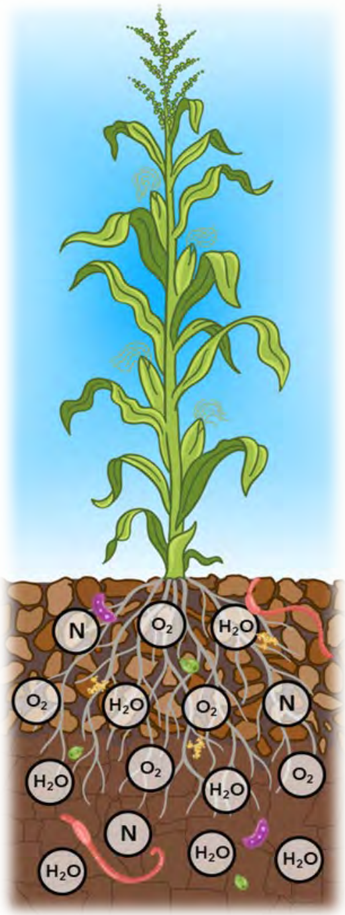
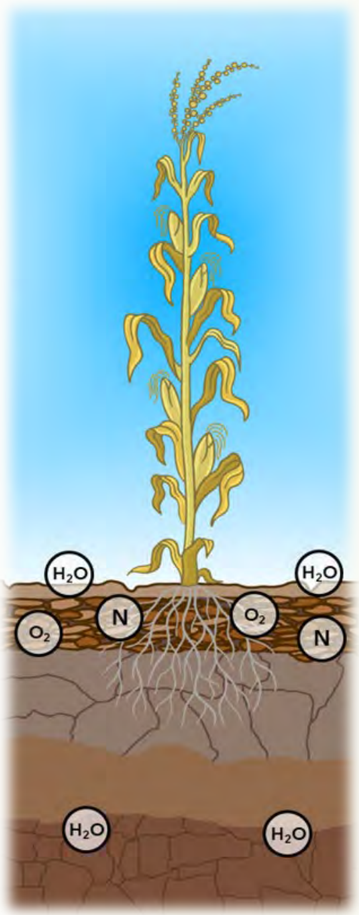
Santé des sols: du savoir à l’adoption

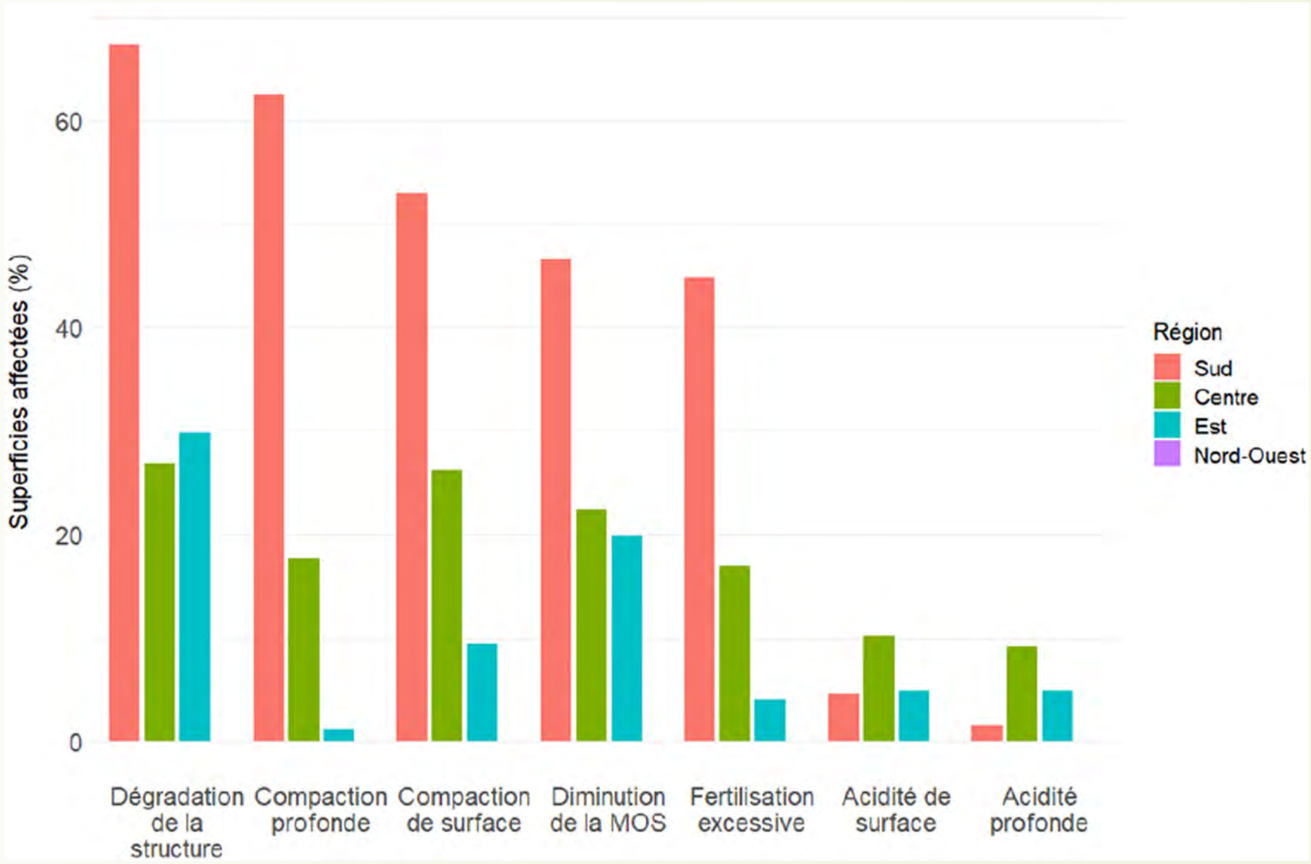
Regards croisés Québec–Union Européenne–Australie

Soil health in Québec: where do we stand?

Soil physical, biological, and chemical health form the foundation of a productive and resilient agri -food system.



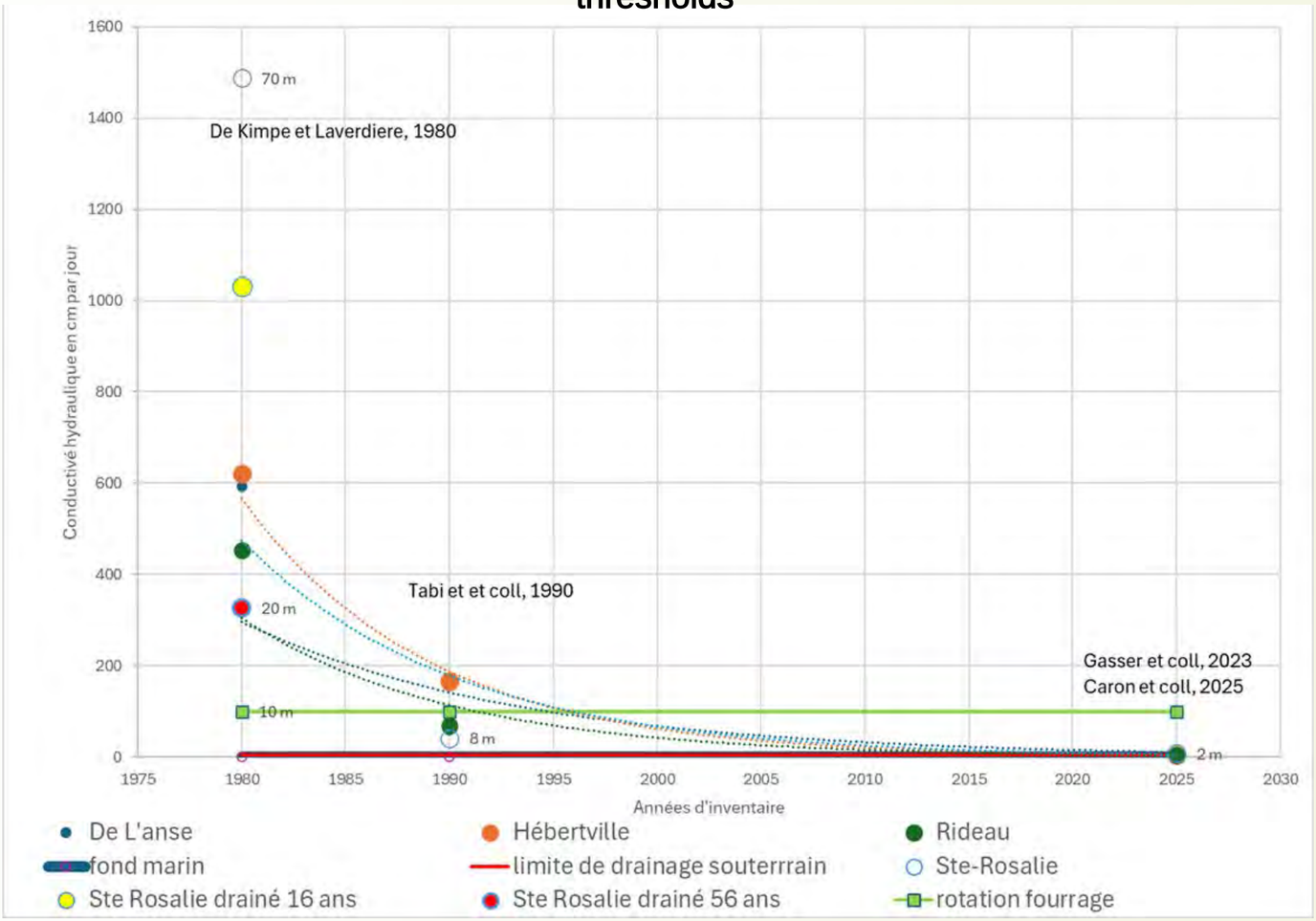




Findings from the study on the health status of Québec's agricultural soils (EESSAQ; Gasser et al., 2026)

Soil health in Québec: where do we stand?

Hydraulic conductivities at (or near) critical drainage thresholds

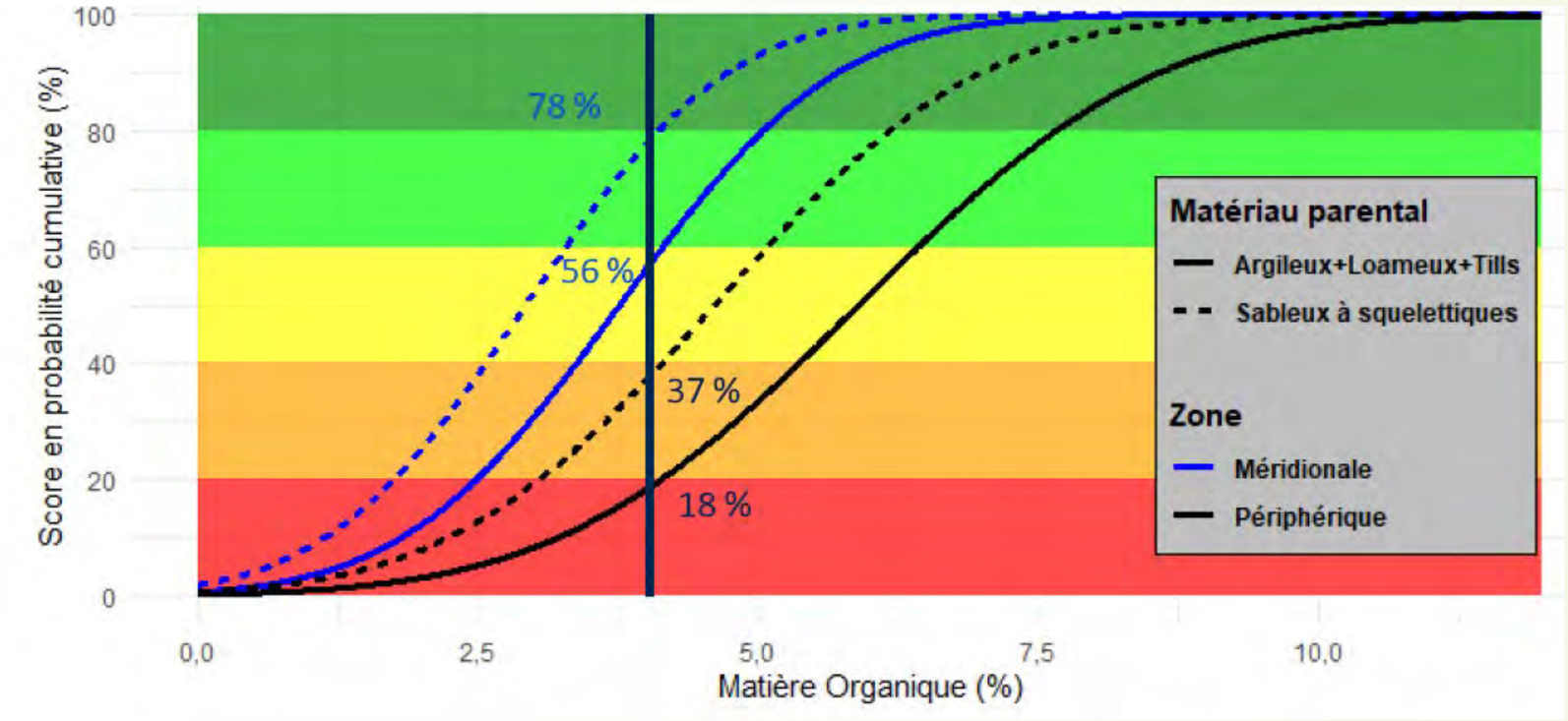


Graph : Jean Caron

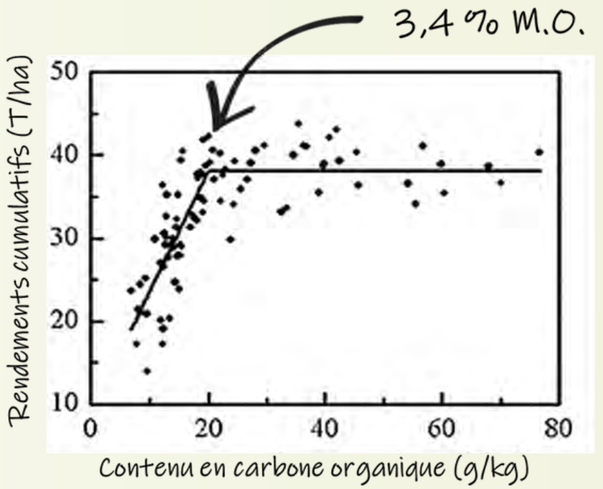
Photos: Samson, ME

Soil health in Québec: where do we stand?

More than 50% of agricultural land in southern Québec has soil organic matter contents below 4%



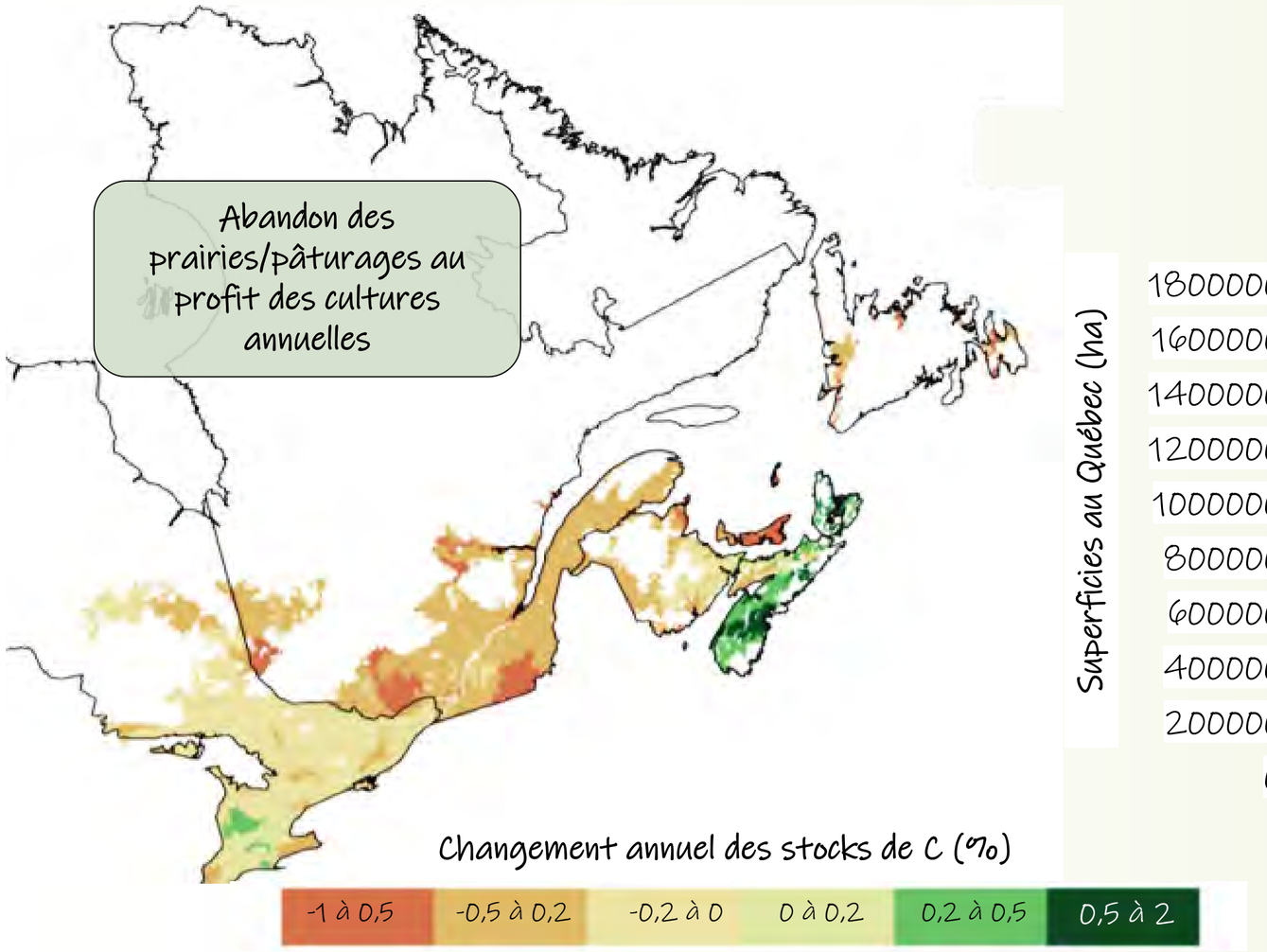
Findings from the study on the health status of Québec's agricultural soils
(EESSAQ; Gasser et al., 2026)

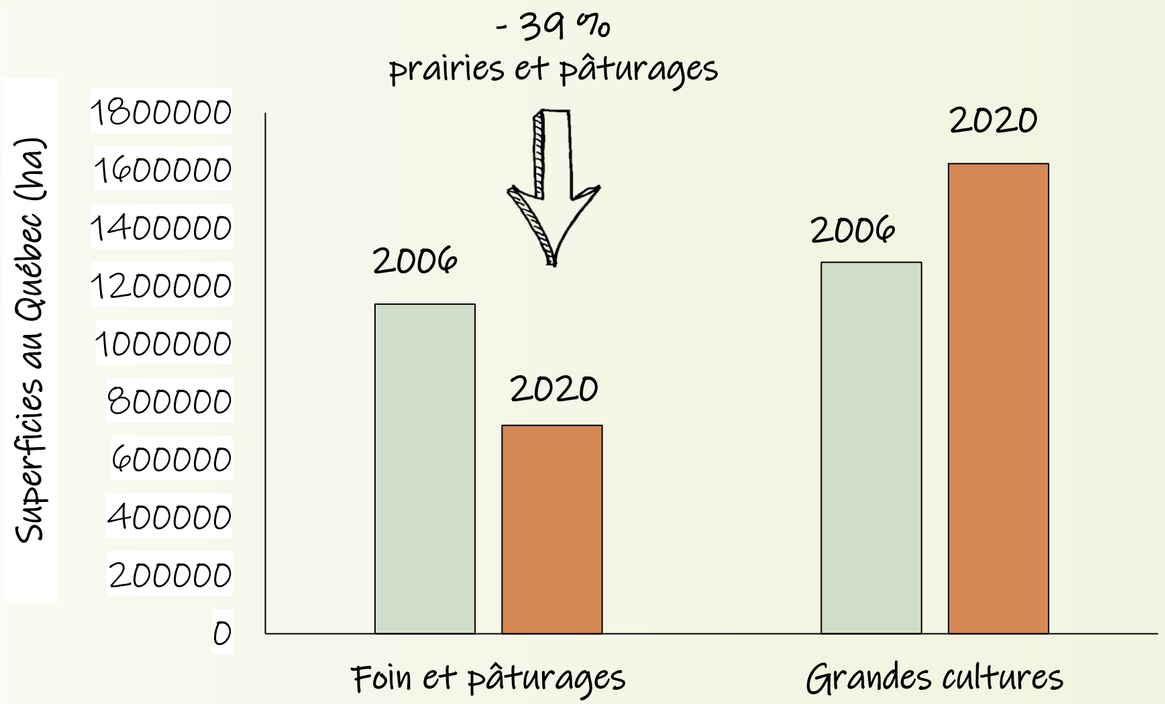


Larney, F. AAFC

Photo: Watters, N.

Soil health in Québec: where do we stand?





Données : Fan et al., 2017 et Institut de la Statistique du Québec

Soil health in Québec: where are we heading?

Photo: Samson, ME

Research and knowledge transfer efforts

- RQRAD, ESSAQ, living labs, etc.
- Significant investments in knowledge transfer and outreach activities
- Governmental programs to promote adoption of beneficial management practices

Limited adoption and a few steps back...

- Significant and continuous decrease in grassland and pasture areas (Statistiques Canada)
- In a 2023 UPA survey, 12% of respondents indicated that they used intercropping in annual cropping systems (UPA, 2023)
- The federal government recently announced the closure of several AAFC research centres and farms.

What now?

What is the way forward to strengthen the science-policy interface, and scale up adoption?

Photo: Samson, ME

Claire Chenu, PhD

Claire Chenu is Professor at AgroParisTech and Research Director at INRAE (UMR Ecosys, Palaiseau, France). Her research focuses on soil organic matter, including its dynamics, the processes underlying its persistence, its functions, and carbon storage in agricultural soils.

She is a member of the FAO Intergovernmental Technical Panel on Soils. She chairs the Scientific and Technical Committee of the French national soil expertise network, RNEST Sols, and coordinates the European Joint Programme EJP SOIL: “Towards climate-smart sustainable management of agricultural soils.”

Towards healthy soils :
insights from a European research program

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

Towards healthy soils : insights from a European research program

Claire Chenu

INRAE, AgroParisTech, Université Paris-Saclay, Palaiseau, France

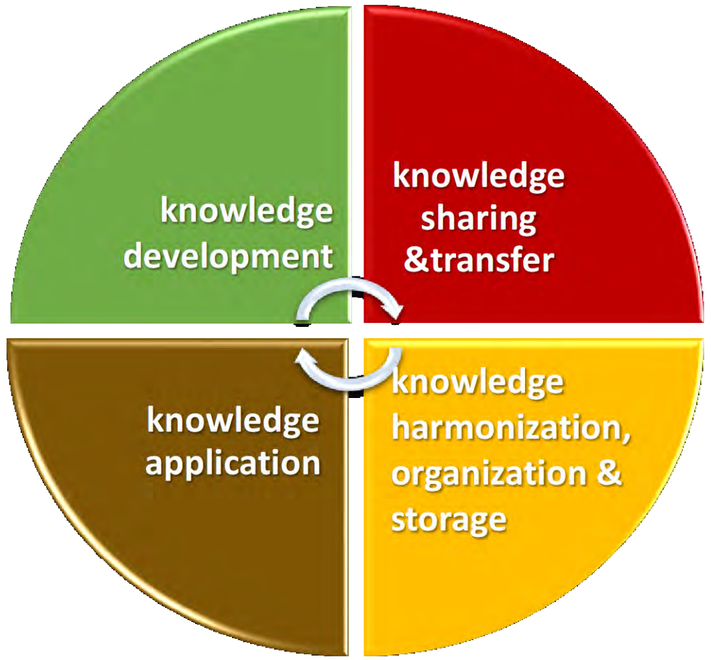
claire.chenu@inrae.fr

EJP SOIL, Towards climate-smart and sustainable management of agricultural soils

Long-term alignment of soil research

Farmers /farming sector are stewards of land and soil resources

EJP SOIL, Towards climate-smart and sustainable management of agricultural soils: Knowledge framework & expected impacts



understanding of soil management for climate change mitigation, adaptation, sust° production & sustainable environment

understanding soil carbon sequestration and its contribution to climate change mitigation

strengthening scientific capacities and cooperation

supporting harmonised European soil information

fostering the uptake of climate-smart sustainable soil management practices

developping region-specific fertilisation practices

Long-term alignment of soil research

Farmers /farming sector are stewards of land and soil resources

Current status of soil health and sustainable soil management in Europe

EJP SOIL
European Joint Programme

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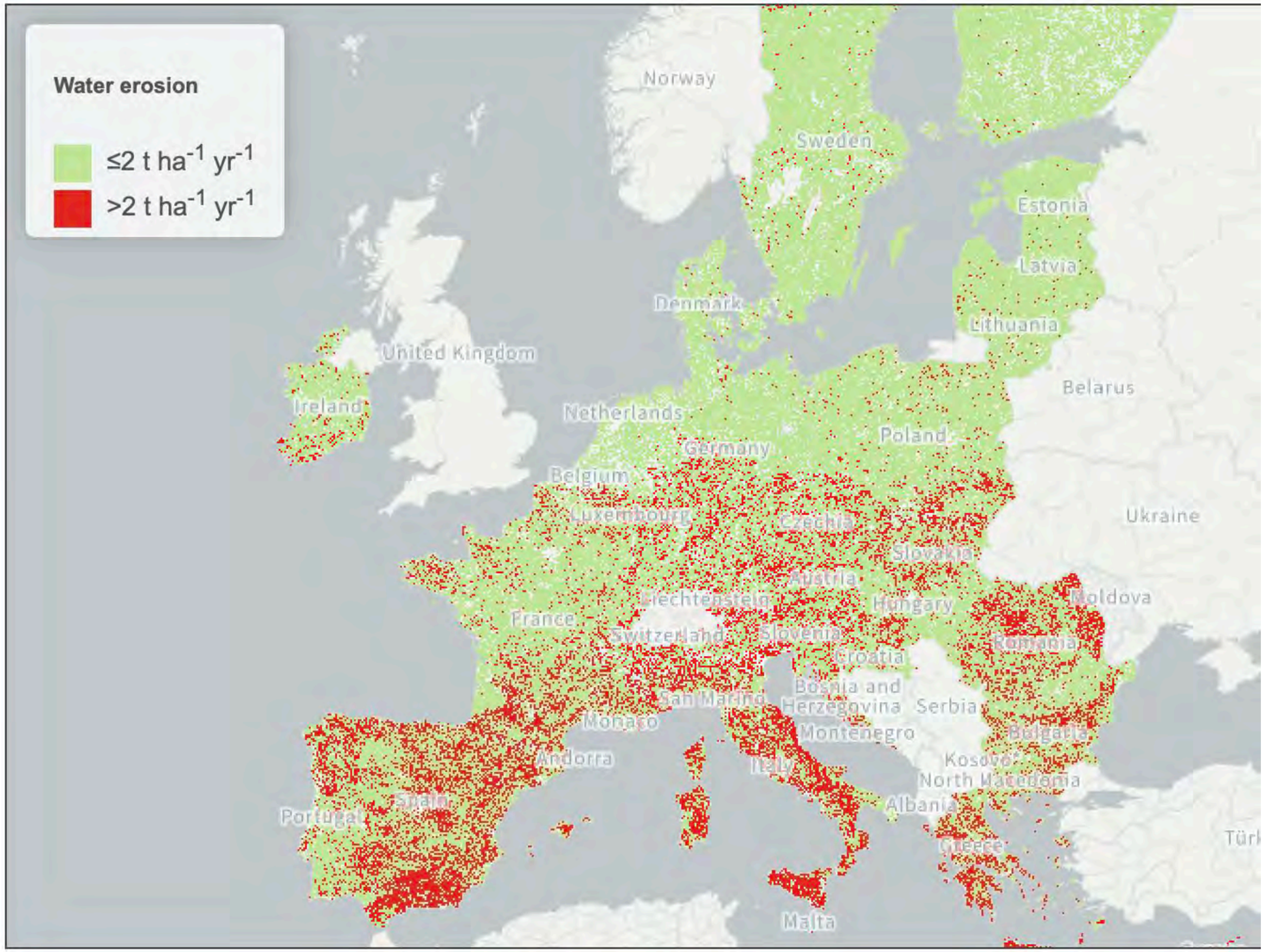
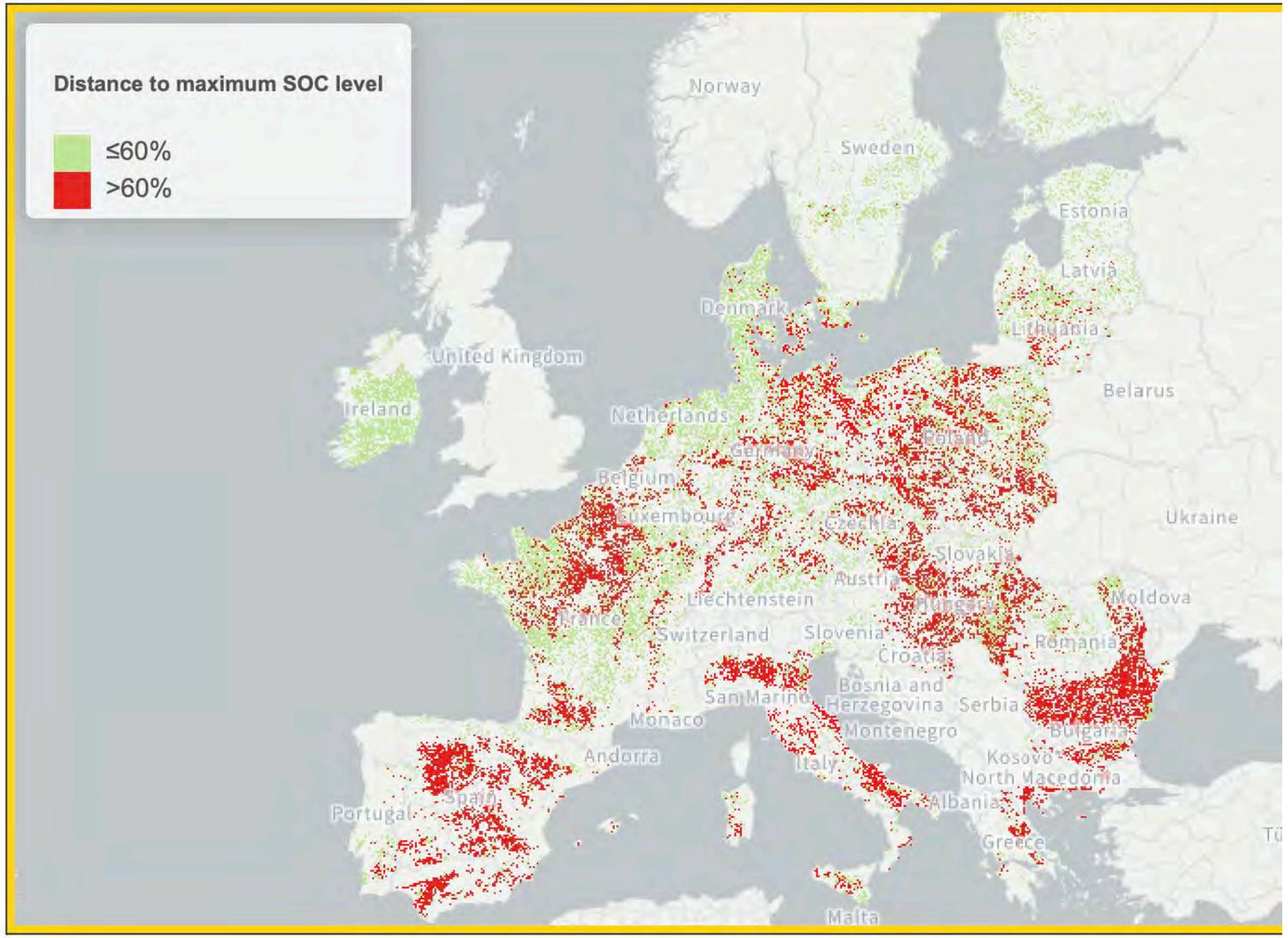
An EU soil health dashboard: water erosion



Russle 2015

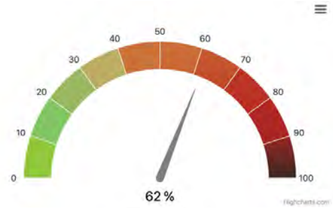
2 t soil ha^{-1} y^{-1}

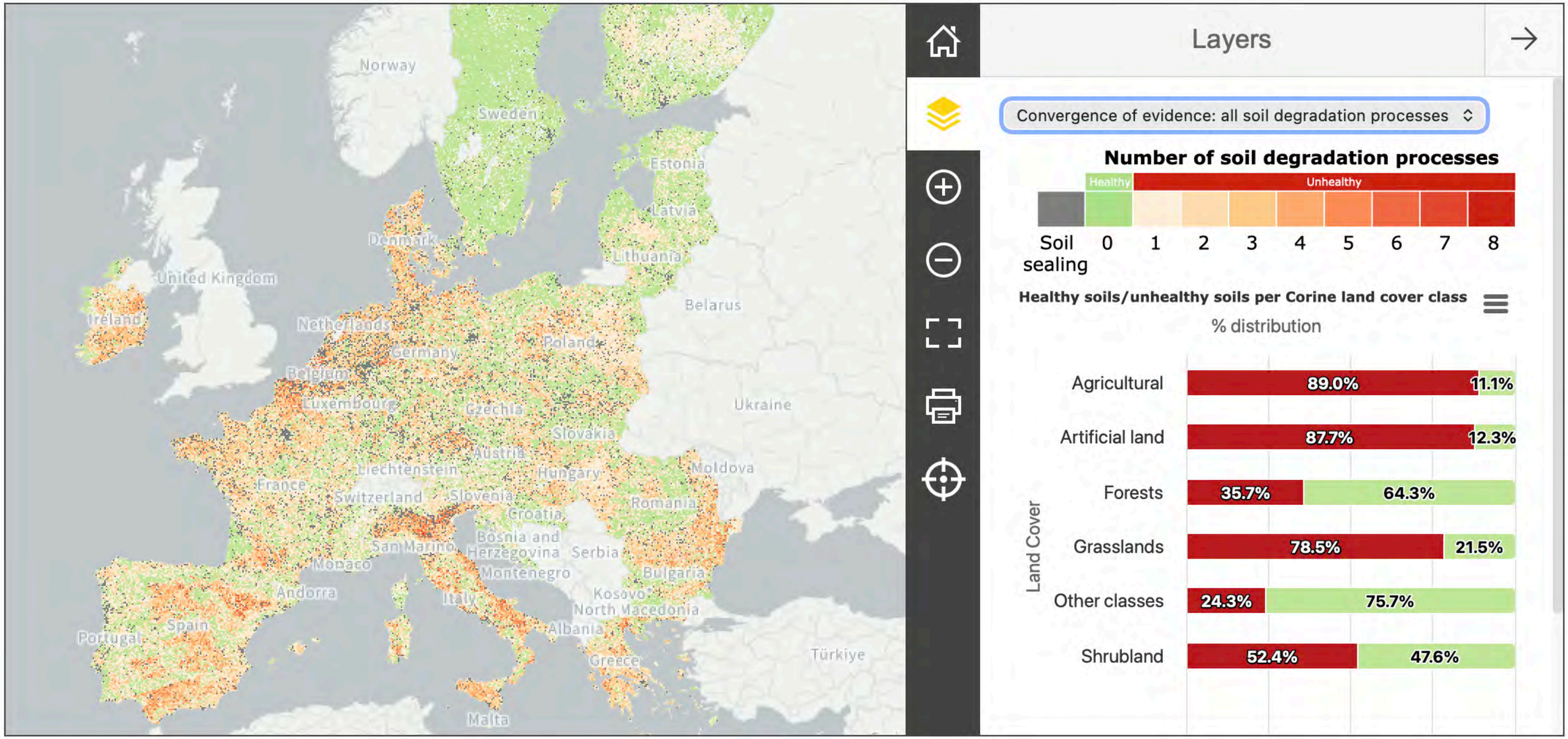
An EU soil health dashboard: SOC levels



Distance to maximum SOC level = permanent grassland SOC content

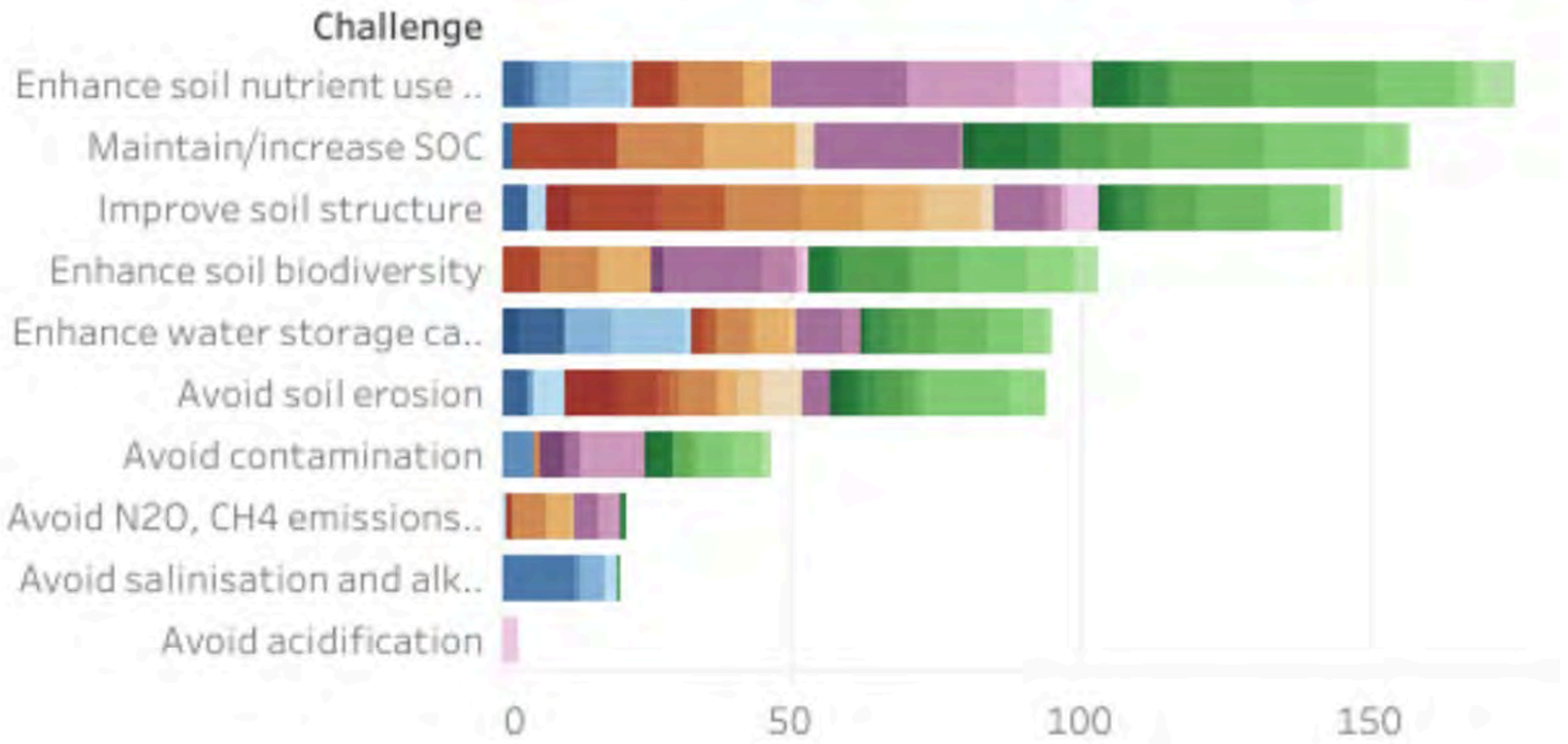
An EU soil health dashboard

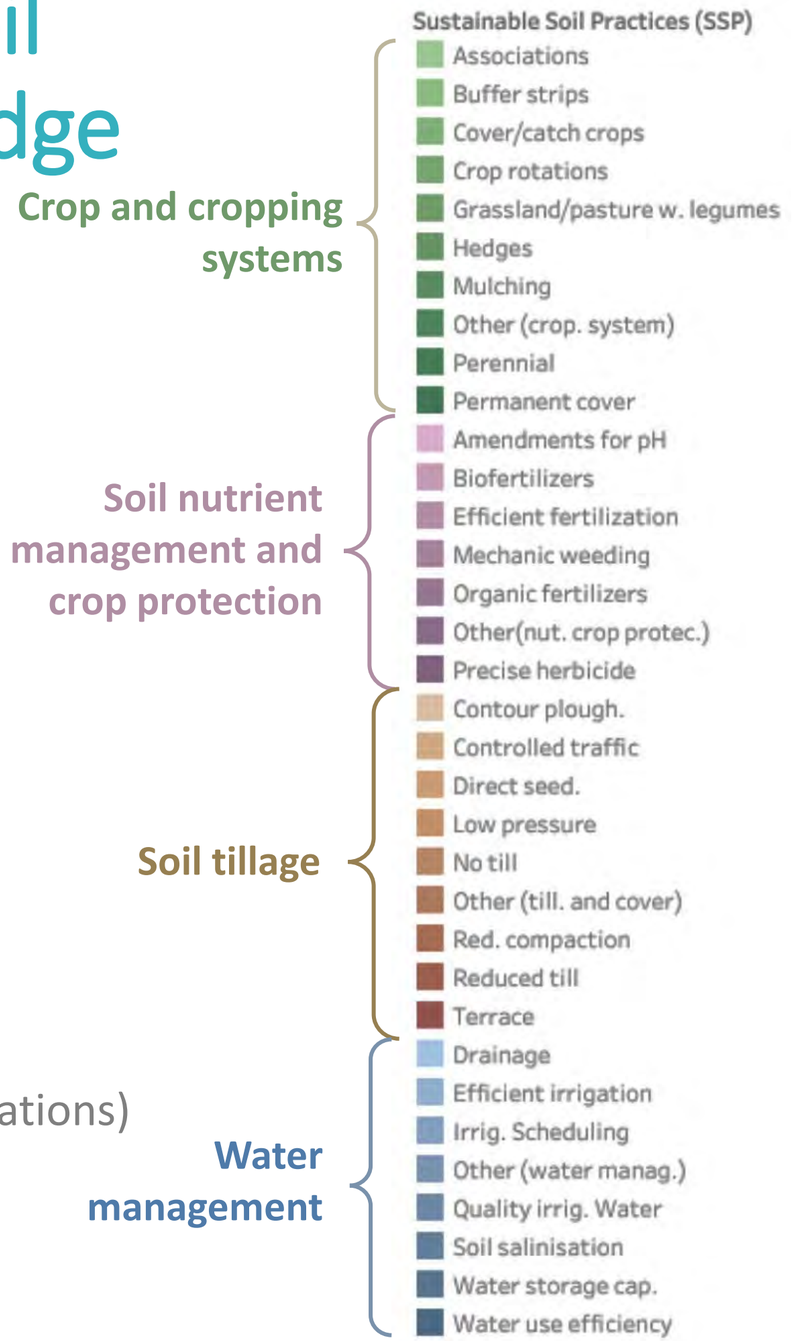




https://esdac.jrc.ec.europa.eu/esdacviewer/euso-dashboard/

Contribution of sustainable soil practices to soil challenges: an EU analysis of available knowledge





Paz et al. EJP SOIL Deliverable 2.1

Paz et al. 2024- EJSS DOI: 10.1111/ejss.13468

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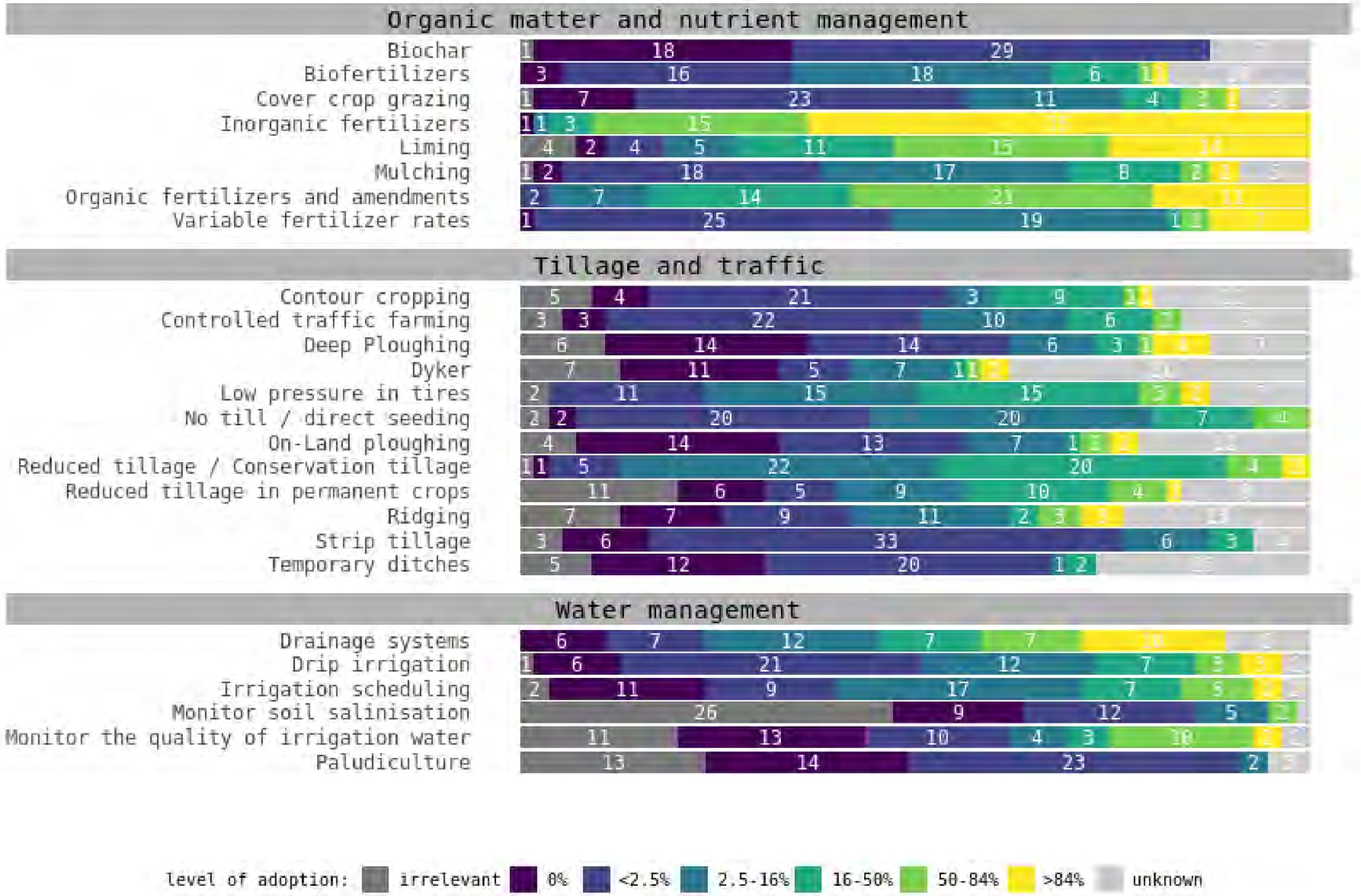
Current implementation of sustainable management options in Europe



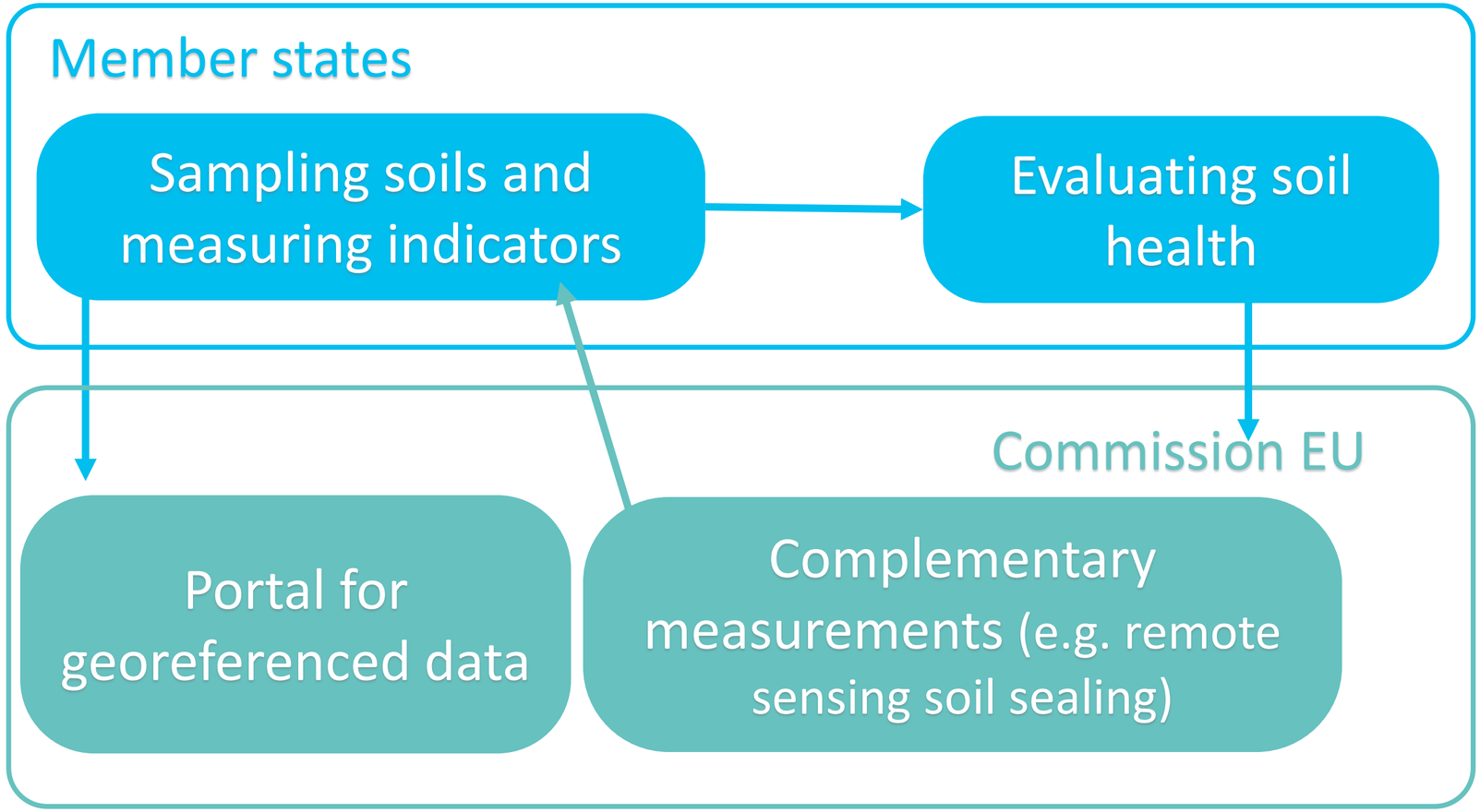
Heller et al. (2024). European Journal of Soil Science

- Erosion
- Land take and sealing
- Contamination
- Soil organic matter loss
- Biodiversity loss
- Compaction
- Salinisation
- Acidification

«By 2050, all soil ecosystems in the EU will be healthy and therefore more resilient. »

Content of the EU Soil Monitoring and Resilience directive

Every 6 y:



Central policy questions:

- Spatial units?
- Sampling strategy?
- Soil health indicators?
- Target and threshold values?
- Evaluating soil health?

Challenge 1- Producing knowledge scientifically robust and usable

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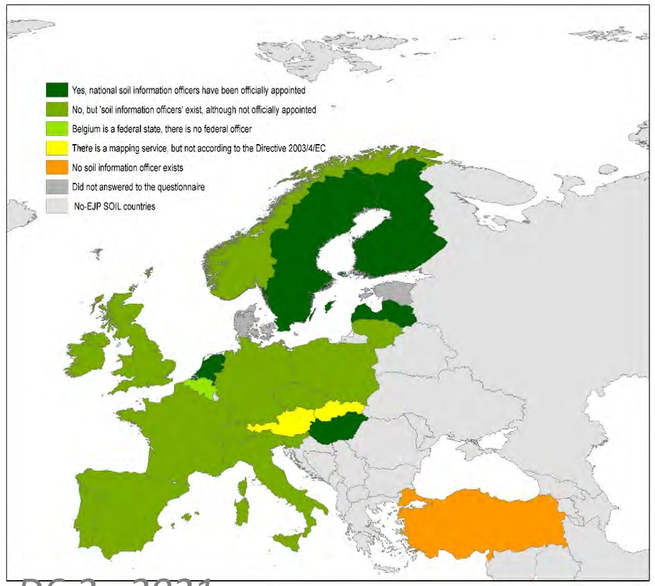
Establishing a baseline: stocktakes

Existing national soil data

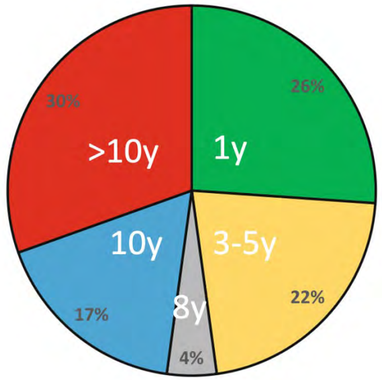
D6.1, 2021 10.5281/zenodo.12704083
Cornu et al. 2023, EJSS
DOI: 10.1111/ejss.13398

Formal and informal national soil data officers



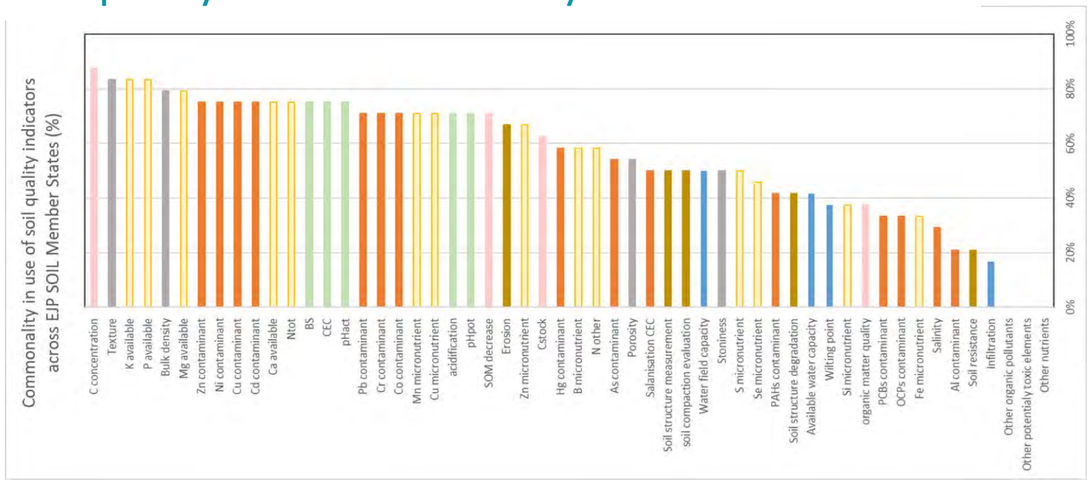
D6.2., 2021
10.5281/zenodo.10014912

Fertilisation recommendations accross Europe



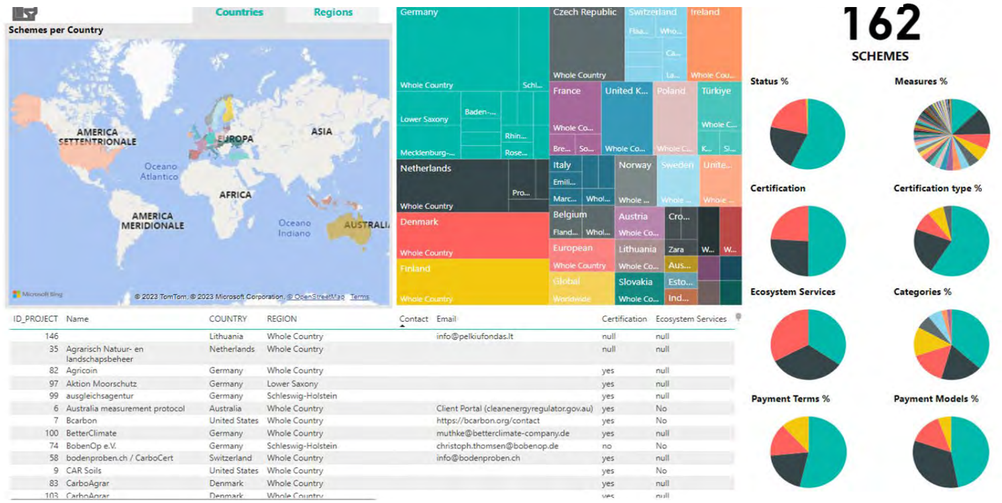
Higgins et al., 2023, EJSS
https://doi.org/10.1111/ejss.13422

Soil quality indicators used by Member States



Faber et al., 2022

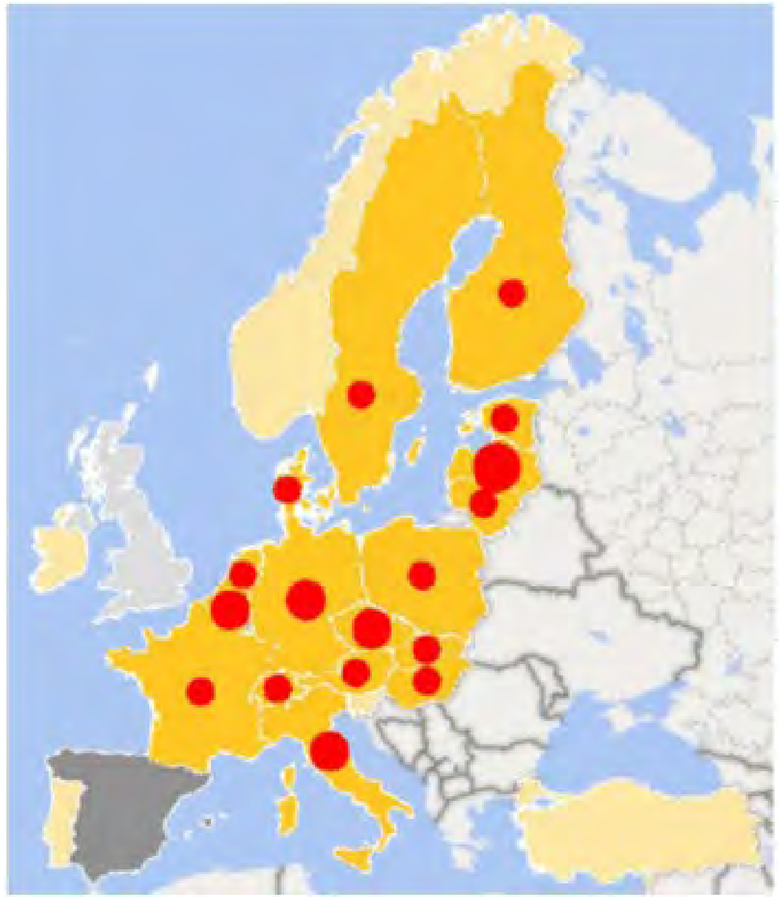
Existing C farming schemes



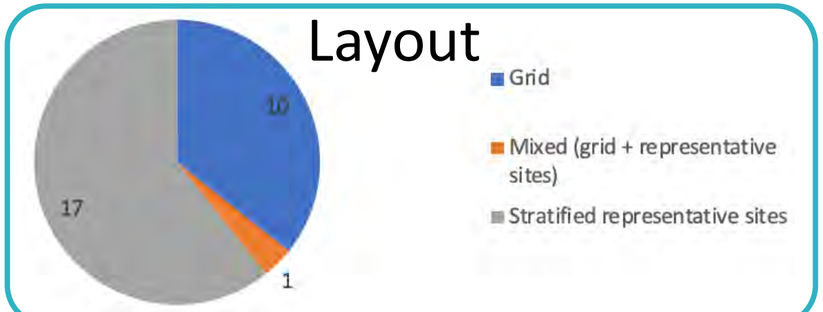
http://reports.crea.gov.it/powerbi/CarbonSchemesInventory.html 10.5281/zenodo.13970636
Thorsoe et al. 2025. Land use policy https://doi.org/10.1016/j.landusepol.2025.107747

Taking stock: existing national soil monitoring programmes

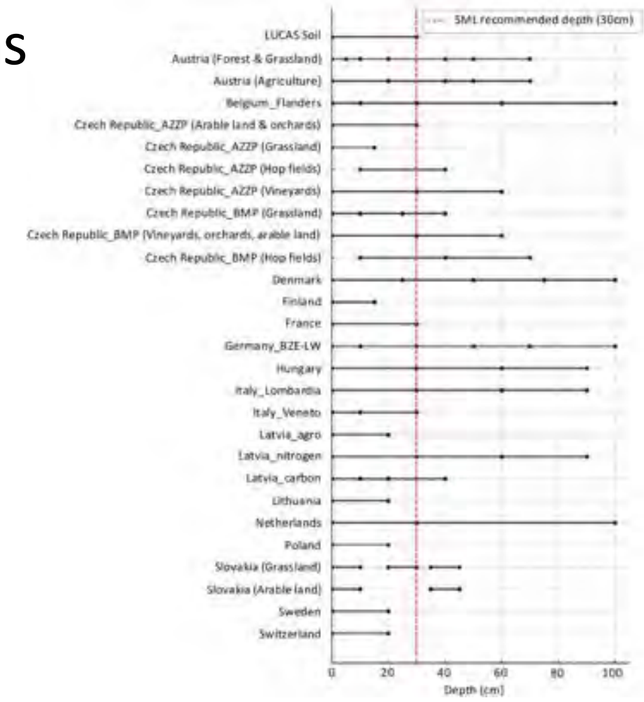
Existing SMS



Layout



Sampling depths



EJP SOIL A. Bispo et al. Deliverable D6.3, 2021

Mason et al., 2025 EJSS, https://doi.org/10.1111/ejss.70163

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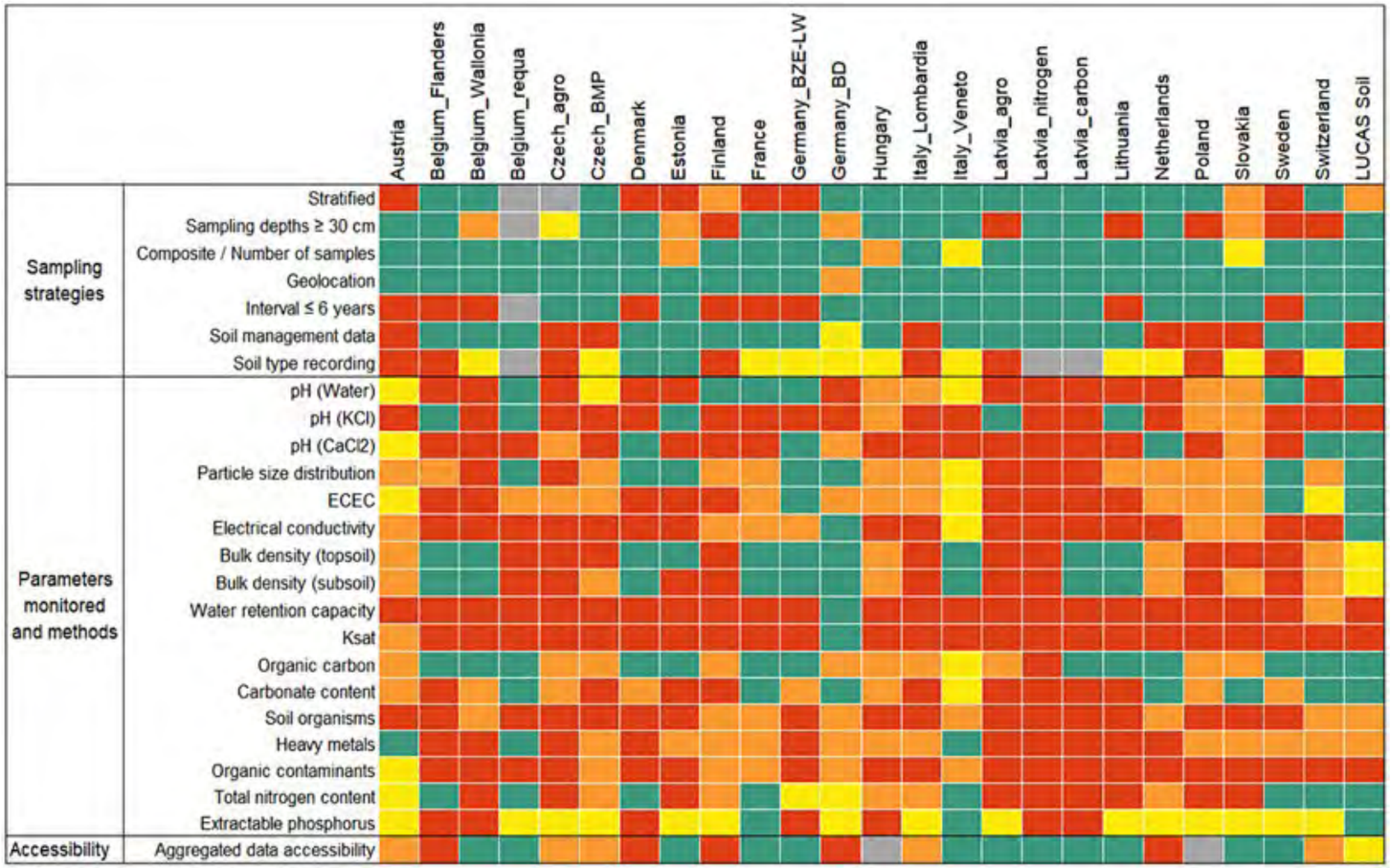
Taking stock: existing national soil monitoring programmes



Similarities with EU Soil Monitoring Law (2025)

Soil monitoring systems with very diverse protocols and with different soil parameters monitored, and no willingness to change (but can be extended) **=> harmonization needed**

EJP SOIL A. Bispo et al. Deliverable D6.3, 2021

Mason et al., 2025, https://doi.org/10.1111/ejss.70163

EJP SOIL European Joint Programme

Challenge 2- Turning knowledge into decision-support tools

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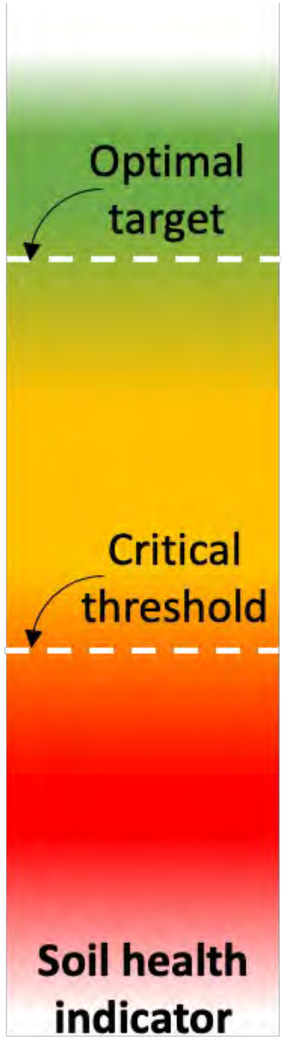
Setting soil health targets and thresholds for agricultural soils

WP6, SIREN, SERENA, MINOTAUR
BENCHMARKS, AI4Soils



- **Fixed:** *published and robust values, fit for purpose*
- **'Natural'**: *based on a desirable reference situation*
- **Distribution**: *based on data within the population*
- **Relative change**: *based on the current soil condition*

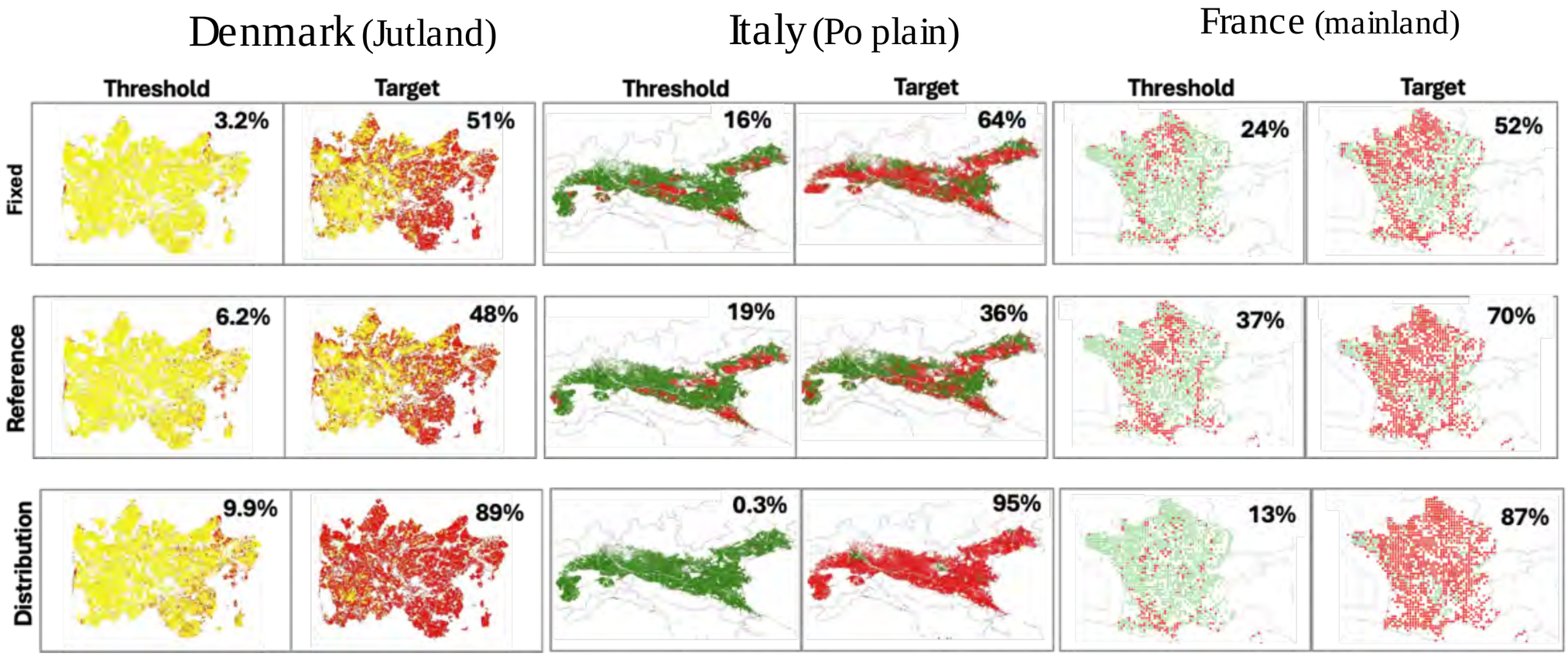
Matson et al. 2024, JEMA
https://doi.org/10.1016/j.jenvman.2024.123141

Setting soil health targets and thresholds for agricultural soils

Wessolek et al. 2008 in Baritz et al. EEA report 2023

Threshold: 60% of SOC in permanent grassland
Target : 80% of SOC in permanent grassland

Threshold = 12.5%
Target = 87.5%



Matson et al. 2024, JEMA
https://doi.org/10.1016/j.jenvman.2024.123141

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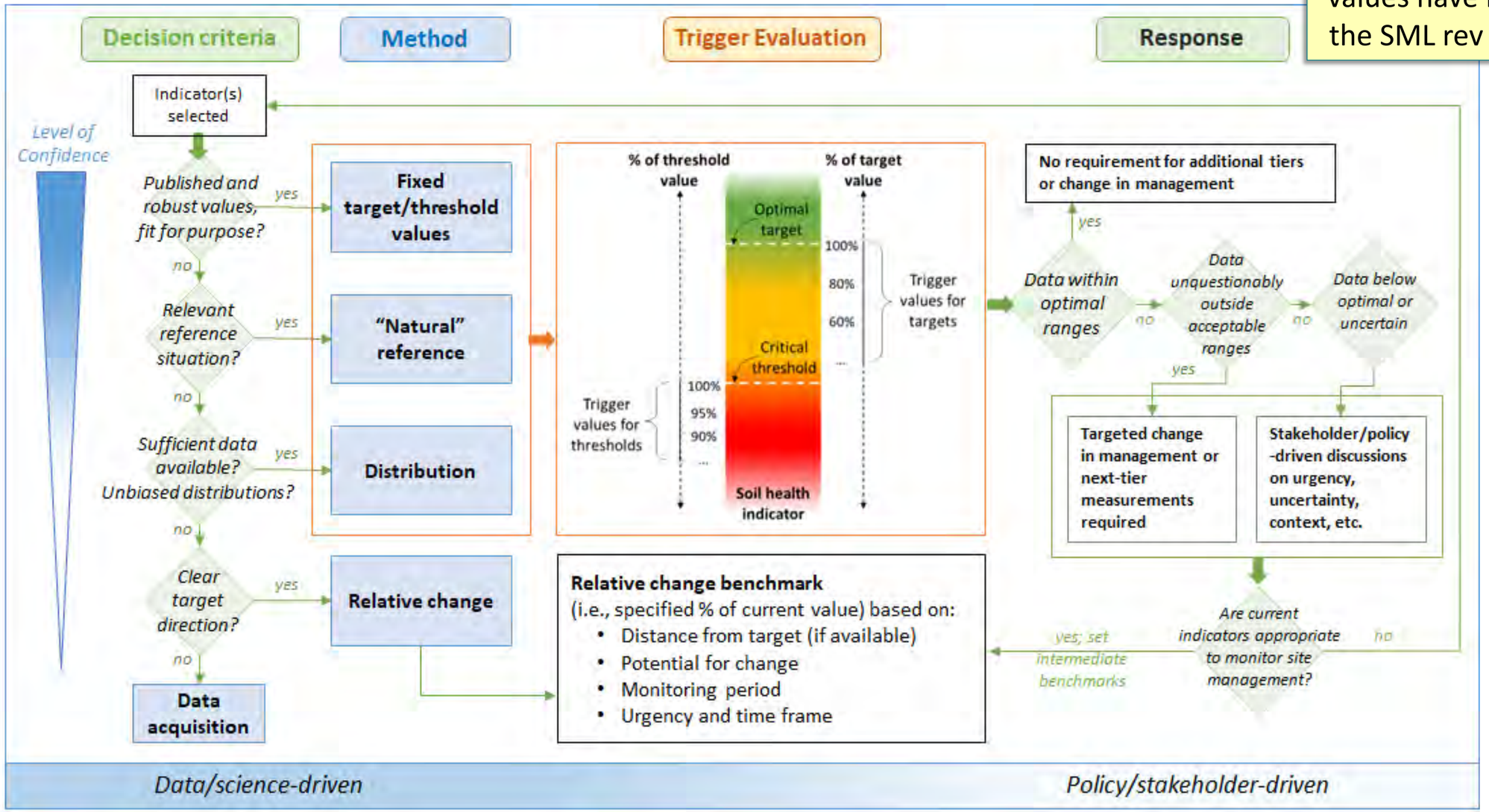
A proposed framework to set critical values

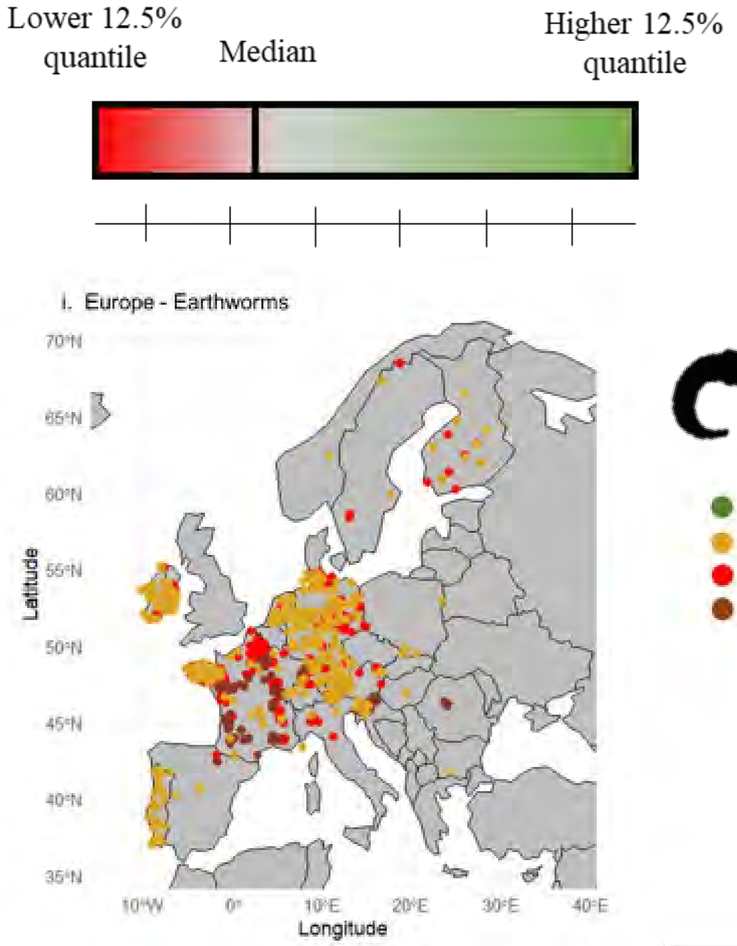
The concepts of operational trigger values and target values have been included in the SML rev II text proposal.

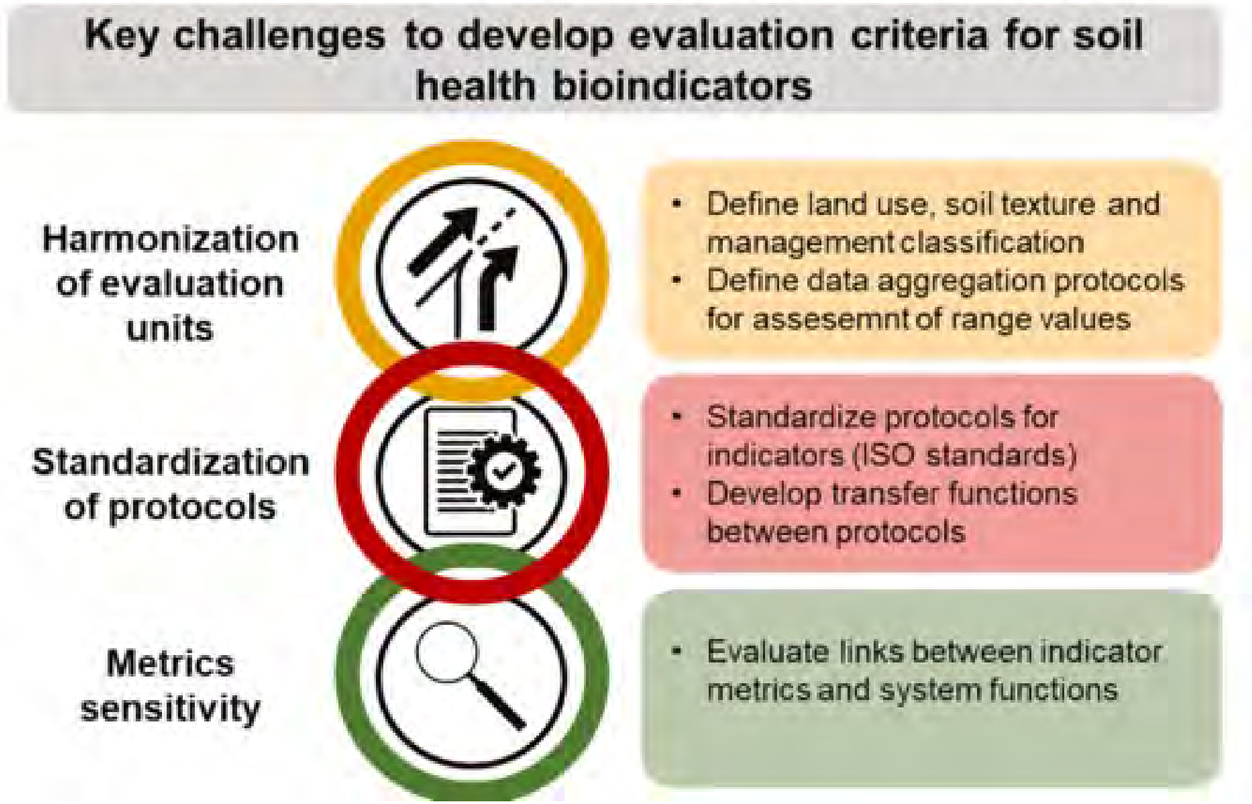


Matson et al. 2024, JEMA
https://doi.org/10.1016/j.jenvman.2024.123141

Selecting critical values for biological indicators: feasability?

Setting targets and thresholds using the distribution approach and open access data





Riggi et al. 2025 Ecol Indic.

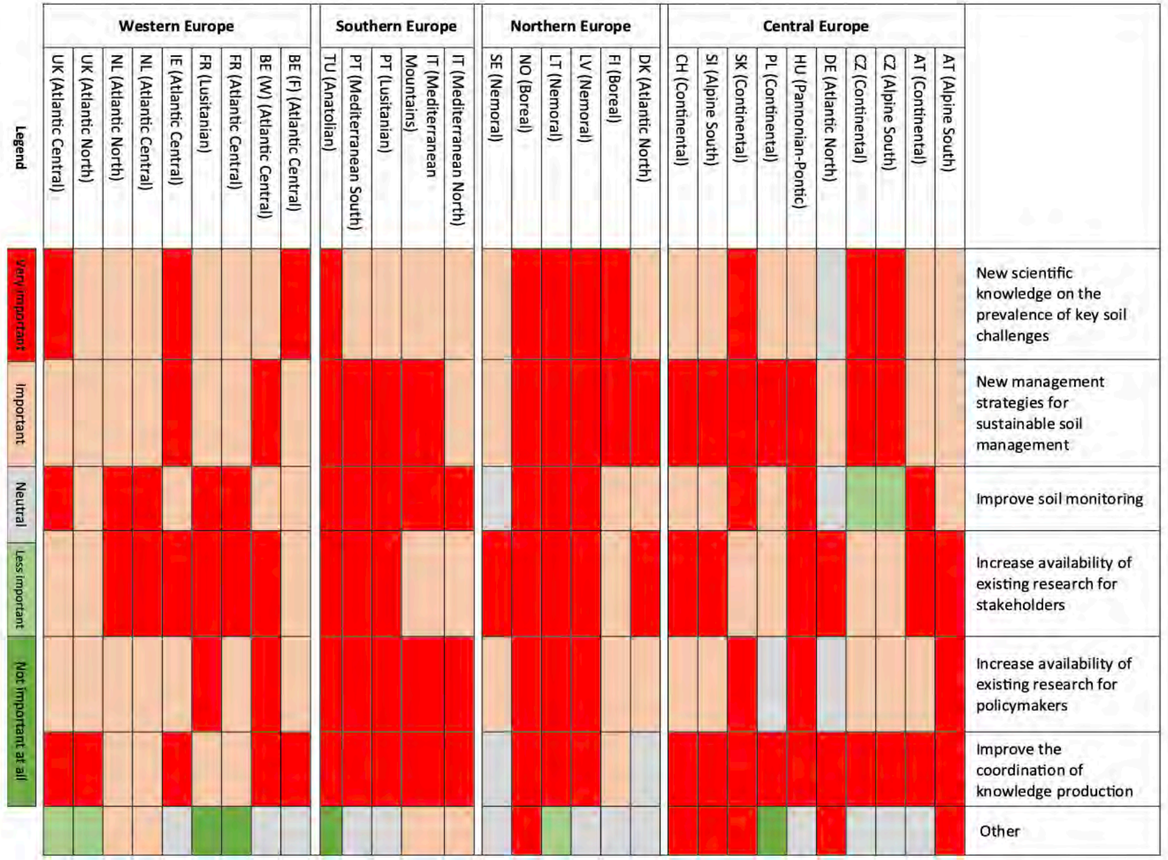
https://doi.org/10.1016/j.ecolind.2025.114063

https://doi.org/10.5281/zenodo.14244122

https://ariadne.sk8.inrae.fr/

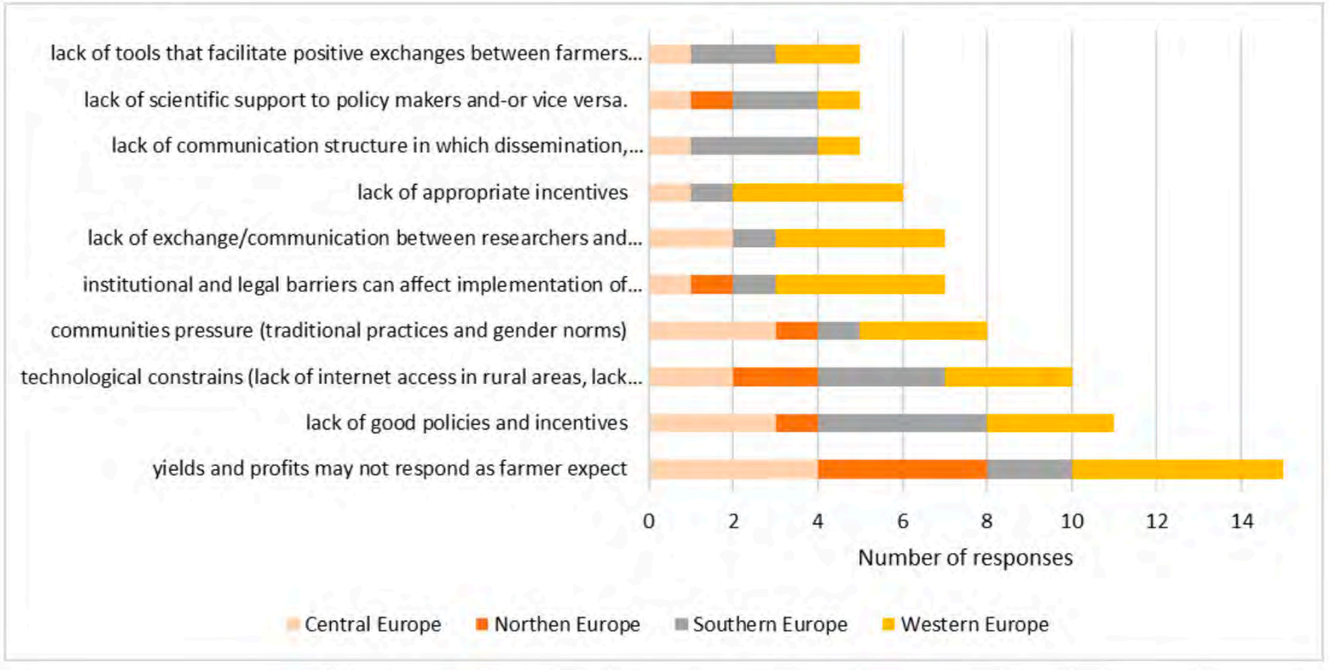
Barriers to adoption: an EU wide consultation

How important are the following undertakings to improve soil knowledge?



Thorsoe et al. 2023, Europ J. Soil Science
https://doi.org/10.1111/ejss.13439

What are the main barriers to soil knowledge application?



Vanino et al. 2023. Journal of Environmental Management
https://doi.org/10.1016/j.jenvman.2022.116581

Challenge 3- From knowledge to collective capacity

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An open-source meta-dataset of running European mid- and long-term agricultural field experiments

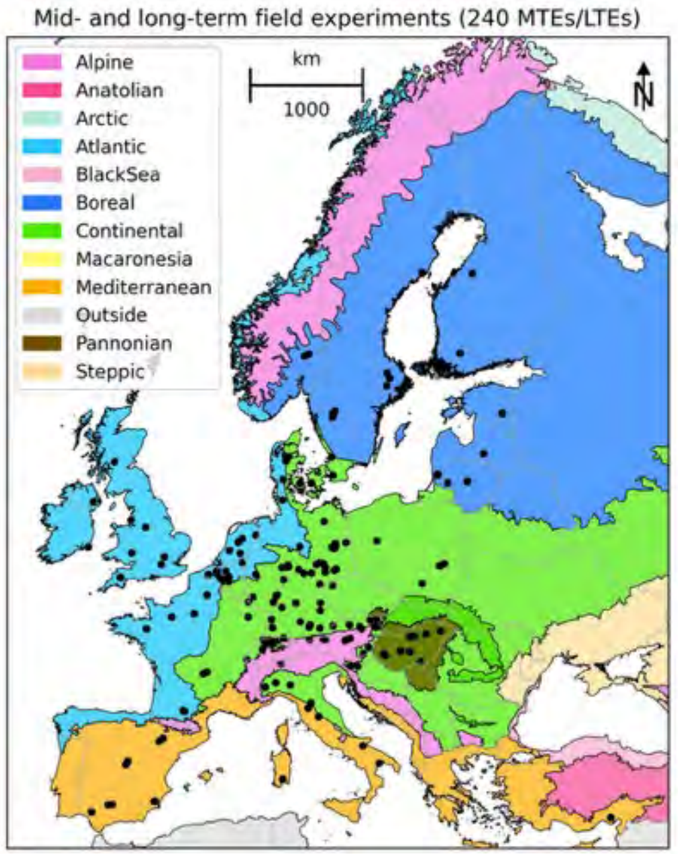
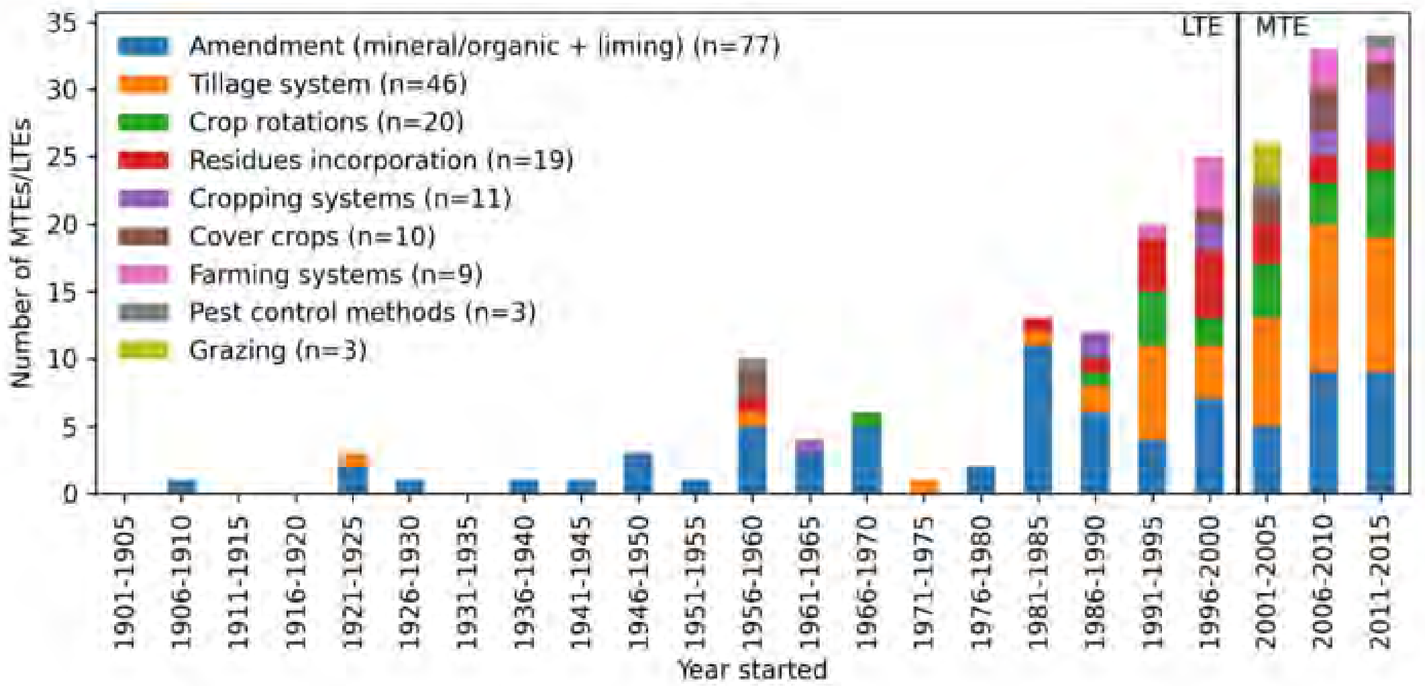


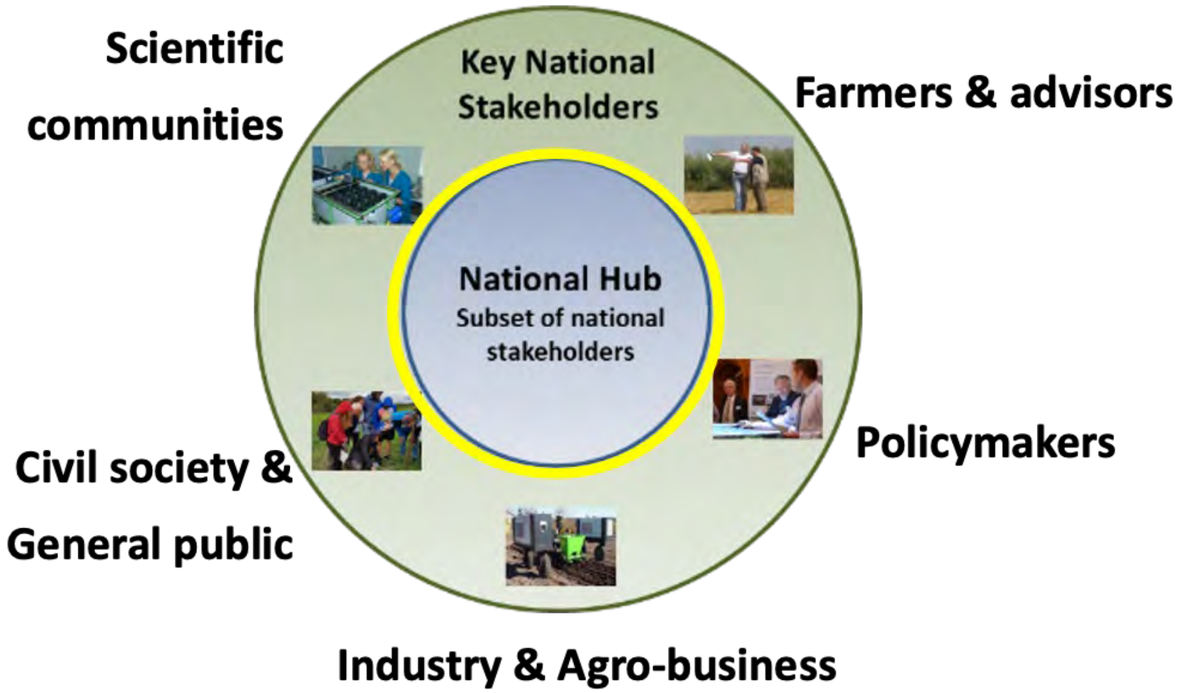
FIGURE 3 Distribution of the collected mid- and long-term field experiments across Europe with European biogeographical regions.



Evolution of research themes in newly started MTE/LTE

Dommez et al. 2022, Data in Brief
Blanchy et al. 2023, Soil Use and Management DOI: 10.1111/sum.12978
Collaboration with Bonares that hosts the database and will maintain it https://lte-eu.bonares.de/experiments

EJP SOIL National Hubs: a new instrument for national stakeholders' consultation & science - policy interface

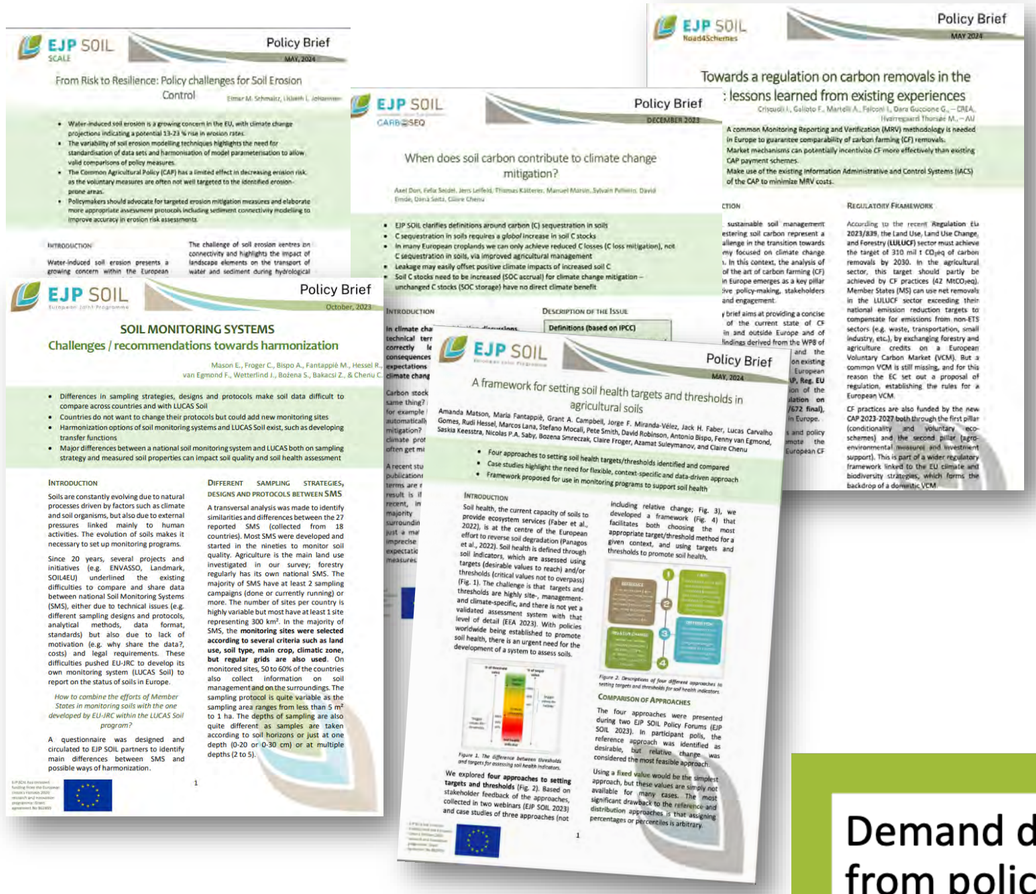


In each country, under responsibility of Programme Owners, not compulsory, flexibility

- Provide input & feedback to EJP SOIL programme
- Voice national position & needs
- Contribute to and learn from the work done in research
- Contribute to dissemination of EJP SOIL outputs.




Progressive and collective elaboration of policy relevant syntheses and messages



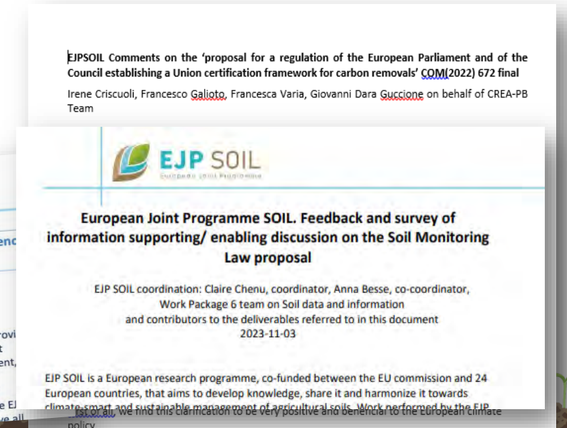
- Elaboration of policy briefs
- Preparation of policy events
- Responses to EC consultations

Demand driven from policy stakeholder needs

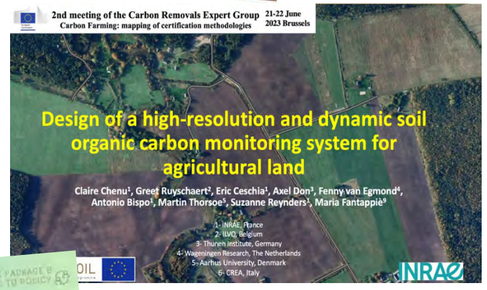
Identify projects, WP's that can contribute with relevant findings

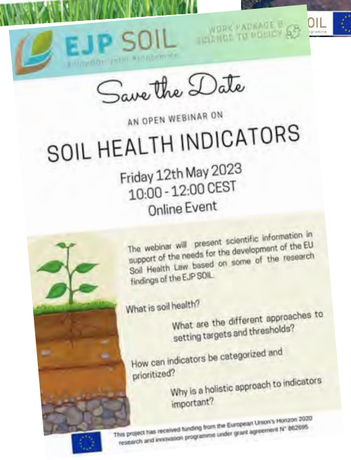
Bring together relevant experts to collaborate on a cohesive message

Provide guidance where needed to refine policy messages



Direct interactions with policy makers





- Organisation of policy events
- Invited presentations at policy meetings
- Working meetings with DG ENV SML team
- Meetings with national policy makers

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From science to policy and practice?

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From science to policy : challenges

Producing knowledge scientifically robust and usable	*Credibility*
Turning knowledge into decision-support tools	*Salience*
From knowledge to collective capacity	*Legitimacy*

Learning process - challenging for scientists

- Understanding policy needs
- Knowledge development: Time scale issue
- Identifying authoritative results : consensus
- Communicating uncertainty and complexity
- Ad-hoc dissemination

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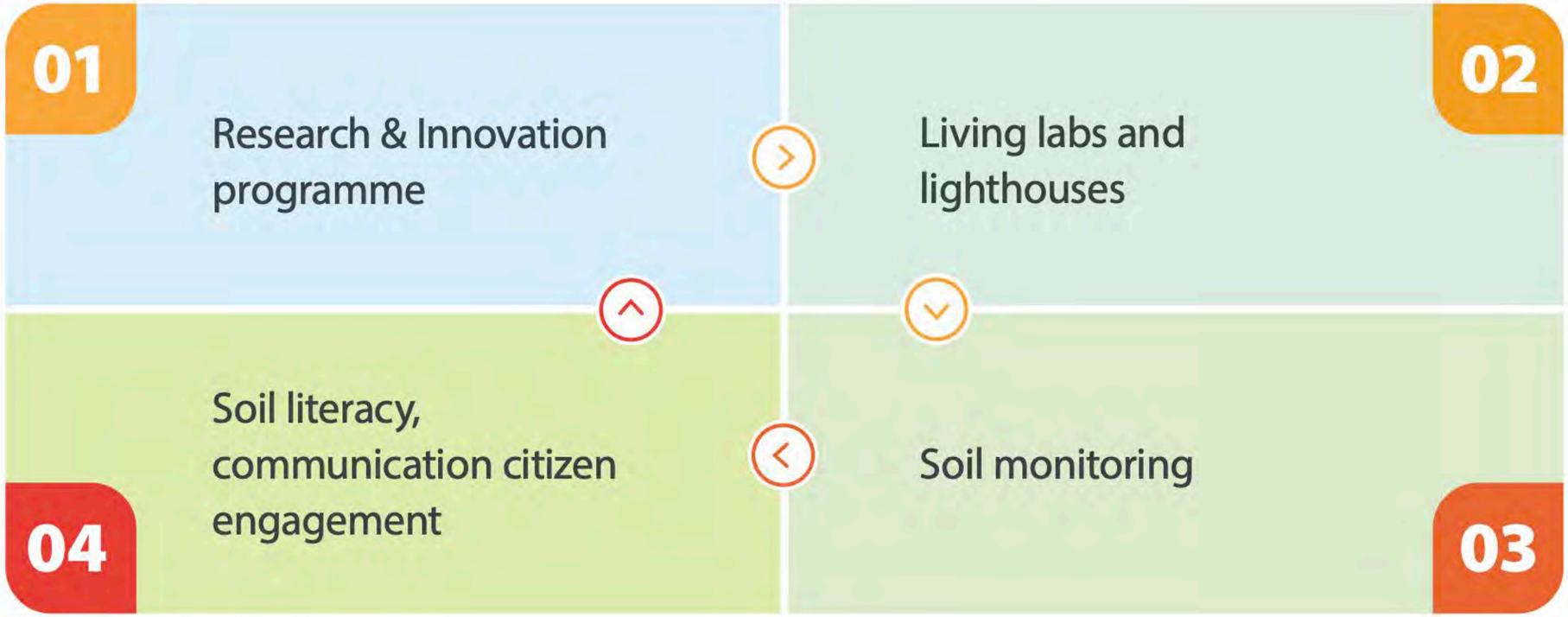
EU MISSIONS

SOIL DEAL FOR EUROPE

2021-2027



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Interactive pdf

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Thank you for your attention

Lachlan Graham

Lachlan is a 4th generation farmer from NSW Australia. Specialising in ruminant livestock systems, he has been practicing and championing regenerative agriculture since 1990. His leadership has been recognised nationally, receiving, amongst other honors, Australian Beef Farmer of the Year and Australian Farmer of the Year in 2013.

Lachlan is the Co Founder and Regen Ag Lead at Fresh Earth Agriculture, where he leads the development and scaling of regenerative farming systems, landscape restoration programs and nature based decarbonisation initiatives. He also serves as Chief Operating Officer of the Australian Beef and Lamb Company (ABL), a regenerative red meat supply chain business connecting Australian beef and lamb from paddock to plate across global markets.

Across all roles, Lachlan is focused on scaling regenerative agriculture, accelerating decarbonisation pathways and building resilient, future focused agricultural supply chains.

Fresh earth agriculture:
valuing regenerative impact

Fresh Earth Agriculture – Valuing Regenerative Impact

Making regenerative agriculture measurable, investable, and profitable

FRESH EARTH AGRICULTURE

February 2026

Australian Context

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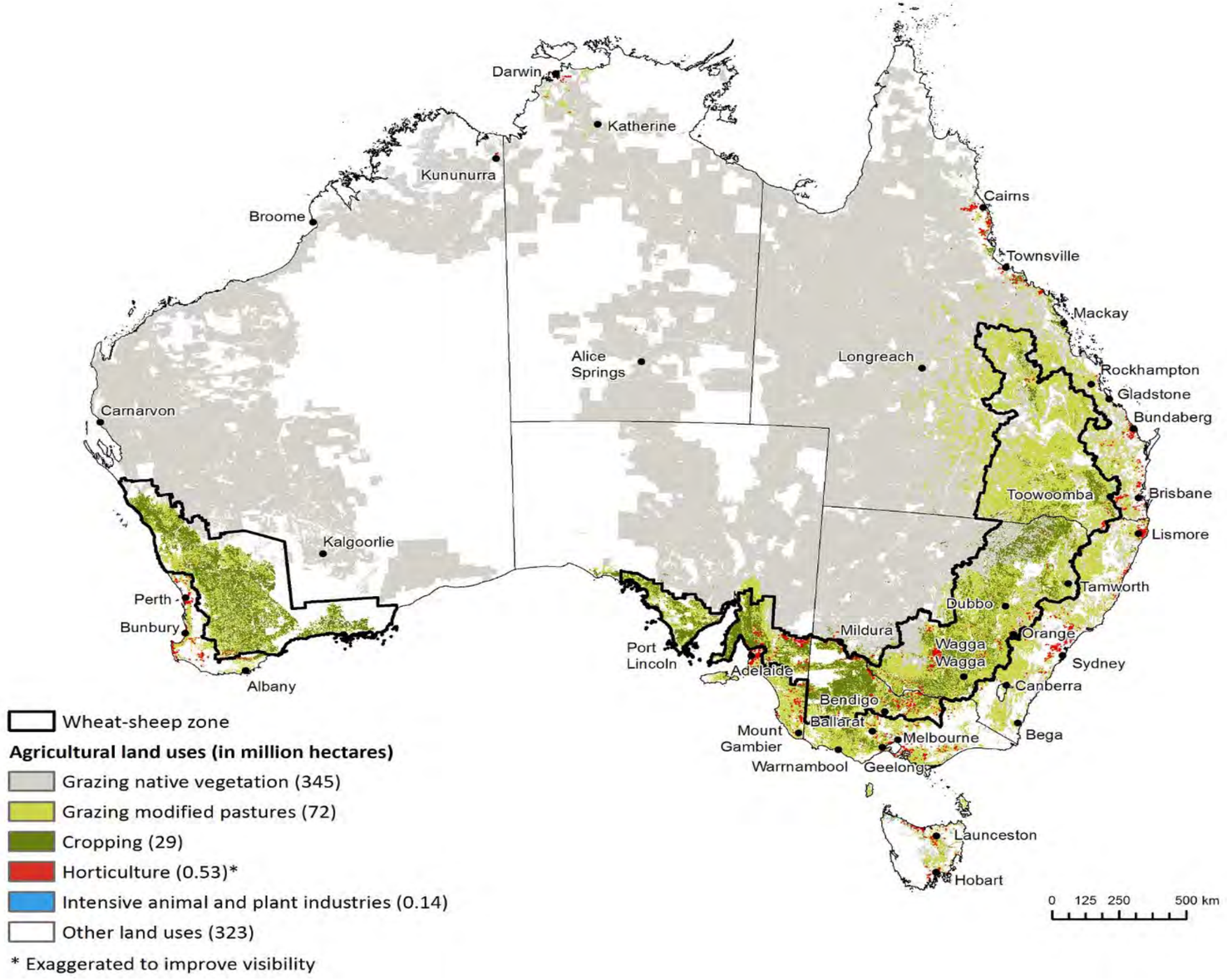
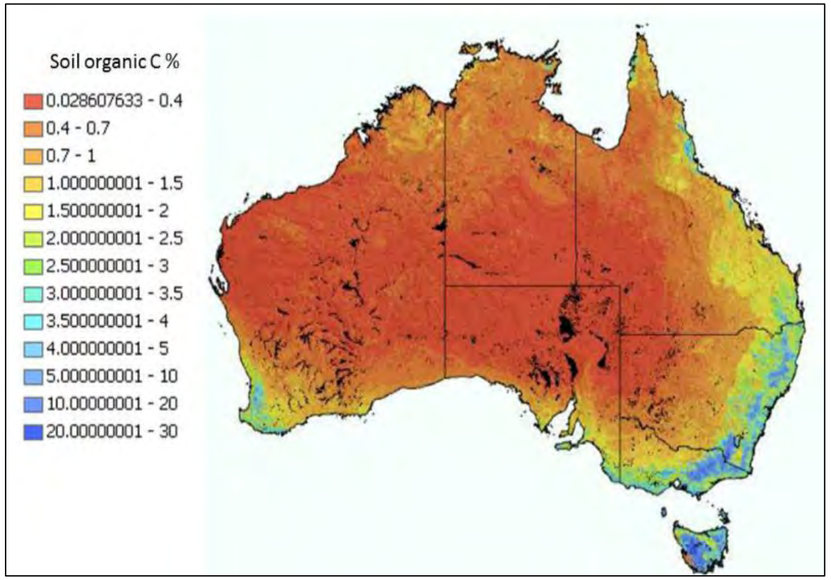
Industry, Soils and Markets

Australian Production Snapshot

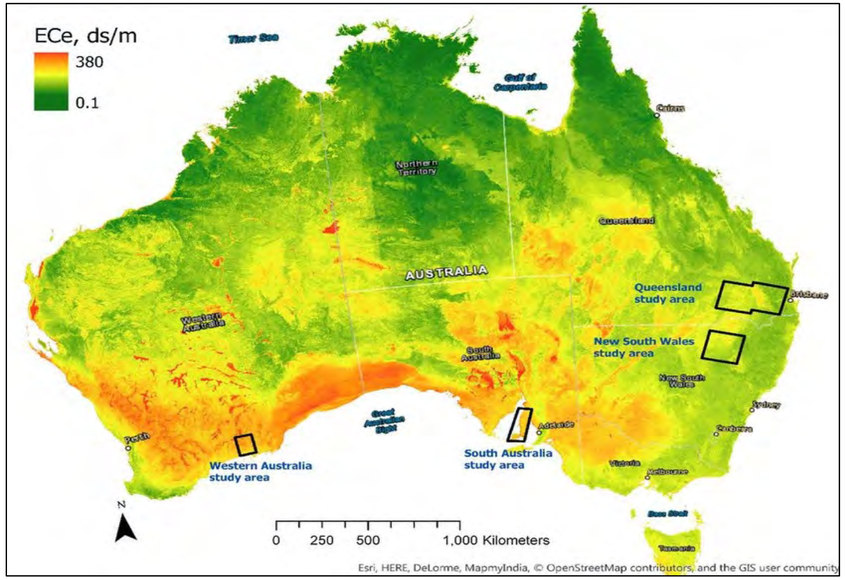


Australian Soil Snapshot

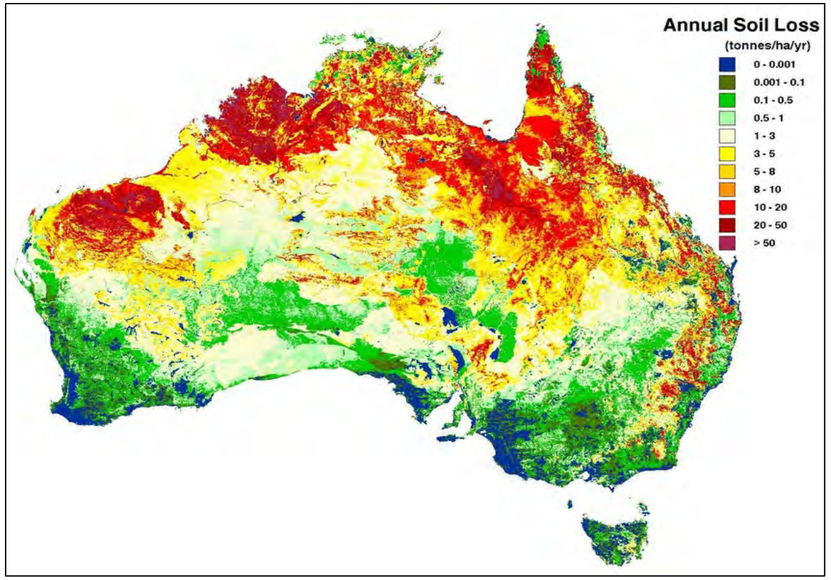
Low Soil Organic Carbon



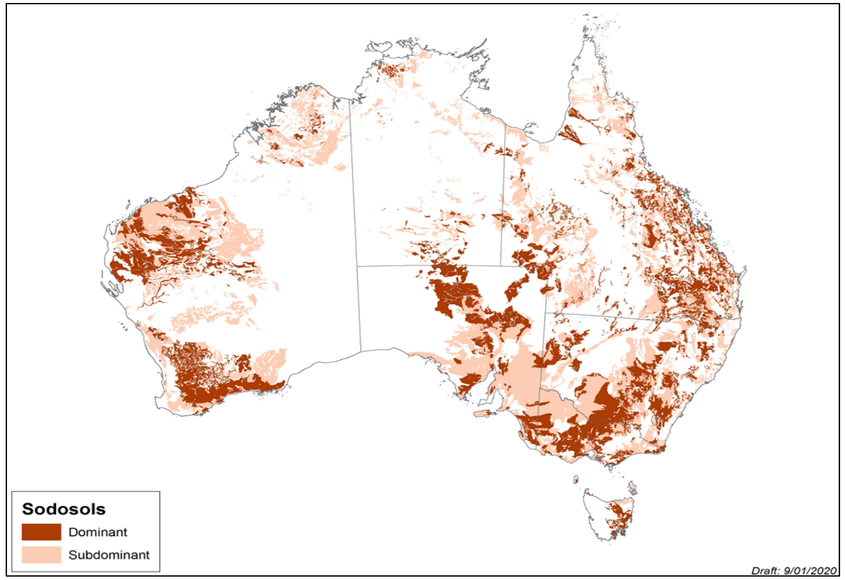
Salinity



Erosion Risk



Sodicity & Dispersion



Australian Environmental Markets

Carbon Market:

CLEAN ENERGY REGULATOR

Australian Carbon Credit Unit (ACCU) Scheme

Project Methodologies

Australian Carbon Credit Unit

1 ACCU = 1 T CO^2e

Current Price = $37.50

Biodiversity Market:

NSW GOVERNMENT Biodiversity Conservation Trust

Biodiversity Offset Scheme

Stewardship Agreement

Species Credit

Ecosystem Credit

Prices vary (1 Koala = $400+)

Barriers to Adoption

High audit/measurement costs

Credit price uncertainty

25 to 100-year “permanence” requirements

Lack of rewards for “early adoptors” who already managed land well

Risk of drought or fire reversing carbon

Complex methodologies and lack of baseline data

Fresh Earth Agriculture – Introduction

Our mission:

Addressing low-quality soils, rising protein demand, and climate uncertainty through regenerative ag programs

Our approach:

Stacking Projects to Diversify Land Use

High-Integrity Project Registration

- Clean Energy Regulator’s ACCU Scheme
- NSW Biodiversity Stewardship Agreements
- Wind farm lease agreements

Fresh Earth Agriculture – Key Tenets

1. Land is not a static asset
2. Healthier soils increase productivity
3. Resilient ecosystems reduce risk
4. Natural capital can be valued in measurable, provable ways
5. Regenerative programs can be replicated when biophysical data is understood

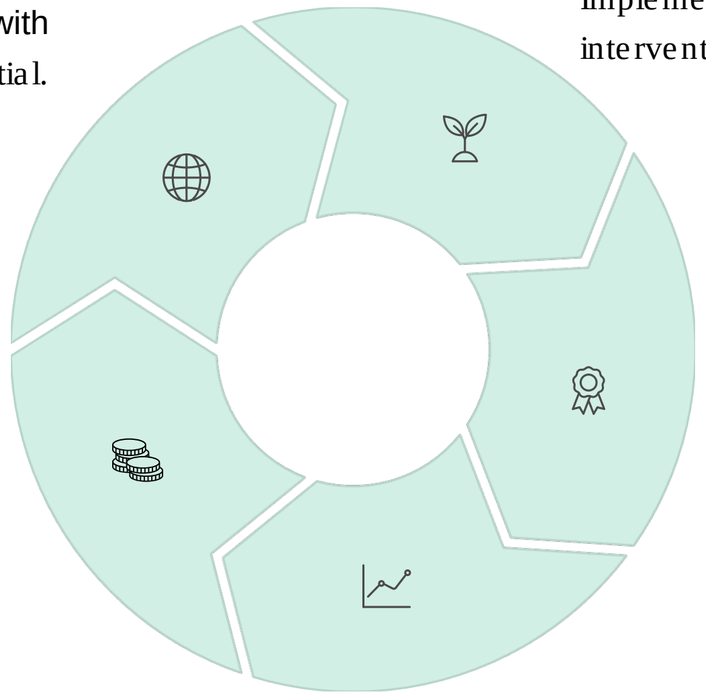
Fresh Earth Agriculture – Change of Practice Model

Land Asset

Identification and assessment of land assets with high uplift potential.

Regenerative Program Stack

Implementation of tailored regenerative interventions and project methodologies.



Product & Credit Generation

Generation of high-quality agricultural products, carbon, and biodiversity credits.

Digitize & Repeat

Program metrics aggregated and true value tokenized. Programs become repeatable and scalable across new land assets.

Measure, Report & Verify

Continuous data collection, verification, and reporting of biophysical outcomes.

Fresh Earth Agriculture – Ownership Model

Fractional Ownership

Wholesale Investors

Retail Investors

Institutional Investors

Buy Land Tokens/Shares

Access to Land Regen. Projects

Regen Operating System

Agriculture Experts

Design interventions

Agriculture Suppliers

Provide inputs

Agriculture Operators

Operate interventions

AI & Blockchain

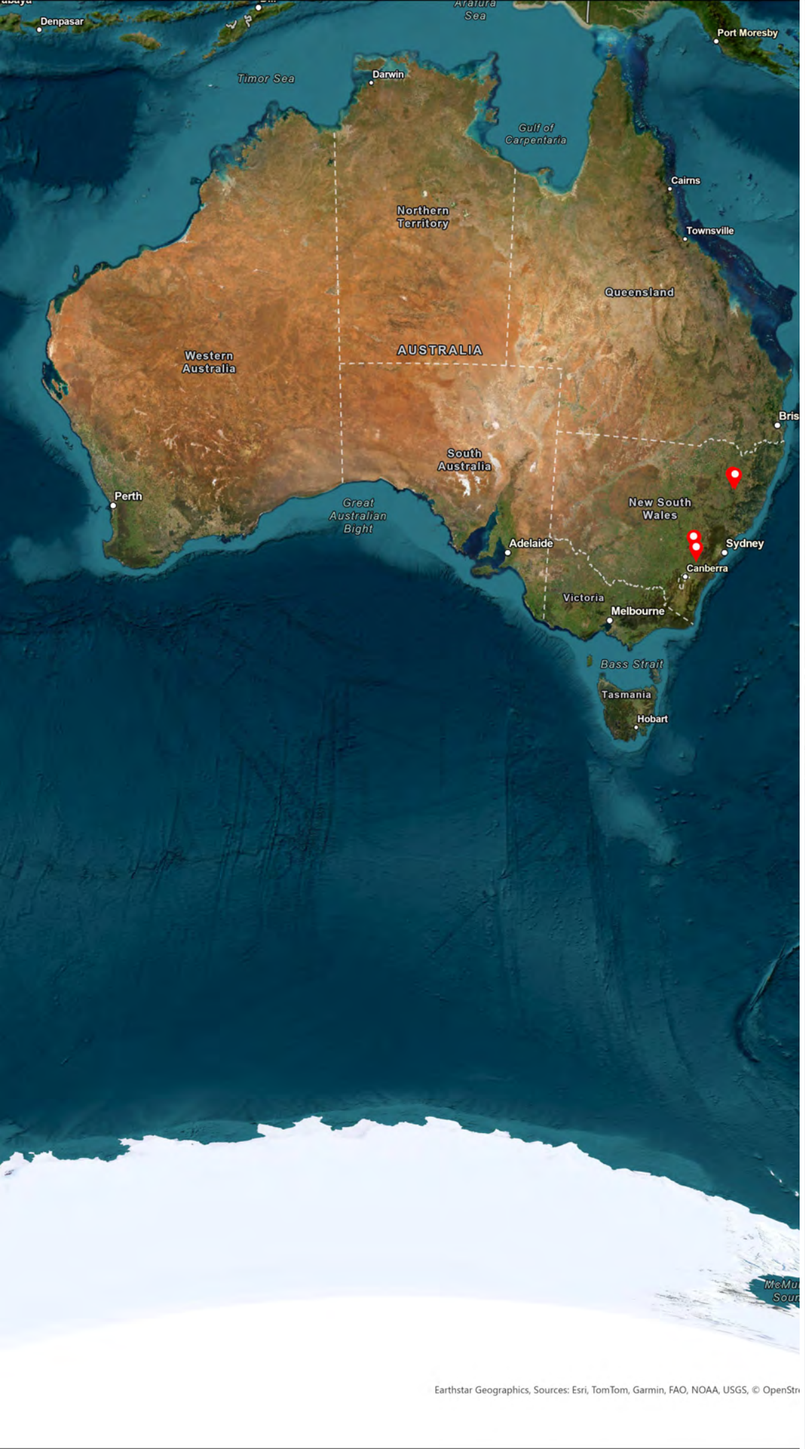
Verify impact

Environmental Marketplace

ESG Buyers and Corps

Buy Verified Credits

Buy Regen Produce


Denpasar
Port Moresby
Timor Sea
Darwin
Gulf of Carpentaria
Cairns
Northern Territory
Townsville
Queensland
Western Australia
AUSTRALIA
South Australia
Perth
Great Australian Bight
New South Wales
Adelaide
Sydney
Canberra
Victoria
Melbourne
Bass Strait
Tasmania
Hobart
Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStr


Glenclair
Talbingo
New South Wales
Coffs Harb
Newcastle
Mildura
Cooksvale
Lenore
Aggregation
Sydney
Hillview Park
Wollongong
Canberra
Albury
Victoria
Bendigo
Ballarat
Melbourne
Geelong
Bass Strait
Devonport
Tasmania
Launceston
Hobart
Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap


Pilliga
Glenclair
Talbingo
Tamworth
Goonoo
Dunedoo
Towarri
Dubbo
Barrington Tops
Goulburn River
Muswellbrook
Wellington
Mudgee
Maitland
Wollemi
Cessnock
Newcastle
Orange
Yengo
Bathurst
Parr
Lithgow
Gosford
Katoomba
Cooksvale
Lenore
Aggregation
Blue Mountains
Sydney
Royal
Nattai
Hillview Park
Bowral
Wollongong
Goulburn
Kiama
Morton
Nowra
Canberra
Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap

Existing Portfolio

Property Locations Across NSW

7

Active Properties

Strategically located across diverse agricultural zones

9

Active Projects

Soil carbon, reforestation, biodiversity, and renewables

$200m AUD

Pipeline of Properties

Currently engaging investors and off-takers to acquire and integrate strategically located properties

100%

Verification Rate

All projects registered under high-integrity schemes

Case Study: Glenclair Aggregation

Bendemeer, NSW

Key Characteristics

Total land area of
4209ha | 10,400ac*

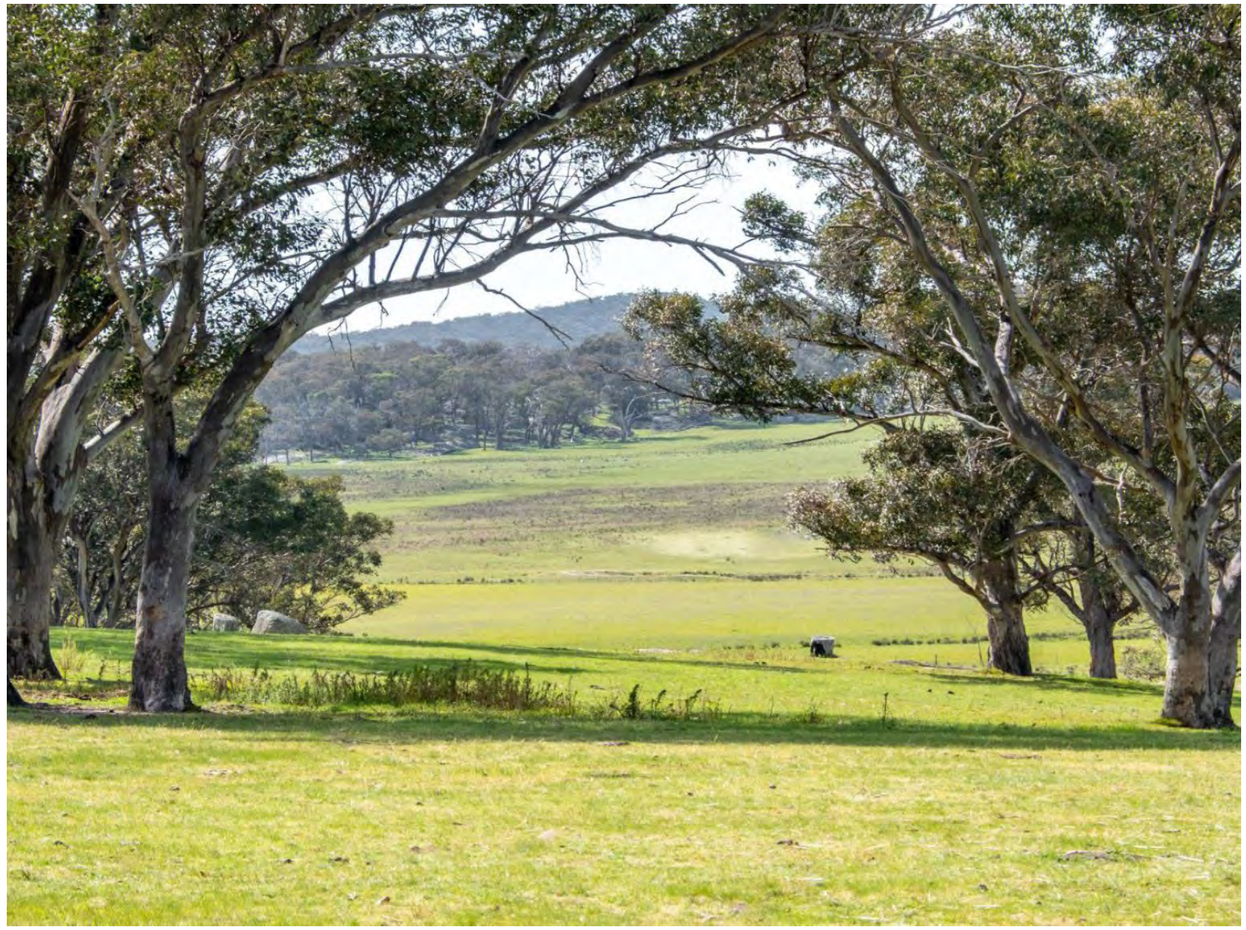
Cattle breeding,
1000 head*

Substantial
infrastructure

Long term rainfall
750mm to 800mm

Majority granite and
basalt soils

Elevation range
700m to 1,100m



Project Planning

Soil Carbon

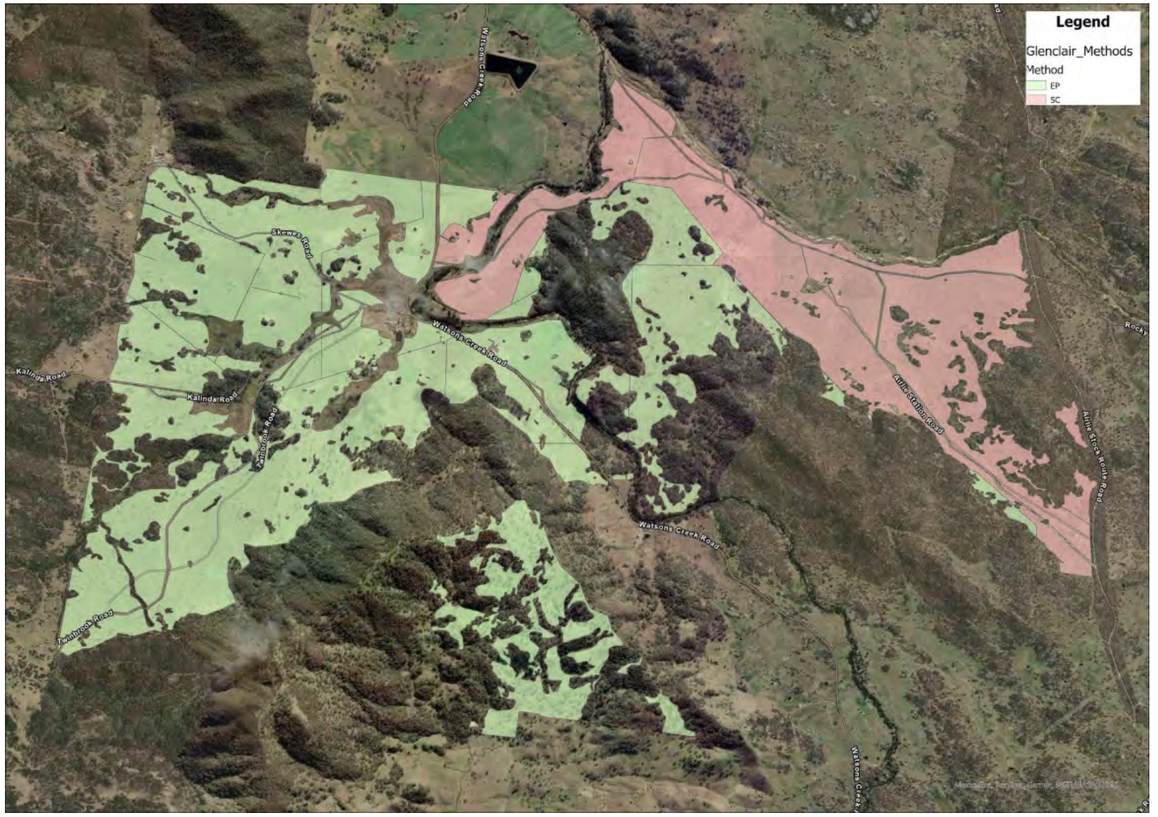
- Baseline soil sampling
- Land management strategy

Reforestation

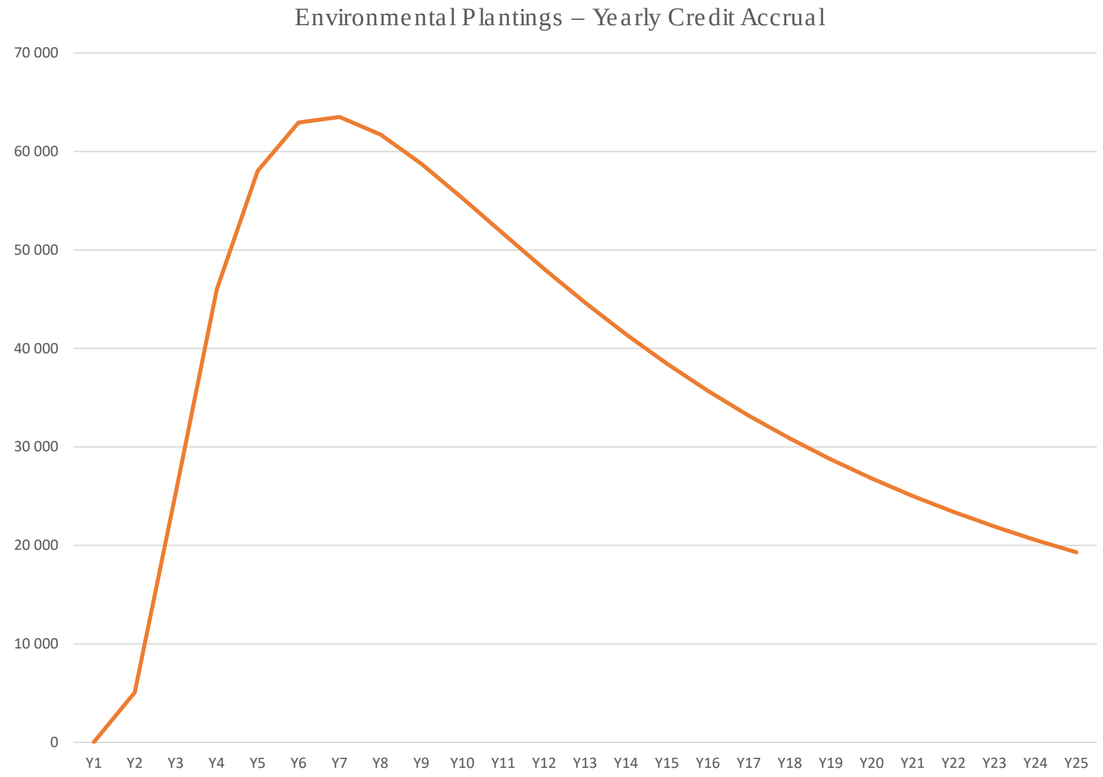
- Species selection
- Management plan and risk assessment

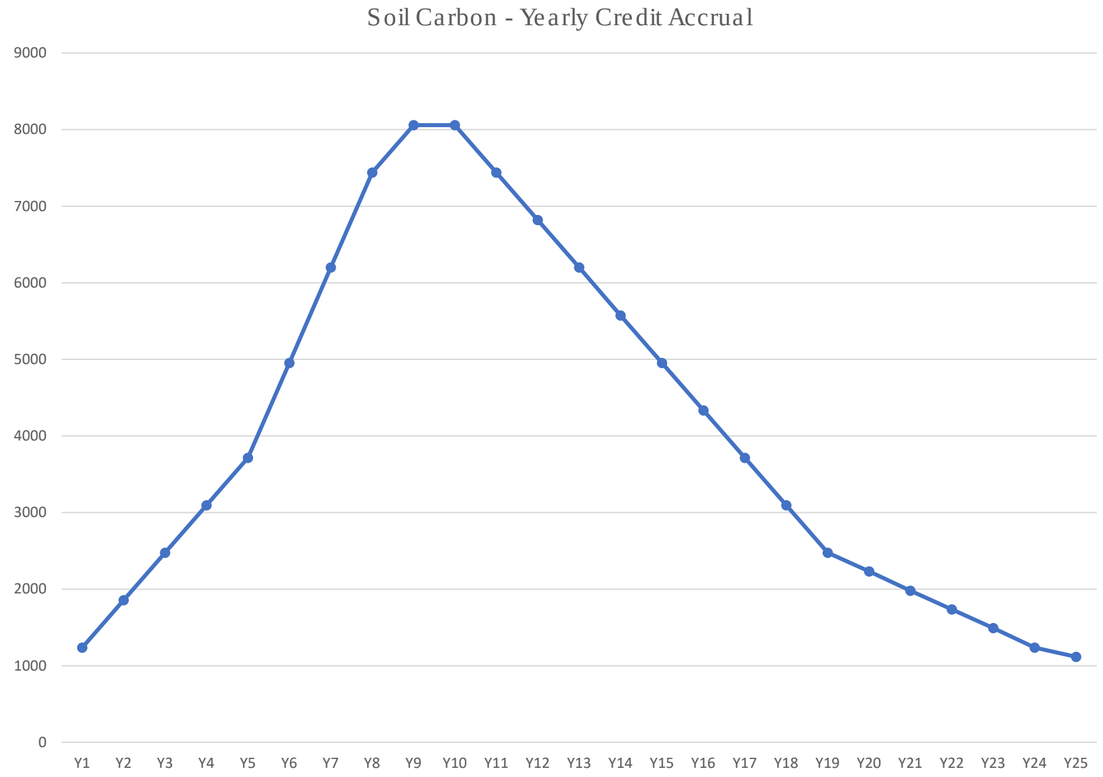
Biodiversity

- Conservation area
- Site assessments



Project Forecasting





Reforestation

- Project area = 1,297 hectares
- High tree growth Y1-Y7

Soil Carbon

- Project area = 495 hectares
- SOC% Estimate = 1.4%
- SOC% Target over 25 years = 2.4%

Activities and Impact

Soil Carbon

- Rotational grazing
- Targeted fertiliser
- Pasture restoration

- Increased carrying capacity
- 100,000 tCO_2e sequestered over 25 years

Reforestation

- Site preparation
- Tree planting

- Reduced soil erosion
- 920,000 tCO_2e sequestered over 25 years

Biodiversity

- Fencing
- Pest control

- Improved biodiversity
- 9,800 ecosystem credits

Investment Highlights

- Property Purchase Price
  - $14,500,000
- Agistment Revenue (25-year projection)
  - $15,886,312 (14.8% of revenue)
- Carbon Credit Sales (25-year projection)
  - Environmental Plantings: $55,353,195 (51.5% of revenue)
  - Soil Carbon: $9,990,997 (9.3% of revenue)
- Biodiversity Credit Income
  - $26,197,800 (24.4% of revenue)
- Total Expenses (25-year projection)
  - $35,534,784
- IRR
  - Unlevered: 18.4%
  - Levered: 24.9%

Seeing it on Farm…

Carbon Projects at Glenclair

Site Assessments

Design and Baseline

On-site Implementation

Soil Carbon Baseline Sampling

Reforestation Site Assessment

Reforestation Site Preparation

Partnering with Industry and Research

Strategic Alliances

Collaborative Ecosystems

Driving Innovation

ZNE Agriculture
Cooperative Research Centre

Research Demonstration Sites

tia
TASMANIAN INSTITUTE OF AGRICULTURE

Life Cycle Analysis

THE UNIVERSITY OF SYDNEY

Sustainable Beef Marketing

mla
MEAT & LIVESTOCK AUSTRALIA

Co-Innovation Project

“Zero Net Emissions Agricultural Cooperative Research Centre” Producer Demonstration Site

RESEARCH PROGRAM 1:

Low-emissions plant solutions

This program will develop solutions for low-emissions broad-acre and horticultural systems, as well as reduce emissions in cattle and sheep via the delivery of anti-methanogenic plant properties and low-emissions, high-productivity mixed-species pastures.

RESEARCH PROGRAM 2:

Towards methane-free cattle and sheep

This program will provide the technology and quantification required to transition livestock production to a low-methane emission future.

RESEARCH PROGRAM 3:

Whole-farm and mixed enterprise systems analysis

This program will integrate all the science emerging from the CRC to provide farmers with the guidelines, resources, metrics, and benchmarking tools required for a profitable transition to net-zero emissions.

RESEARCH PROGRAM 4:

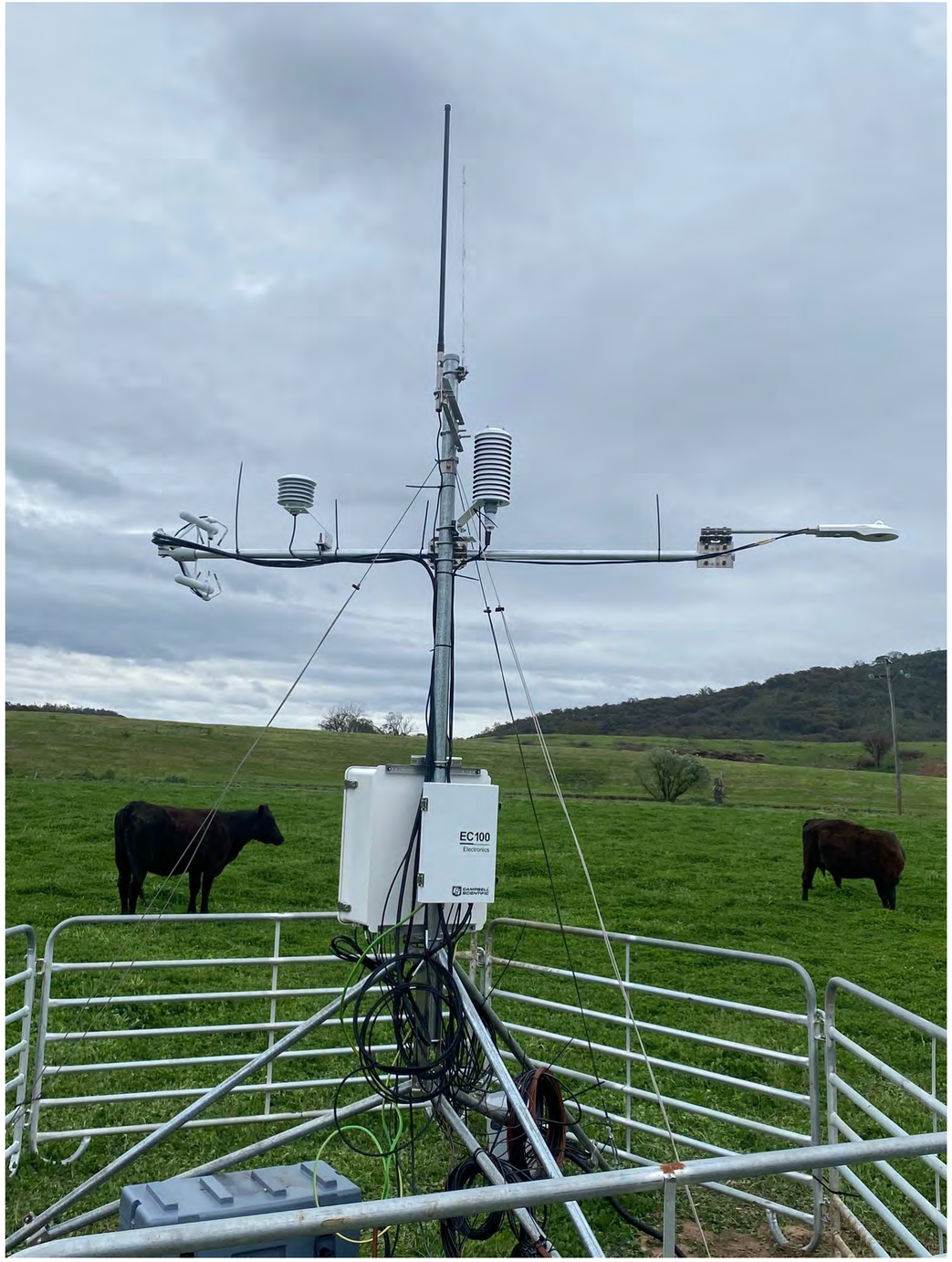
Delivering Value from Net Zero

This program will develop renewable energy and circular economy solutions that create profitable opportunities for agribusinesses and rural communities. The program will improve supply chain management and enhance access to key export markets.

73 partners across industry, government and education

$300 million in funding over 10 years

Three of the first 9 partner producer demonstration sites



Connecting our story to Consumers…

Red meat products from our regenerative programs

Offtake Emissions

Premiums for products

Global market appetite

ABL

AUSTRALIAN BEEF & LAMB COMPANY

The Australian Beef and Lamb Company specializes in delivering Australian beef and lamb to a range of global markets.

Through fostering strong partnerships with our suppliers across Australia, we guarantee the production of consistent quality beef and lamb in line with the expectations of our global customer base.

ABL Co Pastoral Program

Essential Standards:

Grass Fed

Zero-tolerance for animal cruelty

Never Confined

100% Free From HGPs

No Antibiotics

GMO-free

Optional Standards:

Regenerative

G.A.P.

Broadening Impact

MURRAY DARLING BEEF

ANDERSON CUSTOM MEATS

CHIPOTLE MEXICAN GRILL

KEEP RIVER AUSTRALIAN GRASS-FED BEEF

TWR™ TETON™ WATERS RANCH

SQUIRES CREEK Australian Lamb by ABL Co

ENTREES FINEST INC SINCE 1988

USDA PROCESS VERIFIED

Panel - Discussion