

Transforming Knowledge
into Development
Centro Nacional de Alta Tecnología

CONARE
CONSEJO NACIONAL
DE RECTORES

CeNAT
Centro Nacional de Alta Tecnología

CeNAT 2022 REPORT



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into Development
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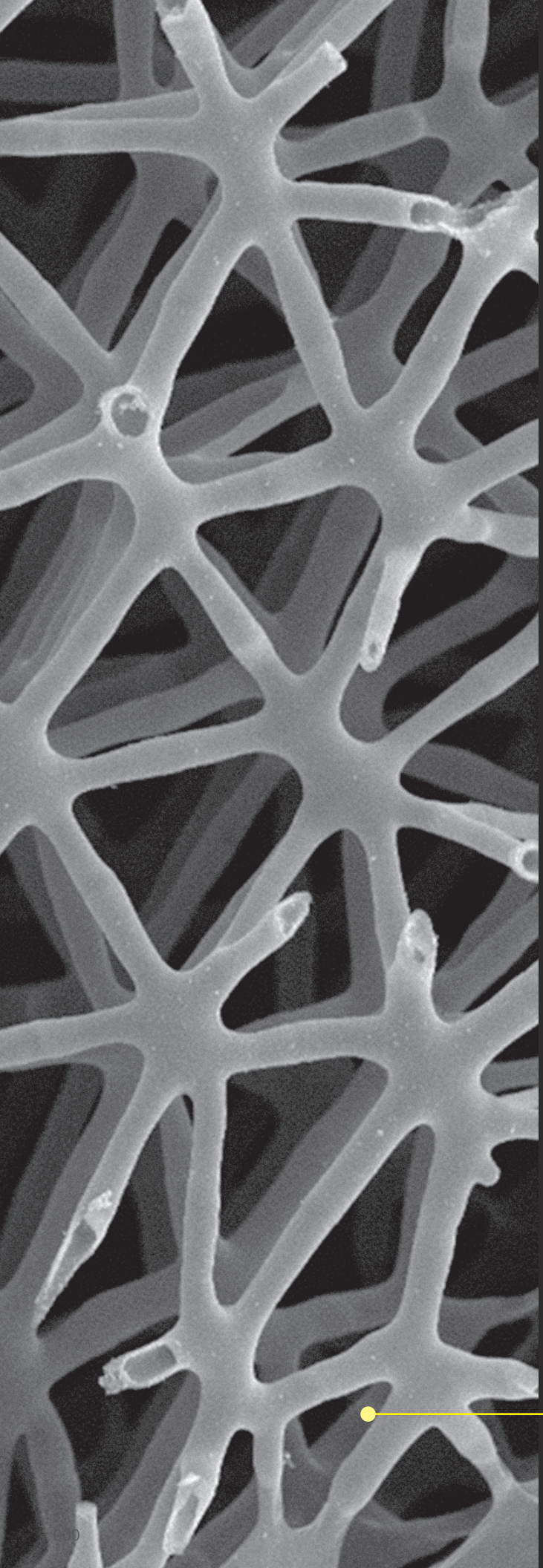

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Acronyms

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
UCR	University of Costa Rica
TEC	Costa Rica Institute of Technology
UNA	National University
UNED	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, Innovation, 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
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 Metals and Minerals 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 Mesoamérica	ILSI Mesoamerica Association
STEAM	Sciense, Technology, Engineering, Art and Mathemathics
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
PAO	Annual Operational Plan
CIPRONA	Natural Products Research Center
FIDA	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
IGN	National Geographic Institute
PEN	State of the Nation Program
IMN	National Meteorological Institute
FONAFIFO	National Forest Financing Fund
OCDE	Organization for Economic 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
CEPAL	Economic Commission for Latin America and the Caribbean
PIACT	Interactive Platform for Tropical Climate Application
LAICA	Industrial Sugar Cane ChamberGuild of Health
CAPROSA	Professionals
CASAGRI	Farmers House
OEA	Organization of American States
ANAGAN	National Association of Cattle Breeders
MEP	Ministry of Public Education
UNESCO	United Nations Educational, Scientific and Cultural Organization



CeNAT

contributes to research and innovation for the benefit of the country

The 2022 Annual Report of Centro Nacional de Alta Tecnología is an exercise in accountability and transparency, which is based on best practices and is also framed as part of integral, transparent, and responsible management, as fundamental principles of our administrative, research, and knowledge transfer management.

The health crisis of COVID-19 forced us to rethink and adjust the way work and the provision of services were carried out. For this reason, the work in 2022 was still marked within this context, where a large part of the adaptive process was supported using technological infrastructure.

Eduardo Sibaja Arias

Director
Centro Nacional de Alta Tecnología

CeNAT, as a program of Consejo Nacional de Rectores, has continued to responsibly fulfill its role of providing public value, through the articulation of the academic, business, and government sectors, thus contributing to research and innovation for the benefit of the country.

For this, it is essential to maintain a permanent reading of the environment and an efficient and effective allocation of resources, hand in hand with the defined strategic priorities. This 2022 CeNAT Annual Report integrates the actions, projects, and results of the laboratories - LANOTEC, CENIBiot, PRIAS, and CNCA and the Environmental Management Area, with support from the administrative management of the Centro de Alta Tecnología Foundation (FunCeNAT). This document describes the generated contributions of public value, the projection towards the citizenry, the business ecosystem, and the governance institutionality.

One of the fundamental axes of the Center is the transfer of knowledge, described in the institutional results section of this document. For CeNAT, it is important to foster collaboration spaces to generate and facilitate knowledge transfer, through the development of socio-productive projects and training programs.

CeNAT capitalizes on more than 20 years of creation, which brings along with it challenges that entail analysis. The achieved goals drive us to set challenging objectives that continue to support the national development path, the strengthening of the well-being of the population, and its economic, social, and environmental sustainability.



Within the framework of institutional accountability and transparency, we present the 2022 Annual Report as a compendium of the entity's multidisciplinary management, which includes the work of the areas, laboratories, and programs of CeNAT, with the administrative management support of the Centro de Alta Tecnología Foundation (FunCeNAT).

This Report synthesizes the data, information, and results of the actions carried out in materials science and engineering, biotechnology, advanced computing, environmental management, and culture and society.

During these three years of the pandemic, it is essential to highlight the work of the personnel who maintained their commitment to quality and compliance with the different processes, while generating knowledge about science and technology at the service of the country.

The achieved goals drive us to set challenging objectives that continue to support the national development path by strengthening the population’s well-being and its economic, social, and environmental sustainability.



Background of **CeNAT**

In 1997, during the Figueres-Olsen national presidency, 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 was due to the role that the academy plays, as the main generator of research in Costa Rica.

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 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 was based on experiences of countries such as Korea, Singapore, and Israel -the latter with the Technion or Israeli Technological Institute, located in Haifa.



The following year, 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 and call it after Dr. Franklin Chang Díaz. Article 3 of that law would also provide 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.

After the approval of the Law, CONARE, under the Coordination Agreement for State Higher University Education, in session number 5-99, on March 2, 1999, created CeNAT as a center for scientific and technological development, which would contribute to strengthening the research efforts of state universities.

The creation of CeNAT represented an inter-university encountering instance for the academy, the Government, and the productive sectors of the country. It encompasses different high technology fields, thus taking 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 its trajectory, CeNAT has consolidated a work platform based on the high technical-professional capacity of its staff in all areas and laboratories, its equipment, and its facilities, thus allowing it to promote various research and knowledge transfer projects, which drive the vision to transform knowledge into development.



Strategic **Planning**

One of CeNAT's essential characteristics is its continuous improvement and reinvention capacity in the new contexts and challenges that society has faced throughout its 23 years of existence.

The year 2022 was a difficult year, after going through two years of drastic changes when society was trying to return to a new normality. During the 2020-2022 period, the health crisis caused by the COVID-19 pandemic was faced, which caused the operational units of CeNAT and FunCeNAT to carry out an adaptation of reformulation and definition processes of new operational actions, taking advantage of the capacity and ability of their staff for innovation. Also, a strength of the Center is its physical, instrumental, computer, and telematic infrastructure, as well as its innovative virtual and face-to-face lines of work, which ensure the integrity and efficiency of its workers and compliance with the research work.



Training, lectures, workshops, and virtual seminars were developed, as well as webinars, television, and radio news capsules, based on different platforms of great scope and impact, aimed at the different levels of society and productive sectors.

The year 2022 was characterized by the return to a new normality, without completely neglecting the virtual modality, always looking for new lines and modern and innovative tactics, for the development of institutional strategic objectives, and supporting the necessary social development to adjust to the changes generated in our environment.

This year, CeNAT has an updated philosophical framework of its main Strategic Plan and the Strategic Plans of its laboratories, including a mission, vision and development objective that guide the course of the institution during this five-year period. However, this philosophical framework should be updated and adjusted to the new reality during the year 2023, so that the 2024-2028 five-year work plan will be aligned with the National Plan for Higher Education.



CeNAT
Centro Nacional de Alta Tecnología

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 incorporates the 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 provide the country with science, technology, innovation, and strategic entrepreneurship for competitiveness and economic, social, and environmental development" (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.

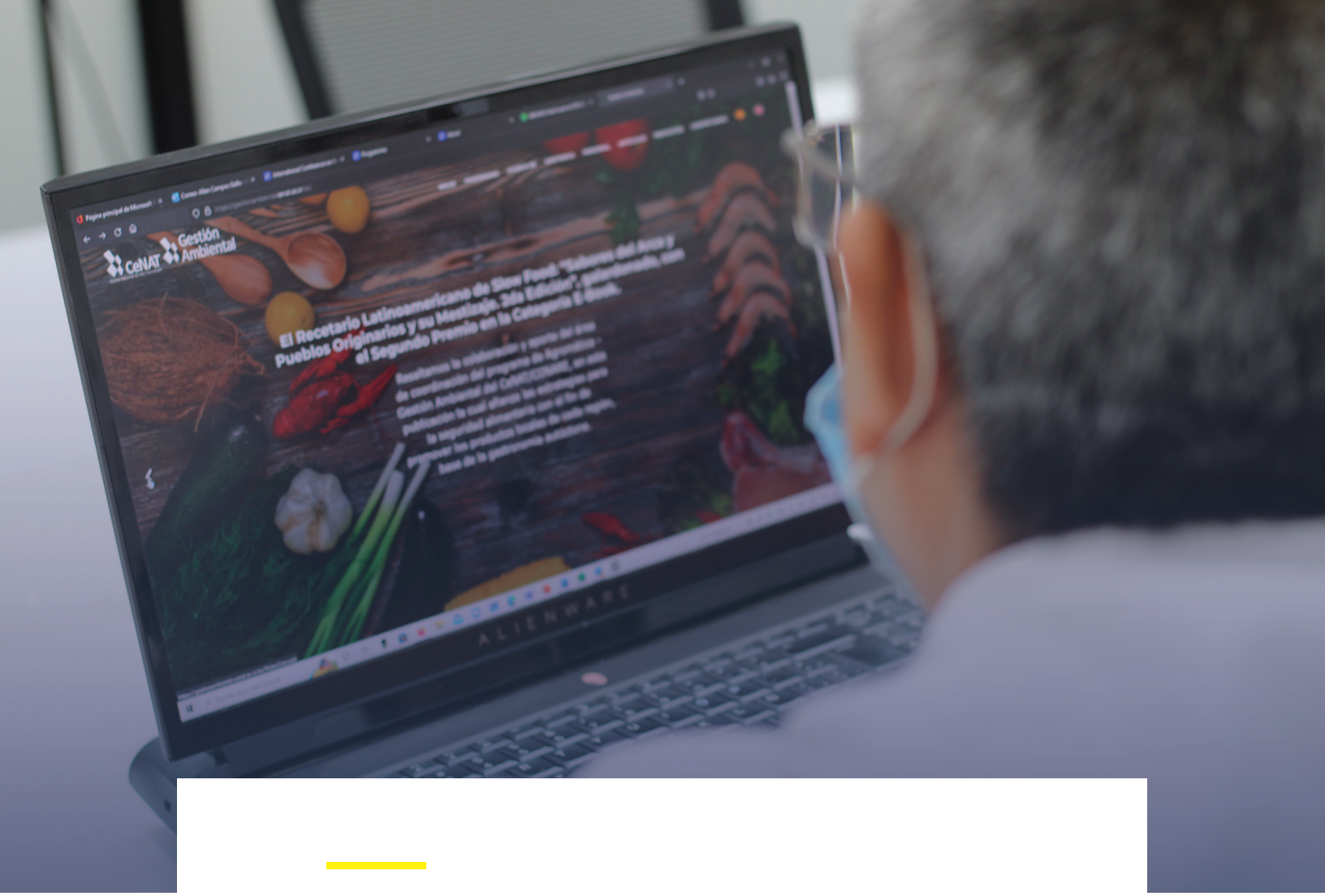
Objectives of CeNAT

The objectives come from the constitutive deed of CeNAT, which guides the work of the institution, its 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 linkage 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 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.





Institutional Values of **CONARE - CeNAT**

- Teamwork
- Discipline
- Respect
- Communication
- Responsibility
- Tolerance
- Honesty and Loyalty
- Commitment



Values and Principles Enforced at **CeNAT**

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

Values Enforced at CeNAT



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.

CeNAT **Strategic Lines**

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.



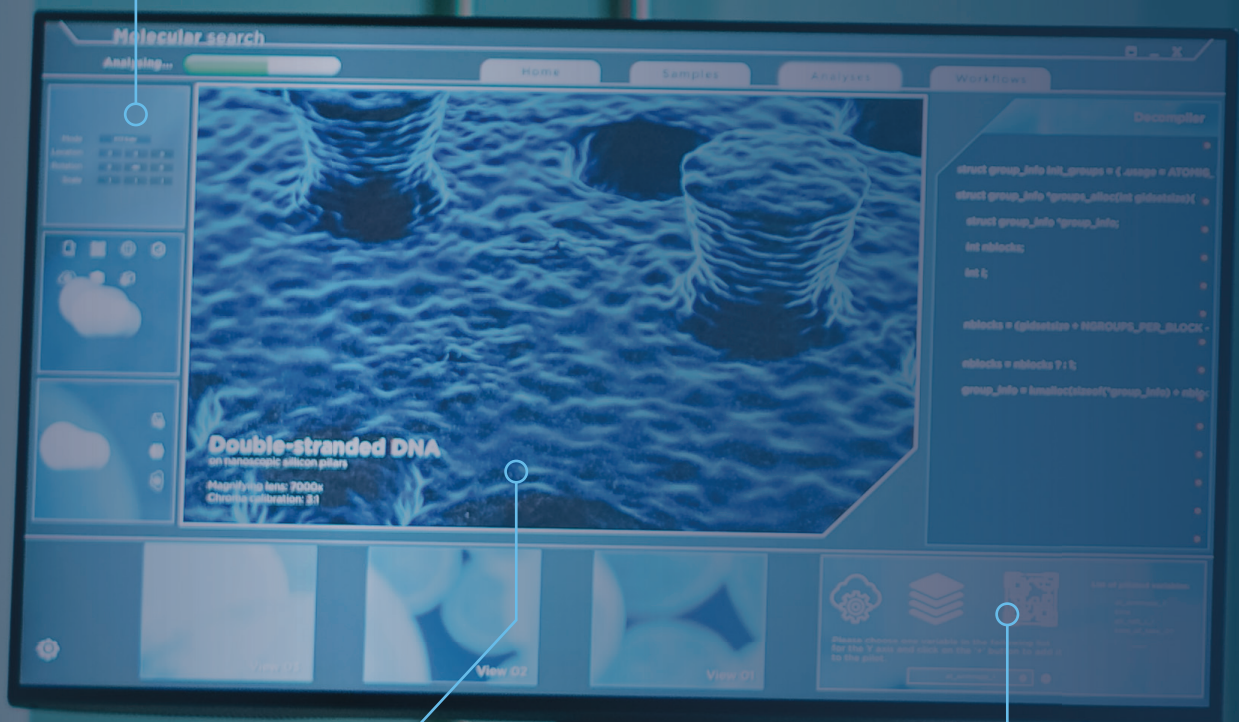
OUR AREAS,

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)**

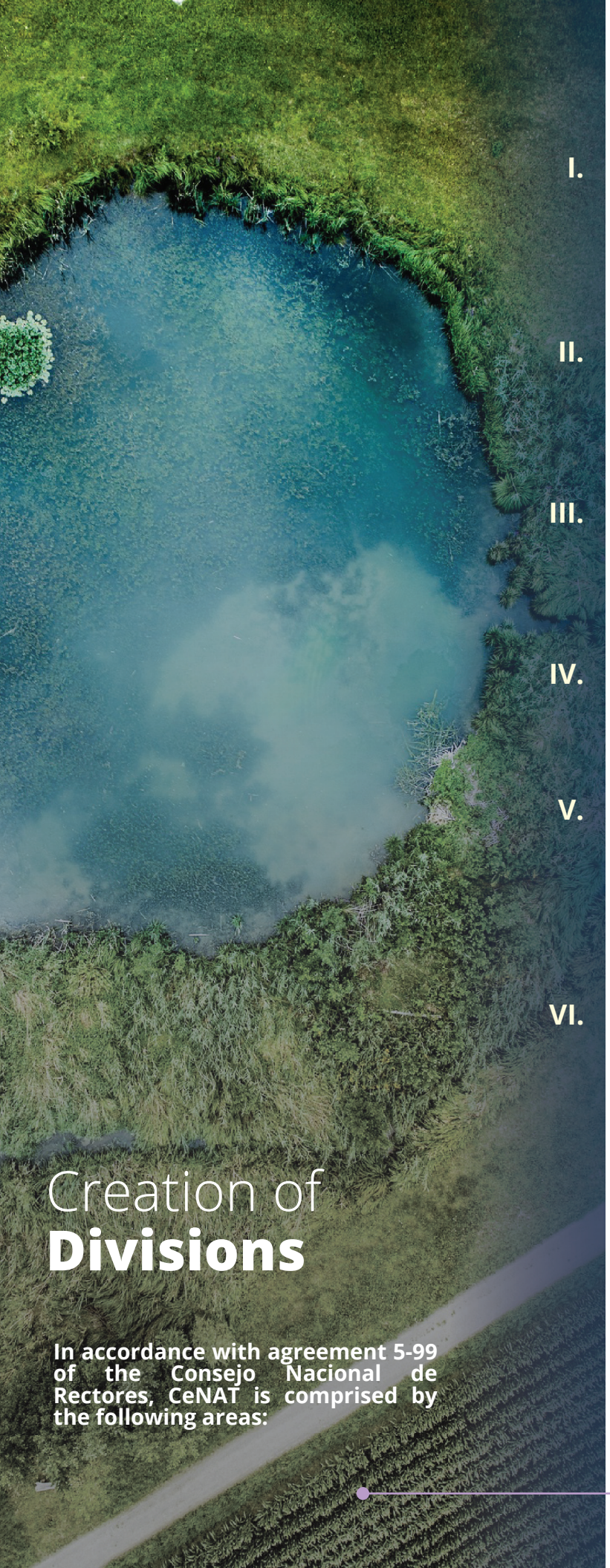
CENIBIOT Laboratory

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:** It was constituted in 2004, by the National Nanotechnology Laboratory (LANOTEC).

II. **Biotechnology Area:**
Since 2013, this operational area is part of CENIBiot Laboratory.

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

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

V. **Science, Culture, and Society Area:**
This is 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, since 2003.

Programs:

- **Variability and Climate Change Observatory,** since 2010.
- **Agromatics, Food Safety, and Slow Food,** since 2010.

9 years

2013:
CENIBiot Laboratory

12 years

2010:
Variability and Climate Change Observatory

2010:
Agromatics, Food Safety and Slow Food



13 years

2009:
Advanced Computing Collaboratory (CNCA)

CeNAT 2022

1998 (24 years)

18 years

2004:
National Nanotechnology Laboratory (LANOTEC)

19 years

2003:
PRIAS Laboratory



Consejo Nacional de Rectores

Scientific Council comprised by CONARE Vice-Chancellors for Research

General Director of CeNAT

Science and Engineering of Materials	Biotechnology	Advanced Computing	Environmental Management		Science, Culture and Society
				Agromatic	
LANOTEC	CENIBiot	CNCA	PRIAS	Climate Observatory	
Knowledge Generation	Knowledge Generation	Knowledge Generation	Knowledge Generation	Knowledge Generation	
Knowledge transfer	Knowledge transfer	Knowledge transfer	Knowledge transfer	Knowledge transfer	Knowledge transfer
Internationalization	Internationalization	Internationalization	Internationalization	Internationalization	Internationalization
Sustainability	Sustainability	Sustainability	Sustainability	Sustainability	Sustainability

Directorate **of CeNAT**

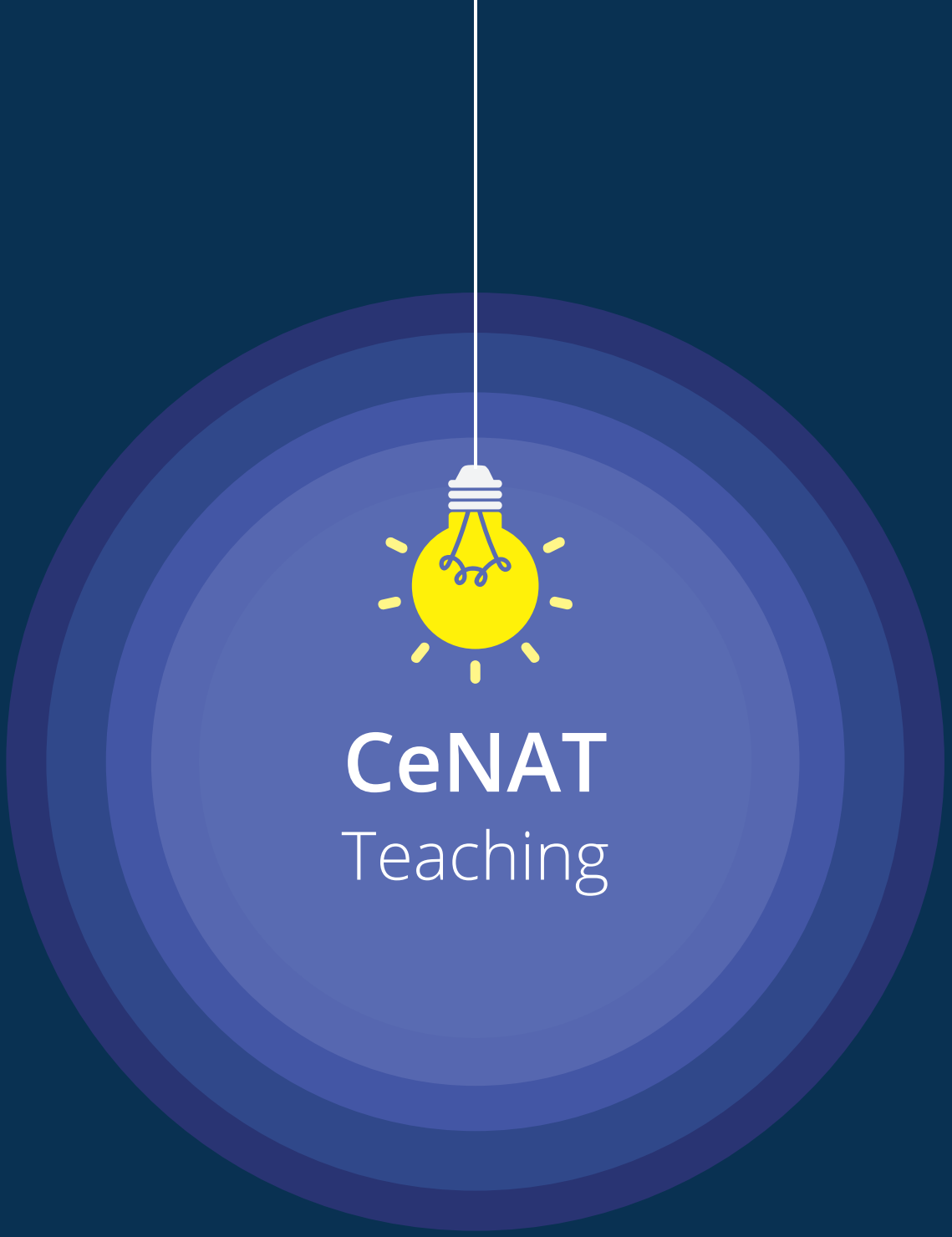
For CeNAT's Directorate, the year 2022 posed a new challenge: to come out of a drastic change that the pandemic led us to, to return to a new normality, which implied defining a line of work that would cover both environments, in a balanced way.

In terms of technical achievements, it was a very productive year for CeNAT in publications, research, and knowledge transfer, among others, contributing to the development of society.

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: "To ensure 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
  - CREATEC
  - CeNAT-CONARE Scholarships
- Continuous follow-up to the actions carried out by each area and program attached to CeNAT.



CeNAT
Teaching

The Science, Culture and Society area oversees the CeNAT Teaching program, which envisages knowledge transfer activities.

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 2022, CeNAT Teaching was not operational.



Relevant **Lectures**

During the period covered by this Annual Report, there was participation in relevant lectures, which are listed below:

What are the answers from science for the reuse of recovered plastics? Ibero-American Night of NII 2022 Researchers, a worldwide event organized by Ibero-American States (OEI) and held virtually on September 29 and 30, 2022. It was taught by Dr. José Vega Baudrit.

Nanotechnology and LANOTEC: on the way to regulation in Costa Rica. Nanotechnology Conference in Costa Rica, organized by ACS Chapter UNA. The lecture was taught by Dr. José Vega Baudrit, on October 12, 2022.

“Characterization of ultrathin layers and nanometric patterns by AFM”. Participation at the "Membrane technologies for the treatment and recovery of water resources” workshop, organized by CSIC, UBA, and LANOTEC. October 10 to 14, 2022. Taught by Dr. José Vega Baudrit.

Validation of scientific resources. On November 3, 2022, Dr. José Vega Baudrit taught a lecture at the Ministry of Foreign Affairs and Worship, Session of the Workshop on Economic Diplomacy - CTI, organized by MREC, Monserrat Vargas.

“Solid-lipid nanoparticles to improve the antioxidant effect of bioactive molecules derived from Curcuma longa and Uncaria Tomentosa”, webinar. Discussion panel on Opportunities and challenges of the bioeconomy paths in the Russia-Ukraine scenario, with the conference “Biorefineries of waste”, organized by IICA, on July 08, 2022. It was taught by Dr. José Vega Baudrit.

Let's talk about microplastics, what does science tell us? The Nanoandes Network, Loja, Ecuador. Virtual meeting organized by Nanoandes 2022, where researchers Yendry Corrales Umaña and Melissa Camacho Elizondo discussed the topic: Biomimicry, on November 16, 2022.

"Nanomaterials in Medicine and 3D Applications" 1st International Seminar of the CYTES ENVABIO100 Network: Obtaining biodegradable films 100% from natural origin for the food industry, organized virtually by the Envabio Network of Cyted, November 14 to 16, 2022.

"New challenges for scientific research: the search for scientific evidence based on laboratory accreditation processes", at the Nanotechnology Dissemination Workshop, Montevideo, Uruguay. Taught by Dr. José Vega Baudrit, from August 29 to September 1, 2022.

"Scientific evidence and myths about microplastics: analysis and innovation", Chemistry Congress, CQCR 2022. Taught by Sergio Paniagua Barrantes and Andrea Rivera Álvarez, on November 29, 30, and December 1, 2022.



CNCA

In silico Identification of miRNA as possible therapeutic targets for Micro Invasive Bladder Cancer (MIBC) treatment, by researcher Maripaz Montero, at the "4th IEEE International Conference on BioInspired Processing, BIP 2022".

Simulations and epidemiological data in Central America, by researcher Mariela Abdalah, at the "National Congress of Public Health CONSAP 2022".

CENIBiot

V Biosynthesis of nano-metalloids in Pseudomona putida: Madrid Spain. Speaker: Max Chavarría Vargas.

Biodiversity and bioeconomy come together to promote changes in sustainable agricultural production systems, WAITRO. South Africa. Emanuel Araya Valverde. August 22 - 26, 2022.

Link:
https://www.acs.org/content/acs/en/meetings/acs-meetings.html.



Environmental Management

Lecture at the Ibero-American Night of Researchers 2022. Organized by the Ministry of Science, Innovation, Technology, and Telecommunications (MICITT), September 2022. Taught by Dr. Patricia Sánchez Trejos.

Workshop on Differentiation Strategies for rural development to Uganda-Slow Food. Training taught by Dr. Patricia Sánchez from Agromatics, on food safety and Slow Food subjects. On April 25, 2022.

Lecture on **"Identification, conservation, and valuation of local and cultural products, as a territorial promotion strategy through GIAHS / Globally Important Agricultural Heritage Systems), aimed at tourism"** taught by Dr. Patricia Sánchez Trejos. May 27, 2022.

Presentation - **"The GIAHS, as a heritage valuation strategy for the development of Tucurrique",** taught at the XXXIII Latin American Congress of Sociology, ALAS Mexico 2022. This presentation was taught by Dr. Patricia Sánchez Trejos, coordinator of the Agromatics Program. August 2022.

Live lecture in Turkey at the 1st International Symposium on Traditional Foods and Sustainable Food Systems on Food Systems, GIAHs, and Blue Zones. Taught by Dr. Patricia Sánchez Trejos, on August 10, 2022.

On the initiative of the Chancellors of CONARE's member universities, in 2013, the scholarship program started. It is aimed at encouraging students enrolled in the state universities to conduct their final graduation or research works, linked to the areas of CeNAT.

The goals and topics of these research works and theses should be directly linked to the competence topics of LANOTEC, CNCA, CENIBiot, 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.

In 2022, the variation in the dates of the scholarship contest was maintained, with the purpose of avoiding overlapping scholarships with respect to the year 2021 and as a result of a rethinking of the strategies so that more contestants could meet the requirements. For this reason, the 2022 scholarships began in June of the same year and are projected to end in April 2023.

At the request of the State University for Distance Education (UNED) to adjust the dates to its school cycles, the 2023 scholarship contest began on November 28, 2022, and will run until May 7, 2023, with the purpose of starting execution in August 2023.

To achieve greater identification of the student body, five different promotional posters were designed, according to affinity with the different laboratories, in addition to four promotional videos. The posters are displayed below.





Table 1

Scholarships allocated (by university and laboratory by year) from 2017 to 2022

CENAT - CONARE 2017 2017 SCHOLARSHIPS NUMBER - UNIVERSITY - LABORATORY

UNIVERSITY	LANOTEC							CENIBIOT							ENVIRONMENTAL MANAGEMENT							CNCA							PRIAS							TOTAL / UNIVERSITY					
	2017	2018	2019	2020	2021	2022	Subtotal	2017	2018	2019	2020	2021	2022	Subtotal	2017	2018	2019	2020	2021	2022	Subtotal	2017	2018	2019	2020	2021	2022	Subtotal	2017	2018	2019	2020	2021	2021	Subtotal	2017	2018	2019	2020	2021	2022
UCR	1	3	1	5	7	6	23	4	5	4	4	2	2	21	0	1	1	0	1	2	5	2	1	5	2	2	2	14	0	0	1	0	2	3	6	7	10	12	11	14	15
UNA	1	2	0	1	0	0	4	0	1	0	0	1	1	3	1	1	1	0	0	0	3	0	0	0	1	0	0	1	2	2	1	0	0	1	6	4	6	2	2	1	2
UNED	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	2	1	1	0	5	0	0	0	0	0	0	0	2	0	1	0	0	0	3	3	0	3	1	2	0
ITCR	2	1	2	2	1	1	9	2	1	0	1	0	0	4	0	0	0	1	0	1	2	0	3	1	0	2	0	6	0	1	2	1	3	2	9	4	6	5	5	6	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	4	6	3	8	9	7	37	6	7	4	5	3	3	28	2	2	4	2	2	3	15	2	4	6	3	4	2	21	4	3	5	1	5	6	24	18	22	22	19	23	21

Source: Information from the year 2022 provided by the Laboratories and Area of CeNAT.

Total number of CeNAT-CONARE scholarships 2017 to 2022 by laboratory and area



ALLOCATION OF SCHOLARSHIPS 2017 - 2022

UNIVERSITY	CNCA	CENIBiot	LANOTEC	Environmental Management	PRIAS	Total / University
UCR	14	21	23	5	6	69
UNA	1	3	4	3	6	17
UNED	0	0	1	5	3	9
TEC	6	4	9	2	9	30
UTN	0	0	0	0	0	0
TOTAL / LAB	**21**	**28**	**37**	**15**	**24**	**125**

Source: Information on the year 2022 provided by the Laboratories and Area of CeNAT.



Table 2

INDIVIDUALIZATION OF THE ALLOCATED SCHOLARSHIPS

No.	Student	Proposal	University	Area/Laboratory
1	**Maria Valeria Rojas Chinchilla**	"Evaluation of the crosslinking capacity of proanthocyanidins from Cas fruits (Psidium friedrichsthalianum) on collagen matrices for tissue regeneration".	UCR	CENIBiot
2	**Sheila Jiménez Mesén**	Evaluation of inducers and fermentation conditions on the activity of cellulolytic enzymes produced with the fungus Penicillium oxalicum, using banana rachis.	UCR	CENBiot
3	**David Redondo**	Redesign of the temperature control system of a chemical compounds extraction plant.	TEC	CENIBiot
4	**Celia Miranda Oporta**	Development of Biomimetic Bone Structures Using Bioprinting Method by Extrusion of Volatile Solvents.	UCR	LANOTEC
5	**Paola Sánchez**	Synthesis and characterization of carbon quantum dots by the microwave-assisted pyrolysis method from citrus and non-citrus juices.	UCR	LANOTEC
6	**Jean Guerrero Piña**	Design, manufacture, and performance evaluation of graphene oxide membranes for biogas biorefining.	TEC	LANOTEC
7	**Estefanie Tatiana Grant Rogers**	Evaluation of the technical and environmental pre-feasibility of the synthesis of a copper-based pigment recovered from the cooling system of waste laptop computers.	UCR	LANOTEC
8	**Keylan Simmons Coto**	Development of a TiO2 photocatalyst on (FTO) to implement in the degradation of persistent pollutants in aqueous media.	UCR	LANOTEC
9	**Ricardo Quesada Grosso**	Development of two types of nanoparticles that carry natural extracts of polyphenols obtained from a natural extract of a native plant from Costa Rica.	UCR	LANOTEC
10	**Ana Carlota Reyes Ferrufino**	Biochemical and histological characterization of the darkening phenomenon during the initial in-vitro sprouting of bamboo nodal explants (Guadua amplexifolia J. Persl.).	UCR	LANOTEC

No.	Student	Proposal	University	Area/Laboratory
11	**Eduardo Aguilar Bejarano**	Cheminformatic Approaches for the Quantitative Prediction of Tautomerism in Bioactive Molecules.	UCR	CNCA
12	**Carlos Pasquier Jaramillo**	Risk classifier for individuals susceptible to COVID-19.	UCR	CNCA
13	**Fabiola Solano**	Remote sensing for the evaluation of some water quality parameters: Tortuguero River.	TEC	PRIAS
14	**Michael Emilio Quesada Valverde**	Comprehensive inventory and asessment of geosites for the promotion of a tourist route in Coto brus, Costa Rica.	UCR	PRIAS
15	**Andrea Hidalgo Piedra**	Neotectonics of the Jaris fault in the transtensive segment of Corralar, Central region of Costa Rica.	UCR	PRIAS
16	**Shirley Méndez Cordonero**	Generation of cartographic and geostatistical material on the dynamics of land cover change in the Peñas Blancas National Wildlife Refuge.	UNA	PRIAS
17	**Hanzel León González**	Diversity index based on the use of geospatial tools to identify vulnerable areas in the Guácimo-Tortuguero Biological Corridor.	TEC	PRIAS
18	**Róger Andrés Hernández Jiménez**	Influence of the intensity and amount of precipitation on the deposition of atmospheric nitrogen in the tropical cloud forest in Monteverde, Costa Rica.	UCR	PRIAS
19	**Andrea Rivera Álvarez**	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 – 2025.	UCR	Environmental Management
20	**Fiorella Calderón**	Design of a Prototype Mobile Research Center powered with clean energy for the scientific expedition to Antarctica in January 2022-2025.	TEC	Environmental Management
21	**Karina Ramírez Monge**	Development of two innovative prototype products from Coyol nut oil and expeller for the sustainable development of a community in Abangares.	UCR	Environmental Management

NUMBER OF CENAT-CONARE 2022 SCHOLARSHIP PROJECTS BY LABORATORY AND AREA

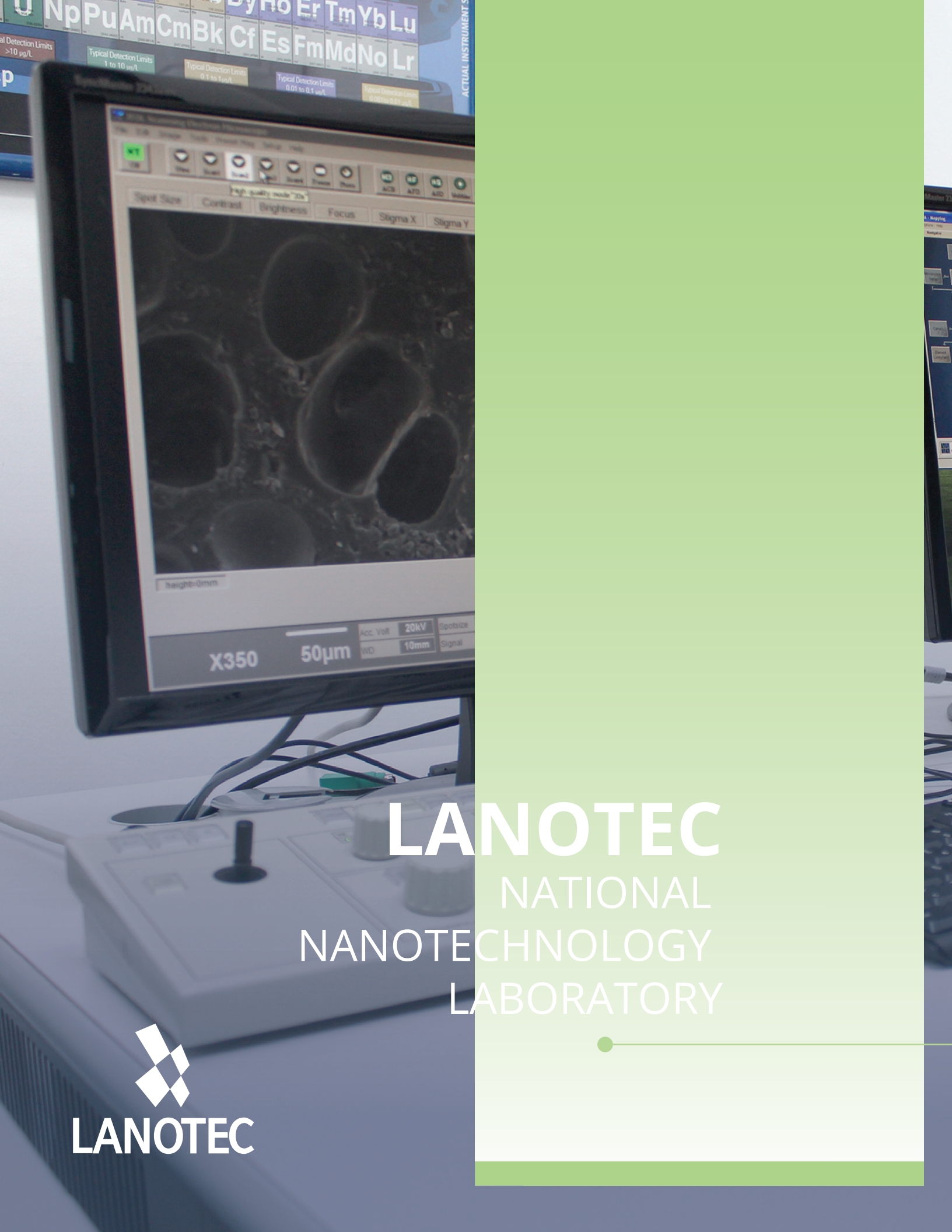




Summary

All the approved proposals have a high impact both in the generation of new knowledge (through articles, graduation papers, generation of new products, etc.), and in issues related to clean energy, generation of new products, and prevention of natural disasters, among others.

It should be noted that a new schedule is being tested for the 2023 scholarship contest, at the request of UNED, to try to reach a larger population from all universities. In the same way, new communication strategies are being worked on for this purpose.



LANOTEC

NATIONAL NANOTECHNOLOGY LABORATORY

LANOTEC

LANOTEC
Annual Operational Plan
(CeNAT-CONARE) 2022



INDICATORS	DISTRIBUTION OF THE GOAL		
	Public	Private	Total
Scientific publications - Dissemination	27	11	38
Knowledge transfer activities	27	3	30
Research projects	11	14	25
Attention to students	56	10	66
Agreements	1	1	2

Introduction

The National Nanotechnology Laboratory (LANOTEC) is attached to the National High Technology Center (CeNAT). It was officially inaugurated on October 18, 2004, and began its activities as a research center in 2006, with the appointment of its current director.

Currently, LANOTEC is widely recognized in the region for maintaining a technological leadership at the Central American and the Caribbean levels. A recent publication lists it as one of the three centers in the region with a wide potential in technologies associated with microtechnology, nanotechnology, and materials science, among others.

In addition, it has a strategic vision oriented towards supporting the scientific vocations of children and young people to consolidate the national efforts towards the areas of STEM and gender issues.

Currently, LANOTEC achieves a greater impact in the activities carried out around the areas of scientific research, innovation-entrepreneurship, and support to companies in the health sector, specifically in medical devices and pharmacy, under the ISO 17025 standard certification process, as well as teaching and extension.



Development Goal

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



Mission Statement

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

Vision Statement

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.



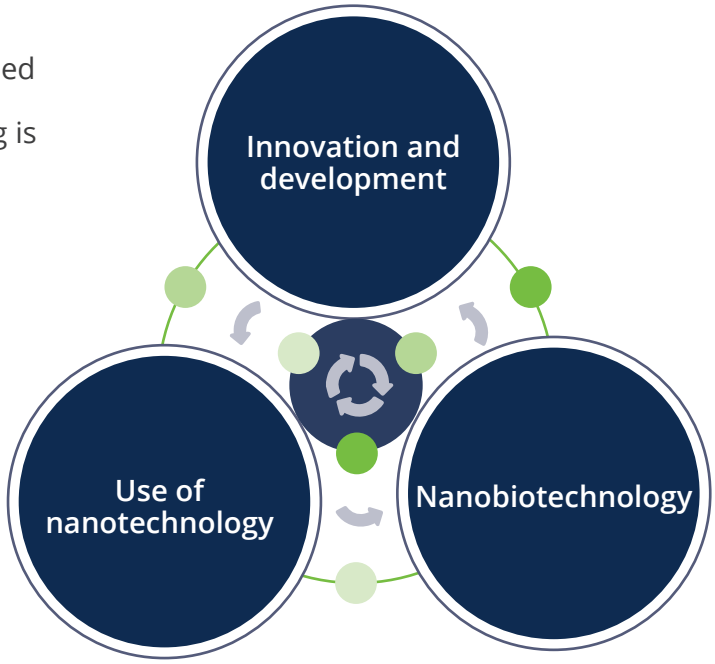
Values

- 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.

With the work carried out in the different areas, the following is sought:



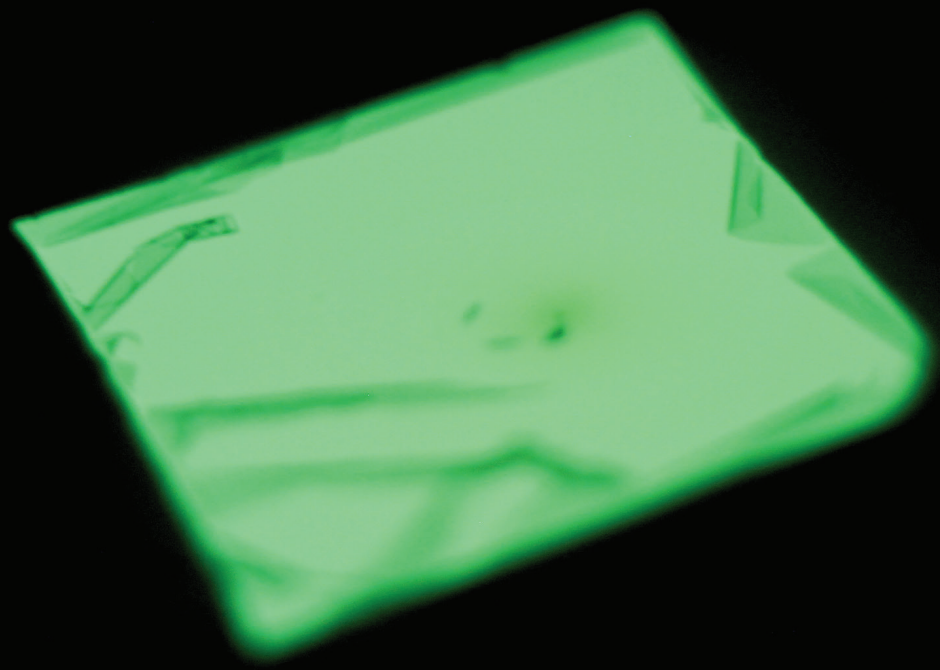
Objectives

To conduct research in the areas of micro and nanotechnology, focused on nanostructures, microsensors, and advanced materials, with potential applications on energy, environment, health, and information technologies.

To serve as a nanotechnology training center-laboratory in collaboration with government institutions, stakeholder companies, and state education academic programs.

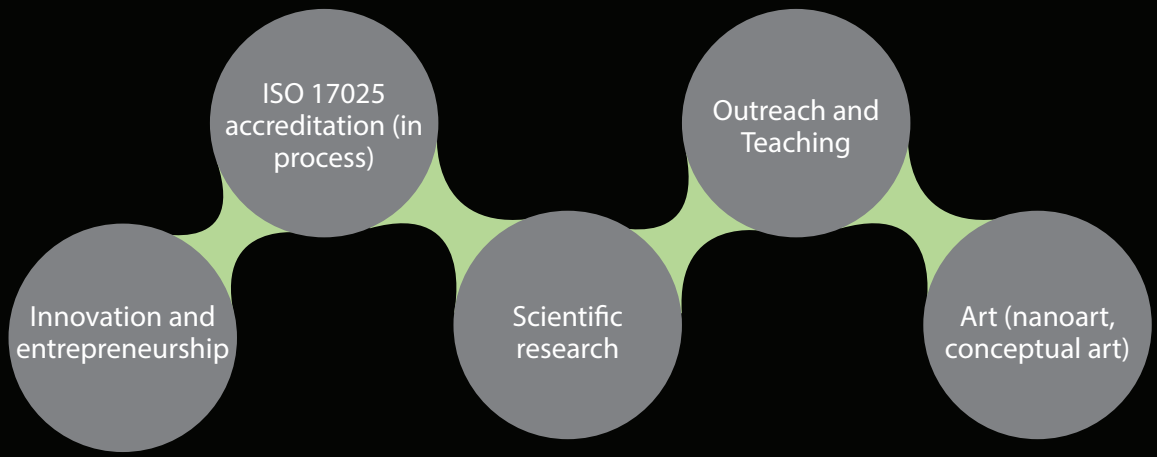
To establish strategic alliances with high-tech industries (both national and foreign) for the development of specialized services and products that contribute to the productive sector of the country.

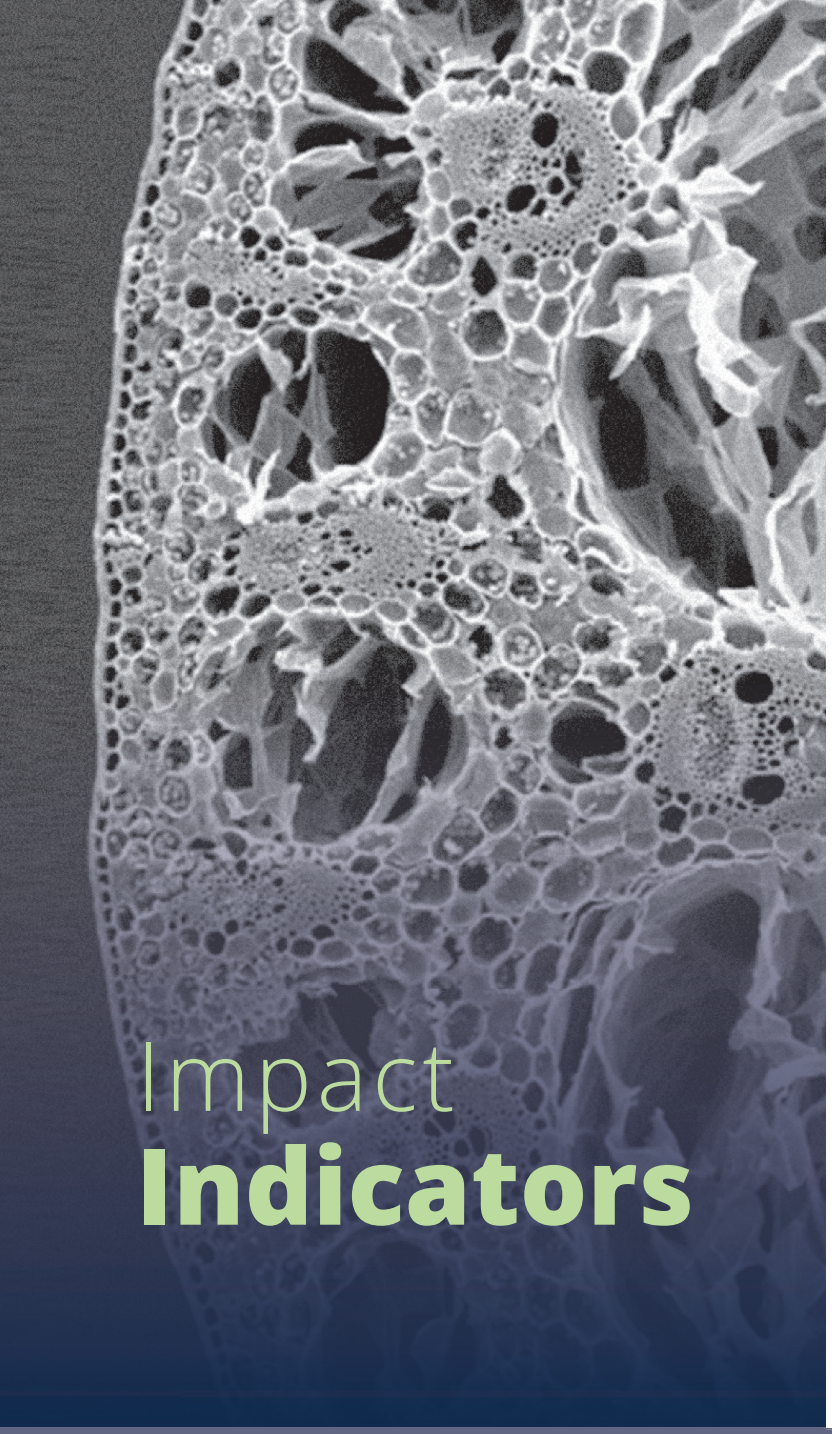




Strategic **Nodes**

- Innovation and entrepreneurship
- ISO 17025 accreditation
- Scientific research
- Extension and teaching, scientific vocations
- Art (Nanoart, conceptual art, art, and sports)





Impact **Indicators**

Publications

31 Indexed

4 Non-indexed

3 Specialized

	Public	Private
Q1	14	4
Q2	6	2
Q3	1	2
Q4	1	1
Specialized	3	-
Non-indexed	2	2
TOTAL	**27**	**11**

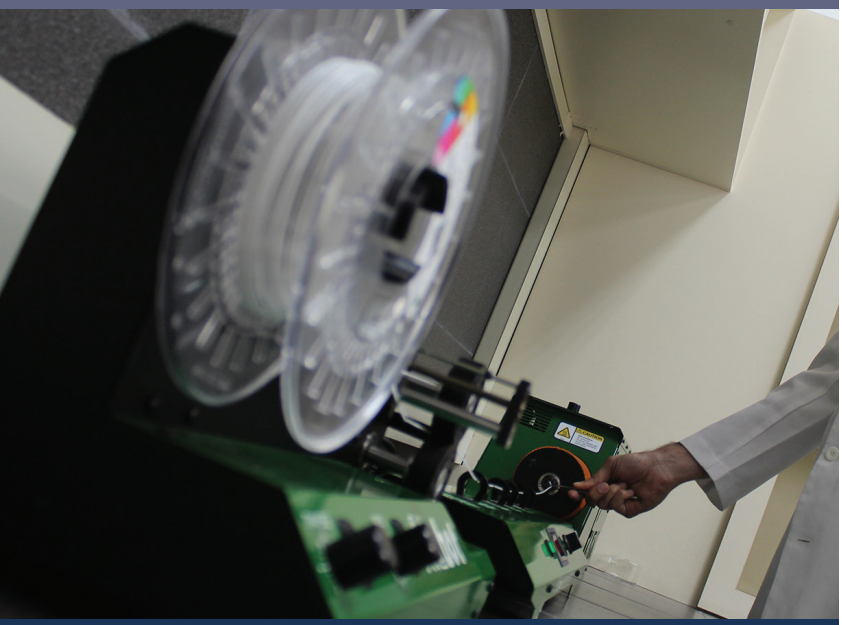
38

Knowledge **transfers**

11 **Lectures, workshops, presentations taught internationally**

- Revaluation of by-products of the Costa Rican pineapple agro-industry to obtain nano and micromaterials of commercial interest.
- Nanotechnology in Costa Rica: LANOTEC and its tools for the development of R+D+i.
- Bioinspired nanomaterials for potential biomedical applications.
- Lecture – "Obtaining nanomaterials of industrial interest from the recovery of agro-industrial waste".

- Lecture – “Impact of environmentally relevant concentrations of silver nanoparticles on the soil microbial community”.
- Discussion panel – “Opportunities and challenges of the bioeconomy paths in the Russia-Ukraine scenario”.
- II Nanotechnology Dissemination Workshop, Montevideo, Uruguay.
- NII 2022 Ibero-American Night Meeting of Researchers.
- Workshop - “Membrane technologies for the treatment and recovery of water”.
- Lecture about advances in biorefinery, use of agro-industrial waste, CR and LAC case in Nanoandes event.
- Biomimicry talk.



3 Lectures taught internationally

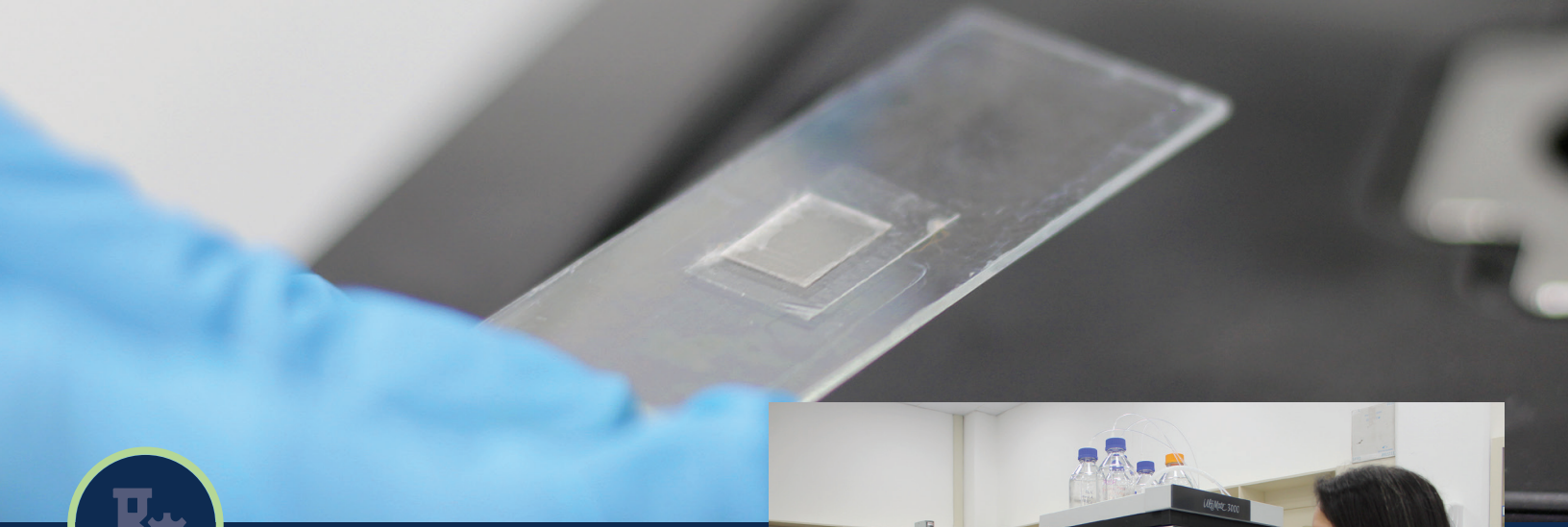
- Talk and poster at symposium - “Collaborative Approaches to Advances in Organic and Hybrid Electronics.”
- IV Clinical Bioinformatics Conference on Nano-phytopharmaceuticals for the prevention and treatment of COVID-19: design based on in silico and in vitro study of candidate inhibitors of the SARS-CoV-2 virus.
- I International Seminar of the CYTED ENVABIO100 Network: Obtaining Biodegradable Films of 100% Natural Origin for the Food Industry.

16 Talks, workshops, presentations taught nationwide

- Circular Economy in coordination with ACIPLAST.
- Artificial intelligence and data science.
- Clusters in Costa Rica.
- Nanotechnology within the framework of the Secretariat of Chemical Substances.
- Lecture on Nanotechnology at the School of Chemistry.
- Lecture – “Perspectives on the fabrication of nano and microstructures”.
- Scientific poster making workshop.
- Nanotechnology dissemination workshop.
- Lecture - "Advances in Colloid Chemistry".
- Nanotechnology and its applications in polymers.
- Lecture - CENTRO NACIONAL DE ALTA TECNOLOGÍA - CeNAT, Diplomacy Workshop Seminar.
- Nanotechnology Conference in Costa Rica.
- Lecture - "Applications of Nanotechnology in Agriculture and their impact on soil microorganisms”.
- Revaluation of pineapple biomass to obtain high-tech materials with commercial value.
- Presentation at the Chemistry Congress, CQCR 2022, UCR. (SPB and ARA).
- Introductory workshop on nanotechnology. (DBM).

30 **TOTAL**

650 **People benefited**





Research **Projects**

11 **Public:**

- **2** FEES
- **2** CONARE Funds
- **7** Internal (OPERATIONAL LANOTEC)
  - **2** National Linkages
  - **5** International Linkages

14 **Private:**

- **4** CONICIT Funds and 2 MICITT Funds
- **6** Private funds
- **4** Privately Funded Projects Scientific vocations

25 **TOTAL**

Projects in negotiation

- Korea 2023
- Proquinal, Phase III
- Proquinal Fungi
- TRISAN

Attention to **Students**

- **13** Scholarships
- **20** Accompaniments in thesis
- **1** Interns
- **2** Volunteers
- **15** National interns
- **15** Professional practices

66 TOTAL



Linkages

National Academic Sector:

- University of Costa Rica
- National University
- State University for Distance Education
- Costa Rica Institute of Technology
- ULatina
- Ulacit
- Invenio
- International University of the Americas (UIA)

International companies:

- Philips Morris
- Purdy Motor Group
- Confluent
- Boston Scientific
- Allergan
- Smith & Nephew
- Microvention
- Proquinal
- CooperVisión
- Establishment Lab
- Bayer
- Ilsi Mesoamerica

International Universities or Institutes:

- Adolphe Merkle Institute, Switzerland
- University of the Republic of Uruguay
- Private Northern University, Peru
- Max Planck Institute, Germany
- Fraunhofer Institute, Germany
- Bar Ilan University, Israel
- University of Belgrade, Serbia

National companies:

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

Agreements

1 National

UIA

1 International

Politecnico di Torino

2 TOTAL



Summary of **Projects**

FEES PROJECTS

	Project	Progress
1	Role of neutrophils and its complement in the modulation of the immune response against important bacterial infections in Costa Rica.	This project allows to generate basic scientific information on the pathogenesis and biology of these bacteria, favors inter-university collaboration, and the training of new researchers. It 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 agro-industrial and marine waste.	The goal of this proposal is to develop biodegradable chitosan films, with antimicrobial activity, from agro-industrial and marine waste.

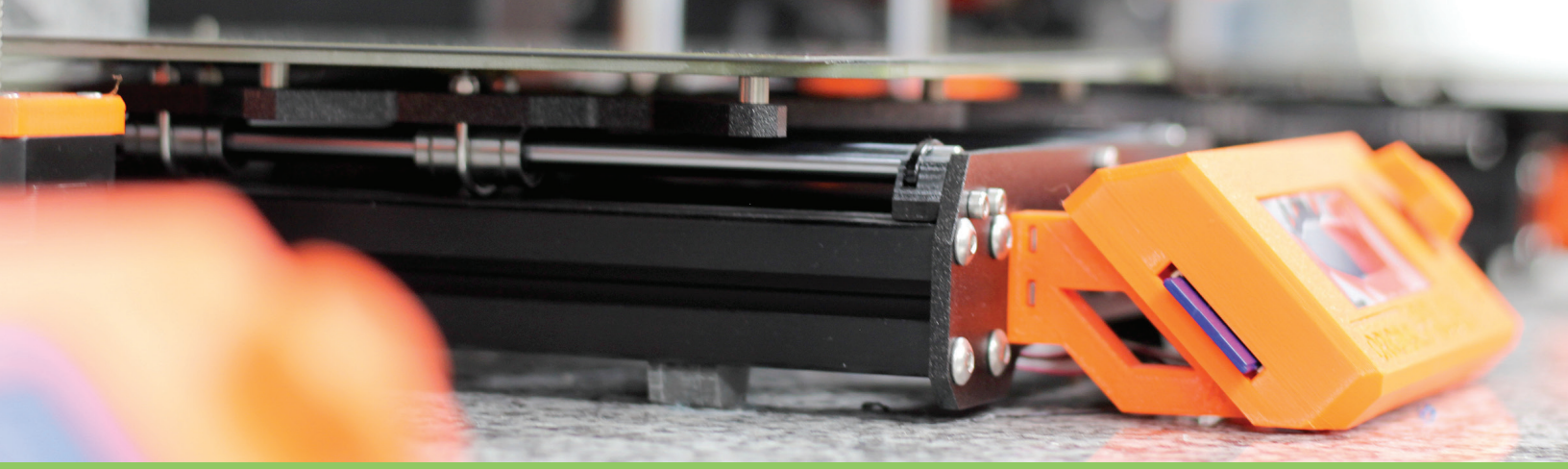
CONARE-FUNDED PROJECTS

	Project	Progress
3	Costa Rican Chemistry Olympiad and Costa Rican Olympiad of Sciences (OLCOQUIM-OLCOCI).	The purpose of this project is to promote scientific vocations and environmental management in students who participate in the Costa Rican Chemistry and Science Olympiads, within the general framework of the ODES.
4	Understanding of the velvet worm anti-adhesive sin mechanism as a model for biodegradable and low protein adsorption coatings (Max Planck).	This project aims to generate fundamental knowledge about the non-stick properties of velvet worm skin and its mechanisms to design sustainable non-stick coatings, within the concept of biomimicry.



LANOTEC OPERATION PROJECTS (INTERNAL PROJECTS)

Project	Progress
5 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 an international collaborative development based on science and technology. The project consists of the manufacture, characterization and scaling of a membrane composed of electrospun nanofibers that contain nanoparticles with a high Arsenic capture-power. Due to the adsorption mechanism and its low cost, the membrane does not require electricity to act, and therefore, it can be used both in developed urban centers and in vulnerable communities without access to electricity or safe water.
6 Structural elucidation of Irbesartan Form A using Rietveld and Le Bail methods.	Work is being done in collaboration with the Laboratory of Applied Crystallography of the National University of San Martín, 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.
7 Nano-phytomedicines for the prevention and treatment of COVID-19: Solid-lipid nanosystems and in-silico and in-vitro study of natural inhibitory candidates of the SARS-CoV-2 virus.	Collaboration project with UCR, which aims to publish the scientific paper - Design of Hybrid Polymeric-Lipid Nanoparticles Using Curcumin as a Model: Preparation, Characterization, and In Vitro Evaluation of Demethoxycurcumin and Bisdemethoxycurcumin-Loaded Nanoparticles.
8 Development and implementation of tools for understanding nanotechnology from practice: making the invisible visible 2021-2023.	The objective is to train educators and teenagers in bio-nanotechnology through talks and practices using easy-to-understand language. Bilateral Costa Rica-Uruguay Project. The scheduled workshops on the dissemination of nanotechnology were developed, both in Costa Rica and in Uruguay. Additionally, the respective recordings were made for the video editing related to the experimental part with respect to nanobiotechnology.
9 Crystal polymorphism in nanomaterials and soft systems: basic aspects and technological relevance.	This is a macro project that addresses various topics. LANOTEC participates specifically 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 with equipment available in the pharmaceutical industry will be considered. Based on the results obtained, it can be extended to other molecules of pharmacological interest.
10 Identification of vascular basement membrane and surrounding extracellular matrix proteins to which snake venom metalloproteinases bind by electron immunomicroscopic studies.	Study of 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 electron immunomicroscopic tests to identify the component to which these toxins bind.
11 Development of medical device a prototype that allows the approach of minimally invasive neurological pathologies.	The objective of this project is to develop minimally invasive access mechanisms and artifacts that facilitate the development of complex neurological operations by 3D printing from the LANOTEC FabLab, in conjunction with Dr. Miguel Esquivel from Hospital México.



PRIVATE FUNDED PROJECTS

	Project	Progress
12	Promotion of Challenge Fair science vocation.	Encouraging a rapprochement with the country's academic centers and supporting the development of science events (fairs), to encourage the development of science vocations in the country. This project depends on the interest of the organizers of the National Science and Technology Fairs, as well as the National Engineering Fair.
13	Bio-inspired and low-cost 3D printing of hydrogels with biomedical applications.	This proposal involves developing a bioinspired nanocarrier system that responds to mechanical stimuli, such as the shear forces found in cheap and widely available syringe needles. Using this mechanical force to cause a simple and benign chemical reaction within a bio-based and biodegradable hydrogel that leads to gelation of the hydrogel. Finally, applying this principle to 3D printing of hydrogels by using print setups in Simple and affordable 3D, e.g., a syringe needle in a robot. These objectives will be addressed according to the experience of the partners involved, i.e., velvet worm, hydrogel formulation and instrument development in Costa Rica, 3D printing, synthesis and characterization of nanocarriers and development of materials sensitive to stimuli in Switzerland.
14	H2020– Automated functional screening of IgGs for diagnostics of neurodegenerative diseases (AUTOIgG).	Development of experimental cell 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.
15	Production and characterization of bacteria-repellent microcontact printed substrates and bactericidal nanostructured surfaces.	Study of bactericity and repellency, and development of a synthesis methodology of carbon quantum dots and their use in bioimaging. This ended at the beginning of 2023.
16	Evaluation of the impact of cigarette smoke vs THS on indoor air quality.	The impact on air quality in an outdoor space, produced by the smoke emitted by smoking conventional cigarettes, was evaluated against the aerosol generated by the THS device.
17	Evaluation of the antimicrobial activity of vinyl fabrics produced by the “Proquinal Argento” company, 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 the AFM and SEM. In addition, microbiological tests will be carried out using two bacteria, one Gram - and one Gram + bacterium, following the JIS Z 2801.44 test method. The protocols used in phase I will be followed.
18	Material characterization	Collaboration project with UCR for sample processing and analysis.

PRIVATE FUNDED PROJECTS

	Project	Progress
19	Development of nanoparticle carriers of natural polyphenols to control grain contamination by mycotoxins.	Development of nanoparticle carriers of natural polyphenols to control grain contamination by mycotoxins.
20	Evaluation of the physicochemical characteristics of the abaca produced in the Horquetas, Sarapiquí area and the development of a purification methodology for the fibers obtained by the Costa Rican extraction process. Abaca fiber project.	The main objective of the project is to evaluate the morphological characteristics and silica content present in the abaca of Costa Rica. In addition, to compare with the data reported for the crops from the Philippines and Ecuador, and to 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.
21	BAC credit cards.	Evaluate samples of credit and/or debit cards from the BAC company that are made up of 2 commercial polymers.

OTHER PUBLIC FUNDS

	Project	Progress
22	FI-55B-19: Revaluation of coffee brush as an alternative adsorbent material to activated carbon in the removal of bromacil from water sources.	Obtain new low-cost adsorbent materials from coffee biomass as an alternative to activated carbon in the removal of bromacil from water sources.
23	FI-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 up 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 inhibition studies of the SARS-CoV-2 virus and COVID-19 treatment.
24	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.	Generation of agro-industrial capacities and creation of a comprehensive unit (a quality control laboratory to carry out physical-chemical, organoleptic, and microbiological characterization) to improve the production process of Turrialba cheese with Designation of Origin.
25	ECO-INPUTS - PINN: Development of two agro-nutritional formulations to improve agricultural soils, to ensure their efficient use in agriculture, and to reduce environmental impact.	This project focuses on the manufacture of agricultural inputs oriented towards soil improvement and crop nutrition; as well as to develop new alternatives that allow to improve in an integral and sustainable way the agricultural production systems of our country.

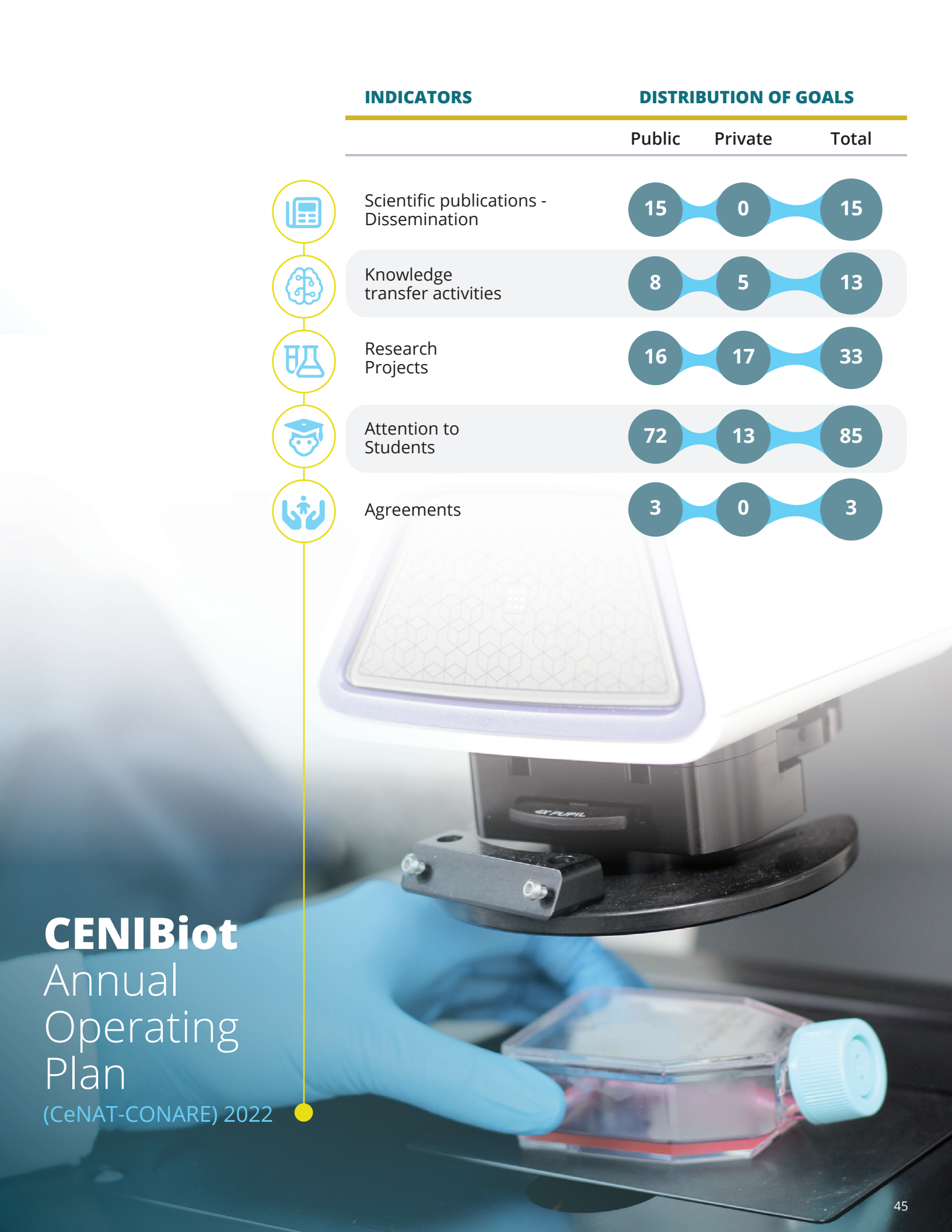


CENIBiot

Laboratory

CENIBiot

INDICATORS	DISTRIBUTION OF GOALS		
	Public	Private	Total
Scientific publications - Dissemination	15	0	15
Knowledge transfer activities	8	5	13
Research Projects	16	17	33
Attention to Students	72	13	85
Agreements	3	0	3



CENIBiot Annual Operating Plan

(CeNAT-CONARE) 2022

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).

It 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".

The development objective at CENIBiot is to generate biotechnological research that contributes to the development of Costa Rica, through projects with scientific and innovation impact, that empower society in the economic, social, and environmental fields, through the exchange of knowledge, services in science, and support to entrepreneurship.

CENIBiot 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 main strategic actions developed by CENIBiot (CeNAT-CONARE) in 2022 include the main goals based on the opening, linking, and internationalization actions proposed on the 2019-2024 CENIBiot and CeNAT Strategic Plan, as well as the implementation and continuity of the proposals raised in:

- The Improvement and Implementation Plan of CENIBiot's 2019-2024 Strategic Plan
- 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 2022

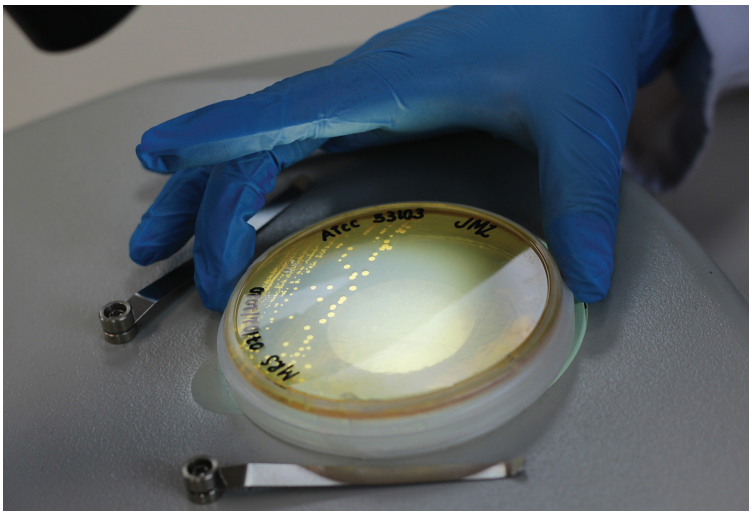
With the execution of CENIBiot's Operational funds (CENIBiot - CeNAT), the maturation of projects aimed at generating innovative biotechnological solutions has been promoted, as well as the strategic linkage of the different sectors, through technology transfer and university-company linkage. Maturity is not only evident in productivity sustained over time, but also in the significant increase in the impact of scientific publications, among which a publication in Nature Microbiology and a cover in the journal Environmental Microbiology stand out.

With the execution of CENIBiot's private funds (CENIBiot - CeNAT), for the first time on record, agreements were reached with companies for the execution of projects that effectively consider the scaling up of bioprocesses to produce plants of commercial interest for international markets, scaling up in stirred tank up to 50 liters, and producing botanical extracts of high quality and purity for international markets. We can affirm that, finally, thanks to a sustained, rigorous, and planned effort of many years, CENIBiot is scaling up in all fields where opportunity has been envisaged, thus contributing to national development with solutions that, by design, other relevant national stakeholders can't do so. These projects add to dozens of sales of biotechnology services, but with a greater scope. This represents a leap in the potential positive impact for the productive sectors of traditionally empirical industries that are beginning to recognize the importance of rigorous scientific research in their innovation processes.



Development Goal

To generate biotechnological research that contributes to the Sustainable Development Goals for 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 Statement

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 Statement

We are 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.

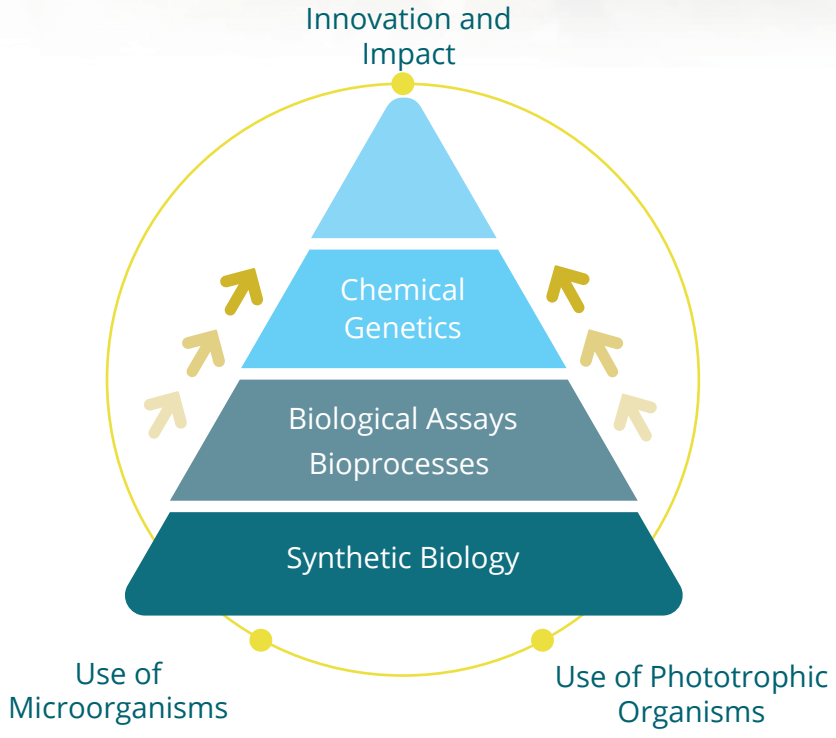
Values

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

Principles

- 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 achieve an effective consolidation of linkages and strategic alliances with the academia, the business sector, and the government.

To position CENIBiot as a specialized center in industrial bioprocesses, for both scientific and business development.

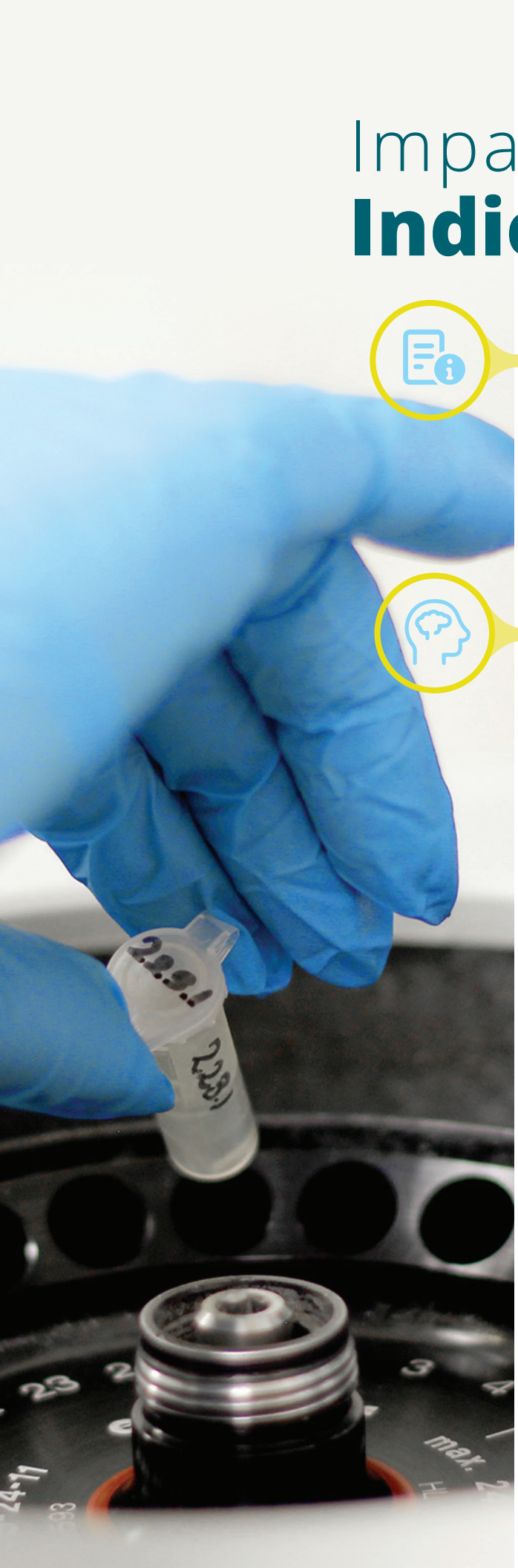
To have a structured and optimized quality management system.

To improve the professional development of the human capital of CENIBiot.

Strategic **Nodes**

- Research in Health Biotechnology
- Research in Bioprospecting
- Research in Molecular Biology
- Research in Phototropic Organisms
- Research in Bioprocesses.





Impact **Indicators**

Publications

15 Indexed

Knowledge **transfers**

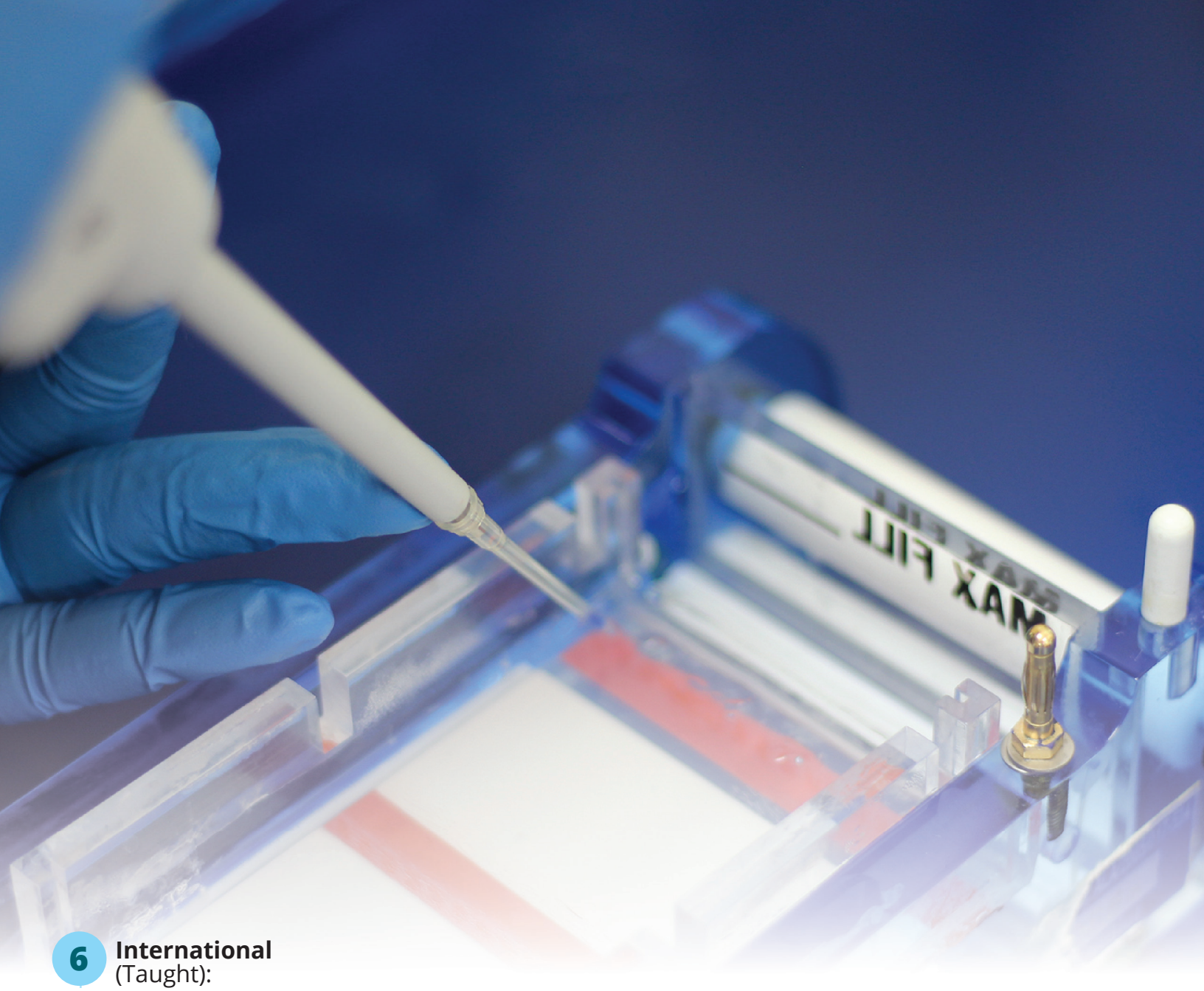
7 **National** (Received):

Courses, Workshops, Symposia:

- TC-001-2022 Lecture: Case study for practice in RStudio
- TC-002-2022 Lecture: The Ascomycota in: "Agroecology of fungi in Coffee, Organization for Tropical Studies", Las Cruces Biological Station. June 2022.
- TC-003-2022 Lecture: The Basidiomycota. In: "Agroecology of fungi in Coffee, Organization for Tropical Studies", Las Cruces Biological Station. June 2022.
- TC-004-2022 Antibiotic-producing Micrococcales govern the microbiome that inhabits the fur of two- and three-toed sloths: Poster accepted at the International Society for Microbial Ecology (ISME) in Switzerland Lausanne.
- TC-005-2022 Bacterial fermentation practical course.
- TC-008-2022 Fermentation monitoring variables using a bioreactor.

Other:

- TC-010-2022 A external expert reviewer for a UCR project.



6 **International**
(Taught):

Courses, workshops, symposiums:

- TC-006-2022 In vitro cultivation of plants using both a traditional system and Temporary Immersion systems.
- TC-007-2022 Biosynthesis of nano-metalloids in Pseudomona putida.
- TC-012-2022 Poster: Biodiversity and bioeconomy come together to promote changes in sustainable agricultural production systems.
- TC-013-2022 Course: Bacterial and Viral Metagenomics: concepts, tools, and future perspectives.
- TC-011-2022 Course: Fundamentals, operation, and scaling up of bioreactors.
- TC-009-202 Introductory course on the use of Bioreactors

13 **TOTAL**

393 **People benefited**



Research Projects

33 TOTAL

16 Public

2 FEES

- FP-011-2022 Development of a food product from microalgae biomass of Arthrospira maxima with high nutritional value (FEES).
- FP-015-2022 Contamination of Costa Rican corn by toxigenic Fusarium species (FEES).

14 Interns

17 Private

3 CONICIT FUNDS: (Incentive Funds)

- FP-023-2022 - Application of nanobiotechnology for the development of carrier-in a-carrier transport systems for the transfection of nucleic acids.
- FP-028-2022 Formulation of a biofungicide based on peptides extracted from Trichoderma asperellum and evaluation of its ecotoxicity and safety.
- FP-029-2022 Bioles as a source of inspiration for the generation of new native microbial biostimulants for agricultural innovation in Costa Rica.

14 Other Funds

Private
Projects in negotiation:

- Base CampResearch
- Pelón de la Bajura
- Ingenio el Viejo
- PRONUVO
- Flora Nueva
- Nippon Paper
- CORBANA



Attention to **Students**

8	Scholarships
9	Accompaniment in thesis
52	Volunteers
16	Professional practices
85	TOTAL

Articulations

National Academic Sector:

- UCR
- UNA
- TEC
- UNED

International companies:

- Nippon Papper Papylia CR
- Boston Scientific
- Thrive Natural Care
- Cambrium
- Mammoth Biosciences
- Standard Fruit Company

International Universities or Institutes:

- International Pharmacy Students Federation (IPSF)
- Universidad de Salamanca
- Hamburg University of Technology
- University of Wisonsin-Madison
- Instituto tecnológico de Monterrey
- Centro Nacional de Bioechología de España
- Leibnitz University Hannover
- University California-San Diego
- WAITRO
- University of Lausanne
- Consiglio Nazionale delle Ricerche



National companies:

- Association of Craft Brewers of Costa Rica
- Organization for Tropical Studies, Inc.
- Aura Agrícola S.A.
- Bio CR
- Biotech C.R S.A.
- CoopeAgri R.L.
- CoopeCuna R.L.
- Cooperativa de Caficultores y Servicios Múltiples de Tarrazú R.L.
- CORBANA, S.A.
- Corporación de Desarrollo Agrícola del Monte S.A.
- doTERRA
- Eremita Beverage, S.A.
- Establishment Labs S.A.
- Granja Avícola Santa Marta S.A.
- Inversiones TicoBirra.com S.A.
- Stein Laboratories
- LISAN S.A.
- Novatec Industrial S.A.
- Numu Brewing
- Rise Kombucha S.A.
- Speratum
- Stein Corp.
- Sur Química S.A.
- Treintaycinco - Beer Factory
- Vinícola Costa Rica KNB Limitada

Agreements

3 National:

- CV-001-2022 CeNAT-UCR (CIPRONA) “Microorganisms associated to solar panels and their potential for the production of natural pigments” research project.
- CV-002-2022 CeNAT-Parque TEC Agreement.
- CV-004-2022 Search for antibiotic-producing bacteria in the Amblipigida Cave of Costa Rica” UCR-CeNAT.



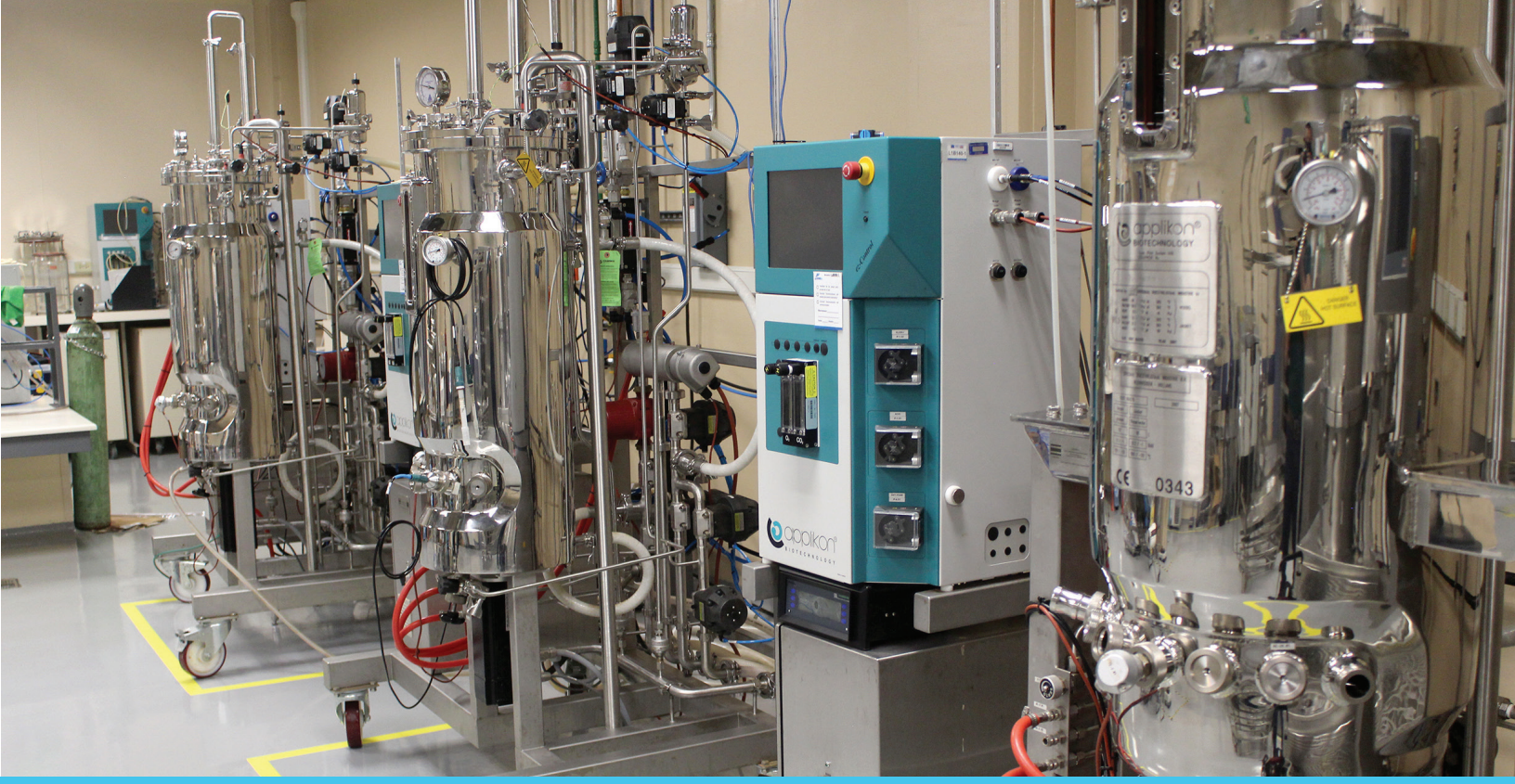
Summary of **Projects**

PUBLIC FUNDED PROJECTS

Public	Progress
1 Development of a food product from microalgae biomass of Arthrospira maxima with high nutritional value (FEES).	Temperature tests in spray drying and respective quantification of pigments by spectrophotometry (chlorophyll, carotenes, and phycocyanin).
2 Contamination of Costa Rican corn by toxigenic Fusarium species (FEES).	Research from the Center for Research in Grains and Seeds (CIGRAS-UCR) has found that most corn produced in Costa Rica contains high concentrations of mycotoxins, whose toxicity is associated with cancer in humans and animals. Therefore, the project directed by CIGRAS-UCR seeks to determine the factors that influence the contamination of maize in the field by toxigenic species of Fusarium spp. in Costa Rica. One of the factors to be studied is the microbial community of the soils where corn is grown, which is where CENIBiot is contributing to this project. This will contribute to better management of the crop in the field, reduce the contamination of the corn grain by mycotoxins, and therefore reduce the exposure of the Costa Rican population to these toxins.
3 Karyotype and genome size in Cas populations	In this project that concluded with the publication of a scientific manuscript, the first description of the cas genome was made, whose scientific name is Psidium friedrichsthalianum (O. Berg) Nied. The availability of this tool will allow researchers from all over the world to explore the potential of this fruit as a functional food, as well as a great diversity of associated molecular studies.
4 Evaluation of the efficacy of an experimental treatment for Chagas disease using purified fractions from the Hamelia genus plants collected in Sarapiquí and the Osa Peninsula.	Search for new and selective antiparasitics against the intracellular form of Trypanosoma cruzi, for which there is no cure available to date.
5 Role of sorption in lymphocyte in-vitro proliferation.	Sorcin is a protein that regulates intracellular calcium flux in mammalian cells, which has been related to lymphocyte physiology, but whose function is still unknown. Describing part of this function is the goal of this project.

PUBLIC FUNDED PROJECTS

	Public	Progress
6	Construction of a vector based on Tellurite genes for the genetic manipulation of multi-resistant bacteria.	Elaboration of a pSEVA construct with which replacing the antibiotic resistance genes with the tellurite resistance genes was possible, verifying the correct elaboration of the plasmid in an E. coli system, and with the purpose of continuing with tests in multi-resistant bacteria.
7	Melina's genetic footprint	Melina wood (Gmelina arborea) has several characteristics that make it suitable for the establishment of commercial plantations, including its easy propagation, fast growth, and that it has been classified as high-quality wood for its resistance and durability, with a variety of applications in the manufacture of furniture, laminated wood, particle board, and in the production of pulp and paper. In the forestry industry, highly productive trees generated from genetic improvement programs are selected, which are then propagated by cloning. In collaboration with INISEFOR of UNA and CENIBiot, a fast, reproducible, and reliable method was developed for the certification of clonal identity and quality control of clonally propagated Melina trees.
8	Biodegradation of fungicides with endophytic strains of Trichoderma	In a paper associated with this research, Trichoderma species isolated from living leaf tissues of wild Rubiacaeae (coffee family) plants were studied to determine their tolerance to fungicides and bio-removal potential. These findings suggest that the wild plant endosphere could be an attractive guild for finding new Trichoderma species with promising bioremediation capabilities. Furthermore, the results demonstrate that attention should be paid when combining certain types of agrochemicals with antagonistic fungi in Integrated Pest and Disease Management strategies or when transitioning to organic agriculture.
9	Mechanism of Cardiac Dysfunction induced by circulating histones	It aims at describing the role of specific histones in cardiac dysfunction that arises during sepsis. So far, only the function of mixtures of these molecules is known.
10	Domestication process of Coyol (Acrocomia aculeata) as a bioenergetic alternative in Costa Rica	The Coyol (Acrocomia aculeata) is a species of palm tree that is traditionally used to prepare the drink called “coyol wine”. However, its oleaginous fruit can be used to produce biodiesel, human consumption, pharmaceuticals, and cosmetics. The species has the potential to become a new commercial oilseed crop if properly managed and its germplasm improved. In a collaboration between the School of Biology at TEC and CENIBiot, in this project, the diversity and genetic structure of A. aculeata in Costa Rica were studied, with DNA markers in plants collected throughout the country. Essentially, it covered almost all the current geographic occurrences of this species in Costa Rica. The genetic diversity found was low with a structure of basically only three populations. The results of this project serve as a reference for future studies on the diversity of germplasm of this species in Mesoamerica, and also as a baseline for future conservation and management efforts of this species.
11	Preparation of protocols for handling equipment and training in analysis techniques-Bioprospecting.	The need to train laboratory personnel, students, and interns in equipment handling and protocols was detected, due to the great demand associated with CeNAT scholarships, theses, and other daily student attention processes. As a result, manuals were developed to reduce training time and the variability of results due to differences in procedures.



PUBLIC FUNDED PROJECTS

Public	Progress
12 Extraction of lignin from different lignocellulosic biomasses to evaluate its use in the production of materials.	The project consists of the extraction of lignin from various lignocellulosic materials, which are currently waste from the country's agro-industrial sector, to later evaluate its use in the production of materials or chemicals. The materials include coconut husk, palm mesocarp fiber, coconut fiber, coconut husk-coir fiber, banana frond fiber, palm frond fiber, palm husk, coffee pulp, pineapple stubble, pineapple stubble fiber, and sugarcane bagasse. The Project did not continue.
13 Effects of endophytic fungi from plant isolates of the Rubiaceae family on the morphology and physiology of coffee plants.	Rooster's eye (Mycena citricolor) is a disease that affects coffee plantations, mainly in Central America. Currently, there are few alternatives to control the pathogen that are environmentally friendly and affordable. Therefore, in this collaborative project between UCR and CENIBiot, fungi were isolated from the plant endomycobiota of native plants that are from the same family as coffee. The results allowed an understanding of the potential use of little-studied species of endophytic fungi that are not only capable of reducing the impacts of phytopathogens but also of improving plant growth, thus helping in the transition to organic agriculture.
14 Effects of endophytic fungi on the health and resilience of coffee plants - Trichoderma	A collateral project related to the endophytic fungi and Rubiaceae plant from which efficacy tests of new endophytic fungi were carried out under controlled in vitro conditions, to later be used in field trials. The result is a potential product.
15 An initial approach to the bioprocess for obtaining lipoteichoic acid from Lactobacillus rhamnosus GG for future applications.	Flask fermentations with changes in growth temperature to evaluate if there is a difference in production, as well as tests of different extraction protocols to choose the most efficient yield.

PROJECT WITH OTHER FUNDS

Public	Progress
16 Research of the downstream neuronal path of Neuregulin-2. (VIE).	Neroregulin (NRG-1) is part of a molecular network and its associated receptor (ErB4) is part of a molecular network whose activity has been altered in diseases of the central nervous system such as schizophrenia. The goal of this project has been to study the molecular pathways that are activated as part of the intracellular signaling cascade that is triggered when this protein is stimulated.
17 Profiling and validation of the downstream molecular pathophysiology of the hyperstimulation of NRG1-ErB4 relevant to schizophrenia (VIE).	Neroregulin (NRG-1) is part of a molecular network and its associated receptor (ErB4) is part of a molecular network whose activity has been altered in diseases of the central nervous system such as schizophrenia. Through a model of neuroregulin overexpression in genetically modified mice, in this collaborative project, new activities were discovered for this protein, associated with the postsynaptic regulation of molecular signals in the hippocampus.
18 Characterization of the microbiota associated with the biodegradation of historical documents of Costa Rica VI-2019 2019.	Knowledge of the lignocellulolytic degradation capacity in historical documents allows for formulating strategies to combat biodeterioration. For this reason, the identification of fungi that have grown in historical documents of Costa Rica and their ability to degrade cellulose is necessary knowledge to work against biodeterioration and preserve documents of cultural and historical relevance.
19 Genomic and postgenomic analysis of the biosynthetic pathways of antibiotic production in Streptomyces sp M54. VI-4953-2019.	The Streptomyces sp M54 bacterium, isolated from the wasp Polybia plebeja, has an antimicrobial capacity expressed within the biosynthetic gene clusters it has, which have been previously characterized. However, some of these clusters have not been characterized and can potentially be antibiotic biosynthetic pathways.
20 Microorganisms associated with solar panels and their potential to produce natural pigments: A pilot study of the University of Costa Rica.	Determination of the microbial communities that grow on the surface of solar panels, in addition to the analysis of the ability of these microorganisms to resist ultraviolet radiation to a greater extent compared to other organisms. In the same way, the production of pigments by some of the microorganisms that grow in these conditions was determined.
21 Study of the physicochemical and microbiological defense mechanisms of the eggs of Costa Rican forest birds.	Identification of microorganisms on the surface of eggs of Costa Rican forest birds, as a study of the microbiological defense capacity through the production of antibiotics against pathogens that reduce the viability of the eggs.
22 Search for antimicrobial-producing bacteria in the fur of sloths of the Choloepus and Bradypus genera from Costa Rica.	Sloth fur is an environment rich in bacteria, insects, algae, and fungi, which coexist with each other. Within these interactions, the ability of some bacteria to help control the growth of pathogens through the production of antibiotics is being studied.
23 Characterizing the microbial communities that inhabit the Amblipigida Cave and evaluating their potential to produce antibiotics – SIPPRES	Caves are environments that are poor in organic matter, within which microorganisms grow and coexist competitively for resources. This competitive environment is favorable for finding antibiotic-producing bacteria.



PROJECT WITH OTHER FUNDS

Public	Progress
24 Formulation of a peptide-based biofungicide extracted from Trichoderma asperellum and evaluation of its ecotoxicity and safety, FI-048B-19 (MICITT).	This project is the study of the purification and formulation of a biofungicide based on peptides extracted from the Trichoderma asperellum biocontrol fungi. Here, the Bioprocesses area at CENIBiot works on the bioprospecting of molecules of interest to satisfy the demand of different types of industries. These peptides are called peptaibols, which have the ability to inhibit the growth of various phytopathogenic fungi. The purpose of the project is to bring to the market a biofungicide that has been developed for several years, and for which we already have evidence of its biological effect.
25 Application of nanobiotechnology for the development of carrier-in a-carrier transport systems for nucleic acid transfection, FI-215B-17 (CONICIT).	Development of mixed encapsulations of non-toxic lipids and polymers that in turn allow the transfection of both in vitro cellular lines and in vivo tissues. Extreme environments such as volcanoes, fumaroles, acid soils, etc. are a potential source of novel enzymes with applications in multiple industries.
26 Bioprospecting for new extremozymes in Costa Rican volcanic environments, FI-255B-17 (MICITT).	This international inter-institutional project focused on the search for new enzymes from metagenomic analyzes of microbial communities in extreme environments.
27 Biotechnological production of terpenes from endemic species of Costa Rica, for the control of Fusarium oxysporum f.sp. cubense, a causal agent of Panama disease in banana plantations (Musa spp.), FI-254B-17(MICITT).	From this project, novel enzymes with the ability to synthesize molecules from the terpene families were isolated, identified, produced, and optimized. These new molecules have activity against the causal agent of Panama disease and serve as a structural basis for the development of new treatments for this banana disease.
28 Use of agro-industrial waste through the development of bioprocesses to produce common and fine chemical products (MICITT).	An international inter-institutional project that generated scientific review articles dedicated to the study of the possibilities of using residual biomass from agro-industry, for example, pineapple, and sugar cane. These scientific documents serve as the basis for planning harvesting activities using biotechnology within the framework of the national bioeconomy strategy.

PROJECT WITH OTHER FUNDS

Public	Progress
29 Design of collagen-based medical devices for tissue regeneration, from the use of by-products from the aquaculture industry (GTR).	Manufacture of membranes as products from the mixture of collagen with viable natural polymers for the development of medical devices for tissue regeneration. The raw materials of this project are agro-industrial waste, and the project is part of the national circular economy strategy.
30 Development and transfer of a biotechnological process to produce microorganisms and the formulation of biopesticides for the control of pests and diseases of national interest - BIOTECH CR GRM.	The project is in stage 2: separation operations, carrying out filtration tests, and solid formulation of the final product, as well as optimization of the inoculation of the fermentation in the bioreactor.
31 Bioles as a source of inspiration for the generation of new native microbial biostimulants for Costa Rican agricultural innovation, FI-041B-19 (MICITT).	This project seeks to generate a collection of native Costa Rican microorganisms with commercial application in Costa Rican agricultural production systems and their potential export from complex bio-inputs called bioles. These types of products are part of the supply of biological inputs used in sustainable agricultural production systems that seek to either reduce or eliminate the use of agrochemicals (mainly pesticides and fertilizers). The microorganisms in the formulation of these products have been extracted from other latitudes, which added to the edapho-climatic conditions from which they were isolated, producing very diverse effects on crops. In addition, there are no quality controls on the products, which is why it represents a source of mistrust for some stakeholders in the Costa Rican agricultural sector. The systematic and validated study with genomic tools of bioles and microorganisms is generating the necessary knowledge for the development of an innovative product for the agricultural sector that will also contribute to reducing the use of agrochemicals. It is expected that in addition to the product being developed with microorganisms native to Costa Rica, a validated scientific base (know-how) will be generated to continue with the discovery and development of new products of the same nature.
32 Nanoencapsulation of Bacillus for the control of Radopholus similis (pathogenic nematodes of banana) - CORBANA.	The project is about optimizing and choosing the most promising Bacillus strain, in order to scale up and improve the production process of a potentially marketable biocontroller by encapsulating it from spray drying.
33 Production of peptaibols from Trichoderma sp with alternative reagents.	This project seeks to evaluate the performance of peptaibol biosynthesis when laboratory quality reagents are replaced with lower quality reagents, in order to reduce production costs with a view to scaling up.

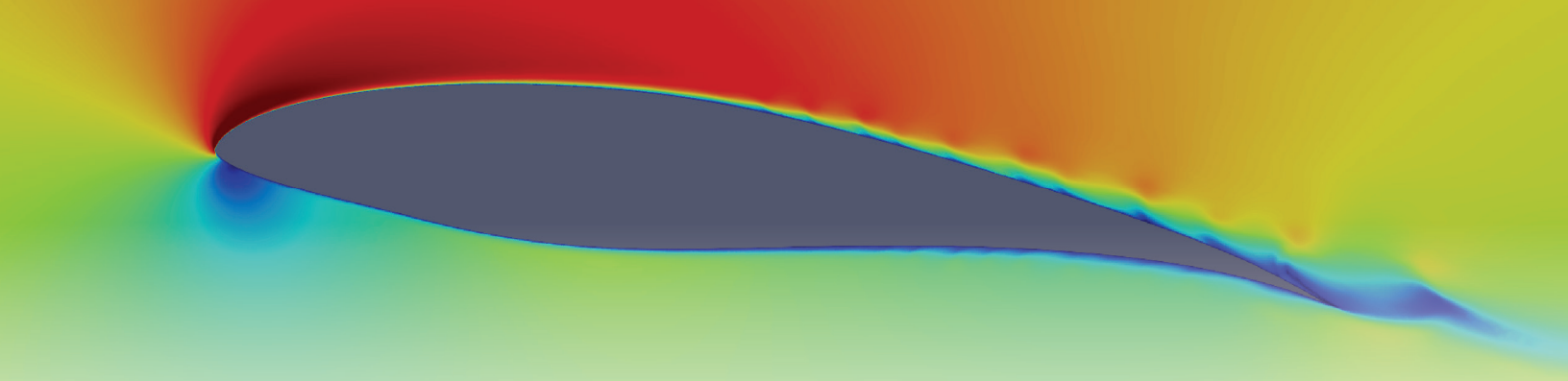




CNCA

NATIONAL ADVANCED COMPUTING COLLABORATORY

CNCA



CNCA Annual Operating Plan (CeNAT-CONARE) 2022

INDICATORS	DISTRIBUTION OF GOALS		
	Public	Private	Total
Scientific publications - Dissemination	10	0	10
Knowledge transfer activities	41	0	41
Research projects	10	4	14
Attention to students	7	0	7
Agreements	2	0	2
Cluster operation	355	0	355
Cluster usage	70.460	0	70.460

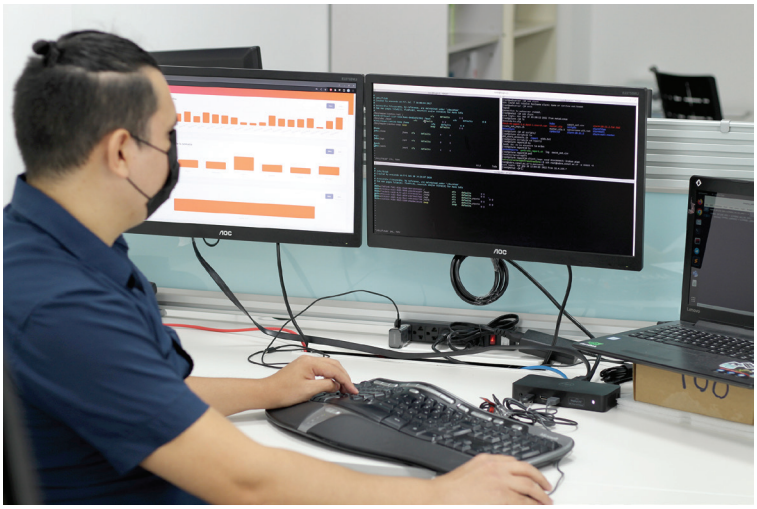
Introduction

The National Advanced Computing Collaboratory (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 CNCA aims to provide two pillars of scientific development to the Costa Rican community. In addition to theory and experimentation, simulation and analysis of data constitute fundamental pieces in the exploration of the knowledge frontier. To achieve this aspiration, computer hardware and software tools are essential. The work of CNCA members then deals with the computer cluster and the applications installed in it. The CNCA must provide a computer infrastructure of excellence for the development of projects and services that allow the creation of high-impact solutions for 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 Statement

We are a research laboratory that promotes the management of complex information, with professionals specialized in advanced computing who carry out studies with the highest scientific standards, innovating in technological development and articulating studies at a national and international levels.

Vision Statement

We aim to be a self-sustaining advanced computing laboratory with the highest technological infrastructure, impacting on 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:

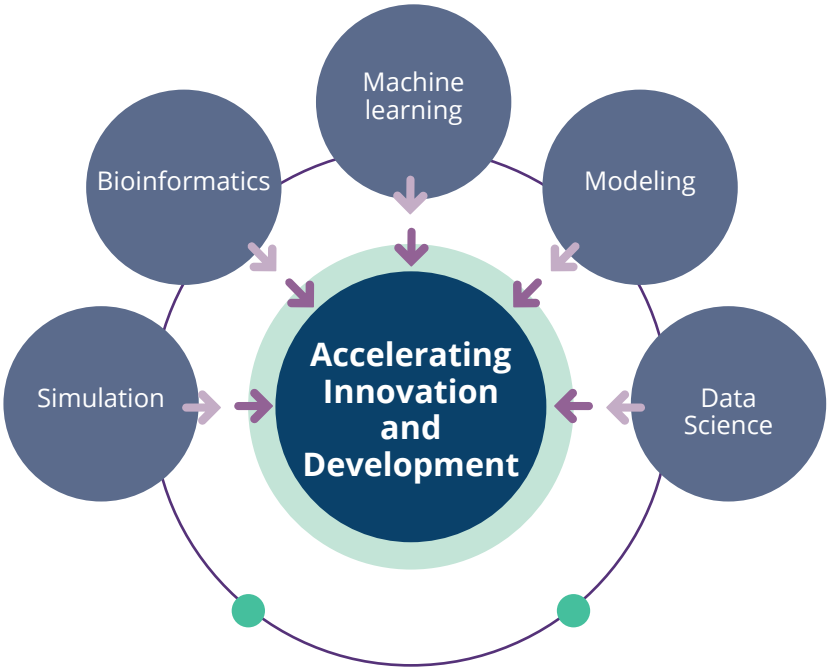
Values

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

Principles

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

Operating **Structure**:

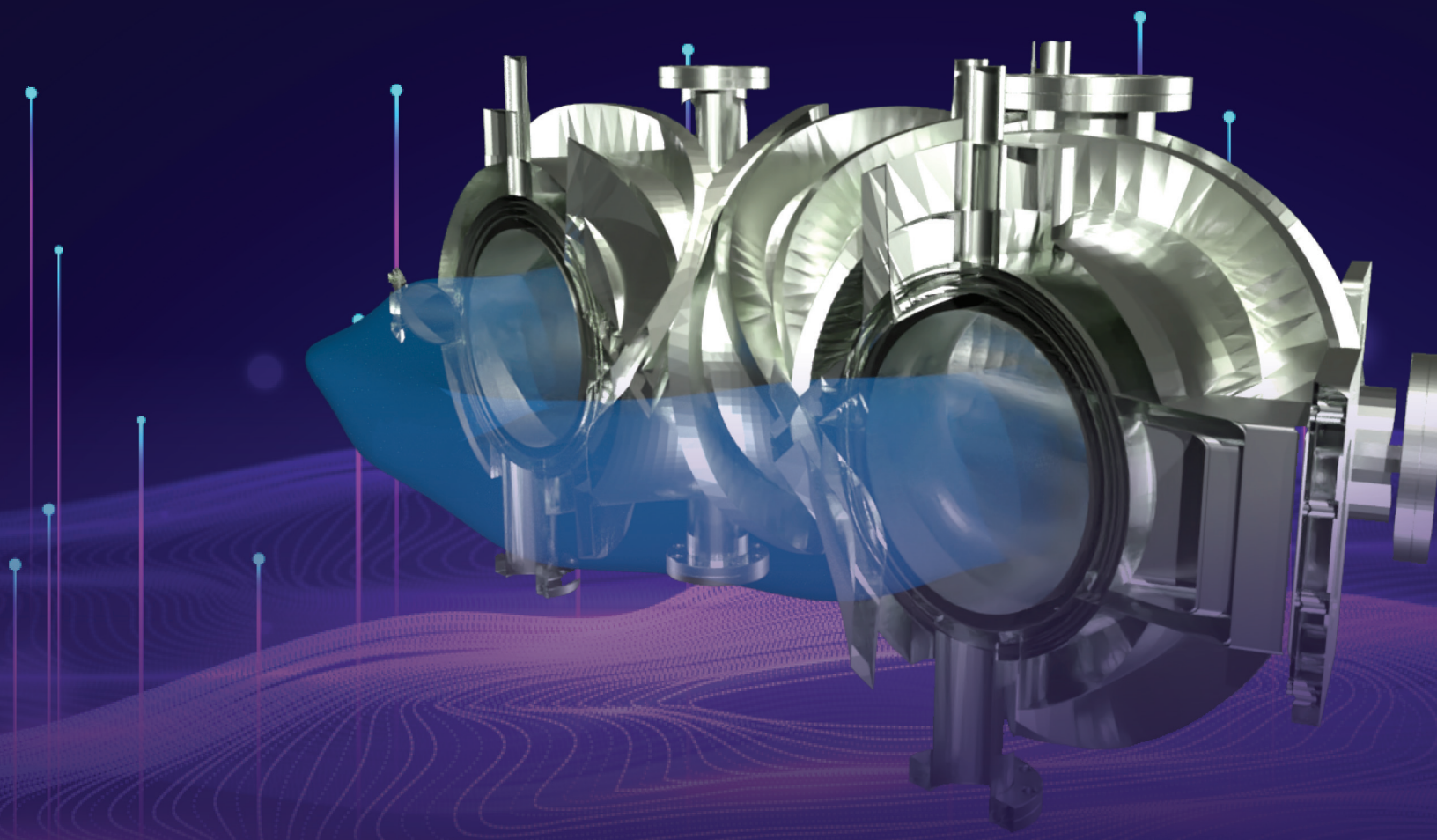


Objectives

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

- To provide advanced computing infrastructure under constant improvement, update and use for scientific research.
- To effectively communicate the results and activities of the collaboratory.
- To create mechanisms to attract external funds.
- To guarantee the professional growth of the members of the collaboratory.
- To enhance the scientific production of the collaboratory.
- To strengthen the training offer of the collaboratory.





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

10 Indexed papers by SCOPUS.

Knowledge **transfers**

41 **Transfers taught:**

- **10** Advanced Computing Seminars
- **5** Programming workshops on introduction to programming, scientific computing, and machine learning with Python language for different scientific domains.
- **6** Programming workshops on introduction to programming, statistical analysis, and data visualization with R language for different scientific domains.
- **2** Workshops on Bioinformatic processing of genomic and metagenomic data.
- **1** Workshop on "Adaptive Message Passing Interface"
- **1** Workshop on "Computational fluid dynamics"
- **6** Workshops on the use of Kabré and Linux.
- **2** Programming schools in advanced computing and Big Data subjects. HPC School and Costa Rica Big Data School in face-to-face mode.
- **5** International presentations at academic conferences, meetings, seminars, and forums.
- **3** International presentations on high performance computing subjects at a national and international scientific domain.

Total of **1071 people** benefited from knowledge transfers.

Research **Projects**

10 Public-funded projects

- **1** FEES-funded Project
- **6** Internal projects
- **2** TEC Projects
- **1** CONARE-funded Project

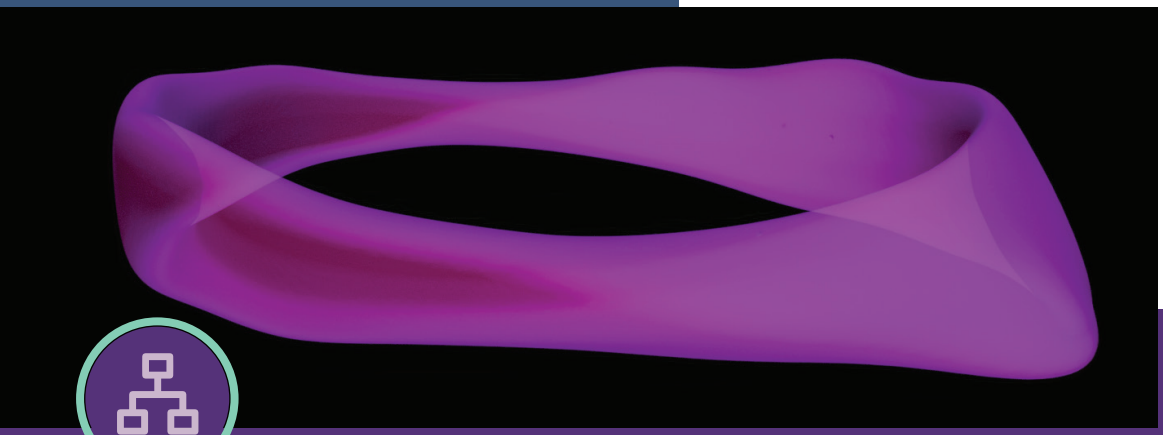
4 Private-funded Projects

Total **14 computational** science and parallel and distributed computing research projects.

7 Students

6 Scholarships

1 Intern



Computational **Infrastructure**

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

522 accounts with access to computing infrastructure services.

70,460 science hours in simulations and data processing.



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)

Agreements

2 national agreements to work in the field of advanced computing.

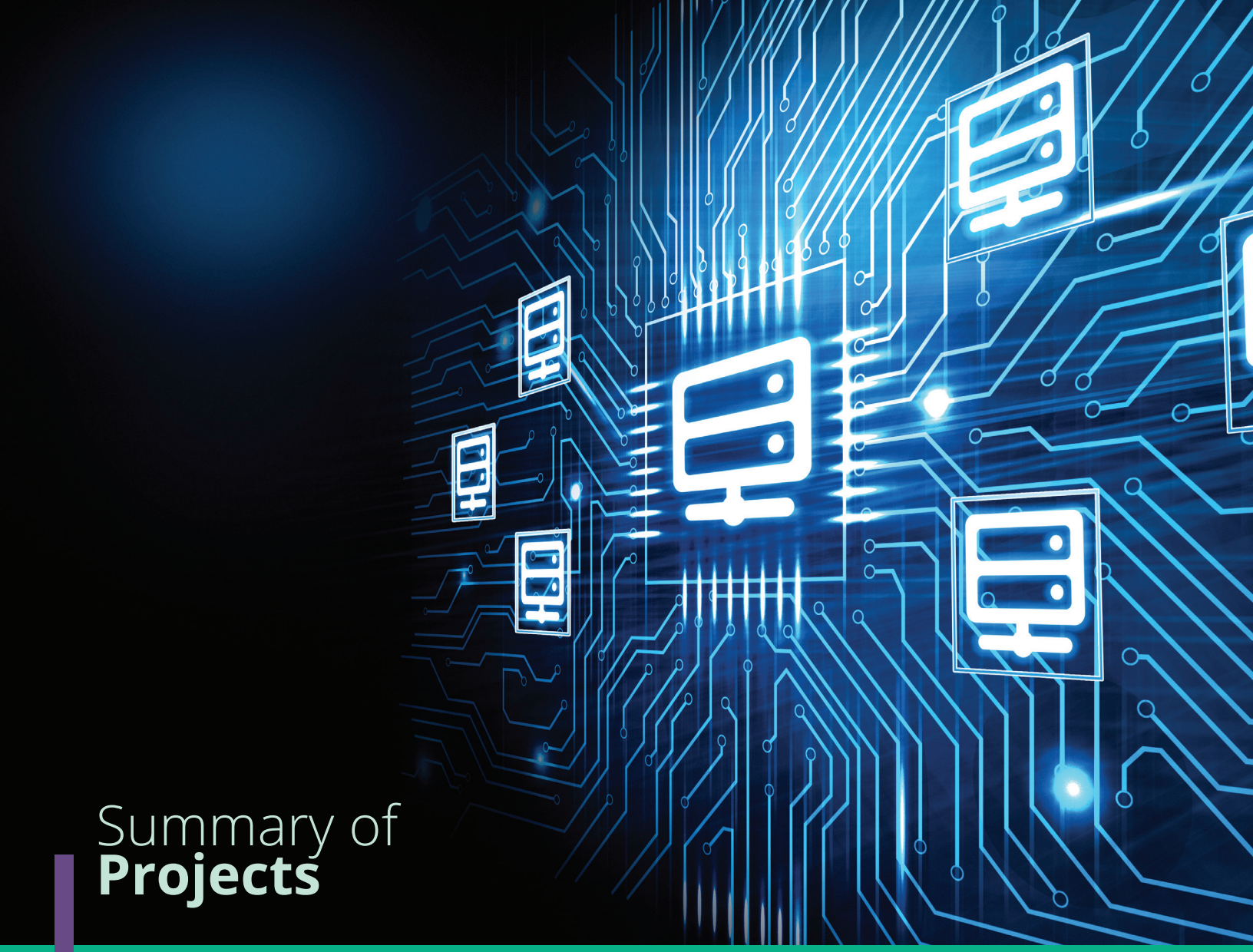
- CIMPA
- INTA



RedCONARE

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

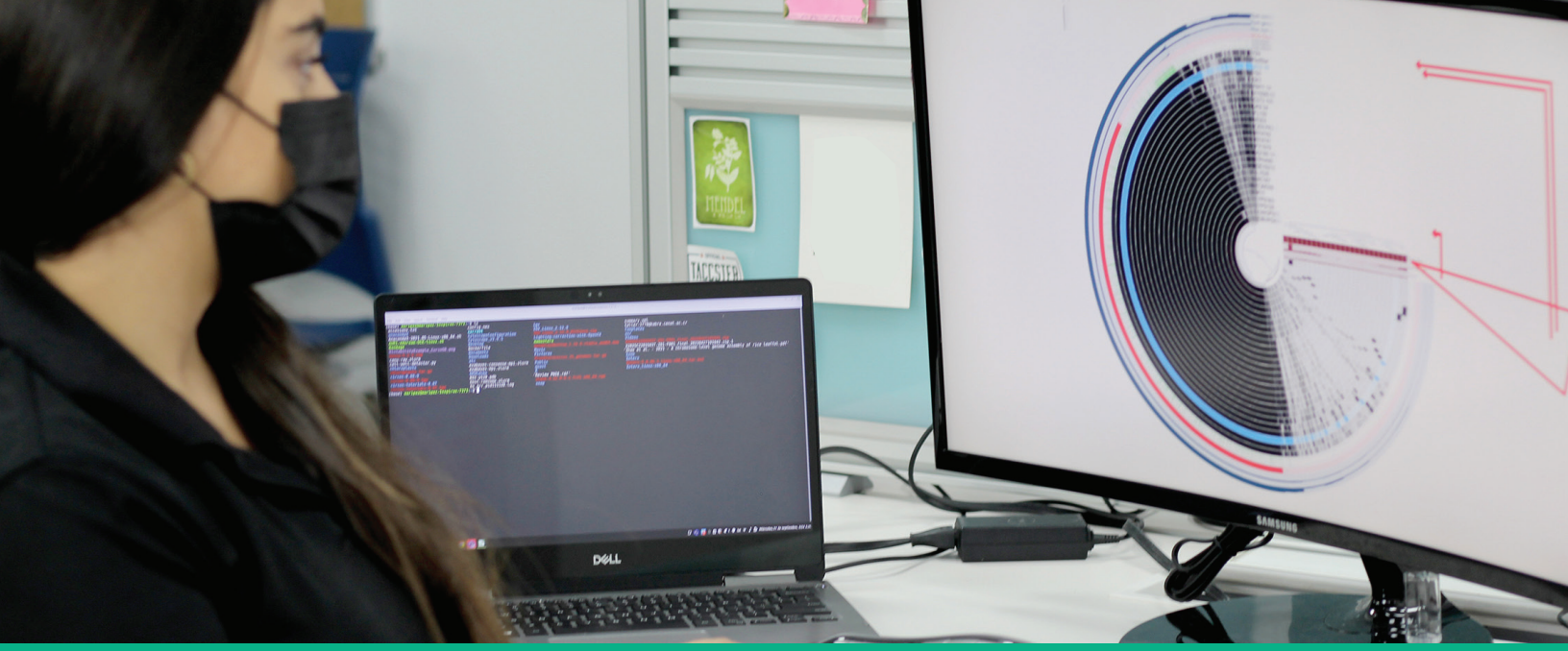
- Network services are available to approximately 14533 students, staff, and teachers.
- Access to Eduroam internationally in 106 countries that participate in the deployment of the connectivity network.
- There are more than 2 billion authentications of the Eduroam network in international territories.
- 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 PROJECT

Project	Progress
1 Analysis of microbial plasmidoma in contaminated water and its possible effects on health and the environment.	Plasmids are mobile genetic elements that allow microorganisms to adapt to various types of habitats, but little is known about the impact of pollution on their diversity in aquatic ecosystems. The goal of this project is to characterize the diversity and typology of the set of plasmids (plasmidoma) in the water column, sediment, and polystyrene microplastics exposed at different points of the Virilla River basin, where approximately half of the Costa Rican population discharges its sewage and other pollutants. To do this, metagenomic analysis, data science, and artificial intelligence will be used. The diversity of plasmid families, accessory genes, the plasmid-host relationship, potential transfer mechanisms, and variations in the contamination gradient will be characterized. The consortium brings together specialists in microbial ecology, clinical microbiology, bioinformatic analysis, and risk analysis by contaminants. It is proposed to generate novel scientific information on the ecology of plasmids in an aquatic ecosystem, but at the same time, to research the potential side effects of anthropogenic contamination on the transmissibility of plasmids with genes relevant to human health and aquatic communities.



CONARE-FUNDED PROJECT

Project	Progress
2 Advancing plasma physics computer simulations with the latest high-performance computing techniques.	This project explores advanced computing technologies for process simulation programs in plasma physics. These simulations pose great challenges for their execution in supercomputing environments. First, they show irregularities in the charge distribution of the required computations. Second, the simulations are run in environments with different computational architectures. This project is carried out in collaboration with scientists from the Max Planck Computing and Data Facility (MPCDF) in Germany.

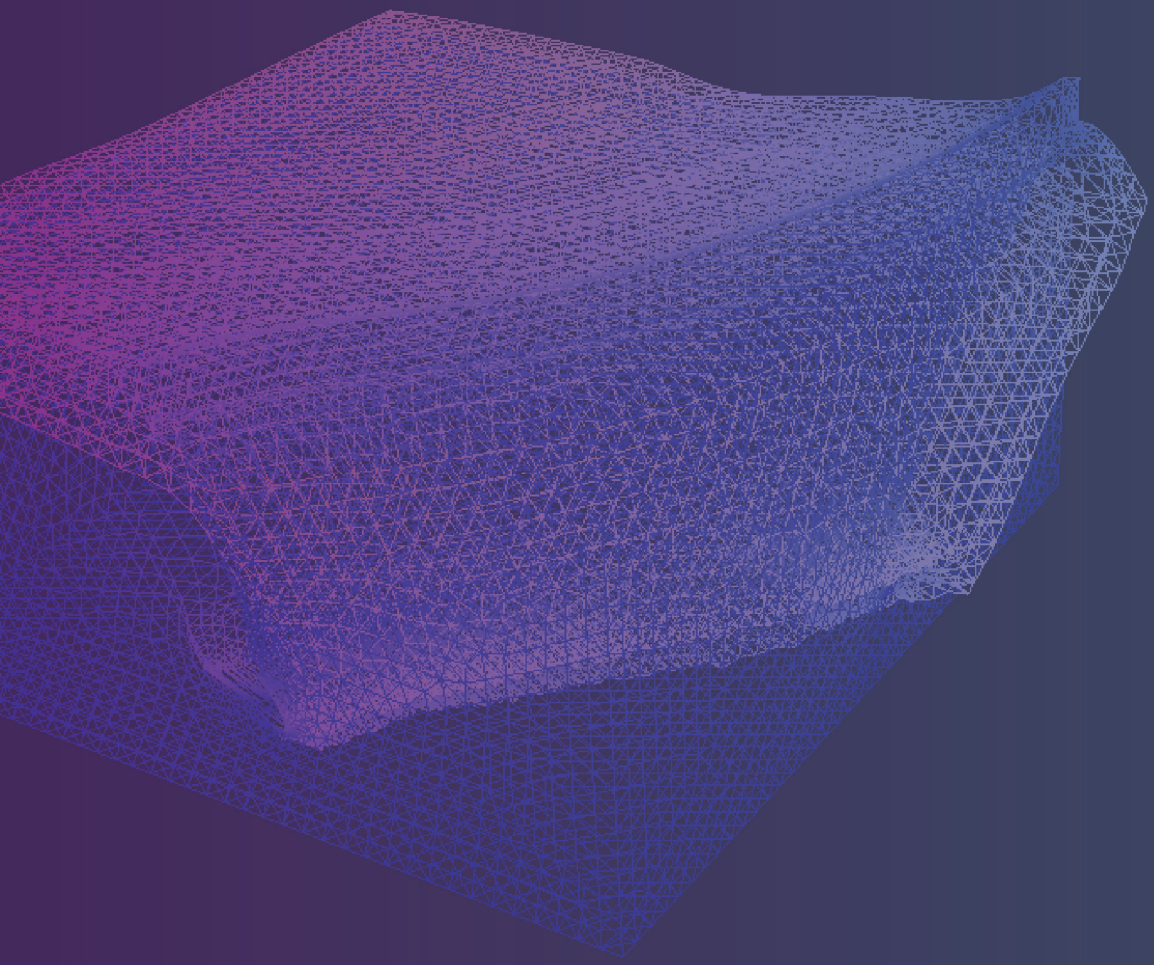
TEC PROJECTS

Project	Progress
3 Construction of a computational tool for the analysis of public health strategies for dengue in Costa Rica	This project explored the variables that are usually associated with dengue epidemics in our country. Dozens of variables were analyzed, coming from open data repositories. A correlation analysis of these variables was made, and it was found that two of them present a strong relationship with the reported cases. From there, different data visualizations and the extension of a base model were elaborated to include the new variables. This project was carried out in collaboration with scientists from the Center for Research in Pure and Applied Mathematics (CIMPA) of the UCR.
4 Development and application of a computational tool for the detection and automatic location of earthquakes in Costa Rica through deep learning techniques and Big Data	A workflow based on deep learning tools was built for the analysis of large amounts of seismological data. In collaboration with scientists from UNA's Volcanological and Seismological Observatory of Costa Rica (OVSICORI), neural network models were implemented that have been successful in detecting seismic events from global data to be applied in the country's seismic record. It was found that these models have a high potential to generate new information about seismic events and to better explain seismological phenomena in specific regions.

INTERNAL PROJECTS

Project	Progress
5 Cas genome (Psidium friedrichsthalium) assembly and annotation for the search of polyphenols of biotechnological interest	Cas (Psidium friedrichsthalianum) is a tropical tree species of the Myrtaceae family and is considered an autochthonous crop in Costa Rica with unexploited characteristics as a functional food. This species has not been fully domesticated and can be found in home gardens, paddocks, small groups, and, more recently, in small and medium plantations. In this study, we sought to achieve the first draft of Cas genome assembly using hybrid assembly and its structural annotation of genetic models. The results of this study provide an overview of the first draft of the Cas genome assembly and its bioprospecting potential. This new genomic resource represents the basis for exploring the genetic potential of this crop with functional food characteristics.
6 Machine Learning applied to bioacoustic recognition of tropical birds	This project consists of applying deep learning models to detect and classify different species of tropical birds in the country. For this, there are audio files from repositories such as the UNED BioSonidos - Collection of Nature Sounds, which must be explored and processed for analysis. It is sought, therefore, that the research serves as an input to assess the state of biodiversity conservation and to detect possible changes in the natural environment.
7 Programmatic analysis of GPU performance data	In this project, a tool was built to collect performance data on program executions on computer architectures that include graphics processing cards (GPUs). This data is then processed programmatically so that it can be analyzed repeatedly as the user of the system formulates the questions. These questions are asked by programming in a high-level language, and this allows scrutiny of data derived from initial analyses.
8 Industry Project 4.0	The project that bears the name “Revol-U-tionizing a look at university profiles on the way to industry 4.0”, is a collaboration between the Advanced Computing Collaboratory and the CONARE National Observatory of Professionals. The main objective is to determine the probability of automation of university degrees according to professional profiles through computational tools. This is achieved with the support of the computer infrastructure and the data analysis experience that CNCA professionals have. During this stage of the project, a database was built to consolidate the skills and competencies of the majors of the state universities, to then extract these characteristics from the documents provided by the universities for each career. From there, it is possible to calculate the present value of each of the skills and competencies to finally carry out the calculation of the probability of automation of each element to be reflected in a general way for each race.





INTERNAL PROJECTS

Project	Progress
9 Cellular image processing and analysis	The project consists of the development of a visual learning system that can carry out a semantic segmentation of cellular structures known as microvilli by detecting and quantifying the associated geometric patterns in microscopic images. Also, computer vision techniques, image processing, and machine learning are being used. This is with the purpose of analytically identifying the microvilli that may be related to deficiencies in living organisms, which would allow eventual diseases to be detected at the cellular level, recognizing their implications, and thus determining how to attack the diseases.
10 Improvement of the Kabré computing platform	Currently, having a high-performance computing infrastructure that can be used by researchers and academics, allows for greater advances in different projects that require it, thus saving time and resources for the institutions that make use of it. The main goal of this project is to optimize and refine the current services provided by the Kabré computing platform, as well as to add others that allow more efficient use of it, so that users who use it notice a significant improvement, thus leading to much more extensive use of it.

PRIVATE-FUNDED PROJECTS

	Project	Progress
11	Central American Network for Epidemiological Data Management	This network was funded by the International Development Research Centre (IDRC) of Canada, through a call for scientific networks from CSUCA and SICA. The project had the participation of more than 40 members, from more than 12 countries in the Latin American region. The network forged a community of researchers, professionals, and specialists in different areas of epidemiological data management. The theme involves experts from areas such as computer science, epidemiology, medicine, statistics, mathematics, and others. Seminars, courses, panels, and discussion spaces were organized.
12	Urban vehicular mobility with Waze.	This project seeks to analyze and understand vehicular mobility patterns from the traces of the Waze platform database. In cooperation with The State of the Nation Program (PEN), a platform was built to automatically download Waze data in real-time and a workflow to clean that database, leaving a format that is clear and efficient for its post-processing.
13	RISC2: A network for supporting the coordination of Computing research between Europe and Latin America	This project is funded by the European Commission with the aim of strengthening the cooperation bridges between Europe and Latin America on advanced computing issues. It seeks to develop training in high-performance computing technologies and methodologies, approaches with local governments for the development of public policy on relevant issues, scientific and technical exchange activities, and collaborations for the development of joint proposals for research projects.
14	NatGEO (Development of three technological tools for marine ecology and its application on the Antillean manatee in Costa Rica)	This project is about the development and implementation of an algorithm that can detect either the presence or absence of manatees in audio recordings, by analyzing the vocalizations of these mammals. It uses neural networks and subsequently counts the number of individuals present, with techniques for grouping the acoustic attributes of the identified tunes. This project aims to increase the ecological and ecosystem knowledge of these marine mammals, thus determining points of interest of manatees, their navigation patterns, and their populations on the Caribbean coast of our country to eventually elaborate strategies and actions in favor of manatee conservation.





PRIAS
LABORATORY

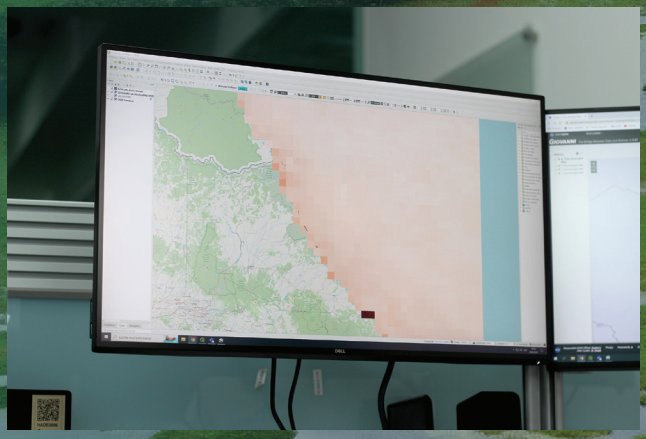
PRIAS

PRIAS
Annual Operating Plan
(CeNAT-CONARE) 2022



INDICATORS	DISTRIBUTION OF GOALS		
	Public	Private	Total
Scientific publications - Dissemination	2	18	20
Knowledge transfer activities	10	1	11
Research projects	7	4	11
Attention to students	14	2	16
Agreements	1	0	1

Introduction



PRIAS is comprised of a team of professionals from different areas of science. Its laboratory maintains a close relation with institutions of the public and private academic sectors, both nationally and internationally, for the promotion of scientific research and transfer of knowledge. This is achieved through the acquisition, treatment, storage, analysis, representation, and dissemination of information in areas of Photogrammetry, Remote Sensing, Geographic Information Systems, Global Positioning System, Spatial Data Infrastructure, Geodesy, and Computer Science, which constitute the discipline of Geomatics.

Attached as a Laboratory to the Centro Nacional de Alta Tecnología (CeNAT), PRIAS is a program of the Consejo Nacional de Rectores (CONARE). It conducts the promotion and development of scientific research activities in various fields.

The activities carried out during the year 2022 showed achievements and important progress made in the seven major areas of Geomatics mentioned above and with applications to Earth Observations, as well as the linkage with the academic-public-private sector.



Development Goal

To develop geospatial research to contribute to gain knowledge of the Costa Rican territory and the achievement of the Sustainable Development Goals, thus enabling a contribution in decision-making, through specialized scientific-technical assistance projects that empower improvement in the academic, socioeconomic, and environmental areas in the region.



Mission Statement

We are a geospatial research laboratory made up of a specialized team of professionals who work with the highest scientific standards in earth observation, articulated with higher education in Costa Rica and international cooperation, within the framework of innovation with the public, private, and social sectors.

Vision Statement

We aim to be a self-sustaining scientific research laboratory with high impact on decision-making both nationally and internationally to strengthen geospatial innovation, by transferring technical and scientific knowledge at the academic, socioeconomic, and environmental levels.



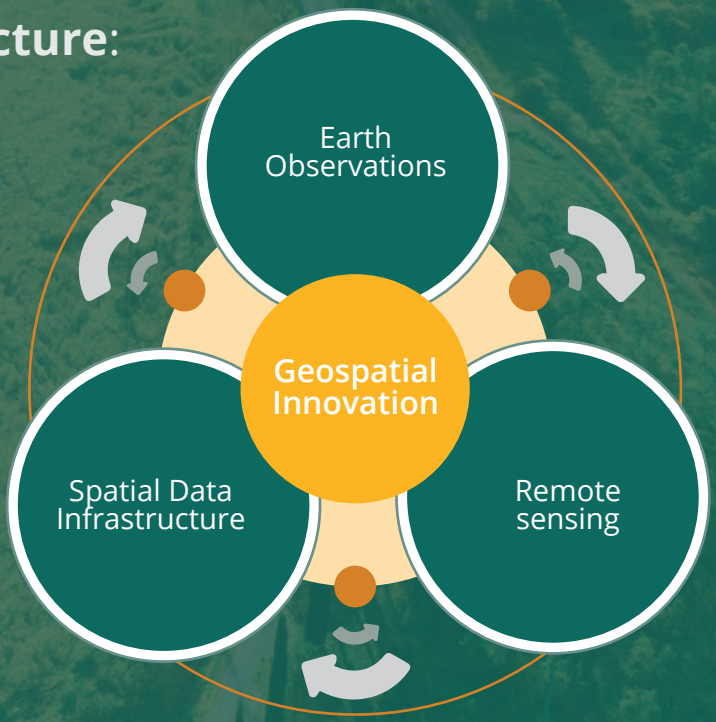
Values

- Empathy in collaborative work.
- Willingness to multidisciplinary learning.
- Creativity to face improvements.
- Commitment to the goals set in each project.

Principles

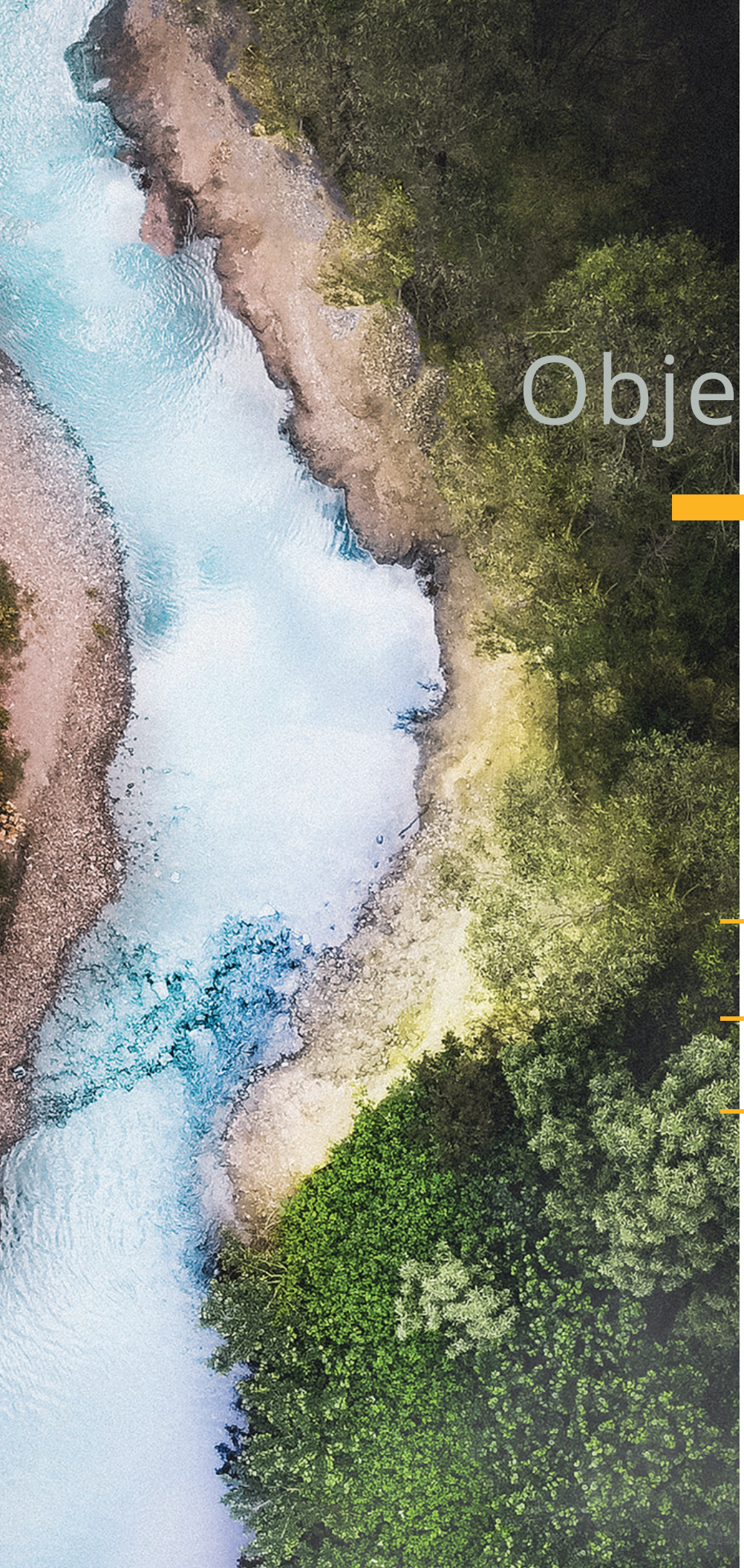
- Efficient use of technological infrastructure.
- Interdisciplinary collaborative work.
- Knowledge transfer adapted to populations.
- Willingness for constant improvement of the projects that are undertaken.

Operational **Structure**:



Strategic Axes

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



Objectives

To position the image of the laboratory through the establishment of strategic alliances that allow for services and scientific-technological exchange.

To attract additional resources for the development of research and innovation at PRIAS Laboratory.

To improve the internal processes of the PRIAS Laboratory on geospatial data management.

To increase the operational capacities at the PRIAS Laboratory, for the maintenance of a culture of continuous improvement.



Strategic **Nodes**

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



Impact **Indicators**

Publications

1	Indexed
1	No indexed
18	Specialized
20	TOTAL



Knowledge **transfers**

5 Workshops

- Lecture on Productive Chains.
- Workshop - Instrumentation for understanding the light reflectance in trees of the Mesoamerican tropics.
- Specialized workshop - "Introduction to the use of the Google Earth Engine platform" (UNED students).
- Specialized workshop - "Introduction to the use of the Google Earth Engine platform" (UCR students).
- Completion workshop of the MONEO-WET project.

6 Participations

- Presentation - "Use of technological tools for decision-making on restoration and ecosystem conservation subjects."
- Lecture - "Using the UN Biodiversity Lab to Monitor the Pulse of the Planet".
- Presentation - “Application of earth observations as a management tool for productive landscapes and tree cover in Costa Rica”.
- Lecture - “Copernicus User Uptake workshop series on managing natural resources”.
- Ibero-American Night of Researchers.
- Presentation at the international topography congress - “MOCUPP as a technological tool in the Monitoring of productive landscapes in Costa Rica”.

11 Total **250** People benefited



Research **Projects**

7 **Public :**

- 4 Internal
- 2 PEN
- 1 Operational PRIAS CeNAT

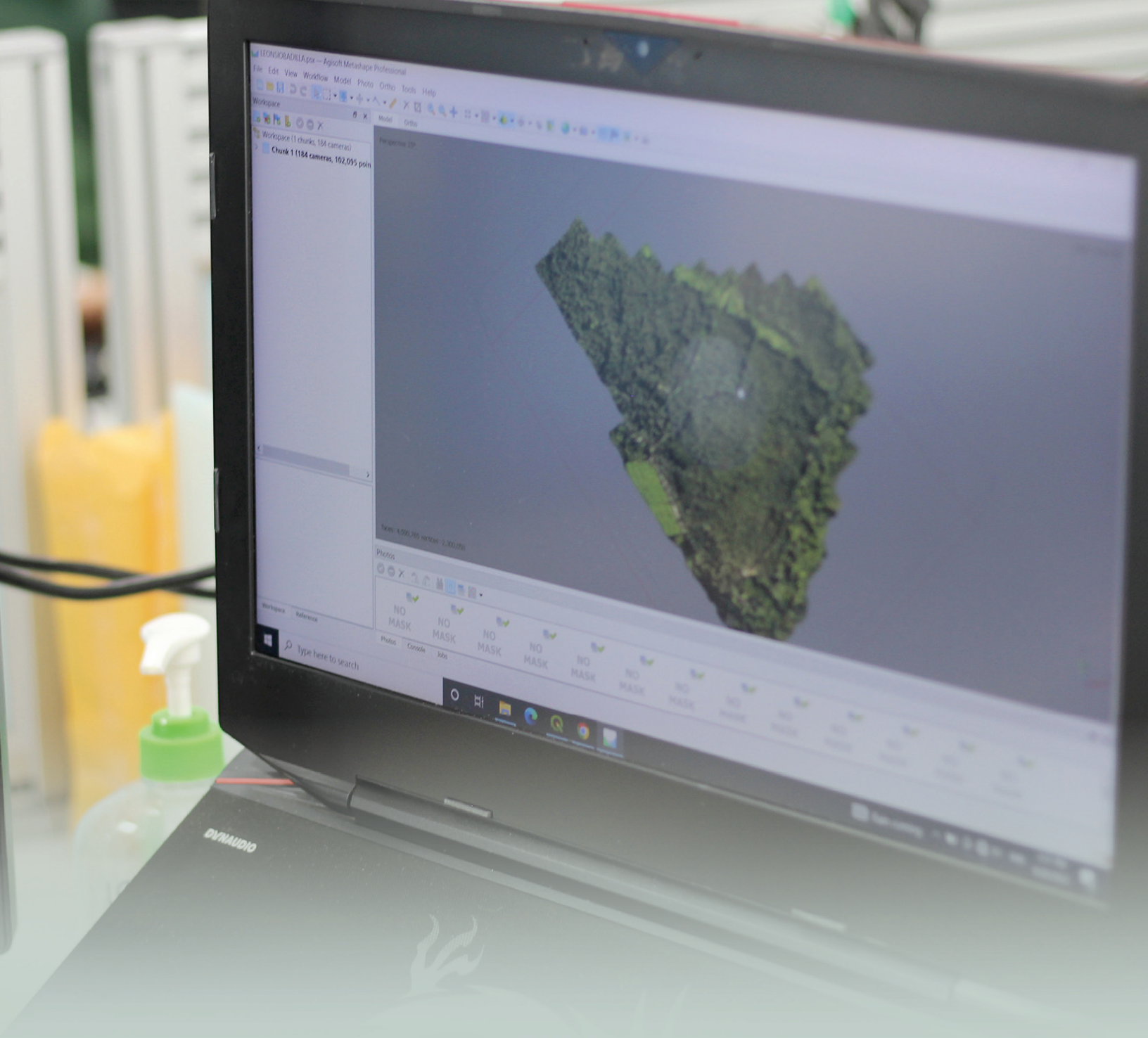
4 **Private:**

- 3 Other funds
- 1 CONICIT funds

11 **Total**

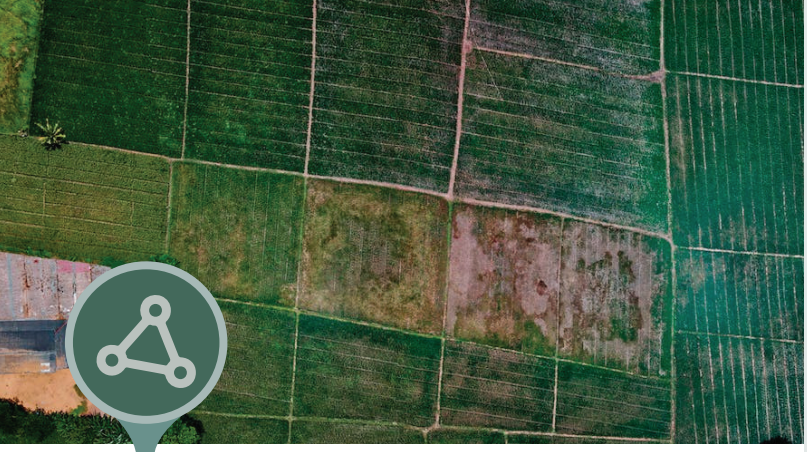
11 **Projects under negotiation:**

- Candidacy of the laboratory in the FAO Awards 2022, in the Partnership category (https://www.fao.org/fao-awards/partnership/about/es), with the Change in Use of Productive Landscape Monitoring (MOCUPP) project.
- Classification and updating of life zones as adaptive technological tools for decision-making boosting, with a focus on climate change adaptation in the Central American and Caribbean region (Trilateral Cooperation Instrument Brazil, European Union, Germany (Regional Fund)). Funded by GIZ.
- Commitment in the "Design of Cases", to Financial Agents of Banco Popular.
- Holdridge Life Zones Update, CCT.
- CoopeAgri.
- Development of a grass crop classification model based on spectral variables using satellite and aerial images. Funded by CAF.
- DISCOVERY “Designing a model to predict manatee habitat using remote sensing techniques combined with monitoring of manatee presence in Costa Rica”.
- Pan American Woods.
- CONARE-DFG research projects (module 2): Generation of synthetic training data for improvement of marine wildlife detection in remote sensing images.
- Rolex Awards, “Design of a marine spatial zoning system for the Golfo Dulce, in Costa Rica”.
- WAITT FOUNDATION “Marine Mammals from space: obtaining the spectral signatures of the Antillean Manatee and the humpback whale as a basis for developing a remote monitoring methodology using satellite images”.



Attention to **Students**

- **11** Scholarships
- **1** Interns
- **2** Final Graduation Works
- **2** Assistant Students
- **16** **TOTAL**



Linkages

6 National Academic **Sector**

- Professional and Vocational Technical High Schools.
- Costa Rica Institute of Technology.
- University of Costa Rica.
- State Distance Education University.
- National University of Costa Rica.
- National Technical University.

37 International universities **or institutes**

- United States Agency for International Development (USAID).
- Central American Aeronautics and Space Association (ACAE).
- Inter-American Development Bank (IDB).
- Boston University.
- German Aerospace Center (DLR)
- Copernicus Reference Center of the University of Chile.
- European Commission.
- Community of Latin American and Caribbean States (CELAC).
- Global Environment Facility (GEF).
- Georgia University.
- Global Fishing Watch.
- Government of Ecuador.
- Google Earth Engine.
- Gordon and Betty Moore Foundation.
- National Aeronautics and Space Administration (NASA).
- National Geographic Society.
- Natural Capital Project.
- United Nations (UN).
- Food and Agriculture Organization of the United Nations (FAO).
- Organization for Economic Cooperation and Development (OECD).
- United Nations Development Program (UNDP).
- Secretariat for Central American Economic Integration (SIECA).
- Secretariat for the Group on Earth Observations (GEO).
- United States Forest Service.
- United States Geological Survey (USGS).
- Silvacarbon.
- Central American Integration System (SICA).
- Regional Visualization and Monitoring System (SERVIR).
- German Society for International Cooperation (GIZ).
- System for Earth Observations, Data Access, Processing & Analysis for Land Monitoring (SEPAL).
- UNDP Biodiversity Lab.
- International Union for Conservation of Nature (IUCN).
- Fairbanks University.
- University of Mayland.
- Stanford University.
- University of British Columbia.
- Waitt Foundation.

55 National Universities or Institutes

- Aqueduct and Sewer Institute (AyA).
- Central Bank of Costa Rica (BCCR).
- Banco Popular.
- National Chamber of Palm Producers (CANAPALMA).
- National Chamber of Pineapple Producers and Exporters (CANAPEP).
- Tropical Agricultural Research and Higher Education Center (CATIE).
- Center for Research and Training in Public Administration (CICAP).
- Agronomical Research Center (CIA)
- National Center for Geoenvironmental Information (CENIGA).
- National Commission for Risk Prevention and Attention to Emergencies (CNE).
- National Commission for Biodiversity Management (CONAGEBIO).
- National Power and Light Company (CNFL).
- Consejo Nacional de Rectores (CONARE).
- National Council for Scientific and Technological Research (CONICIT).
- Comptroller General of the Republic (CGR).
- Regional Agricultural Cooperative of Milk Producers (COOPELECHE).
- Livestock Corporation (CORFOGA).
- Water Directorate.
- Climate Change Directorate (DCC).
- Environmental Quality Management Directorate (DIGECA).
- General Directorate of Civil Aviation (DGAC).
- National Forest Financing Fund (FONAFIFO).
- Costa Rican Institute of Electricity (ICE).
- Costa Rican Institute of Fisheries and Aquaculture (INCOPESCA).
- Costa Rican Coffee Institute (ICAFE).
- National Geographic Institute (IGN).
- National Geographic Institute (IGN).
- Inter-American Institute for Cooperation on Agriculture (IICA).
- National Meteorological Institute of Costa Rica (IMN).
- National Learning Institute (INA).
- 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 Science, Technology, and Telecommunications (MICITT).
- Ministry of Foreign Trade (COMEX).
- Ministry of Economy, Industry, and Commerce of Costa Rica (MEIC).
- Ministry of the Presidency.
- Ministry of Housing and Human Settlements (MIVAH).
- Municipality of Garabito.
- Municipality of San José.
- Volcanological and Seismological Observatory of Costa Rica (OVSICORI).
- State of the Nation Program (PEN)
- SIRGAS Network (Geocentric Reference System for South America).
- Seismological Network.
- 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).
  State Phytosanitary Service.
- National System of Territorial Information (SNIT).
- National Monitoring System for Land Cover and Use and Ecosystems (SIMOCUTE).
- Administrative Environmental Court (TAA).
- CENFOTEC University (Training Center in Information and Communication Technologies).
- Latin American University of Science and Technology (ULACIT).
- Vice Ministry of Water and Oceans.

7 International **Companies**

- Earth Blox.
- EO Data Science.
- Pacific Scientific Institute.
- Microsoft Corporation.
- Picturatus.
- Planet Inc.
- Yamaha Marino.

8 National **companies**

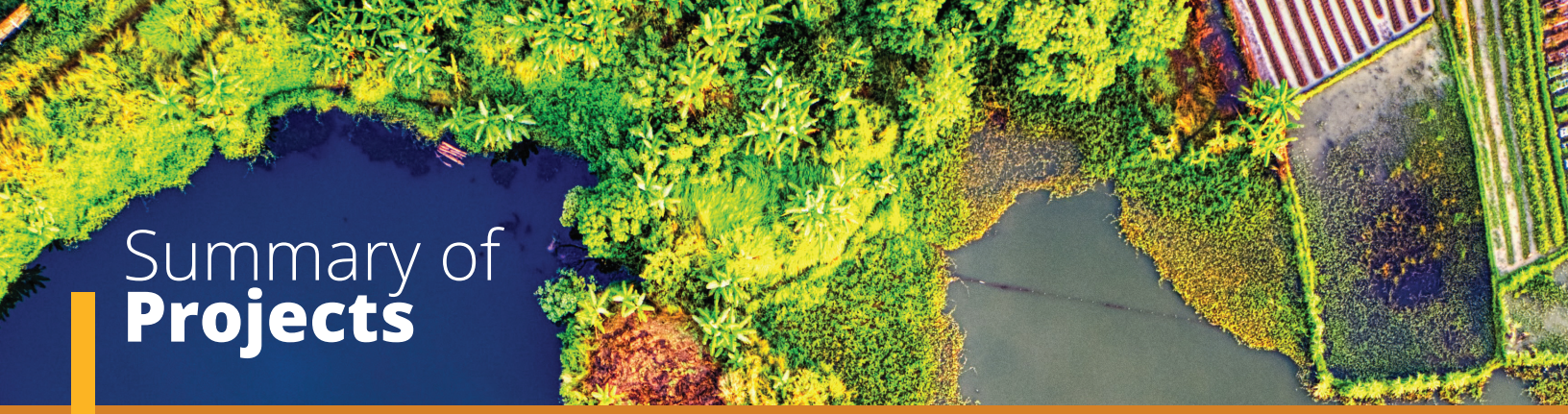
- Aeronautical Education Academy (AENSA).
- Geotecnologías S.A.
- Kölbi.
- Manejo Técnico Ambiental MTA S.A.
- MTF Teca Ltda.
- PALMA TICA.
- Panamerican Woods Plantations S.A.
- Pineapple Development Corporation (PINDECO).



Agreements

1 International

- Letter of Understanding CeNAT - DLR.



Summary of **Projects**

PUBLIC FUNDS

Internal Projects

	Project	Progress
1	Internal project for implementation of distributed storage in GeoCenter	The purpose of the project is to take advantage of the GeoCenter resources to implement a distributed system of container orchestration technologies within the PRIAS data center. The aim of the project is the implementation of a distributed system for the automation of deployment, scaling, and management of containerized applications within the PRIAS data center.
2	Internal Spectral Signatures Project	The Spectral Signature Library project aims to develop a tool to enable the cataloging, managing, and sharing of spectral signature data collected in different internal and external research projects. Furthermore, it seeks to support research conducted in the country by supporting student interns, CeNAT-PRIAS fellows, or assistants. In addition, it collaborates in the generation of hyperspectral data information for institutions within the triple helix. This project is carried out in measuring crops of major socioeconomic relevance in several regions of the country, in different phases of crop development, and in developing research projects through collaborations with institutions or scholarship holders in spectral signature data research to enable the generation of data to feed the library.
3	Internal Implementation of Spatial Data Infrastructure PRIAS Project	The Spatial Data Infrastructure Implementation project aims to develop a spatial data infrastructure web implementation based on the optimization of the use of the GeoCenter to offer an array of services. This project seeks to implement an inventory system for laboratory assets, as well as to host and monitor the different GeoCenter services. It is also used to document the GeoCenter process and management guides in the PRIAS knowledge base.
4	Unmanned Aircraft for Research (UAV) Internal Project	The Unmanned Aircraft for Research (UAV) project aims to generate data for research through the use of UAVs and photogrammetry. This project seeks to support research conducted in the country by supporting student interns, the CeNAT-CONARE scholarship program, assistants, and PRIAS laboratory projects. In addition to collaborating in the generation of photogrammetric data information for institutions within the triple helix, the project also seeks to increase the generation and analysis capacities of photogrammetric data and aerial images.

PRIAS-CENAT OPERATIONAL PROJECT

Project	Progress
5 Operational PRIAS	The development of this project is linked to the fulfillment and development of the different indicators of the laboratory.

JOINT PROJECTS WITH THE STATE OF THE NATION PROGRAM (PEN)

Project	Progress
6 Local productive structures: productive and labor chains and territorial value chains in Costa Rica (PEN).	The purpose of the local productive structures project is "to build 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, to link it with other socio-environmental variables". For the project, the decrees or laws that created these territories are taken as a reference, in order to create a database that includes this first-hand information for the delimitation of these geographical spaces. In addition, as of 2022, SINAC provided a SEMEC database containing different metrics that were analyzed and segregated by Conservation Areas, which has served to establish a unique reference framework for the country that is endorsed by the National System of Conservation Areas (SINAC).
7 Cantonal Historical Geospatial Representation of Costa Rica period 1905-2014 (pen), a Project with State of the Nation Program (PEN)	This project aims to construct the spatial representation in the form of geographic information layers to enable the reproduction of the Territorial Administrative Division of Costa Rica for the periods 1905, 1950, 1963, 1973, 1984, and 2014. Since 2018, a series of publications have been made in the National Territorial Information System (SNIT), using information from the agricultural censuses of the years 1905, 1963, 1973, 1984, and 2014. In the year 2019, the layers for the years 1867, 1888, and 1927 were included. And in the years 2021 and 2022, with supplementary information, agricultural and livestock farming products such as Beekeeping, Rice, Bananas, Cocoa, Coffee, Cane, Pigs, Beans, Cattle, Corn, Potato, and Pineapple were extracted. This information has been useful not only to understand how the territorial distribution of Costa Rica was made up for the years described but also in the agricultural crops that were cultivated.



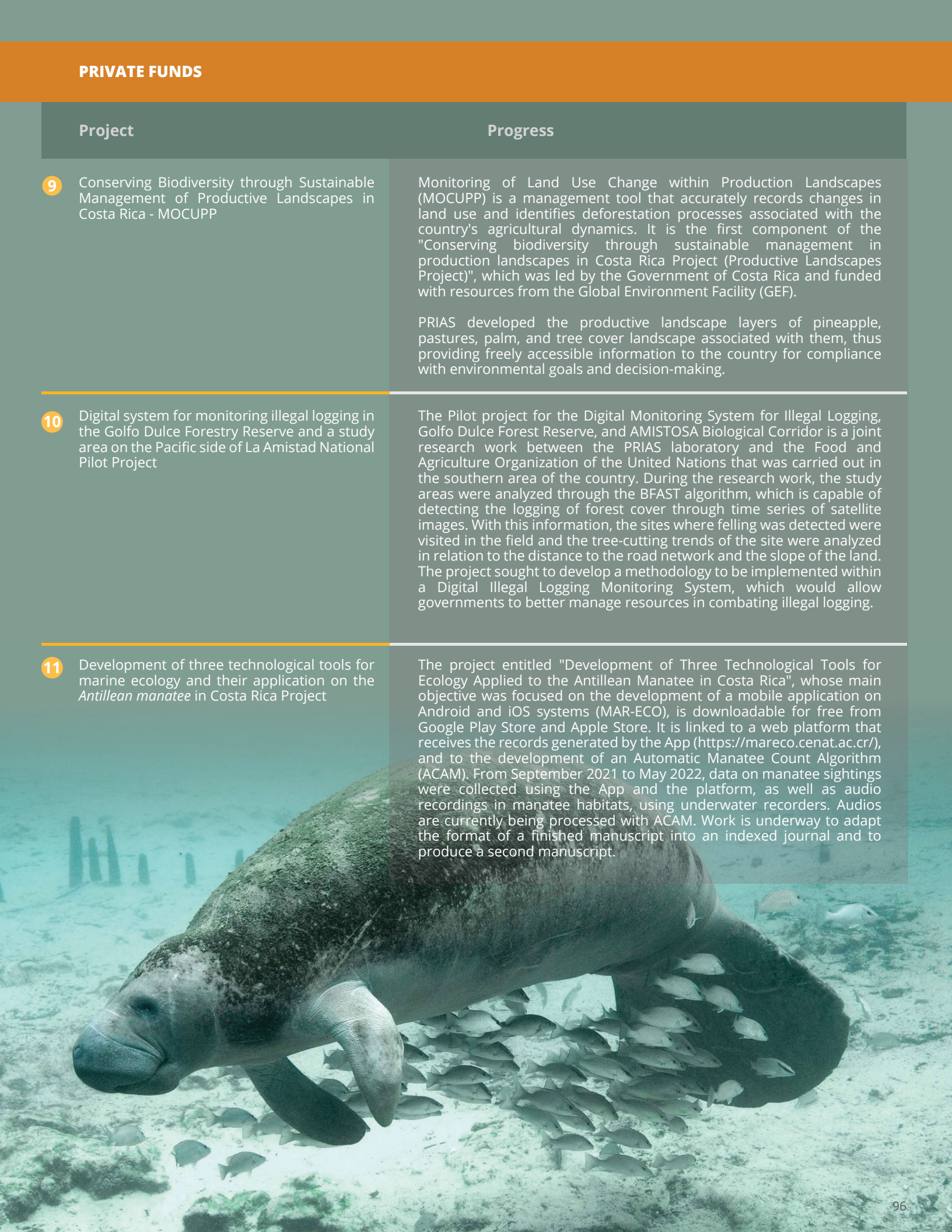


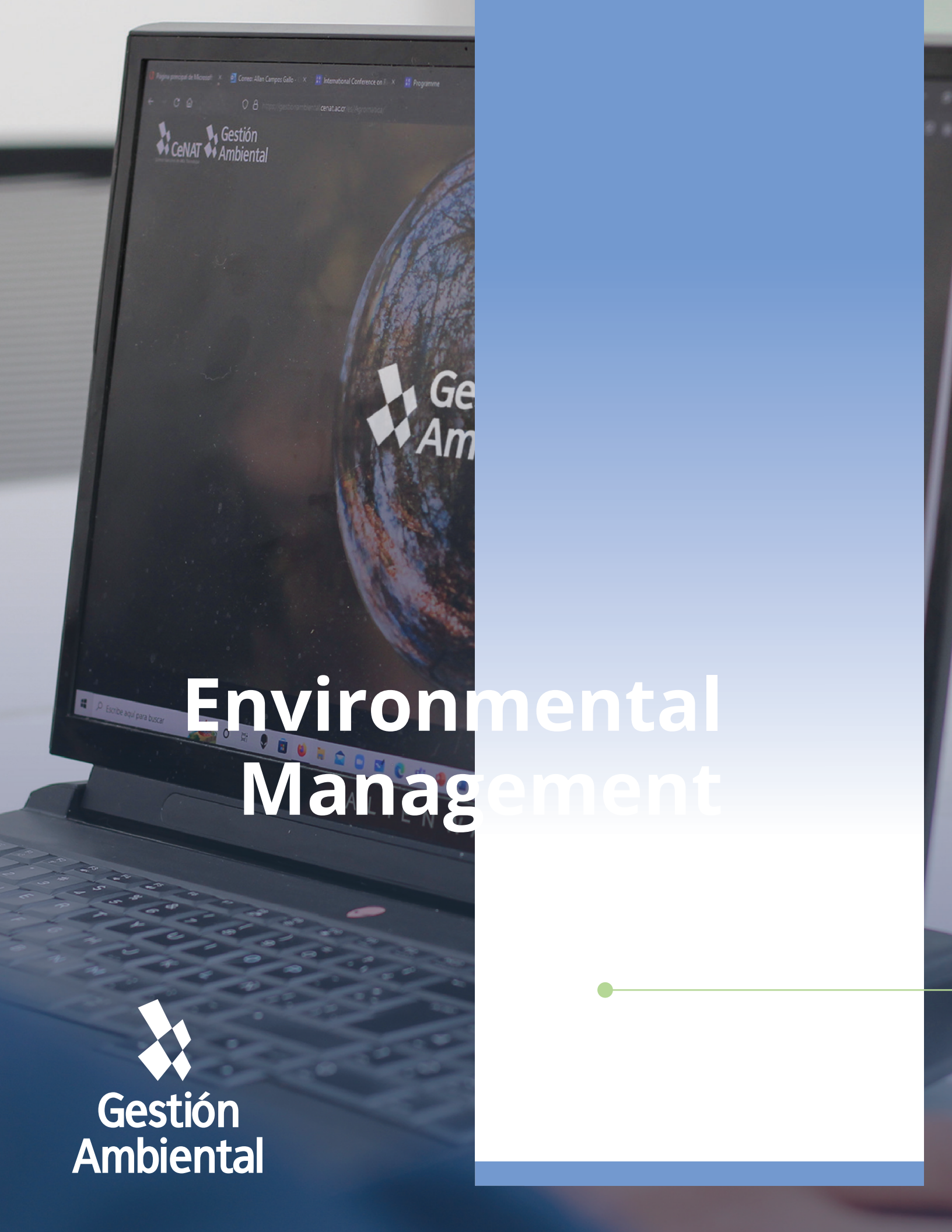
CONICIT-FUNDED PROJECTS

Project	Progress
8 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).	The MONEO-WET project is a joint research work between the PRIAS laboratory and the German Aerospace Agency. It was carried out in the Térraba-Sierpe National Wetland, where, through spectral signatures, satellite images, laboratory samples, and bio-optical equations, various indicator components of water quality were quantified in the wetland, including total suspended matter, dissolved organic matter, and chlorophyll. The project sought to adjust the parameters of the bio-optical equations with information from the tropical water bodies in the wetlands, in order to develop a methodology to generate distribution maps of the water quality variables, and in this way, to promote the development of an environmental monitoring system for water bodies.

PRIVATE FUNDS

Project	Progress
9 Conserving Biodiversity through Sustainable Management of Productive Landscapes in Costa Rica - MOCUPP	Monitoring of Land Use Change within Production Landscapes (MOCUPP) is a management tool that accurately records changes in land use and identifies deforestation processes associated with the country's agricultural dynamics. It is the first component of the "Conserving biodiversity through sustainable management in production landscapes in Costa Rica Project (Productive Landscapes Project)", which was led by the Government of Costa Rica and funded with resources from the Global Environment Facility (GEF). PRIAS developed the productive landscape layers of pineapple, pastures, palm, and tree cover landscape associated with them, thus providing freely accessible information to the country for compliance with environmental goals and decision-making.
10 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	The Pilot project for the Digital Monitoring System for Illegal Logging, Golfo Dulce Forest Reserve, and AMISTOSA Biological Corridor is a joint research work between the PRIAS laboratory and the Food and Agriculture Organization of the United Nations that was carried out in the southern area of the country. During the research work, the study areas were analyzed through the BFAST algorithm, which is capable of detecting the logging of forest cover through time series of satellite images. With this information, the sites where felling was detected were visited in the field and the tree-cutting trends of the site were analyzed in relation to the distance to the road network and the slope of the land. The project sought to develop a methodology to be implemented within a Digital Illegal Logging Monitoring System, which would allow governments to better manage resources in combating illegal logging.
11 Development of three technological tools for marine ecology and their application on the *Antillean manatee* in Costa Rica Project	The project entitled "Development of Three Technological Tools for Ecology Applied to the Antillean Manatee in Costa Rica", whose main objective was focused on the development of a mobile application on Android and iOS systems (MAR-ECO), is downloadable for free from Google Play Store and Apple Store. It is linked to a web platform that receives the records generated by the App (https://mareco.cenat.ac.cr/), and to the development of an Automatic Manatee Count Algorithm (ACAM). From September 2021 to May 2022, data on manatee sightings were collected using the App and the platform, as well as audio recordings in manatee habitats, using underwater recorders. Audios are currently being processed with ACAM. Work is underway to adapt the format of a finished manuscript into an indexed journal and to produce a second manuscript.





Environmental Management

Gestión Ambiental

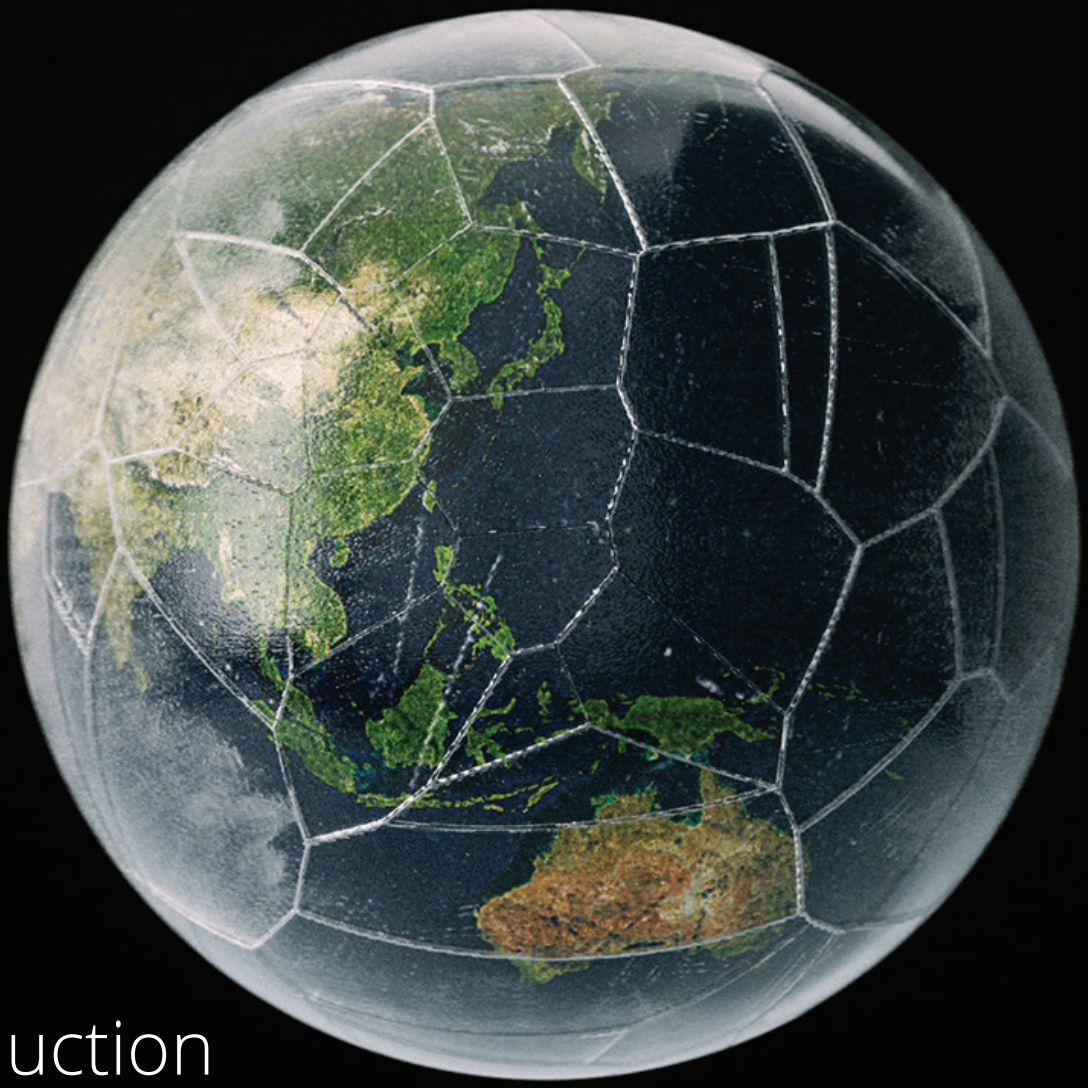
Environmental Management Area

Annual Operating Plan

(CeNAT-CONARE) 2022



INDICATORS	DISTRIBUTION OF GOALS		
	Public	Private	Total
Scientific publications - Dissemination	2	0	2
Knowledge transfer activities	15	5	20
Research projects	2	3	5
Attention to students	10	3	13
Agreements	1	0	1



Introduction

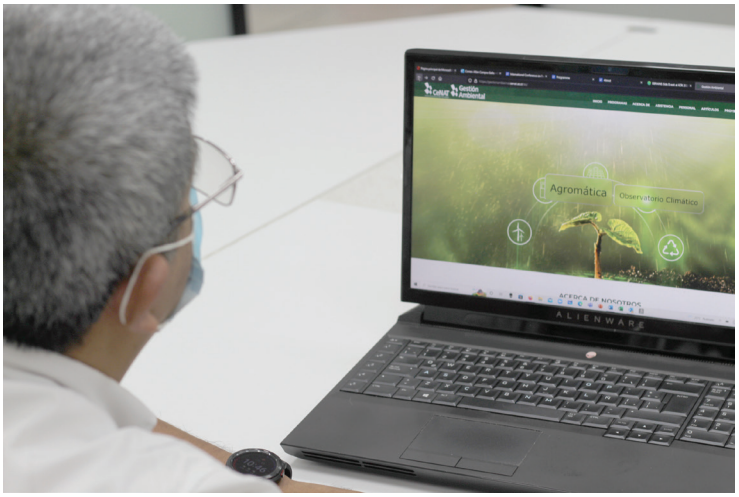
The Environmental Management Area links and articulates environmental, climatic and agromatic actions among the universities linked to CONARE, state institutions and the business sector. Topics include advisory and search for sustainable alternatives in productive processes, natural resources, best practices, academic and specialized training activities, research and applications of new environmentally friendly technology. This area is supported by Environmental Management representatives from UCR, TEC, UNA, UNED and UTN 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 based on the Sustainable Development Goals, 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 Statement

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 Statement

We aim to be a self-sustaining research area with high economic and social impacts 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

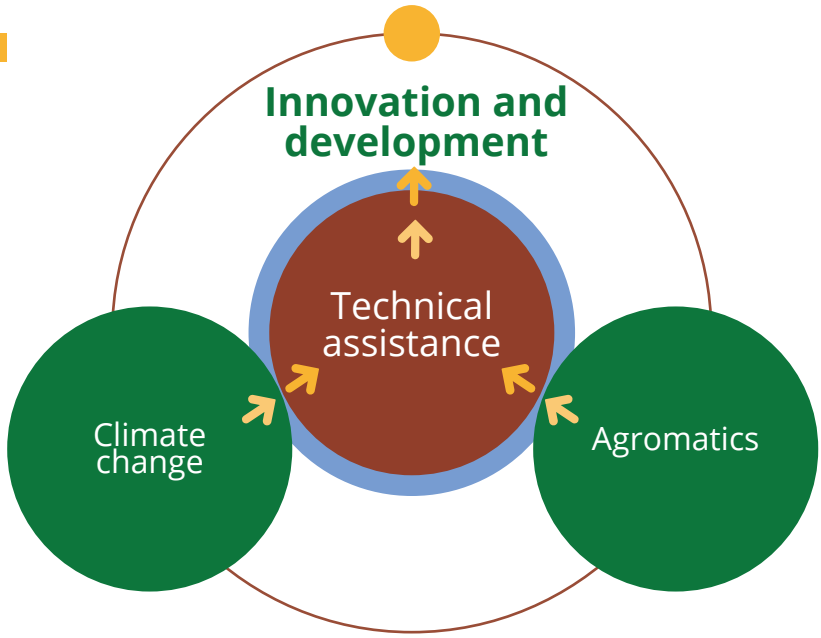
- Human team care.
- Support to food industry and productive support in continuous improvement.
- Collaborative management in the projects that are undertaken.
- Socialization of scientific information to society.

Principles

- 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**:



Development Objective of the **Environmental Management Area**

To manage effective links with different stakeholders of civil society, both nationally and internationally.

To implement technology tools for both access and dissemination of information

To increase knowledge in communities on environmental management matters.

To strive to the financial sustainability of Environmental Management.

Strategic **Nodes**

- 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**

Area **Direction**

The Coordination 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.

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

In addition -following instructions by CeNAT's General Directorate-, the Environmental Mannagement Area 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 advice of CeNAT's General Directorate-, we provide support to 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.



Thanks to the agreement signed between CeNAT and the National Meteorological Institute (IMN/MINAE), it was possible to serve several thousand producers and decision makers in a constant and efficient manner, not only from Costa Rica, but also from the entire Central American Region, contributing weather forecasts and reports on variability and climate change, using three key tools - PIACT's web page, 34 WhatsApp and Telegram chats, and a Facebook page.

As will be detailed later, these tools and CeNAT/CONARE - IMN/MINAE joint work allow, at different levels of interest and understanding, timely and adequate tactical and strategic decision-making, both for matters related to prevention and mitigation of atmospheric events, and for Central American agricultural production.

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.

2022 AOP **Strategic Actions**



The strategic Environmental Management actions developed during the year 2022 focused on the aforementioned programs and meet the needs and goals proposed in the 2016-2020 Environmental Management Strategic Plan. In addition, it included the delegations and assignments established by the General Directorate of CeNAT.



Impact **Indicators**

Publications

2 Specialized

Knowledge **transfers**

20 **TOTAL**

8 **Lectures**

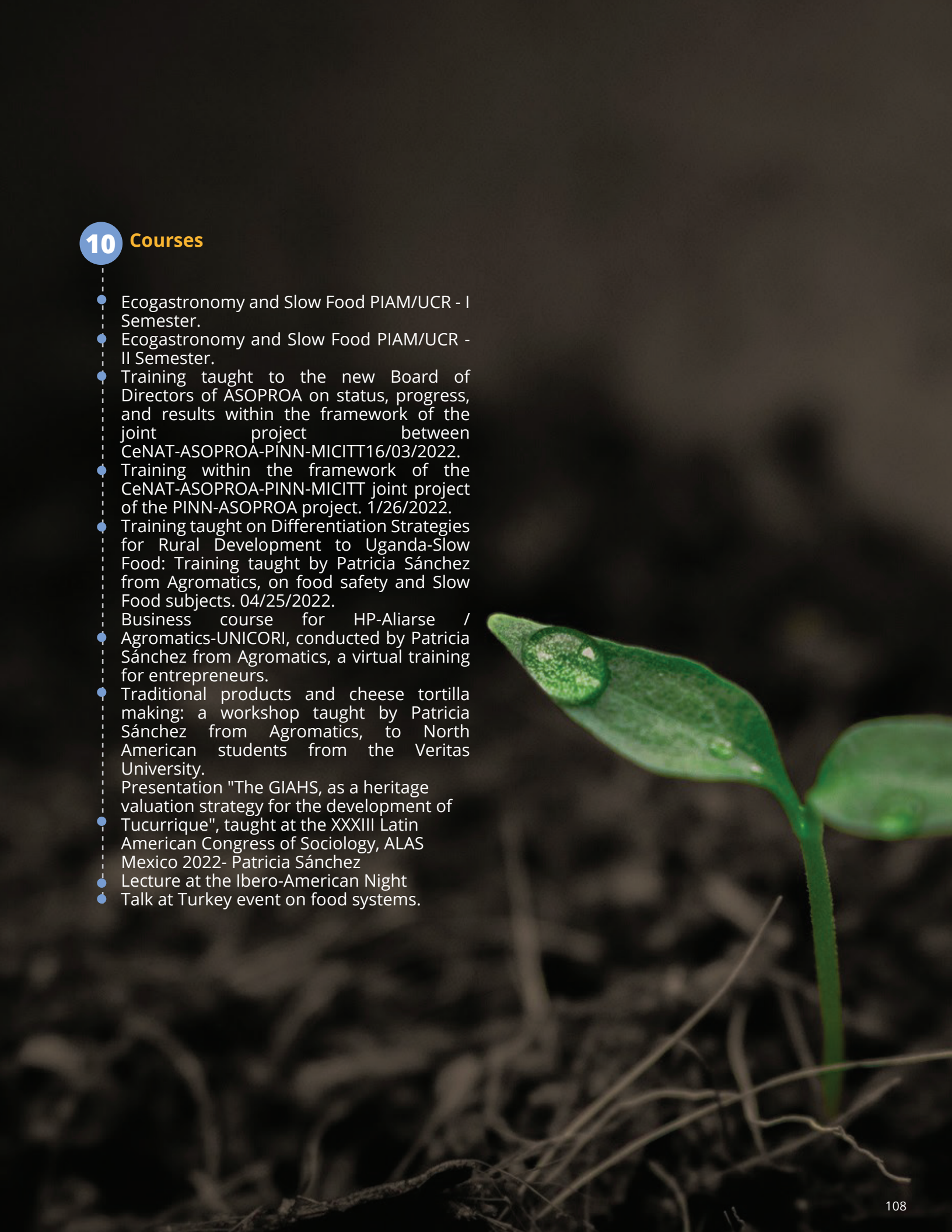
- Lecture about Mother Earth
- Lecture on the importance of conserving water resources
- Lecture - "Identification, conservation, and valuation of local and cultural products, as a territorial promotion strategy through a GIAHS / Important Systems of World Agriculture), with an orientation towards tourism". Patricia Sánchez.
- “Fossil fuels” Cinema Forum
- Lecture - "Wastewater"
- Lecture - "Clean energy"
- Lecture "Sustainable Purchases"
- Round table - Environmental compensation

2 **Workshops:**

- Workshop on composting preparation and process
- Climate Crisis Activism workshop

10 Courses

- Ecogastronomy and Slow Food PIAM/UCR - I Semester.
- Ecogastronomy and Slow Food PIAM/UCR - II Semester.
- Training taught to the new Board of Directors of ASOPROA on status, progress, and results within the framework of the joint project between CeNAT-ASOPROA-PINN-MICITT16/03/2022.
- Training within the framework of the CeNAT-ASOPROA-PINN-MICITT joint project of the PINN-ASOPROA project. 1/26/2022.
- Training taught on Differentiation Strategies for Rural Development to Uganda-Slow Food: Training taught by Patricia Sánchez from Agromatics, on food safety and Slow Food subjects. 04/25/2022.
- Business course for HP-Aliarse / Agromatics-UNICORI, conducted by Patricia Sánchez from Agromatics, a virtual training for entrepreneurs.
- Traditional products and cheese tortilla making: a workshop taught by Patricia Sánchez from Agromatics, to North American students from the Veritas University.
- Presentation "The GIAHS, as a heritage valuation strategy for the development of Tucurrique", taught at the XXXIII Latin American Congress of Sociology, ALAS Mexico 2022- Patricia Sánchez
- Lecture at the Ibero-American Night
- Talk at Turkey event on food systems.





People reached

- Lectures and Trainings: **2,500 people**
- PIACT Interactive Platform: **2,000 users**
- Facebook page: **45,000 people** reached monthly on average.
- **8,000 Technical assistances** to producers in variability and climate change
- WhatsApp/Telegram groups: **21 WhatsApp groups and 13 Telegram groups with an impact on 8,000 users from Costa Rica and 3,000 from the rest of Central America reached daily, at least once a day** (4 times a day during the tropical storm season).



Research Projects

5 TOTAL

2 Public

- Operational Environmental Management Project
- Antarctica project

3 Private

- PINN-ASOPROA Project: "Creation of the Comprehensive Quality Unit of the Turrialba Cheese Designation of Origin" PINN-MICITT.
- Earth Market Project.
- UPS Environmental Management Project.

Projects/Proposals Under Negotiation

- Desamparados Landfill Project
- Collaboration in joint proposals between Convivios Slow Food (Italy-Limón-San José-Mexico)
- Collaboration in project proposal "Study of Nutritional Factors that affect the quality of Turrialba cheese with Denomination of Origin in Costa Rica".

Sale of Services

Sale of Services:

- Project Manager in promotion and development of CeNAT-FunCeNAT-CONICIT Culture of innovation. Allan Campos.
- Project Manager in Atlas of Innovation. Allan Campos.

Attention to **Students**

CeNAT-CONARE Scholarships

3 CeNAT-CONARE Fellow students

Assistant Hours

9 Assistant students

High School student vocational practice

1 Student with vocational practice

13 TOTAL

Linkages

National Academic **Sector**

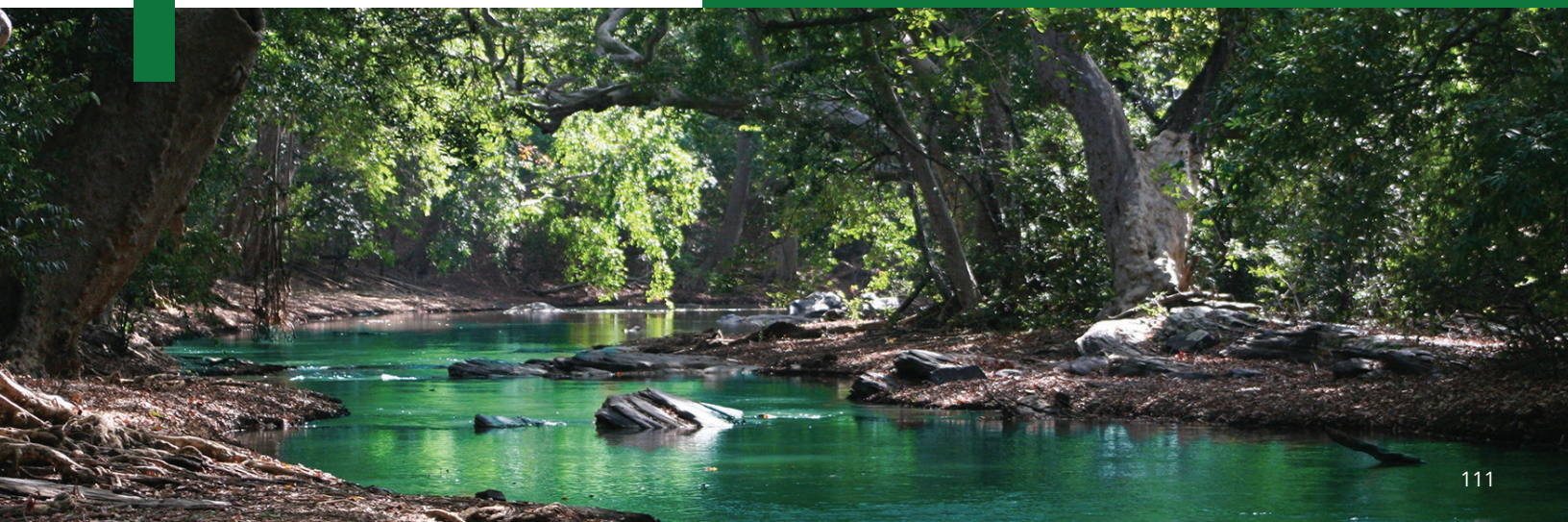
- Linkages with **5 public universities,** through research projects and/or collaboration.

International Universities **or Institutes**

- Scientific and Technological Research Council. TUBITAK-Turkey
- Toros University - Turkey
- Mondragon University, Spain.

International **Companies**

- ISEF Science Fair event in conjunction with the European Union
- UNA University in Nicaragua
- Organization of American States (OAS)
- National Association of Cattle Breeders (ANAGAN)
- Walmart Central America
- TRIFINIO Plan: organization of members of the borders of Honduras, Guatemala and El Salvador.
- Honduran National Radio
- Slow Food members from Uganda



National **Companies**

- Ministry of Agriculture and Livestock
- Repretel Channel 6
- Columbia Radio Station
- La Extra Newspaper
- Industrial Sugar Cane Chamber (LAICA)
- National Institute of Innovation and Transfer in Agricultural Technology (INTA)
- CACPROSA
- Farmer House (CASAGRI)
- Livestock Corporation (CORFOGA)
- Radio Santa Clara
- MICITT-CONICIT
- Ministry of Economy, Industry, and Commerce of Costa Rica (MEIC)
- Costa Rican Institute of Tourism (ICT)
- Ministry of Environment and Energy, Costa Rica (MINAE)
- Ministry of the Presidency
- National Learning Institute (INA)
- Ministry of Justice
- Banco Popular de Desarrollo Comunal (BPDC)
- ASOPROA
- Chamber of Industries of Costa Rica
- National Bank of Costa Rica (BN)
- Embassy of the Arab Emirates, Costa Rica
- Board of Pensions and Retirements of National Teachers (JUPEMA)
- National Meteorological Institute (IMN)



Agreements

1 National

- IMN-CeNAT Framework Collaboration Agreement



Summary of **Projects**

1 **Project**
OPERATIONAL ENVIRONMENTAL MANAGEMENT

Progress

The Environmental Management Area provides technological support and accurate, pertinent and timely information to more than 9,000 producers throughout Costa Rica and Central America. Subjects relate to climate variability and change, food security, Agromatics and the Slow Food global trend, for proper decision-making. It also supports research and development processes on the economic and nutritional added value of national producers, by advising and training producer associations.

Finally, Environmental Management promotes scientific vocations and provides support to student fellows, interns and other modalities to encourage the new generations.



2 Project ANTARCTICA

Progress

The Antarctica project is a historically fundamental milestone for Costa Rica, since it involves the development of a scientific mission from the Costa Rican Public Universities to Antarctica, traveling in a vehicle powered by clean energy, which is being developed at CeNAT, with the support and design of both researchers and university students.

3 Project UPS ENVIRONMENTAL MANAGEMENT

Progress

This project provides operational sustainability to various projects and programs, including the Interactive Platform for Tropical Change (PIACT), 21 WhatsApp groups and 13 Telegram groups, as well as the website of the Climate Observatory.

Furthermore, it allows hiring personnel and students who support projects of various kinds, in support of triple helix stakeholders, such as government entities, producers, and national and international consortiums, all related to sustainable development, clean energy and the environment.

4 Project EARTH MARKET

Progress

It conducts training and promotional activities for producers and farmers, in Tucurrique, Turrialba, and the Caribbean area, among other places in the country. It also develops the activity called "Mercado de la Tierra", which encourages the participation of chefs, artisans, and students, among other people, with the added value of local food and food security. Finally, it supports and participates in the Integrated Program for the Elderly (PIAM).



5 **Project**

"CREATION OF AN INTEGRAL QUALITY UNIT OF THE TURRIALBA CHEESE DESIGNATION OF ORIGIN",
PINN- ASOPROA-MICITT PROJECTS

Progress

This is a project funded by the PINN-BID Fund, to facilitate the development of an Integral Quality Unit (UCI) for the benefit of the Association of Agricultural Producers of Santa Cruz de Turrialba (ASOPROA SC), so that cheese producers in the Turrialba area can verify, firstly, the added value of their product, which has the Designation of Origin seal. In addition, it will become a self-sustaining instrument to validate the quality of the products offered by the producers in the area.



INSTITUTIONAL
RESULTS

SUPPORT IN **KNOWLEDGE TRANSFER**

In addition to its focus on research development, for LANOTEC is also essential to maximize work in extension and teaching, since we are concerned with developing and enhancing the promotion of scientific vocations 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 at different Science and Chemistry Olympiads, starting the process at the national level to select the representatives to participate at the events at the international level.



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

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

In 2022, the following activities were carried out at the international level:

- XV Central American and XIII Caribbean Chemistry Olympiad.
- XXVI Iberoamerican Chemistry Olympiad.
- 54° International Chemistry Olympiad.
- 19th International Junior Science Olympiad.

Because of the pandemic that is being faced worldwide, the organization of the International Chemistry Olympiad decided to carry it out online, using the Zoom and OlyExam platforms. This year, a step has been taken to return to face-to-face and the first face-to-face Olympics was the International Youth Science Olympiad.

XV Iberoamerican **Chemistry Olympiad**

The Olympiad was held in a mixed way, with the first exam taken virtually and the final one in person. In addition, category A students took a laboratory exam aimed at those who obtained the best grades in the final exam.

During this process, tests must be prepared and reviewed; there is participation at activities and contribution to logistics.

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.

For the 2022 Costa Rican Chemistry Olympiad, the distribution of participants was the following:





TOTAL **670**

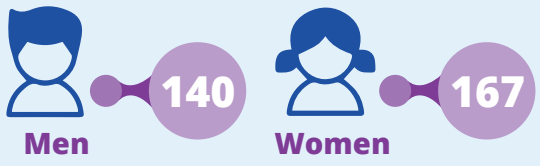
V Costa Rican **Science Olympiad**

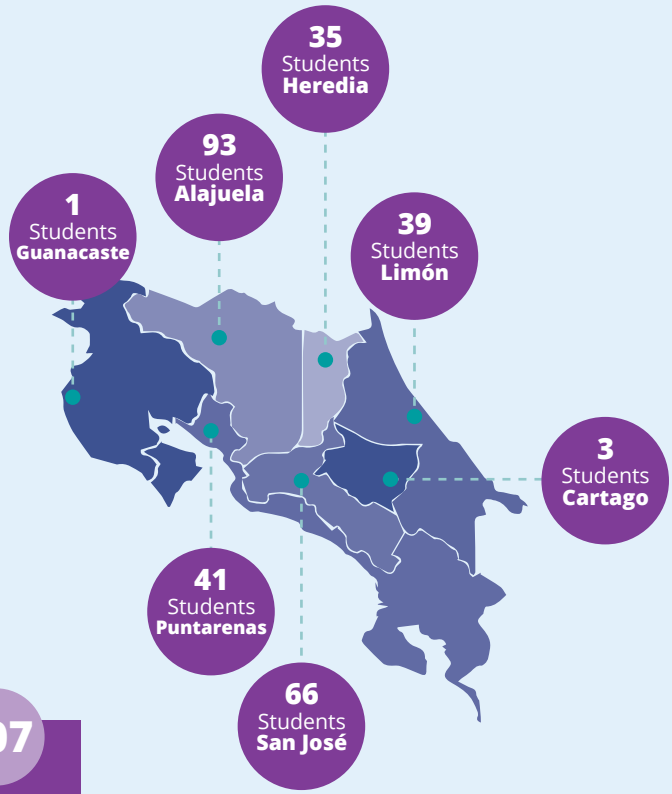
The Olympiad was held in a mixed way, with the first exam taken virtually and the final one in person. In addition, a laboratory internship was carried out with the students who obtained the best grades in the final exam. In this internship, students carried out laboratory practice and after that, they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

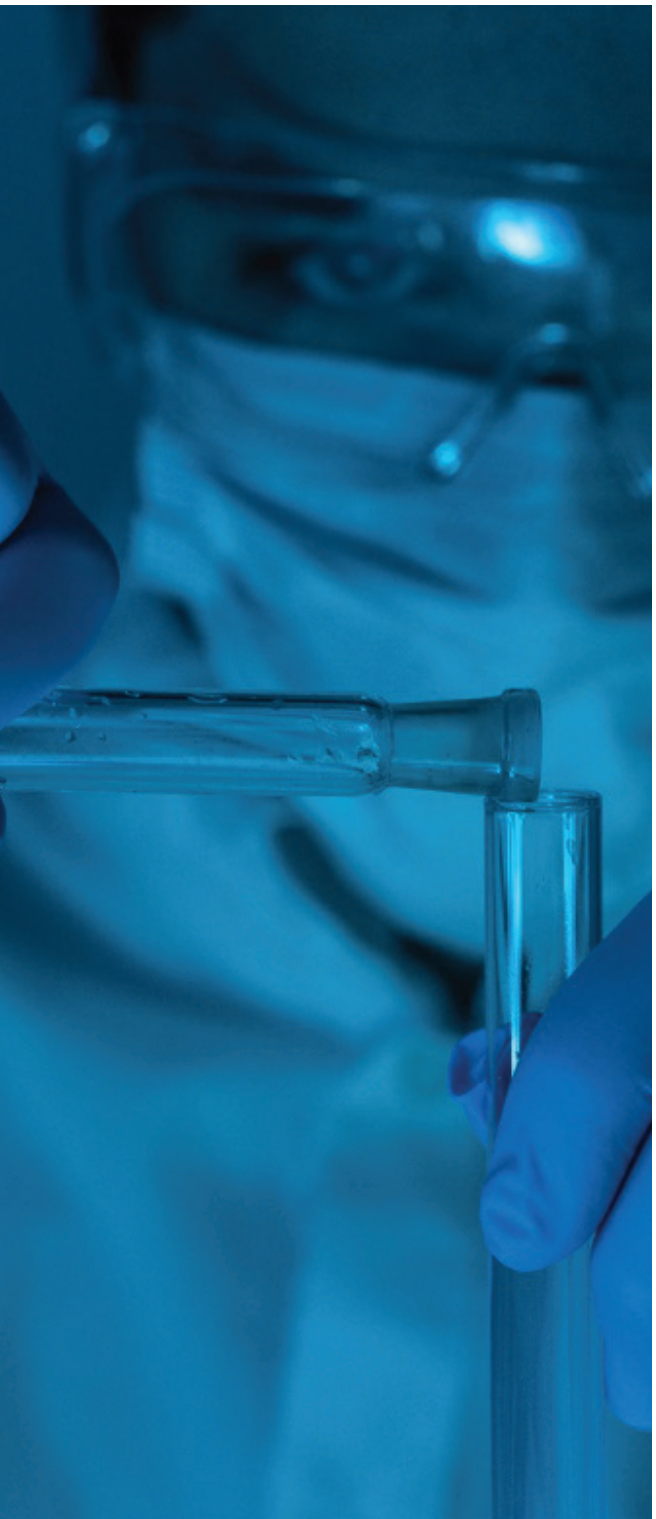
Below is the distribution of the participants in the Costa Rican Chemistry Olympiad:





307
TOTAL

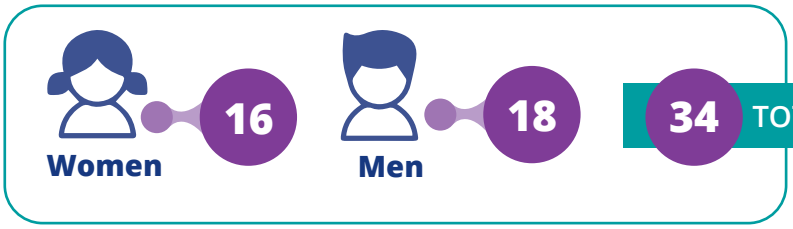
VII Camp for the Promotion of **Scientific Vocations, mainly Chemistry**



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 the 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 2022, the participants in the camp were distributed as follows:



Olympiad	Students
Sciences	18
Chemistry	16
TOTAL	34

XV Central American **and XIII Caribbean Chemistry Olympiad**

The Olympiad was held virtually, using the Zoom, Google Drive, and OlyExam platforms. The protocol acts were carried out via Zoom.

The meetings for discussion of evidence, translation, and decision were held on the Streaming platform. This test was performed at the CeNAT Computer Laboratory. The students spent 5 hours in a CeNAT computer lab. This time there was no practical test.

The event was organized by Cuba and was held virtually from November 14 to 19, 2022. The delegation included:

- Andrea Rivera Álvarez, Head of Delegation
- Mario Villalobos Forbes, Mentor
- Matías Portillo Fuentes, Student
- Oscar Rojas Rojas, Student
- Tomas Garay García, Student
- Wendy Villalobos González, Supervisor
- Yansy Vargas Solís, Supervisor

Achievements

Tomas Garay García
Bronze MEDAL

Matías José Portillo Fuentes
Bronze MEDAL

Oscar Francisco Rojas Rojas
Special Mention MEDAL

XXVI Iberoamerican **Chemistry Olympiad**

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 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.

The theory 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 Olympiad was organized by Mexico and was held from October 22 to 29, 2022. The Costa Rican delegation was made up of:

- Randall Syedd León, Head of Delegation
- Ricardo Ulate Molina, Mentor.
- Tiany Jimena Araya Vega, Student.
- Queshia Mariam Porras Rivera, Student.
- Daniel Alberto Sáenz Obando, Student.
- Mario Villalobos Forbes, Supervisor
- Andrea Rivera Alvarez, Supervisor

Achievements

Daniel Alberto Sáenz Obando
Bronze MEDAL

54° International **Chemistry Olympiad**

The Olympiad was held virtually, using the Zoom and OlyExam platforms, and the protocol activities were carried out from the activity page.

The meetings for discussion of evidence, translation, and decision were held on the streaming platform. The written test was performed on the OlyExam platform, and the students had five hours to complete it.

The activity was organized in China, from July 08-18, 2022. The Costa Rican delegation was made up of:

- José Roberto Vega Baudrit, Head of Delegation
- Wendy Villalobos González, Mentor Professor
- Daniel Saenz Obando, Student
- Oscar Rojas Rojas, Student
- Queshia Porras Rivera, Student
- Andrea Rivera Alvarez, Supervisor
- Mario Villalobos Forbes, Supervisor

Achievements: no medals or prizes were awarded; however, the commitment, participation, and growth of the students at an academic level during the development of the Olympiad is highlighted.



19° International **Chemistry Olympiad**

This Olympiad was organized to be held in person. The discussions, translations, and judgments were made by the tutors 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.

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

The Olympiad was held Colombia, from December 02 to 12, 2022. The Costa Rican delegation was made up of:

- Kenneth Castillo Rodríguez, Biology Leader
- Andrea Rivera Álvarez, Physics Leader
- Ricardo Ulate Molina, Chemistry Leader
- Mateo Sancho Dive, Student
- Miranda Herrera Venegas, Student
- Maria Paula Corrales Villegas, Student
- Dario Rivera Espinoza, Observer

Achievements

Miranda
Herrera Venegas
Bronze
MEDAL

INNOVATION



Entrepreneurship:
Support to Companies in Applied Scientific Research

LABORATORY
LANOTEC



Company	Research
NAVAL	Production and characterization of bacteria-repellent microcontact printed substrates and bactericidal nanostructured surfaces.
AMI	Bio-inspired and low cost 3d-printing of biomedical hydrogels.
Stein Laboratories	New Product Generation - Confidential Status.
Calox Laboratories	Product development consulting.
ECOINSUMOS	PINN: Development of two agro-nutritional formulations to improve agricultural soils, ensure their efficient use in agriculture, and reduce environmental impact.
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 of 3D images at nanomolecular-scale and circulating molecular biomarkers of associated genes.



Company	Research
Philips Morris	Evaluation of the impact of cigarette smoke vs THS on indoor air quality.
Coopervision Manufacturing Costa Rica	Analysis and characterization of materials
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.
Lisan Laboratories	Development of an analytical method.
Nitinol Devices and Components CR S.R.L.	Material characterization analysis.
BAC Credomatic	BAC credit cards.
University of Medical Sciences (UCIMED)	Material characterization analysis.
Sumedco de Costa Rica	Material characterization analysis
CR Process Impact S.R.L.	Material characterization analysis
ASOPROA Santa Cruz LANOTEC and Environmental Management	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.



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 setting.
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.
Bio CR	Development and validation of quantification and identification methods by HPLC and mass spectrometry techniques.
Corbana S.A.	Molecular identification (DNA barcoding) of living organisms
Corporación de Desarrollo Agrícola del Monte S.A.	Molecular identification (DNA barcoding) of living organisms.
CoopeAgri R.L.	Quantification of total polyphenols.
Speratum	Implementation Unit.
Treinta y cinco fábricas de cervezas S.A.	Production of Microorganisms Bacteria, yeasts, and fungi.
Stein Laboratories	Development and validation of quantification and identification methods by HPLC and mass spectrometry techniques.



Company	Research
LISAN	Quantification of vitamins.
Numu Brewing	Production of Microorganisms Bacteria, yeasts, and fungi.
Sur Química S.A.	Amino-acid profiling.
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.

Source: Information provided by CeNAT's laboratories for 2022.

Apoyo a organismos o instituciones de **investigación científica aplicada**

PRIAS
LABORATORY

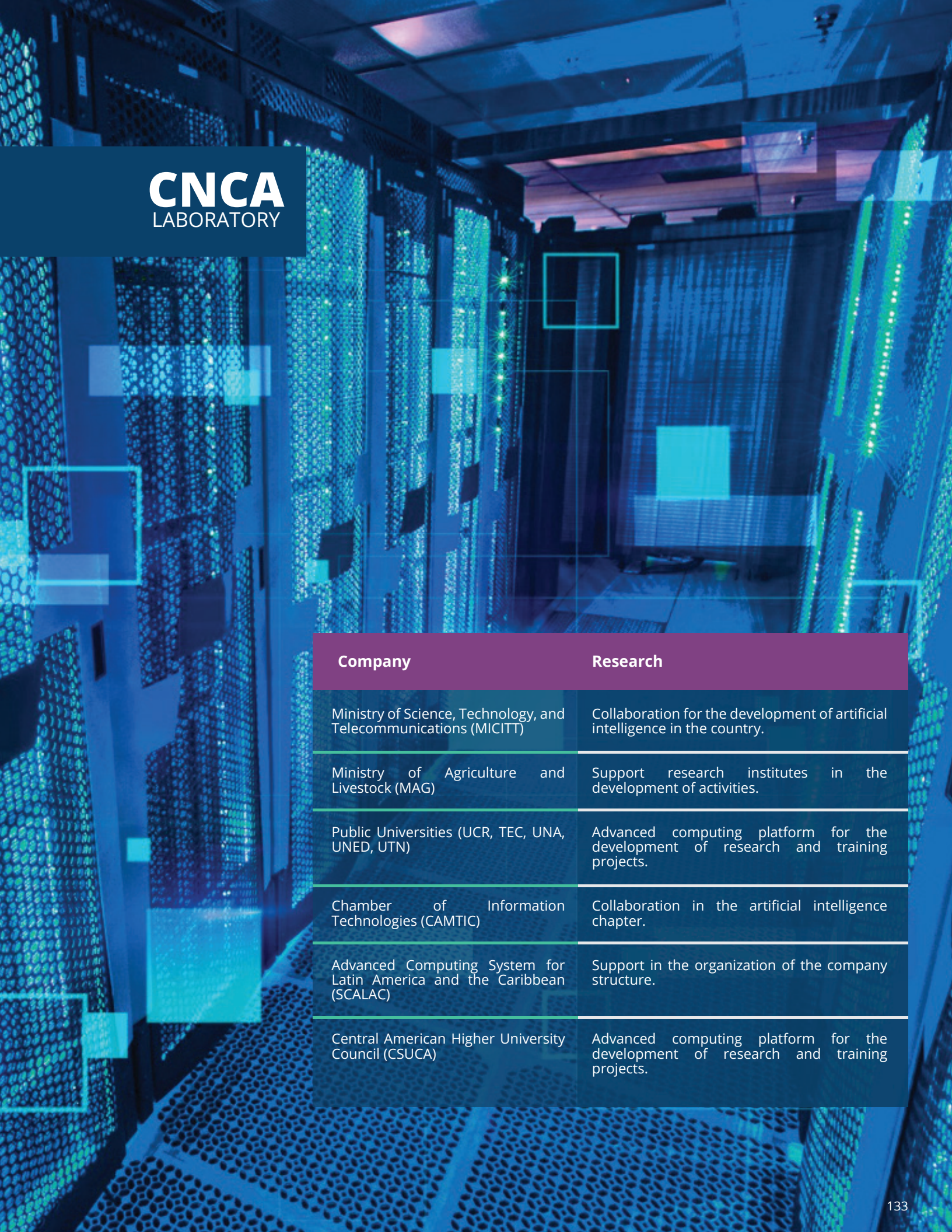


Company	Research
CONICIT, MICITT, DLR, SINAC, MINAE	MONEO-WET Project Applicability of Sentinel-2, DESIS, and Landsat 8 satellite imagery data for water quality studies, on water bodies related to crop coverage surroundings of the National Térraba-Sierpe Wetland (MONEO-WET).
UNDP, MAG, MINAE, TEC, National Registry, SNIT, and other users of the available information	MOCUPP Project: Conserving Biodiversity through Sustainable Management of Productive Landscapes in Costa Rica.
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.
National Geographic Society, Microsoft Corporation, SINAC, and other users of the information available	NATGEO Project: Development of three technological tools for marine ecology and its application on the Antillean manatee in Costa Rica.
TEC	Workshop - Instrumentation for understanding the light reflectance in trees of the Mesoamerican tropics.
UNED, UCR	Worshop on Google Earth Engine: Training of at least 15 researchers and students from UNED and UNA.
Group on Earth Observations (GEO), UN Habitat, MIVAH, SEPLASA, UNDP, INEC, Municipality of Garabito	One-Pagers of the project were written and published online. Similarly, group 1 of the project participated at the workshop, "Space for Cities: Earth Observation for Sustainable Development" where topics such as describing cross-linkages from data analysis to rational decision-making in policy formulation were discussed. Representation and active participation of the laboratory at the meetings of the Secretariat of the Earth Observations Group, within the framework of the National Project "Tackling deforestation and forest degradation in Costa Rica using Google Earth Engine".

Company	Research
Comptroller General of the Republic (CGR)	Technical support to develop the urban sprawl mapping for Costa Rica in secondary cities. Work is being done on the methodological definition for data analysis and use of images of urban sprawl growth, for expense estimating purposes by the government in the investment of public works for cantons in the national territory.
UNDP, MINAE, British Columbia University, TEC, and other users of available information	ELSA: Mapping nature for people and the planet: Identification and prioritization of essential areas for life, where nature-based solutions can be implemented to meet management, protection, and conservation needs for sustainable development.
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".
Regional Science and Technology Advisory Group (RSTAG), TAA	Within the framework of the Sustainable Development Forum for Latin America and the Caribbean, the Regional Science and Technology Advisory Group (R-STAG) held a meeting. The event was jointly organized by the National Risk Prevention Commission and Attention to Emergency (CNE) and the Centro Nacional de Alta Tecnología through the PRIAS Laboratory. Work was done on the ResilienceTech22 communication campaign to support the organization of the RSTAG meeting. Additionally, a search for mentors for the event was supported. In addition, researcher Heileen Aguilar and Infrastructure Analyst Stephanie actively participated as contestants.
Costa Rican Space Agency	Participation in the definition of strategic lines of the Costa Rican Space Agency.



Company	Research
National School of Civil Protection of the United Mexican States	Researchers from the PRIAS Laboratory Heileen Aguilar, Ezequiel Fallas, and Marilyn Manrow participated as experts by providing an induction training within the Course "Restoration, Ecological Succession and Ecosystems" of the Master's Degree in Land Management and Climate Change, articulating with higher education in Costa Rica and international cooperation the strengthening of geospatial innovation, through the transfer of technical and scientific knowledge at an academic, socioeconomic, and environmental levels.
Recluta Talent Hunter Consulting Firm	PRIAS Laboratory researcher, Francini Corrales Garro, participated at the "Women transforming the world" talk, a space in which women from the technology sector and in leadership positions shared their experiences and vision of actions to eliminate the gender gap and promote the inclusion of women in STEM positions.
CSUCA, USAC	PRIAS Laboratory researcher, Jennifer Fernández Garro, participated as a speaker at the "I Regional Meeting on Innovation, Entrepreneurship, and Knowledge Transfer", held in Guatemala. It was organized by the University of San Carlos in Guatemala (USAC) and the Central American Higher University Council (CSUCA).
Stanford University	Within the framework of the Ecosystem Services Modeling project, the paper called: "Modeling multiple ecosystem services and beneficiaries of riparian reforestation in Costa Rica", by the Stanford University of the United States and with the support of different collaborators such as the PRIAS Laboratory, the Ministry of Environment and Energy through the National Center for Geoenvironmental Information, Banco Central de Costa Rica, Costa Rican Electricity Institute, Tropical Agricultural Research and Higher Education Center, Yale University, Princeton University, as well as the companies Salo Sciences and SPRING.



CNCA
LABORATORY

Company	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 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.



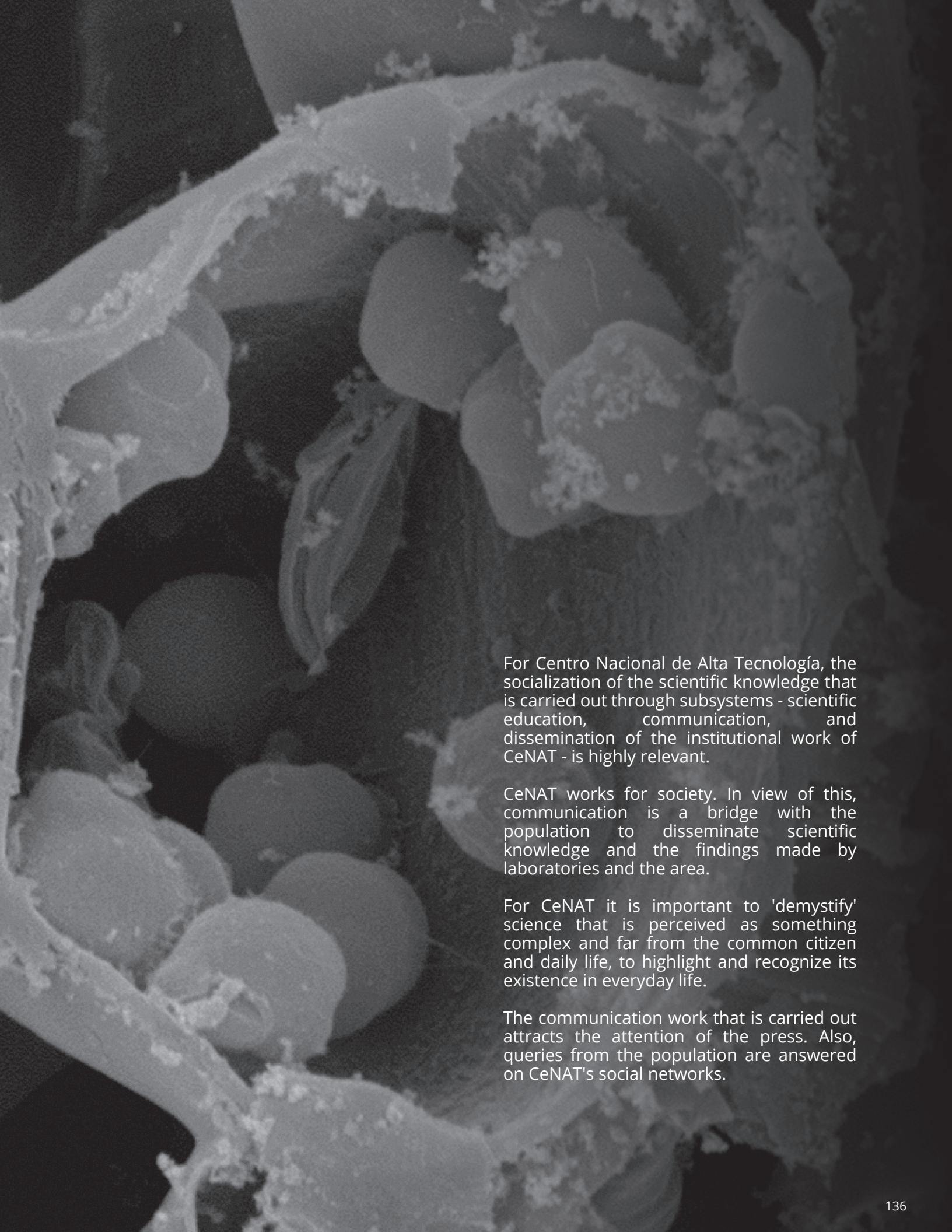
Environmental Management AREA

Company	Research
Restaurateurs, chefs, and cooks, PIAM/UCR	Ecogastronomy and Slow Food Course.
5,300 Producers using the platform in CR and Central America	Management of PIACT and Mercado de la Tierra Facebook pages.
5,300 Agricultural producers	Central American Climate Chat update.
ASOPROA - Santa Cruz	PINN Project. Creation of the Comprehensive Quality Unit for Turrialba cheese with Denominations of Origin.
FUNDECOOPERACIÓN	Support to adaptation of the agricultural sector through the dissemination of meteorological information - Phase II.
CONICIT/Costa Rican Promoter of Innovation and Research	INSPIRA: Promotion and development culture of innovation. Update of the Innovation Atlas of Costa Rica.
Organization of American States (OAS)	PIACT-Trifinio Plan.
Innovation Commission - Chamber of Industries of Costa Rica	Creation of the FESTO-CICR-CeNAT/CONARE Learning Factory.
Scientific / Technological Department-Embassy of the People's Republic of China in Costa Rica	Development of a prototype mobile laboratory for the deployment of the CR-2023 Antarctic Mission.
Collaboration with Slow Food, Uganda	Collaboration to contribute on issues related to added value of products and with differentiation for quality.

Source: Information provided by CeNAT's laboratories for 2022.



Socialization **of Sciences**

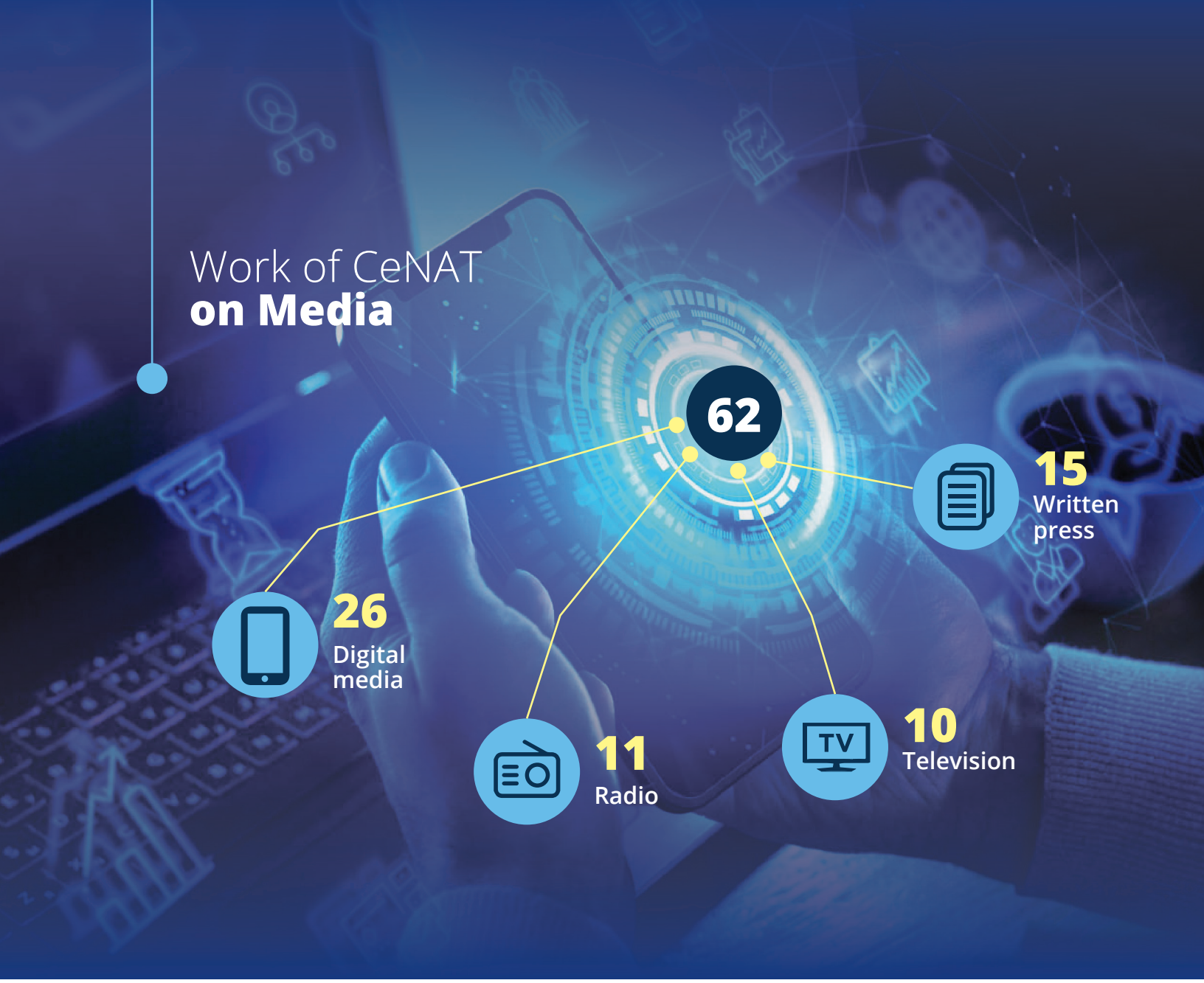


For Centro Nacional de Alta Tecnología, the socialization of the scientific knowledge that is carried out through subsystems - scientific education, communication, and dissemination of the institutional work of CeNAT - is highly relevant.

CeNAT works for society. In view of this, communication is a bridge with the population to disseminate scientific knowledge and the findings made by laboratories and the area.

For CeNAT it is important to 'demystify' science that is perceived as something complex and far from the common citizen and daily life, to highlight and recognize its existence in everyday life.

The communication work that is carried out attracts the attention of the press. Also, queries from the population are answered on CeNAT's social networks.



CeNAT's Social **Networks**

Currently, the presence in social networks is fundamental within the dissemination strategy, as a permanent communication channel, which has the advantage of the immediacy of the information shared to the audiences of the institution. CeNAT has a YouTube channel, a Soundcloud profile, a Facebook page and a website, which represent the institutional channels that provide information to the different audience segments.

On social networks, CeNAT provides content with informative and educational value, which contributes to promoting scientific vocations. It is intended to provide service information with topics that are of interest to them.

Within the digital ecosystem, our Facebook page is constantly growing in followers and the audience is stratified by 53.80% women and 46.20% men. The posts that are made are announcements of virtual courses or workshops, news of the institutional work, CeNAT-CONARE scholarship programs, knowledge transfer activities, research projects and digital media campaigns that are developed on different topics.

In 2022, two campaigns were implemented

CeNAT-CONARE Scholarships and Research Projects of the divisions





SOCIAL **MEDIA**



Source: Information from the year 2022.

*The number of followers has been generated organically, without resorting to paid social media advertising. As of December 31, 2022

Countries that follow CeNAT's **activities socialized on Facebook**

Costa Rica
Mexico
Peru
Ecuador
U.S
Guatemala
Colombia
Spain
Nicaragua
El Salvador
Honduras
Argentina
Germany
Bolivia
France
Brazil
Chile
Canada
Panama
UK
Venezuela
Paraguay
Italy
Netherlands
Portugal
Switzerland
Uruguay
Dominican Republic
Puerto Rico
Denmark
Sweden
South Korea
Austria
Russia
Belgium
Japan
Israel
Turkey
Egypt
Australia
Czech Republic
Philippines
Cuba
Vietnam
Iraq
Norway
New Zealand
Syria
Nigeria



Source: Information from the year 2022.

Below, the main data of information on reach, achievements and impacts evidenced by each of the Laboratories of CeNAT in the year 2022 are presented.

Human Resources **at CeNAT**

Fundación Centro de Alta Tecnología

Officials, collaborators and scholarships.
Period 2022-2021

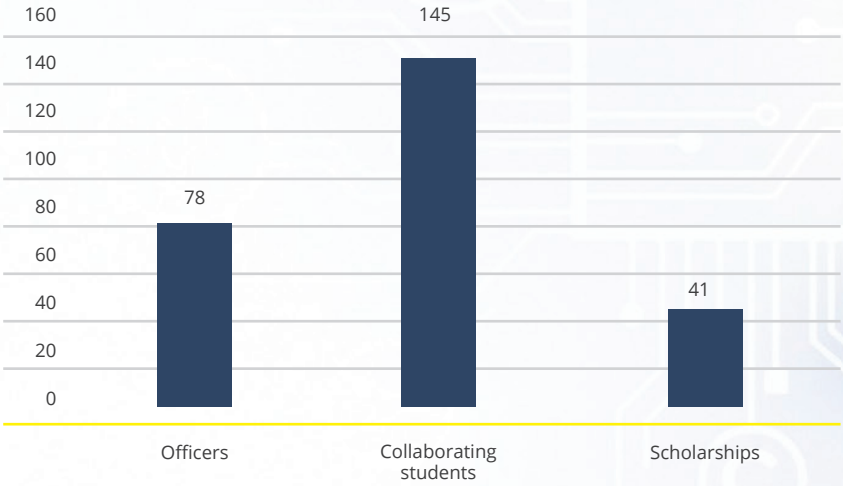




ORIGIN	YEAR 2022	YEAR 2021
Officers	78	66
Collaborating students	145	149
Scholarships	41	42
Total	**264**	**257**

Source: Information on the year 2022 provided by the Laboratories and Area of CeNAT.

Officials, **collaborators and scholarships 2022**



Source: Information on the year 2022 provided by the Laboratories and Area of CeNAT.



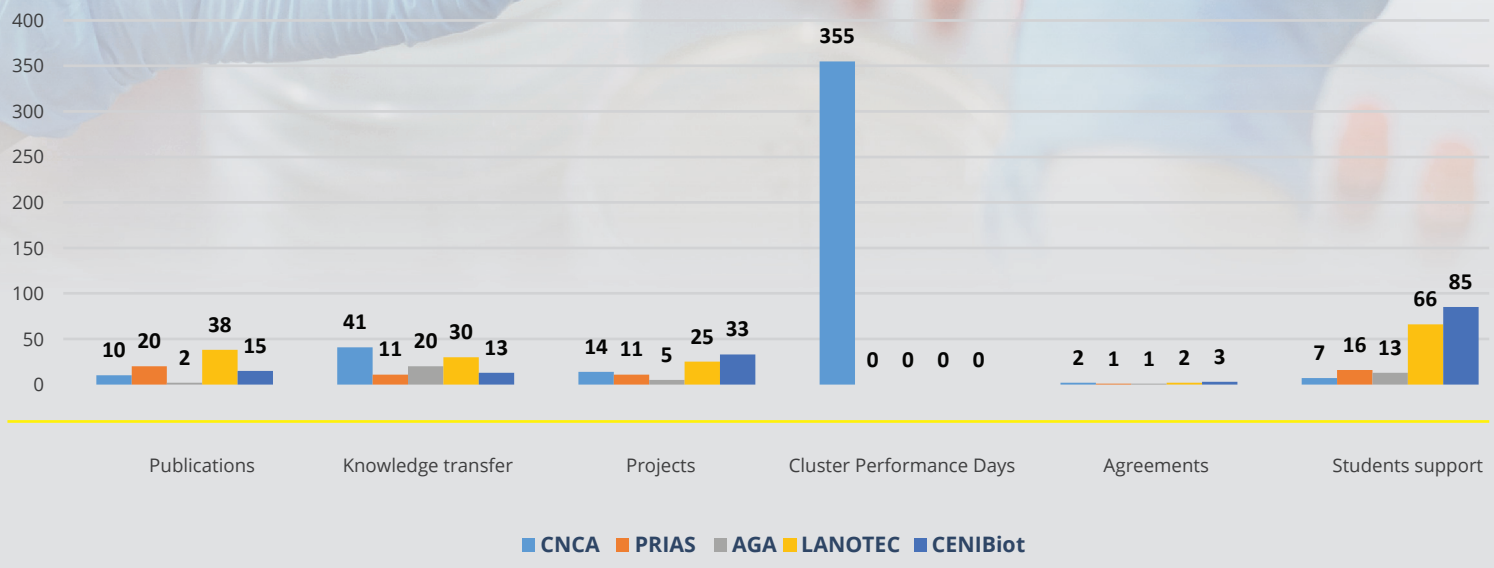
CeNAT
Public and private indicators 2022

Indicator	CNCA	PRIAS	AGA	LANOTEC	CENIBiot	Total
Publications	10	20	2	38	15	85
Knowledge transfer	41	11	20	30	13	115
Projects	14	11	5	25	33	88
Cluster Performance Days	355	-	-	-	-	355
Cluster usage hours	70460	-	-	-	-	70460
Agreements	2	1	1	2	3	9
Student support	7	16	13	66	85	187

2022 Indicators, according to CeNAT Laboratories and Areas

Source: Information on the year 2022 provided by the Laboratories and Area of CeNAT.

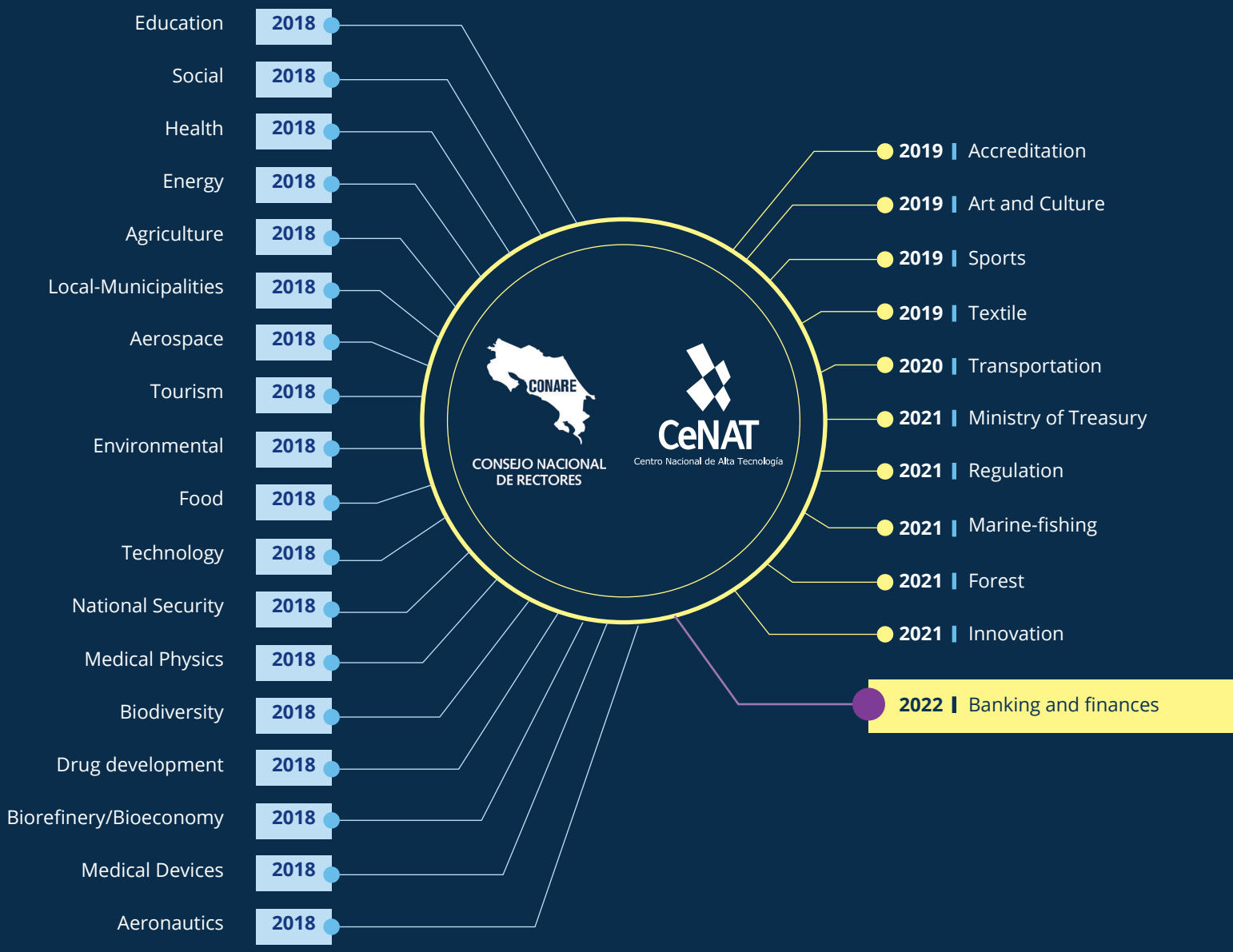
Public and **private indicators 2022**



Source: Information on the year 2022 provided by the Laboratories and Area of CeNAT.

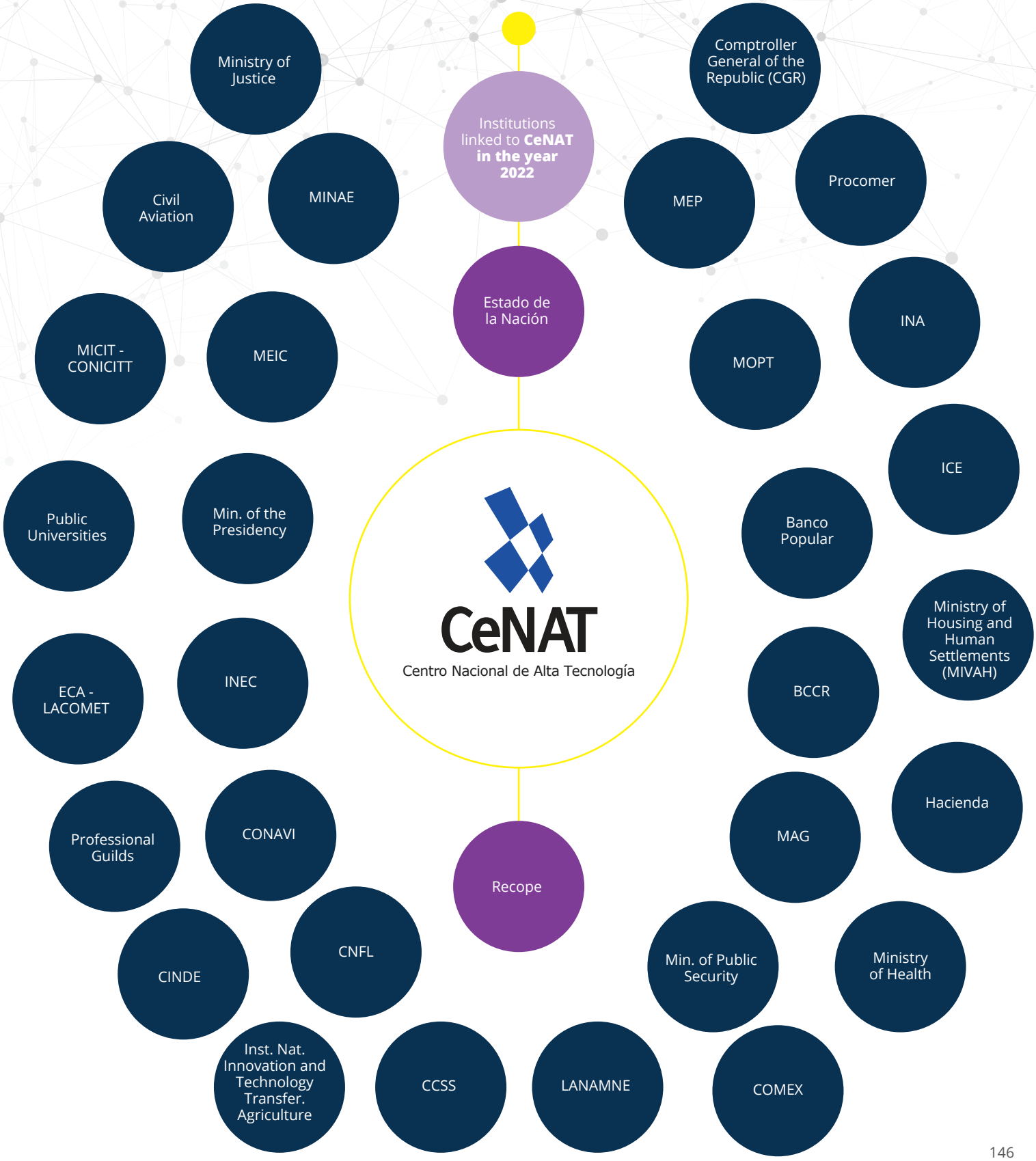
Strategic Sectors of **Society Linked with CeNAT**

Identification of sectors CeNAT has relation with as of November 2022



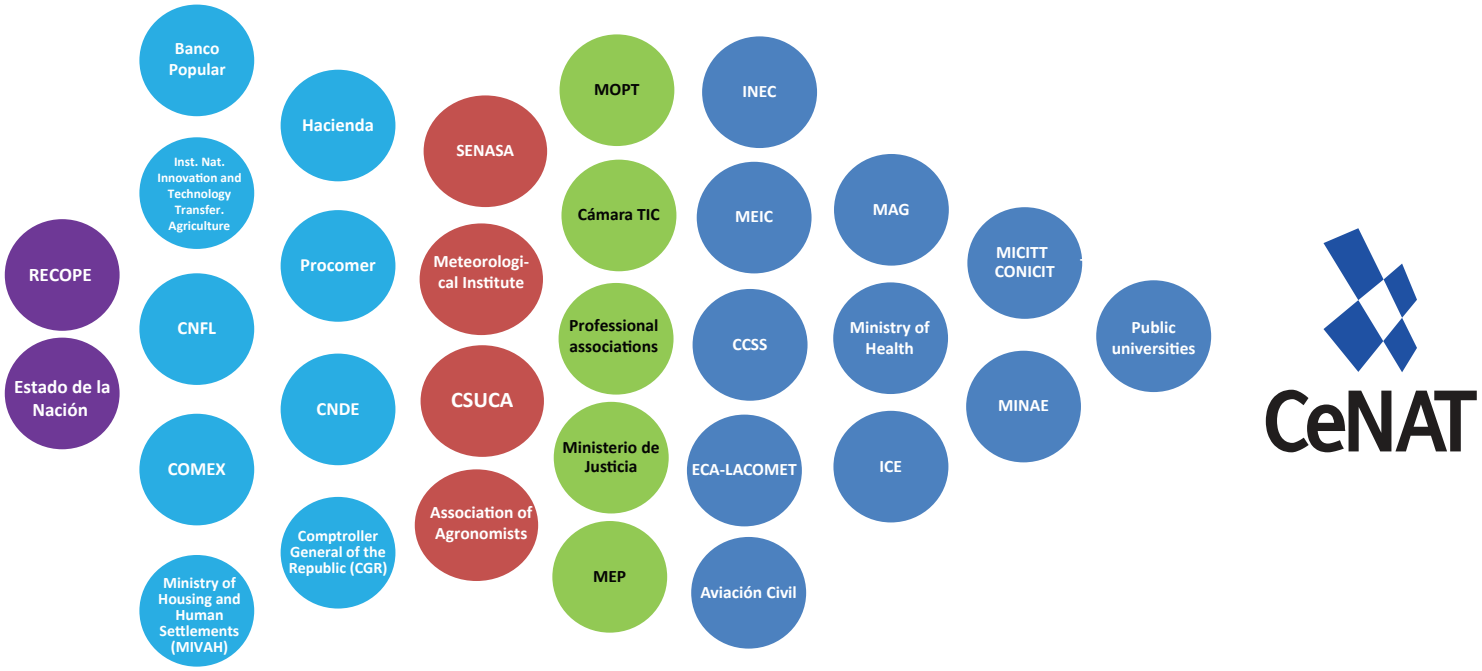
Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.

Institutions that **maintain a link with CeNAT by 2022**





Institutions linked **with CeNAT in 2022**



Incorporated in 2022

Incorporated in 2021

Incorporated in 2020

Incorporated in 2019

Incorporated in 2018

Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.



Institutions, organizations, and companies linked **to CeNAT in the year 2022**



Incorporated in 2022

Incorporated in 2021

Incorporated in 2020

Incorporated in 2019

Incorporated in 2018

Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.

Institutions that held and initiated linkages with **CeNAT in 2022**



COUNTRIES	LANOTEC	CENIBIOT	CNCA	PRIAS	Environmental Management
Germany	X	X	X	X	X
Argentina	X		X		X
Australia				X	
Belize			X		
Bolivia	X				
Brazil	X	X	X		
Bulgaria	X				
Canada	X	X	X	X	
Chile	X	X	X	X	
China	X	X			X
Colombia	X	X	X		X
Cuba	X				
Ecuador	X	X	X	X	
El Salvador	X	X	X		X
Slovenia		X			
Spain	X	X	X		X
U.S	X	X	X	X	X
France	X		X		
Guatemala	X		X		X
Honduras		X	X		X
England		X			
Israel	X				
Italy	X		X		X
Japan					
Mexico	X	X	X		X
Nicaragua			X		X
Panama	X		X		X
Paraguay	X				
Peru	X	X			
Portugal	X		X		
Czech Republic					X
Republic of Korea	X				
Serbia	X				
South Africa		X			
Switzerland	X	X			
Turkey					X
Uruguay	X		X		
Uganda					X
Venezuela			X		

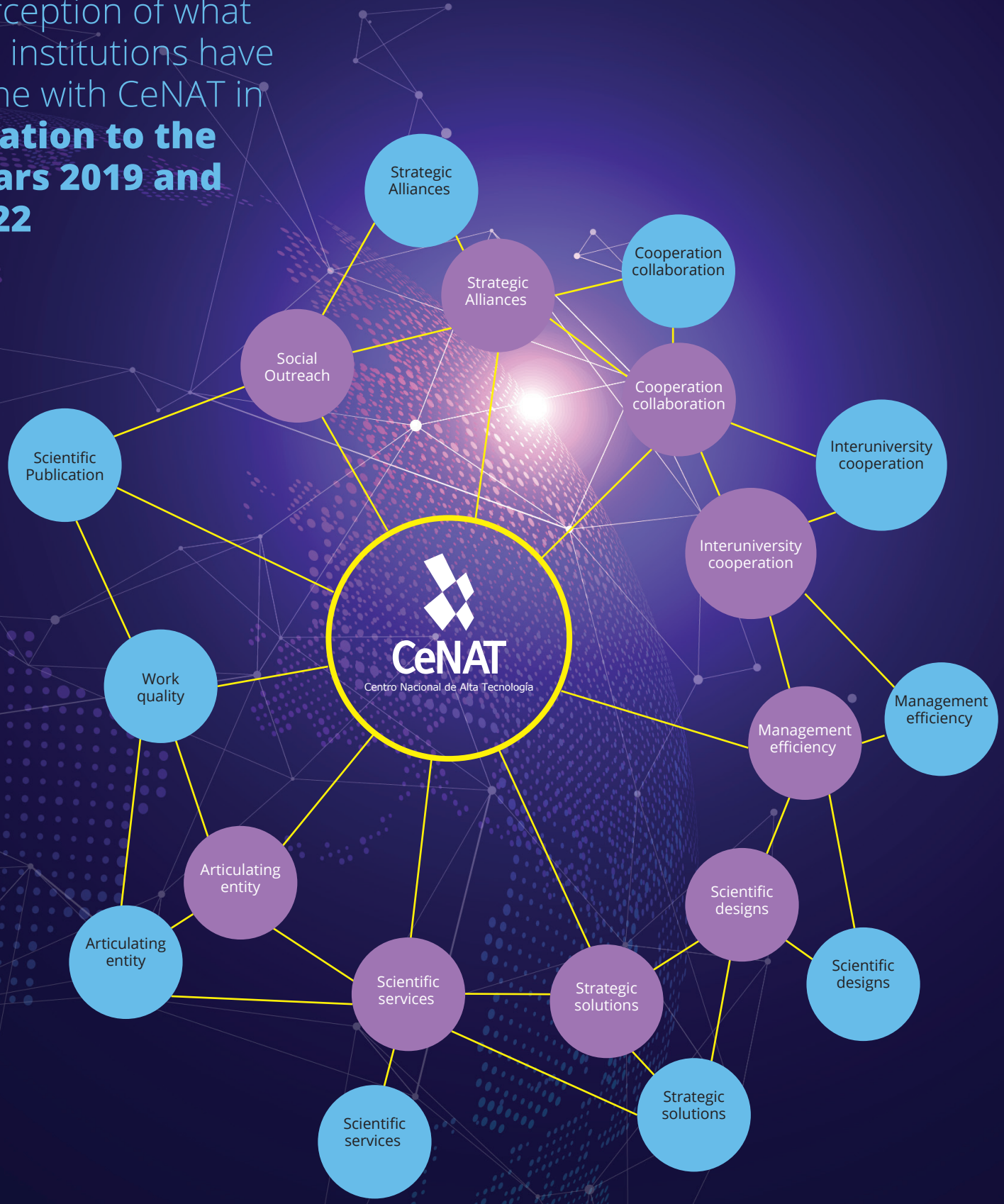
Source: Analysis of the information provided by the directors of CeNAT's laboratories and programs, updated to November 2022.

World map of the scope of **CeNAT in 2022**



Source: Analysis of the information provided by the directors of CeNAT's laboratories and programs, updated to November 2022.

Perception of what the institutions have done with CeNAT in **relation to the years 2019 and 2022**



Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.

Expectations of CeNAT **institutions in the next 5 years**

CeNAT
Centro Nacional de Alta Tecnología

2019

- CeNAT at the forefront of research
- CeNAT as an ally to meet institutional objectives
- CeNAT supports country goals
- CeNAT supports reliability of the data (2)
- CeNAT in the development of joint projects (4)
- 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 (2)
- CeNAT in joint publications
- CeNAT in solutions to global problems
- CeNAT socializes the use of information

2022

- 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 (2)
- CeNAT in upscaling of technology transfer (3)
- CeNAT in research projects (3)
- CeNAT does not compete for research funds (3)
- CeNAT as strategic partnerships (4)
- CeNAT in effective collaborations (7)

Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.



INDICATORS OF **INSTITUTIONAL WORK**

Impact Reached in 2022 at CeNAT

15,076
Facebook Followers

509,239
Average reach of Facebook posts

49
Nationalities of Facebook followers

42,437
Number of countries that follow the page

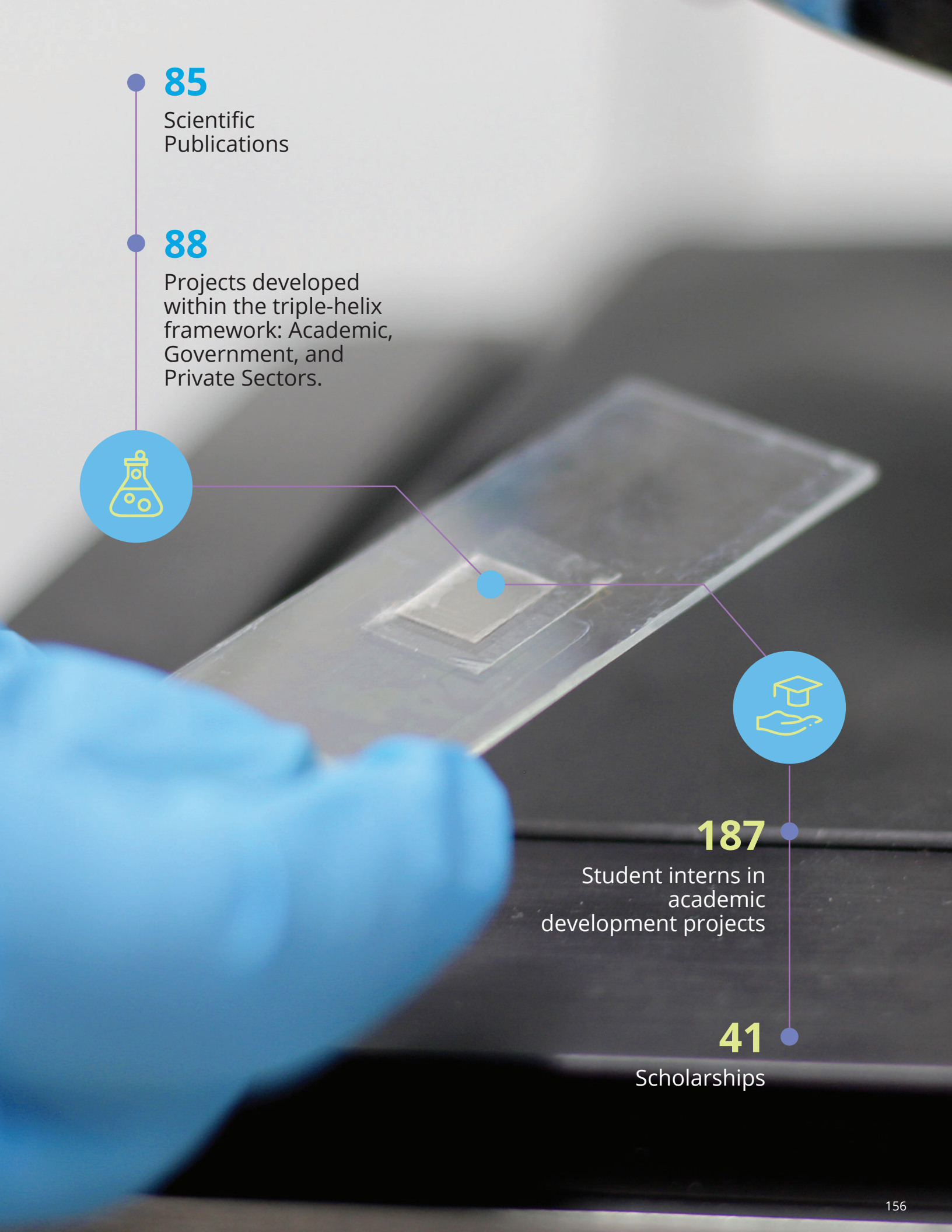




3
Registered patents

7
Registration processes

2
Researchers in the United States Invention Registration



85

Scientific Publications

88

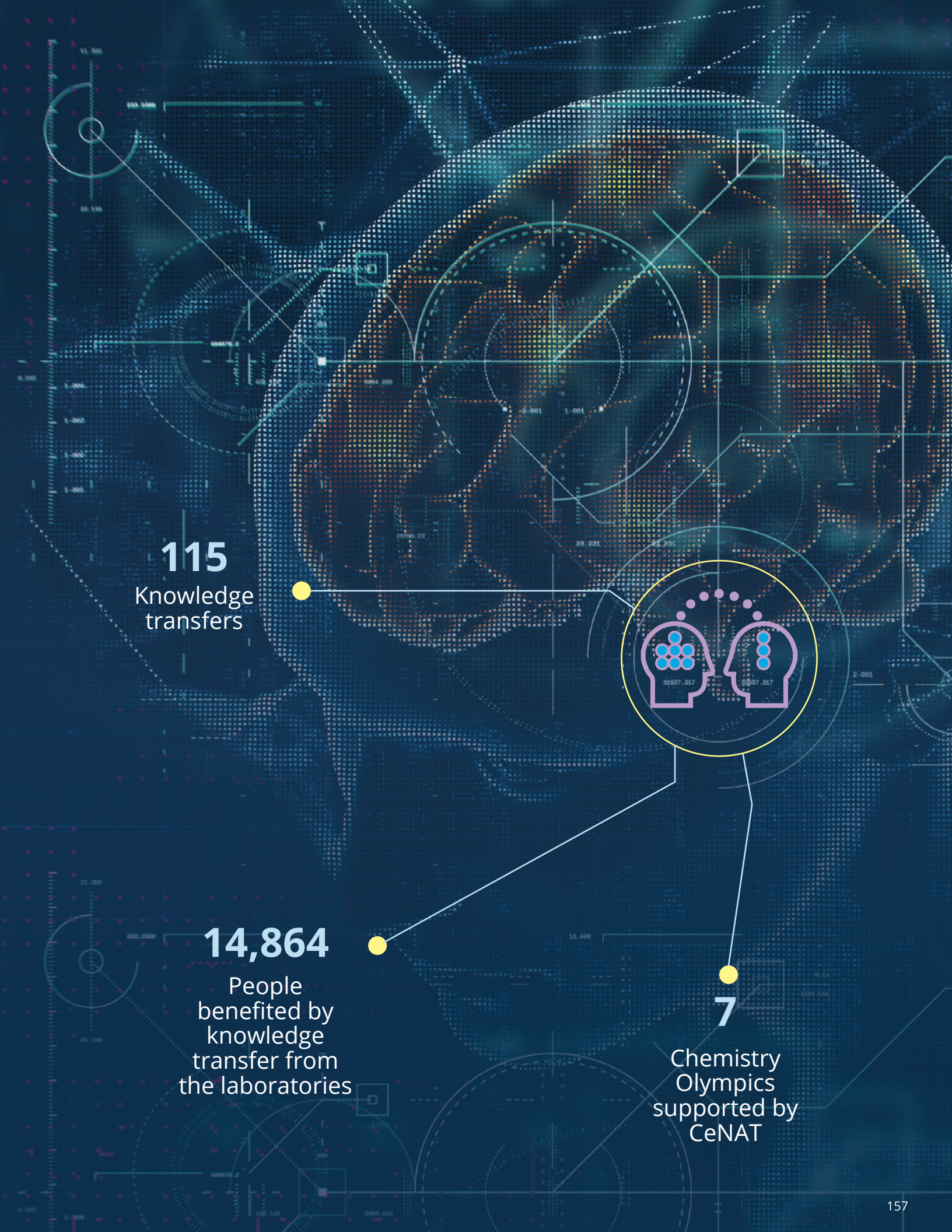
Projects developed within the triple-helix framework: Academic, Government, and Private Sectors.

187

Student interns in academic development projects

41

Scholarships



115

Knowledge transfers

14,864

People benefited by knowledge transfer from the laboratories

7

Chemistry Olympics supported by CeNAT



355
People using simulation cluster

522
Accounts with access to computing infrastructure services

70,460
Usage hours in simulations and data processing

144,161 Students and professors from public universities with access to the Edu-Roam network

106 Participating countries in the Eduroam network

2 trillions Logins to the Eduroam network in international territories

5 Eduroam deployed in the headquarters and campuses of the 5 Public Universities

14,533 Network services available to students, officials and teachers



8,000 Technical assistance to producers in Variability and Climate Change

29 Articulation with strategic sectors

35 Link with inter-institutional networks

39 Countries linked to CeNAT

39 Support for applied science research companies

32 Support for applied science research organizations or institutions

Source: Information for the year 2022 provided by the Laboratories and Areas of CeNAT.



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 concerning the proper management and administration of the resources received under 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 of representatives of the State Institutions of University Higher Education (IESUE), the local city government (Municipality), and of the Government of the Republic. The Board has appointed an Executive Director in charge of FunCeNAT.

It is worth mentioning that at the time of creating CeNAT, within the legal context, the chancellors of CONARE member universities 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.

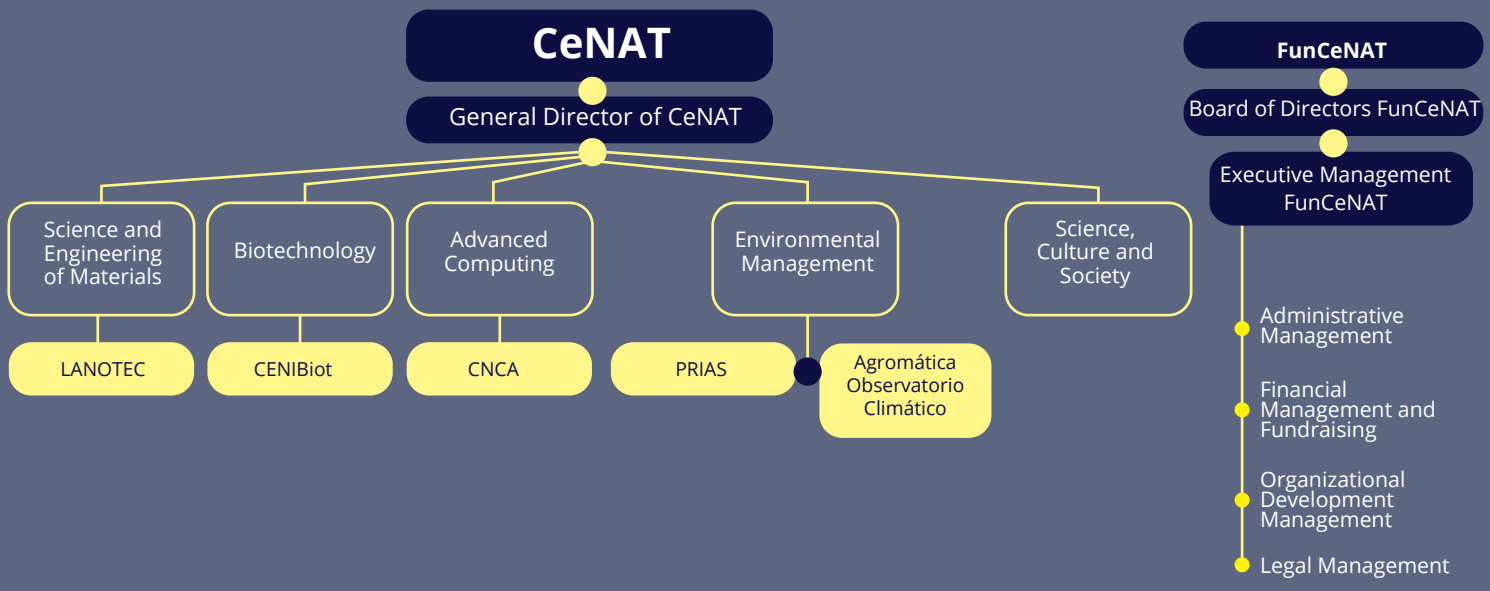
It always aligns all its activities with the guidelines issued by CONARE, its Board of Directors, the Comptroller General of the Republic, and the audit department of CONARE, as well as the External Audit, so that its activities and actions comply with all the applicable laws and regulations.

FunCeNAT is the foundation that provides ongoing support to CeNAT laboratories and programs based on four organizational development pillars, namely:



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

The operational structure below shows how CeNAT works.





FunCeNAT and **Financial Results**

PRENDAS, VARGAS Y CÓRDOBA

CONSULTANTS AND ADVISORS
AUTHORIZED PUBLIC AND PRIVATE ACCOUNTANTS
Limited Liability Company | Corporate ID: 3-102-272831

Independent Audit Report

To the Managing Board of Fundación
Centro de Alta Tecnología

We have carried out the audit of the attached balance sheet of Fundación Centro de Alta Tecnología (FunCeNAT) as of December 31, 2022, of the related statements of integral activities and accumulated surplus, and changes in net assets and cash flows that correspond to the twelve-month period ended on that date.

Management's accountability for the financial statements:

FunCeNAT's Management is responsible for the preparation and reasonable presentation of the financial statements, in accordance with the International Financial Reporting Standards and for the internal control it deems necessary to allow for the preparation of financial statements to be free of material errors, both fraud and mistakes.

Auditor's accountability:

Our responsibility is to issue an opinion on such financial statements, based on our audit. We perform our audit in accordance with International Standards on Auditing. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves the execution of procedures to obtain audit evidence supporting the amounts and disclosures in the financial statements of FunCeNAT. The selected procedures depend on the judgment of the auditor, including their risk assessment for significant error, whether caused by fraud or error. In conducting these risk assessments, the auditor takes the internal controls of the Organization relevant to the reasonable preparation and presentation of the financial statements into consideration, in order to design audit procedures that are appropriate to the circumstances. An audit also includes an assessment of the accounting policies used and the reasonableness of the accounting estimates made by the Administration, as well as the general assessment of the presentation of the financial statements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a reasonable basis for our opinion.

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Fax: 2281-2971.
www.prendasvargas.com
Apdo. Postal 168-2120
San José, Costa Rica

Opinion:

In our opinion, the Balance Sheet of the Fundación Centro de Alta Tecnología (FunCeNAT) as of Saturday, December 31, 2022, the related income statement, statement of changes in net assets, and cash flows statement that are relative to the twelve-month period ended on that date, reasonably present, in all their important aspects, the financial situation in accordance with the International Financial Reporting Standards.

Matters that do not affect opinion:

1 Our audit was conducted with the purpose of presenting an opinion on the financial statements of FunCeNAT as of December 31, 2022 and for the twelve-month period ended on that date. The supplementary financial information for the period ended December 31, 2022 -shown in the Annex- is presented for additional analysis purposes and is not required as part of the basic financial statements. This supplementary information was subject to the same audit procedures applied to the audit of the financial statements as of December 31, 2022 and for the twelve-month period ended on that date. Therefore, in our opinion, it was reasonably presented in all significant respects when considered in relation to the financial statements, taken as a whole.

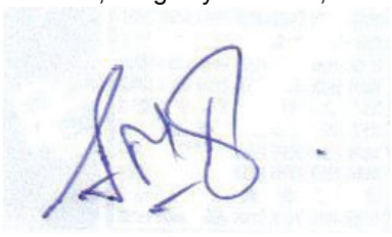
2 As of Administrative Resolution DM-RM-6934-2022 issued by the Ministry of Health of the Government of the Republic of Costa Rica on September 16, 2022, new guidelines related to the COVID-19 pandemic are established and are in force after to the repeal of Decree 42227-MP-S of March 16, 2020, which declared a state of national emergency throughout the territory of the Republic of Costa Rica, due to the health emergency situation caused by the COVID-19 disease.

Based on the criteria of the State of Costa Rica of having achieved control of COVID-19 in the national territory, as a result of the effort to comply with sanitary measures in the periods 2020, 2021, and partially 2022 by society as a whole, a series of new guidelines to achieve the reactivation and continuity of activities and services were promoted.

As of the date of the opinion of the external auditors on the financial statements of FunCeNAT as of December 31, 2021, the Administration was unaware of the future effects that the virus known as COVID-19 could cause and estimated that its effect had been slight. The general impact on operations for the twelve-month period ended December 31, 2022, is also considered by FunCeNAT Management to be slight.

The attached financial statements must be read considering the effects mentioned in Note 10 - Contingency due to the COVID-19 pandemic, which mentions the national emergency throughout the territory of the Republic of Costa Rica caused by the COVID-19 pandemic.

Prendas, Vargas y Córdoba, Ltda.

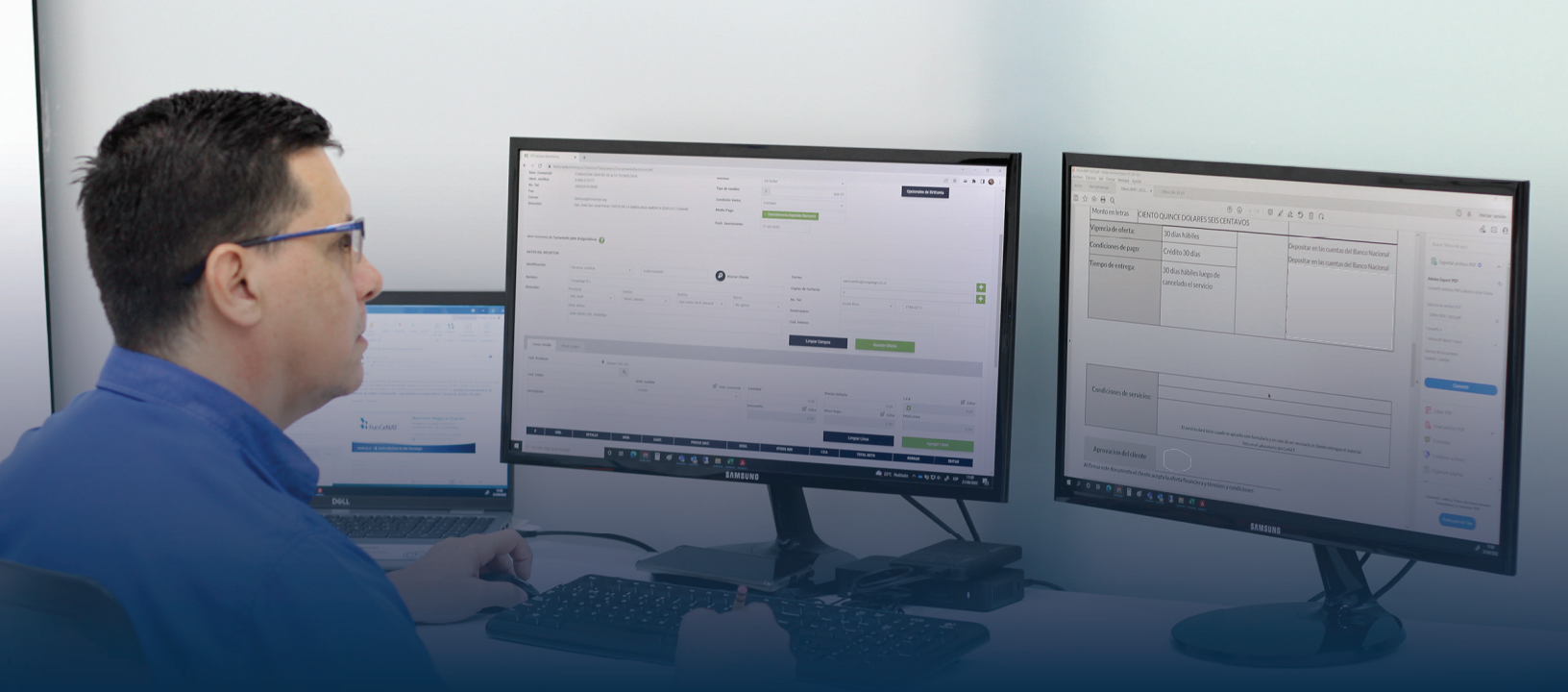




Marcelo Prendas González
Certified Public Accountant, card No. 822

Loyalty Policy No. 0116 FIG 7, expiring on September 30, 2023.
Stamp of Law Nº 6663.

San Jose, Friday, March 17, 2023.



FUNDACIÓN CENTRO DE ALTA TECNOLOGÍA
(Nonprofit Organization)

BALANCE SHEET
As of Saturday, December 31, 2022 and 2021
(Amounts shown in Colones)

ASSETS	2022	2021
Current Assets:		
Cash and cash equivalents	¢15,272,053	¢83,708,044
Transitory investments	998,415,280	1,374,681,285
Accounts receivable	56,318,720	81,347,862
Total current assets	1,070,006,053	1,539,737,191
Long-term investments	1,150,593,337	1,262,064,288
Furniture and equipment, net amounts	1,376,346	1,927,800
TOTAL ASSETS	¢2,221,975,736	¢2,803,729,279
LIABILITIES		
Current		
Current liabilities:		
Accounts payable and accumulated expenses	¢39,692,996	¢63,650,571
Restricted funds projects - public funds	1,361,793,396	1,750,419,058
Restricted funds projects - private funds	634,485,777	753,191,011
Total Liabilities	2,035,972,169	2,567,260,640
NET ASSETS		
Accumulated surplus	186,003,567	236,468,639
Total current assets	186,003,567	236,468,639
TOTAL LIABILITIES AND NET ASSETS	**¢2,221,975,736**	**¢2,803,729,279**



FUNDACIÓN CENTRO DE ALTA TECNOLOGÍA
(Nonprofit Organization)

COMPREHENSIVE INCOME STATEMENT AND ACCUMULATED SURPLUS
FOR THE TWELVE-MONTH PERIOD ENDED Saturday, December 31, 2022 AND 2021
(Amounts shown in Colones)

	2022	2021
REVENUE:		
Fund Revenue	¢67,407,535	¢104,423,217
Project Management Revenue	35,377,076	55,960,077
Other Revenue	12,393,924	8,303,258
Total Revenue	115,178,535	168,686,552
EXPENSES:		
Remunerations	145,794,149	127,714,838
Services	6,209,203	6,067,299
Materials and Supplies	209,525	596,055
Depreciation expenses	551,454	854,300
Benefits	11,006,551	5,241,105
Training and protocol	1,519,228	1,241,154
Other minor expenses	353,497	309,032
Total Expenses	165,643,607	142,023,783
SURPLUS (LOSS) FOR THE PERIOD	(50,465,072)	26,662,769
ACCUMULATED SURPLUS AT THE BEGINNING	236,468,639	209,805,870
ACCUMULATED SURPLUS AT THE END	**¢186,003,567**	**¢236,468,639**



FUNDACIÓN CENTRO DE ALTA TECNOLOGÍA
(Nonprofit Organization)

CASH FLOW STATEMENT
FOR THE TWELVE-MONTH PERIOD ENDED DECEMBER 31, 2022 AND 2021
(Amounts shown in Colones)

OPERATING ACTIVITIES	2022	2021
Surpluses for the period		
Adjustments to reconcile period surplus to net cash used in operating activities:	¢(50,465,072)	¢26,662,769
Depreciation expense	551,454	854,300
Cash received from operations	(49,913,618)	27,517,069
Changes in assets and liabilities that provide (or use) cash:		
Accounts receivable	25,029,142	(38,296,161)
Restricted private funds	(118,705,234)	38,096,996
Restricted public funds	(388,625,662)	249,864,941
Accounts payable	(23,957,575)	(123,191,840)
Net cash received from operating activities	(556,172,947)	153,991,005
INVESTMENT ACTIVITIES:		
Increase in long-term investments	111,470,951	51,302,228
Net cash paid (used) in investing activities	111,470,951	51,302,228
FUNDING ACTIVITIES:		
Net cash paid (used) in investing activities	-	-
INCREASE (DECREASE) IN CASH AND TEMPORARY INVESTMENTS	(444,701,996)	205,293,233
CASH AND TEMPORARY INVESTMENTS, BEGINNING OF YEAR	1,458,389,329	1,253,096,096
CASH AND TEMPORARY INVESTMENTS, END OF YEAR	**¢1,013,687,333**	**¢1,458,389,329**



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- National University
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- MICITT

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- **Dr. Randall Loaiza Montoya,** Director, CENIBiot Laboratory
- **Dr. Esteban Meneses Rojas,** Director, National Collaboratory of Advanced Computing
- **Allan Campos Gallo, MBA** Director, Environmental Management Area
- **Cornelia Miller Granados, MBA** PRIAS Laboratory Director

Directorate of CeNAT

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- **Karol Palma Odio,** Direction Administrative Assistant



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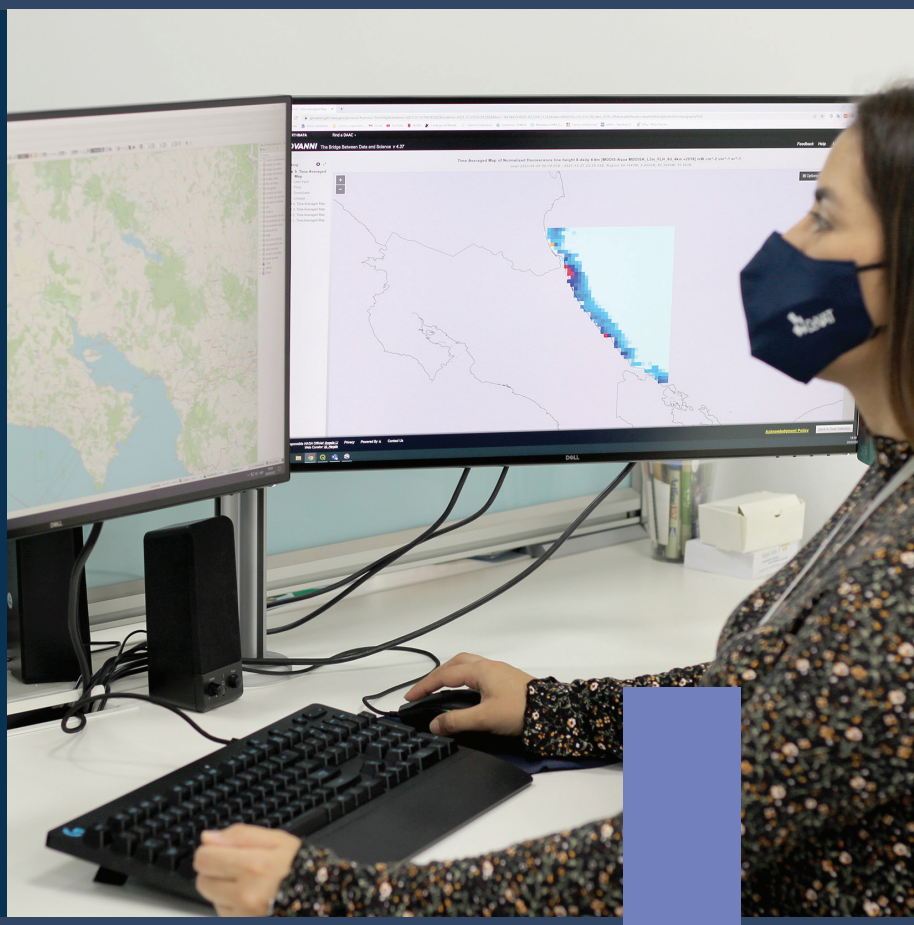
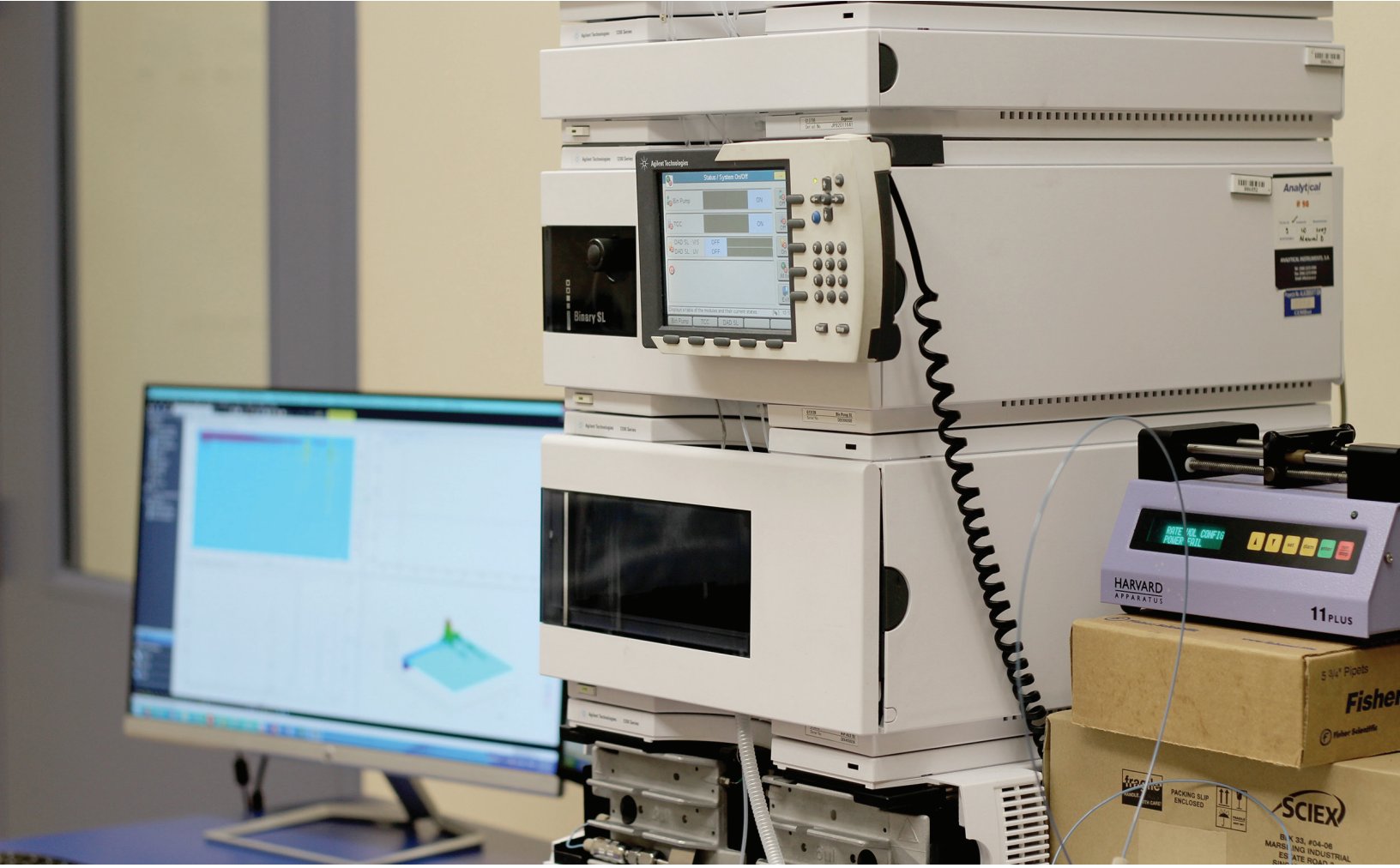
- Yerlin Vargas Solano
- Ketcha Hernández Vargas
- Francini Corrales Garro



Private Projects

- Kenneth Obando Rodríguez
- Gabriel Salas Gutiérrez
- Maria Camila Aguilar Gomez



CENIBiot

- Max Chavarría Vargas
- Emanuel 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
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- Monica Baizan Rojas
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- Mónica Zamora Rodríguez



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Agromatics, Food Safety And Slow Food

- Dr. Patricia Sánchez Trejos

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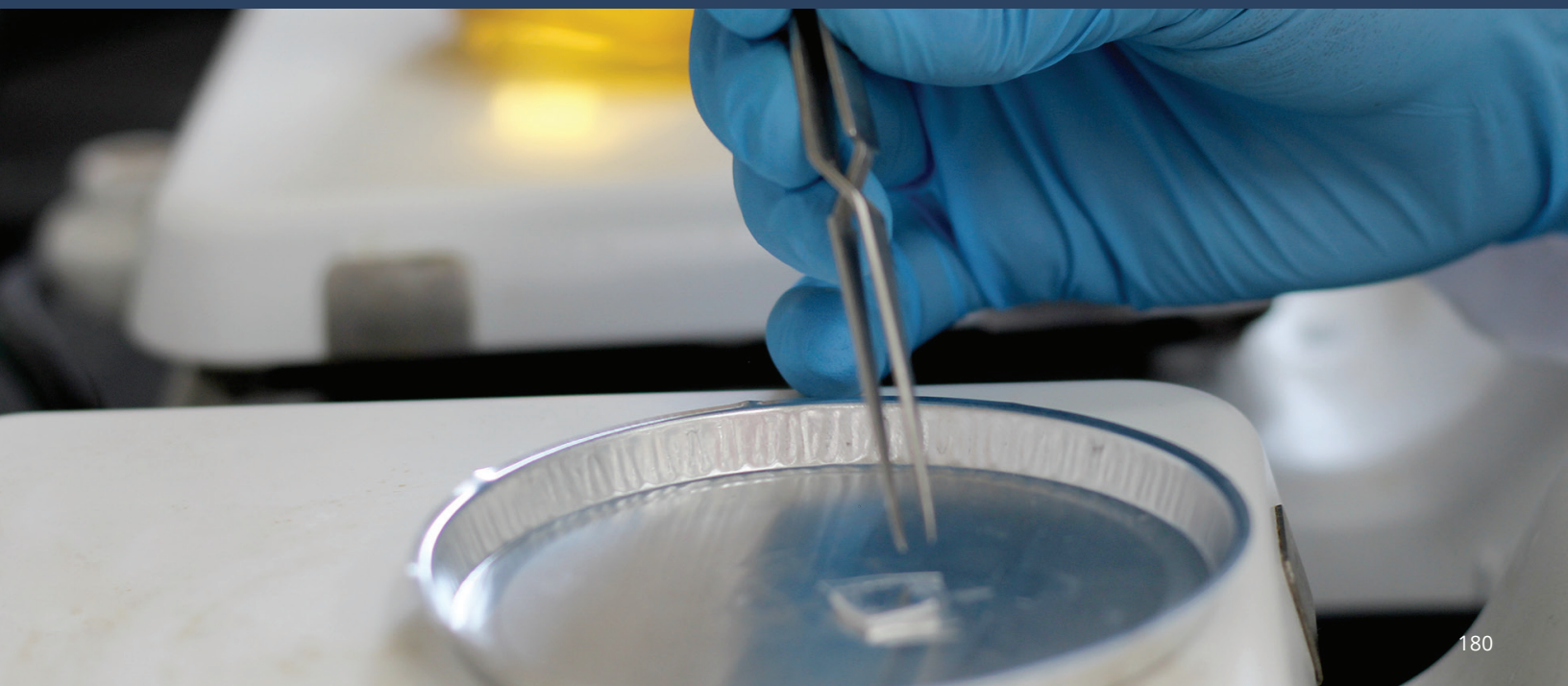



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