
CONARE
CONSEJO NACIONAL
DE RECTORES
CeNAT
Centro Nacional de Alta Tecnología
Transforming
Knowledge
into Development
Centro Nacional de Alta Tecnología
CeNAT
REPORT
2023

CONSEJO NACIONAL DE RECTORES

CeNAT
Centro Nacional de Alta Tecnología

Transforming Knowledge into Development

Centro Nacional de Alta Tecnología

CeNAT REPORT 2023

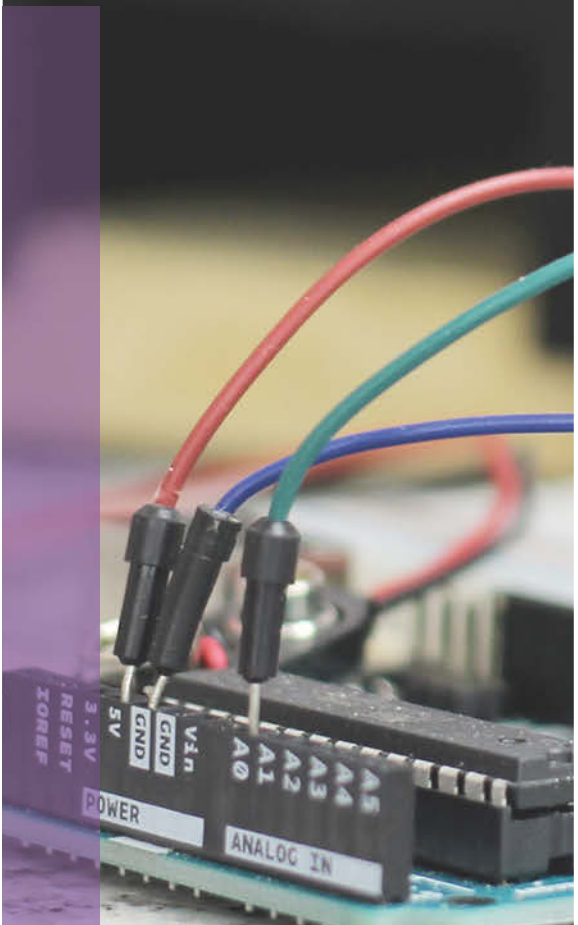
303.483
C755c Consejo Nacional de Rectores. Centro Nacional de Alta Tecnología.
CENAT 2023 report : Transforming Knowledge into Development [Recurso electrónico] / Centro Nacional de Alta Tecnología. – Datos electrónicos (1 archivo : 34 mb). -- San José, C.R. : CONARE - OPES, 2024.

ISSN 2215-6933
Formato pdf, (198 páginas.)

1. INFORME DE LABORES. 2. CIENCIA Y TECNOLOGÍA. 3. DESARROLLO CIENTÍFICO Y TECNOLÓGICO. 4. CONSEJO NACIONAL DE RECTORES. CENTRO NACIONAL DE ALTA TÉCNOLOGÍA. 5. COSTA RICA. I. Título.

Index

Acronyms



CONARE	National Council of University Deans
CeNAT	Centro Nacional de Alta Tecnología
PRIAS	PRIAS Laboratory
LANOTEC	National Nanotechnology Laboratory
CNCA	National Advanced Computing Collaboratory
CENIBiot	National Center for Biotechnological Innovations
CREATEC	Program for Creativity and Entrepreneurship in High Technology
TEC	Costa Rica Institute of Technology
UCR	University of Costa Rica
UNA	National University
UNED	Universidad Estatal a Distancia (State Distance Education University)
UTN	National Technical University
Edu-Roam	Education Roaming
LACOMET	Costa Rican Metrology Laboratory
USAID	United States Agency for International Development
BCCR	Central Bank of Costa Rica
CCSS	Costa Rica Social Security Fund
CONICIT	National Council for Scientific and Technological Research
ICE	Costa Rican Institute of Electricity
INA	National Institute for Learning (INA)
INEC	National Institute of Statistics and Census
MAG	Ministry of Agriculture and Livestock
MICITT	Ministry of Science, Technology and Telecommunications
MINAE	Ministry of Environment and Energy
RREE	Ministry of Foreign Affairs and Culture
FEES	Special Fund for Higher Education
SAF	Agroforestry Systems
PILA	La Amistad International Park
UdelaR	University of the Republic of Uruguay
CONICET	National Council for Scientific and Technical Research
UBA	University of Buenos Aires
CNEA	National Atomic Energy Commission
Univalle	Universidad del Valle, Colombia
UNI	National University of Engineering, Peru
CNRS	Centre National de la Recherche Scientifique, France
UGA	University of Grenoble Alpes, France
TGA	Thermogravimetry
FTIR	Fourier Transform Infrared Spectroscopy
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
CANAPEP	National Chamber of Pineapple Producers and Exporters
IJSO	International Junior Science Olympiad
COLAEIQ	Latin American Congress of Students of Chemical Engineering and Related Majors
ACOMET	ACOMET Metales y Minerales S.L.
INS	National Insurance Institute
AFM	Atomic Force Microscopy

QUIMICAM	Chemistry Camp
ECMAR	National Marine-Coastal Science Station
ICHO	International Chemistry Olympiad
NAVAL	NAVAL United States Geological Survey
INALVE	Inalve Food Industries
FIFCO	Florida Ice and Farm Company
ULEAD	LEAD University
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
USGS	United States Geological Survey
ESA	European Space Agency
DLR	German Space Agency
ILSI Mesoamerica	ILSI Mesoamerica Association
STEAM	Science, Technology, Engineering, Art, and Mathematics
ALLBIOTECH	Latin American Network of Young Leaders in Biotechnology
DOS PINOS	Cooperativa de Productores de Leche Dos Pinos R.L.
PINN	Innovation and Human Capital Program for Competitiveness
CITA	National Center for Food Science and Technology
INTA	National Institute of Innovation and Transfer in Agricultural Technology
AECID	Spanish Agency for International Development Cooperation
TUHH	Hamburg University of Technology, Germany
CORBANA	National Banana Corporation
BIOTECH	Biotechnology
SEVRI	Specific Institutional Risk Assessment System
AOP	Annual Operational Plan

CIPRONA	Products Research Center
IFAD	International Fund for Agricultural Development
COOPETARRAZU	Cooperativa de Caficultores y Servicios Múltiples de Tarrazú R.L.
PRISLAB	Pattern Recognition and Intelligent Systems Laboratory
TIC	Information and Communications Technology
SUTEL	Superintendency of Telecommunications of Costa Rica
Zii	Wireless Internet Zones
MOCUPP	Change in Use of Productive Landscape Monitoring
GIZ	German Corporation for International Cooperation
CNFL	National Power and Light Company
SIMOCUTE	National Monitoring System for Land Cover and Use and Ecosystems
SFE	State Phytosanitary Service
MINAE	Ministry of Environment and Energy
IGN	National Geographic Institute
PEN	State of the Nation Program
MAG	Ministry of Agriculture and Livestock
IMN	National Meteorological Institute
FONAFIFO	National Forest Financing Fund
OECD	Organization for Cooperation and Development
GPSDD	Global Partnership for Sustainable Development Data
BM	World Bank
SICA	Central American Integration System
GEF	Global Environment Fund
USAIG	United States Aircraft Insurance Group
SERVIR	National Civil Service Authority
FAO	Food and Agriculture Organization of the United Nations
ECLAC	Economic Commission for Latin America and the Caribbean
PIACT	Interactive Platform for Tropical Climate Application
LAICA	Sugar Cane Chamber
CAPROSA	Guild of Health Professionals
CASAGRI	Farmers House
OAS	Organization of American States
ANAGAN	National Association of Cattle Breeders
MEP	Ministry of Public Education
UNESCO	United Nations Educational, Scientific and Cultural Organization

Eduardo Sibaja Arias

Director
Centro Nacional de Alta Tecnología

CeNAT
contributing to research and innovation for the benefit of the country

25 years have passed since the Government of the Republic (1994-1998) and the Consejo Nacional de Rectores promoted the creation of the Centro Nacional de Alta Tecnología. This scheme was inspired by a model implemented in countries such as Korea, Japan, Malaysia, Singapore, and Israel, which explicitly linked the government, universities, and high-tech companies to form a tripartite alliance focused on scientific-technological research and innovation as driving forces of the economy.

In the midst of this panorama, a dream began to take shape that today, 25 years later, is a reality: the Centro Nacional de Alta Tecnología (CeNAT), a program created by the Consejo Nacional de Rectores (CONARE) in session N°5-99 of March 2, 1999 as an "interuniversity body specialized in the development of research and postgraduate studies in high-tech areas and the development of linkage and technological innovation projects with the government and business sectors".

Through these more than two decades, CONARE's CeNAT has developed extensive research experience, thanks to the work of its four laboratories - PRIAS Laboratory, National Nanotechnology Laboratory (LANOTEC), CENIBiot Laboratory, National Advanced Computing Collaboratory (CNCA), and the Environmental Management Area.

All of them focus their work on research and innovation, to transform scientific and technological knowledge into development.

During these years of achievements and challenges, we have implemented accountability instruments that strengthen transparency processes. One of them is the Annual Report that compiles the management of CeNAT and each division, which allows us to measure the degree of efficiency and effectiveness of our work.
In this 2023 Report, we present the institutional management figures. This year, CeNAT recorded 95 projects developed within the framework of the triple helix (academia, government, and private sector), 157 knowledge transfers, 66 scientific publications, technical assistance to more than 9,000 producers, support to 28 applied science research organizations or institutions; support to 45 applied science research companies; support to seven Olympiads and science fairs, and 85,363 science hours in simulations and data processing, among other management indicators.

Our work would not be possible without the support of the Consejo Nacional de Rectores (CONARE) and the alliances with strategic partners such as the University of Costa Rica (UCR), the Costa Rica Institute of Technology (TEC), the National University (UNA), the State University for Distance Education (UNED), the National Technical University (UTN), the Ministry of Science, Innovation, Technology and Telecommunications (MICITT), the former National Council for Scientific and Technological Research (CONICIT) -currently Costa Rican Promoter of Innovation and Research-; among many other institutions, companies and research centers of great renown, both national and international.

Presenting this Report and our management results within the framework of the 25th anniversary makes us reflect on maintaining coherence with reality and meeting the demands of these times, while very clearly marking the roadmap.

During this period, CeNAT has been consolidated as a unique center both in Costa Rica and in the region. **Our management indicators reflect our commitment to excellence and also challenge us to continue growing on the path of continuous improvement, while contributing to the strengthening of science and technology.** In addition, we have been helping to cultivate scientific vocations in future generations as a fundamental country goal.

Background **of CeNAT**

The initiative for the creation of a National High Technology Center in Costa Rica was raised with the support of state universities to attract investment in high technology. It took place in 1997, due to the role that the academy plays, as the main generator of research in Costa Rica, during the Figueres-Olsen national presidency.

Because of that, In October 1997, the Government of the Republic presented to the Consejo Nacional de Rectores (CONARE) an initiative to use the formerly used building by the US United States Agency for International Development (USAID) for the establishment of a national center in high technology, through which the academia would be linked with the Government and the productive sector, in areas of high impact linked to the attraction of foreign investment, for the benefit of national development. The proposal used Korea, Singapore, and Israel -the latter with the Technion or Israeli Technological Institute, located in Haifa- as reference countries.

On May 25, 1998, the Legislative Assembly enacted Law 7806, authorizing the transfer of the building to CONARE to create the Centro Nacional de Alta Tecnología (CeNAT) and call it after Dr. Franklin Chang Díaz. Furthermore, Article 3 of that law would also provided for the creation of the Centro de Alta Tecnología Foundation (FunCeNAT), whose purpose is to fulfill the legal duty of managing the resources required for the execution of the projects developed through CeNAT.

Subsequently, the CONARE, under the Coordination Agreement for State Higher Education, in session number 5-99, on March 2, 1999, created the CeNAT.

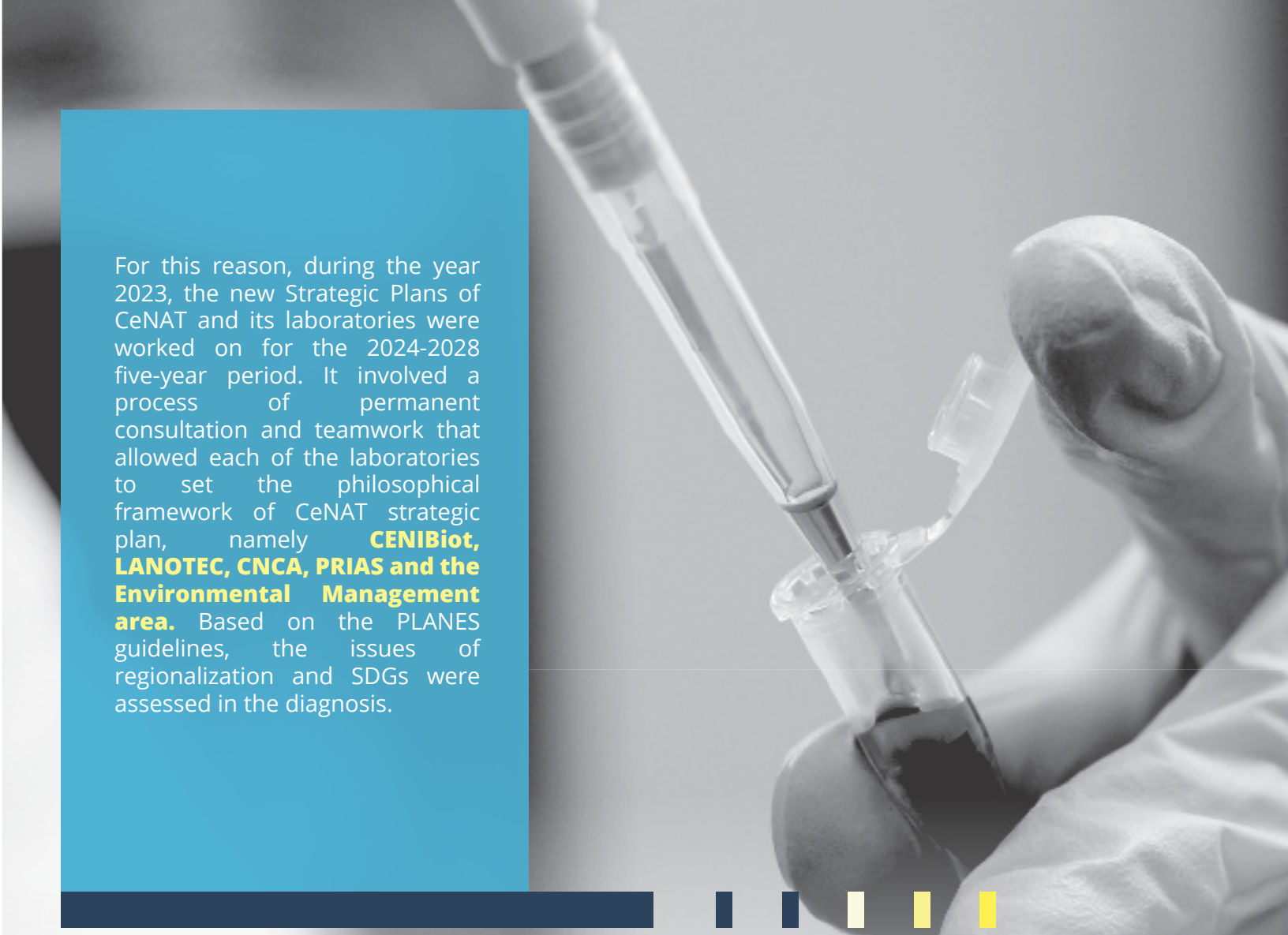
Under the above the above, CONARE supported the proposal to create a scientific and technological development center, which would enhance the research efforts of universities.

This is how CeNAT was formed as an inter-university encountering instance for the academy, the Government, and the productive sectors of the country, in different high technology fields, thus joining forces to enhance the potential of the country and to take advantage of the opportunities that technological development offers to countries that, like Costa Rica, have invested significantly in the education of their population at all levels.

During these years, the Center has consolidated a work platform based on the high technical-professional capacity of the personnel in its areas and laboratories, its equipment, and facilities, thus allowing it to promote various research and knowledge transfer projects, focused on the vision to ***transform knowledge into development.***

Strategic **Planning**

The year 2023 was an important year in terms of Strategic Planning. This year, CeNAT had an updated philosophical framework of its Strategic Plan and the Strategic Plans of its laboratories, including a mission, vision, and development goal that guide the course of the institution during this five-year period. However, this philosophical framework had to be updated to address new realities.



For this reason, during the year 2023, the new Strategic Plans of CeNAT and its laboratories were worked on for the 2024-2028 five-year period. It involved a process of permanent consultation and teamwork that allowed each of the laboratories to set the philosophical framework of CeNAT strategic plan, namely **CENIBiot, LANOTEC, CNCA, PRIAS and the Environmental Management area.** Based on the PLANES guidelines, the issues of regionalization and SDGs were assessed in the diagnosis.

The conclusion of the process determined that each laboratory has a different nature of undertaking its substantive management; therefore, the consultancy was asked to delve into the following aspects:

- Diagnosis of the organizational perception of CeNAT.
- Guidelines to address organizational lines of each Laboratory.
- Review the philosophical framework of the 2019-2023 Strategic Plan.
- Plan the substantive actions of each laboratory.
- Achieve an index that identifies the indicators of the substantive activity of each instance.
- Achieve an index that specifies the financing monitoring indicators.
- Integrate each of the philosophical frameworks to the areas of each laboratory into the CeNAT Strategic Plan.

Each of the points stated was worked on in a participatory manner with the management of the area and laboratories, integrating leading professionals and key informants into the discussions who validated the progress of each aspect expressed.

CENTRO NACIONAL DE ALTA TECNOLOGÍA

Transforming knowledge into development

Mission of CeNAT

"We are an inter-university coordination body that facilitates and promotes the proper functioning and systemic development of scientific research in higher education, in various areas of high scientific-technological content, oriented to research, linkage, environmental development, and extension, within an innovation framework with the government, civil society, and the private sector" (as inspired by the constitutive deed of CeNAT).

Vision of CeNAT

"To be a leading innovative Center that generates high-technology knowledge, products and services for the promotion of high-impact scientific-technological collaboration, promoting learning spaces, strengthening competitive development, and knowledge exchange at the highest level, while enhancing the mechanisms that support inter-university and institutional coordination of excellence both at national and international levels".

In addition to its mission and vision statements, CeNAT incorporated a Development Goal into its philosophical framework, as a contribution by the Center to the development of the country.

Development Goal

To conduct research activities that will provide the country with the necessary, relevant, and strategic technology for competitive development of the different sectors of society, in the economic, social and environmental scopes, through innovation, development, training and services in science and technology (based on the constitutive deed of CENAT).

Main **Objective**

To conduct training and research activities that would provide the country with the necessary, relevant, and strategic technology for the competitive development of the different sectors of society in the economic, social, and environmental areas.

Objectives of **CeNAT**

The objectives come from the constitutive deed of CeNAT, which guides institutional work, contribution, and the areas that it should manage to address the impact of the scientific exercise.

Specific **Objectives**

The specific objectives describe the major categories that come from the constitutive deed towards their orientation to collaborate to the scientific development of the country.

Regarding Science Promotion

To promote the development of research activities to provide the country with the necessary, relevant, and strategic technology, for the competitive development of the different sectors of society in the economic, social, and environmental areas.

To carry out anything that represents social, cultural, and scientific wellbeing according to or pursuant to Article 1 of the Law on Foundations.

Regarding Information and Training

To promote the creation and to provide contributions to support thinking spaces, as well as to coordinate actions that support scientific and technological development and conformation of multidisciplinary teams of researchers with a high level of training and experience (high level of critical mass), especially at the graduate level.

To promote technology extension, through exhibitions, conferences, seminars, technology markets, and training courses, among others.

Regarding Contribution to Postgraduate Specializations

To promote and support the implementation of academic research programs at the graduate level in coordination with state higher education university institutions.

Regarding Inter-Sectoral Linkage

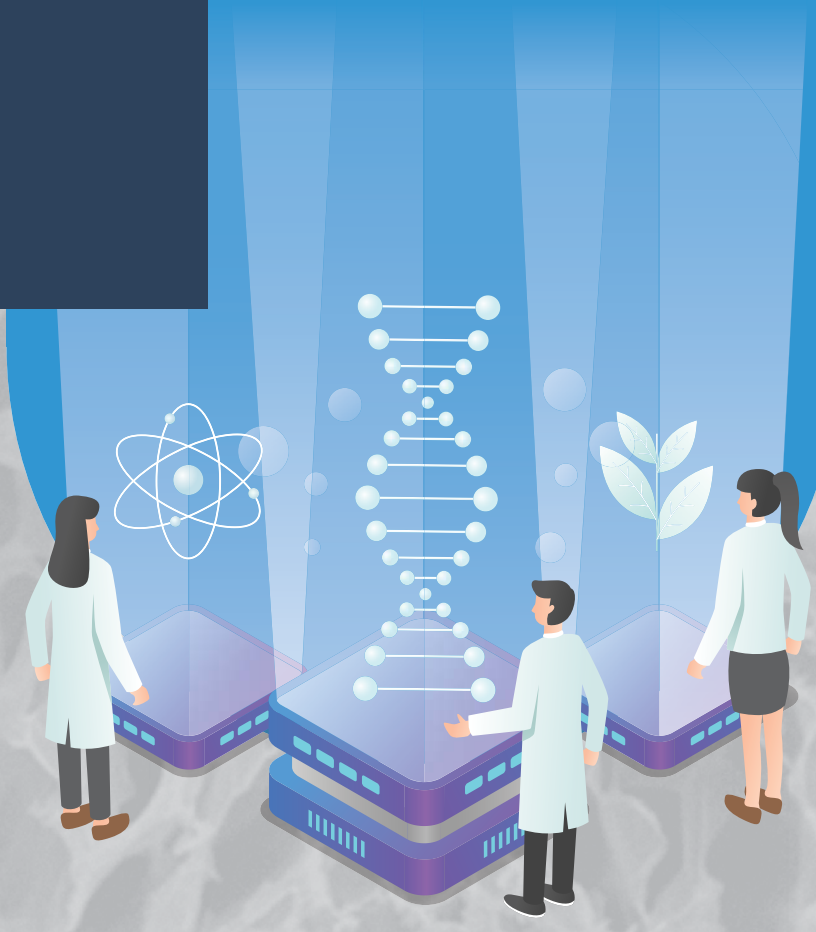
To promote the coordination of public and private sectors involved in generation, training, transfer, and application of high technology.

To encourage and promote the generation of businesses with high technological content and high added value for the country.

Regarding Contribution to the Country's Development

To conduct -with research purposes- activities for development, licensing, utilization of resources (know-how), donation or purchase of patents, inventions, industrial or utility models.

To publicize and sell publications arising from research; to assign, sell, transfer, and grant licenses for use of its patents, industrial or utility models, as well as any other assets that belong to its intellectual property.



Values and Principles Enforced at CeNAT

Our values comprise those indicated by CONARE, and then the values and principles that are enforced at CeNAT are presented below.

Institutional Values of CONARE

- Communication
- Planning
- Quality
- Transparency

Values Enforced at CeNAT

- Willingness to excellence in the work that is undertaken
- Transparency in the exercise of research
- Tolerance and flexibility in the processes that are developed
- Ongoing learning attitude
- Critical and self-critical position to address improvements in all research processes
- Continuous personal improvement attitude at the scientific level

Principles Enforced at CeNAT

- Collaborative and integrated work in all processes
- Scientific rigor in the studies undertaken
- Work conducted within interdisciplinary complexity
- Effective communication
- Accountability in goals and times set for each task
- Commitment to impact generation on the actions undertaken

Strategic Areas

Materials Science and Engineering	Biotechnology	Advanced Computing	Environmental Management	
LANOTEC	**CENIBiot**	**CNCA**	**PRIAS**	**Agromatics Climate Change**
Life Sciences	Sustainable agriculture	Artificial Intelligence	Geospatial Management	Variability and Climate Change
Standards and Regulations	Microbial communications	Bioinformatics	Geoinformatic Development	Agromatics
Scientific Vocations	Bioprocesses	High Performance Computing	Aerospace Catalyst	Clean energies
	Drug discovery	Scientific Computing		
		Data Science		
		Advanced Networks		
		Infrastructure		

These strategic lines highlight the importance of the collegiate work of each dependency that makes up the organization, where each action contributes to efficiency and projection.

Strategic Lines

CeNAT

The strategic lines are present in the work of CeNAT. They are defined as cross-sectional lines of the substantive activities carried out by the laboratories and the Environmental Management Area.

These strategic lines highlight the importance of the collegiate work of each dependency that makes up the organization, where each action contributes to efficiency and projection.

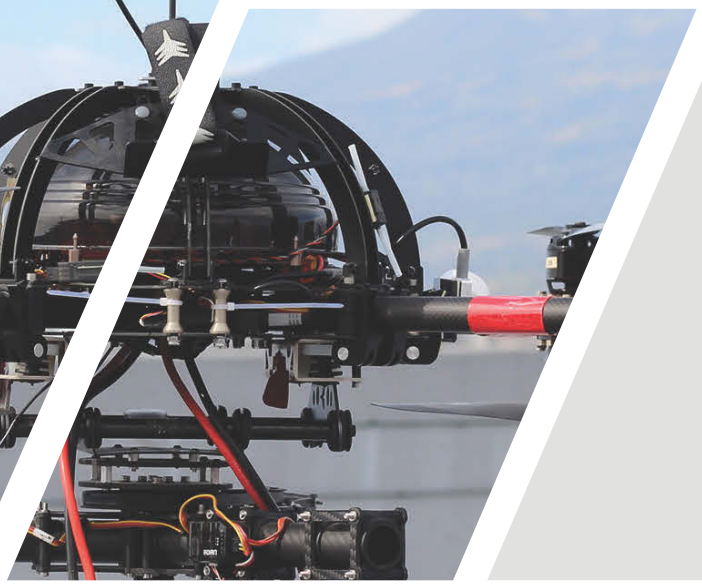
The strategic lines and their definitions are identified below.

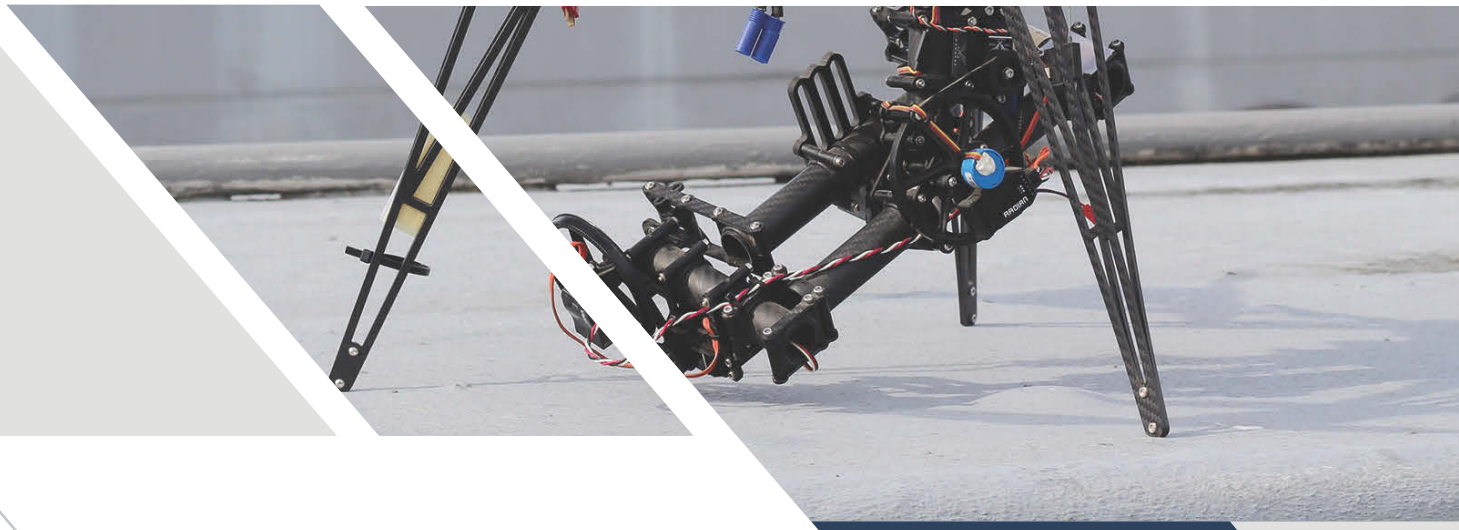
Knowledge Generation:
It provides the country with knowledge on relevant and strategic high technology, for the competitive development of the different sectors of society in the economic, social, and environmental scopes.

Learning Transfer:
It supports learning spaces from interuniversity coordination to articulate actions that support scientific and technological development and the formation of multidisciplinary groups of researchers with high scientific rigor.

Internationalization:
It strengthens knowledge exchange at the highest national and international levels, both in the public and private sectors.

Institutional Management:
It strengthens organizational management through mechanisms that support the sustainability of CeNAT promoting efficient and transparent accountability and the development of scientific relevance.





OUR AREAS, **LABORATORIES, AND PROGRAMS**

Our Areas, **Laboratories, and Programs**

Areas

- Materials Science and Engineering
- Biotechnology
- Advanced Computing
- Manufacture
- Environmental Management
- Science, Culture and Society

Laboratories

- National Nanotechnology Laboratory **(LANOTEC)**
- **CENIBIOT** Laboratory
- National Collaboratory of Advanced Computing **(CNCA)**
- **PRIAS** Laboratory

Programas

- Climate Observatory
- Agromatics
- CREATEC
- CeNAT - CONARE Scholarships
- CeNAT Teaching

Creation of **Divisions**

In accordance with agreement 5-99 of the Consejo Nacional de Rectores, CeNAT is comprised by the following areas:

I. **New Materials Area:**
Constituted in 2004, by the National Nanotechnology Laboratory (LANOTEC).

II. **Biotechnology Area:**
Since 2013, the CENBiot Laboratory integrates this operational area.

III. **Advanced Computing Area:**
Since 2009, the National Advanced Computing Collaboratory (CNCA) is part of it.

IV. **Manufacturing Area:**
There is no operating unit attached to it.

V. **Science, Culture, and Society Area:**
A cross-sectional area that is managed directly by the Directorate of CeNAT. It encompasses the CeNAT Teaching, CREATEC and CeNAT-CONARE Scholarship programs.

VI. **Environmental Management Area (AGA):**
This area includes one laboratory and two programs:

PRIAS Laboratory: It started in 2003.

Programas:

Variability and Climate Change Observatory: It started in 2010.

Agromatics, Food Safety, and Slow Food: It started in 2010.

13 years
Variability and Climate Change Observatory

2010

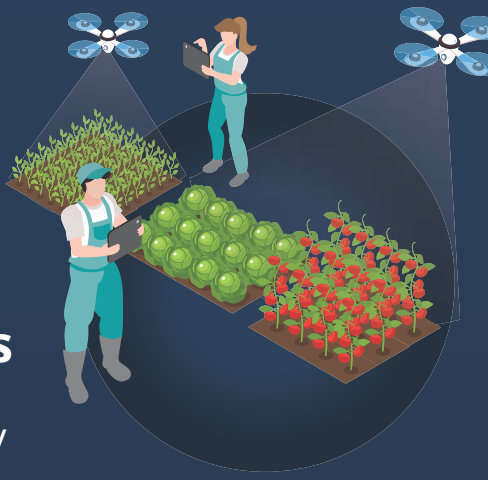
Agromatics, Food Safety and Slow Food

19 years
National Nanotechnology Laboratory (LANOTEC)

2004

2003

20 years
PRIAS Laboratory



2009

14 years
Advanced Computing Collaboratory (CNCA)

2013

10 years
CENIBiot Laboratory

CeNAT 2023

1998 (25 years)

Organizational Development of **CeNAT**

FunCeNAT

Board of Directors

Executive Management

CONSEJO NACIONAL DE RECTORES

Scientific Council composed of CONARE Vice-Chancellors for Research

Director General of CeNAT

FunCeNAT

- Administrative Management Services
- Financial Management Services
- Legal Management Services
- Human Talent Management Services
- Communication Management Services
- Strategic Consulting and Management
- International Articulation
- High Technology Equipment
- Strategic Scientific Communication

FunCeNAT does not belong to the CeNAT structure, its role is to provide services and support in administrative, financial, and legal management.

Materials Science and Engineering Area	Biotechnology	Advanced Computing	Environmental Management		Science, Culture and Society
LANOTEC	**CENIBiot**	**CNCA**	**PRIAS**	**ÁREA DE GESTIÓN AMBIENTAL**	
Life sciences	Sustainable agriculture	Artificial Intelligence	Geospatial Management	Programs	Programs
Standards and Regulations	Microbial communities	Bioinformatics	Geo-computer development	Variability and Climate Change	CeNAT Teaching
Scientific Vocations	Bioprocesses	High Performance Computing	Catalyst Aerospace Technology	Agromatics	CREATEC
	Metabolic diseases	Scientific Computing		Clean energies	Cenat - CONARE Scholarships
		Data Science			
		Advanced Networks			
		Infrastructure			

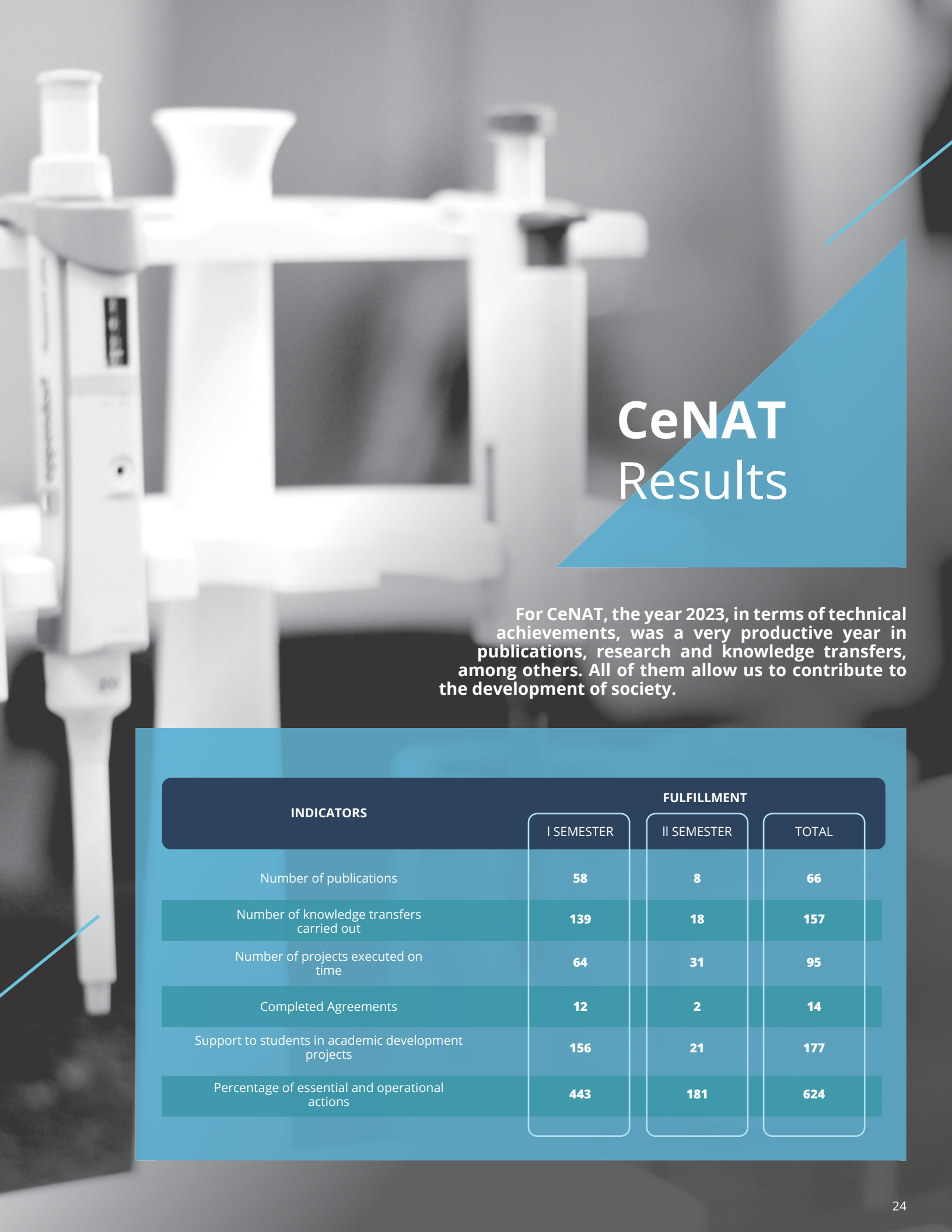
Monitoring of the organizational management indicators of the laboratories and the Environmental Management Area

Monitoring of the organizational sustainability indicators of the laboratories and the Environmental Management Area

The managing actions of CeNAT's Directorate are aligned to what was defined in the constitution deed of the Centro Nacional de Alta Tecnología, as follows: It seeks the correct performance of CeNAT, following the guidelines dictated by CONARE and the strategic lines defined by the Scientific Council.

The fundamental basis of the work of the Directorate is to watch over the strategic lines of the Center, such as:

- Monitoring and execution of agreements and conventions of CeNAT
- Establishment of the operational tactics and goals to be developed by the organization
- Overseeing the Sciences, Culture, and Society areas, which integrate the following programs:
  - CENAT Teaching
  - CeNAT-CONARE Scholarships
- Continuous follow-up to the actions carried out by each area and program attached to CeNAT



CeNAT Results

For CeNAT, the year 2023, in terms of technical achievements, was a very productive year in publications, research and knowledge transfers, among others. All of them allow us to contribute to the development of society.

INDICATORS	FULFILLMENT		
	I SEMESTER	II SEMESTER	TOTAL
Number of publications	**58**	**8**	**66**
Number of knowledge transfers carried out	**139**	**18**	**157**
Number of projects executed on time	**64**	**31**	**95**
Completed Agreements	**12**	**2**	**14**
Support to students in academic development projects	**156**	**21**	**177**
Percentage of essential and operational actions	**443**	**181**	**624**

CeNAT Teaching

CeNAT Teaching is part of Science, Culture and Society, one of the areas of CeNAT.

In this program, knowledge transfer activities are visualized. With this goal, CeNAT Teaching organizes lectures, workshops, and conferences aimed at different sectors of society, government, and academia, taught by world-class national and international experts, and linked to activities and/or projects of CeNAT, in scientific and technological subjects. In 2023, CeNAT Teaching was not operational.

Relevant Lectures:

In 2023 there was participation in relevant lectures, which are listed below:

LANOTEC

Modulation, analysis, and application of surface chemistry: a collection of stories

This lecture took place in person at the Department of Materials Science of the National Yang Ming. The event was organized by Prof. Hsin-Chieh Lin. It was taught by researcher Sergio Paniagua on January 20, 2023.

The Scientific Collaboration of LANOTEC in the Area of Polymers and Bioplastics

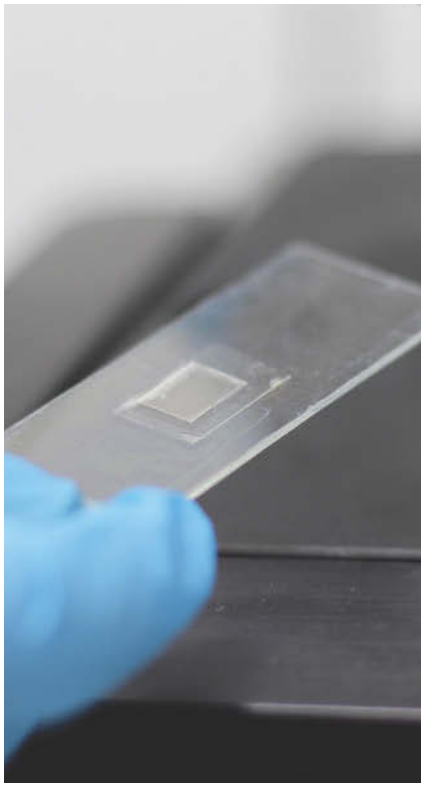
Lecture: CINDE international webinar: Bioprocessing, Microalgae and Biopackaging/Bioplastics. The event was held virtually and was organized by CINDE. The exhibition was developed by researcher Diego Batista on February 28, 2023.

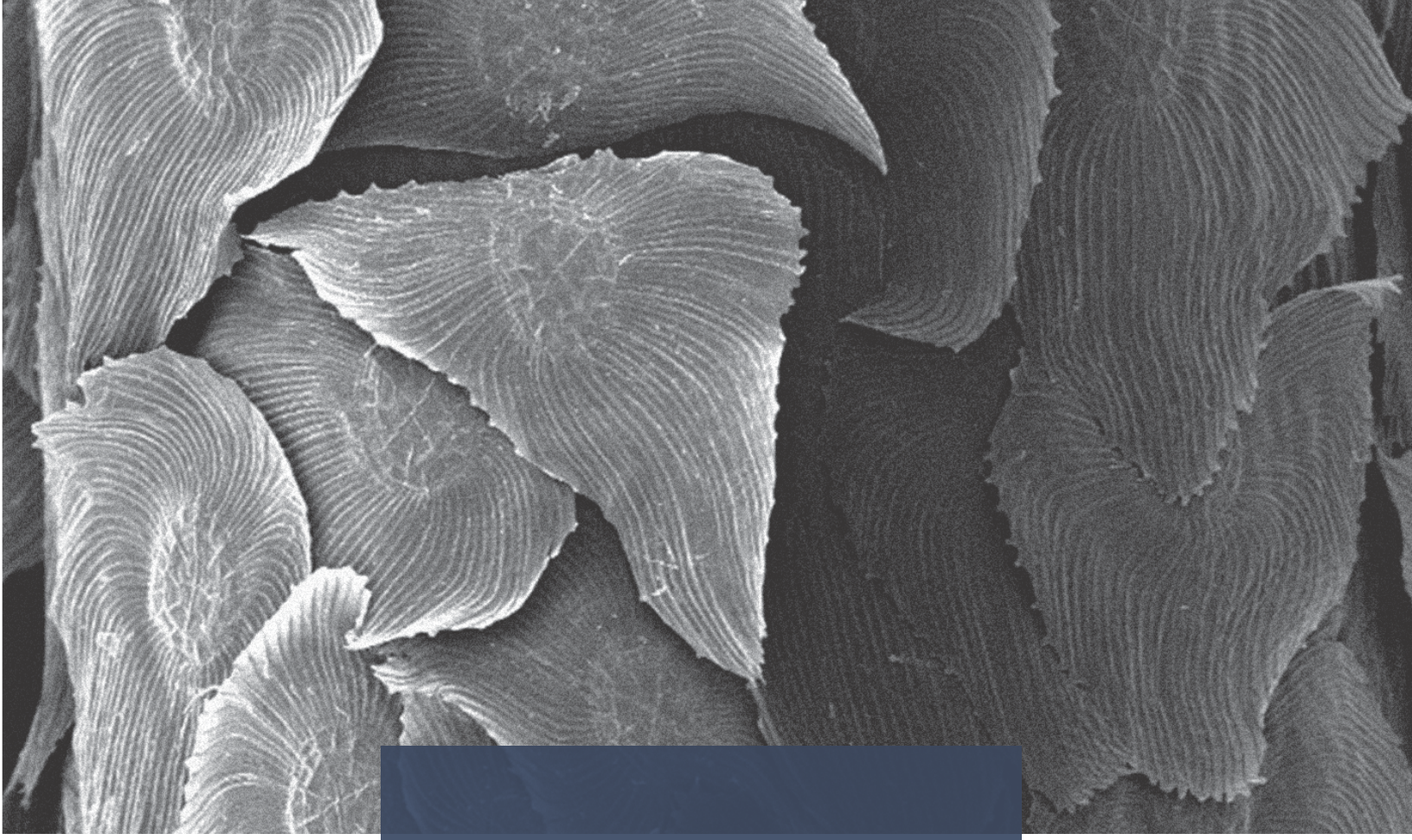
Biotechnology: engine for social and economic development in Costa Rica

Participation at the CRBiomed event: Biotechnology and Life Sciences Cluster. The Event was held virtually and was organized by CRBiomed. The conference was imparted by the director of LANOTEC, José Vega on June 9, 2023.

Nanotechnology and 3D printing applications

On August 29, 2023, the "Science Fair for Children" event was held in person. The event was organized by the CONARE Research Promotion subcommittee. The speaker from LANOTEC was researcher Rebeca Corrales.



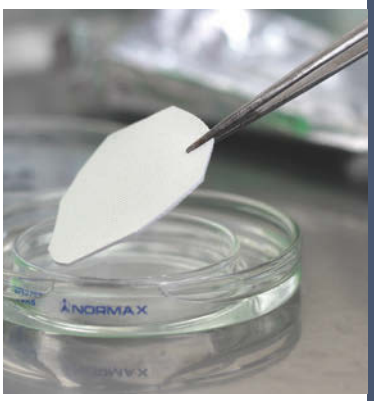


Sphingolipid-based synergistic interactions to enhance chemosensitivity in lung cancer cells

A lecture imparted by researcher Susana Mesé during the international event, “Sphingolipid Biology: the dawn of a new era” in Portugal. The event was organized by FEBS.

Nanoformulations of natural products: curcuminoids from Curcuma longa and proanthocyanidins from Uncraria tomentosa

The Chemical Society of Peru and SILAE organized the XXX Peruvian Congress of Chemistry and XXX Italo-Latin American Congress of Ethnomedicine, where on October 18, 2023, researcher Andrea Araya taught, in person, the lecture “Nanoformulations of natural products: curcuminoids of Curcuma longa and proanthocyanidins from Uncraria tomentosa”.



Generation and Applications of Aluminum-Based Nanostructures: from Antibacterial Surfaces to Plasmonic Substrates

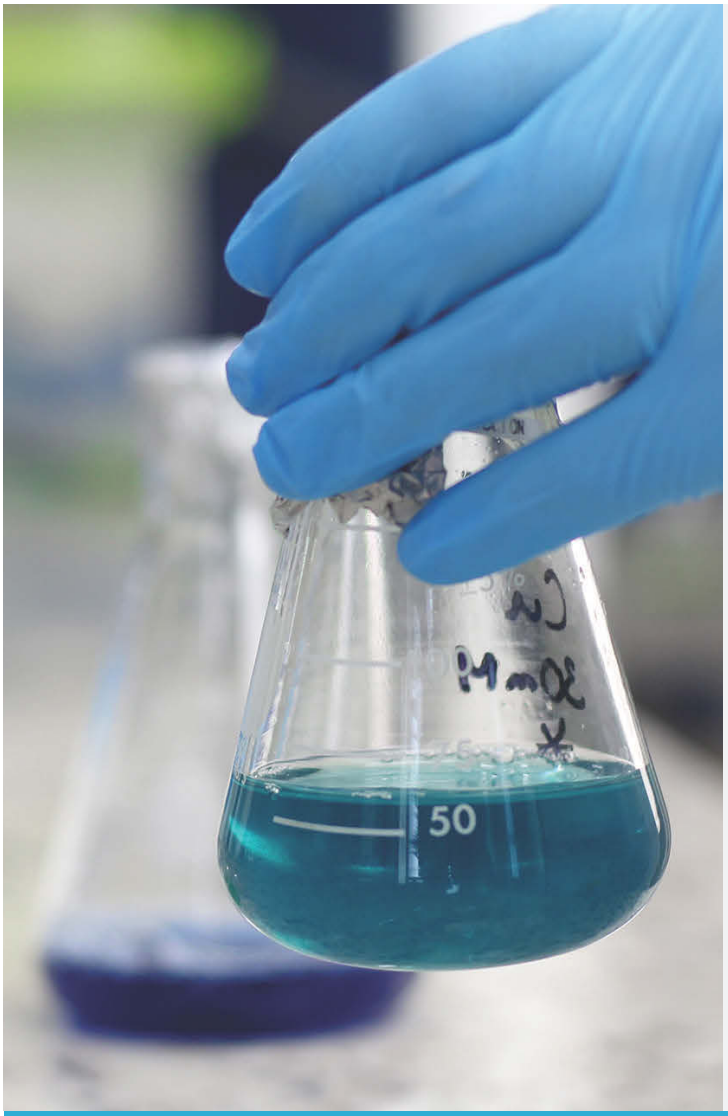
El 20 de octubre el investigador Sergio Paniagua impartió la charla citada anteriormente, durante la Conferencia del Caribe sobre Materiales Funcionales CARIBMAT 2023, en Puerto Rico. El evento fue presencial.

CNCA

Evaluation of Alternatives to Accelerate Scientific Numerical Calculations on Graphics Processing Units using Python, by researcher Johansell Villalobos, at the “CARLA 2023 Latin America High Performance Computing Conference” event.

Benchmarking AI-based plasmid annotation tools for antibiotic resistance genes mining from metagenome of the Virilla River, Costa Rica, by researchers Melany Calderón, Dorian Rojas Villalta, Kenia Barrantes, María Arias, and Keilor Rojas, at the “5th IEEE International Conference on “BioInspired Processing, BIP 2023”.

Microvilli Semantic Segmentation in Microscopy Images Using a Visual Learning Pipeline, by researcher Fabricio Quirós, at the 22nd IEEE International Conference on Machine Learning and Applications, ICMLA 2023.



CENIBiot

Speaker: **Max Chavarría Vargas**

Symposium: I Costa Rican Symposium on Environmental Microbiology: from Biodiversity to Biotechnology, San José, Costa Rica

Modality: In person
Date: Monday, October 23, 2023

Speaker: **Randall Loaiza Montoya**

Lecture at Digital Sequence Information (DSI) collaborations for biodiscovery",
during the scientific sessions held during the United Nations General Assembly (UNGA78)

Modality: Virtual
Date: September 18, 2023

Speaker: **Emanuel Araya Valverde**

Lecture: Latest research on the diversity of the tropical palm Acrocomia aculeata in Costa Rica and its potential for oil production, University of Göttingen, Germany

Modality: Virtual
Date: Saturday, February 25, 2023

ENVIRONMENTAL MANAGEMENT

Sustainable purchasing practices within the institution and our homes, conducted by researcher Jazmín Calderón Quirós on November 20, 2023. CONARE, via Zoom

Primatology Symposium XI: Seed dispersal by (*Alouatta palliatta*) in severely disturbed habitats, Santa Cruz, Guanacaste, Costa Rica, conducted by researcher Jazmín Calderón Quirós on November 22, 2023. Panama, via Zoom

Wastewater workshop: "An impact on the environment", conducted by researcher Jazmín Calderón Quirós on November 28, 2023. CeNAT/CONARE, via Zoom

Workshop - Actions within the institution to address climate threats, conducted by researcher Jazmín Calderón Quirós on November 29, 2023. CONARE

Refrigerant gas lecture "A simple action for a big impact", conducted by researcher Jazmín Calderón Quirós on November 29, 2023. CeNAT/CONARE, via Zoom

Lecture: "An opening to solid waste management", conducted by researcher Jazmín Calderón Quirós on December 11, 2023. CONARE

Expression and gastronomy workshop "The pejibaye in your hands", conducted by the coordinator of the Agromatics, Food Security and Slow Food program, Patricia Sánchez, June 17, 2023. Museo Nacional.

PRIAS

Environmental-geospatial learning experiences within the framework of action of the PRIAS Laboratory and geospatial information at the service of citizens. Researcher Heileen Aguilar and infrastructure analyst Stephanie Leitón presented the topic, Environmental-geospatial learning experiences within the framework of action of the PRIAS Laboratory at the Virtual Symposium on Environmental Education Experiences, held on September 28, 2023

Master lecture about the work of the PRIAS laboratory: PRIAS, 20 years building geospatial research. November 27, 2023, at the PRIAS 20 years of Geospatial Research event. As part of this, the director, Cornelia Miller, gave a master lecture about the work of the laboratory and the researcher Heileen Aguilar gave the closing words about the commitments and upcoming goals that PRIAS will be carrying out

Lecture about the MONEO-WET project. May 2, 2023. Researcher Iván Ávila gave a keynote talk to students from the School of Environmental Engineering of the Technological Institute of Costa Rica about the MONEO-WET project in the segment "Talks at noon" organized by the school. He was accompanied by researcher Heileen Aguilar and there the CeNAT-CONARE Scholarship program was also promoted

PRIAS, 20 years building geospatial research: In December 2023, director Cornelia Miller participated as a guest at the first Latin Women in Space session with a presentation on PRIAS' 20 years of building geospatial research and her role as a female leader in STEM areas with a focus on earth observations.

CeNAT – CONARE Scholarship Program

On the initiative of the Deans of CONARE's member universities, in 2013, the scholarship program started, which is aimed to encourage students enrolled in the state universities to develop final graduation or research works, linked to the areas of CeNAT.

The goals and topics related to these research works and theses should be directly linked to the competence topics of LANOTEC CNCA, CENBiot, PRIAS, and Environmental Management, according to specific contests that are held at public universities, which are disseminated by the institutional media and by the Vice-Chancellorships for Research at each university.

During the year 2023, upon request from the State Distance University (UNED), the dates of the contest were adjusted so that adjust to their own school cycles, so that the 2023 scholarship contest began on November 28, 2022 and was extended until August 2023, so that they began in September 2023 and are projected to conclude in June 2024.

An important milestone was the celebration of the first 10 years of the CeNAT/CONARE Scholarship Program, within the framework of which the first report of the scholarships developed during the last 10 years. In addition, a poster presentation of the 2022-23 scholarships and a high-level protocol event were held on August 22, 2023.

With the intention of avoiding overlapping scholarships and adjusting calendars, the 2024-25 contest began on December 10, 2023 to conclude the entire process in June 2024 and with the expectation of starting the new scholarships in July 2024.

For the scholarship promotion strategy, five different promotional posters were produced, according to affinity with the different laboratories, and the four promotional videos developed the previous year were reused. The posters are displayed below.

TABLE 1

Allocated Scholarships (by university and laboratory per year) from 2018 to 2023

CENAT - CONARE 2018-2023 SCHOLARSHIPS NUMBER - UNIVERSITY - LABORATORY

UNIVERSITY	LANOTEC							CENIBIOT							ENVIRONMENTAL MANAGEMENT							CNCA							PRIAS							TOTAL / UNIVERSITY					
	2018	2019	2020	2021	2022	**2023**	**Subtotal**	2018	2019	2020	2021	2022	**2023**	**Subtotal**	2018	2019	2020	2021	2022	**2023**	**Subtotal**	2018	2019	2020	2021	2022	**2023**	**Subtotal**	2018	2019	2020	2021	2022	**2023**	**Subtotal**	2018	2019	2020	2021	2022	2023
UCR	3	1	5	7	6	**5**	**27**	5	4	4	2	2	**3**	**20**	1	1	0	1	2	**2**	**7**	1	5	2	2	2	**2**	**14**	0	1	0	2	3	**1**	**7**	10	12	11	14	15	**13**
UNA	2	0	1	0	0	**1**	**4**	1	0	0	1	1	**2**	**5**	1	1	0	0	0	**0**	**2**	0	0	1	0	0	**0**	**1**	2	1	0	0	1	**0**	**4**	6	2	2	1	2	**3**
UNED	0	0	0	1	0	**1**	**2**	0	0	0	0	0	**0**	**0**	0	2	1	1	0	**0**	**4**	0	0	0	0	0	**0**	**0**	0	1	0	0	0	**1**	**2**	0	3	1	2	0	**2**
ITCR	1	2	2	1	1	**0**	**7**	1	0	1	0	0	**1**	**3**	0	0	1	0	1	**1**	**3**	3	1	0	2	0	**2**	**8**	1	2	1	3	2	**0**	**9**	6	5	5	6	4	**4**
UTN	0	0	0	0	0	**0**	**0**	0	0	0	0	0	**0**	**0**	0	0	0	0	0	**0**	**0**	0	0	0	0	0	**0**	**0**	0	0	0	0	0	**0**	**0**	0	0	0	0	0	**0**
TOTAL / LAB	6	3	8	9	7	**7**	**40**	7	4	5	3	3	**6**	**28**	2	4	2	2	3	**3**	**16**	4	6	3	4	2	**4**	**23**	3	5	1	5	6	**2**	**22**	22	22	19	23	21	**22**

Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

Total number of CeNAT-CONARE scholarships 2018 to 2023 by laboratory and area

ALLOCATION OF SCHOLARSHIPS 2013 - 2023

University	CNCA	CENIBiot	LANOTEC	Environmental Management	PRIAS	Total / University
UCR	29	30	35	8	8	**110**
UNA	1	17	10	6	10	**44**
UNED	1	0	2	5	4	**12**
TEC	10	12	11	4	15	**52**
UTN	0	0	0	0	0	**0**
TOTAL / LAB	**41**	**59**	**58**	**23**	**37**	**218**

Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

TABLE 2

Detail of the Scholarships allocated in the year 2023

DETAIL OF ALLOCATED SCHOLARSHIPS				
No.	**Student**	**Proposal**	**University**	**Area/Laboratory**
1	Adolfo Enrique Piedra Mora	Development of a parametric three-dimensional model of the historical architectural heritage of the Hermitage of Agony of Liberia with HBIM methodology using three-dimensional laser scanning	UCR	PRIAS
2	Brayan Rodriguez Delgado	Implementation of an automated learning algorithm for the detection of burned areas with satellite images in Costa Rica	UNED	PRIAS
3	David José Araya Gutiérrez	Genetic diversity of the Hevea brasiliensis tree (Willd. Ex A. Juss) for commercial cultivation in Costa Rica	TEC	CENIBiot
4	Dilan Rojas Saborío	Collagen membranes reinforced with natural nanofibers obtained from biomass for guided tissue regeneration	UNA	CENIBiot
5	Dorian Rojas-Villalta	Genomic and functional bioprospecting of new molecules with antibiotic potential in new strains of Extremophilic microorganisms from Antarctica	TEC	CNCA
6	Esteban Bertsch Aguilar	Creation and Evaluation of Computational Models for the Prediction of Lipophilicity in Carbohydrates	UCR	CNCA

DETAIL OF ALLOCATED SCHOLARSHIPS				
No.	**Student**	**Proposal**	**University**	**Area/Laboratory**
7	Geisel Cabrera Lazo	Encapsulation prototype of Trichoderma sp. with polymer matrices to combat Fusarium sp. in papaya cultivation	UNA	CENIBiot
8	Isaura Gutiérrez Vargas	Machine Learning for the forecast of minimum flows on the Pacific slope of Costa Rica	UCR	CNCA
9	Javier Stuardo Chinchilla Orrego	Analysis of the process and quality of synthetic and artisanal compost (Takakura) obtained from the degradation of PLA (40 µm) used for food packaging	UCR	LANOTEC
10	Johana Valera Rangel	Characterization of metabolites with antifungal activity produced by actinomycetes of the genus Pseudonocardia	UCR	CENIBiot
11	Jordan Hernández Ledezma	"Novo prosperous coffee: morpho-physiological and molecular performance of candidate M3 mutants of coffee (Coffea arabica L cv. Catuaí) in response to "orange rust" (Hemileia vastatrix) and the increase in temperature"	UNED	LANOTEC
12	Julián Sánchez Castro	Simulation of the magnetic field of the stellarator SCR-1 for the calculation of the radial velocity and visualization of the field vector map in turbulent flow	TEC	CNCA
13	Karen Andrea Salazar Barrantes	Atorvastatin calcium trihydrate: solid state characterization, compatibility study and effect of the tablet production process on its polymorphic stability	UCR	LANOTEC
14	Laura Rojas Artavia	Polylactic Acid Nanofiber Scaffold Impregnated with Deflazacort with Air Jet Spinning Technique	UCR	LANOTEC
15	Lucía Noboa Jiménez	Ultrastructural changes and gene expression patterns induced by Trichoderma rifaii in Coffea arabica upon infection by Mycena citricolor	UCR	CENIBiot
16	Luis Diego Mora Araya	Green synthesis and characterization of gold nanoparticles using Malpighia emarginata for the improvement of oncological treatments in radiotherapy.	UNA	LANOTEC

DETAIL OF ALLOCATED SCHOLARSHIPS				
No.	**Student**	**Proposal**	**University**	**Area/Laboratory**
17	Michael Solano Rojas	Experimental determination of the significant variables of a granulation process in a fluidized bed equipment and a coating process in a perforated drum equipment of the Pharmaceutical Research Institute (INIFAR) for the manufacture of coated tablets	UCR	LANOTEC
18	Randall Vinicio Hidalgo Sánchez	Diversity and genetic structure of the coral Pocillopora spp at two sites in the Eastern Tropical Pacific	UCR	CENIBiot
19	Sebastián Moya Salas	Evaluation of Raman signal enhancement of rhodamine 6G on gold layers with commercial optical disk nanotopographies, by means of SERS spectroscopy	UCR	LANOTEC
20	Vanessa Morales Cerdas	Dietary flexibility of howler monkeys (Alouatta palliata palliata) in altered habitats in Santa Cruz, Guanacaste: implications for sustainability and conservation	UCR	ENVIRONMENTAL MANAGEMENT
21	Andrea Rivera Álvarez (Extensión)	Development of a clean, photovoltaic, and wind powered system from peripherals (computers, refrigerators, compressors, and others) of a mobile laboratory, an electrical prototype, Mission Antarctica 2022 – 25	UCR	ENVIRONMENTAL MANAGEMENT
22	Fiorella Calderón (Extensión)	Design of a mobile research center Prototype powered with clean energies for the scientific expedition to Antarctica in January 2022-2025.	TEC	ENVIRONMENTAL MANAGEMENT

Summary

All the approved proposals have a high impact both in the generation of new knowledge (through articles, graduation papers, new product generation, and related), and in issues related to clean energy, new product generation, and prevention of natural disasters, throughout these 10 years.

Furthermore, the result quantitatively speaking demonstrates very good management and promising future projections, thanks to the Program's great capacity for adaptation and resilience.

LANOTEC

NATIONAL NANOTECHNOLOGY LABORATORY

LANOTEC

LANOTEC
Annual Operational Plan
(CeNAT-CONARE) 2023

INDICATOR	DISTRIBUTION OF GOALS ACHIEVED		
	Public	Private	Total
Scientific publications - Dissemination	27	6	33
Knowledge transfer activities	33	7	40
Research projects	18	18	36
Attention to students	55	9	64
Agreements	3	1	4

INTRODUCTION

The National Nanotechnology Laboratory (LANOTEC) is attached to the Centro Nacional de Alta Tecnología (CeNAT). On October 18, 2004, it started conducting research with the goal of being a technological leader in the Central American and the Caribbean region, with cutting-edge engineering on the study of advanced materials for research, design, and training in technologies associated with microtechnology, nanotechnology, and materials science.

It specializes in the study of materials, development of scientific research and generating knowledge from the various areas that work in synergy for the development of advances in science, allowing collaboration with the formation of human capital, giving relevance to scientific research and contributing to develop specific applications for the productive sector in different types of industries by making the most of its expertise in materials, polymers, microbiology, among others with the aim of supporting areas such as: medicine, geophysics and space exploration, among others.

It has established areas in which scientific research, innovation-entrepreneurship, as well as teaching and extension predominate.

Among the objectives to be met at the Laboratory is the contribution to the development of technologies that allow improvement of products and processes in the industrial sector and help to reduce the gap in nanotechnology between developed and poor countries. This will be achieved with training and support of a scientific committee that, together with the Director, mark the course that Laboratory should follow in scientific research.

Development Goal

To generate scientific value from nanobiotechnology to process and product innovation initiatives that impact economic development of Costa Rica.

Mission

We are a research laboratory for the use of nanobiotechnology that has specialized professionals who carry out studies with the highest scientific standards within the framework of innovation and development for the public, private, and social sectors of the Region.

Vision

We aim to be a self-sustaining research laboratory with high economic impact both nationally and internationally, which contributes to knowledge generation in nanobiotechnology, being a leader in strengthening competitive development and intersectoral articulation.

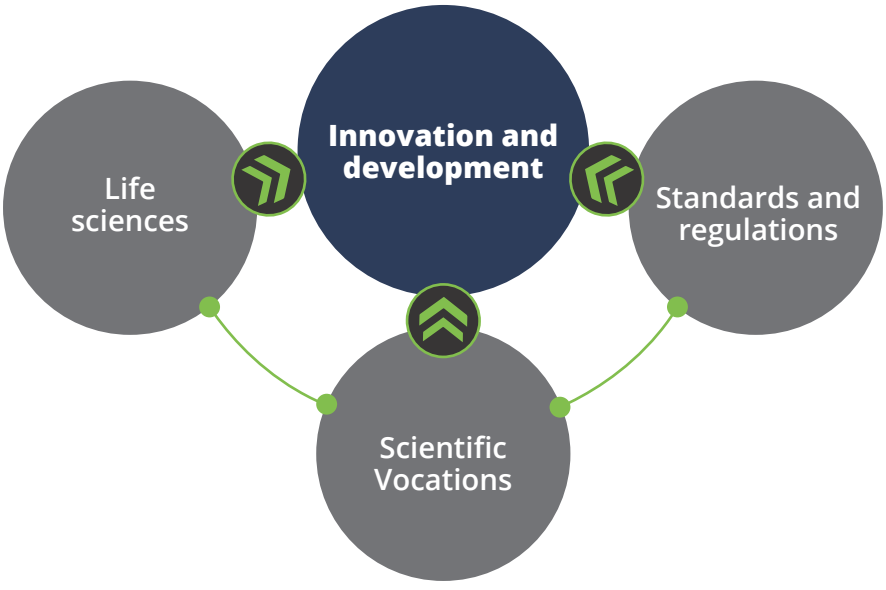
Values

- Collaborative management in the projects that are undertaken
- Socialization of scientific information
- Responsible project management
- Commitment to the processes and products that are undertaken

Principles

- Efficient use of time
- Efficient use of technological infrastructure
- Accountable administrative management of research projects
- Generation of ideas for process improvements

LANOTEC
Strategic Development Areas



Strategic Objectives

To promote innovation and excellence in Life Sciences to address the Challenges of Sustainable Development in Costa Rica

To develop and promote robust regulations and standards for the sustainable and ethical advancement of Nanotechnology and Biotechnology in LANOTEC that has an impact in Costa Rica

To foster the development of Scientific Vocations in STEM through Innovative and Collaborative Educational Programs, Aligned with the SDGs and the OECD Guidelines

Strategic Nodes

- Innovation and entrepreneurship
- ISO 17025 accreditation
- Scientific research
- Outreach and Teaching
- Art (Nanoart, conceptual art, and sports)

Impact Indicators

PUBLICATIONS

33
TOTAL

29 Indexed in Scopus

4 Other - indexed

Detail of publications:

Classification	Public	Private	Total
Q1	13	2	15
Q2	3	1	4
Q3	1	-	1
Q4	1	-	1
Specialized	-	-	-
Indexed SCIMAGO Scopus	5	2	7
Indexed in other indices	4	1	5
Total	27	6	33

KNOWLEDGE

TRANSFERS

40
TOTAL

35 **National**
- Workshops
- Courses, symposia

5 **International**
- Workshops
- Courses, symposia

People benefited: **1,038**

Research **Projects**

36
TOTAL

18 Public

- 2 FEES
- 3 CONARE Funds
- 13 Internal (OPERATIONAL LANOTEC)
  - 9 National Linkages
  - 3 International Linkages

18 Private

- 4 Other Public Funds
- 14 Private funds

Projects in negotiation

- Dos Pinos
- Coopeatenas

Attention to **Students**

64
TOTAL

- 15 Scholarships
- 37 Thesis support – Final graduation project, Internship, and Volunteering
- 12 Assistant hours

Linkages

National Academic Sector:

- University of Costa Rica
- National University
- Costa Rica Institute of Technology,
- National Tecnical University
  State University for Distance Education
- Invenio University
- ULACIT, ULatina Costa Rica

International Universities or Institutes:

- University of the Republic of Uruguay
- Private Northern University, Peru
- Max Planck Institute, Germany
- University of Belgrade, Serbia
- University of Buenos Aires, Argentina
- Sorbonne University, Paris, France

International companies:

- Philips Morris
- Confluent Medical
- Boston Scientific
- Allergan
- Smith Interconnect
- Proquinal
- CooperVisión
- Establishment Lab
- Ilsi Mesoamerica

National companies:

- Stein Laboratories
- Calox Laboratories
- Lisan Laboratories
- Florida Ice & Farm
- Corp.
- Asoproa
- Ecoinsumos

Agreements

4

TOTAL

3 National
1 International

Summary of Projects

FEES PROJECTS

	Project	General description
1	Role of neutrophils and complement in the modulation of the immune response against bacterial infections of importance in Costa Rica	This project allows generating basic scientific information on the pathogenesis and biology of these bacteria. It favors interuniversity collaboration and the training of new researchers and improves the general understanding of two bacterial infections of high importance in animal and human public health at the national level
2	Obtaining biodegradable films with antimicrobial activity from agroindustrial and marine waste	The objective of this proposal is to develop biodegradable chitosan films, with antimicrobial activity, from agroindustrial and marine waste

CONARE-FUNDED PROJECTS

	Project	General description
1	LANOTEC Operation	Promotion of scientific development in the Region through collaborative work between the LANOTEC team of researchers and students, focusing on the execution of projects, the publication of results, the creation of agreements and the transfer of knowledge. The purpose is to generate a significant impact in the public, private and social sectors, contributing to the advancement and strengthening of the region
2	Costa Rican Chemistry and Science Olympiad (OLCOQUIM)	The purpose of this project is to promote scientific vocations and environmental management in students who participate in the Costa Rican Science and Chemistry Olympiad, within the general framework of the ODES
3	**Max Planck:** Understanding of the velvet worm anti-adhesive sin mechanism as a model for biodegradable and low protein adsorption coatings	This project aims to generate fundamental knowledge about the non-stick properties of velvetworm skin and its mechanisms to design sustainable non-stick coatings, within the concept of biomimicry

LANOTEC OPERATIONAL PROJECTS (INTERNAL PROJECTS)

	Project	General description
1	CSIC- Arsenic-free - new nano-structured multifunctional materials to remove arsenic in groundwater	ARSENIC-FREE proposes to contribute to human development through the implementation of international collaborative development with a scientific-technological basis. The development consists of the manufacturing, characterization and scaling of a membrane composed of electrospun nanofibers containing nanoparticles with high As uptake power. Due to the adsorption mechanism and its low cost, the membrane does not require electrical energy to act and therefore can be used both in developed urban centers and in vulnerable communities without access to electrical energy or safe water
2	Structural elucidation of Irbesartan Form A using Rietveld and Le Bail methods	Work is being done in collaboration with the Applied Crystallography Laboratory of the General San Martin University of Argentina. Experimental powder X-ray diffraction data of Irbesartan form A have been used. Rietveld and Le Bail methods have been applied to these data using the FullProf Suite software. Not very promising results have been obtained so far; therefore, work is being done on the manually determined calculations of all the hkl reflections of the structure, based on the record of this structure reported in PDF4/Organics
3	Development and implementation of tools for understanding nanotechnology from practice: making the invisible visible 2021-2023	The objective is to train educators and adolescents in bionanotechnology through lectures and practices using easy-to-understand language. Costa Rica-Uruguay Bilateral Project. The scheduled workshops on the dissemination of nanotechnology were held, both in Costa Rica and Uruguay Additionally, the respective recordings were made for the editing of the videos related to the experimental part related to nanobiotechnology

LANOTEC OPERATIONAL PROJECTS (INTERNAL PROJECTS)

	Project	General Description
4	Crystal polymorphism in nanomaterials and soft systems: basic aspects and technological relevance	This is a macro project that addresses several topics, LANOTEC specifically participates in the line "*Polymorphism in compounds of pharmaceutical interest*: influence of crystallite size" , whose objective is to study the influence of crystallite size on the retention of the most suitable polymorphs of the selected molecules (saquinavir and curcumin) for their bioavailability. Crystal size reduction processes will be considered with equipment available in the pharmaceutical industry. Accordingly, the results obtained can be extended to other molecules of pharmacological interest
5	Identification of the proteins of the vascular basement membrane and surrounding extracellular matrix to which snake venom metalloproteinases bind by means of immunoelectron microscopy studies	To study the distribution and colocalization of different types of hemorrhagic metalloproteinases from snake venoms with proteins of the vascular basement membrane and surrounding extracellular matrix in murine muscle tissue by means of immunoelectron microscopy tests in order to identify the component to which these toxins bind
6	Development of a prototype of a medical device that allows the minimally invasive approach to neurological pathologies	The objective of this project is to develop minimally invasive access mechanisms and artifacts that facilitate the development of complex neurological operations, using 3D printing from the LANOTEC FabLab, in conjunction with Dr. Miguel Esquivel from Hospital México
7	Effect of the tablet production process on the polymorphic stability of atorvastin calcium trihydrate	Characterization of the raw material of atorvastatin calcium trihydrate (ATC) and evaluate the impact of manufacturing processes on its polymorphic stability, including the analysis of drug-excipient interactions as an integral part of preformulation studies. The purpose is to guarantee the quality and safety of the final product by understanding and controlling the polymorphic aspects during the formulation of the ATC, thus contributing to the optimization of its manufacturing process
8	Development of nanoparticle carriers of natural polyphenols to control grain contamination by mycotoxins.	Development and evaluation of the effectiveness of polymeric nanoparticles (NPs) that encapsulate polyphenols extracted from Costa Rican plants, in order to control mycotoxins in grains such as corn, beans, rice and peanuts. This project also aims to provide a viable alternative for small producers by addressing the limited stability and solubility of polyphenols, and at the same time, guarantee the safety of grains stored in common conditions used by these producers in Costa Rica

LANOTEC OPERATIONAL PROJECTS (INTERNAL PROJECTS)

	Project	General Description
9	Interaction of metal oxide nanoparticles of relevance in soils with phosphate ions and organic matter	Comparison of the reactivity of three iron and aluminum oxide mineral nanoparticles (ferrihydrite, nano-Al(OH)3 and allophane) in relation to phosphate and soil organic matter (SOM) retention. Use adsorption experiments on model systems and electron microscopy and spectroscopy techniques to characterize interactions at the micro and nanoscopic level. The purpose is to generate fundamental knowledge to understand the reactivity of NPox in soils, establishing the bases for future research on their impact on essential ecosystem functions, such as nutrient supply and organic carbon storage, in Costa Rican soils
10	Evaluation of the potential of fluorescent sensors analogous to sphingomyelin to identify mechanisms of chemotherapeutic interactions in cancer cells	To analyze sphingolipid metabolism and chemotherapeutic interactions in a lung cancer model using the A549 cell line loaded with a fluorescent sphingolipid analog (SM-BODIPY). We aim to investigate the cytotoxic interactions between conventional chemotherapeutic drugs (epirrubicin, cisplatin and paclitaxel) and perturbations in the sphingolipid pathway (enzymatic inhibitors) or autophagy modulators (activators or inhibitors) using fluorescence microscopy. The ultimate goal is to improve the understanding of cellular responses to treatments, with potential implications for the development of more effective therapeutic strategies against lung cancer
11	Safety, sustainability and resilience in domestic and small-scale biogas utilization systems in the agricultural and agroindustrial sector	Development of a comprehensive project to modernize anaerobic biodigestion systems in Costa Rica, with emphasis on improving safety and efficiency in biogas production. The aim is to analyze and mitigate the associated risks, applying Materials Science for the purification of methane and the use of nanostructured materials such as activated carbon, graphene oxide and clay soils with iron oxides. LANOTEC will contribute with its experience in biorefining and development of nanotechnology for filters. The final objective is to implement a pilot plan in the Caribbean region, training beneficiaries in the safe and sustainable management of biogas and installing filters to improve the safety and efficiency of biodigestion systems

LANOTEC OPERATIONAL PROJECTS (INTERNAL PROJECTS)

	Project	General Description
12	Manufacture of biosolar cells from microalgae biomass: Double harvest of solar energy for production of photosynthetic proteins and photovoltaic energy	Development of biosolar cells based on renewable biomass and photosynthetic organisms for efficient solar energy capture. Use nanotechnology to improve efficiency and overcome limitations in charge transfer in the electrodes. Implement a microalgae culture in the TEC under specific natural conditions to produce proteins and extraction of essential pigments for the construction of biosolar cells. Advance knowledge in Costa Rica to take advantage of these biological resources and apply them in devices with high added value, thus contributing to the development of more sustainable and efficient technologies in the capture of solar energy
13	Microfluidic biosensor for detection of Brucella abortus: proof of concept for detection of infectious agents under WHO standards	Improvement of an existing microfluidic device into an affinity biosensor that allows specific detection of bacteria in biological fluids within 30 minutes. Introduce DNA aptamers to ensure specificity of detection. To evaluate the efficiency of the device to separate and concentrate bacteria in biological liquid media. The purpose is to develop a rapid, accurate and economical diagnostic technique for the simultaneous detection of multiple microorganisms in developing countries, meeting the criteria established by the World Health Organization for ideal diagnostic methods

PRIVATE FUNDS PROJECTS

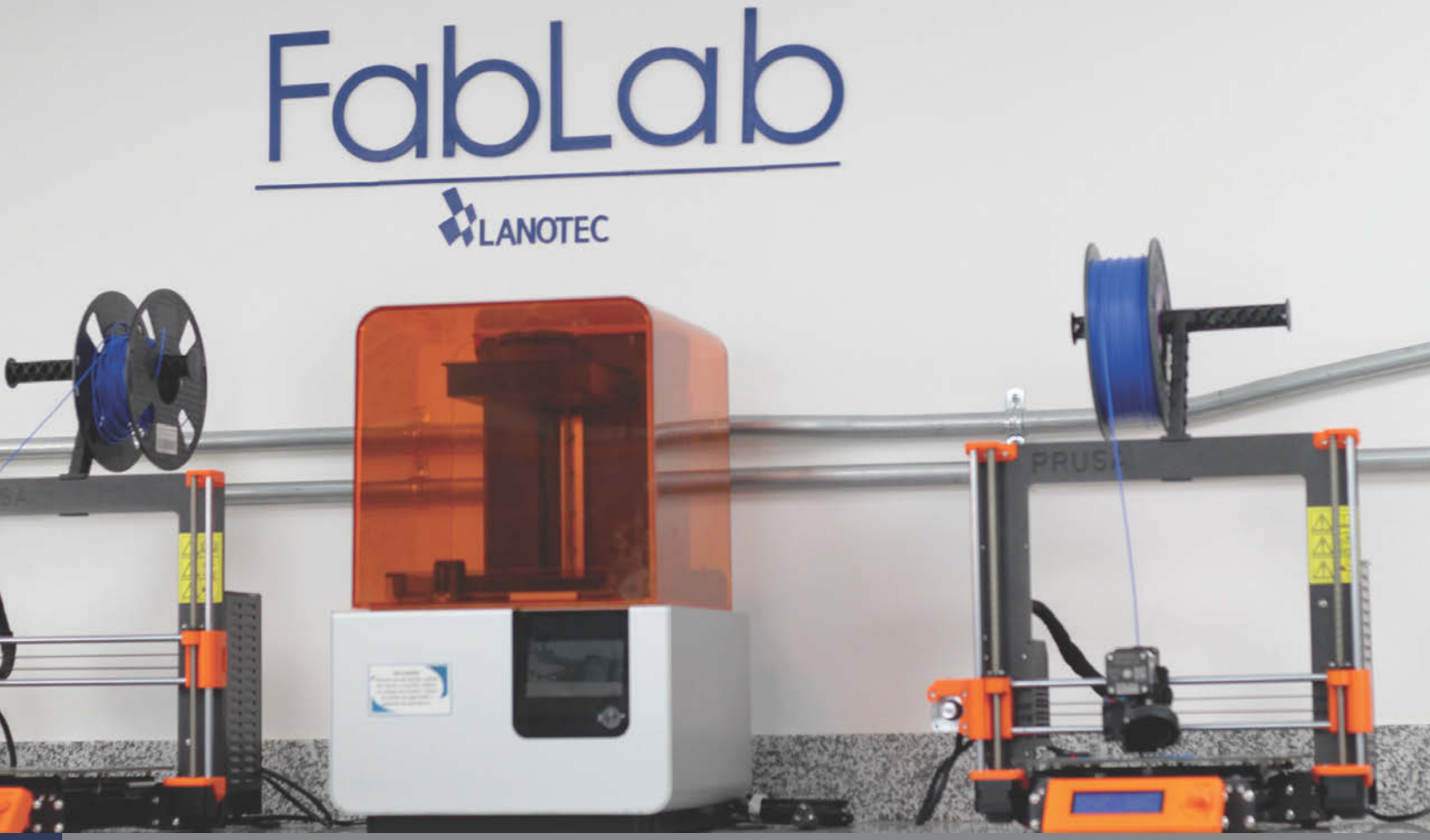
	Project	Objectives
1	LANOTEC UPS	LANOTEC's team of researchers, in collaboration with students, aim to generate scientific value through in the development of projects, publications, agreements and knowledge transfers. These activities are designed to positively impact the development of the public, private and social sectors of the Region
2	BAC Credit Cards Project (BAC Cards)	Evaluation of samples of credit and/or debit cards issued by BAC company made up of 2 commercial polymers

PRIVATE FUNDS PROJECTS

	Project	General Description
3	Promotion of scientific vocations Challenge Fair (Challenge ISEF)	To encourage a rapprochement with the country's academic centers and provide support in the development of scientific events (fairs), in order to encourage the development of scientific vocations at the country level. This project depends on the interest of the organizers of the Scientific and Technology Fairs, as well as the national Engineering Fairs
4	H2020– Automated functional screening of IgGs for diagnostics of neurodegenerative diseases (AUTOIgG)	It involves the development of experimental cellular models and procedures with immunoglobulins (IgGs) from patient sera as diagnostic and prognostic technologies related to neurodegenerative diseases, ND (particularly based on amyotrophic lateral sclerosis - ALS research). Additionally, the definition of the labeling characteristics of the standardized in vitro approach for ND diagnostic protocols, and the design of a small-scale platform based on automated fluorescence microscopy
5	Evaluation of PLA for the eco-sustainable manufacturing of packaging. (FIFCO)	Research of alternative materials to plastic and composting processes to reduce environmental impact
6	Evaluation of the impact of cigarette smoke vs THS on indoor air quality. (PMI Air Quality)	The impact on air quality in an outdoor space, produced by the smoke emitted when smoking conventional cigarettes versus the aerosol generated by the THS device, was evaluated
7	Evaluation of the physicochemical characteristics of abaca produced in the Horquetas de Sarapiquí area and the development of a purification methodology for the fibers obtained by the Costa Rican extraction process. Abaca fiber project. (Nippon Paper)	The main objective of the project is to evaluate the morphological characteristics and silica content present in Abacá from Costa Rica. Additionally, compare with the data reported for crops from the Philippines and Ecuador and determine if the silica content is higher than that reported in other countries; to identify if there is a significant variation that may justify a partial removal process. It is proposed to study the structure of the internal and external plant, both mature and green, to understand their morphological and physicochemical differences
8	Design and development of a concept model to establish a bioinformatic study of lung cancer by means of computer vision at nanomolecular-scale 3D images and circulating molecular biomarkers of associated genes (Lung cancer)	Design and development of a concept model to establish a bioinformatic study of lung cancer by means of computer vision at nanomolecular-scale 3D images and circulating molecular biomarkers of associated genes. This approach seeks to improve the understanding and analysis of the disease, allowing a detailed evaluation of nanomorphology and the presence of circulating molecular biomarkers for better characterization and diagnosis of lung cancer
9	Evaluation of the antimicrobial activity of vinyl fabrics produced by the Proquinal company, Argento project, Phase II.	The main objective of this project is to evaluate the antimicrobial characteristics of vinyl fabrics in terms of bacterial adhesion and antimicrobial activity of two types of fabrics LACA PH and LACA Spectra. For this, the morphology and roughness will be evaluated using AFM and SEM. In addition, microbiological tests will be carried out using two bacteria, a Gram - and Gram + bacteria, following the JIS Z 2801 test method.44. The protocols used in phase I will be followed

PRIVATE FUNDS PROJECTS

	Project	General Description
10	Development of a sensor system for the rapid determination of biomolecules. (Panama Project)	Development of a sensor system with the purpose of achieving the rapid determination of biomolecules
11	Biopolymer prototype, obtained from pineapple biomass waste. (BIO TAG)	Creation of a prototype of biopolymers using biomass waste from the pineapple industry
12	Metal nanoparticles biosynthesized from agroindustrial waste applied in the functionalization of bioplastics for use in the berry industrial chain	Development of metal nanoparticles through biological synthesis using agro-industrial waste and apply them in the functionalization of bioplastics intended for use in the berry industrial chain
13	Alternatives for interface-modified and 2D/3D perovskite absorbers for perovskite solar cell applications. (NAVAL)	Development and optimization of perovskite solar cells through the synthesis, characterization, and application of 3D-2D mixed perovskites. Design, synthesize and evaluate germanium-coordinated substituted arylamines as hole transporters (HTL) in these solar cells. Investigate the impact of using phosphonic acids and carbon quantum dots as surface modifiers and interfacial layers on the performance and stability of perovskite solar cells, by correlating them with properties such as surface energy, changes in local work function, morphology of the active layer, crystallinity and absorbance, using techniques such as force microscopy with a Kelvin probe
14	Biomaterials Prototype Development Program 2023 (CINDE – INA)	To provide the necessary technical support to small companies to promote the development of 10 product prototypes



OTHER PUBLIC FUNDS

	Project	General Description
1	FI-55B-19: Revaluation of coffee brush as an alternative adsorbent material to activated carbon in the removal of bromacil from water sources	Obtaining new low-cost adsorbent materials from coffee biomass as an alternative to activated carbon in the removal of bromacil from water sources
2	CB-0006-20: Nano-phytopharmaceuticals for the prevention and treatment of COVID-19: Scaling of solid-lipid nanosystems and in-silico and in-vitro studies of inhibitor candidates of the SARS-CoV-2 virus	This project involves scaling the solid-lipid nano-formulation processes of curcumin and piperine and their complex materials for their application to other molecules of natural origin with structural similarity, elucidated from in silico and in vitro studies of inhibition of the SARS virus. -CoV-2 and treatment of COVID-19
3	PINN Cheesemakers: Generation of agro-industrial capacities and creation of a comprehensive unit (physical-chemical, organoleptic, and microbiological characterization) to improve the production process of Turrialba cheese with Designation of Origin	It involves the generation of agro-industrial capacities and creation of a comprehensive unit (a physical-chemical, organoleptic, and microbiological characterization laboratoty- to improve the production process of Turrialba cheese with Designation of Origin
4	FI-0002-2022 Cancer therapy through micellar release of drugs based on Costa Rican natural products	Development of smart micelles for the release of substances extracted from Costa Rican flora with potential in the treatment of cancer

CENIBiot

CENIBiot

LABORATORY

CENIBiot Annual Operating Plan

(CeNAT-CONARE) 2023

INDICATORS

DISTRIBUTION OF GOALS

	Public	Private	Total
Scientific publications - Dissemination	14	1	15
Knowledge transfer activities	28	2	30
Research projects	21	5	26
Attention to students	65	7	72
Agreements	1	1	2

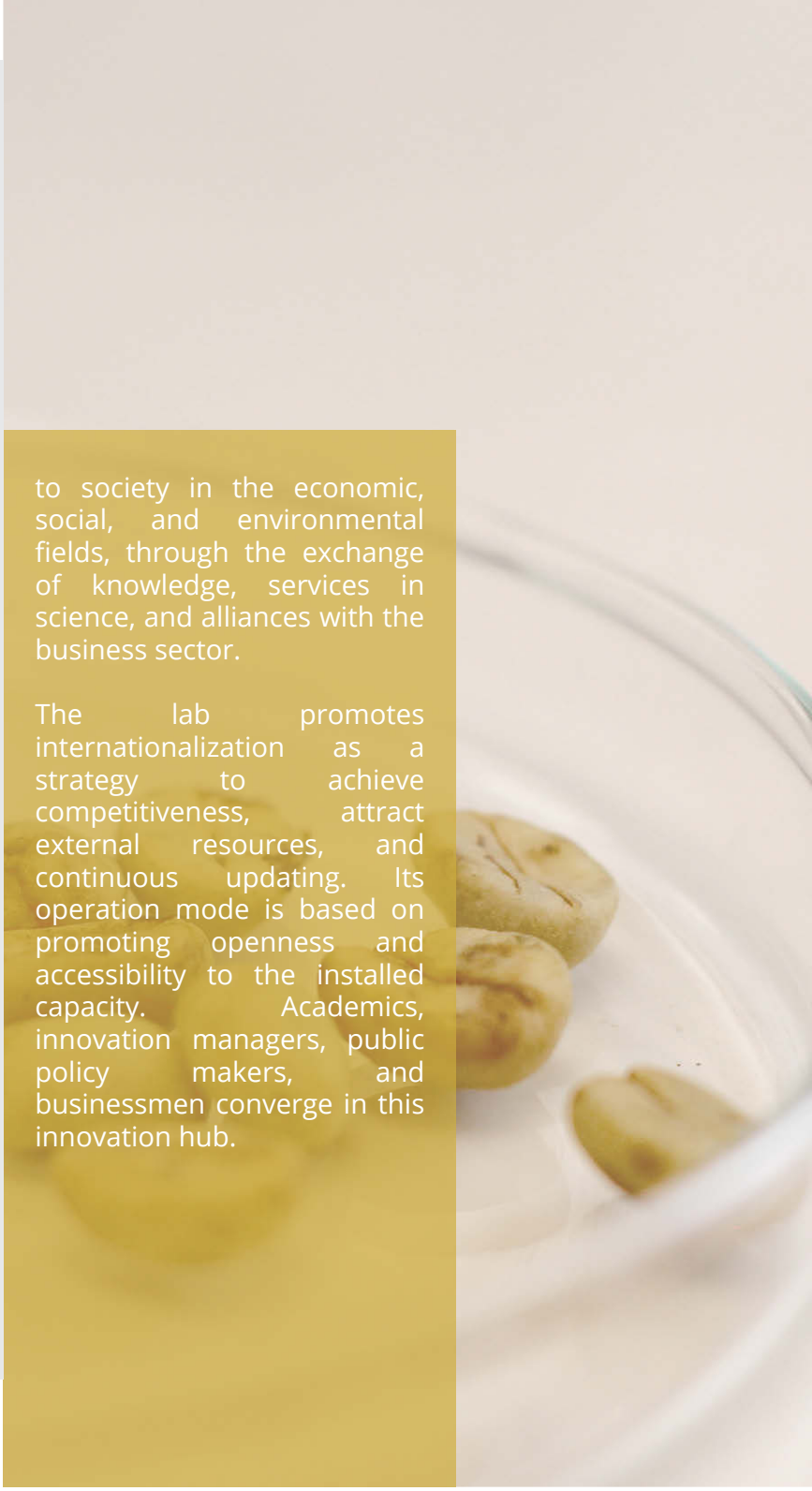
INTRODUCTION

The National Center for Biotechnological Innovations (CENIBiot) is an interuniversity Laboratory for research, development, innovation, and scaling up in biotechnology, attached to Centro Nacional de Alta Tecnología (CeNAT), with the financial support and oversight by the Consejo Nacional de Rectores (CONARE).

CENBiot contributes to the generation of innovative biotechnological solutions and strategic partnerships between the academic, business, and government sectors, through support for entrepreneurship, technology transfer and university-business linkage. This way it seeks to achieve its vision of being a "world-class interuniversity center in biotechnological innovation".

Its Development Goal is to generate biotechnological research that contributes to the development of Costa Rica, through scientific projects and impact innovation that contribute to society in the economic, social, and environmental fields, through the exchange of knowledge, services in science, and alliances with the business sector.

The lab promotes internationalization as a strategy to achieve competitiveness, attract external resources, and continuous updating. Its operation mode is based on promoting openness and accessibility to the installed capacity. Academics, innovation managers, public policy makers, and businessmen converge in this innovation hub.



The goal of this report is to present the main strategic actions developed by CENBiot (CeNAT-CONARE) in 2023, including the main goals based on the opening, linking, and internationalization actions proposed on the 2019-2024 CENBiot and CeNAT Strategic Plan, as well as the implementation and continuity of the proposals raised in:

- The Improvement and Implementation Plan of CENBiot's 2019-2024 Strategic Plan
- The 2024-2028 Strategic Plan prepared during 2023.
- The 2021-2025 National Plan for Higher Education (PLANES) of CONARE.
- The 2022-2027 National Plan for Science, Technology, and Innovation of the Ministry of Science, Technology, and Telecommunications (MICITT).

Strategic Actions Executed in 2023

During 2023, CENIBiot continued to develop strategic lines that are the basis of scientific production and the most relevant alliances with the productive sector inside and outside Costa Rica.

With CENIBiot Operational funds, strategic lines were favored such as the study of microorganisms, their biology, biological interactions in various ecosystems and their use, mainly in agriculture. Approximately 75% of scientific production is based on these themes. Thanks to these strengths we have been invited to participate in prestigious international events organized by institutions such as WIPO, WAITRO, UNESCO-IEEE Entrepreneurship Workshop, and ACTIVA CATIE, among others. Participation at influential forums such as the International Microbiology Literacy Initiative (IMiLI) was consolidated and a high-level international event in environmental microbiology was organized. To continue growing, significant resources were invested in developing novel methodologies in metabolomics that in the future will be reflected in more robust and high-impact projects.

The prestige, trust and visibility associated with the main lines of research favored important collaborations with private actors in Costa Rica and abroad. Highlights include the conclusion of the first stage of the R&D project in collaboration with Mammoth Biosciences, led by Dr. Jennifer Doudna, Nobel Prize winner in chemistry. The "Large-Scale Microbial Diversity Study in Costa Rica" began with the company Basecamp Research from the United Kingdom, which also donated cutting-edge equipment and training for the academic ecosystem, job creation, and economic benefits for the private sector. Thanks to this alliance we participated at the scientific sessions that took place during the United Nations General Assembly (UNGA78) and the collaboration was publicized in the European media. Also, the company Compound-Foods based in San Francisco-California trusted CENIBiot to accelerate the development of a strategic line of its business plan. Finally, the leadership in the study of biofuels for agricultural use provided us with access to competitive funds from the Adelante2 triangular cooperation program between Latin America and Europe, endowed with more than $70 thousand USD in materials and logistics.

In summary, perseverance in strategically defined lines of research begins to bear the expected fruits in the task of "transforming knowledge into development" alongside the productive sectors, in addition to the growing recognition and academic productivity that has been experienced in recent years.

Development Goal

To generate biotechnological research that contributes to the development of Costa Rica, through scientific projects and impact innovation that contribute to society in the economic, social, and environmental fields, through the exchange of knowledge, services in science, and alliances with the business sector.

Mission

We seek to be a biotechnological research and development laboratory that works with high scientific standards and where higher education in Costa Rica, public and private sectors converge to accelerate scientific and technological innovation.

Vision

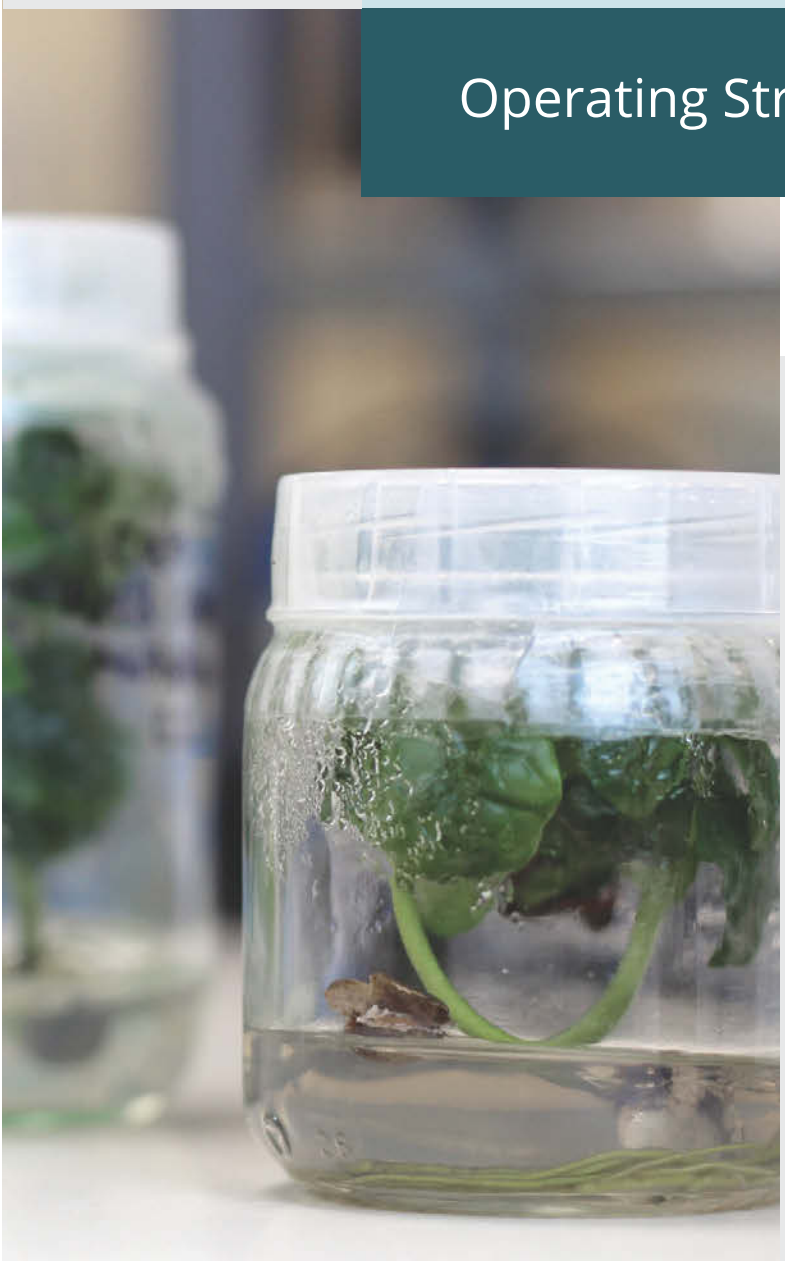
We aim to be a self-sustaining laboratory with high scientific, economic, and social impact at the national and international level that strengthens competitive development through scientific rigor and intersectoral articulation.

Values Enforced at CENIBiot:

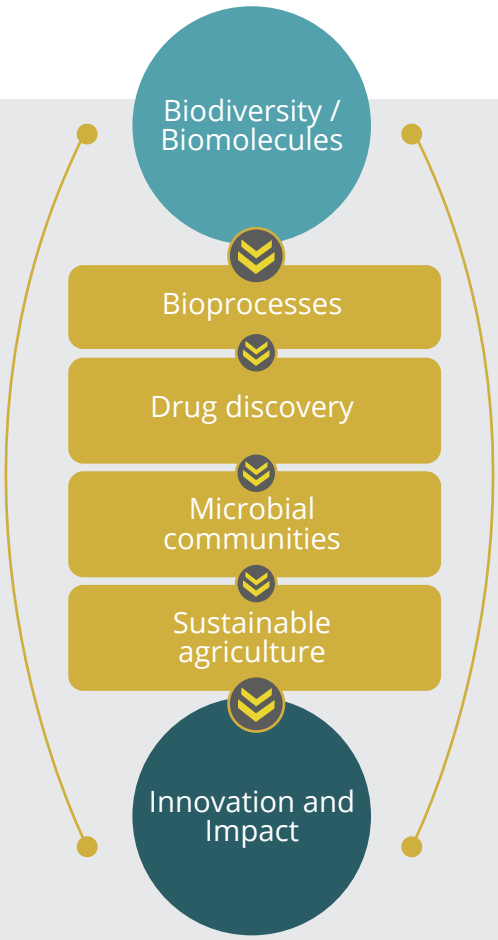
- Human team care
- Ongoing learning attitude
- Attitude of amazement at the findings and achievements obtained
- Collaborative management in the projects that are undertaken

Principles Enforced at CENIBiot:

- Supportive and efficient use of scientific equipment
- Accountable administrative management of research projects
- Willingness for constant improvement of the projects that are undertaken



Operating Structure:



Strategic Objectives

- To generate solutions based on biological inputs that allow ecological agriculture with technological independence and greater profitability
- To understand the composition and kinetics of microbial communities for ecological studies of environmental impact, drug discovery
- To conduct research and development projects in bioprocesses to strengthen regional scientific growth and innovation processes
- To develop research and development projects that link bioproducts with the evolution and prevention of metabolic disorders and their consequences.

Strategic Nodes

- Research in Bioprocesses.
- Research in Drug Discovery.
- Research in Microbial Communities.
- Research in Sustainable Agriculture.

Impact Indicators

PUBLICATIONS

15
TOTAL

14	Indexed	13	Indexed by quartile I
		1	Indexed by quartile II
1	Not indexed		

KNOWLEDGE

TRANSFERS

30
TOTAL

26 **National** (Taught)

2 **International** (Taught)
- Courses, workshops, symposiums

2 **Private Funds**

People benefited **194**

Research **Projects**

26
TOTAL

- 2 FEES
- 19 Internal
- 2 CONICIT funds (Incentive Funds)
- 3 Private Funds

Attention to **Students**

72
TOTAL

- **65** Public funds
  - CeNAT Scholarships: 9
  - Final graduation works: 41
  - Student, assistant, and graduate hours: 15
- **7** Private Funds
  - Student, assistant, and graduate hours: 7

Linkages

National Academic Sector:

- UCR
- UNA
- TEC
- UNED

National and international Universities and Institutes:

- International Pharmacy Students Federation (IPSF)
- University of Salamanca
- Monterrey Institute of Technology
- National Center for Bioecology of Spain
- WAITRO
- WIPO
- CIRAD-France
- CONARROZ
- PROCOMER
- CATIE
- Life Sciences Cluster
- Biomaterials cluster

International companies:

- Nippon Papper
- Papylia CR
- Boston Scientific
- Thrive Natural Care
- Cambrium
- Mammoth
- Biosciences
- Compund-Foods
- BaseCamp Research

National companies:

- Bio CR
- Biotech C.R S.A.
- CoopeAgri R.L.
- CoopeCuna R.L.
- CORBANA, S.A.
- Corporación de
- Desarrollo Agrícola del Monte S.A.
- Establishment Labs S.A. Granja Avícola Santa Marta S.A.
- Stein Laboratories
- Speratum
- Stein Corp.
- BIOTECH
- La Cotinga
- Tirimbina Biological
- Reserve
- Pelón de la Bajura

Agreements

2
TOTAL

1 **National**

- FPP-CV-001-2023 Search for antibiotic-producing bacteria in the Amblipigida Cave of Costa Rica" UCR- CENAT

1 **International**

- FP-CV-001-2023 Diversity Study Large-Scale Microbial Diversity Study in Costa Rica (Basecamp Research)

Summary of Projects

	Public Funded Projects	General description
1	FPP-FP-001-2023 Selection of phosphorus-solubilizing microorganisms with biostimulant potential in plant growth.	The range of working concentrations was reduced to achieve a curve with acceptable linearity to assign a quantifiable value for the samples analyzed. The final evaluation of the field trial in coffee is pending.
2	FPP- FP-002-2023 Contamination of Costa Rican corn by toxigenic Fusarium species (FEES).	Sequencing of the samples has been carried out. Additionally, some pipelines for bioinformatics analysis have been refined and data analysis is in progress.
3	FPP-FP-003-2023 Effects of endophytic fungi from plant isolates of the Rubiaceae family on the morphology and physiology of coffee plants.	The results of this work resulted in a manuscript that has been published in the Journal of Applied Microbiology, so it has concluded.
4	FPP-FP-004-2023 Role of sorcin in lymphocyte in-vitro proliferation.	As a result of the project, the manuscript was sent for review to the journal Biology Methods and Protocols; However, this was rejected and is currently being submitted to the journal Analytical Biochemistry. In addition, progress was made in the planning and writing of a second article that describes the effects that the transfection vehicle has on the change in lymphocyte activity, which could be an undesired effect or one that could potentially be used as a therapeutic effect for the transfection.
5	FPP-FP-005-2023 Evaluation of the efficacy of an experimental treatment for Chagas disease using purified fractions from plants of the Hamelia genus, collected in Sarapiquí and the Osa Peninsula.	The structure of the active compounds has been elucidated and mechanism of action experiments for metabolomics are being performed. In addition, sophisticated statistical analyzes are being performed for activity results against amastigotes.

	Public Funded Projects	General description
6	PFP-006-2023 Genetic imprinting of Melina.	The data obtained from this project was already generated and processed with its results ready. The student who had been working in the project will not present his thesis due to his resignation from the graduate program; however, the project has already concluded.
7	FP-007-2023 Initial approach to the bioprocess for obtaining lipoteichoic acid from Lactobacillus rhamnosus GG for future applications.	Currently the last activity carried out corresponds to the validation of the ELISA kit. The pending activities are application of analytical chemistry on the characterization of the molecule of interest and scaling of the bioprocess.
8	FPP-FP-008-2023 Development of a food product from microalgae biomass of Arthrospira maxima with high nutritional value (FEES).	The experimental stage is now complete. Pending activities are the interpretation of experimental results.
9	FPP-FP-009-2023 Study of the physicochemical and microbiological defense mechanisms of the eggs of Costa Rican forest birds.	31 samples of microbial communities were received and the data were analyzed. In addition, the molecular identification of 140 samples of the total was carried out, reaching 200 samples identified at least to the genus level. Antimicrobial activity tests were carried out on the remaining samples to complete the total number of samples.
10	FPP-FP-010-2023 Characterizing the microbial communities that inhabit the Amblipigida Cave and evaluating their potential to produce antibiotics - SIPPRES.	A series of reviews of the collection of active isolates were carried out, regarding antimicrobial activity tests. The manuscript has already been drafted, which will subsequently be submitted to the latest corrections by the other authors.
11	FPP-FP-011-2023 Verification of analytical balances.	We proceeded with the implementation of the protocol for the use and verification of scales, the calculation structures, and the verification report (objectives 1 and 2). Subsequently, a review of the generated documents was carried out. The project is finished.
12	FPP-FP-012-2023 Chemical services catalogue.	The CENIBiot website is currently being updated (objective II).
13	FPP-FP-013-2023 Validation of protocols necessary to evaluate the cardioprotective effect of natural products and medications.	Protocols for blood metabolomics and DNA extraction from microbial communities for metagenomics are being established.
14	FPP-FP-014-2023 Non-targeted metabolomic analyzes.	The corresponding protocols are in place and work is being carried out in parallel on the procedure for data processing, annotation, and visualization (objectives I and III).

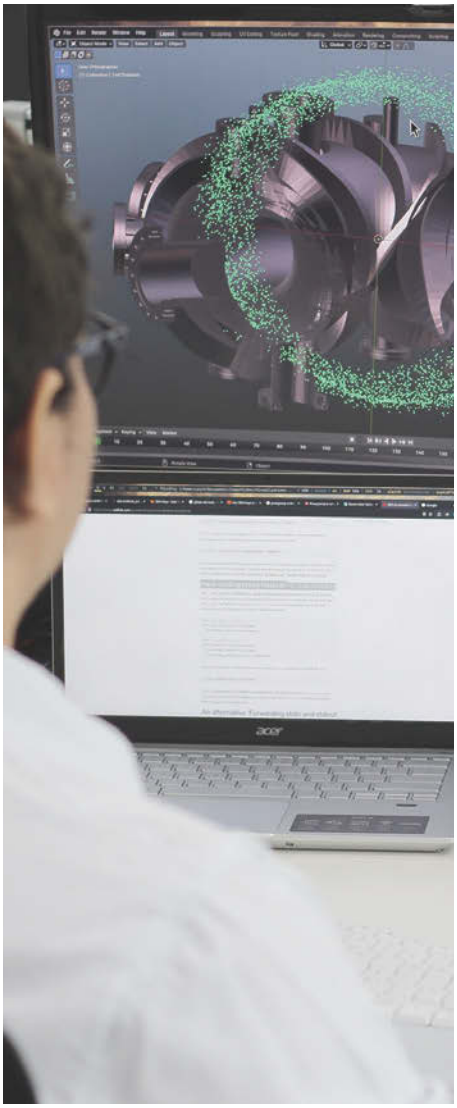
	Public Funded Projects	General description
15	FPP-FP-015-2023 Quantification of free amino acids by LC-MS/MS.	Linearity, repeatability, and reproducibility have been validated and work is being done on the recovery percentage to evaluate the sample treatment.
16	FPP-FP-016-2023 Analysis of the chemical profile of active fractions of Witheringia solanacea by high resolution mass spectrometry.	The data obtained from the project will be used to write the publication, the project is completed.
17	FPP-FP-017-2023 Analysis of the chemical profile of alkaloidal fractions of plants of the genus Amaryllidaceae.	They were awaiting receipt of the sample to be analyzed sent from Chile on November 20. A manuscript is currently being drafted.
18	FPP-FP-018-2023 Evaluation of potential hydrocarbon-degrading microorganisms isolated from an abandoned oil well located in the Cahuita National Park.	Currently, work continues on the graphic analysis of the assembled genomes. Later, a tool will be applied to detect the genes associated with hydrocarbon degradation and compare each assembled and annotated microorganism at the genomic level.
19	FPP-FP-019-2023 Development of a model of metabolic syndrome in mice.	The project is in the initial stages, so the reproduction of C57BL/6Cr mice is being planned.
20	FPP-FP-020-2023 Optimization of in vitro biocompatibility tests for biomedical devices and biomaterials.	The project is in the initial phases, reviewing literature and developing protocols.
21	FPP-FP-021-2023 Bioprocesses Laboratory in focus: A visual documentation.	The video was recorded with the collaboration of the Base Camp team and the Bioprocesses researchers. The audiovisual material is currently being edited to be published in 2024.

CNCA

NATIONAL ADVANCED
COMPUTING COLLABORATORY

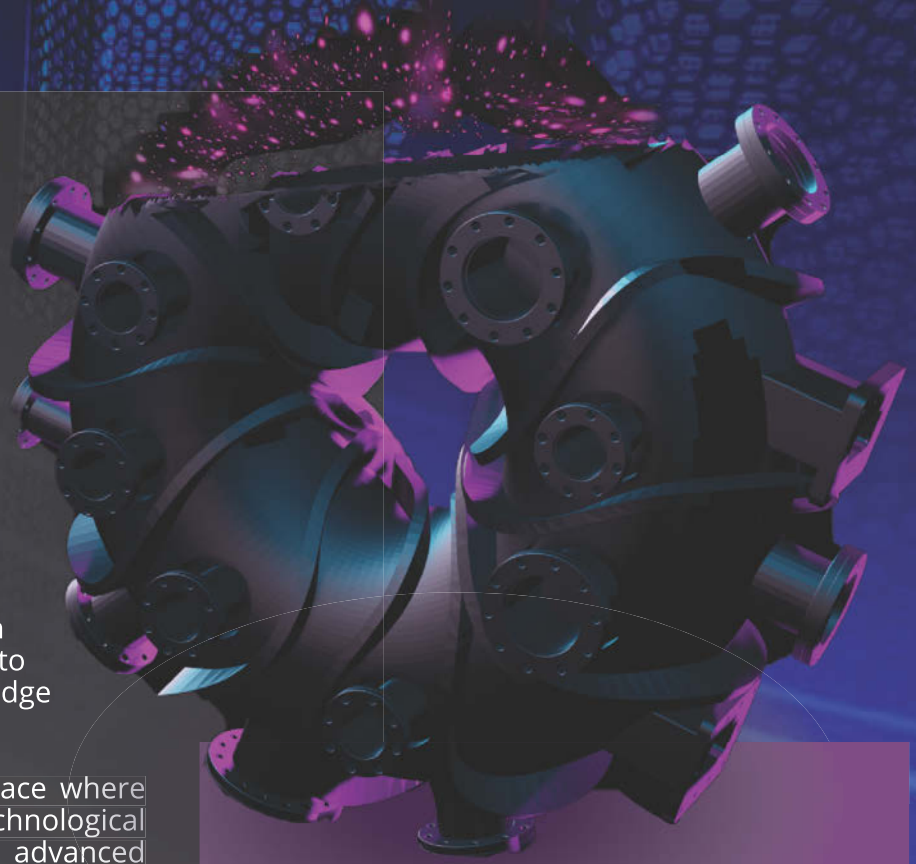
CNCA

CNCA Annual Operating Plan (CeNAT-CONARE) 2023



INDICATORS	DISTRIBUTION OF GOALS		
	Public	Private	Total
Scientific publications - Dissemination	12	0	12
Knowledge transfer activities	50	1	51
Research Projects	13	2	15
Attention to students	14	2	16
Agreements	3	0	3
Cluster operation	365		365
Cluster usage	85,363		85,363

INTRODUCTION



The National Advanced Computing Collaboratory (CNCA) is presented as an interdisciplinary and multisectoral environment that connects academia, government, industry, and society. Its distinction lies in the outstanding quality of its research and innovation. This excellence is reflected both in its institutional management and in its philosophy, which highlights transparency and accountability in all facets of its work, from projects to collaborations and knowledge transfers.

The CNCA is a multidisciplinary space where scientific discovery and technological innovation are accelerated, using advanced computing infrastructure. This infrastructure includes not only specialized and updated hardware, but also a set of efficient applications and trained personnel to take advantage of all that technology. This allows CNCA to work on the core dimensions of the development of research projects, training, and service delivery.

The main objective of the CNCA is to provide two fundamental pillars for scientific advancement in the national and international community. In addition to theory and experimentation, the crucial importance of simulation and data analysis in exploring new frontiers of knowledge is recognized. To achieve this goal, computational tools, both hardware and software, are essential. Thus, the members of the CNCA focus on the computing cluster and the applications installed in it, seeking to provide a computational infrastructure of excellence that facilitates the development of projects and services with a significant impact on society.

Development Goal

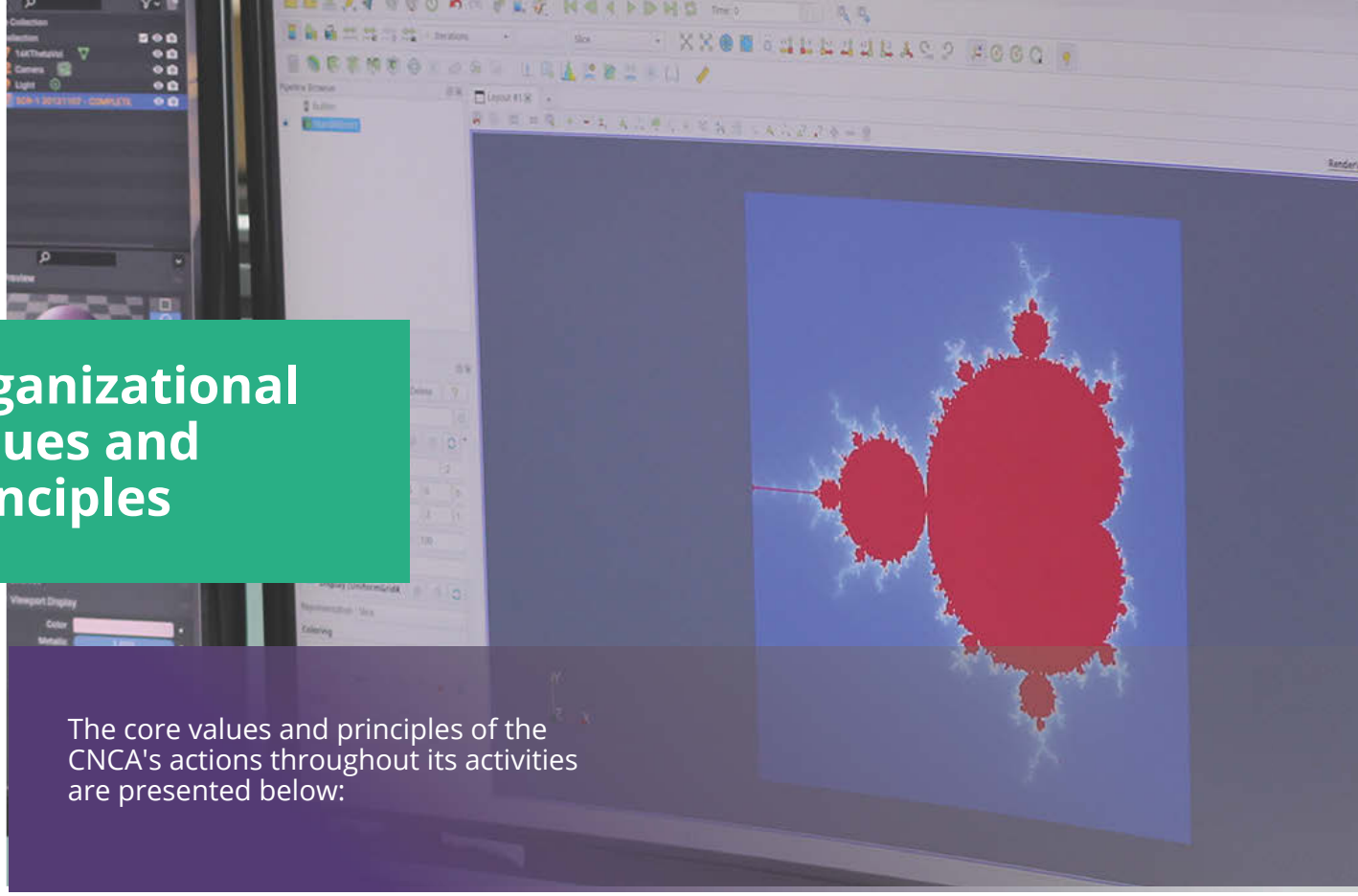
To encourage the use of advanced computing in research, using complex information to boost science and technology development and innovation in Costa Rica.

Mission

We are a laboratory that develops interdisciplinary research through advanced computing to solve complex problems, accelerating scientific and technological innovation.

Vision

We aim to be a self-sustaining advanced computing laboratory with high-end technological infrastructure that generates a high impact both national and international innovation and development.



Organizational Values and Principles

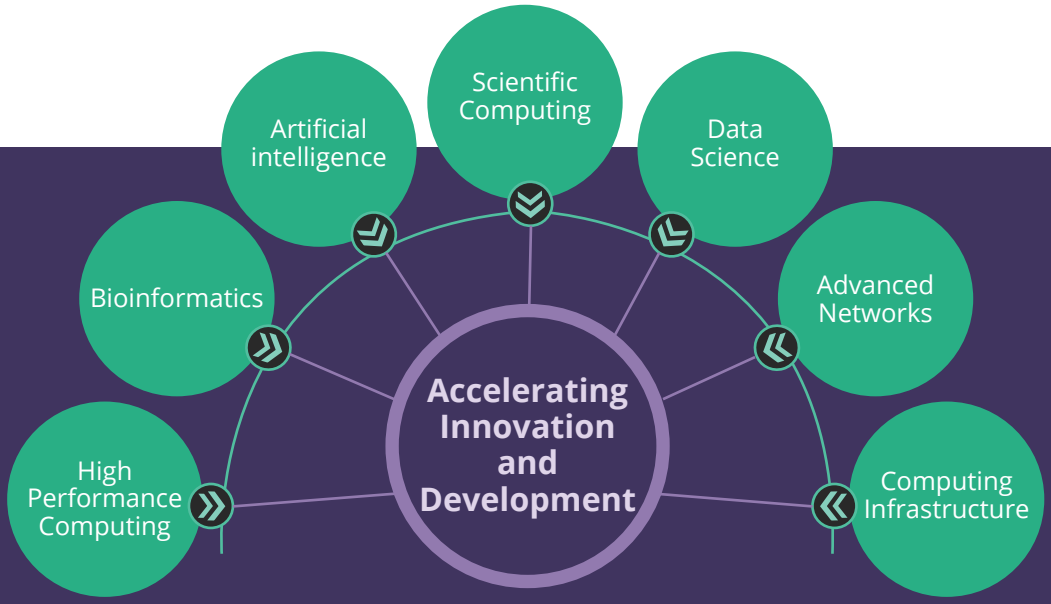
The core values and principles of the CNCA's actions throughout its activities are presented below:

Values

- Willingness to good human relationships
- Willingness to continuous learning
- Collaborative innovation at the laboratory work

Principles

- Creativity in knowledge transfer
- Permanent communication within the work team
- Efficient use of resources
- Collaborative management in the projects that are undertaken



Operating
Structure

Objectives

Using the critical areas as a basis, the strategic objectives have been developed to provide mechanisms to achieve the established goals:

To develop workflows and methodologies that allow the implementation of computer agents that simulate learning skills or human intelligence

To conduct genomic and metagenomic data analysis

To develop research processes in the application of advanced computing techniques

To develop computational modeling and simulation flows

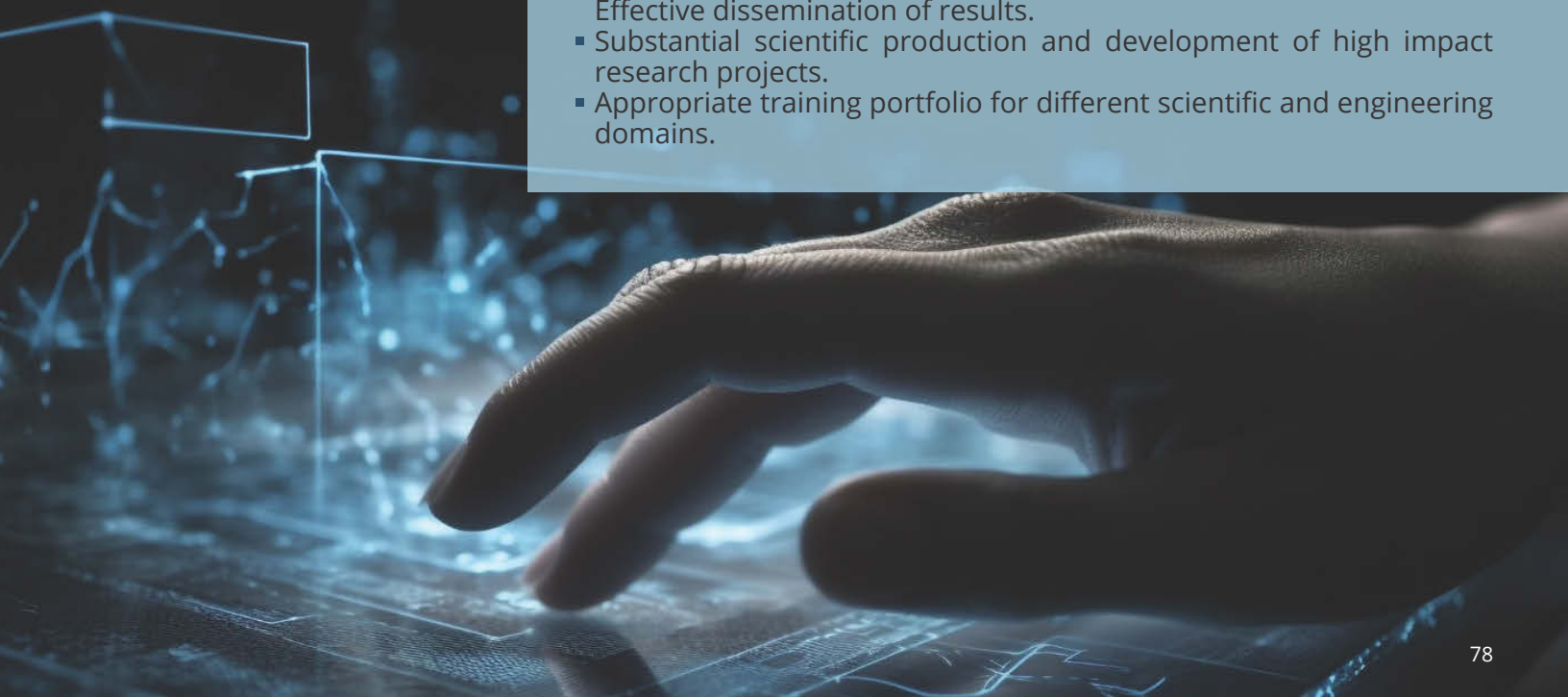
To develop research processes in the application of methods for managing and analyzing large amounts of data (Big Data)

To promote the use of advanced network services by encouraging academic research and the creation of scientific projects and communities

To develop and monitor the computational infrastructure of the Kabré supercomputer, as well as to provide support to its users

Strategic **Nodes**

- Maintenance of the computational cluster with state-of-the-art
- equipment.
- Development of the professional career for human resources. Fundraising through the sale of services and external research funds. Effective dissemination of results.
- Substantial scientific production and development of high impact research projects.
- Appropriate training portfolio for different scientific and engineering domains.

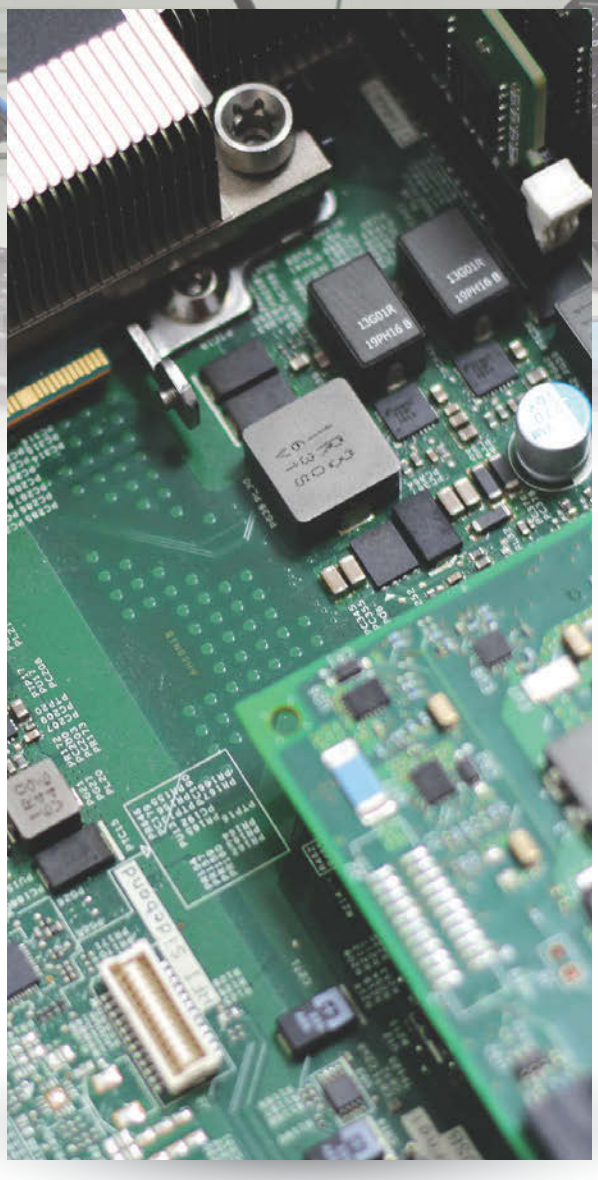


Impact Indicators

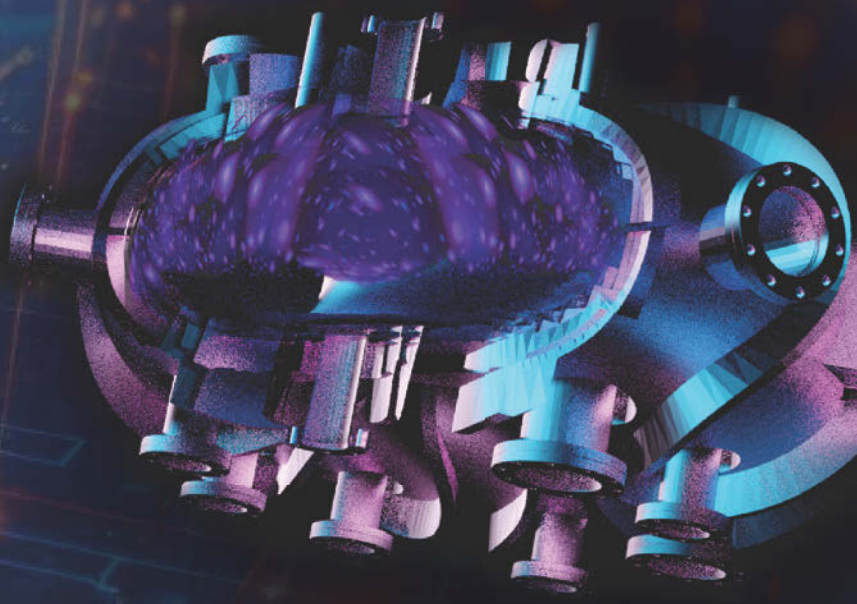
PUBLICATIONS

12
TOTAL

12 indexed papers by SCOPUS



KNOWLEDGE TRANSFERS IMPARTED



51 TOTAL

8	Advanced computing seminars, where an expert in the application of high-performance computing in a particular scientific domain presented their results.
6	Programming training in introduction to programming, scientific computing, and machine learning with the Python language for different scientific domains.
4	Programming training in introduction to programming, statistical analysis and data visualization with the R language for different scientific domains.
2	Bioinformatics processing training for genomic and metagenomics data.
1	Workshop on "Adaptive Message Passing Interface" taught by the laboratory director.
1	Workshop on "Task Parallelism" taught by the laboratory director.
1	Workshop on "Introduction to C programming (HPC Preschool 2023)".
6	Workshops on the use of Kabré and Linux.
2	Programming schools on Big Data topics: Costa Rica Big Data School Limón and Costa Rica Big Data School Puntarenas in face-to-face mode.
7	National presentations at academic conferences, meetings, seminars, and forums.
12	International presentations on high-end performance computing topics in a national and international scientific domain.
1	Programming school on advanced computing topics: Costa Rica High Performance School.

Personas beneficiadas: **663**

Attention to **Students**

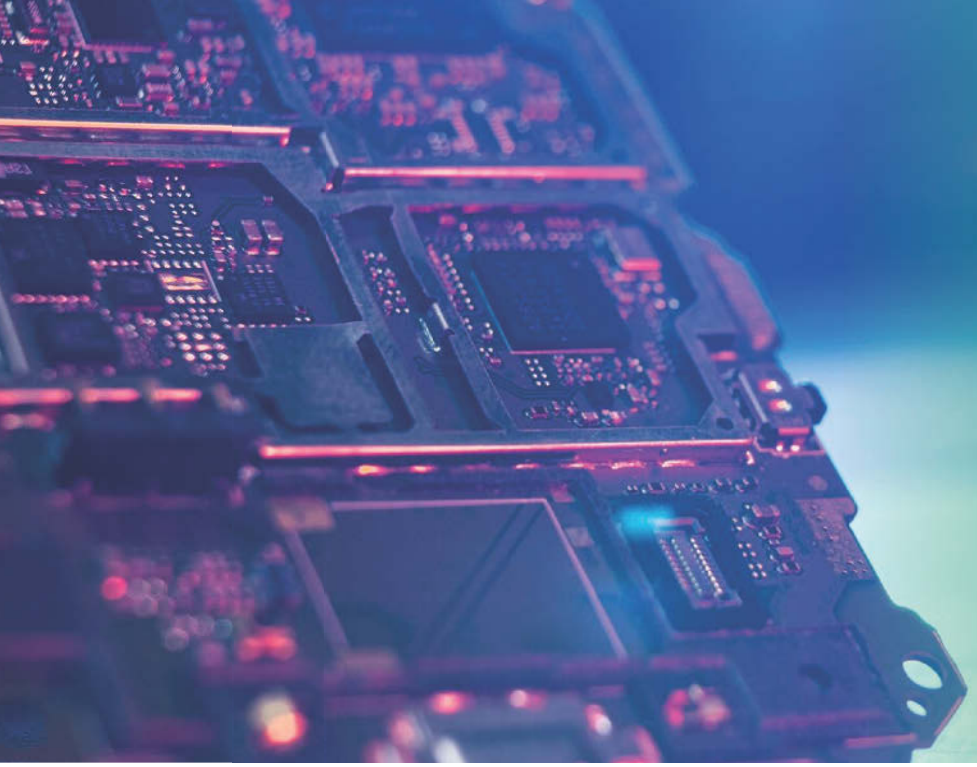
16
TOTAL

14 **Public Funds**

6 Scholarships
8 Student, assistant, and graduate hours

2 **Private Funds**

2 Student, assistant, and graduate hours



Research **Projects**

15
TOTAL

Computational science and parallel and distributed computing research projects.

13 **PUBLIC FUNDS**

- 3 FEES-funded Projects
- 8 Internal projects
- 2 CONARE-funded Projects

2 **PRIVATE FUNDS**

Computational **Infrastructure**

365

days a year of operation of computer services that resulted in:

946

accounts with access to computing infrastructure services

85,363

science hours in simulations and data processing

110%

of the availability of the computing cluster service

Linkages

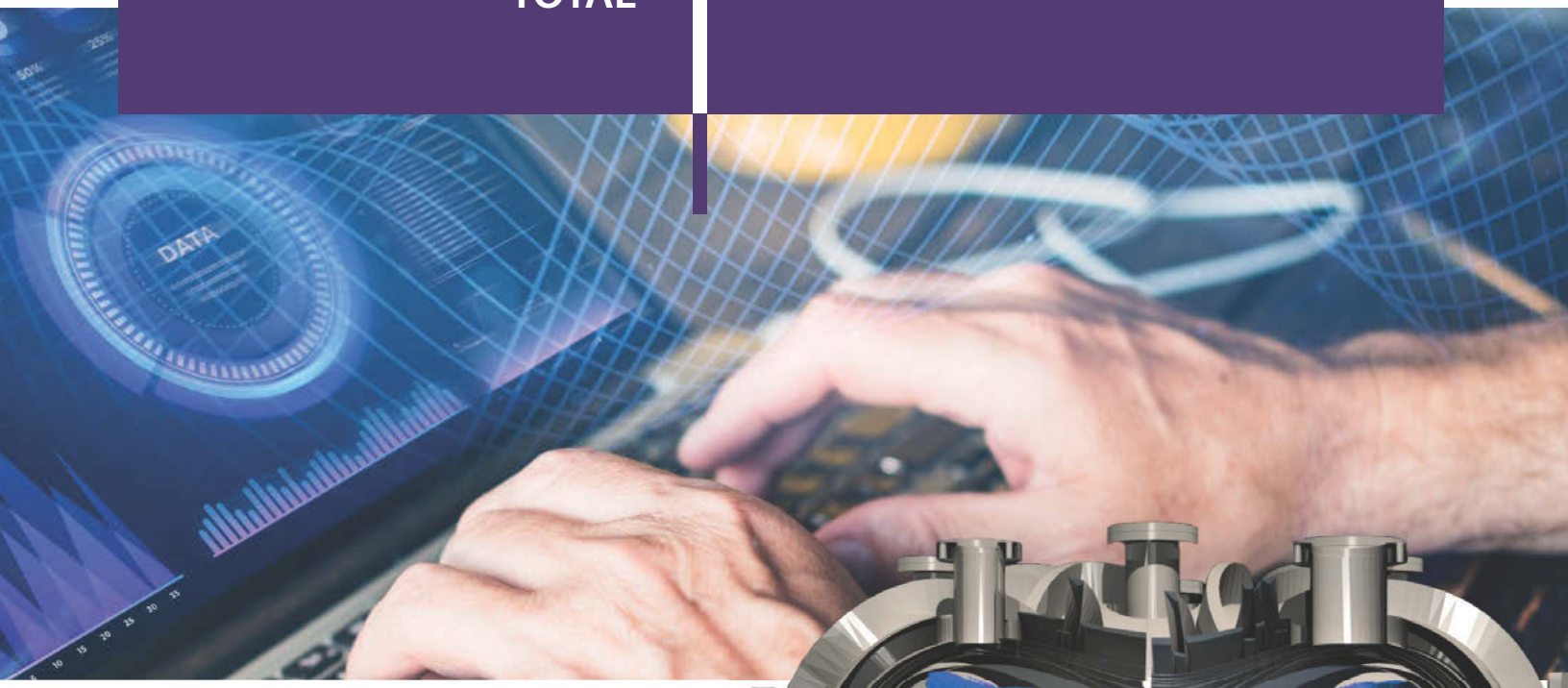
The laboratory has achieved linkages with the following institutions and organizations

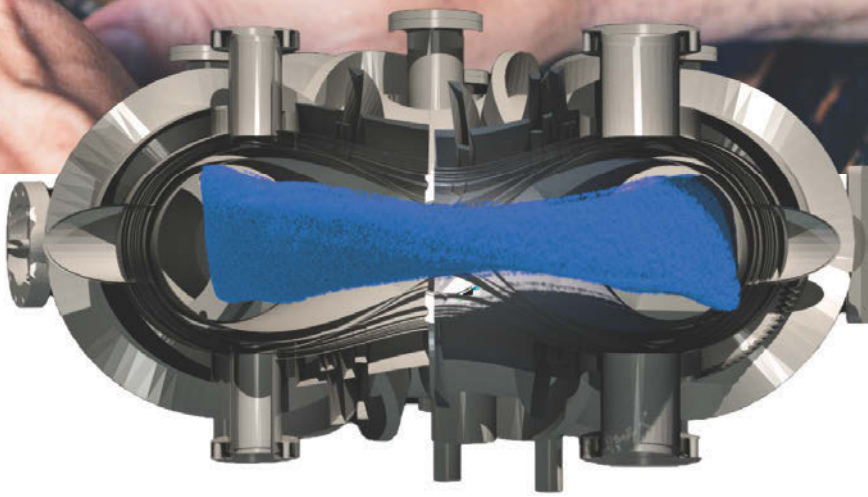
- MICITT-CONICIT
- MINAE
- MAG
- Ministry of Health
- Public Universities (UCR, TEC, UNA, UNED, UTN)
- INA
- Professional associations (CPIC)
- MOPT
- ICT Chamber
- Lawrence Livermore National Laboratory
- SCALAC
- BSC
- CSUCA
- Association of Professionals of CGR
- JUPEMA
- INTA
- CENIA (CHILE)
- ICE
- UCIMED
- Ministry of the Presidency
- Civil Aviation
- Min. Public Security
- Banco Popular
- INEC
- Ministry of Foreign Affairs
- Ministry of Public Education
- CONAVI
- Chamber of Industries of Costa Rica
- LANAMNE
- Treasury
- Procomer
- CINDE
- CNFL
- COMEX
- Ministry of Housing and Human Settlements
- Comptroller General of the Republic
- National Institute on Agricultural Technology Innovation and Transfer
- RECOPE
- SENARA
- AYA
- Chamber of Tourism
- ICT Chamber
- ICAFE
- Work Unions
- CGR Professional Guild
- CANAPEP
- CANAPALMA
- CORFOGA
- Cooperation International
- US Navy
- Lawrence Livermore National Laboratory
- SCALAC
- BSC
- CPIC

Agreements

2
TOTAL

National agreements to work in the field of advanced computing.





RedCONARE

One of the services of RedCONARE and the ICT departments of the universities is Eduroam, which has the following indicators:

Network services are available to approximately **125,000** students, staff, and teachers

Access to Eduroam internationally in **106 countries** that participate in the deployment of the connectivity network

There are more than **2 billion authentications** of the Eduroam network in international territories

Eduroam network deployed in the headquarters and campuses of the **five public universities**. Research centers and the CONARE-CeNAT building

Summary of Projects

FEES-FUNDED PROJECTS

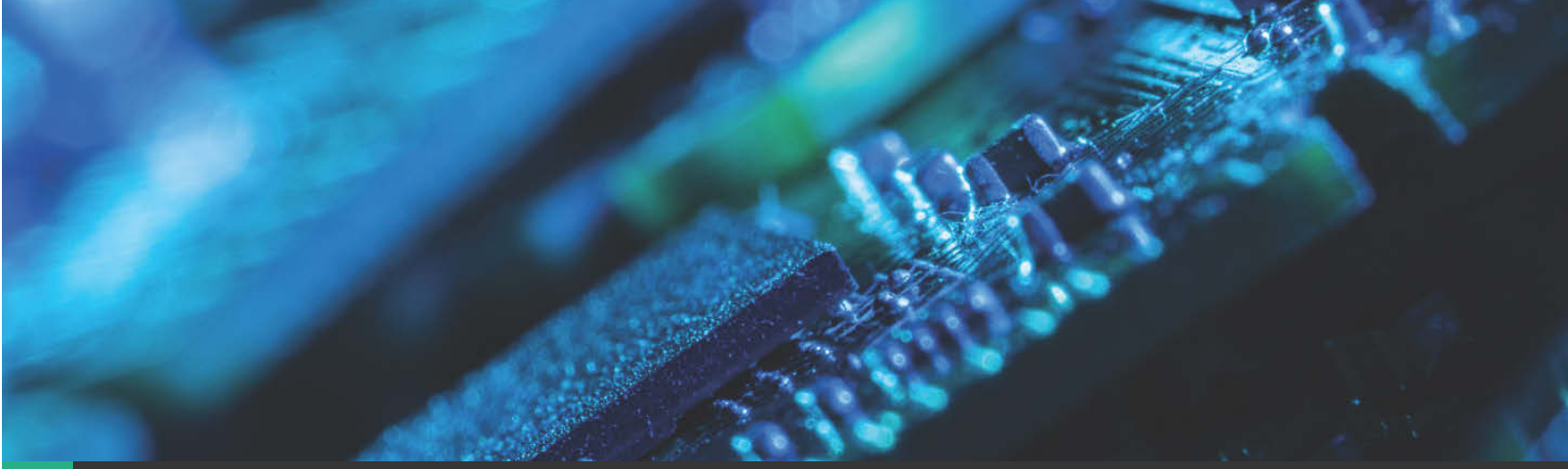
	Project	General description
1	Analysis of the microbial plasmidome in contaminated water and its possible effects on health and the environment	This project seeks to characterize the diversity and typology of the set of plasmids (plasmidome) in the water column, the sediment, and polystyrene microplastics exposed at different points in the Virilla River basin, so it is proposed to generate novel scientific information on the ecology. of plasmids in aquatic environments, and the effect of contamination on the transmission of these and their genes of importance for public health
2	RedCONARE	The main objective of advanced networks is to serve as a fundamental tool to promote scientific research, improve health through medical education, research, and telehealth, as well as enhance education through the efficient storage and distribution of content. educational, facilitate inter-institutional collaboration, allow access to remote instruments and laboratories, and offer network services that facilitate connectivity and data transfer in an agile and secure manner
3	Data Science Desk	The objective of the Data Science and Visualization working group is to promote a broad research process that ranges from in-depth knowledge of the subjects under study to the effective communication of results through visualizations. This involves collecting data from digital sources, using programming techniques to organize the information, and sophisticated statistical analysis. By adopting this approach, we seek to establish a new way of retrieving and analyzing information in an expeditious and accurate manner. This will allow a more complete approach to issues related to human development, using innovative sources of information to advance understanding and informed decision-making

CONARE-FUNDED PROJECTS

	Project	General description
1	Advancing plasma physics computer simulations with the latest high performance computing techniques	The objective of this project lies in understanding the impact of the latest technologies in parallel programming for plasma physics simulations, both from a performance and programming point of view
2	Uncovering novel microbial symbioses occurring in wasps and beetles from Costa Rica	The main objective of this project is to explore and describe in detail the symbiotic relationships between insects and microbes. This approach is based on the interest shared by research groups, who have investigated the chemical evolution, ecology, and molecular interactions in insect-bacteria symbioses, as well as their potential application in agriculture and tropical medicine. This project seeks to deepen the understanding of these symbiotic relationships, identifying new perspectives and applications in the field of microbial ecology. This research will contribute to the advancement of knowledge in this field and will lay the foundation for future research in the area

INTERNAL PROJECTS

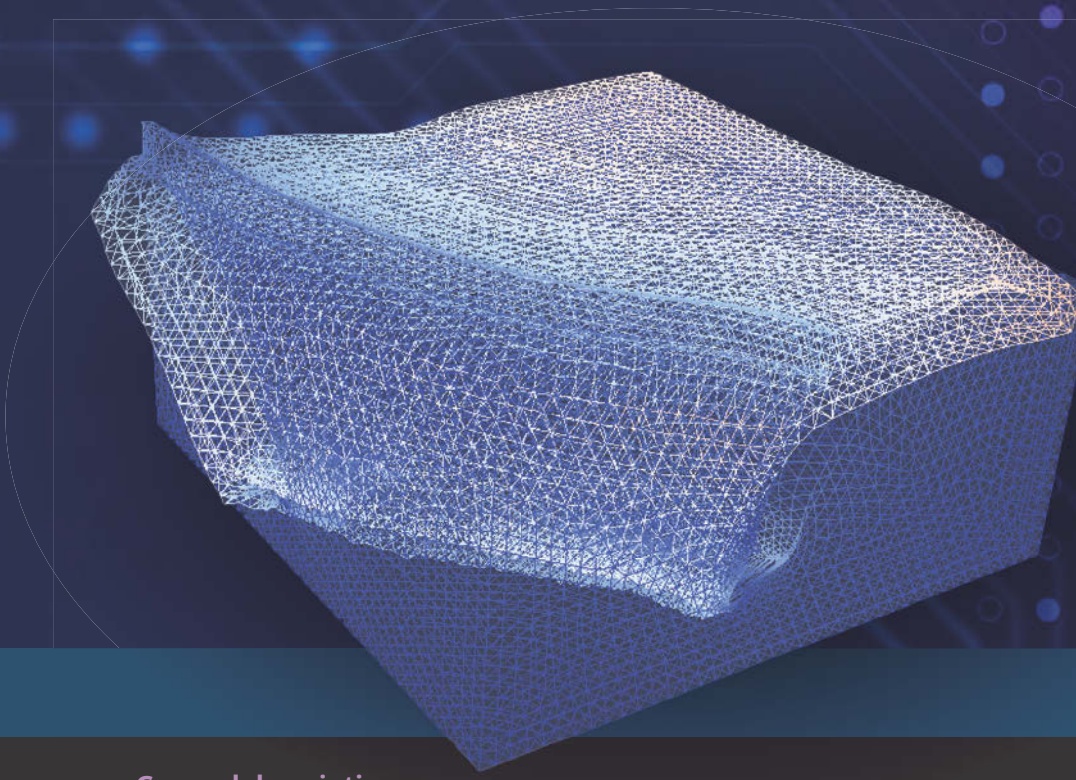
	Project	General description
1	Machine Learning applied to bioaquatic recognition of tropical birds	Applying deep learning models is proposed to detect and classify various species of tropical birds from available audio files, exploring and preparing the formats of these files in the repositories of bird songs for subsequent analysis in the recognition of species in Costa Delicious. The aim is to identify and compare different deep learning mechanisms for this purpose, with the aim of finding the most reliable technique. The aim is to build a workflow for a bird song recognition and classification system, considering the available file formats and the selected deep learning techniques, as well as the processes necessary for the classification and labeling of songs. This workflow will be evaluated with real data from bioacoustic repositories by analyzing the performance of the system in terms of precision and accuracy, identifying possible improvements for future implementations



INTERNAL PROJECTS

	Project	General description
2	Implementation of a bio-acoustic solution based on artificial intelligence that executes the automatic counting of buffalo dolphins and the study of their marine environment in the Golfo Dulce for a population analysis	The development a computational tool is proposed for the automatic analysis of audio recordings with the purpose of identifying cetaceans and classifying the associated underwater noise. This involves a comprehensive review of the state of the art to determine Artificial Intelligence (AI)-based solutions that address similar tasks. In addition, the aim is to create a database that houses acoustic data of cetaceans and underwater noise for subsequent analysis. The goal is to develop an AI model that can identify the type of cetacean, count them and classify underwater noise through automatic analysis of marine recordings
3	Simulation of aerodynamic profiles for small-scale wind turbines	It is proposed to numerically evaluate the performance of SG6043 airfoils in turbulent conditions by simulating lift and drag curves. An aerodynamic simulation of the profiles will be carried out using the OpenFOAM software with the y- Re turbulence model θ. The simulation results will be validated with experimental data. Subsequently, the performance of the modified SG6043 profiles will be evaluated using the validated simulation and the lift and drag curves obtained
4	Exploration and prototyping of Digital Twins in Costa Rica to establish integration with simulation, modeling, high performance computing and advanced networks	A detailed study is proposed on the implementation of digital twins in areas of national interest, with a focus on establishing priorities for the creation of a prototype focused on components where the laboratory can have a significant impact, such as modeling, simulation, programming parallel computing, high-performance computing, and advanced networking. The current state of digital twin technology and its potential implementation in specific sectors of national interest will be examined. The study will be limited to specific components related to modeling, simulation, high-performance computing or advanced networks. Subsequently, a prototype will be developed that integrates some of the main components of digital twins. In addition, alliances will be sought with universities and organizations interested in promoting research and applying this technology for the benefit of the relevant national sectors
5	GPU-accelerated RICH Decoding in Allen	The main objective of this project is to develop a GPU algorithm within the Allen framework for the decoding of detections in the LHCb RICH detectors. This will be achieved by creating an initial implementation of the RICH code on CPU, which will work within the Allen-GAUDI framework. Subsequently, an implementation of the RICH code will be carried out on GPU for the standalone Allen framework, thus taking advantage of the massive processing potential offered by graphics cards. Finally, work will be done on optimizing and parallelizing the RICH code in Allen for execution in a cluster with GPUs, which will allow greater efficiency and speed in data processing from the LHCb's RICH detectors. This project aims to significantly improve the performance and data analysis capabilities of the RICH detectors, thereby contributing to the advancement of particle physics research at the LHCb

	Project	General description
6	Development of artificial intelligence tools for the analysis of electrocardiographic data	The development and implementation of advanced computational solutions is proposed to facilitate data analysis and the application of artificial intelligence for the detection of anomalies in electrocardiographic records. This will include a comprehensive study of the state of the art to identify AI-based solutions. A training and labeled database will be established containing electrocardiographic recordings for further analysis. An AI model capable of identifying heart diseases and other related conditions will be developed by automatically analyzing electrocardiographic data collected from medical centers in the country. This approach will improve early detection and accurate diagnosis of heart disease, which could have a significant impact on the cardiovascular health of the population
7	Improvement of the Kabré computing platform	The refinement and optimization of the administration, security and accessibility systems of the Kabré cluster's computing resources is proposed with the aim of reducing waiting times in job queues, improving system security and more efficiently managing the available resources. This will include optimizing the response time of file systems such as NFS and LUSTRE, implementing better accessibility mechanisms through platforms such as Open OnDemand, and optimizing the SLURM resource management tool. In addition, the security of the platform will be strengthened through the implementation of monitoring systems and the introduction of two-factor authentication. These measures will work together to improve the efficiency, security, and accessibility of the Kabré cluster, benefiting users and maximizing system performance
8	Hydrographic simulation in river hydraulics on GPUs	Setting a complete simulation flow that includes the generation and analysis of watershed data is proposed to evaluate the risk of flooding in Costa Rican regions. This workflow will involve the development of a hydrological simulation of rivers using the SERGHEI code on GPUs, adapting it for efficient execution on this type of processors. Hydrological simulations of several rivers in the country will be carried out to understand their dynamics under various conditions. Subsequently, a post-processing and visualization environment for hydrological data will be developed in Python, using tools such as Xarray, Matplotlib, and NumPy to facilitate the analysis of the results obtained. In addition, another module will be added to the SERGHEI code to solve the Exner equation, considering sediment transport and erosion, which will allow a more complete and precise evaluation of the behavior of rivers in relation to the risk of flooding in the Costa Rican regions



PRIVATE FUNDS PROJECTS

	Project	General description
1	RISC2: A network for supporting the coordination of Computing research between Europe and Latin America	The main objective of the RISC2 project is to foster stronger cooperation between the industrial and research communities in High Performance Computing (HPC) applications and infrastructure deployment, in a context where the widespread use of HPC is generating new benefits in areas such as industry, healthcare and the economy. To achieve this goal, the project will bring together eight key European HPC players, along with leading HPC players from Brazil, Mexico, Argentina, Colombia, Uruguay, Costa Rica and Chile. This collaborative effort will be guided by an external Board made up of leading experts from Latin America and Europe. RISC2 will promote the exchange of best practices through meetings, workshops, and training events, organized to coincide with major HPC events in Europe (such as ISC and EuroHPCSW) and in Latin America (such as CARLA and ISUM). This approach seeks to strengthen coordination and exchange of capabilities between allied regions, recognizing the strategic importance of intense investments in HPC to maintain global competitiveness
2	Central American Network for Management of Epidemiological Data	The objective of the project is to carry out a regional characterization of the waves of Covid-19 infection cases in Costa Rica and Guatemala. This analysis seeks to understand the dynamics of the disease in these regions through detailed study of the available epidemiological data. The aim is to examine the geographical distribution of cases, the temporal evolution of infection waves, incidence rates and the severity of outbreaks in different areas. In addition, it seeks to explore possible correlations with demographic, socioeconomic, and public health variables to identify factors that may influence the spread and impact of the virus in each country. This comprehensive approach will help inform public health decision-making and guide the implementation of Covid-19 control and prevention strategies in Costa Rica and Guatemala

PRIAS
LABORATORY

PRIAS

PRIAS
Annual Operating Plan
(CeNAT-CONARE) 2023

INDICATORS	GOAL PROGRAMMING		
	Public	Private	Total
Scientific publications - Dissemination	3	1	4
Knowledge transfer activities	13	3	16
Research projects	10	1	11
Attention to students	14	0	14
Agreements	3	0	3

INTRODUCTION

PRIAS is a Geomatics laboratory with an emphasis on Earth Observation that provides the country with high-precision information available to all users worldwide, with the aim of addressing challenges and promoting studies on the national and international territory. Attached as a Laboratory to the Centro Nacional de Alta Tecnología (CeNAT), it is a program of the Consejo Nacional de Rectores (CONARE), it conducts the promotion and development of scientific research activities in various fields.

The PRIAS laboratory is a national link for scientific airborne missions, which uses Earth Observation techniques to carry out environmental and cartographic studies that generate relevant information for decision makers and creators of national and international public policies. Its creation enabled Costa Rica as one of the few countries in the world to have a collection of aerial photographs, with different sensors, which has recorded more than 80% of the territory. In addition, the synergy created between institutions in those early years promoted the triple helix development model that continues to this day, and which has an implicit impact and multiplier effect on the efforts made in the Costa Rican territory.

PRIAS is comprised of a multidisciplinary work team and maintains a close relationship with institutions in the academic, public and private sector at a national and international levels. It aims at the promotion of scientific research and transfer of knowledge, through the acquisition, treatment, storage, analysis, representation, and dissemination of information in the areas of Photogrammetry, Remote Sensing, Geographic Information Systems, Global Positioning System, Spatial Data Infrastructure, Geodesy, and Computer Science, which constitute the which constitute Geomatic Science.

This report concentrates the activities carried out during the year 2023, which show achievements and important progress made in the seven large areas of Geomatics mentioned above and with applications to Earth Observations, as well as the linkage with the academic-public-private sectors.

Development Goal

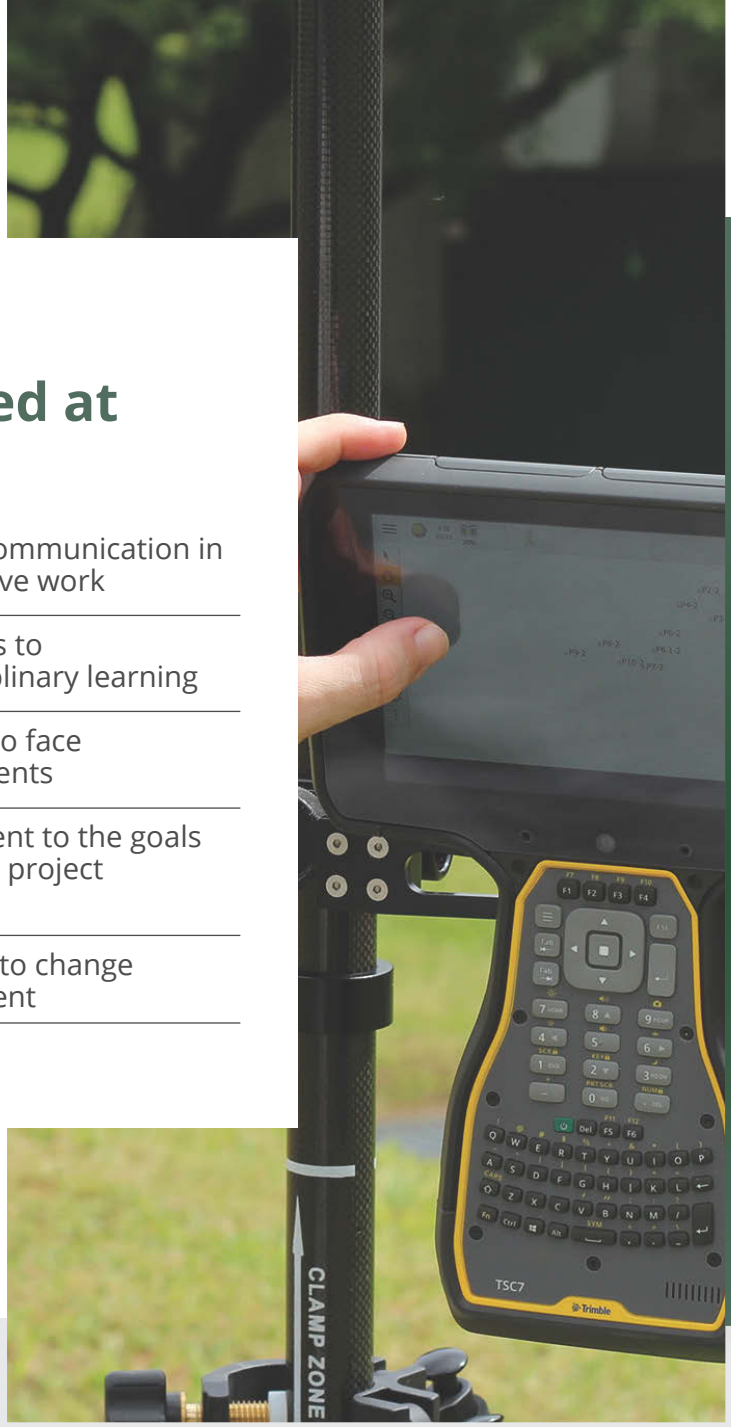
To develop research in earth observations that contribute to the knowledge of the Costa Rican territory through applied geo-aerospace science projects that promote decision-making capacity in the academic, socioeconomic, and environmental fields.

Mission

We are a research laboratory in earth observations made up of a specialized team of professional people who work with the highest scientific standards, articulated with higher education in Costa Rica within the framework of innovation with the public, private, social and economic sectors. International cooperation.

Vision

We aim to be a self-sustaining scientific research laboratory that provides high-value knowledge on issues of innovation in geospatial management, aerospace catalyzing and geoinformatics development, at an academic, socioeconomic and environmental level in the region.



Values Enforced at PRIAS

- Effective communication in collaborative work
- Willingness to multidisciplinary learning
- Creativity to face improvements
- Commitment to the goals set in each project
- Openness to change management

Principles Enforced at PRIAS

- Efficient use of technological infrastructure
- Interdisciplinary collaborative work
- Knowledge transfer adapted to populations
- Willingness for constant improvement of the projects that are undertaken

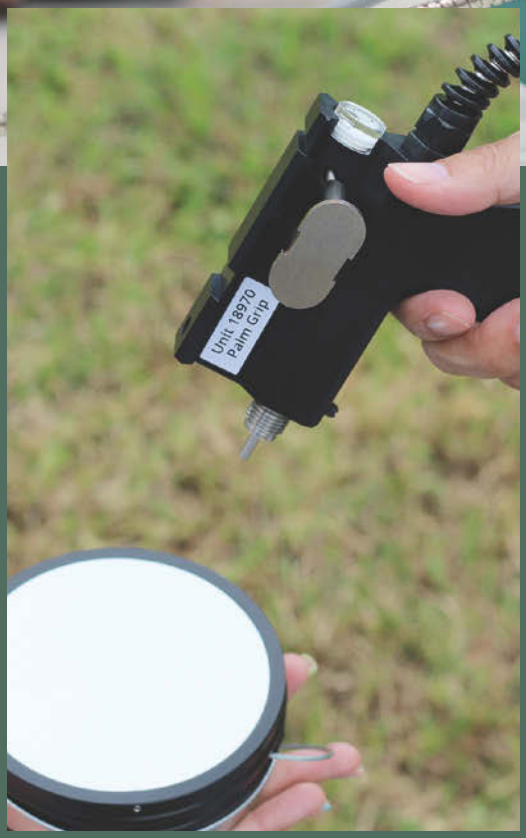
Operational Structure:

Strategic Objectives

To strengthen the management and scientific rigor of geospatial data for data-based decision making

To generate IT solutions to optimize geospatial data systems

To integrate the development of transformative technologies and sciences for the rigor of knowledge and prospective decision making



Strategic Axes

- Geographic Information Systems
- Remote sensing
- Photogrammetry
- Global Positioning System
- Geodesy
- Computational Science
- Spatial Data Infrastructure

Impact Indicators

PUBLICATIONS

4
TOTAL

- 3 Indexed
- 1 Specialized

KNOWLEDGE

TRANSFERS

16
TOTAL

7 National

3 Workshops
3 Lectures
1 Symposiums

9 International

1 Workshops
8 Congresses

People benefited: 568

57 Workshops and/or courses at Universities
511 Presentations, symposiums, conferences

CEC: 230	Environmental Education Experiences: 50
GLOC: 15	AMERIGES: 135
RIAO Optilias: 18	PRIAS event: 43
TEC: 20	

Research **Projects**

11
TOTAL

10 **Public**

- 9 Internal
- 1 Operational PRIAS CeNAT

1 **Private**

- 1 Other funds

4 **Projects under negotiation**

- Proposal Spectroradiometry of Archaeological Salt Flats in Salinas Bay
- Proposal for SDG Indicators 11.3.1 and 11.7.1
- Proposal for priority sites
- Korea-LAC Tech Corps

Attention to **Students**

14
TOTAL

- 8 Scholarships
- 1 Interns
- 1 Final Graduation Works
- 4 Assistant Students

Linkages

72
TOTAL

10 National Academic Sector

- Costa Rica Institute of Technology
- University of Costa Rica
- State Distance Education University
- National University of Costa Rica
- National Technical University

22 International universities or institutes

- United States Agency for International Development (USAID)
- Central American Aeronautics and Space Association (ACAE)
- Inter-American Development Bank (IDB)
- German Aerospace Center (DLR)
- Copernicus Reference Center of the University of Chile
- Global Environment Facility (GEF)
- Global Fishing Watch
- Google Earth Engine
- Natural Capital Project
- Food and Agriculture Organization of the United Nations (FAO)
- United Nations Development Program (UNDP).
- Secretariat for the Group on Earth Observations (GEO)
- Central American Integration System (SICA)
- Regional Visualization and Monitoring System (SERVIR)
- System for Earth Observations, Data Access, Processing & Analysis for Land Monitoring (SEPAL)
- International Union for Conservation of Nature (IUCN)
- Mexico Civil Protection School (ENAPROC)
- RSTAG
- Texas Tech University
- Sevilla University
- Florida International University
- AMEXCID

34 National Universities or Institutes

- Tropical Agricultural Research and Higher Education Center (CATIE)
- National Center for Geoenvironmental Information (CENIGA)
- National Commission for Risk Prevention and Attention to Emergencies (CNE)
- National Commission for Biodiversity Management (CONAGEBIO)
- Environmental Quality Management Directorate (DIGECA)
- General Directorate of Civil Aviation
- National Forest Financing Fund (FONAFIFO)
- Costa Rican Coffee Institute (ICAFE)
- Inter-American Institute for Cooperation on Agriculture (IICA)
- National Meteorological Institute of Costa Rica (IMN)
- Costa Rica National Institute of Statistics and Census (INEC)
- National Institute of Agricultural Technology (INTA)
- Ministry of Agriculture and Livestock (MAG)
- Ministry of Environment and Energy (MINAE)
- Ministry of Housing and Human Settlements (MIVAH)
- Municipality of San José
- State of the Nation Program (PEN)
- SIRGAS Network (Geocentric Reference System for South America).
- National Registry of Costa Rica
- Sectoral Planning Secretariat of Environment, Energy, Ocean, and Territorial Planning (SEPLASA)
- REDD Secretariat (Reducing Emissions from Deforestation and Forest Degradation).
- National System of Territorial Information (SNIT).
- National Monitoring System for Land Cover and Use and Ecosystems (SIMOCUTE)
- Administrative Environmental Court (TAA)
- RedClara
- National Museum
- Aerospace Engineering Group
- National Power and Light Company
- Tropical Scientific Center
- Clodomiro Picado Institute
- Environmental Educators Network
- OTS
- MICITT
- National Institute of Housing and Urbanism

8 International Companies

EO Data Science
Planet Inc.
Space Generation Advisory Council
UNAQ
Orbital Space Technologies
Astralintu Space Technologies
NASA Space Apps Challenge
International Astronautical Federation

3 National companies

Kölbi.
MTF Teca Ltda.
Panamerican Woods Plantations S.A.

Agreements

3
TOTAL

National

- Municipality of San José
- Tropical Scientific Center
- Administrative Environmental Court

Summary of Projects

PUBLIC FUNDS | Internal Projects

	Project	General Description
1	Implementation of distributed storage in data center	To leverage GeoCenter resources for the implementation of a distributed system of orchestration and container technologies within the PRIAS data center, which allows the automation of the deployment, scaling and management of containerized applications within the PRIAS data center
2	Library of Spectral Signatures	Development of a tool that allows cataloging, managing, and sharing spectral signature data collected in different internal and external research projects. As well as supporting the range of research in the country by accompanying interns, CeNAT-PRIAS scholarship holders or practitioners and collaborating in the generation of hyperspectral data information from institutions within the triple helix
3	PRIAS Spatial Data Infrastructure Implementation	To develop a web implementation of spatial data infrastructure by optimizing the use of the GeoCenter to offer a variety of services, as well as an inventory system for the laboratory assets, and hosting and monitoring of the different GeoCenter services
4	Unmanned Aircraft for Research (UAV)	To generate data for research through the use of UAV's and photogrammetry. In addition, it seeks to support the range of research in the country by supporting student interns, the CeNAT-CONARE scholarship program, interns, and projects from the PRIAS laboratory, and collaborating in the generation of photogrammetric data information from institutions within the triple helix

PUBLIC FUNDS | Internal Projects

	Project	General Description
5	Reforestation from the air	Development of tools to reforest from the air with rocketry as a dispersion mechanism and methodology to measure the progress of reforestation
6	The forest fire regime in Costa Rica possible strategies for mitigating its impact on the tropical dry forest	To analyze fire behavior through fire regime variables to generate predictive models of the spatial distribution of forest fires that provide strategic information in mitigating damage in the tropical dry forest It is developed in conjunction with the State Distance University
7	Spatialization of the tree flora of Costa Rica pilot study for the Greater Metropolitan Area	Development of a pilot project to map the tree flora in the Greater Metropolitan Area of Costa Rica, through standardization of collection records in the National Herbarium database, precise georeferencing and the creation of maps This project is developed in conjunction with the National Herbarium, National Technical University, and Technological Institute of Costa Rica

PRIAS-CeNAT OPERATIONAL PROJECT

	Project	General Description
5	Operational PRIAS	The development of this project is linked to the fulfillment and development of the different operational indicators of the laboratory

PUBLIC FUNDS | Joint Projects with the State of the Nation Program (PEN)

	Project	General Description
1	Local productive structures: productive, labor, and territorial value chains in Costa Rica	Building the spatial representation in the form of geographic information layers that allow reproducing the historical analysis of the Protected Wilderness Areas from 1955 to the present, with the aim of linking it with other socio-environmental variables
2	Cantonal Historical Geospatial Representation of Costa Rica for the 1905-2014 period	Building the spatial representation in the form of geographic information layers that enable reproduction of the Territorial Administrative Division of Costa Rica for the periods 1905, 1950, 1963, 1973, 1984, and 2014

PRIVATE FUNDS

	Project	General Description
1	Digital system for monitoring illegal logging in the Golfo Dulce Forestry Reserve and a study area on the Pacific side of La Amistad National Pilot Project	Developing a methodology that could be implemented within a Digital Illegal Logging Monitoring System that will allow governments to better manage resources in the fight against illegal logging, corresponds to joint research between the PRIAS laboratory and the United Nations. United Nations for Food and Agriculture

NASA INTERNATIONAL SPACE APPS CHALLENGE

NASA Space

The PRIAS laboratory participated in the NASA Space Apps Challenge competition through the infrastructure analyst Stephanie Leitón, the intern student Andrés Aguilar (PRIAS Laboratory), the former scholarship recipient Andrea Hidalgo from the CeNAT-CONARE program plus the participation of students from the Engineering Group Aerospace from the UCR, and a software developer.

In this competition they obtained first place locally in Costa Rica and were nominated to participate for a prize in the global competition.

Through this participation, it was possible to generate knowledge that is the basis for the formation of the approach of the Creative Space project of the PRIAS Laboratory.

PRIAS 20 years building Geospatial Research

PRIAS is the first laboratory of the Centro Nacional de Alta Tecnología to celebrate 20 years of dedication; within science and technology, to transform knowledge into development to support informed decision-making based on data and collaborating in the democratization of information.

On November 27, 2023, the commemoration event was held with the purpose of celebrating 20 years of dedication and achievements, as well as reflecting on the milestones achieved and the future of geospatial research. The event had the presence of ambassadors, directors of public, private and international organizations, university authorities, and researchers with extensive experience.

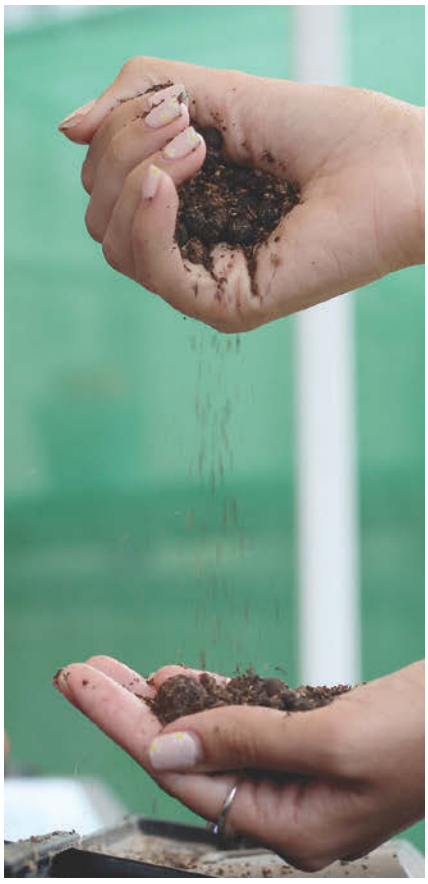
ENVIRONMENTAL MANAGEMENT

Gestión Ambiental

Environmental Management

Annual Operational Plan

(CeNAT-CONARE) 2023

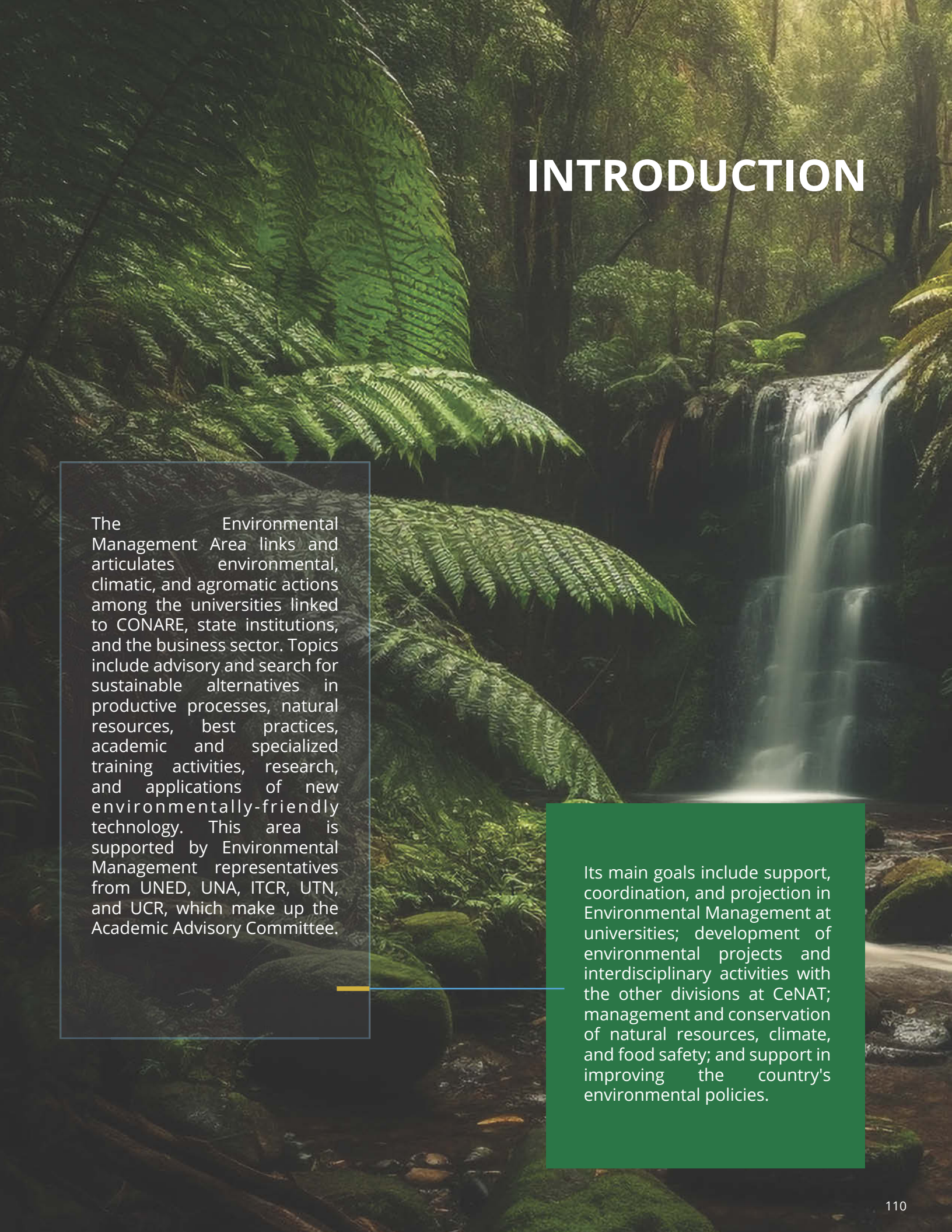


INDICATORS

DISTRIBUTION OF GOALS

	Public	Private	Total
Scientific publications - Dissemination	2	0	2
Knowledge transfer activities	15	5	20
Research projects	2	5	7
Attention to students	8	3	11
Agreements	2	0	2

INTRODUCTION



The Environmental Management Area links and articulates environmental, climatic, and agromatic actions among the universities linked to CONARE, state institutions, and the business sector. Topics include advisory and search for sustainable alternatives in productive processes, natural resources, best practices, academic and specialized training activities, research, and applications of new environmentally-friendly technology. This area is supported by Environmental Management representatives from UNED, UNA, ITCR, UTN, and UCR, which make up the Academic Advisory Committee.

Its main goals include support, coordination, and projection in Environmental Management at universities; development of environmental projects and interdisciplinary activities with the other divisions at CeNAT; management and conservation of natural resources, climate, and food safety; and support in improving the country's environmental policies.

Development Goal

To disseminate and empower society in the economic, social, and environmental fields on climate change, productive chains, and added value of products, by developing technical assistance processes that territorially impact innovation projects, technology, and entrepreneurship for the productive development of Costa Rica.

Mission

We are a research area with national and international linkages, which supports the public, private, and civil society sectors in technical assistance for decision-making in the face of risks of weather events and in productive development, through a team of specialized professionals who carry out studies with the highest scientific standards, within the framework of innovation and development of higher education in Costa Rica.

Vision

We aim to be a self-sustaining research area with high economic and social impact at the national and international levels, which contributes to knowledge generation on climate change, production chains, and product added value, being a leader in strengthening competitive development and technical assistance from the intersectoral articulation.

Values enforced at the Environmental Management Area

- Human team support
- Support to food industry and productive support in continuous improvement
- Collaborative management in the projects that are undertaken
- Socialization of scientific information to society

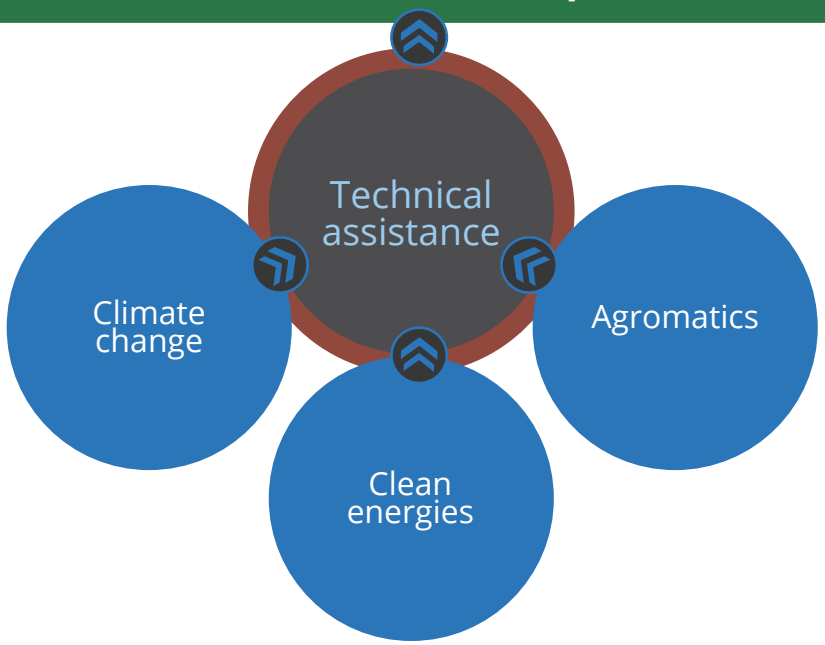
Principles Enforced at the Environmental Management Area

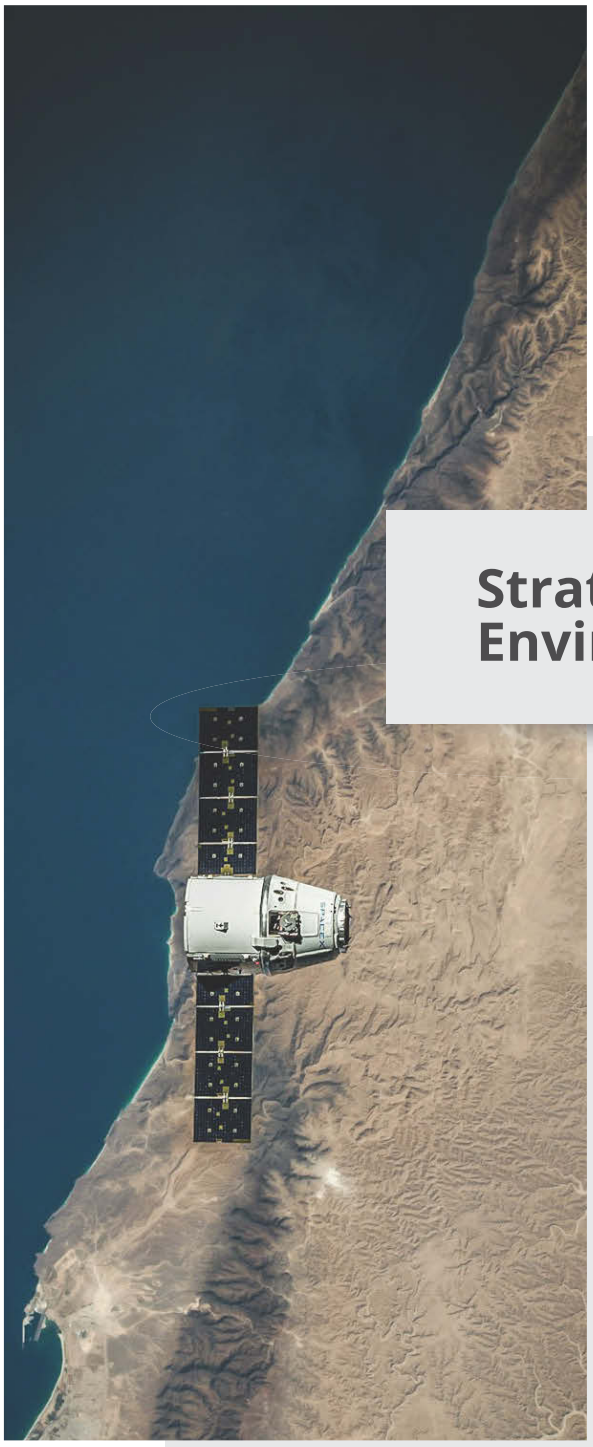
- Efficient use of time
- Accountable administrative management of research projects
- Willingness for constant improvement of the projects that are undertaken
- Knowledge and skills empowerment

Operational Structure:

Strategic development areas of Environmental Management

Innovation and development





Strategic Objectives of the Environmental Management Area

- To provide technical information on atmospheric variability and climate change to the productive decision-making sectors of Costa Rica and Central America
- To generate collaborative actions with communities of agricultural producers in processes of improvement and added value of products
- To promote the development of sustainable energy transformation technologies and solutions in coordination with national and international actors
- To increase knowledge in communities on environmental management matters
- To strive to the financial sustainability of Environmental Management

Strategic Nodes of the Environmental Management Area

- Development of computer platforms and information access tools for decision makers, producers, and communities, on population, spatial, environmental, climate, and agrifood matters
- Development of joint projects to support communities and environmental impact studies with national and international organizations
- Promotion of knowledge and added value of products through agromatic strategies linked to national, regional, and global initiatives, such as the SAN-CRLAC plans, Slow Food, denominations of origin, Mother Earth fairs, and related activities

Programs of the Environmental Management Area

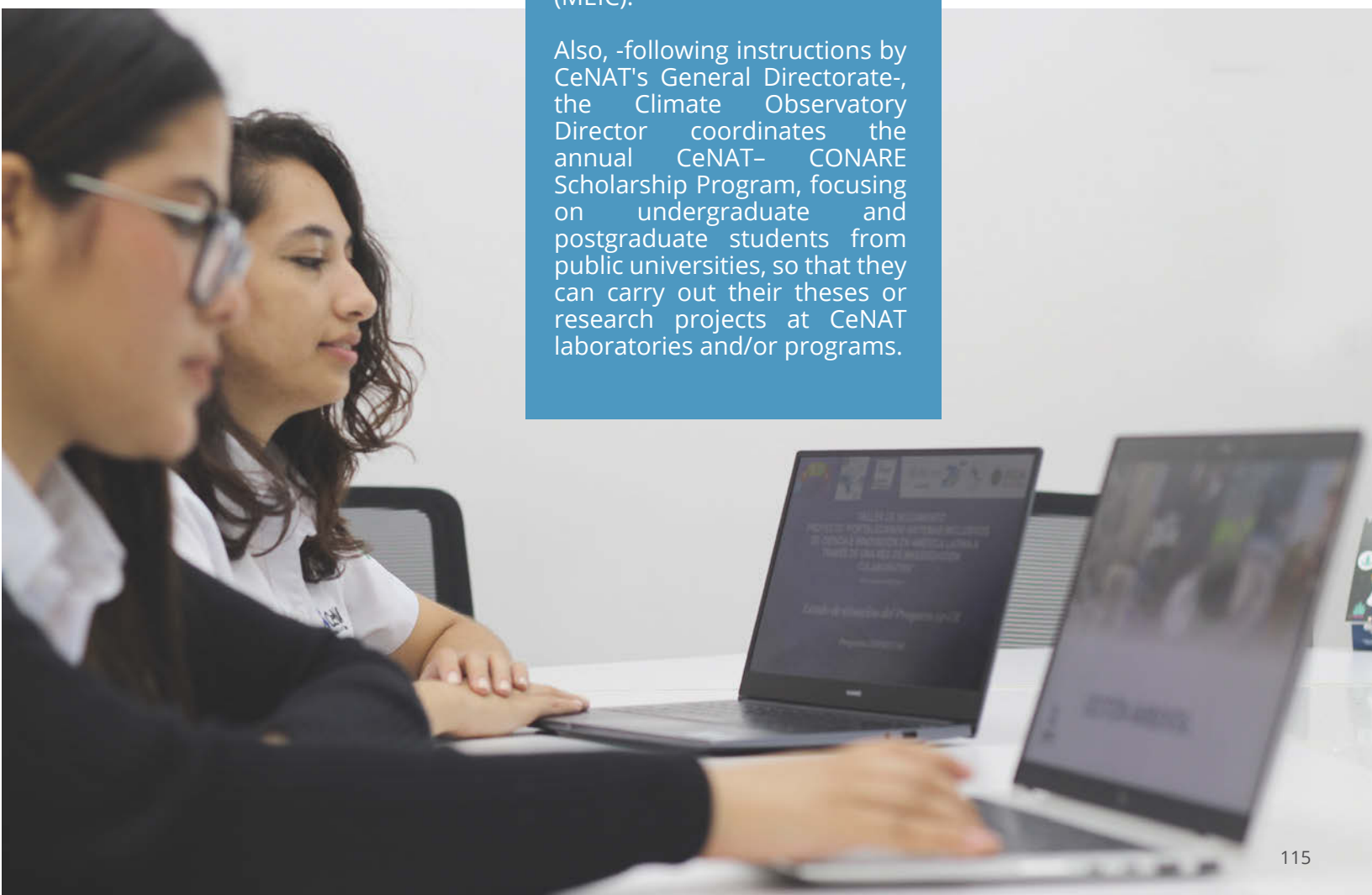
General Coordination

The Direction of the Area supports and aligns the strategic actions of the different programs that make up the Area. In addition, it collaborates in managing the projects developed by PRIAS Laboratory.

Furthermore, it promotes business innovation actions and projects with European and American linkage projects, focusing on SMEs and high-tech ventures. This is done in association with the Ministry of Science, Technology and Telecommunications (MICITT) and the Ministry of Economy, Industry and Commerce (MEIC).

Also, -following instructions by CeNAT's General Directorate-, the Climate Observatory Director coordinates the annual CeNAT– CONARE Scholarship Program, focusing on undergraduate and postgraduate students from public universities, so that they can carry out their theses or research projects at CeNAT laboratories and/or programs.

Finally -also under the advise of CeNAT's General Directorate-, it supports the logistic development of inter-laboratory projects and events (congresses, seminars, and others) of other CeNAT units.



Climate Observatory

The Climate Observatory Program of the Environmental Management Area responds to the need to strengthen the capacity to adapt to the variability and climate change that extreme variations in weather and climate generate on the productivity of the agricultural sector.

It is a Program dedicated to researching past and current situations, as well as climate perspectives with the purpose of social benefit facing climatic adversities.

The Observatory continuously and innovatively provides services to the agricultural sector in research and training, with personalized assistance from a technological platform on issues related to adaptation and resilience to variability and climate change to agricultural communities, in order to sustain productivity and increase the yield of crops and livestock; thus, helping in decision-making and planning of activities.

Agromatics

The Agromatics program is dedicated to working with the support of alliances and high technologies (with universities, institutions, ministries, companies, regulatory bodies, and CeNAT's own laboratories), in publicizing local resources and products.

Both products and their gene expression are typified to detect genes for adaptation to the environment and resistance to diseases and pests, which are linked to quality and hardness, according to the variability of the existing species. Typification is done through the knowledge of the organoleptic and culinary quality of local products, many of which are little known.

In addition, morpho-agronomic, physicochemical, organoleptic, and biochemical characterizations are carried out to allow knowing and evaluating both nutritional and anti-nutritional contents of products and, through high technologies, the technical specifications that may indicate that a product deserves a distinctive sign of quality are endorsed. The aim is to determine the origins and uses of the different products and the good use of agro-industrial by-products. These comprehensive studies make it possible to address natural disasters, climate variability and change, deforestation, and loss of harvests that cause higher prices of products and food insecurity.

Through the alliance with Slow Food, activities are developed to promote quality, clean products (innocuous and with clean technologies that minimize damage to human, animal, and environmental health), and fair pricing, by reducing intermediation chains in a way that not only producers and their families win, but also co-producers, who are conscious consumers and understand the problems of producers and their families and consider the great effort they make to provide more sustainable and healthy products.

Impact Indicators

PUBLICATIONS

2
TOTAL

2 Specialized

KNOWLEDGE TRANSFERS

People benefited: **More than 9,000**

Attention to 23 WhatsApp groups, 13 Telegram groups, PIACT platform, and Facebook page.

20 TOTAL

15 Public

National (Taught)

6 8 Lectures Taught
Workshops, Discussions, Courses taught

International (Taught)

1 Courses and symposia taught

5 Private

National (Taught/Received)

2 3 Lectures Taught
Workshops, Discussions, Courses taught

Research **Projects**

7 TOTAL

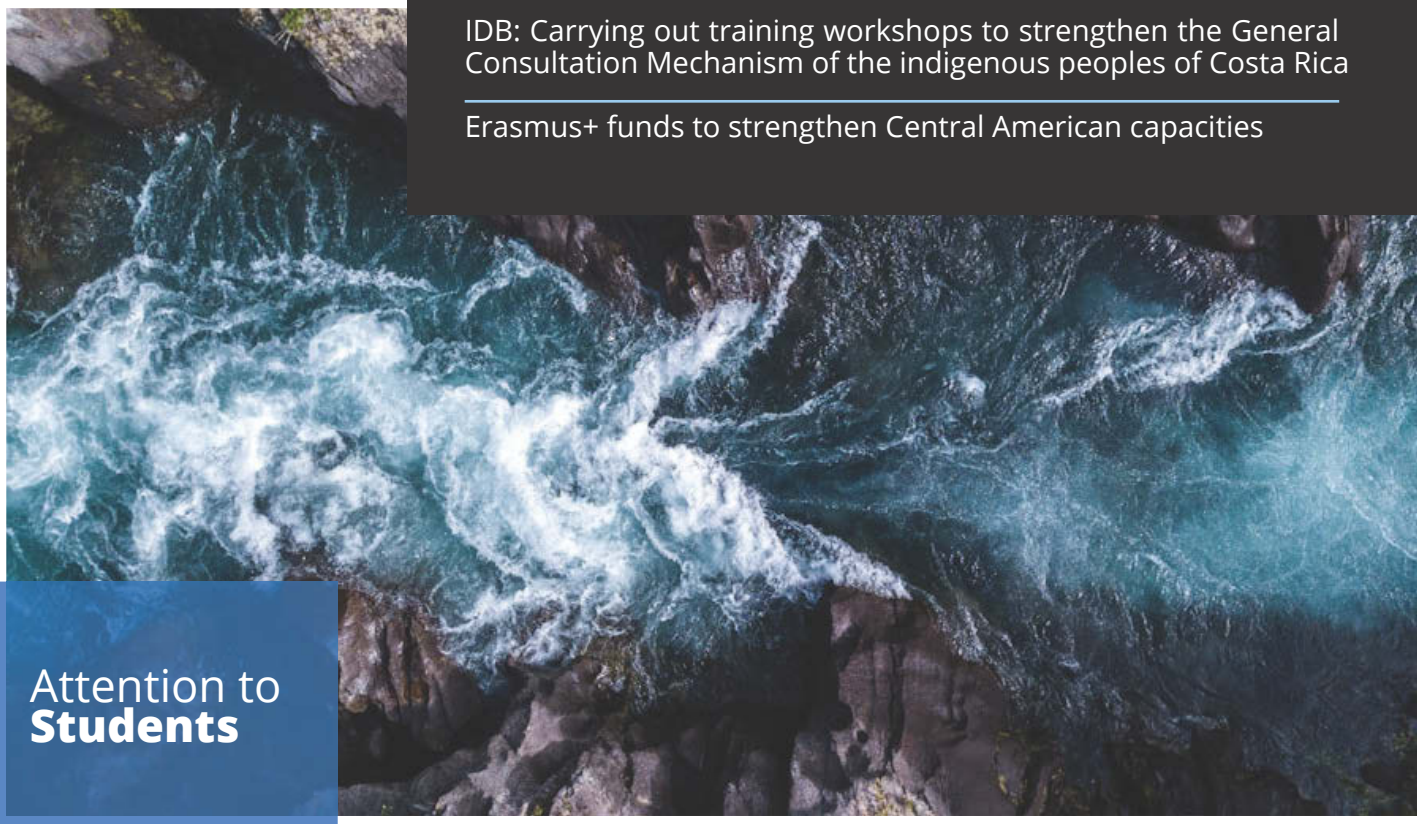
2 **Public**

5 **Private**

Projects/Proposals Under Negotiation

IDB: Carrying out training workshops to strengthen the General Consultation Mechanism of the indigenous peoples of Costa Rica

Erasmus+ funds to strengthen Central American capacities



Attention to **Students**

11 TOTAL

3 **CeNAT-CONARE Scholarships**

3 CeNAT-CONARE Fellow students

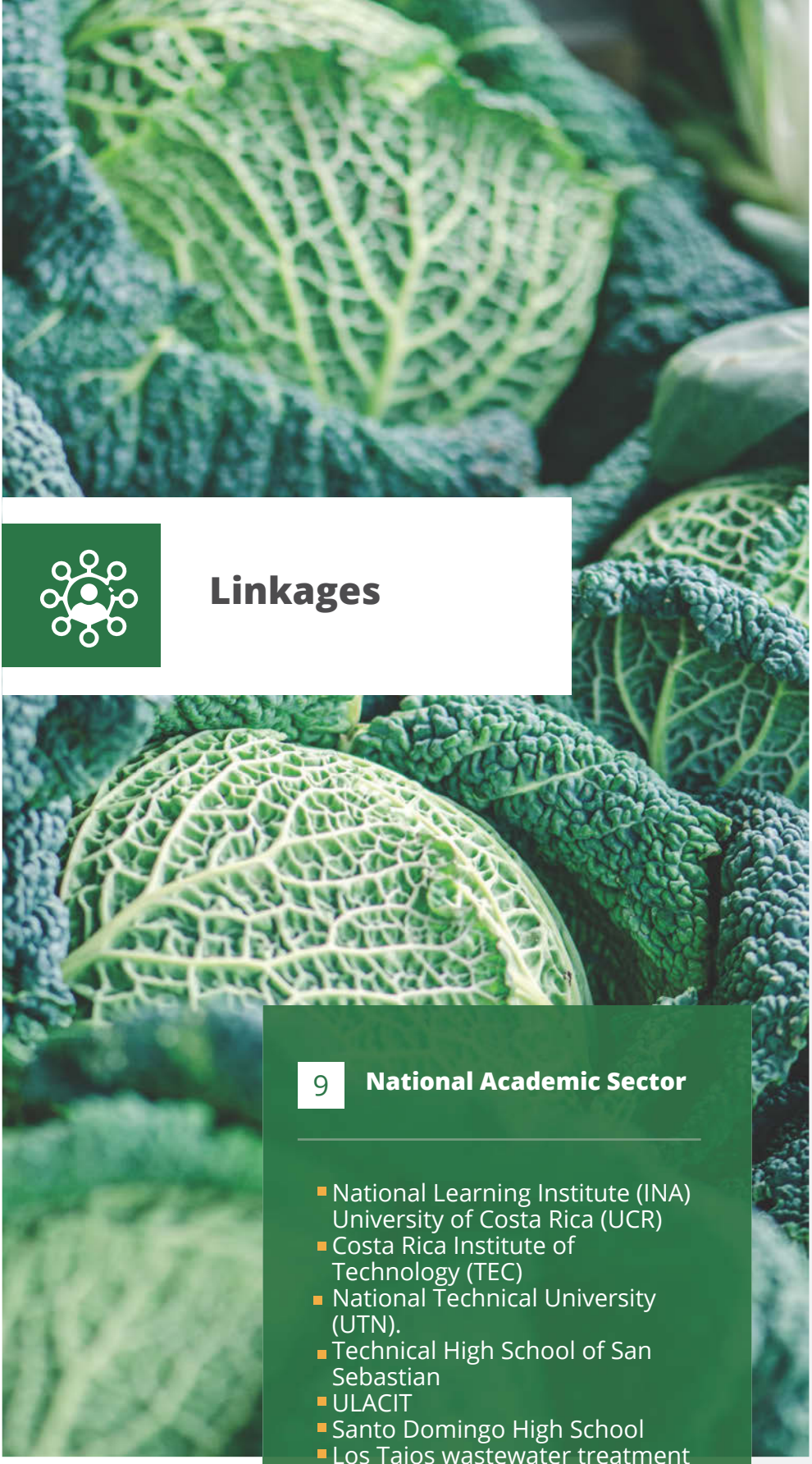
3 **Assistant Hours**

3 Assistant students working by hours

2 **Student Hours**

2 Student working on student hours

3 **Private**



Linkages

9 National Academic Sector

- National Learning Institute (INA) University of Costa Rica (UCR)
- Costa Rica Institute of Technology (TEC)
- National Technical University (UTN).
- Technical High School of San Sebastian
- ULACIT
- Santo Domingo High School
- Los Tajos wastewater treatment plant
- Costa Rican Network of Sustainable Educational Institutions (REDIES)

5 International universities or institutes

- Mondragon University, Spain
- OEI
- EU-SOLARS ERIC
- LifeWatcha ERIC
- OBREAL

3 International Companies

- Rawsuns Technologies – China
- Canadian Embassy
- The Congress of the Americas on International Education (CAEI)

7 National companies

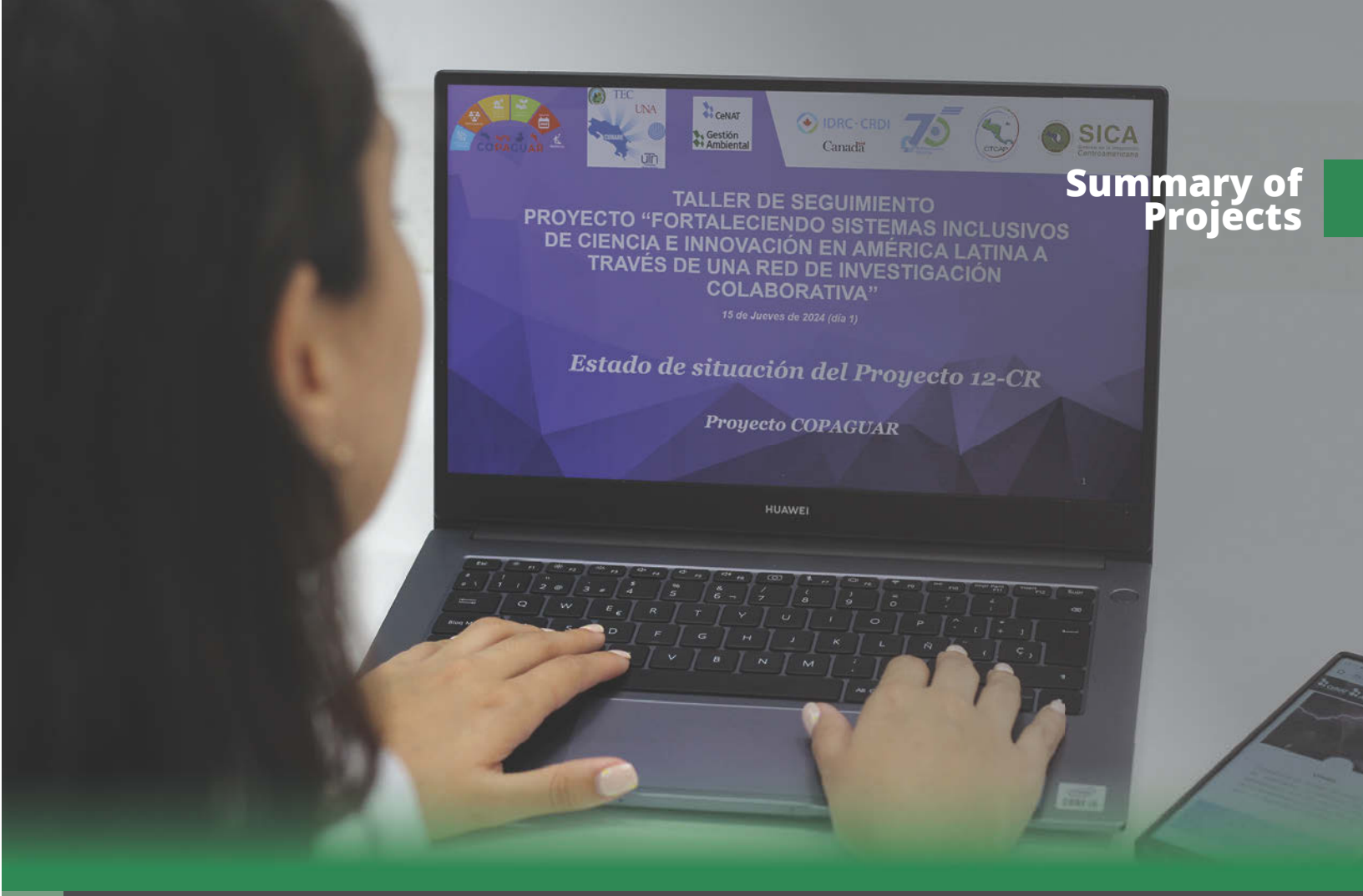
- MICITT
- Costa Rican Promoter of Innovation
- National Bank of Costa Rica (BNCR)
- MEIC
- National Learning Institute (INA)
- National Bank of Costa Rica (BNCR)
- Chamber of Industries of Costa Rica
- Banco Popular y de Desarrollo Comunal

Agreements

2
TOTAL

2 **National**

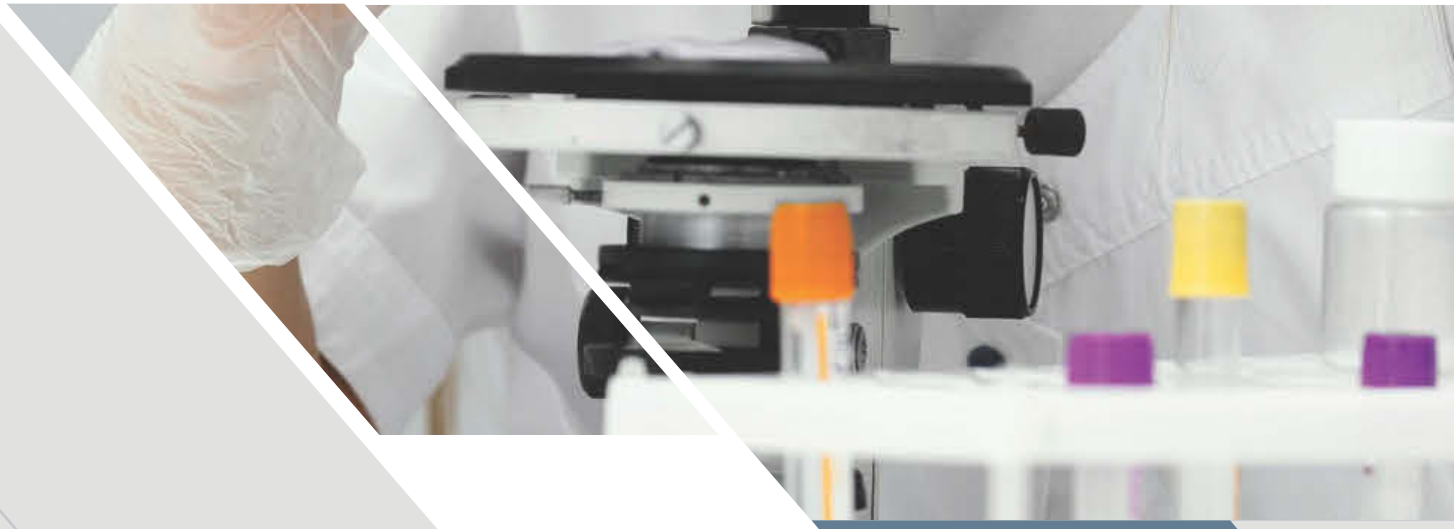
- National Bank of Costa Rica
- Agreement of the Atlantic campus of UCR



Summary of Projects

	Project	General description
1	Environmental Management Project	The Environmental Management Area provides technological support and truthful, pertinent, and timely information to more than 7,500 producers in Costa Rica and Central America, for proper decision-making Likewise, comprehensive quality units and productive support are developed for producer associations. The Environmental Management project has students who provide a very important contribution in the day-to-day work of different activities and projects that are developed in the Area and its Programs
2	Costa Rica - Antarctica Project	In this project, the design of the mobile laboratory powered by clean energy was continued and concluded. The different components and systems for both the conversion to electricity and the photovoltaic complementary power supply were also quoted and built. Finally, the shipment of the components developed in China was coordinated and the purchase of spare parts and other equipment is being coordinated with local suppliers
3	Project "Generation of agro-industrial capacities and creation of a comprehensive unit (physical-chemical, organoleptic, and microbiological characterization) to improve the production process of Turrialba cheese with Designation of Origin (PINN-ASOPROA)"	After a year of negotiations, on December 20, 2023, the resumption and extension of the project was achieved until December 31, 2024. A coordination process began with the Presidency of ASOPROA to continue the purchase of equipment, implementation of the Comprehensive Quality Unit (ICU), and intellectual protection of the by-products obtained

	Project	General description
4	Earth Market Project	Training sessions and promotional activities have been held with producers and farmers, in Tucurrique, Turrialba, and the Caribbean area, among other places in the country. The 2024 Earth market is being coordinated and support work has increased in the PIAM. For this project, the land market fair is scheduled for December, after many years of not being able to carry it out. It is a very important activity that involves chefs, artisans, and students, among other people who are very much engaged in the added value of local foods and food security
5	UPS Environmental Management Project	The professional services of the people who support the PIACT page and manage WhatsApp for the climate perspectives were renewed. In addition, the execution of activities, tours, and related activities of other projects, especially billing the work hours carried out by the area in the PINN project, has been achieved. In this quarter, the hiring of people who are supporting the PIACT page and chat groups has continued
6	CSUCA Project: "Strengthening environmental competencies in communities through technological and methodological innovation to promote resilience in disaster risk management and climate change in the canton of Heredia, Costa Rica, in the district of Almirante, Bocas del Toro , Panama and the Achí indigenous community, from Rabinal in the Department of Baja Verapaz, Guatemala."	The project was approved, and the first disbursement has been managed. The work plans and the first materials for the workshops were developed. Also, the first profiles for the project contracts were generated
7	OEI project of "ENERGYTRAN: EULAC FOR ENERGY TRANSITION: RESEARCH INFRAESTRUCTRES COOPERATION FOR ENERGY TRANSITION BETWEEN EUROPE AND LATIN AMERICAN AND THE CARIBBEAN COUNTRIES"	The proposal was presented and approved by the European Union. Administrative procedures and planning began with LifeWatch ERIC as leader of the work packages in which CeNAT is participating. Work was carried out on the methodological scheme of the project



INSTITUTIONAL **RESULTS**

SUPPORT IN **KNOWLEDGE TRANSFER**

In addition to its focus on research development, for LANOTEC is also essential to maximize work in the area of extension and teaching, by giving special attention to developing and enhancing the promotion of scientific vocations in students from an early age, seeking a rapprochement with educational centers to involve children in the process from the first school cycle.

Part of the commitment in this area is evident in the participation of student delegations in the various Science and Chemistry Olympiad, starting the process at the national level to select the representatives to participate in events at the international level.

At the national level, we were involved in the organization of these activities:

- XXIII Costa Rican Chemistry Olympiad
- V Costa Rican Science Olympiad
- VII Camp for the Promotion of Scientific Vocations, mainly Chemistry

In 2023, the following activities were carried out at the international level:

- XV Central American and XIII Caribbean Chemistry Olympiad
- XXVI Iberoamerican Chemistry Olympiad
- 55th International Chemistry Olympiad
- 20th International Junior Science Olympiad

This year a step has been taken to return to presence, by holding 3 Olympiad events in person - Central American and Caribbean Chemistry Olympiad, the International Chemistry Olympiad, and the International Youth Science Olympiad. The Ibero-American Chemistry Olympiad was held virtually.

XXIII Costa Rican **Chemistry Olympiad**

The event was held in person. In addition, category A 28 students took a laboratory exam aimed at those who obtained the best grades in the final exam.

This process involves preparation and revision of tests, participation at events, and contribution to logistics of activities.

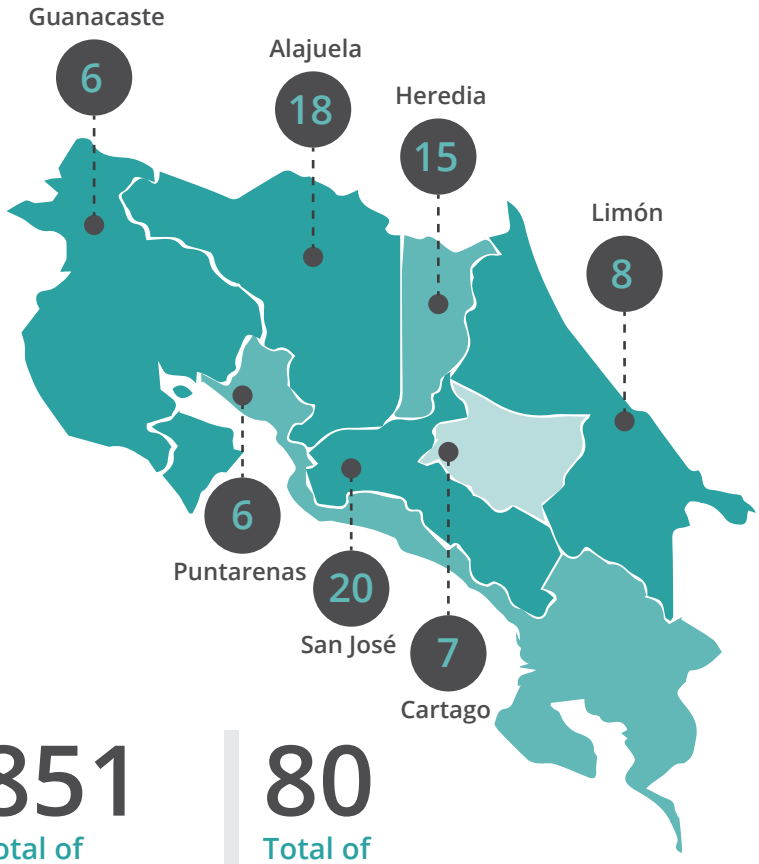
In addition, preselected students are trained to prepare for international competitions. During this process, several "super finals" are made to select those who will participate in the international Olympiad.

In 2023, the distribution of participants at the Costa Rican Chemistry Olympiad was as follows:

Students

	Category A	Category B
♂	151	302
♀	165	233
	316	**535**

Number of institutions by province



851
Total of Students

80
Total of Institutions

V Costa Rican Science Olympiad

The Olympiad was held in a mixed way, with the first exam taken virtually and the final one in person. In addition, a laboratory internship was carried out with the students who obtained the best grades in the final exam. In this internship, students carried out a laboratory practice and after that, they visited some laboratories where they learned about what the laboratory does and what its scope is.

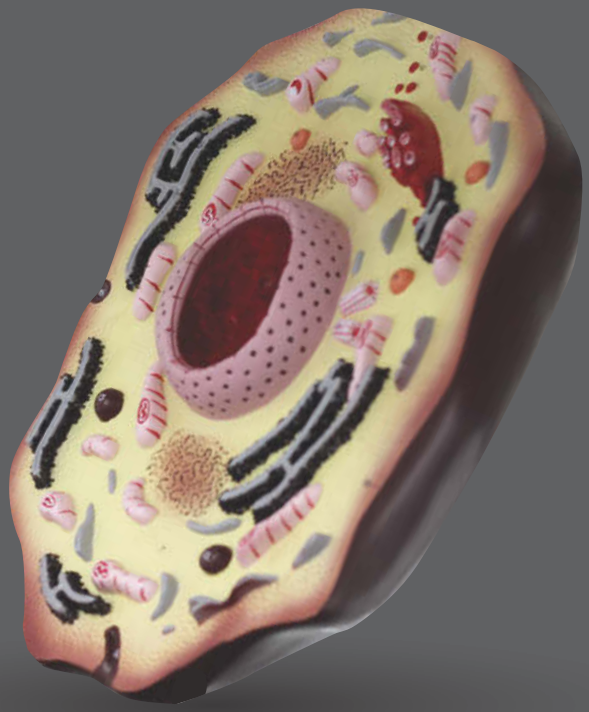
During this process, the exams that have contents from the three areas biology, physics and chemistry are prepared and reviewed, in addition to participating in the activities and managing the logistics of the entire contest.

On the other hand, an annual training course is carried out for pre-selected students to prepare them for the international competition. During this process, a "super final" is held to select those who will participate in the international Olympiad.

In 2023, the distribution of participants at the Costa Rican Science Olympiad was as follows

	Students	
	Category A	Category B
	178	46
	132	32
	310	**78**

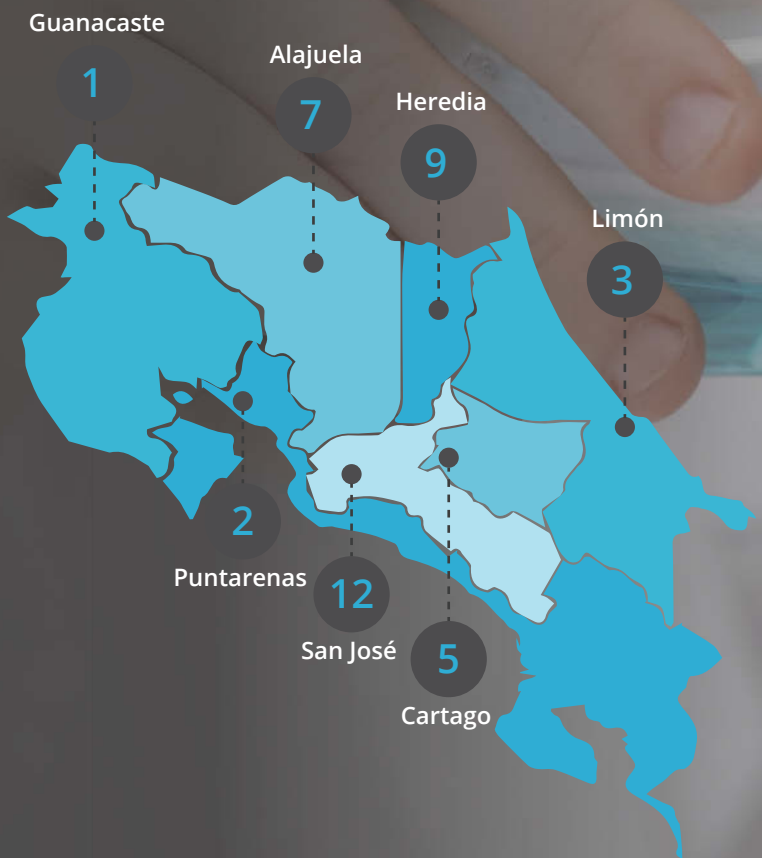
Level	Students
Ninth grade	105
Eighth grade	106
Seventh grade	99
Sixth grade	42
Fifth grade	23
Fourth grade	13
Total	**388**



388
Total of Students

39
Total of Institutions

Number of institutions by province



VIII Camp for Promotion **of Scientific Vocations, mainly Chemistry**

This camp was carried out with the finalist students from the Costa Rican Science and Chemistry Olympiad. After conducting an analysis of the candidates, a group of students from all over the country were selected.

During three days, there were lectures, laboratories, experiments, and recreational activities focused on chemistry, physics, and biology, in addition to working on critical thinking and problem solving.

In 2023, the participants in the camp were distributed as follows

23
Male

39
Total

16
Female

Olympiad	Students
Sciences	17
Chemistry	22
Total	**39**

XVI Central American and XIII Caribbean Chemistry Olympiad

The Olympiad was held in El Salvador from September 2 to 7 and the members of the Costa Rican delegation were:

- Andrea Rivera Álvarez, Head of Delegation
- Mario Villalobos Forbes, Mentor
- Fabian Andrés Flores Alvarado, Student
- Isaac Herrera Chaves, Student
- Gloriana Carrillo Cabezas, Student
- Jorjan Alejandro Madrigal Ugalde, Student

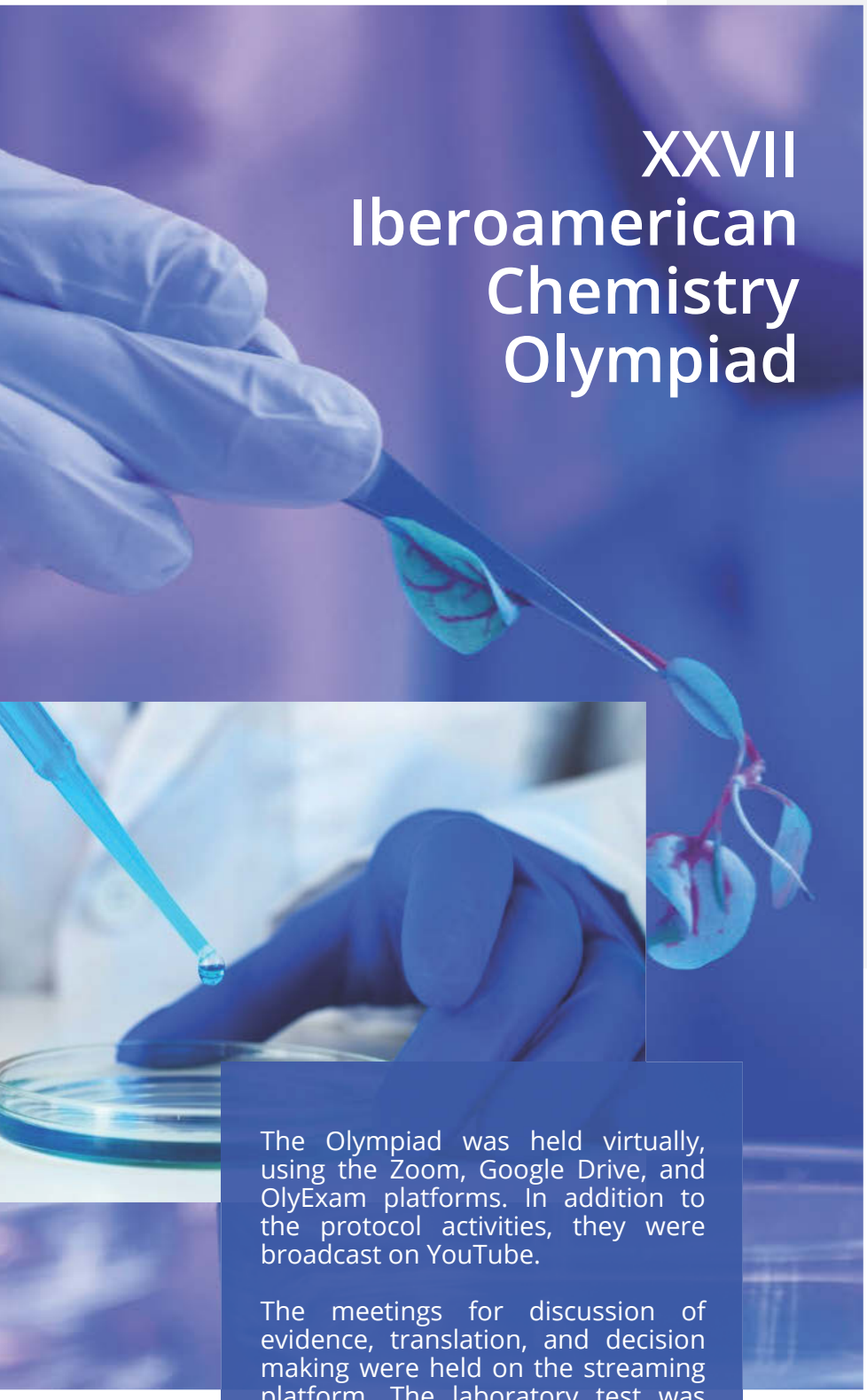
Achievements:

Gloriana Carrillo Cabezas
Bronze Medal

Isaac Herrera Chaves
Bronze Medal

Fabián Andrés Flores Alvarado
Bronze Medal

Jorjan Alejandro Madrigal Ugalde
Silver Medal



XXVII Iberoamerican Chemistry Olympiad

The written test was performed in the same way by the OlyExam platform and the students had five hours to complete it in one of CeNAT's meeting rooms. The discussion, translation, and subsequent test reviews went off smoothly.

The Olympiad was organized by Ecuador and was held from October 02 to 19, 2023. The Costa Rican delegation was made up of:

- Wendy Villalobos González, Head of delegation
- Eduard Ríos Badilla, Mentor
- Fabián Flores Alvarado, Student
- Jorjan Madrigal Ugalde, Student
- Henry Mora Ureña, Student
- José Daniel Muñoz Solís, Student
- Andrea Rivera Alvarez, Supervisor

The Olympiad was held virtually, using the Zoom, Google Drive, and OlyExam platforms. In addition to the protocol activities, they were broadcast on YouTube.

The meetings for discussion of evidence, translation, and decision making were held on the streaming platform. The laboratory test was done through explanatory videos uploaded to Google Drive and the exam document was downloaded and printed through the OlyExam platform. This test was performed at the CeNAT Computer Laboratory.

Logros:

Jorjan Alejandro Madrigal Ugalde
Silver Medal

Fabián Andrés Flores Alvarado
Bronze Medal

José Daniel Muñoz Solís
Bronze Medal

Henry Mora Ureña
Honorable mention

55th International Chemistry Olympiad

The event was held in Switzerland, from July 16-25, 2023. The Costa Rican delegation was made up of:

- José Roberto Vega Baudrit, Head of Delegation
- Manuel Sandoval, Mentor
- Randall Syeed, Companion, with own funds
- Juan Pablo Hernández Abarca, Student
- Henry Mora Ureña, Student
- José Daniel Muñoz Solís, Student
- Alexander Sancho Dive, Student

Achievements:

Although no medals or prizes were awarded, the commitment, participation, and growth of the students at an academic level during the development of the Olympiad was highlighted.

20° International Junior Science Olympiad

This Olympiad was organized to be held in person. The discussions, translations, and judgments were made by the mentor professors of the delegation. During these periods, the questions of each test are approved among all the participating countries; then they are translated, and later the grades obtained by the students are discussed.

The student has three tests to solve - a single selection test, a written test, and a laboratory test. Each test lasts 4 hours. During these tests, students have questions from the 3 areas: chemistry, physics, and biology.

The Olympiad was held in Thailand, from December 01 to 10, 2023. The Costa Rican delegation was made up of:

- Andrea Rivera Álvarez, Head of Delegation and Physics Mentor
- Ricardo Ulate Molina, Mentor
- Kenneth Castillo Rodríguez, Mentor
- Mateo Sancho Dive, Student
- Sol Moya Peñaranda, Student
- Gabriel Ampie Rojas, Student
- Ariana Espinosa Clavera, Student
- Sofía Argüello Herrera, Student

Achievement:

Sol Moya Peñaranda
Bronze Medal

INNOVATION

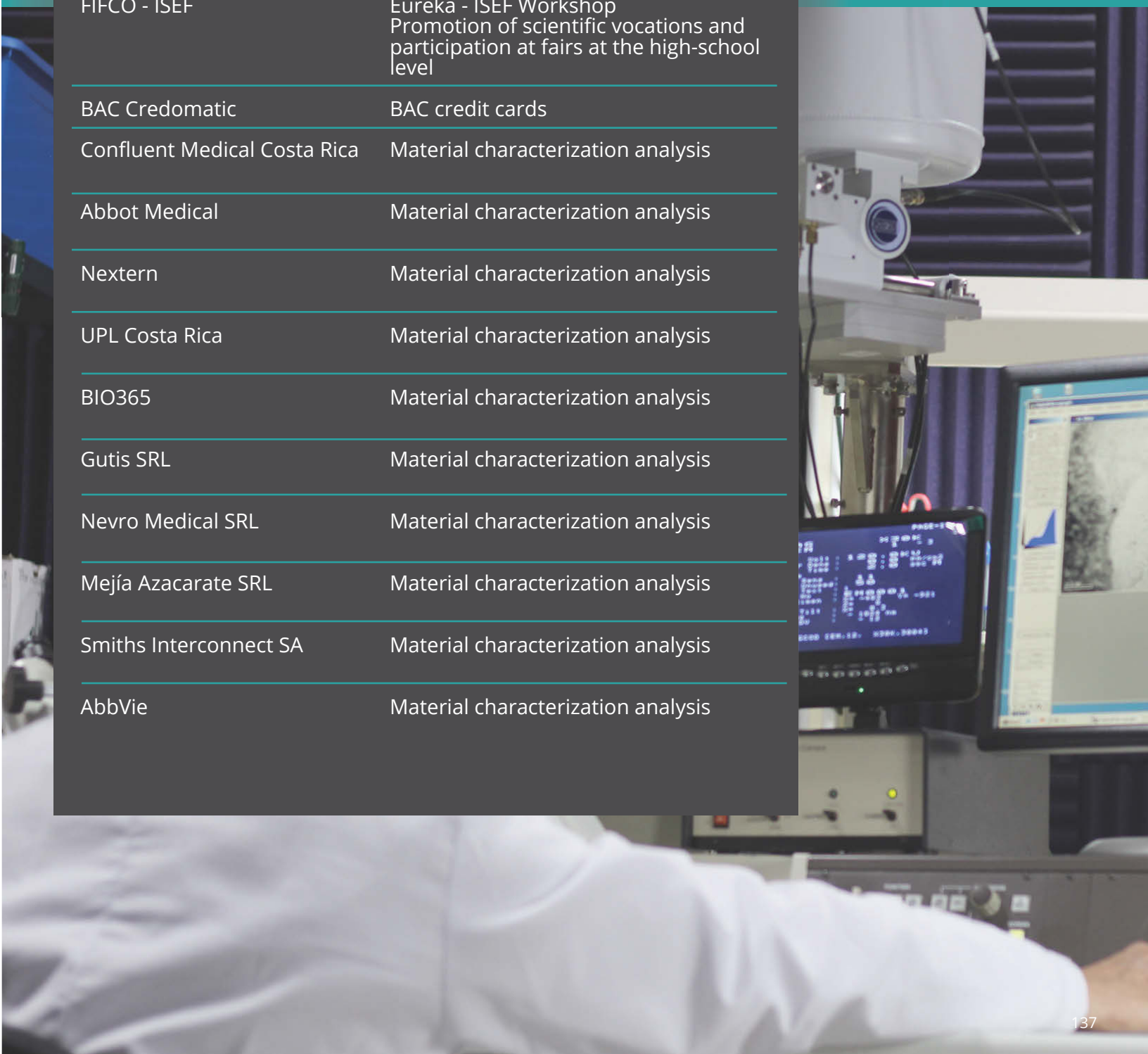
Entrepreneurship:

Support to Companies of Applied Scientific Research

LANOTEC
LABORATORY

COMPANY	RESEARCH
Office of Naval Research Global	Alternatives for interface-modified and 2D/3D perovskite absorbers for perovskite solar cell applications
ASOPROA Santa Cruz	PINN: Generation of agro-industrial capacities and creation of a comprehensive unit (physical-chemical, organoleptic, and microbiological characterization) to improve the production process of Turrialba cheese with Designation of Origin
Boston Scientific de Costa Rica S.R.L.	Material characterization analysis
Calox de Costa Rica S.A.	Material characterization analysis
Philips Morris	Design and development of a concept model to establish a bioinformatic study of lung cancer by means of computer vision at nanomolecular-scale 3D images and circulating molecular biomarkers of associated genes. Evaluation of the impact of cigarette smoke vs THS on indoor air quality
Coopervision Manufacturing Costa Rica	Material characterization analysis

COMPANY	RESEARCH
FIFCO	Plastic bottle characterization analysis
H2020 - EU - University of Belgrade, Serbia	Automated functional screening of IgGs for diagnostics of neurodegenerative diseases (AUTOIgG)
Hologic Surginal Products Costa Rica S.R.L.	Material characterization analysis
Proquinal	Evaluation of the antimicrobial activity of four vinyl fabrics produced by the company
FIFCO - ISEF	Eureka - ISEF Workshop Promotion of scientific vocations and participation at fairs at the high-school level
BAC Credomatic	BAC credit cards
Confluent Medical Costa Rica	Material characterization analysis
Abbot Medical	Material characterization analysis
Nextern	Material characterization analysis
UPL Costa Rica	Material characterization analysis
BIO365	Material characterization analysis
Gutis SRL	Material characterization analysis
Nevro Medical SRL	Material characterization analysis
Mejía Azacarate SRL	Material characterization analysis
Smiths Interconnect SA	Material characterization analysis
AbbVie	Material characterization analysis



COMPANY	RESEARCH
Organic Ecogreen	Workshops and Trainings
SAVAL Laboratory	Material characterization analysis
Fertinyc	Biopolymer prototype, obtained from pineapple biomass waste. (BIO TAG)
Private Northern University, Peru	Metal nanoparticles biosynthesized from agroindustrial waste applied in the functionalization of bioplastics for use in the berry industrial chain

CENIBiot
LABORATORY

COMPANY	RESEARCH
Thrive Natural Care	Preparation, quantification, characterization, and method development for extracts of plant origin materials
Nippon Paper Papylia Co., Ltd.	In vitro plant establishment and genetic fingerprinting protocols
Coopetarrazú	Preparation, quantification, characterization, and method development for extracts of plant origin materials
Biotech C.R. S.A.	Molecular identification (DNA barcoding) of living organisms and development of bioprocess optimization and scaling protocols
Bio CR	Physicochemical quality control analysis for beer

COMPANY	RESEARCH
Corbana S.A.	Molecular identification (DNA barcoding) of living organisms and development of bioprocess optimization and scaling protocols
Corporación de Desarrollo Agrícola del Monte S.A.	Molecular identification (DNA barcoding) of living organisms
CoopeAgri R.L.	Quantification of polyphenols
Speratum	Implementation Unit
Stein Laboratories	Development and validation of quantification and identification methods by HPLC and mass spectrometry techniques
CoopeCUNA	Development, quality control, and knowledge transfer for oil production processes at an industrial scale
Mammoth Biosciences	Description of microbial metagenomes in extreme environments
Granja Avícola Santa Marta	Optimization of production protocols of organic biological amendment for agricultural use
BaseCamp Research	Large-Scale Microbial Diversity Study in Costa Rica, there is also an agreement with the company to carry out future research projects
Compund-Foods	Production of metabolites of commercial interest in coffee cell suspensions and improvement of analytical processes and protocols
Treinta y cinco Fábrica de Cervezas	Storage and cryopreservation of microorganisms
Establishment Labs	Determination of the presence of plasticizers
Fruitpoint Costa Rica	Freeze-drying of samples (Stock of microorganisms through freeze-drying)
Osa Conservation	Nucleic acid extraction

Source:
Information provided by CeNAT's laboratories for 2023.

Support to Applied Scientific Research Organizations or Institutions

CNCA
LABORATORY

INSTITUTION	RESEARCH
Ministry of Science, Technology, and Telecommunications (MICITT)	Collaboration for the development of artificial intelligence in the country
Ministry of Agriculture and Livestock (MAG)	Support to research institutes in the development of activities
Public Universities (UCR, TEC, UNA, UNED, UTN)	Advanced computing platform for the development of research and training projects
Chamber of Information Technologies (CAMTIC)	Collaboration in the artificial intelligence chapter
Advanced Computing System for Latin America and the Caribbean (SCALAC)	Support in the organization of the company structure
Central American Higher University Council (CSUCA)	Advanced computing platform for the development of research and training projects

PRIAS
LABORATORY

COMPANY	RESEARCH
CONICIT, MICITT, DLR, SINAC, MINAE	MONEO-WET Project Applicability of Sentinel-2, DESIS, and Landsat 8 satellite imagery data for water quality studies, on water bodies related to crop coverage surroundings of the National Térraba-Sierpe Wetland (MONEO-WET). In addition, he participated in an internship at the German Space Agency
FAO, SINAC, MINAE, and other users of the available information	FAO-SEPAL Project: Pilot digital system for monitoring illegal logging in the Golfo Dulce Forestry Reserve and a study area on the Pacific side of La Amistad National Park
TEC, National Museum, and UTN	Project: Spatialization of the tree flora of Costa Rica pilot study for the Greater Metropolitan Area
SIMOCUTE	Participation in workshops to update the SIMOCUTE classification system
CONARE-PEN	Project, “Cantonal Historical Geospatial Representation of Costa Rica for the 1905-2014 period: Constructing the spatial representation in the form of geographic information layers that enable reproduction of the Territorial Administrative Division of Costa Rica for the periods 1905, 1950, 1963, 1973, 1984 and 2014”.
	Project, “Local productive structures: productive, labor, and territorial value chains in Costa Rica”

COMPANY	RESEARCH
Regional Science and Technology Advisory Group (RSTAG)	Participation at work sessions and workshops carried out by different representatives on the topic of disasters and risk reduction
Municipality of San José, INEC	Collaboration opportunity for the calculation of SDG indices
RedClara	Through RedCLARA, the PRIAS laboratory is invited to participate in a webinar on the Copernicus program initiative in Latin America, the Ideaton BELLA is held to promote innovation projects related to Earth Observations
Aerospace Engineering Group	Project: Reforestation from the air: Methodology to evaluate the effectiveness of reforestation with rocketry as a dispersion mechanism
UNED-LIIT	Project on the forest fire regime in Costa Rica, possible strategies for mitigating their impact on the tropical dry forest
MTF Teak	Spectral Signature Library Project: Study Integration of the use of remote and in situ sensors for the detection of pests and diseases in Tectona grandis Lf plantations in Nandayure, Guanacaste Costa Rica
ENAPROC, Mexico	Community Capabilities Initiative *Bothrops asper*
Sevilla University	Opportunities for collaboration, among which a framework agreement has been valued, to support the survey of spectral signatures of Salinas

ENVIRONMENTAL MANAGEMENT

COMPANY	RESEARCH
MICITT	Apoyo a realización de talleres de formación en propuestas de la Unión Europea Participación en actividad de cierre del mes de la Ciencia, con Stand
FUNDECOOPERACIÓN	Participación en actividad de presentación de proyectos ADAPTA2 en la Antigua Aduana
OEI	Noche Iberoamericana
IEO – OECD	Desarrollo taller paralelo a Reunión Ministerial Latinoamericana de Ministros de Ambiente de la OCDE
CONARE – GlobalEdu – Procomer	Desarrollo Stand Costa Rica CAEI-2023 en Las Vegas
FunCeNAT – CINDE	Proyecto BID – Biomateriales Proyecto BID – Biodesarrollos
IMN	Búsqueda de fondos para lanzamiento de sondas meteorológicas, en el marco del PIACT
IDB	Presentación de propuestas de investigación en temas de variabilidad y cambio climático
Desamparados Development Association – UNED – UCR	Observatorio de Salud Ambiental de Desamparados

Source:
Information provided by CeNAT's laboratories for 2023.

Socialization of Sciences

For Centro Nacional de Alta Tecnología, the socialization of scientific knowledge is very relevant. It is carried out through subsystems such as scientific education, communication, and dissemination of the institutional work of CeNAT.

CeNAT works for society and therefore communication is a bridge with the population to disseminate scientific knowledge and the findings made by the laboratories and the Area.

The communication work that is carried out entails the attention of the press and solving queries from the population on the social networks.

Work of CeNAT on Media

CeNAT's Social Networks

20 Digital media

11 Radio

9 Television

10 Written press

Currently, presence on social networks is essential under the dissemination strategy, it is a permanent communication channel that has the advantage of the immediacy of the information with the institution's audiences. CeNAT has a YouTube channel, a Soundcloud account, a Facebook page, and a website, which represent the institutional channels. They provide information to the different segments.

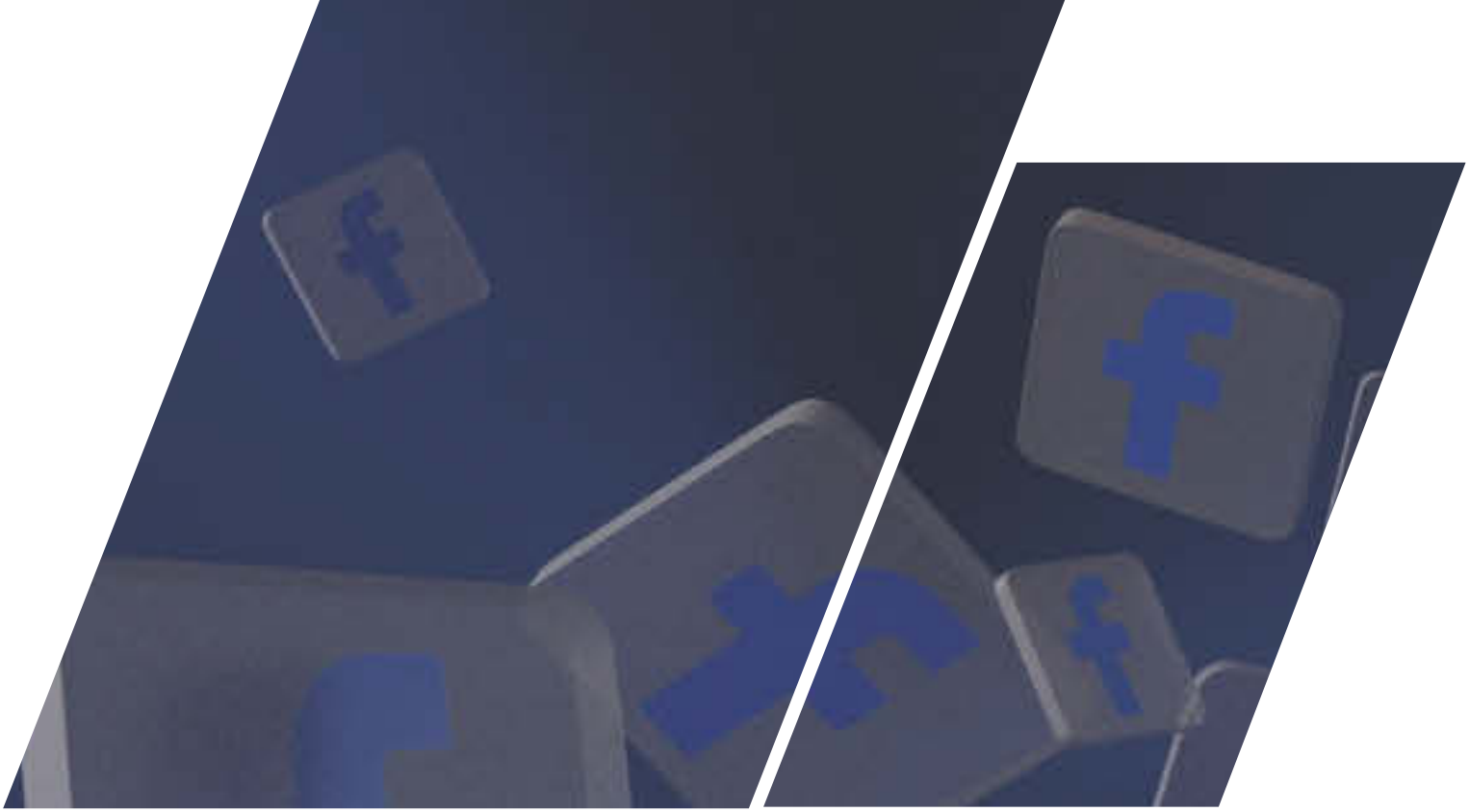
Valuable informative and educational content is published on CeNAT's networks, which contributes to promoting scientific vocations.

The posted content includes announcements of virtual courses or workshops, news of institutional work, CeNAT-CONARE scholarship programs, knowledge transfer activities, research projects, and digital campaigns that are launched on several topics.

Within the digital ecosystem, the Facebook page maintains constant growth in followers, with an audience stratified into 53.70% women and 46.30% men.

Para el 2023 se desarrollaron tres campañas:

Becas CeNAT-CONARE, proyectos de Investigación de las dependencias y Aniversario CeNAT



SOCIAL MEDIA

MORE THAN
15 THOUSAND
Number of followers

MORE THAN
14 THOUSAND
likes to the page

45,000
people
Average monthly reach of posts

49
Number of countries that follow the page

Work of CeNAT on Media

Source: information for the year 2023 provided by CeNAT Communication.

* The number of followers has been generated organically, without resorting to paid social media advertising.

**As of December 31, 2023

Argentina
Australia
Austria
Belgium
Bolivia
Brazil
Canada
Chili
Colombia
Costa Rica
Cuba
Czech Republic
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
France
Germany
Guatemala
Honduras
Iraq
Israel
Italy
Japan
Mexico
Netherlands
New Zealand
Nicaragua
Nigeria
Norway
Panama
Paraguay
Peru
Philippines
Portugal
Puerto Rico
Russia
South Korea
Spain
Sweden
Swiss
Syria
Türkiye
United Kingdom
Uruguay
USA
Venezuela
Vietnam

Countries that follow CeNAT's activities socialized on Facebook

Source: Information from the year 2023.

The main data of information on reach, achievements and impacts evidenced by each of the Laboratories of CeNAT in the year 2023 are presented below.

Human Resources at CeNAT

Centro de Alta Tecnología Foundation

Officers, collaborators and scholarships.
Period 2023-2022

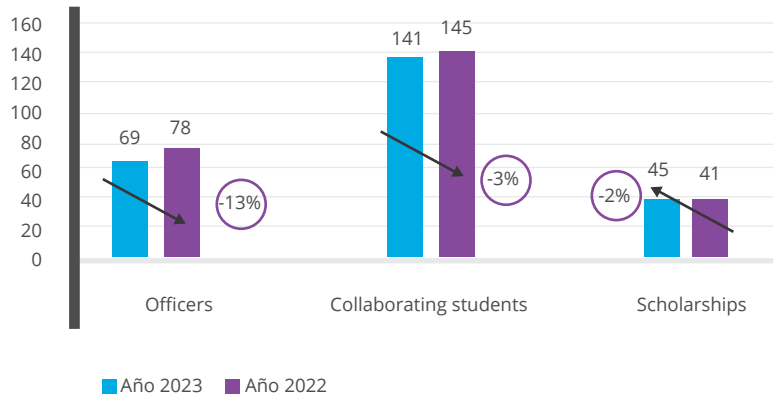
YEAR 2023

255

ORIGIN	YEAR 2023	YEAR 2022	Variation %
Officers	69	78	-13%
Collaborating students	141	145	-3%
Scholarships	45	41	9%
Total	**255**	**264**	**-4%**

Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

Officers, collaborators and scholarships



Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

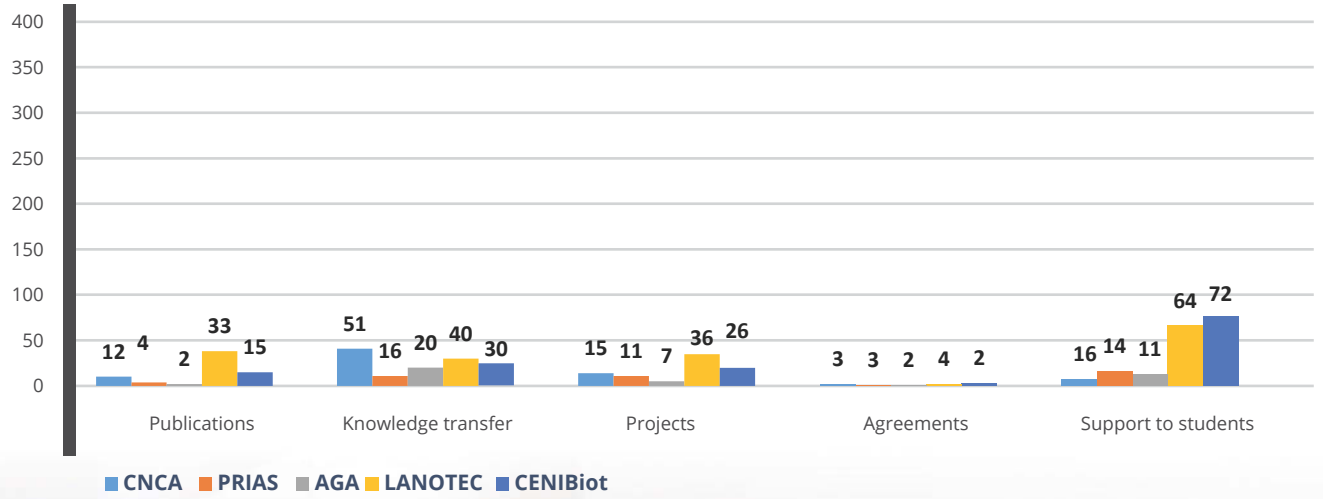
2023 Indicators, according to CeNAT Laboratories and Areas

CeNAT
Public and private indicators 2023

Indicator	CNCA	PRIAS	GA	LANOTEC	CENIBiot	Total
Publications	12	4	2	33	15	66
Knowledge transfer	51	16	20	40	30	157
Projects	15	11	7	36	26	95
Cluster Performance Days	365	-	-	-	-	365
Cluster usage hours	85,363	-	-	-	-	85,363
Agreements	3	3	2	4	2	14
Student support	16	14	11	64	72	177

Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

Public and private indicators 2023



Source: Information on the year 2023 provided by the Laboratories and Area of CeNAT.

Sectors linked to CeNAT in the Last Six Years

Identification of sectors related to CeNAT as of December, 2023

Education	2018
Social	2018
Health	2018
Energy	2018
Agriculture	2018
Local-Municipalities	2018
Aerospace	2018
Tourism	2018
Environmental	2018
Food	2018
Technology	2018
National Security	2018
Medical Physics	2018
Biodiversity	2018
Drug development	2018
Biorefinery/Bioeconomy	2018
Medical Devices	2018
Aeronautics	2018
2019	Accreditation
2019	Art and Culture
2019	Sports
2019	Textile
2020	Transportation
2021	Ministry of Treasury
2021	Regulation
2021	Marine-fishing
2021	Forest
2021	Innovation
2022	Banking and finances
2023	Economy

CONARE
CONSEJO NACIONAL DE RECTORES

CeNAT
Centro Nacional de Alta Tecnología

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

Institutions that Started Relations with CeNAT in 2023

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

Institutions, Organizations, and Companies Linked to CENAT in 2023

Present in 2023

Incorporated in 2021

Incorporated in 2019

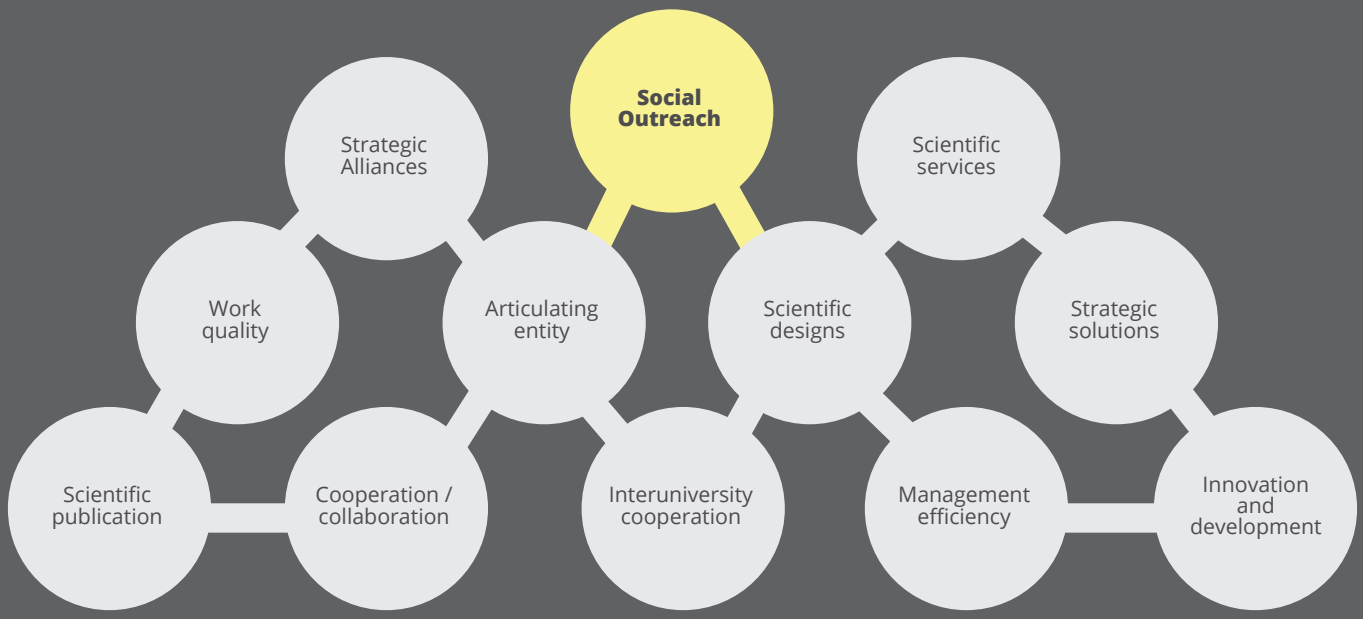
Incorporated in 2022

Incorporated in 2020

Incorporated in 2018

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

Perception of what the institutions have done with CeNAT



Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

CeNAT
Centro Nacional de Alta Tecnología

Expectations of Institutions from CeNAT

- CeNAT at the forefront of research
- CeNAT as an ally to meet institutional objectives
- CeNAT supports country goals
- CeNAT supports reliability of the data
- CeNAT in the development of joint projects
- CeNAT in scientific training
- CeNAT in institutional relation strengthening
- CeNAT as an innovative institution
- CeNAT conducting joint research
- CeNAT is closer to the academy
- CeNAT as organizer of scientific events
- CeNAT in participation in international projects
- CeNAT in joint publications
- CeNAT in solutions to global problems
- CeNAT socializes the use of information
- CeNAT as support to the productive sector
- CeNAT in municipal collaboration
- CeNAT as support in purchasing services
- CeNAT as Prototyping support
- CeNAT in community projection
- CeNAT in institutional projection
- CeNAT in scientific publications
- CeNAT in scientifically-correct relationship
- CeNAT in PINN-funded services
- CeNAT with permanent relationship
- CeNAT in upscaling of technology transfer
- CeNAT in research projects
- CeNAT does not compete for research funds
- CeNAT as strategic partnerships
- CeNAT in effective collaborations

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

Figure 8. World Map of the Scope of CeNAT in 2023

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

Table 1. World Map of the Scope of CeNAT's Laboratories in 2023

	CENIBIOT	CNCA	LANOTEC	PRIAS	Environmental Management
Germany	X	X	X	X	X
Argentina		X	X	X	X
Australia				X	
Belize		X		X	X
Brazil	X	X		X	X
Canada	X		X	X	X
Chile	X	X		X	
China				X	X
Colombia	X	X	X	X	X
Ecuador		X		X	
El Salvador		X			X
Spain	X	X	X	X	X
U.S.	X	X	X	X	X
France	X	X	X		
Guatemala		X			X
Honduras		X			X
England	X				
Israel	X				
Italy		X			X
Japan	X		X		
Mexico	X	X		X	X
Nicaragua		X			X
Panama		X	X	X	X
Peru			X		
UK	X				
Serbia	X		X		
Switzerland	X				
Turkey					X
Uruguay	X	X	X	X	X
Venezuela					

Source: Analysis of the information provided by CeNAT's laboratories, updated to December 2023.

INDICATORS OF INSTITUTIONAL WORK

Impact Reached in 2023 at CeNAT

MORE THAN 15 THOUSAND Facebook Followers

45,000 PEOPLE Average annual reach of Facebook posts

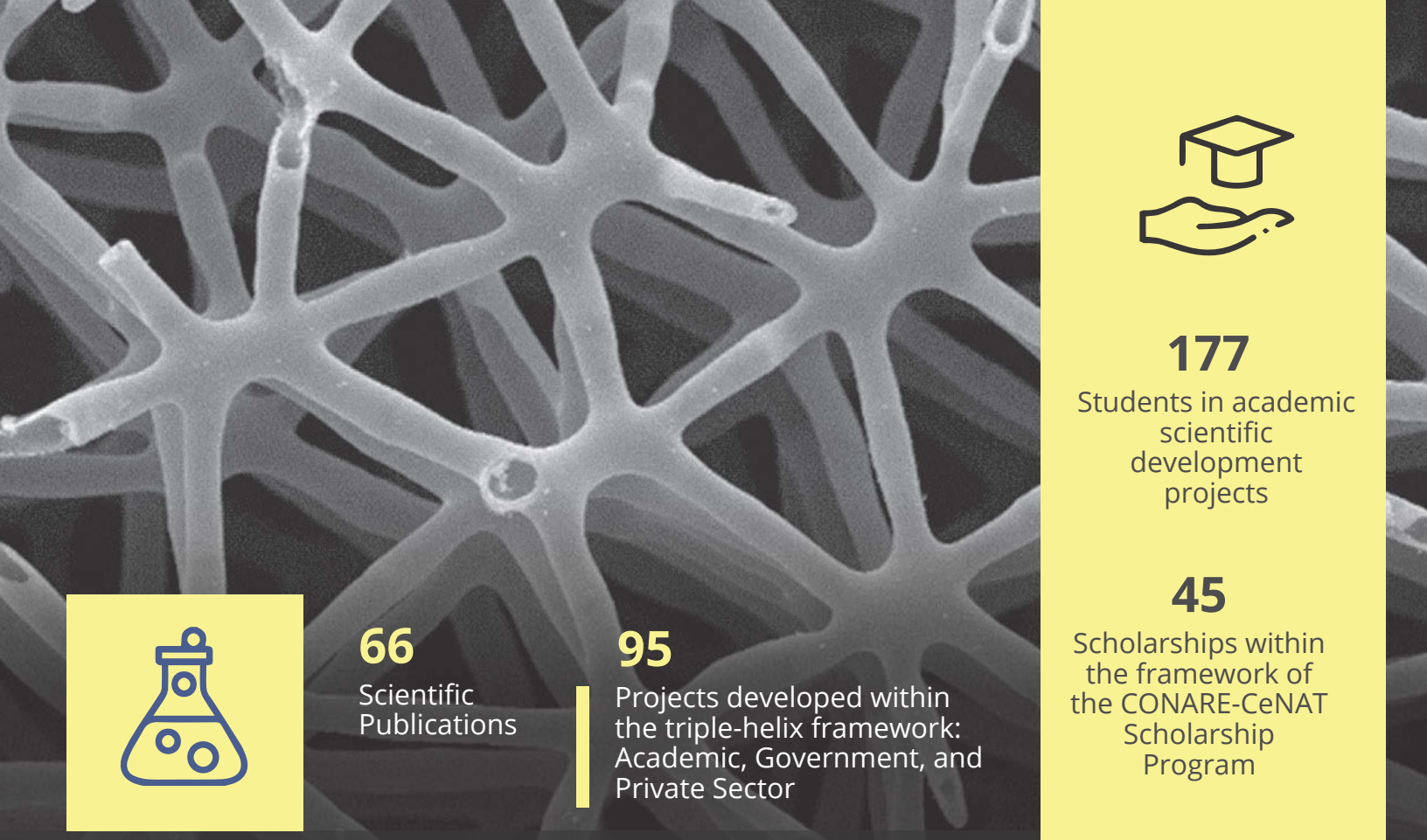
49 Nationalities of Facebook followers

50 Presence in the media

5 Registered patents

7 Registration processes

2 Researchers in the United States Invention Registration



66
Scientific Publications

95
Projects developed within the triple-helix framework: Academic, Government, and Private Sector

177
Students in academic scientific development projects

45
Scholarships within the framework of the CONARE-CeNAT Scholarship Program

365
days of cluster operation

634
accounts with access to computing infrastructure services

85,363
science hours in simulations and data processing

157	Knowledge transfers taught
9,963	Benefited population
7	Olympiad and fairs supported

Impact in 2023

9,000
technical assistance to producers in Variability and Climate Change

28
support to applied scientific research organizations or institutions

45
support to applied scientific research companies

14
agreements

26
linkage with strategic sectors

29
linkage with inter-institutional networks

30
Countries linked to CeNAT

5
Eduroam deployed in the campuses of the 5 Public Universities

6
network services available to students, staff, and teachers

157,316
students and professors of public universities with access to the Edu-Roam network

7.5 billones
logins to the Eduroam Network from international territories

105
Countries with Eduroam

Source: information for the year 2023 provided by CeNAT Communication.

FunCeNAT and Financial Results

FunCeNAT and Financial Results

The Centro Alta Tecnología Foundation (CeNAT Foundation -FunCeNAT) was created by Act No. 7806, of May 25, 1998, with the purpose of managing the resources and attention of the institutional goals of the Centro Nacional de Alta Tecnología (CENAT).

Article 3.- The State and its institutions are hereby authorized to transfer resources to the Centro Nacional de Alta Tecnología, whose administration and management will be handled by the Fundación Centro Alta Tecnología.

FunCeNAT is under continuous supervision by the Comptroller General of the Republic, with regard to the proper management and administration of the resources received under the Act 7386. In the same way, it is audited continuously by CONARE Audit Department, in addition to third-party annual audits.

Furthermore, the Foundation has a Board, comprised by representatives of the State Institutions of University Higher Education (IESUE), the local city government (Municipality), and of the Government of the Republic. The Board appoints an Executive Director in charge of FunCeNAT.

It worth mentioning that at the time of creating CENAT, within the legal context, the chancellors of the universities that are members of CONARE, also created the Centro de Alta Tecnología Foundation (FUNCENAT). This foundation addresses the special characteristics of CENAT in aspects related to its structure and the legal regime provided. Law No. 7806 of May 25, 1998 expressly recognized FunCeNAT as the entity that would hold the legal duty to administer the resources required for the execution of the projects developed through CeNAT.

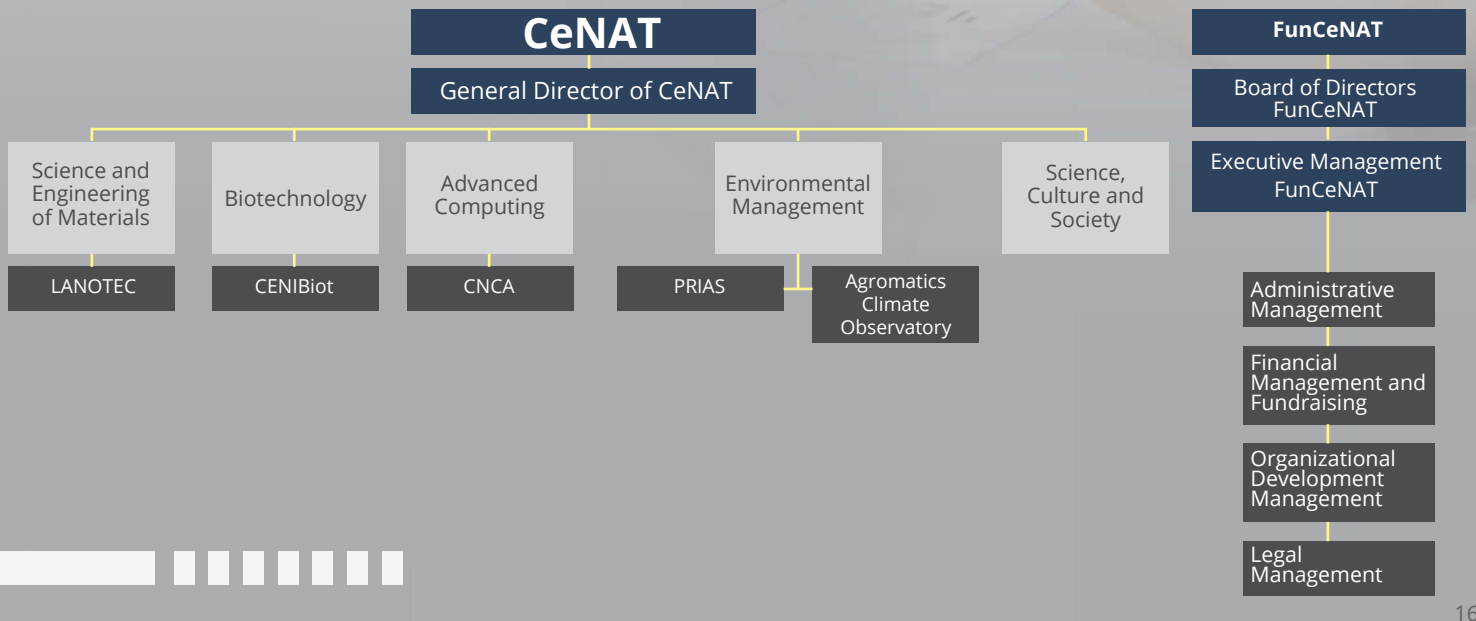
The Foundation acts as a service platform that meets the needs of CeNAT, as well as the public and private projects it manages. For this reason, FunCeNAT actively collaborates in the work of the areas, laboratories, programs and projects, providing support in administrative management in an efficient and transparent way, in sound financial management, in the organizational development at national and internationals, as well as legal support in the actions that the Laboratories, Programs and Projects undertake. Through its work, it strengthens the link with CONARE, in addition to supporting communication and inter-sectoral articulation.

It always aligns all its activities with the guidelines issued by CONARE, its Board of Directors, the Comptroller General of the Republic, and the audit of CONARE, as well as the External Audit, so that its activities and actions comply with all the applicable laws and regulations.

FunCeNAT is the foundation that provides permanent support to CeNAT laboratories and programs in four pillars for organizational development, namely:

- **Administrative** Management
- **Legal** Management
- **Human Talent** Management
- **Financial Management** and Fundraising

The operational structure of CeNAT showing its workflow is presented below.



Financial Results

DC-ALLIANCE
Public Accountants Firm
Santo Domingo, Heredia
P.O. Box 128-3100
+506-88391469.
+506-88359996.

REPORT OF THE INDEPENDENT AUDITORS ON THE SUMMARY FINANCIAL STATEMENTS

To the Managing Board of Fundación Centro de Alta Tecnología (FunCeNAT).

The summary financial statements, which comprise the summary statement of financial position as of December 31, 2023, and the summary income statement for the year then ended, as well as the corresponding explanatory notes, are derived from the audited financial statements of the Centro de Alta Tecnología Foundation - FunCeNAT ("the Foundation") for the year ended on December 31, 2023. In our report dated March 19, 2024, we expressed an unmodified audit opinion on these financial statements. Those financial statements, and the summary financial statements, do not reflect any effects of events that occurred subsequent to the date of our report on those financial statements.

The summary financial statements do not contain all the disclosures required by the International Financial Reporting Standards for Small and Medium Enterprises for the preparation of the audited financial statements of the Centro de Alta Tecnología Foundation (FunCeNAT). Consequently, reading the summarized financial statements is not a substitute for reading the audited financial statements of the Centro de Alta Tecnología Foundation (FunCeNAT).

Management's responsibility for the summary financial statements

Management is responsible for the preparation and reasonable presentation of the financial statements, in accordance with the International Financial Reporting Standards for Small and Medium-sized Enterprises and for any internal control that Management may deem necessary to allow for the preparation of financial statements that are free from material errors, both due to fraud and mistakes not related to fraud.

Auditor's responsability

Our responsibility is to express an opinion on whether the summary financial statements, based on our procedures performed in accordance with the International Standard on Auditing (ISA) 810 "Engagements to report on Summary Financial Statements."

DC-ALLIANCE
Public Accountants Firm
Santo Domingo, Heredia
P.O. Box 128-3100
+506-88391469.
+506-88359996.

Opinion

In our opinion, the summary financial statements derived from the audited financial statements of the Centro de Alta Tecnología Foundation (FunCeNAT) for the year ended December 31, 2023, are consistent, in all material respects with those financial statements, in accordance with International Financial Reporting Standards for Small and Medium Enterprises.

Ms. Zorahyda Vargas V.- C.P.A. No. 4204
Policy No.0116 FIG 7
Expiration: September 30, 2024
Tax Stamp No.6663, ¢1,000
Paid and affixed to the original document
March 19, 2024

CENTRO DE ALTA TECNOLOGIA FOUNDATION (FunCeNAT)

SUMMARY STATEMENTS OF FINANCIAL POSITION AS OF DECEMBER 31, 2023 AND 2022 AND JANUARY 1, 2022 (Restructured)

(Figures Expressed in Costa Rican Colones)

	2023	2022 (Restructured)	01/01/2022 (Restructured)
ASSETS			
CURRENT ASSETS			
Cash and Cash Equivalents	¢ 102,938,521	¢ 17,356,247	¢ 131,407,809
Investments held to maturity	457,638,814	260,273,653	524,474,251
Interest receivable on investments	20,066,474	21,829,069	18,363,673
Accounts Receivable	17,743,157	34,489,650	62,984,189
TOTAL CURRENT ASSETS	**598,386,966**	**333,948,619**	**737,229,922**
Investments held to maturity	1,845,873,090	1,886,650,771	2,064,571,557
Computer equipment, net	824,892	1,376,346	1,927,800
TOTAL ASSETS	**¢2,445,084,948**	**¢2,221,975,736**	**¢2,803,729,279**
NET LIABILITIES AND ASSETS			
LIABILITIES			
Accounts payable and accumulated expenses	¢ 125,506,227	¢ 39,692,996	¢ 63,650,571
Restricted Public Funds	1,435,815,380	1,361,793,396	1,750,419,058
Restricted Private Funds	655,443,141	634,485,777	753,191,011
TOTAL LIABILITIES	**2,216,764,748**	**2,035,972,169**	**2,567,260,640**
NET ASSETS			
Accumulated Surpluses	186,003,567	236,468,639	209,805,870
Surplus or (deficit) of the period	42,316,633	(50,465,072)	26,662,769
Total Current Assets	**228,320,200**	**186,003,567**	**236,468,639**
TOTAL LIABILITIES AND NET ASSETS	**¢2,445,084,948**	**¢2,221,975,736**	**¢2,803,729,279**

CENTRO DE ALTA TECNOLOGIA FOUNDATION (FunCeNAT)

SUMMARY INCOME STATEMENTS FOR THE YEARS ENDING DECEMBER 31, 2023 AND 2022 (Restructured)

(Figures Expressed in Costa Rican Colones)

	2023	2022 (Restructured)
REVENUE:		
Interest on investments	¢ 74,466,899	¢67,407,535
Project Management Interest	146,502,142	35,377,076
Total Revenue	220,969,041	102,784,611
EXPENSES:		
General and administration expenses	159,185,419	165,643,607
Foreign exchange differences, net	19,548,373	(3,511,989)
Other expenses/income	(81,384)	(8,881,935)
Subtotal	178,652,408	153,249,683
SURPLUS (LOSS) FOR THE PERIOD	**¢ 42,316,633**	**¢ (50,465,072)**

INSTITUTIONAL LEADERSHIP

Consejo Nacional de Rectores

Dr. Emmanuel González Alvarado
Chancellor, National Technical University

Dr. Gustavo Gutiérrez Espeleta
Chancellor, University of Costa Rica

María Estrada Sánchez MSc.
MSc., Chancellor, Costa Rica Institute of Tecnology

Francisco González Alvarado
M.Ed., Chancellor, National University

Rodrigo Arias Camacho
MBA., Chancellor, State University for Distance Education

Scientific **Council**

Lilliana Rodríguez Barquero
M.Sc. National Technical University

Dr. María Laura Arias Echandi
University of Costa Rica

Dr. Floria Roa Gutiérrez
Costa Rica Institute of Tecnology

Dr. Ing. José Luis León Salazar
Eng. Costa Rica Institute of Tecnology

Dr. Jorge Herrera Murillo
National University

Dr. Rosibel Víquez Abarca
PhD. State University for Distance Education

Strategic **Partners**

University of Costa Rica

Costa Rica Institute of Technology

National University

Universidad Estatal a Distancia (State Distance Education University)

National Technical University

Costa Rican Promoter of Innovation and Research

MICITT

Centro de Alta Tecnología Foundation

President:
Rodrigo Arias Camacho, MBA

Secretary:
Dr. Emmanuel González Alvarado

Treasurer:
Dr. Gustavo Gutiérrez Espeleta

Board Member 1:
Rose Marie Ruiz Bravo

Board Member 2:
Marielos Aldi Villalobos

First Comptroller:
Jorge Chaves Arce

Second Comptroller:
Francisco González Alvarado, MBA

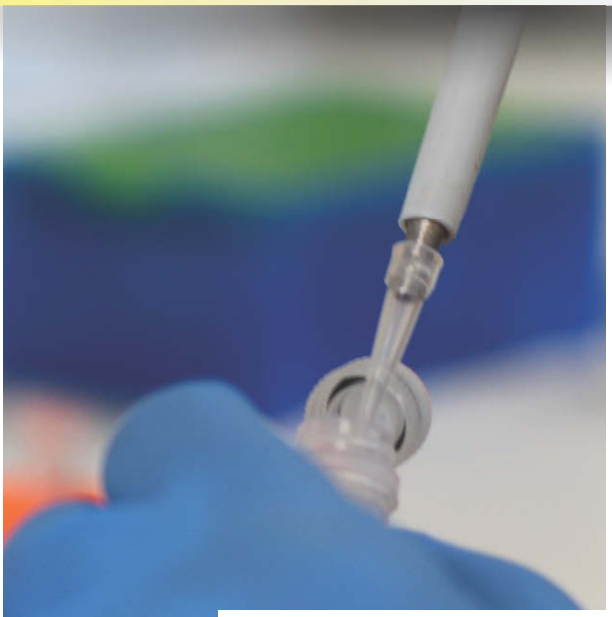
CeNAT Director:
Eduardo Sibaja Arias, Eng.

OPES-CONARE- Legal Advisor:
Mr. Gastón Baudrit Ruiz

Directorate **of CeNAT**

Eduardo Sibaja Arias
Eng., Director, CeNAT

Karol Palma Odio
Administrative Assistant



Laboratory **Directors**

Dr. José Vega Baudrit
Director, National Nanotechnology Laboratory

Dr. Randall Loaiza Montoya
Director, National Center for Biotechnological Innovations

Dr. Esteban Meneses Rojas
Director, National Collaboratory of Advanced Computing

Allan Campos Gallo
Eng., Director Environmental Management Area

Cornelia Miller Granados
Eng., PRIAS Laboratory Director

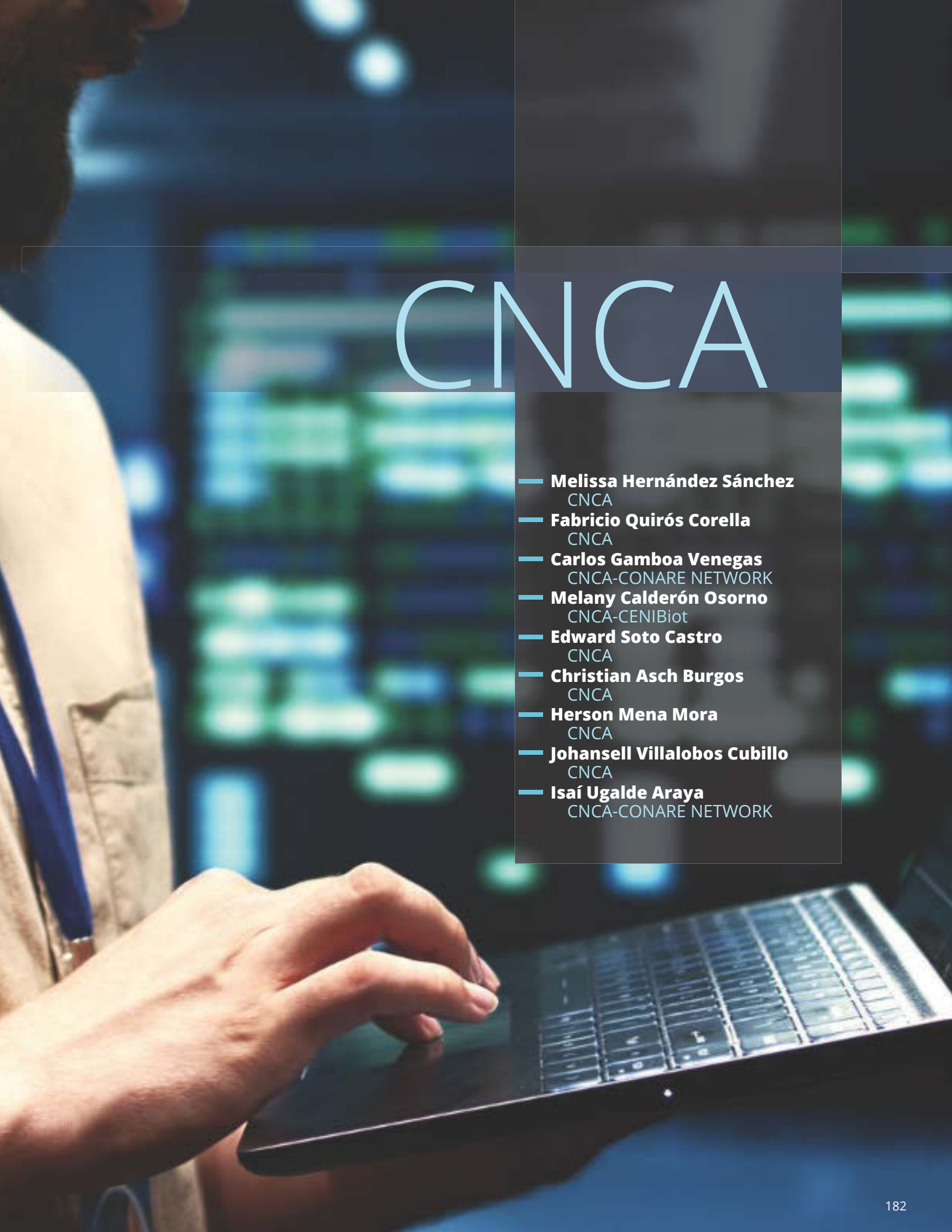
Officers

CeNAT

Melinda Corrales Ramírez CeNAT- Environmental Management
Rubén Padilla Hernandez CeNAT
Sugey Rivera Obando CeNAT
Andreina Leal Sánchez CeNAT
Fabián Ramírez Villalobos CeNAT-PRIAS

LANOTEC

Rebeca Rodríguez Fonseca
Charys López Borbón
Anthony Mayorga Hernández
Fabiola Rodríguez Ulloa
Andrea Araya Sibaja
Diego Batista Menezes
Gabriela Montes de Oca Vásquez
Juan Miguel Zúñiga Umaña
Melissa Camacho Elizondo
Reinaldo Pereira Reyes
Rebeca Corrales Brenes
Sergio Paniagua Barrantes
Yendry Corrales Ureña
Susana Mesén Porras
Claudia Chaves Villarreal
Daniela Zúñiga Rivera
Andrea Rivera Álvarez



CNCA

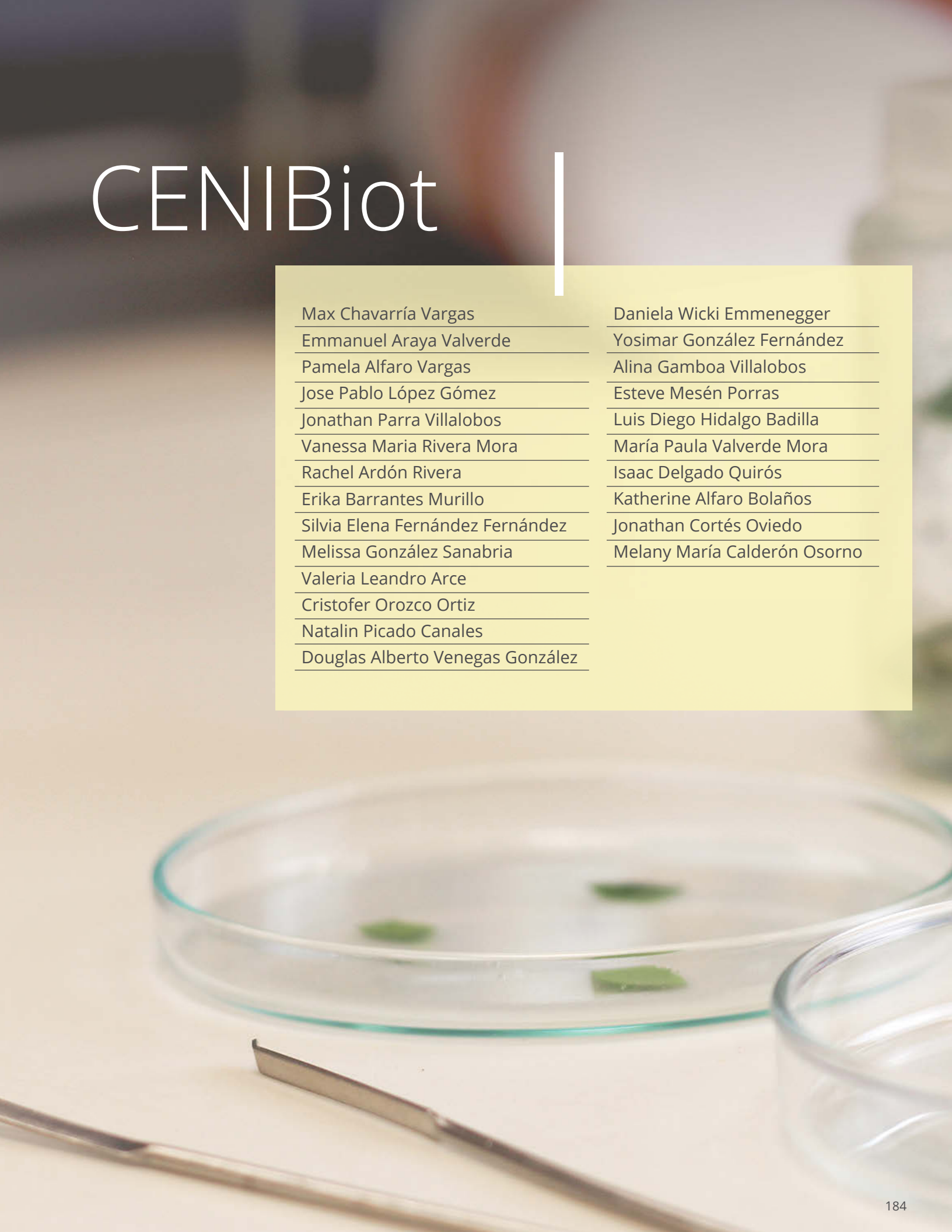
- **Melissa Hernández Sánchez**
  CNCA
- **Fabricio Quirós Corella**
  CNCA
- **Carlos Gamboa Venegas**
  CNCA-CONARE NETWORK
- **Melany Calderón Osorno**
  CNCA-CENIBiot
- **Edward Soto Castro**
  CNCA
- **Christian Asch Burgos**
  CNCA
- **Herson Mena Mora**
  CNCA
- **Johansell Villalobos Cubillo**
  CNCA
- **Isaí Ugalde Araya**
  CNCA-CONARE NETWORK

PRIAS

Heileen Aguilar Arias
PRIAS
Iván Ávila Pérez
PRIAS
Stephanie Leitón Ramírez
PRIAS
Milagro Jiménez Rodríguez
PRIAS
Christian Vargas Bolaños
PRIAS
Mariana Ávila Ruiz
PRIAS
Jose Umaña Ortiz
PRIAS
Fabián Ramírez Villalobos
CeNAT-PRIAS

CENIBiot

Max Chavarría Vargas
Emmanuel Araya Valverde
Pamela Alfaro Vargas
Jose Pablo López Gómez
Jonathan Parra Villalobos
Vanessa Maria Rivera Mora
Rachel Ardón Rivera
Erika Barrantes Murillo
Silvia Elena Fernández Fernández
Melissa González Sanabria
Valeria Leandro Arce
Cristofer Orozco Ortiz
Natalin Picado Canales
Douglas Alberto Venegas González
Daniela Wicki Emmenegger
Yosimar González Fernández
Alina Gamboa Villalobos
Esteve Mesén Porras
Luis Diego Hidalgo Badilla
María Paula Valverde Mora
Isaac Delgado Quirós
Katherine Alfaro Bolaños
Jonathan Cortés Oviedo
Melany María Calderón Osorno



Program Coordinator

Patricia Sánchez Trejos
Agromatics, Food Safety And Slow Food

Jazmín Calderón Quirós

State of the Nation

Gustavo Rojas Godínez

Erick Rojas Zuñiga

Maria Camila Aguilar Gomez

Sebastián González Rosales

José Mario Achoy Sánchez

FunCeNAT

Cynthia Cordero Solís
Administrative Director

Mauricio Segura Chacón

Jeannette Vargas Arce

Yakelyn Bejarano López

Margarita Quan Zepeda

María Fernanda Hernández Jiménez

Carolina Morales Cerdas

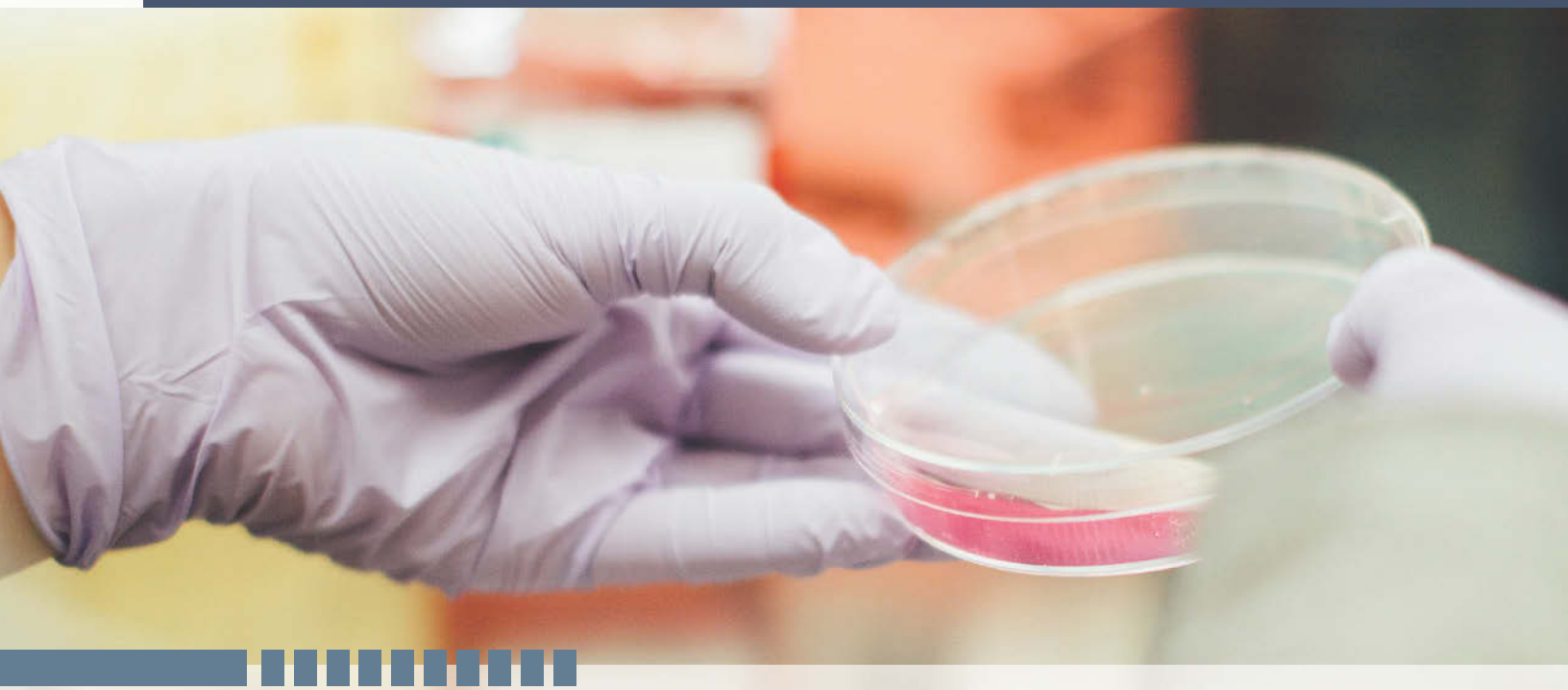
Paula Valverde Mora

Scholars and Collaborators

Sheila Jiménez Mesén	University of Costa Rica (UCR)	CENIBiot
Valeria Rojas Chinchilla	National University of Costa Rica (UNA)	CENIBiot
Antony Torres Solano	University of Costa Rica (UCR)	CENIBiot
David Araya Gutiérrez	Costa Rica Institute of Technology (TEC)	CENIBiot
Dilan Rojas Saborío	National University of Costa Rica (UNA)	CENIBiot
Geisel Cabrera Lazo	National University of Costa Rica (UNA)	CENIBiot
Johana Valera Rangel	University of Costa Rica (UCR)	CENIBiot
Lucia Noboa Jiménez	University of Costa Rica (UCR)	CENIBiot
Randall Hidalgo Sánchez	University of Costa Rica (UCR)	CENIBiot

Carlos Pasquier Jaramillo	University of Costa Rica (UCR)	CNCA
Eduardo Aguilar Bejarano	University of Costa Rica (UCR)	CNCA
Esteban Bertsch Aguilar	University of Costa Rica (UCR)	CNCA
Dorian Rojas Villalta	Costa Rica Institute of Technology (TEC)	CNCA
Isaura Gutiérrez Vargas	University of Costa Rica (UCR)	CNCA
Julián Sánchez Castro	Costa Rica Institute of Technology (TEC)	CNCA

Andrea Rivera Álvarez	University of Costa Rica (UCR)	EM
Fiorella Calderón Jiménez	Costa Rica Institute of Technology (TEC)	EM
Karina Ramírez Monge	University of Costa Rica (UCR)	EM
Vanessa Morales Cerdas	University of Costa Rica (UCR)	EM



Ana Carlota Reyes Rufino	University of Costa Rica (UCR)	LANOTEC
Estefanie Tatiana Grant Rogers	University of Costa Rica (UCR)	LANOTEC
Jean Carlo Guerrero Piña	Costa Rica Institute of Technology (TEC)	LANOTEC
Keylan Simmons Coto	University of Costa Rica (UCR)	LANOTEC
Ricardo Quesada Grosso	University of Costa Rica (UCR)	LANOTEC
Lisa Stephanie Badilla Vargas	University of Costa Rica (UCR)	LANOTEC
Karina Ramírez Monge	University of Costa Rica (UCR)	LANOTEC
Paola Sanchez Navarro	University of Costa Rica (UCR)	LANOTEC
Javier Chinchilla Orrego	University of Costa Rica (UCR)	LANOTEC
Jordan Hernández Ledezma	National University for Distance Education (UNED)	LANOTEC
Luis Diego Mora Araya	University of Costa Rica (UCR)	LANOTEC
Sebastián Moya Salas	University of Costa Rica (UCR)	LANOTEC
Laura Rojas Artavia	University of Costa Rica (UCR)	LANOTEC
Karen Salazar Barrantes	University of Costa Rica (UCR)	LANOTEC
Michael Solano Rojas	University of Costa Rica (UCR)	LANOTEC

Fabiola Solano Cerdas	Costa Rica Institute of Technology (TEC)	PRIAS
Shirley Méndez Cordonero	National University of Costa Rica (UNA)	PRIAS
Andrea Hidalgo Piedra	University of Costa Rica (UCR)	PRIAS
Hanzel León González	Costa Rica Institute of Technology (TEC)	PRIAS
Róger Hernández Jiménez	University of Costa Rica (UCR)	PRIAS
Michael Quesada Valverde	University of Costa Rica (UCR)	PRIAS
Adolfo Piedra Mora	University of Costa Rica (UCR)	PRIAS
Brayan Rodríguez	National University for Distance Education (UNED)	PRIAS

TEAM MEMBERS

CENIBiot

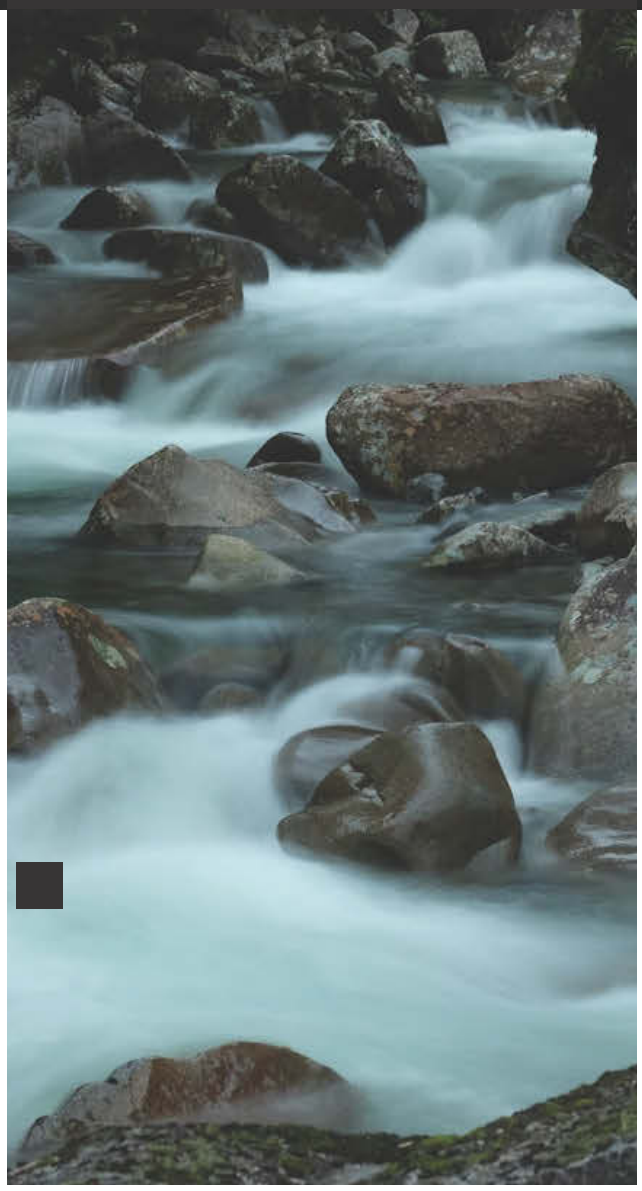
Verónica Ramos Salazar
María Torres Hidalgo
Jazmín Calderón Quirós
Hazel Alvarado Pérez
Darling Mora Rojas
Daniela Lai Sánchez
Camille Bernand-Pardell
Brayan Villalobos Quintanilla
Bayron Leiva Gamboa
Paula Chiví Ramírez
Luis Hidalgo Badilla
Dessiré Arrieta Murillo
Yili Liang Wu
Alison Salas Campos
Montserrat Mendoza Salas
Michelle Montero Quesada
Jonathan Sánchez Vargas
Andrés Hernández León
Daniela Viquez Espinosa
Maria Paniagua Rojas
Maricruz Monge Mora
Alexis Jerez Navarro
Esteban Escalante Campos
Andrea Calvo Obando
Sofía Trejos Valverde
Ariana Herrera Quesada
Bethania Zamora Zuñiga
María Henríquez Granados
Mauro Jimenez Gonzalez
Diana Vargas Hernández
Noelia Rechnitzer Sandí
Priscila Campos Astorga
Andrés González Vega
Victor Viquez Muñoz
Sharon Chacón Vargas
María Gómez Bogantes
Allan Artavia León
Ashelee Sosa Cordero
David Morera Uribe
Karla Montero Castro
Raquel Jiménez Umaña
Meilsey Godínez Portuguez
Cristopher Arguello Rivera
Ariel Arroyo Chaves
Diógenes López Barrantes
Juan Ignacio Garro Rodríguez
Kevin Segura Rodríguez
Mariana Campos Hernández
Montserrat Mendoza Salas
Ashly Bolaños Umaña
Kenneth Solís Morales
Andrés Abarca Herrera
Karol Aguilar Guerrero
Michelle Montero Quesada
Adrián González Jiménez
Jennifer Calvo Alemán.
Mariana Elizondo Blanco
Alexander Monge Zuñiga
Monzerrat Sánchez Salas
Efraín Escudero Leiva

CNCA

José Daniel Amador Salas
Kevin José Facey Torres
Josef Ruzicka González
Dorian Rojas Villalta
Adrián González Jiménez
Antonio Piedra Pacheco
Fernando Herrera Valverde
Mariel Chacón Sánchez
Danniela Cartín Quesada
Juan Pablo Ureña Madrigal

Environmental Management

Jazmín Calderón Quíros
Daniel Serrano Delgado
Miranda Sánchez Zamora
Jazel Domínguez Alvarado
Siony Calvo Brenes
Mirsa Domínguez Alvarado
Marina Ortega Gutiérrez
Martha Montero Vindas
Wenfry Grijalba Villegas



LANOTEC

Mauricio Vallejo
Michelle Gutiérrez Campos
Mónica Alfaro Porras
Sara Montero Vargas
Christopher Arguello Rivera
Amanda Sofia Calderón Campos
Catalina Alvarado Jiménez
Ernesto Villegas Villegas
Jeshua Acuña Matamoros
José Pablo Chávez Pérez
Juan Pablo Carballo Gonzales
Kolleen María Alvarado Rodríguez
Tracy Cambronero Sibaja
Valery Torres Garita
Paola Céspedes Ajún
María Francinie Guevara Hidalgo
Esteban Mena Porras

Annaby Contreras Aleman
Dennise Paola Murillo Sojo
Gabriel Abarca Hidalgo
Andrés Chinchilla Velhagen
Jimena Arias Ulloa
Jose Alejandro Rojas Hidalgo
Isaac Portobanco Villalobos
Jose Pablo Alvarado Espinoza
Julián de Jesús Morales Monge
Sergio Bernabé Velásquez Garnica
Alejandro Ureña Clarke
Kevin Segura Rodríguez
Sara Cordero Fuentes
Iván Solís Sandí
Yeymi Torrez Sequeira
Fabricio Chaverri Segura
Andrea Rivera Álvarez
Tamara Quesada Soto
Daniela Zúñiga Rivera
Kenia Blandón Bolaños
Camilo José Zapata Segura
Sergio Solano Calderón
Christopher Murillo Bolaños
Carlos Valenciano Elizondo
Daniel Esteban Rojas Pérez
Daniel Portuguez Molina
Steven David Ceciliano Castro
Nicole Vílchez Mejías

PRIAS

Andrés Aguilar Carboni
Manuel Calderón Rodríguez
Natalia Martínez Rojas
Walter Pereira Vargas
Luis Gamboa Calvo
Lucía Elizondo Sancho

ESTADO DE LA NACIÓN

Marines Álvarez Fallas
Ludwing Hall Romero
Yahaira Araya Porras
Stephanie Castro Jiménez
Aaron Barquero Salas
Mario Cortés Vásquez
Kevin Mora Ávila
Christian León Trigueros
Andrea Marín Bolaños
Lisbeth Bonilla Cruz
Fabiana Conejo Arias
Juan Ignacio Sandoval

CeNAT REPORT 2023

CONSEJO NACIONAL DE RECTORES

CeNAT
Centro Nacional de Alta Tecnología

Transforming Knowledge into Development

Centro Nacional de Alta Tecnología

(506) 2519-5835 | Fax: (506) 2232-0423 /centro.nacional.de.alta.tecnologia

cenat@cenat.ac.cr www.cenat.ac.cr

1.3 Km North of the US Embassy, Pavas, San Jose, Costa Rica