilson Rocha da Nascimento Júnior, Luiz Cortinhas, Nils Edvin Asp, Marcus Emanuel Barroncas Fernandes and José Maria Landim Dominguez, the article published in Springer Nature evaluated the current situation of Brazilian mangroves and the impact of sea level changes.

# Protecting pollinators and our food supply: understanding and managing threats to pollinator health

Signed by H. Siviter, A. Fisher II, B. Baer, M. J. F. Brown, I. F. Camargo, J. Cole, Y. Le Conte, B. Dorin, J. D. Evans, W. Farina, J. Fine, L. R. Fischer, M. P. D. Garratt, Tereza Cristina Giannini, T. Giray, H. Li-Byarlay, M. M. López-Uribe, J. C. Nieh, K. Przybyla, N. E. Raine, A. M. Ray, G. Singh, M. Spivak, K. Traynor, K. M. Kapheim and J. F. Harrison, the article was published in Springer Nature and presented the importance of pollinators to human food supply.

### **ITV INFRASTRUCTURE**

In the last year, ITV has fulfilled its commitment to maintaining a state-of-the-art and operational technology infrastructure. The laboratories at the Institute have received new equipment, to strengthen our research in areas such as numerical weather modeling, DNA sequencing and microscopic analysis. With the new acquisitions, our research gains in robustness and production capacity.



#### Full Photodocumentation System (for electrophoresis) – AXYGEN GDBL–1000 (1 unit)

This documentation system enables capturing of print-quality 16-bit TIFF images. The systems are quick to set up and include intuitive user interface for image capture, notes and contrast settings. The images may be easily saved and opened in common gel analysis software for more detailed analysis.



#### ULT Freezer 570 L (-80°C) (1 unit)

With vacuum thermal insulation technology, the equipment takes up less space than traditional models. In addition, the freezer was built with green technology, ensuring lower carbon dioxide emissions.

# DNA sequencers – NextSeq 2000 Sequencing System (2 units)

The flexibility, accessibility and scalability of the equipment ensure quick results with reduced operating costs. With the wide range of flow cells available, the devices support a variety of applications.

#### DNA Sequencer – QuantStudio™ Absolute Q™ Digital PCR System (1 unit)

The equipment has been designed to yield straightforward and quick results. Compartmentalization, thermal cycling and data acquisition stages are integrated into a single instrument. With this sequencer, the workflow can be completed in less than five minutes of practice.

### **RESEARCH GROUPS**

Research groups	Projects	Researchers
Environmental Geology and Water Resources	04	06
Environmental Technology	15	10
Biodiversity and Ecosystem Services	10	08
Environmental Genomics	06	08
Socioeconomics and Sustainability	02	04
Data Science	02	05

### **MASTER'S DEGREE**

ITV DS has created the Professional Master's Degree in "Sustainable Use of Natural Resources in Tropical Regions" to contribute to the training of human resources in the Northern Region of Brazil, with the following main objectives:

- Train professionals capable of addressing issues related to the use of natural resources and meeting society's new demands for sustainable development;
- Provide a systemic and integrated vision of the use of natural resources and contribute to the generation of technological innovation based on a systemic vision of the sustainability of these resources.



The program has two areas:

Socioeconomics and Sustainability in Mining: addresses mining as a complex system, striving for balance between economic, social and environmental development.

Sustainable Use of Biological Resources: covers studies aimed at contributing to the sustainable use of natural resources, with the development of strategies to balance human activity and environmental protection.

The Program is open to students nationwide, with a focus on State residents, and involves professionals from companies engaged in sustainability management, as well as students qualified in areas related to natural resources (biologists, agronomists, chemists, physicists, geologists, engineers, computer scientists, oceanographers) and sustainability (environmental engineers, meteorologists, geographers, economists, sociologists, anthropologists) or related fields.

#### Professional Master's Degree ITV DS in numbers



Highlighted publications with the participation of students/graduates of the program Assessing entomological collection data to build pollen interaction networks in the tropical Amazon forest

#### Author:

Luiza Araújo Romeiro (first author)

The article deals with interactions between plants and bees, with an emphasis on plants that can benefit bees and that can potentially be prioritized in forest restoration strategies. The article was featured in Agência Bori and Galileu magazine. Late Quaternary Isoëtes megaspores as a proxy for paleolimnological studies of the southeastern Amazonia

#### Authors:

Keyvilla da Costa Aguiar, Karen da Silva Lopes, Mariana Maha Jana Costa de Figueiredo, Luiza Santos Reis, Tacísio M. Rodrigues (coauthors)

The article uses knowledge of Isoetes species for climate and past hydrology studies. The article was published in the Journal of South American Earth Sciences. Mapping copper concentrations in tropical open cast mining fronts from X-ray fluorescence and FAAS techniques: A comparative study

#### Author:

Sormane de Freitas Fogo (first author)

Published in the Journal of South American Earth Sciences, the study develops a non-destructive, accurate and low-cost method for analyzing samples from the mining front, helping in decision-making for mineral processing feed.

![](_page_18_Picture_13.jpeg)

### **RESEARCH HIGHLIGHTS**

ITV is investing on research as a key factor for development, in line with the United Nations Sustainable Development Goals (UN SDGs). Overall, the Institute is developing 39 projects spread across different areas, but in line with multidisciplinarity and interdisciplinarity. In 2023, all of ITV's projects yielded significant results, and below are this year's highlights.

#### ENVIRONMENTAL GEOLOGY AND WATER RESOURCES

# Land use and water impact

Striving to ensure water security in the Itacaiúnas river watershed (BHRI), the interdisciplinary project "Monitoring Critical Events in BHRI" stands out, using hydrometeorological monitoring data, remote sensing techniques and mathematical modeling to answer questions such as: What role do protected areas play in preserving water resources? How can deforestation and climate change affect water security in the region? The start of the project, in 2021, was marked by the expansion of hydrometeorological monitoring in the Itacaiúnas river watershed, where Vale's operations in northern Brazil take place. Based on information from the weather stations, rainfall intensity equations could be updated, which are required for drainage projects. In places where data is scarce, the project uses state of the art remote sensing techniques to estimate hydrological variables.

In a context of future climate scenarios, by combining mathematical modeling and climate projections, it was possible to predict a trend towards a reduction in water availability and an increase in maximum flows in the Itacaiúnas river basin. This study also showed that climate change can increase the length and intensity of the dry seasons, effects that can affect multiple uses of water and increase the frequency of fires. In 2023, an analysis of pollutant dispersion in surface water was carried out in the Parauapebas River, an affluent of the Itacaiúnas river in Pará. The study used data measured on site and mathematical modeling toshow which concentration patterns of chemical elements in water can be harmful in case of human consumption. Also in 2023, the project presented a nationwide study for estimation the cumulative impact of anthropogenic uses on aquatic ecosystems.

This study was presented at Vale e Natureza 2023, focusing on the rivers of the Pan-Amazonian region. Operating since 2021, the project deliveries scheduled for 2024 are:

- Estimation of hydrological and physical attributes at different scales in the BHRI and other areas, using remote sensing and mathematical modeling;
- Effects of teleconnections on ground carbon flow in the Pan-Amazon and Cerrado river basins;
- Evaluating Conservation Units and Indigenous Lands as Nature-Based Solutions for Water Quality in the Legal Amazon.

#### **Project:**

Event monitoring Critical in river basins where Vale operates **Coordination:** Paulo Rógenes Monteiro Pontes **Period:** Feb/21 to Dec/24 **Funding (2023):** BRL 656,563.00 (USD 127,577.00)

![](_page_20_Picture_6.jpeg)

#### **BIODIVERSITY AND ECOSYSTEM AND ENVIRONMENTAL GENOMICS SERVICES**

#### **Biodiversity of Caves**

Two studies on biodiversity in subterranean Amazonian ecosystems are underway at ITV DS. The goal of these projects is to explore caves in the Carajás region in an attempt to learn about the dwelling species, understand how they are distributed, their ecology and their possible responses to human activities. In addition, the technological aspect present in both studies seeks to implement automation and efficiency gains in technical processes for evaluation of underground biodiversity. Properly evaluating biodiversity in these ecosystems is a key step in the process of licensing extraction activities, with technical solidity being the primary objective of these projects.

The first project, Biological Diversity of Caves, studies the genetic diversity of plants, bats and cave invertebrate species using next-generation genomic sequencing and DNA bar coding techniques. The goal is to increase agility and efficiency in the diagnosis of new species and better definition of areas of influence of caves, resulting in quicker clearance of suitable exploration areas. Deliveries include:

- Generation of 200 genetic references for invertebrates and/or bats associated with caves through NGS sequencing;
- Description of genetic references of bat species (Furipterus, Natalus and/ or Lonchorhina), and plants that grow roots into caves, to expand the database related to cave species for delimiting the scope of influence in Carajás;
- Sequencing and assembly of nuclear genomes of two cavedwelling animal species using NGS platforms.

The study "Caves: Refining Bat Sampling" explores underground biodiversity through the study of sounds. Focused on the bat group, this project has built a library of sound references for the bat species of Carajás and proposes refined protocols for cave relevance and monitoring studies implemented by Vale in cave areas. The proposal is to ensure agility and effectiveness in the diagnosis of the occurrence and distribution of underground species and better definition of the cave area of influence, which may guicken the clearance of more suitable exploration areas.

#### The main deliveries are:

- Training in bat bioacoustics for future sound base bat identification;
- Study of soundscape indexes for cave monitoring;
- Development of machine learning models capable of identifying bat sounds from audio files obtained in caverns and making them available to service providers.

Name: Caves Biological Diversity Coordination: Santelmo Vasconcelos Period: Mar/19 to Dec/24 Funding (2023): BRL 1,405,714.00 (approx. USD 273,145.11)

Name: Caves: Refining Bat Sampling Coordination: Leonardo Trevelin Period: Mar/19 to Dec/24 Funding (2023): BRL 306,434.00 (approx. USD 59,543.37)

![](_page_21_Picture_11.jpeg)

![](_page_22_Picture_0.jpeg)

# ENVIRONMENTAL GENOMICS

#### Genome of the Brazilian Biodiversity

The project Genomics of the Brazilian Biodiversity (GBB) was launched in 2022 by ITV DS in collaboration with the Chico Mendes Institute for Biodiversity Conservation (ICMBio). This program aims at the production of genome references and species genetic diversity of endangered species of the Brazilian fauna and flora, as well as producing genomic data for the development of native species of economic interest. The project will also use eDNA to monitor biodiversity sites to establish the technology as a working tool.

Vale is the main investor in this initiative, as it recognizes the importance of research for the preservation of biodiversity in Brazil and fosters the potential of the Brazilian scientific community to generate knowledge. GBB shall receive a USD 25 million investment by 2027, aimed at producing studies on species of great conservation interest, including those found in Federal Conservation Units under the aegis of ICMBio throughout Brazil.

GBB's main deliveries in 2023:

Full genome sequencing of 11 species of Brazilian fauna. The sequenced samples were inherited from the AmaZOOmics project. The species defined in a joint effort with ICMBio will begin sequencing in 2024;

- Workshop in May 2023: Forming collaborations for obtaining and depositing tissues Strengthening among institutions (ITV, ICMBio and Universities);
- Workshop to define target species for the project (Sep/2023): Definition of 80 priority species and projects together with ICMBio;
- Launching of the GBB page on the ITV website;
- Workshop for disclosure of the GBB project to journalists (Oct/2023): 148 media appearances;
- Training workshop for ICMBio staff on the use of tools for environmental DNA studies (Nov/2023);
- Training workshop in assembly of reference genomes (Dec/23): Training ITV fellows and ICMBio staff to assemble reference genomes that will be generated for the species in the coming years as part of the GBB project;

- GBB at the forefront of analyzing national biodiversity data;
- GBB / ITV joining the international consortium "Earth Biogenome Project – EBP", comprising the major global genomic studies;
- White paper article focused on the opportunities and challenges of genomic sequencing in a widely diverse country.megadiverso.
  - Name: Biodiversity Genomics Brazilian (GBB) Coordination: Alexandre Aleixo Period: 2027 Funding (2023): R\$ 16,219,466.00 (approx. USD 3,151,613.94)

#### **ENVIRONMENTAL GENOMICS**

#### No Net Loss in Carajás

The concept of no net loss refers to the need to avoid net losses and therefore generate a net gain for biodiversity. The principle is linked to the idea of environmental compensation and impact prevention, guided by the Hierarchy of Impact Mitigation: avoid, minimize, repair, remedy or offset impacts on biodiversity. Prevention strategies are guided by identifying priority areas. Offset strategies are guided by the adoption of methodologies to preserve biodiversity ecosystem function. The objective of the No Net Loss Carajás project is to improve biodiversity management and identify gaps for application of the Mitigation Hierarchy in mining activities in Carajás, including the definition of priorities for future research. Risk reduction for licensing and maintenance of operations, clearance of mineral resources and the strengthening of the company's reputation are among the benefits of the study. The main deliverables of the No Net Loss project in Carajás are:

- Study of the causes of environmental degradation in the cangas of the Carajás complex;
- The quantification of losses and gains to biodiversity associated with mining in the region, including losses avoided due to the creation of the Campos Ferruginosos National Park;
- Identify gaps in the implementation of the Mitigation Hierarchy and the No Net Loss of Biodiversity target in Carajás.

Name: No Net Loss in Carajás Coordination: Markus Gastauer Period: Jan/22 to Dec/25 Funding (2023): BRL 404,297.00 (approx. USD 78,559.00)

ts: Elena Bab

Credits: Personal archive

#### **EXTREME EVENTS CENARIOS**

The objective of the project "Vulnerability of Vale's Mineral Chain to Events of Extreme Rainfall" is to investigate the change characteristics in regional climate regimes associated with current and future extreme climate events, over the eastern Amazonian region and to assess the vulnerability of phases of Vale's mineral production chain (mine and port) to these events. The study was performed in partnership with the Federal University of Alagoas and provides support to the decision making process in management of climate– related risks, in order to reduce vulnerabilities to extreme events in the mineral chain.

#### Among the main deliveries are:

- Evaluation of the regionalization's ability to represent the main climate patterns and extreme events in the Eastern Amazonian region, focusing on the Mining Chain;
- Climate maps of extreme rainfall indicators in Vale's Northern Corridor;
- Analysis of the likelihood of extreme rainfall events in the future climate considering the scenarios of the Inter–Government Panel on Climate Change (IPCC) based on the regionalization of the Eastern Amazonian region, focusing on the mining chain.

#### Name:

Vulnerability of Vale's Mineral Chain to Extreme Rainfall Events in Climate Change Scenarios Coordination: Cláudia Costa Period: Jan/22 to Dec/24 Funding (2023): BRL222,984.00 (approx. USD 43,328.00)

#### SOCIOECONOMICS AND SUSTAINABILITY

#### The cocoa value chain

With support from the Vale Fund under the 2030 Forestry Target, the project "Cocoa: pollination, fermentation and bioeconomy" mapped the socio-economic and productive condition of 874 farming families, distributed respectively as follows: 360 in Medicilândia, 284 in Tucumã and 230 in Ourilândia do Norte, state of Pará.

The reality account of the cocoa farmers sheds light on the progress of cocoa farming in the state of Pará, as well as the actual challenges in the production process. The drawing of the age pyramid shows that the population is mostly comprised of elderly people, married adults with low educational level. The aging of the rural population showcases the longevity of this group of people, but also reflects the decrease in the number of heirs to the cocoa plantation. The scarcity of family workforce may justify the growth

of the "sharecropper" category as the main labor force available to work the fields.

Combined with family labor, the average size of rural properties (ranging from 28.5 ha to 58.5 ha) validates the category of family farmer. These requirements are used as a parameter that establishes the guidelines for formulating the National Policy for Family Farming and Rural Family Enterprises. Legal insecurity is still experienced by farmers regarding regularization of rural property, as the number of interviewees who lack any regulatory land property documentation is negligible. This shows the level of vulnerability of farmers settled in this area.

Even in the face of such challenges, soil and climate conditions associated with the historical production of cocoa crops enhance the productive potential of family farming, requiring major interference from public policies aimed at improving infrastructure and technical assistance to improve and transfer technologies adapted and/or developed to improve cocoa farming.

![](_page_25_Picture_7.jpeg)

The sample results found during the work were used to propose the cocoa value chain. By facilitating an understanding of the cocoa business potential and identifying possible weaknesses in production links, solutions can be found to increase the cocoa value chain in the state of Pará.

#### Name: Cocoa: pollination, fermentation and bioeconomy Coordination: Tereza Cristina Giannini Socioeconomics Coordination Axis: Rosa de Nazaré Paes da Silva Period: Mar/21 to Dec/25 Funding (2023): BRL 1,109,063.00 (approx. USD 215,502.00)

#### **DATA SCIENCE**

50

#### Data science for sustainable development – Integrating information

Anyone who has ever had to perform a biodiversity inventory in areas of interest has probably come across the difficulty of collecting and organizing fauna and flora data in various public and/or private databases. The DatalakeDS project was born in search of solutions to these issues: an initiative with several ITV researchers and Vale areas to build a scientific data lake. Data lakes centralize and integrate data from different sources, enabling advanced analysis. They offer flexibility, scalability and time and cost savings in data management, facilitating strategic decision-making. In DatalakeDS, data is organized into fields with specialized support, ITV researchers and partners, enabling fine quality control, data and metadata tracking.

Operating since 2022, the project provides a very diverse set of assets in its data catalog, available in partnership with the Vale Data Governance initiative (Vale's global data management). A few numbers on each theme of DatalakeDS, which is in constant development:

- Carbon is the topic with the largest data set, accounting for 70% of the entire catalog. Some assets are geared towards decision-making and supporting audits in Vale's Climate Change area;
- Biodiversity is a theme (4%)
  created to support the species inventory actions for São Marcos Bay and adds functionalities from the Biolink system (web system for fauna and flora inventories);

Meteorology is another topic under development (26%) to support the operational chain through short- and very short-term forecasting models.

Name: Data science for sustainable development (DatalakeDS) Coordination: Ronnie Alves Period: Jan/22 to Dec/24 Funding (2023): BRL 296,873.00 (approx. USD 57,685.00)

![](_page_26_Picture_10.jpeg)

![](_page_26_Picture_11.jpeg)

![](_page_27_Picture_0.jpeg)

ITV has been asked by Vale, the sponsoring institution, to expand its research beyond its area of operation and its enterprises, to support the public goals of preserving and restoring the environment and lifting people out of extreme poverty.

That's why ITV has taken an indepth look at the Amazon and all its potential for leveraging value for people nature conservation. One of the main initiatives in this direction is the mapping of genetic heritage as a basis for generating value both for environmental protection and conservation actions, and for economic development through biotechnological routes.

The Institute has also sought to develop new approaches to monitoring species as a means of assessing human impact on ecosystems, but also as a tool for qualifying protected areas and quantifying biodiversity to value conservation and restoration initiatives linked to carbon fixation.

To enable the market of this research, ITV is approaching to the innovation environment. Activation of the environment through the training of young scientists and entrepreneurs, aiming at possibilities that are opening and to prepare this audience to deliver products and services has been initiated. We expect that using the technologies under development will unlock value of the forest that has not yet been fully revealed.

The future of ITV stepping towards the use of new technologies that enable conservation and monitoring of native or recovered areas, as well as revealing the value of the genetic heritage of our biodiversity and realizing it in harmony with environmental conservation.

![](_page_28_Picture_0.jpeg)

![](_page_28_Picture_1.jpeg)