



NEIKER

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

2023 REPORT

RESEARCH AND INNOVATIVE
SOLUTIONS FOR THE AGRO-FOOD
AND FORESTRY SECTOR

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NEIKER

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& TECHNOLOGY ALLIANCE



EUSKO JAURLARITZA
GOBIERNO VASCO

EKONOMIAREN GARAPEN,
JASANGARRITASUN
ETA INGURUMEN SAILA

DEPARTAMENTO DE DESARROLLO
ECONÓMICO, SOSTENIBILIDAD
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INTRODUCTION

01

“ NEIKER technology centre has been a main ally of our companies in the agri-food and forestry chain ”



In 2023 NEIKER celebrated its 25th anniversary as a centre attached to the Basque Government, although the seed of what it is today dates back to 1851, when the Model Farm of Agriculture was created in Arkaute (Araba) to promote agricultural activity in the territory.

Throughout its history, the NEIKER technology centre has been a main ally of our companies in the agri-food and forestry chain in improving their competitiveness, resilience and adaptation to climate change, and in the development of their R+D+i.

NEIKER has been characterised by its capacity to adapt, to incorporate talent, knowledge and new lines of work to respond to the needs of the sector, which has enabled it to face the profound changes experienced in the environment and in the sector itself and to offer at all times what it required.

The sector now needs to transform itself and move towards more productive, sustainable systems that are more resilient to the effects of climate change. It must also adapt to competition and the demands of an increasingly demanding and global market.

To do this, we rely on the use of technology and innovation, which improve the efficiency and performance of agricultural and livestock processes, and help to mitigate the impact of climate change, as well as saving time, effort and money. The agritech roadmap, which encompasses all these actions and which NEIKER is promoting, contributes to this and enables more sustainable production in line with the agri-food policies promoted by the Basque Government, such as the Plan for the Promotion of Organic Farming (FOPE), the Strategic Plan for Gastronomy and Food (PEGA) or the Strategic Plan for Wood (PEMA).

All these actions will allow us to continue to make progress and face the future with guarantees.

President of NEIKER
Bittor Oroz



“ We have contributed to boosting, through knowledge and applied R+D+I, the agri-food and forestry economy of our environment ”

In addition to the anniversary, our progress in agritech last year also stands out, hand in hand with the sector, to implement new technologies in order to achieve advanced and competitive farm management. Precision agriculture with reductions of up to 20% in fertilisers, the implementation of bioptic cultivation systems that increase commercial production by up to 20% and digitalisation in extensive livestock farming that optimises the value chain in the livestock sector are beginning to become a reality.

Finally, I would like to highlight the fact that EMAKUNDE has recognised NEIKER as a ‘Collaborating Entity in Equality between Women and Men’. This distinction is the result of our long-standing commitment to equality, which has become a transversal axis of our strategy thanks to the participation of the whole team.

From NEIKER, we are looking forward to another 25 years!

2023 has been a special year for NEIKER because we have celebrated 25 years since the creation of NEIKER as the Basque Institute for Agricultural Research and Development. Since then, we have contributed to boosting, through knowledge and applied R+D+I, the agri-food and forestry economy of our environment, helping numerous companies in the primary sector to become more competitive and sustainable, and to prepare themselves to face the future with more guarantees.

During these 25 years we have equipped ourselves with reference infrastructures to respond to the needs of society and the sector, such as our pioneering high biological safety facilities (NCB3) that allow us to work with high-risk pathogens (mad cow disease, avian flu or SARS CoV-2). We have also been able to incorporate lines of work that were once emerging and are now consolidated, such as the bioeconomy, agritech, One Health and soil health, which today form the backbone of our actions.

We have tried to make listening, proximity and adaptability our hallmarks. Undoubtedly, a satisfactory trajectory of which NEIKER’s team feel very proud, and which would not have been possible without the trust of our allies, collaborators and clients.

Director General of NEIKER

Leire Barañano

NEIKER Board of Administrators

Chair

Bittor Oroz Izagirre

Vice-Minister of Agriculture, Fish, and Agro-Food
Policy of the Basque Country

Director general

Leire Barañano Orbe

Secretary, non- Board member

Sonia Masip Moriarty

Legal Manager at NEIKER

Members

Iñaki Aldekogarai Labaka

Service Director at the Ministry of Economic Development,
Sustainability and the Environment of the Basque
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Alaitz Ortuondo Pérez

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Quality and Food Industries Director at the Ministry
of Economic Development, Sustainability and
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Nerea Múgica Herrán

Technical Director of Garlan S. Cooperativa

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Agriculture and Livestock Director at the Ministry
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the Environment of the Basque Government

Karmele Pikabea Echave

Director of Euskaber

Xabier Patxi Arrieta

Director of Information Technologies and Communication
at the Ministry of Public Governance and Self-Governance
of the Basque Government

Arrate Lacalle Gutiérrez

Representative of the workers at NEIKER

Federico Saiz Alonso

Chair of BaskEgur

ABOUT NEIKER

02



ABOUT US

We are a technology centre specialising in the creation of innovative solutions for the agri-food and forestry sectors. As an entity dependent upon the Basque Government Ministry of Economic Development, Sustainability, and the Environment, at NEIKER we work to bring knowledge and value to said sectors.

We are part of the **Basque Research and Technology Alliance (BRTA)**, a Basque Government consortium that brings together different technological agents in the Basque Country to tackle industrial challenges in the Basque Country and compete with large leading international research and technology-development corporations.

Moreover, we are part of the Basque Network of Science, Technology and Innovation, which groups scientific and technological bodies and entities. Working as a network enables us to conduct a balanced R+D+I activity, aimed at improving the productivity and competitiveness of the Basque Country's agricultural production systems.



... AND WHAT WE DO

- **We develop new technologies to improve profitability and management of farms**, with a special focus on agri-tech, in order to meet the quality and safety requirements of the agri-food industry and the end consumer.
- **We create scientific knowledge and transferable solutions** that contribute wealth and well-being to our society and surroundings.
- **We contribute to the development of an agro-food and forestry sector** in the Basque Country, the preservation and sustainability of our agrarian and natural environment and developing policies that drive the circular bioeconomy in the Basque Country.



CONTRIBUTION TO SUSTAINABLE DEVELOPMENT GOALS



EXPERTISE



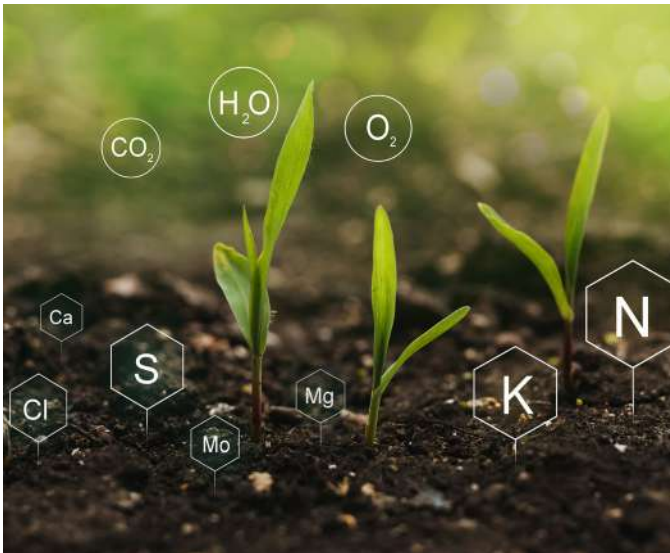
PLANT RESEARCH

- Production systems and good agricultural practices.
- Plant genetic improvement and indicators for resistance to diseases and ailments
- Alternative crops and biomolecules of agri-food interest.
- Crop irrigation dosage
- Diagnosis, epidemiology and control of pests and diseases
- Precision agriculture

ANIMAL RESEARCH

- Genetic improvement
- Food and nutrition
- Production systems
- Applied ethology and welfare
- Epidemiological diagnoses, control and observance of animal diseases
- Zoonosis and food safety
- Environmental biosafety, wildlife and vectors as sources of infection for production livestock and people





ENVIRONMENTAL RESEARCH

- Conservation and sustainable use of agricultural and natural resources
- Recovery of degraded soils
- Environmental monitoring
- Impact, mitigation and adaptation to climate change
- Greenhouse gas emissions in agro-livestock systems
- Circular bioeconomy

FORESTRY RESEARCH

- Plant physiology and tissue culture
- Genomics
- Forestry pathology
- Sustainability and ecosystem services
- Biodiversity enhancement

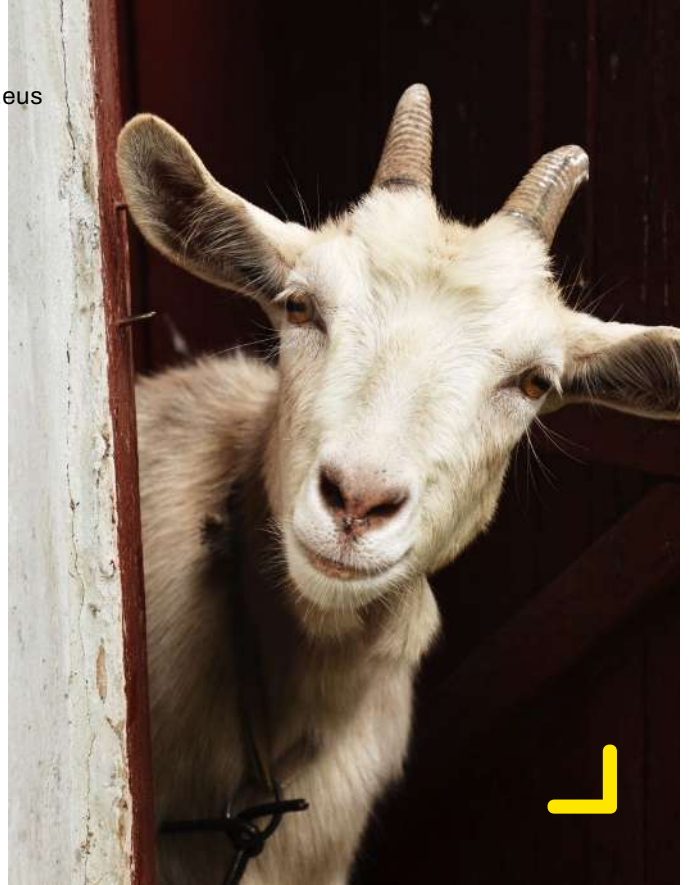


HELPING THE FARMING SECTOR



We contribute to the competitiveness and sustainability of the agro-livestock and forestry sector through research and applied science.





AGRITECH

We incorporate high tech solutions into the farming, livestock, and forestry sector to help it to transform and move toward more productive, sustainable systems that are resilient to the effects of climate change.

SUSTAINABILITY

We promote sustainable and environmentally respectful production processes. We defend farming activity and share its contribution to preserving biodiversity, mitigating climate change, and maintaining the landscape.

COMPETITIVENESS

We use cutting-edge technologies and new production systems to increase profitability, competitiveness, and sustainability for operations, guaranteeing their continuity.

CLIMATE CHANGE

We predict future scenarios and seek possible channels to mitigate and adapt to climate change, suggesting alternatives to current production systems. We inventory greenhouse gases emitted by the livestock sector.

GENETIC IMPROVEMENT

We obtain more competitive products that are more focused on industry and consumer needs, better adapted to climate change and with a reduced environmental impact through genetic improvement.

ONE HEALTH

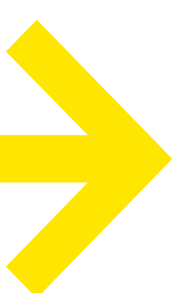
We study the relationship between animal, human, and environmental health. We attempt to reduce the effect of zoonotic diseases and seek alternatives to rationalise application of plant protection products in agriculture and reduce the use of antibiotics with livestock.

ORGANIC PRODUCTION

We research and generate objective and scientific knowledge that helps to foment and strengthen this type of agriculture, making it compatible with the sector's competitiveness.

CIRCULAR BIOECONOMY

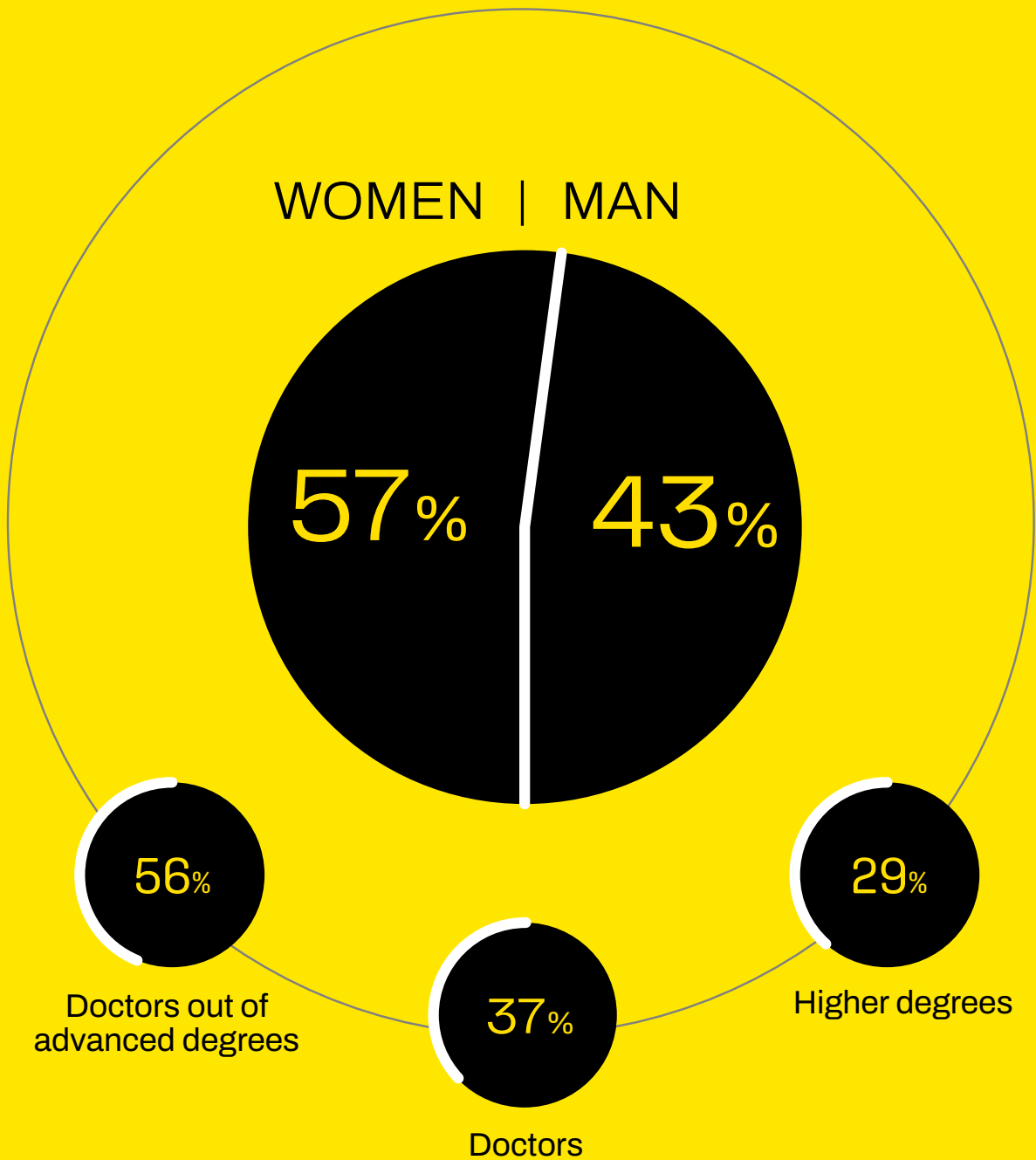
Production processes should not generate waste. Reducing and converting this waste into materials for new products is a way for us to fight climate change, reduce dependency on raw materials, and create new economic activities.



NEIKER'S TEAM

Commitment, scientific excellence, focus on results, and client satisfaction are what define us.

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PROFESSIONALS



WHAT MOVES US



- **Focus on internal and external clients and providing solutions based on scientific knowledge**

We seek solutions both internally and externally, creating value

- **Efficiency and excellency**

We efficiently generate knowledge and advanced solutions

- **Sustainability and innovation**

In all scopes of work with an advanced-management model based on processes and promoting ongoing improvement

- **Welfare and development of people**

We create opportunities for development for all people in safe environments that help their welfare

- **Achievement-oriented**

- Promoting transfer, dissemination, and ongoing improvement for companies and society

- **Ethical commitment**

- We act by following the principles of neutrality, devotion to public service, impartiality, transparency, honesty, and equality



25 YEARS DRIVING THE AGRO-FOOD AND FORESTRY SECTOR

03



In 2023, we celebrated 25 years as a public company under the Basque Government, transformed into the *Instituto Vasco de Investigación y Desarrollo Agrario de Euskadi* (Basque Institute of Research and Agricultural Development of Euskadi).

However, we are veterans: the seed of what we are today hearkens back to 1851, when the Model Agriculture Farm was created in Arkaute (Araba) to drive agricultural activity in the region.

Our **ability to adapt** has allowed us to tackle the profound changes that occurred in the environment and the sector.

We have **collaborated with the leading players in the agro-livestock and forestry sector in the Basque Country:** we are grateful to our partners, collaborators, and trusted clients.

SOME OF OUR MAIN MILESTONES

[1998 - 2023]

- 1998** We became NEIKER, although our origins date back to 1851.
- 1999** We inaugurated the Germplasm Bank with hundreds of seeds from different plant species.
- 2003** Level 3 Biosafety Laboratory to investigate high-risk infectious agents (mad cow, bird flu, or SARS CoV-2).
- 2004** We incorporated the clonal multiplication technique to improve the forestry sector .
- 2006** We detected the first case of bird flu in the Basque Country .
- 2007** Zorbak, the potato created by NEIKER, conquers European McDonald's restaurants.
- 2008** Animal welfare joins our lines of work.
- 2013** Early detection of vine diseases (downy mildew, powdery mildew, and botrytis) before symptoms appear in the plant.
- 2014** Agronews, our APP with information on infestations, diseases, ice warnings, and irrigation recommendations.
- 2015** We launched EUSKOBASOA 2015 to improve the forestry-wood sector.
- 2016** We joined the Red Vasca de Ciencia, Tecnología e Innovación (Basque Network of Science, Technology, and Innovation).





2017

We increased the competitiveness of Latxa, Manech, and Basque-Bearnaise breeds with genetic selection programmes.

2018

We recovered contaminated soils with plants and microorganisms.

2019

We joined the Basque Research and Technology Alliance (BRTA).

2020

The Beltza potato, rich in antioxidants and obtained by NEIKER, reaches the market.

Along with IRTA, we launched the animal welfare seal Welfair™.

2021

We obtained the organic production certificate for seven hectares of our farms.

We promoted the bioeconomy in the agro-livestock and forestry sector of the Basque Country.

2022

We helped to make the Basque Country be declared free from cow tuberculosis by the European Commission.

2023

We strengthened agritech in the Basque Country to transform the primary sector.



SOME EXAMPLES OF OUR COLLABORATION WITH THE SECTOR



“Alliances between technological centres and companies from the agro-food sector are necessary to find solutions to market demands. The new Edurne and Beltza potato varieties we developed with NEIKER are a good example of this.”

**General Manager of
UDAPA S. Coop.**
Alfonso Sáenz de Cámara

“There is increasing demand for more environmentally respectful products. We worked with NEIKER, which has multi-disciplinary teams and cross-cutting knowledge, to help us to achieve both sustainable and profitable production, all at once.”

**Manager of the KAIKU
cooperative**
Iñigo Aranburu

“Like other businesses, climate change is affecting us. Which is why it was important for Ostatu to collaborate with NEIKER to adapt traditional vineyards to new techniques and to introduce new technologies that help to mitigate climate change.”

**Managing Director of
Bodegas Ostatu**
Mariasun Saéñz de Samaniego

“Since 2020, we have been collaborating with NEIKER on the use of insects to add them to the agro-food chain. We are a startup and truly appreciate that our size and type of business do not pose an obstacle to work with a technological centre like NEIKER.”

CEO of Insekt Label
Josu Oleaga

SCIENTIFIC AND MANAGEMENT EXCELLENCE

04



We research to make it easier for companies to add R+D+i to their strategies, so they can confidently tackle the triple “technological-digital, energetic-climate, and social-health” transition as a result of the impact of global trends and circumstances.

We generate and share knowledge with and for the Basque farming sector and Basque society in general.

2023 MILESTONES

For the second time in the past 10 years, we have published over **75 articles in journals of international prestige** (Scopus database).

We participated in the **Sare National Carbon Farming Network**, whose purpose is to create a space for knowledge on carbon sequestration in farming land, an issue that sparks great expectations and controversy in Europe.

We led the Work Group “**Ecosistemas Alimentarios Seguros, Sostenibles y Saludables (Safe, Sustainable, and Healthy Food Ecosystems)**,” a key part of the PCTI-Basque Government’s Healthy Food Pilot Group.

We joined the **Permanent Council of the Doctorate School of the UPV/EHU (University of the Basque Country)** as Representative of Doctorate Programme Collaborating Entities.

We celebrated the **First NEIKER Young Researcher Workshop** to acknowledge their work and provide them with the opportunity to present their research.

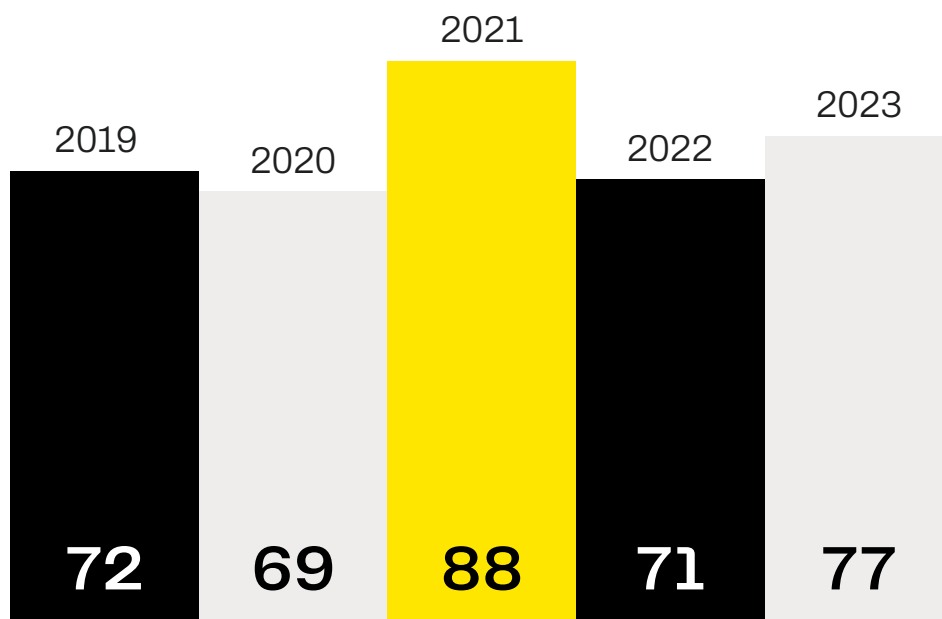
We continue to establish new alliances with key players. In 2023, the alliance with the technological centre VICOMTECH is of note. VICOMTECH is a great collaborator to meet technological and digital transition goals in the agro-food sector. Also of note is IRTA, a leading agro-food research centre.

PUBLICATIONS

SCIENTIFIC-TECHNOLOGICAL EXCELLENCE



N° of scientific publications indexed.



- NEIKER has a Hirsch h-index ≥ 90 .

- Over 75 articles indexed on Scopus with over 100 citations.

- Over 75 articles indexed on Scopus with over 100 citations.

PATENTS

In 2023, we transferred the patent for the “In-vitro method for early diagnosis of cow paratuberculosis” to the company **BIOLAN**.

In collaboration with **INIA-CSIC**, we also filed the patent “Genetic markers to classify cows based on their tolerance, susceptibility, and resistance to paratuberculosis.”

In collaboration with UPV/EHU, we filed for a patent to detect root exudates using paper microfluidic devices.

COLLABORATIONS

With **SEIPASA**, **CERTIS**, **BASF** and **SYNGENTA**, to design new, more efficient and sustainable pest and disease control itineraries.

With **UAGA**, **AGA** and **ABERE** to advance sustainable production systems.

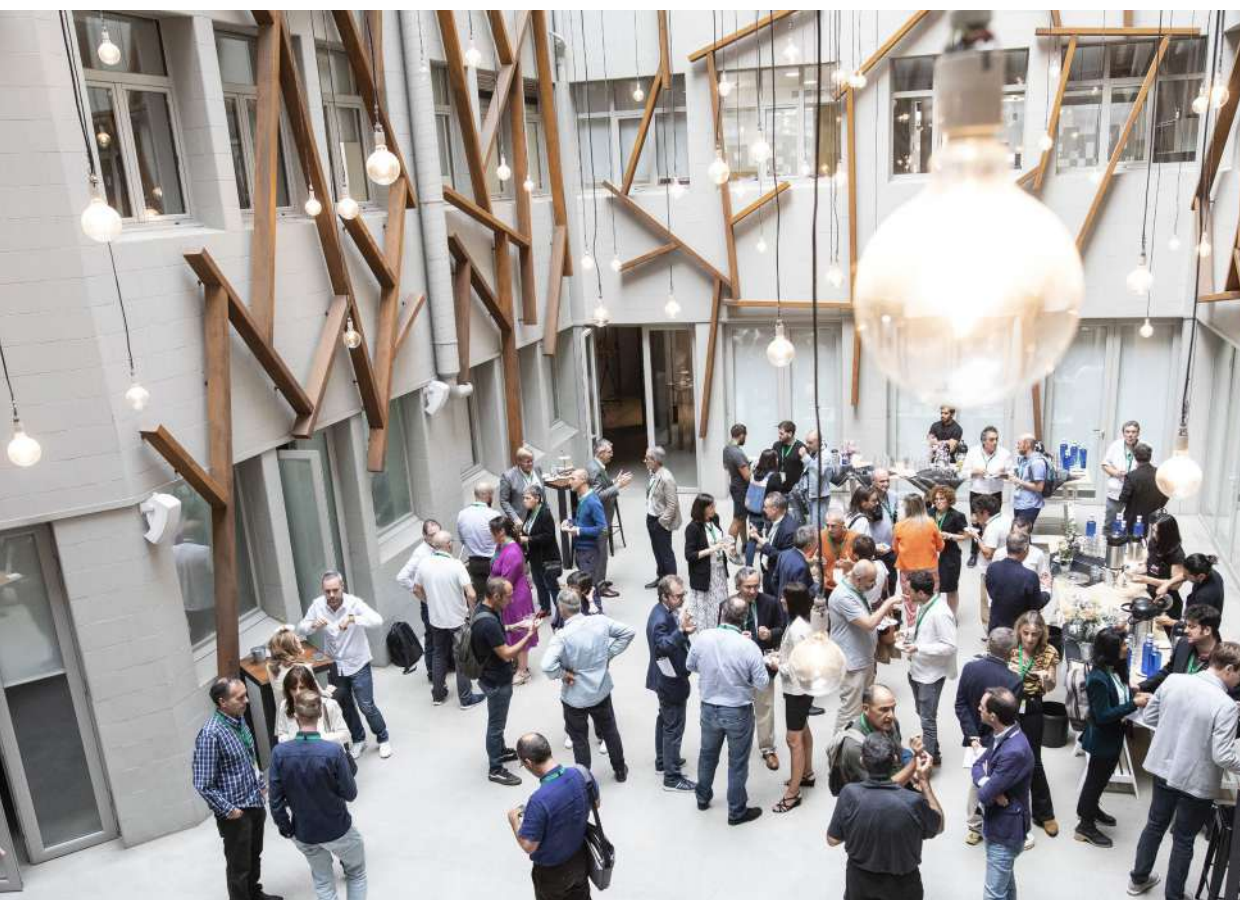
With **GARLAN** and **UDAPA** to promote the implementation of technification-digitalisation in agriculture (AGRITECH).

With **EITFOOD** and **LURSARE** to promote and extend regenerative agriculture for its contribution to soil protection and climate change mitigation.

With **IHOBE** to establish lines of work for the mitigation and adaptation of the agricultural sector to climate change, and for soil conservation.

With **BC3** to define future lines of work to generate knowledge to guarantee a primary sector that is resilient to climate change in the Basque Country.

With **BIOBIZZ**, **AVANZA-BIO**, **GARAIA** and **BARRENETXE** to create new products and develop new cultivation techniques, such as organic fertilisation in hydroponics (bioponics).



LOCAL AND INTERNATIONAL ACKNOWLEDGEMENTS

 **Three NEIKER researchers, again in Stanford's Ranking**

They are Carlos Garbisu, specialist in environmental microbiology and scientific director of NEIKER, Ramón Juste, expert in animal health, and Inma Estévez, a well-known scientist in ethology and animal welfare.

 **VITISAD POCTEFA, proyecto liderado por NEIKER, recibe el premio 'EuropaSeSiente'**

This award recognises projects that raise visibility and awareness in citizens as to the results and the added value from the support of European funds in Spain.





🔗 **LIFE URBASO, coordinated by NEIKER, winner of the Lurra Bizkaia award**
Awarded by the Water Consortium of Bilbao Bizkaia, these awards acknowledge the work of entities and associations that are implicated in guaranteeing equal access to water and its conservation.

🔗 **Our colleague María Canive Ruíz, runner-up for the Syva 2023 award for the best doctoral thesis in animal health**
Entitled “Marcadores inmunológicos y genéticos asociados a infecciones causadas por *Mycobacterium avium* subsp. *paratuberculosis* (MAP) en ganado bovino (Immunological and genetic markers associated with infections caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP) in bovine livestock),” the thesis focused on developing new strategies for early diagnosis of the infection caused by MAP based on biomarkers.



MEMBERS OF...



Aclima



Fundación Vasca para la Seguridad Alimentaria



Agencia Vasca de Innovación



Asebio



Basque Research & Technology Alliance



Lekunberriko Instituto Laktologikoa



European Forest Institute



Innovative Community of EIT



Elhuyar



Basque Food Cluster

ALLIANCES



AZTI



BasqueEgur



BCC Basque Culinary Center



BC3 Basque Centre for Climate Change



BCAM Basque Center for Applied Mathematics



CICbioGune



CICbiomaGune



Cidetec



CIEFAP Centro de Investigación y Extensión Forestal Andino Patagónico (Argentina)



CTFC Centro de Ciencia y Tecnología Forestal de Cataluña



Gaiker



HAZI



IRTA Instituto de investigación de la Generalitat de Cataluña



Tecnalia



Tekniker



UPV-EHU



USSE



VICOMTECH

MAIN CLIENTS



Aberekin



ABRA



ADR Añana



ADR Lautada



AEA
Technology



Agromillora



Alavesa
de patatas



Avanzabio



Barrenetxe



BASF



BaskEgur



Batura Mobile
Solutions S.L



BIOLAN



Boehringer



Bodegas
Itsasmendi



Contino



Econatur



ENKŌA System
S.L



Egoin



Ferninagro



Garlan



GARAIA



Gorka Izagirre



Harakai-Urkaiko

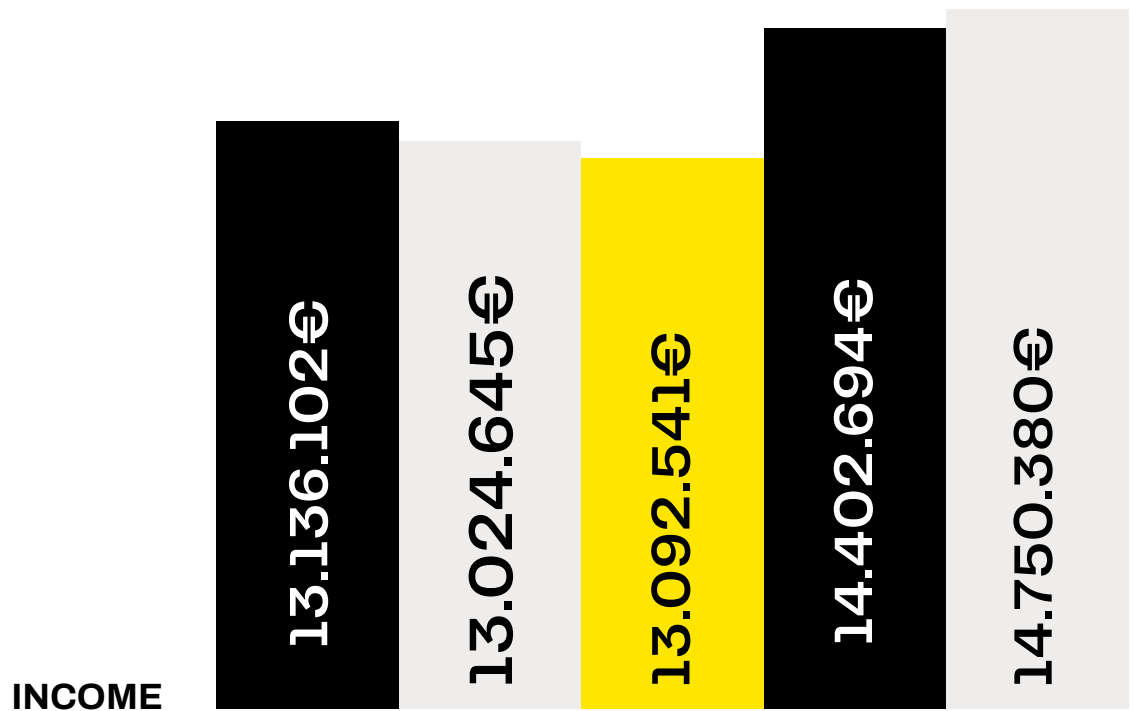
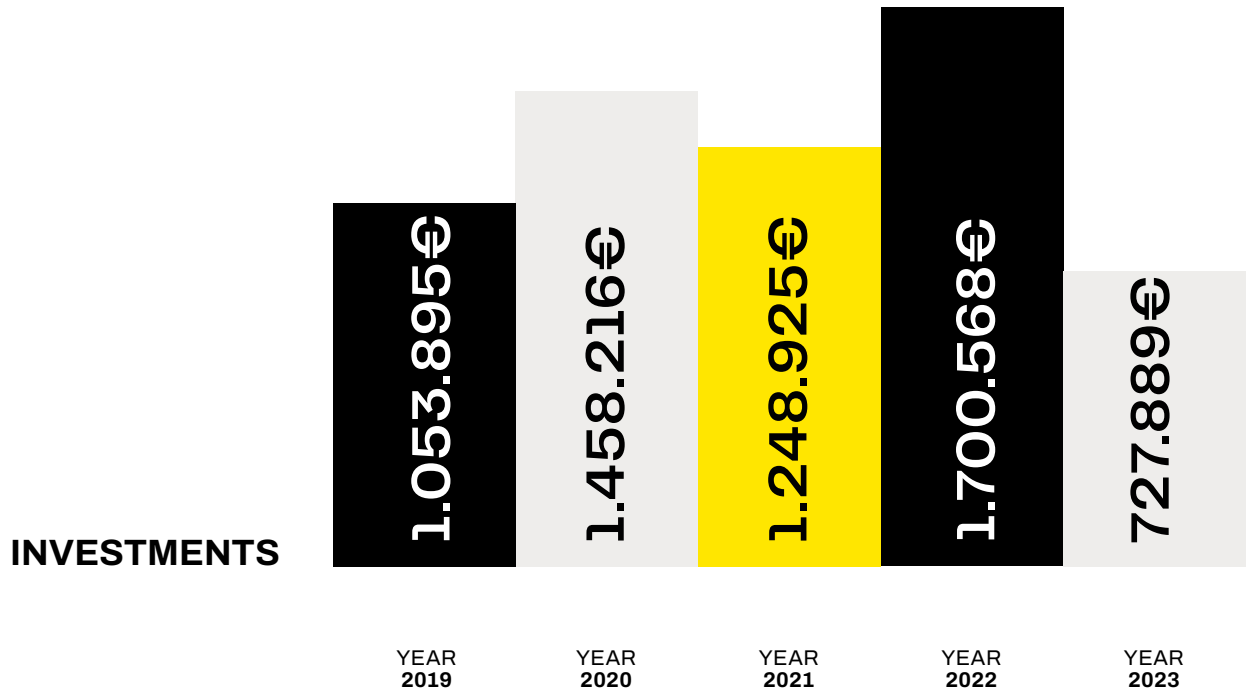


IK-Ingeniería





FINANCIAL-ECONOMIC INDICATORS



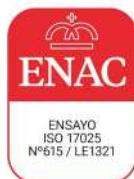
GOVERNANCE: **COMPLIANCE AND EQUALITY**

In 2023, we started up the tool “Information Channel” on our website, available in three languages.

- We also held another awareness workshop on the Code of Ethics to internally share the set of principles that governs NEIKER.
- In 2023, EMAKUNDE granted us recognition as **“Collaborating Entity for Equality of Women and Men”**, due to our commitment to make equality a strategic and cross-cutting cornerstone at NEIKER.
- We participated in BAI SAREA de Emakunde, a network consisting of collaborating entities for equality, where we shared experiences, lessons, etc., to promote equality between women and men.



CERTIFICATIONS



LEADING FACILITIES AND ANALYTICAL SERVICES

05



The information obtained by our analytical services is nowadays essential for the development of the sector in terms of economic efficiency and sustainability.



ANALYTICAL SERVICES

- **Over 100,000** analyses in 2023.
- **Over 25 years** providing consulting services for the agro-livestock and forestry sector.
- **Over 20** highly qualified **professionals**
- **OVER 300 clients** from all links on the chain of value 300.

Members of the network of biological alert (RE-LAB)

OUR ANALYTICS

Animal health:

reproductive and viral diseases in ruminants, microbacteriorosis, microbiology for feed and raw materials, detection of pathogens in milk, antibiotic resistance, etc.

Preservation of natural resources:

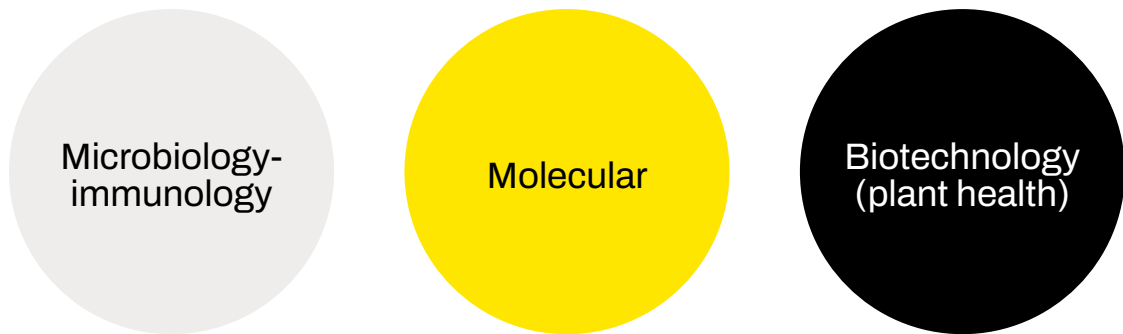
fertility and hydric properties of soil, physiological and biological parameters of soil, consulting for transition toward agro-ecology, consulting on mitigating climate change, etc.

Plant health:

certification for seed and ware potatoes; purity trials and botanical seed germination, detection of quarantine organisms, disease diagnosis, identification of plant species variety, issuance of plant passport for proprietary propagating material...

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accredited techniques
in the following areas:



Laboratory infrastructures
and greenhouses



- Microbiology and immunology laboratory
- Pathological anatomy, clinical biopathology, and parasitology areas
- Level-3 biocontainment laboratory (NCB-3)
- Facilities for animal experimentation with levels 2 and 3 of biocontainment
- Soil and plant matter analysis laboratory
- Plant analysis laboratory
- Biological contingency-2 greenhouse for trails with SL-2 quarantine pathogens
- Greenhouses for hydroponic and aeroponic growing of plants and microalgae
- Chromatography area
- Biotechnology areas
- Analytical chemistry area

LEADING FACILITIES

High-security facilities

1.520 m²

NCB-3 laboratory

673 m²

NCB-2 and SL-3 greenhouses

845 m²

Laboratories

3.305 m²

Laboratories for Conservation
of Natural Resources

705 m²

Animal Health laboratories

1.100 m²

Plant Health laboratories

1.500 m²

Greenhouses and tunnels

7.138 m²

Glass, plastic and rigid plate-covered
greenhouses

3.500 m²

Test culture surface

2.000 m²

NBC-1 and aeroponics greenhouses

1.638 m²

Livestock facilities

2.765 m²

Experimental farms for arable and fruit crops

100 ha

Other facilities

1.810 m²

Warehouses, selection rooms
and characterisation and services

900 m²

Agriculture warehouse

500 m²

Field workshops

340 m²

Refrigeration chambers

70 m²

2023. RESEARCH AND TRANSFER

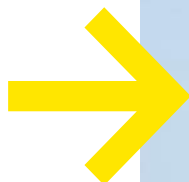
06



#AGRITECH

ARTIFICIAL INTELLIGENCE TO DISCOVER SOIL HEALTH IN EUROPE

Around 60-70% of European soil does not have adequate health. This is mainly due to the loss of organic matter and biodiversity and the fact that there is no specific legislation to care for this resource today. We must activate methods to measure and assess progress in achieving healthier soil. For this reason, NEIKER is participating in the project AI4SoilHealth, whose objective is **to create a digital infrastructure that monitors and predicts soil health indicators on the continent. This platform uses artificial intelligence** to analyse different aspects of soil, to use remote detection systems, or to create maps.



DRONES TO PROTECT FORESTS FROM PESTS

The use of drones in agriculture and the forestry sector is new. We need data to assess their impact and to learn how to best use them. NEIKER has participated in the pioneer project G.O. PhytoDron. **It seeks to foster the use of drones in precision agriculture to preserve plant health in crops, all while making regulatory progress.** This is the only project in Europe that has conducted tests with this tool on pines. This research was conducted with BASKEGUR in Aramaio (Álava).

During the project, we learned that drifting with drones has its own function, that the device is more precise and requires less product, and that specific training is essential.





VIRTUAL FENCES TO CONTROL HERDS FROM DIGITAL DEVICES

A large part of the Basque Country's natural landscape is because livestock has been linked to the region for thousands of years. Herding has multiple benefits that are both environmental and socioeconomic. But situations such as a lack of shepherds to manage livestock "in the field," the existence of many terrains that are not physically delimited, the cost of maintaining enclosures on mountains, etc., imply inefficient management of pasture resources and, oftentimes, and increase of fuel material, with the consequent risk of fire.

For this reason, **in 2023, we developed a virtual fence solution.** This is an app where the livestock manager designs the virtual fence(s) and devices that interact with the animals, so they do not cross the established virtual limit. This technology provides simple and efficient control over animals and grazing with a mobile telephone or a tablet, which provides efficient management of both animals and the grazing area.

#SUSTAINABILITY AND #COMPETITIVENESS

LARGER LETTUCE, MORE RESPECTFUL OF THE PLANET

With bioponics, we achieved lettuce 20% larger than lettuce obtained with hydroponic crops.

Bioponics is a system that combines hydroponics (soil-free crops) with organic instead of mineral fertilisers. Its noteworthy advantages include a reduced carbon footprint and increased sustainability. The research lasted two years and consisted of collaboration between the bio-fertiliser companies Biobizz and AvanzaBio.

Likewise, together with Garaia and Barrenetxe, we have managed to demonstrate that the drastic reduction of phytosanitary products is possible in lettuce under glass. Both projects have been co-financed by the Basque Government's call for Operational Groups and have had the active participation of producers who are very committed to the environment.





THE ROLE OF UDDER MICROBIOTA IN MASTITIS

Mastitis is one of the most frequent illnesses in dairy cows, and one that most affects livestock operations. By using mass sequencing techniques, **NEIKER studied the role of udder microbiota on mastitis. The use of conventional microbiological cultivation methods is sometimes unfruitful for diagnosis.** This work allowed us to differentiate between different microbial community profiles in milk. While samples from healthy animals display profiles with greater microbial diversity, animals with clinical mastitis have lower microbial diversity, a sign of a clear alteration and loss of balance in the endogenous microbiota. However, we also observed intermediate situations, which suggest that mastitis is a dynamic process where the udder microbiota is in a state of constant change. This proves how complex it is to define one single profile for microbiota associated with the development of mastitis.

#SUSTAINABILITY AND #COMPETITIVENESS

IN SEARCH OF THE KEYS TO GENETIC RESISTANCE TO ILLNESS IN COWS

The specific genetics of each animal is one of the most important factors in resistance to infections, such as those caused by microbacteria that cause bovine paratuberculosis and tuberculosis. In collaboration with the Spanish Frisian Confederation (CONAFE) and the INIA Department of Genetic Improvement, and under the framework of the project PARARESILIENCIA (PID2021-122197OR-C21), **we identified gene variants associated with lower susceptibility and greater resistance to microbacteria illnesses**. Specifically, we worked on developing predictive gene models integrated into an advanced bioinformatic tool to help the livestock operator to select the most immuno-competent animals since birth to reproduce.

ENVIRONMENTAL FOOTPRINT OF THE FARMING SECTOR IN ÁLAVA

In collaboration with Abere, Garlan, and UAGA, we are developing the GENAGROALAVÉS project **to analyse the environmental footprint of operations and show their contributions to environmental maintenance**. We used the Life Cycle Analysis software SimaPro, a powerful tool that can analyse several environmental indicators. The purpose is to establish a working methodology to be able to advance in the calculation of the carbon balance of agriculture, starting with the calculation of the environmental footprint and continuing with the analysis of carbon content and the effect of management practices on soil carbon.

INNOVATIVE SOLUTIONS FOR SHEEP HEALTH AND NUTRITION

In 2023, the EUROSHEEP project came to an end. This is the European network to **exchange knowledge on the health and nutrition of sheep and lambs to guarantee profitability in the sector**. NEIKER coordinated this project in Spain. It included the participation of over 1,200 livestock operators, shepherds, veterinarians, researchers, and academics from Europe. At EUROSHEEP, they shared the needs, concerns, and experiences of players who work in the sector to obtain greater knowledge and establish solutions and good practises to guarantee the profitability of sheep livestock in Europe.





#CLIMATE CHANGE

AGROFORESTRY TO INCREASE FOREST RESILIENCE TO WILDFIRES

The combination of forestry production and grazing in one same region, known as agroforestry, has become an option of great interest to achieve forests that are more resistant to climate change. It allows livestock to use forests, preventing or reducing fires, increasing biodiversity, and promoting development of the rural economy.

Agroforestry in a network of 11 areas located in 4 regions (Basque Country, Galicia, Asturias, and Trás-Os-Montes-in Portugal) and with animals of indigenous breeds in danger of extinction. In 2023, we launched from NEIKER the demonstration areas with Terreña cows in Orozko (Bizkaia) and with Sasi Ardi sheep in Jauregi/Azilu (Álava). The animals also have a virtual fence device to keep display areas grazing-free within the enclosure to compare grazing areas to areas that have not been grazed.





EUROPEAN PLATFORM FOR EARLY WARNING OF DROUGHT, FIRE, AND FLOODING

The digital platform ClimAlert for predicting water-related climate risks is now finished and available. NEIKER, along with other European agents, **developed this tool to help provide more efficient public-private water management and to avoid soil erosion stemming from climate change**. ClimAlert, which is based on meteorological data and satellite images from different sources and open-access data, monitors past and future climate variables (temperatures, precipitations, etc.) in one specific zone. It also issues warnings in the event of extreme weather conditions. Since its start-up, ClimAlert has monitored drought in the Basque Country and provided valuable information for Basque public administration to make decisions.

#CLIMATE CHANGE

**GREEN FEED, NEW INFRASTRUCTURE
TO DECARBONISE LIVESTOCK**

The European Union has established improved food efficiency as one of the main lines to mitigate methane emissions. NEIKER has been working on this for years. Our latest addition to make progress in this regard is Green Feed, **a mobile device designed to individually calculate daily methane and CO₂ production that NEIKER has acquired.** It can be transported to the cow farms with which we collaborate on different projects and is the only device with these characteristics available on the Cantabrian coast that is specific to cow livestock. This is along with other complementary devices that NEIKER already has, such as incubation in bottles, a rumen simulator (Rusitec), and our newly installed respiration chambers to research improved food and production efficiency.





MONITORING DISEASE-VECTOR ARTHROPODS

Mosquitoes and ticks are important disease vectors, both for animal and for human health, especially in a context of climate change that foments their proliferation and spread. In 2023, we continued our work monitoring invasive mosquitoes in the Basque Country. **We observed a wide spread of these invasive mosquitoes, with *Aedes* spp. eggs present in 95% of the municipalities studied.** Moreover, we recorded a significant increase in the number of positive samples and the number of eggs per trap in comparison with 2022, which shows that these species continue to progress in our region, especially the tiger mosquito, most likely favoured by the summer's environmental conditions in 2023.

With the aim of coordinating the agents involved in the surveillance and control of invasive mosquitoes, the Inter-institutional Coordination Group was established in 2023, led by the Vice-Ministries of Health and Agriculture, Fisheries and Food Policy. A Technical Secretariat was also created. NEIKER actively participates in both groups and continues to be a scientific-technical reference in issues related to arthropod vectors.

#ORGANIC PRODUCTION

“FARM TO FORK” ORGANIC FLOUR

Introducing organic products to the market is easier when all links on the chain of value are connected. This was precisely the objective of the LANIRINA project: **to create synergies so that the cultivation of organic grain on the Llanada Alavesa could go from the producer to the consumer with no need for middlemen.**

For this reason, they transformed this raw material into organic flour with added value and higher quality to offer it directly to end consumers in the format of flour or organic products made with the flour, like bread, pastries, and pizzas.

NEIKER provided its knowledge to select grain varieties that provide the best yield for organic agriculture, along with guidelines to ensure the quality of the grains and consulting on the best way to handle it.





PROGRESS IN ORGANICALLY GROWN SQUASH, SOY, AND BEETROOT

Organic production has continued to take over more hectares of land in the Basque Country. According to data from the Ministry for Agriculture and Ecological Food of the Basque Country (Ekolurra), in 2022, the surface area devoted to organic cultivation grew by 15% in comparison with 2021 in the Basque Country. For this kind of cultivation to continue expanding, research into new varieties that can contend with current challenges is essential. Within this context, **in 2023, we presented progress on new varieties of beetroot, squash, and soy for transformation into plant protein for human food, as well as new commercial kinds of wheat for production of organic flour.** This field work falls under the Plan para el Fomento de la Producción Ecológica (Plan to Promote Ecological Production) (FOPE), driven by the Basque Government and promoted by Ekolurra and NEIKER.

#BIOECONOMY

BIOFERTILISERS FROM GROWING MICROALGAE

With the **SEA2LAND** project, based on circular economy, we seek solutions to challenges related to food production, climate change, and reusing waste. In 2023, **we implemented an innovative methodology that uses brine generated by local tuna canneries as a culture medium to produce marine microalgae.** This process recovered over 90% of the organic nitrogen contained in brines, consisting mainly of amino acids and proteins. Moreover, microalgae production costs were lowered, and the environmental impact of dumping brines was avoided.

We have also developed several biologically-based fertiliser prototypes. One of the most noteworthy is an organic fertiliser made with microalgae biomass (produced in effluents from fish processing as a growth substrate). Results from field tests display a very good productive response and improvements in soil health.





WE USE GRAPE STEMS AND COFFEE GROUNDS AS A FOOD ADDITIVE

Using sub-products or waste from the food industry in circular economy processes is essential and will turn livestock production into a more sustainable system that meets the growing demand for products of animal origin, like meat, dairy, etc. For this reason, **NEIKER is working on different projects where we will reuse said sub-products from the farming sector as possible food additives for livestock.**

One of them is **NEWFEED** where we designed feed for ruminants (dairy cows and sheep) that includes grape stems from wineries in their formula, using circular economy processes. We have verified that including grape stems in feed does not negatively affect the animals' productivity, milk, composition, or sensory quality of the dairy products. However, **it did improve the fatty acid profile of the milk with a higher percentage of polyunsaturated omega-6 and omega-3 fatty acids, resulting in healthier milk.**

Another project is **ECOFEED** where we designed feed for ruminants (dairy cows and sheep) that include coffee grounds from the food and restaurant sector in the formula. We verified that including coffee grounds in feed does not negatively affect the animals' productivity, milk composition, or sensory quality of the dairy products. However, **it reduced enteric methane emissions from the animals by 19% and improved their antioxidant status, with the positive environmental and health implications that these changes entail.**



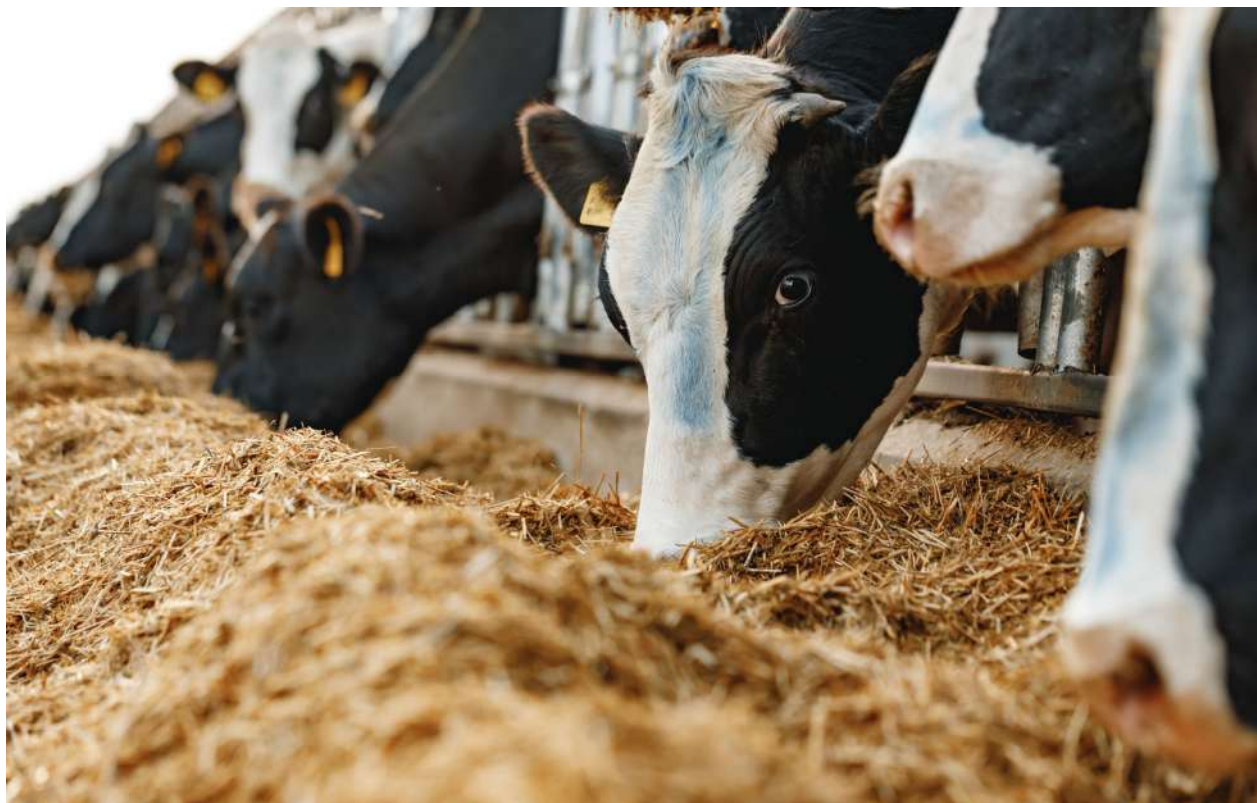
#ONE HEALTH

WE MONITOR THE HEALTH STATUS OF WILD FAUNA IN THE BASQUE COUNTRY

Studying the health of wild fauna provides greater knowledge of pathologies that affect the species in our region, their prevalence, and their geographical distribution. Some of these illnesses are of special interest since they can also affect domestic species or humans.

In 2023, we detected 5 outbreaks of highly pathogenic bird flu, affecting laughing gulls, yellow-legged gulls, and great cormorants, 7 outbreaks of Newcastle disease in Eurasian collared doves, mute swans, and other waterfowl, and one outbreak of botulism mainly affecting mallards. We also monitor other relevant pathologies, such as animal tuberculosis, brucellosis, hydatidosis, scabies, Aujeszky's disease, and epizootic haemorrhagic disease. Moreover, we keep watch over the possible entry into the Basque Country of emerging illnesses, such as African swine fever or the West Nile virus.





WE CONTINUE TO FIGHT AGAINST ANTIBIOTIC RESISTANCE

The fight against the spread of resistant bacteria in livestock is a global objective because the emergence and spread of infections caused by antibiotic-resistant bacteria could jeopardise the efficacy of these medications.

NEIKER has been working on this for years, improving laboratory techniques and conducting epidemiological studies on the prevalence of resistant bacteria. In the latest period, we studied the transmission dynamic of resistant bacteria on dairy cow livestock farms. Thus, in collaboration with Veterinarians from the Ministry of Health and Addictions of the Basque Government, **we conducted a study to monitor resistant bacteria in healthy animals at slaughterhouses (chicken, bovine, ovine, and porcine livestock)**. Moreover, along with Osakidetza and Public Health, we participated in a “Collaborative multi-disciplinary network to monitor antibiotic-resistant bacteria in the Basque Country” to compare the resistant bacteria circulating in the environment where people, animals, and food interact.

#ANIMAL WELFARE



PRACTICAL GUIDES TO ENSURE WELFARE OF PULLETS AND LAYING HENS

Under the project “Best Practice Hens,” we published a transect-based protocol (a method used to estimate population abundance and density) to assess the welfare of pullets and laying hens kept in aviary systems. Said assessment protocol is available in different languages (including Spanish) and can be downloaded on the project website: <https://bestpracticehens.eu/es/materiales/>. It is accompanied by an Excel file, which is also available on the same page, which hugely facilitates the quantitative logging of welfare indicators and results obtained. The purpose of the assessment, both for pullets during the rearing phase and for adult hens while laying, is the early detection of health and welfare issues to control them. This, in turn, improves productive yield.

PROTOCOLS TO CERTIFY DUCK WELFARE

Throughout 2023, we worked on designing and testing a protocol to certify animal welfare for ducks based on the transect methodology (method used to estimate population abundance and density). This project arose from the company FOIEGOOD'S need to certify duck welfare throughout their production cycle— in which no force— feeding phase is carried out- with the Welfair® seal. We also worked with FOIEGOOD to improve their facilities, such that ducks are provided bathroom access and they can make better use of the meadows where they are reared. FOIEGOOD is the first company in the world to develop an alternative product for Foie gras, where ducks undergo forced-feeding procedures. Therefore, they are eligible for this animal welfare certification.



#FORESTRY IMPROVEMENT

Our activity falls under EUSKOBASOA 2050 Basque Country Plan for Forestry Improvement. It consists of four main lines of action: health, alternative species, wood quality and the reactivation of a genetic improvement plan (with another two cross-cutting lines: climate change and sustainability).

FOREST SOIL AND WATER QUALITY

In LIFE URBASO project, we studied the interactions between the water, the soil, and the vegetation in forests and how this aspect influences management. We also **suggested guidelines for forestry management in drainage basins for human consumption because the quality and quantity of the water we drink depends on this**. In 2023, we monitored eight basins intended to produce potable water. In 4 of these basins, we sought to modify forestry management to apply close-to-nature forestry (with permanent forest cover) to protect the soil. In so doing, we care for collecting consumption water, all while ensuring wood production by maintaining and improving biodiversity.

Management at the other 4 basins was similar to management to date. We collected daily water samples all year long in order to analyse different parameters that are fundamental for the purification process. These data helped us to identify the most sensitive period of the year for ensuring water quality, vital information to fulfil health criteria for the quality of water for human consumption set forth by Royal Decree 140/2003.





KNOWLEDGE AND CONTROL OF “BANDA MARRÓN” AND “BANDA ROJA”

In 2023, we continued to work with diseases, especially the “banda marrón” and the “banda roja.” Among other observations, to date, **we have detected 39 different genotypes of the “banda marrón” in the Basque Country, with lines present in the north and the south and, for the first time, hybrids between lines.** This could explain its great ability to adapt, to colonise new habitats, and to cause serious harm to more tolerant pine species. Regarding disease control, we have defined the most suitable management strategies to prevent and control these diseases. To this end, we studied and selected 12 natural substances and local organisms (yeasts, for example) that are especially effective against forest diseases.

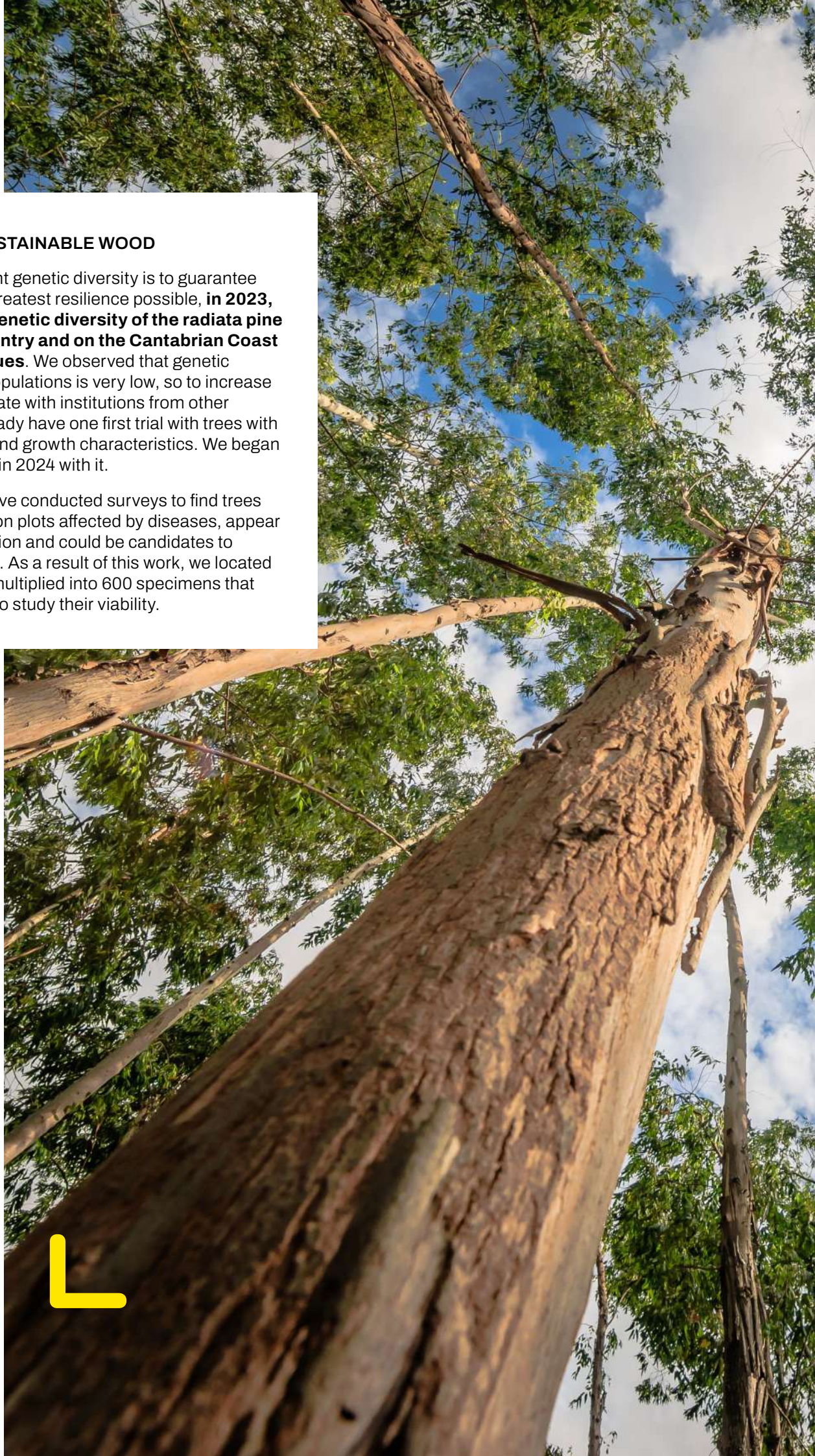


#FORESTRY
IMPROVEMENT

QUALITY AND SUSTAINABLE WOOD

Given how important genetic diversity is to guarantee materials with the greatest resilience possible, **in 2023, we analysed the genetic diversity of the radiata pine in the Basque Country and on the Cantabrian Coast with DNA techniques.** We observed that genetic diversity in these populations is very low, so to increase it, we must collaborate with institutions from other continents. We already have one first trial with trees with the desired shape and growth characteristics. We began controlled crossing in 2024 with it.

Furthermore, we have conducted surveys to find trees that, despite being on plots affected by diseases, appear to be in good condition and could be candidates to tolerate the disease. As a result of this work, we located 51 individuals that multiplied into 600 specimens that have been planted to study their viability.





NEW ALTERNATIVES

Under EuskoBasa 2050, we also worked to determine the right species for each specific zone, considering factors such as the climate (current and future), the soil, and the specific needs of each tree. Thus, considering that the Basque Country's climate will be more temperate, with less water during the summer period, it will move toward "Mediterraneanisation." In this regard, in collaboration with the Higher Institute of Agronomy of the University of Lisbon, , **we tested the growth of trees that survive under the climatic characteristics of the Portuguese regions of Sintra and Tapada de Ajuda. According to forecasts, they will behave similarly to Basque forests in upcoming decades.**

FOREST ECOSERVICES

In 2023, we also undertook several projects related to forest ecoservices. Thus, **we developed a map of soil carbon stock, where mountain pastures stand out as the zones with the most carbon in the first 30 cm of soil, followed by forest zones.** The average carbon content in soil is 73 tonnes of carbon per hectare, and mature forests in the Basque Country characterised by NEIKER have an average content of 100 tonnes of carbon per hectare, 35% above average.


We also, **studied the evolution of rain's erosive capacity in the Basque Country, which will increase due to climate change.** It is predicted that this will be especially intense in the eastern region of Gipuzkoa in several decades. In this context, forestry that guarantees permanent ground cover will play a fundamental role if we wish to comply with the Soil Protection Strategy of the Basque Country 2030.



LIFE SILFORE project day, in Orozko (Bizkaia), on 5 December 2023.

#TRANSFER DAYS AND #WEBINARS

We share and transfer our knowledge, research, and solutions with the sector.

-  **Strategies to control viruses in Ibarra chilli pepper crops**
(25 January)
-  **Technical workshop for slaughterhouse veterinarians**
(25 January)
-  **Challenges in the agro-food and forest sector**
(2 March)
-  **Environmental footprint of operations: how to measure it and reduce its impact**
(15 March)



- [!\[\]\(467d80e979964f7f8c752fb22248b5b7_img.jpg\) **Implementation of organic crops: high-value organic flour**
\(31 March\)](#)
- [!\[\]\(b71552d33dbf62adf5e5199a70ee02bf_img.jpg\) **Technological innovations in the ovine sector: situation and use in livestock in New Zealand**
\(20 April\)](#)
- [!\[\]\(03134b765d1473836ff001925b1b0550_img.jpg\) **Workshop on bioeconomy**
\(27 April\)](#)
- [!\[\]\(aed6947356668967079310026052edc0_img.jpg\) **Field visit to learn the results of test on winter grains**
\(25 May\)](#)
- [!\[\]\(e61aeb0d9066d5d9e54d9b655f50da3d_img.jpg\) **Profitability of sheep through health and nutrition**
\(30 May\)](#)
- [!\[\]\(f7af41ce0777e13bda91fa715111c02a_img.jpg\) **Advanced methodologies for more sustainable forest management**
\(31 May\)](#)
- [!\[\]\(476ddb2354d4ad1cb23a2236b1e49873_img.jpg\) **Seed potato: demands of seed user and new trends on the consumption potato market**
\(7 June\)](#)
- [!\[\]\(1d505a46c82c5cefa23b88c2eee900ce_img.jpg\) **Field tour of NEIKER's organic agriculture plots**
\(29 June\)](#)
- [!\[\]\(3a98690f11ee4baf67262bd776464219_img.jpg\) **Presentation of results from tests on grain varieties and the use of drones in crop management**
\(21 September\)](#)
- [!\[\]\(35522fe6386206890679adb7b63391b6_img.jpg\) **Innovation in Bioeconomy in the Basque Country**
\(4 October\)](#)
- [!\[\]\(d28d4a3445dac344f03b5cebc14c5170_img.jpg\) **Participation in the Potato Fair of Valdegovía, presenting new NEIKER varieties**
\(15 October\)](#)
- [!\[\]\(3e37ae08976ee7fa41b108254fcb66a7_img.jpg\) **Agritech experiences in agriculture and livestock**
\(26 October\)](#)
- [!\[\]\(7b30e10e474a15019e378034a5556dd2_img.jpg\) **The role of agroforestry to preserve and manage resilient agro-forest systems**
\(5 December\)](#)
- [!\[\]\(be2bdf77bab097eb6ddf17878ba7ec4d_img.jpg\) **Precision agriculture and digitisation of the farming sector**
\(15 December\)](#)

AVERAGE SCORE OF
OUR WORKSHOPS

→ **8,5**

WITH OUR ENVIRONMENT

07

SCIENCE DISSEMINATION



We participated in **Zientzia Azoka** to drive scientific culture through projects designed by youth. We were on the jury to select winning proposals and we welcomed participating schools for a two-day stay.

We also supported initiatives like **Pint of Science** to disseminate science in fun, personal talks and in formats that are more accessible to the public. Once again last year, in 2023 we were in Vitoria (beer in hand), chatting about the bioeconomy and how it can help us to transition toward a more sustainable and environmentally respectful economy.



SUPPORT FOR BASQUE



In 2023, we took part in the innovative **Ikusgela** project to disseminate science in Basque. Using language and resources adapted to new narratives, with a fresh tone, NEIKER participated in 8 videos on subjects such as species migration and the diseases they bring, or precision agriculture.

Moreover, with the '**NEIKER saria**' award, we continue to promote sharing science in Basque, as part of the CAF-Elhuyar awards. Last year was the seventh time. The winning article was on the diversity of values and interests of the Aralar natural park.

SOLIDARITY

We continue to support the NGO Saluganda, 2010ean sortu zen, Ugandako landa eremuetak, created in 2010 to improve the quality of life of women, girls, and boys in rural areas of Uganda. Saluganda's lines of action are education, water and sanitation, agriculture and livestock, and health and nutrition. In 2023, we expanded our agricultural consulting with soil studies on school gardens where we detected lost fertility, so we could make fertiliser recommendations.

And we have **collaborated with Banco de Alimentos** (Food Bank) since 2015, donating excess generated through our research activities to the entity. In 2023, we delivered 23,000 kilos of potatoes that helped over 1,200 families.



EQUALITY

As an entity that believes in and works toward equality, last year we supported and participated in different initiatives to make our stance clear. These **include STEAM Sare and International Day of Women and Girls in Science** (11 February or #11F) which, through talks at school centres, raises visibility for the work that women do in STEM (*Science, Technology, Engineering and Mathematics*).



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