Harnessing Biodiversity and Agro-industrial Residues in Costa Rica: Local Solutions to Promote Sustainable Agriculture Through Novel Biostimulants

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CeNAT (National Center of High Technology)

Nanjing, China

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CENIBIOT
Biotechnology

- Bioprocess
- Plant biotechnology
- Bioprospection
- Biomedical research

PRIAS
Earth Observations

- Information systems
- Remote sensing
- Geodesy
- Infraestructure of space data

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CNCA
Advanced Computing

- Seismology
- Bioinformatics
- Artificial Intelligence
- High Performance Computing

LANOTEC
Nanotechnology

- Nanobiotechnology
- Biorefineries
- Nanomedicine
- New materials

GESTIÓN AMBIENTAL
Environmental Management

- Climate observation
- Agromatics
- Food security
- Origin denomination of food

Costa Rica’s Facts

1. Home to about 6% of the world's species.The country's biodiversity includes tropical rainforests, dry forests, mangroves, and other wetlands.
2. Has reversed deforestation, increasing forest cover to nearly 60% of the country.
3. Has many national parks and other protected areas, covering almost 30% of the country's land area.
4. Has launched a plan in 2019 to achieve net zero emissions by 2050. The plan aims to reform transport, energy, waste, and land use.
5. The greatest markets of agricultural products are the USA and Europe (~80-90%)

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Challenges faced by Costa Rican agriculture

- Biological degradation of soils
- Maintenance of production in the same but increasingly degraded planting areas
- Demand in international markets to reduce the use of agrochemicals
- Healthier food production
- Lags in the approval and importation of new, more environmentally -friendly agricultural inputs
- Agrochemical price increases

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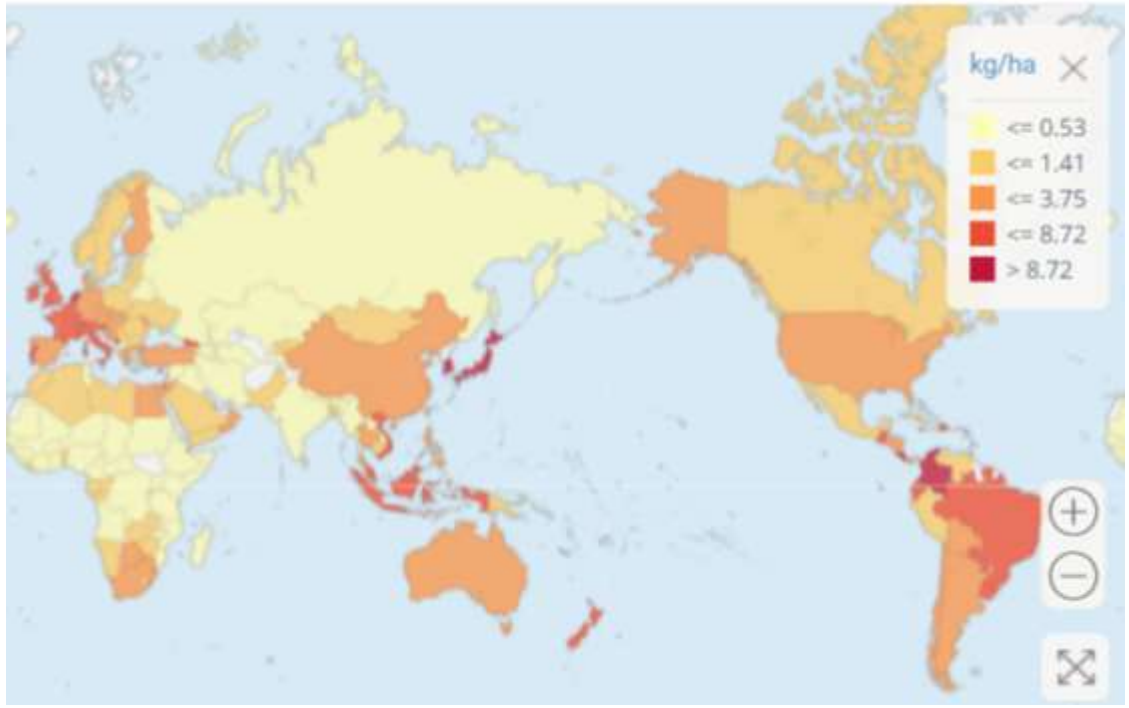
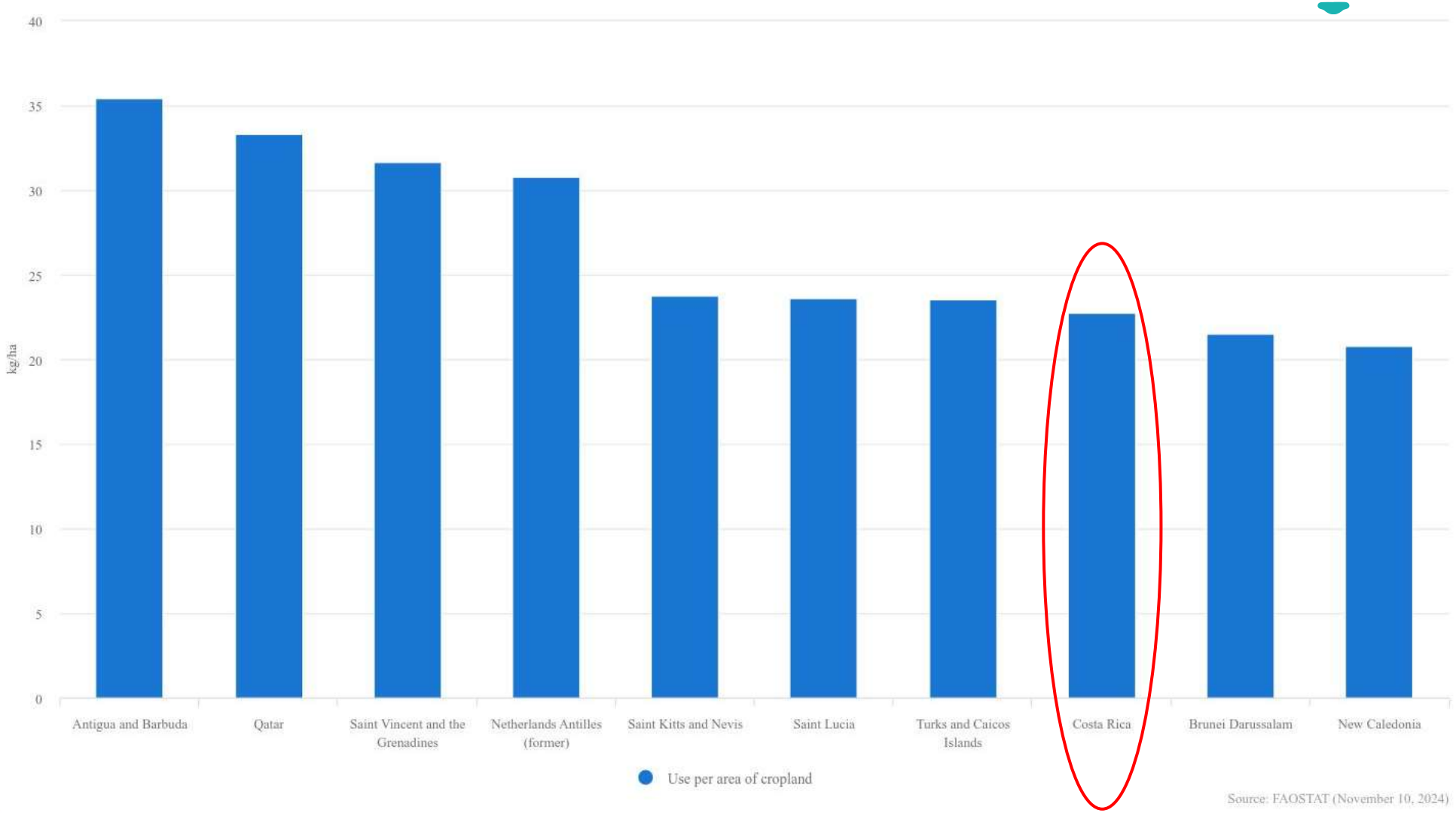
Some pressures of the agricultural sector

Costa Rica is in the top ten of countries on the use of pesticides per area



Pesticides use per area of cropland in kilograms / hectare, 2000 – 2022. Source FAOSTAT



Local knowledge to formulate biostimulants with residues from agroindustry: **BIOLES**

- BIOLES are liquid formulations obtained from the fermentation of plant and animal waste, resulting in a complex mixture of molecules and communities of microorganisms, both with responses on plants and their productivity
- Bioles are produced on-site

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- **In farm production**
- Microbial biostimulants
- **More eficient fertilizers**
- Discovery of new molecules and novel biological inputs for agriculture

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COFFEE: 3 years trial of chemical vs biological management

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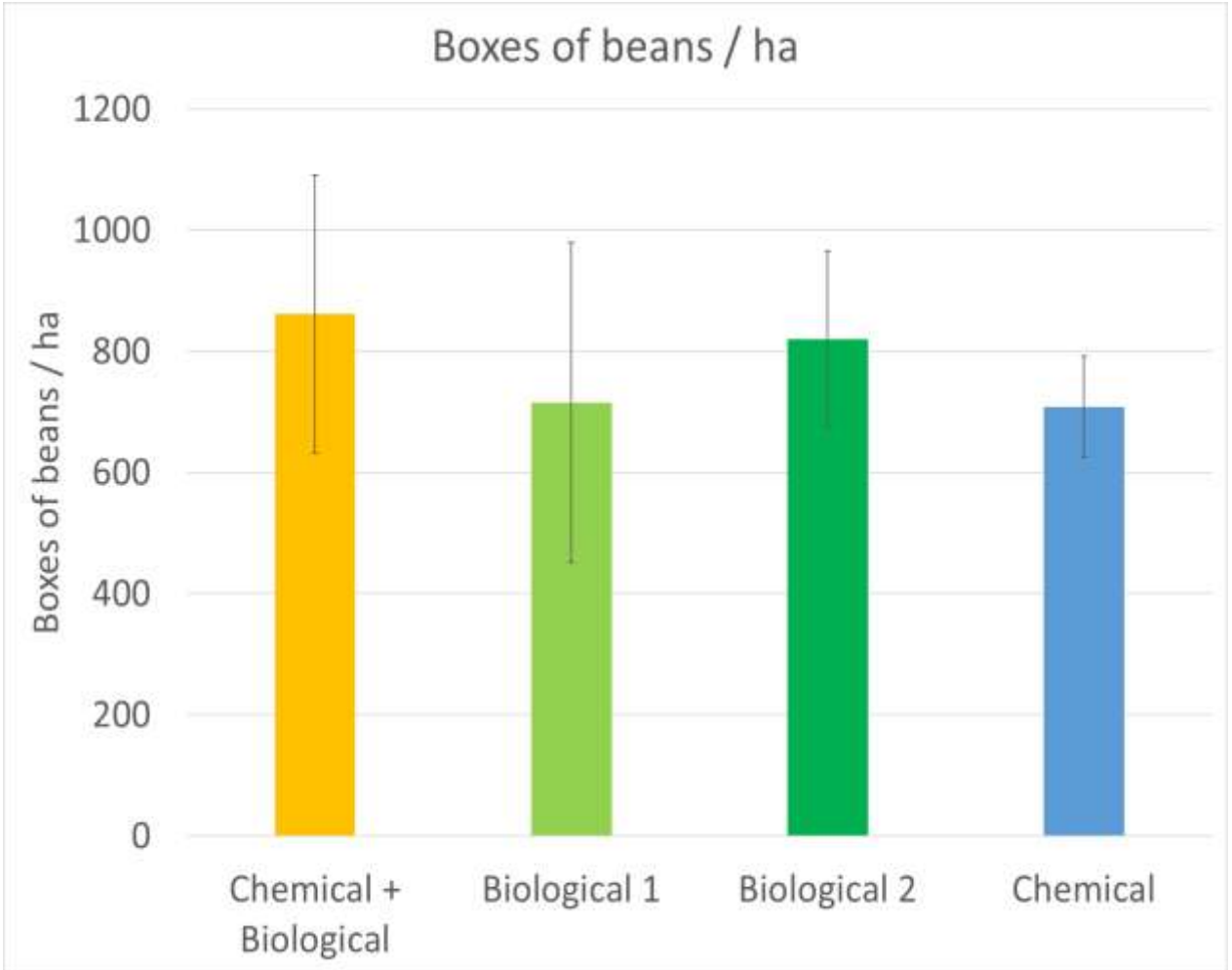
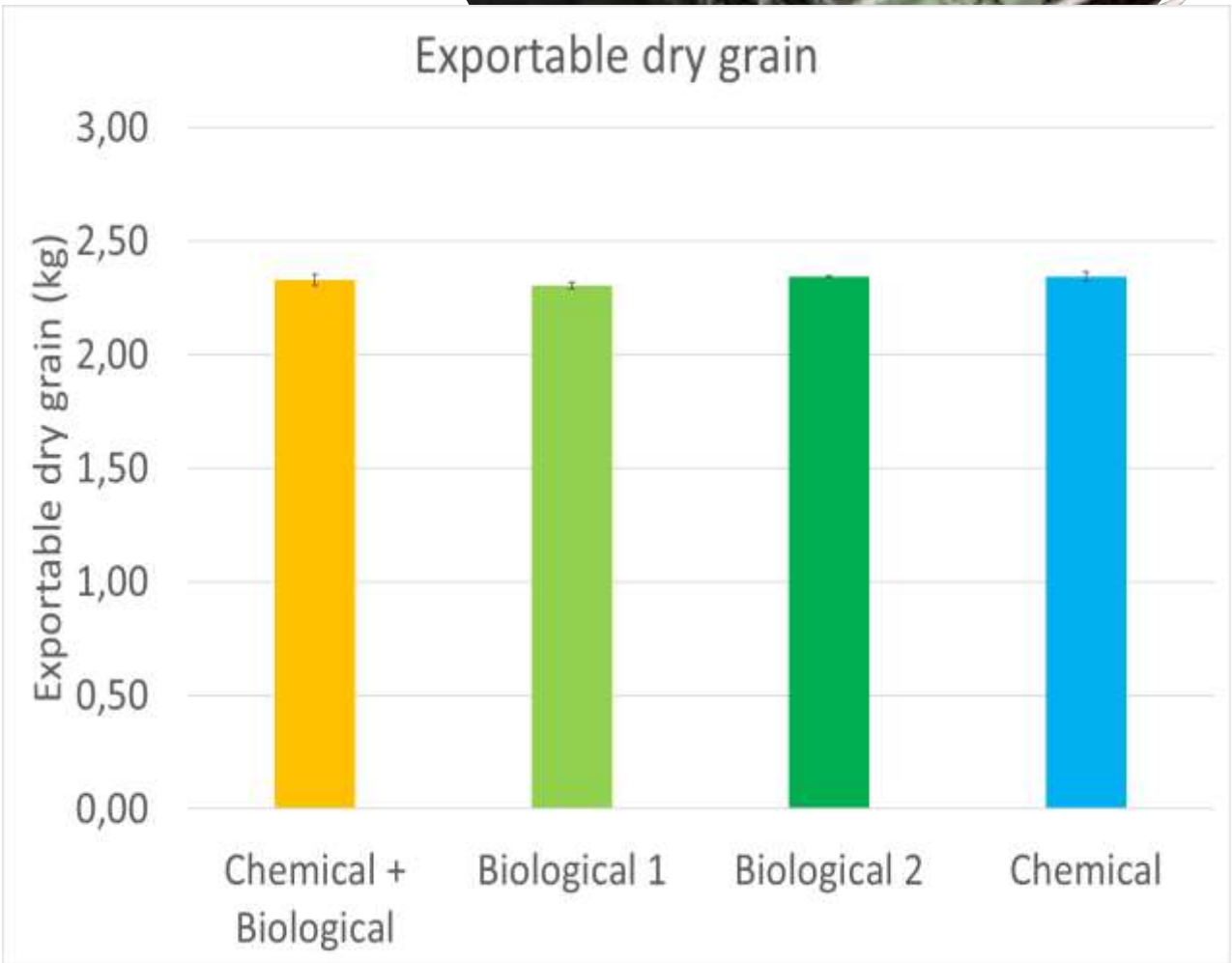
1. Chemical + Biological: chemical soil fertilization + bioles
2. Biological 1: Only bioles
3. Biological 2: Bioles with compost
4. Chemical: only chemical fertilization





LETTUCE: trial of biological (bioles) vs chemical management









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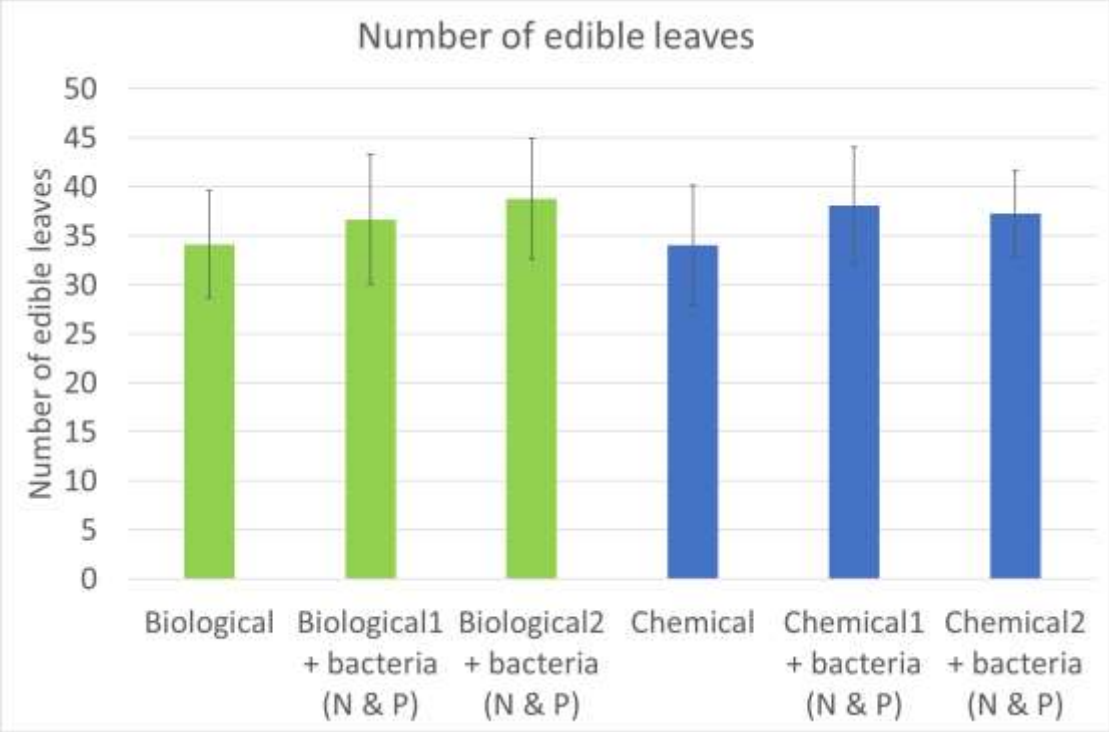

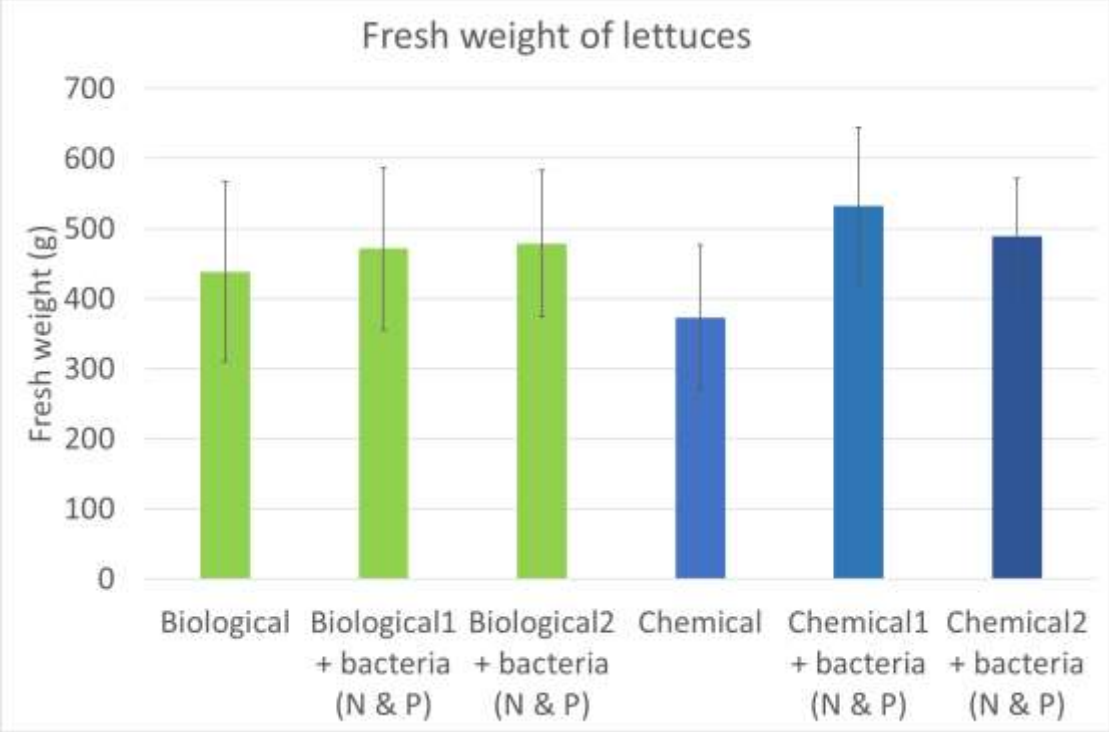

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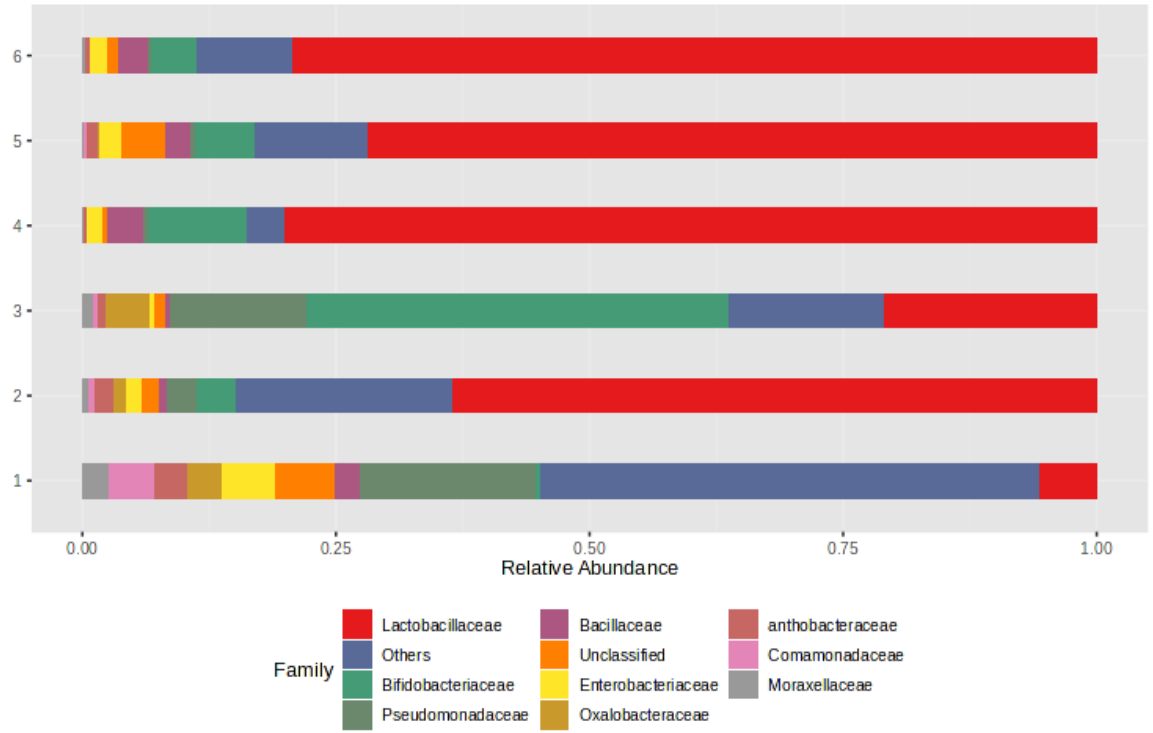
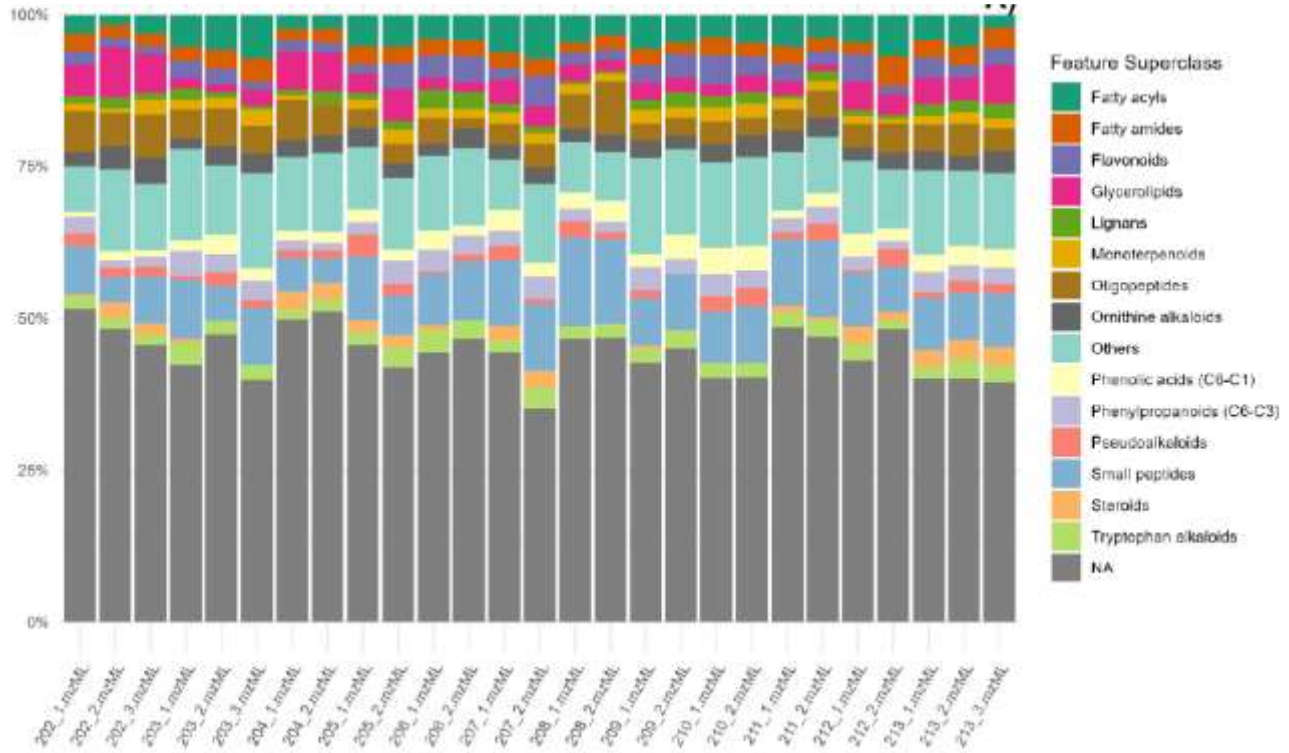
Characterization of bioles

Metagenomics of 16s rRNA



Metabolomics



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Knowledge transfer to farmers through cooperation projects

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MINISTERIO DE AGRICULTURA Y GANADERÍA
GOBIERNO DE COSTA RICA

CIB Corporación para Investigaciones Biológicas
La ciencia al servicio de la vida

SLU
SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES

COSTA RICA COOPERACIÓN SURSUR COOPERACIÓN TRIANGULAR

Adelante 2
COOPERACIÓN TRIANGULAR UE-ALC
FACILIDAD COFINANCIADA POR LA UNIÓN EUROPEA

MINISTERIO DE ASUNTOS EXTERIORES, UNIÓN EUROPEA Y COOPERACIÓN
aecid
Cooperación Española

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Similar or higher yield and better grain quality of coffee beans and lettuces, compared only chemical fertilization

Coffe cup quality improved as well as higher quality of nutrition content in lettuces

BIOLES as novel biostimulants

Reduction of both production costs around 20-30% and chemical fertilizers by 40-50%

Knowledge transfer to +1000 members in a cooperative models of farmers

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Source of novel molecules for biological inputs in agriculture.

Bioles as biorefineries of molecules with biostimulant activity

Easy to transfer through local governments supporting sustainable agriculture

BIOLES as novel biostimulants

Source of novel microbes with different biostimulant activity

Revalorization of residues is feasible and low cost with environmental, social and economical impact

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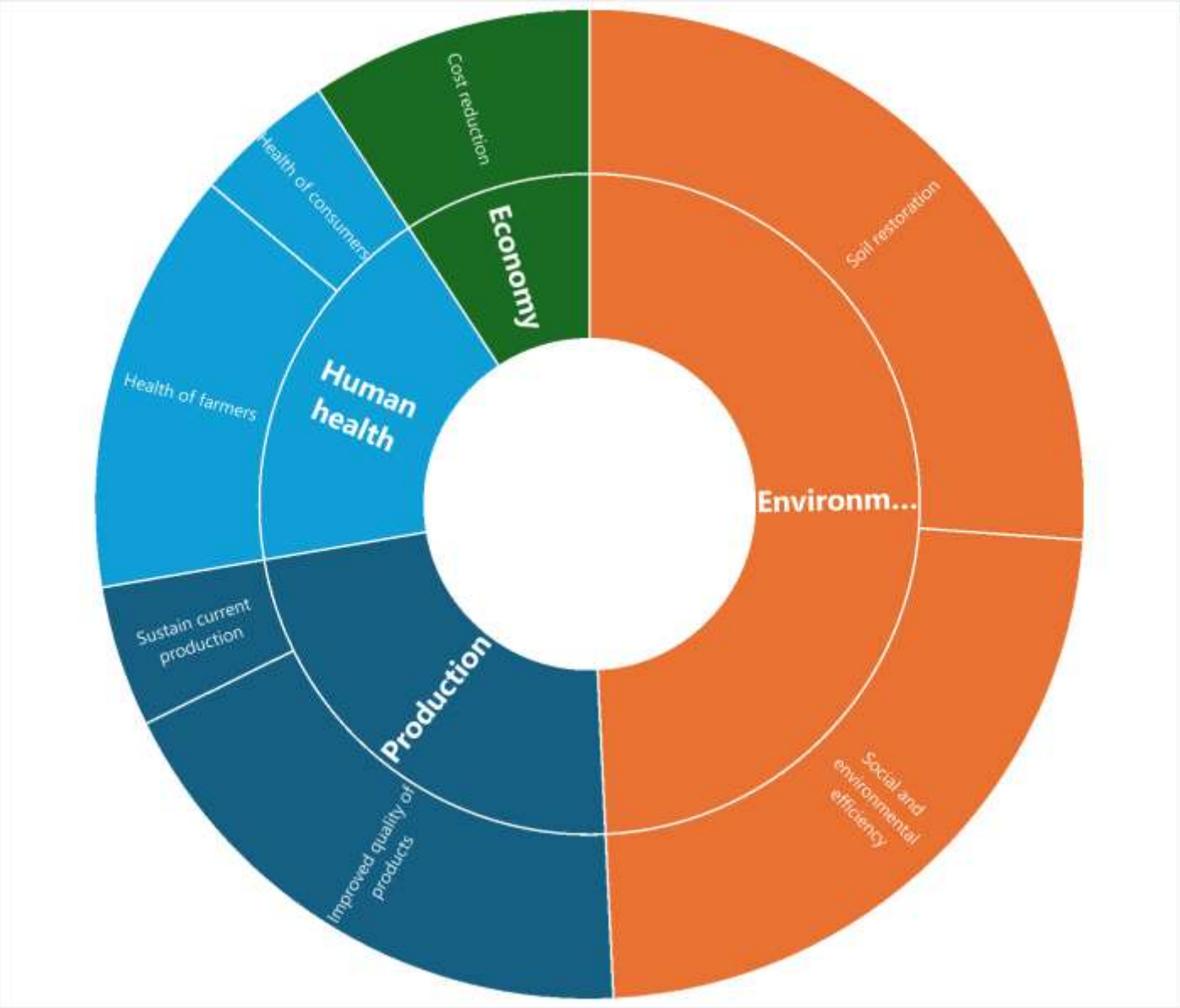
Impact of bioles on Costa Rica's farmers



¿Where should we go?

Improvement of production in controlled conditions: bioles as biorefineries

Scaling up and development of extractions methods

Formulation

Field testing

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Thanks for your attention

All of these organizations are acknowledged in its effort to accomplish SDGs and the financial support and have supported the project