LEGUMINOSE

the way to a green transition

Legume-cereal intercropping for sustainable agriculture across Europe

Introduction and overview of LEGUMINOSE

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22nd November 2023

HORT@ From research to field

AGRESTIC

Il progetto LIFE AGRESTIC ha ricevuto finanziamenti dal Programma LIFE dell'Unione Europea

FINAL CONFERENCE

LIFE AGRESTIC

Reduction of Agricultural GReenhouse gases EmiSsions Through Innovative Cropping systems

Horizon Europe

THE NEXT EU RESEARCH & INNOVATION PROGRAMME (2021 – 2027)

European Commission

Identify the obstacles to intercropping and enhance farmers' acceptance by providing knowledge and demonstrations that promote economic, environmental, and social benefits of legume-cereal intercropping.

- **Co-design legume-cereal intercrop** combinations and crop rotation systems adapted to different pedoclimatic conditions
- Elucidate suits of **intercropping benefits beyond** yield and N cycling
- Provide **web-based interactive platform** for assisting site-specific decision support tool
- Multi-actor approach to make "**biodiversity**" an integrated element of farms using **On-farm living labs** and knowledge sharing
- Map current **barriers** among stakeholders across the whole value chain, use **behaviour change methodologies** to develop strategies to overcomes these barriers
- Create **Two-way communication** channel and knowledge exchange activities by building collaboration with non-EU countries (Pakistan and Egypt)
- Co-create a set of **policy recommendations** and contribute to the implementation of existing EU policies i.e. Green Deal, Farm2Fork….

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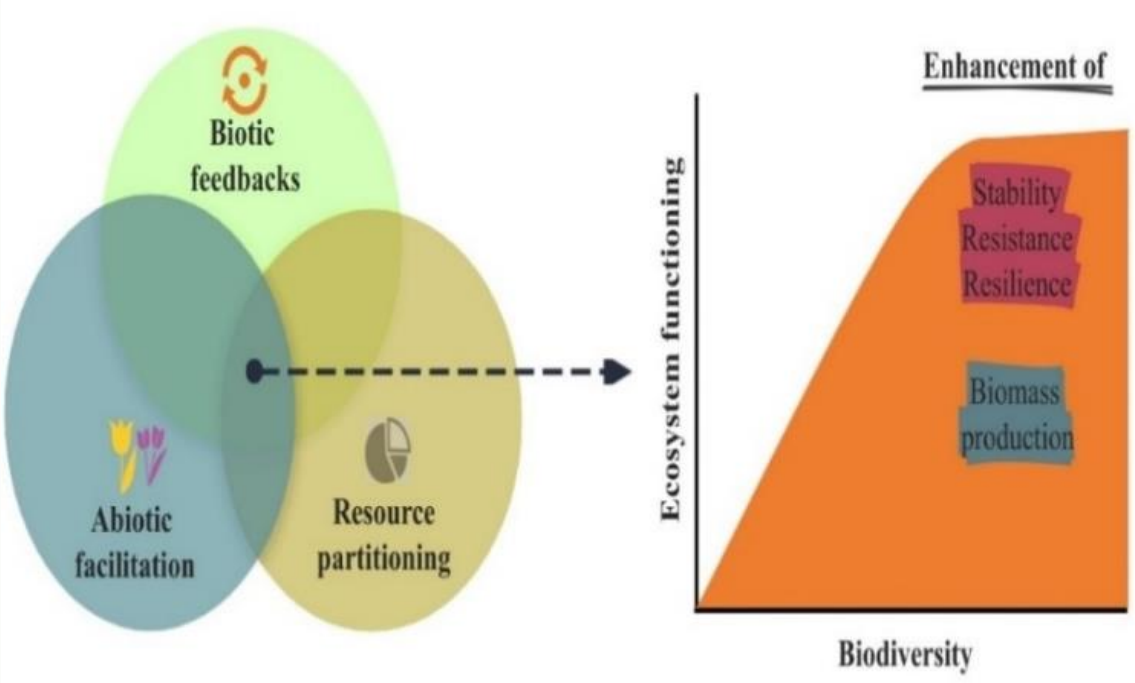
The project idea is based on the concept of ecological intensification, assuming that components of biodiversity can be used to either complement (ecological enhancement) or even replace artificial inputs (ecological replacement).



Theoretical principles of ecological biodiversity with prediction of enhanced ecosystem functioning.

"division of labour"

- ✓ Higher efficiency and functioning of the cropping system

- ✓ Utilization of different abiotic resources, thereby increased overall resource pool availability
- ✓ Complementarity, less competition
- ✓ Biotic interaction, dilution effect

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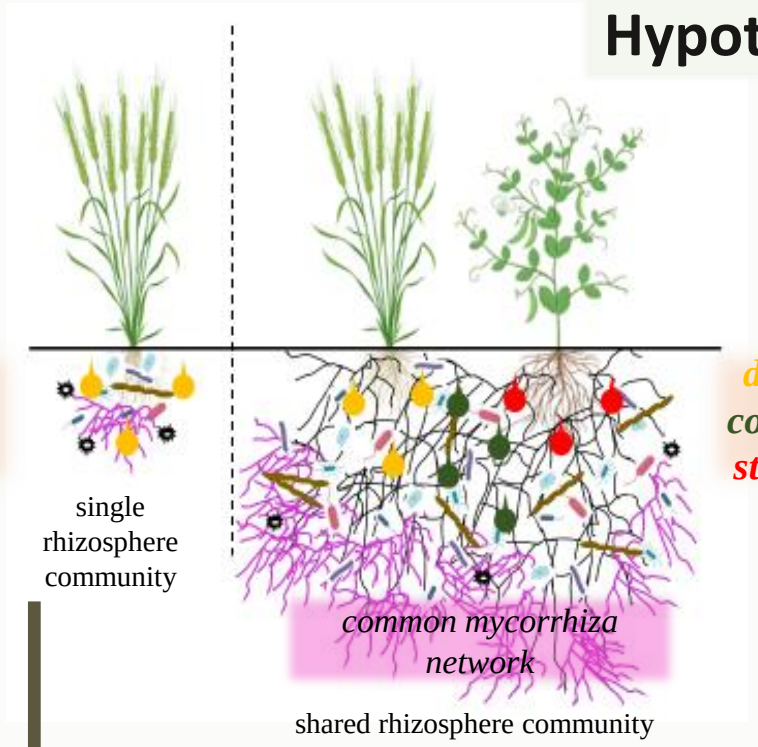
Hypothesis and Rational

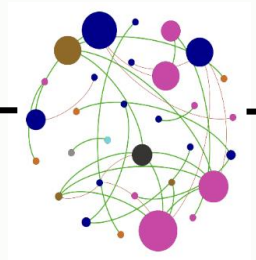
1. The higher plant diversity of intercropping systems will increase plant health and reduce the application rates of pesticides in agroecosystems as compared to monocultures
2. The increasing plant health is the result of increasing below ground networks between trade partners and their rhizosphere microbial community
3. Intercropping reduces fertilizer inputs and tighten nutrient cycles by symbiotic trades between plants and microorganisms and by intra plant synergism



Hypotheses

less diverse community & limited co-occurrence

- high probability of pathogenicity
- higher pest, pathogen & weed

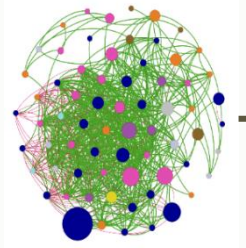


- limited microbial activities
- less nutritional availability and mobilization

limited plant production

more diverse community & higher co-occurrence

Enhancement of
- microbial biomass & activities
- high nutritional availability and mobilization



Suppression of soil borne disease, pest and weed through;
- reduced host pathogenicity
- physical barrier
- allelopathic interaction
- bio-fumigation
- induced systematic persistence
- resource exploitation

higher plant production

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Pilot demonstration (research field trials) and on-farm living labs for optimisation of legume-cereal intercropping

Outreach activities

LEGUMINOSE components

Remote sensing and modelling for continuous farm mapping and decision support on intercropping

Socioeconomic impacts and sustainability of the proposed strategies across Europe and beyond

Multi-actor approach

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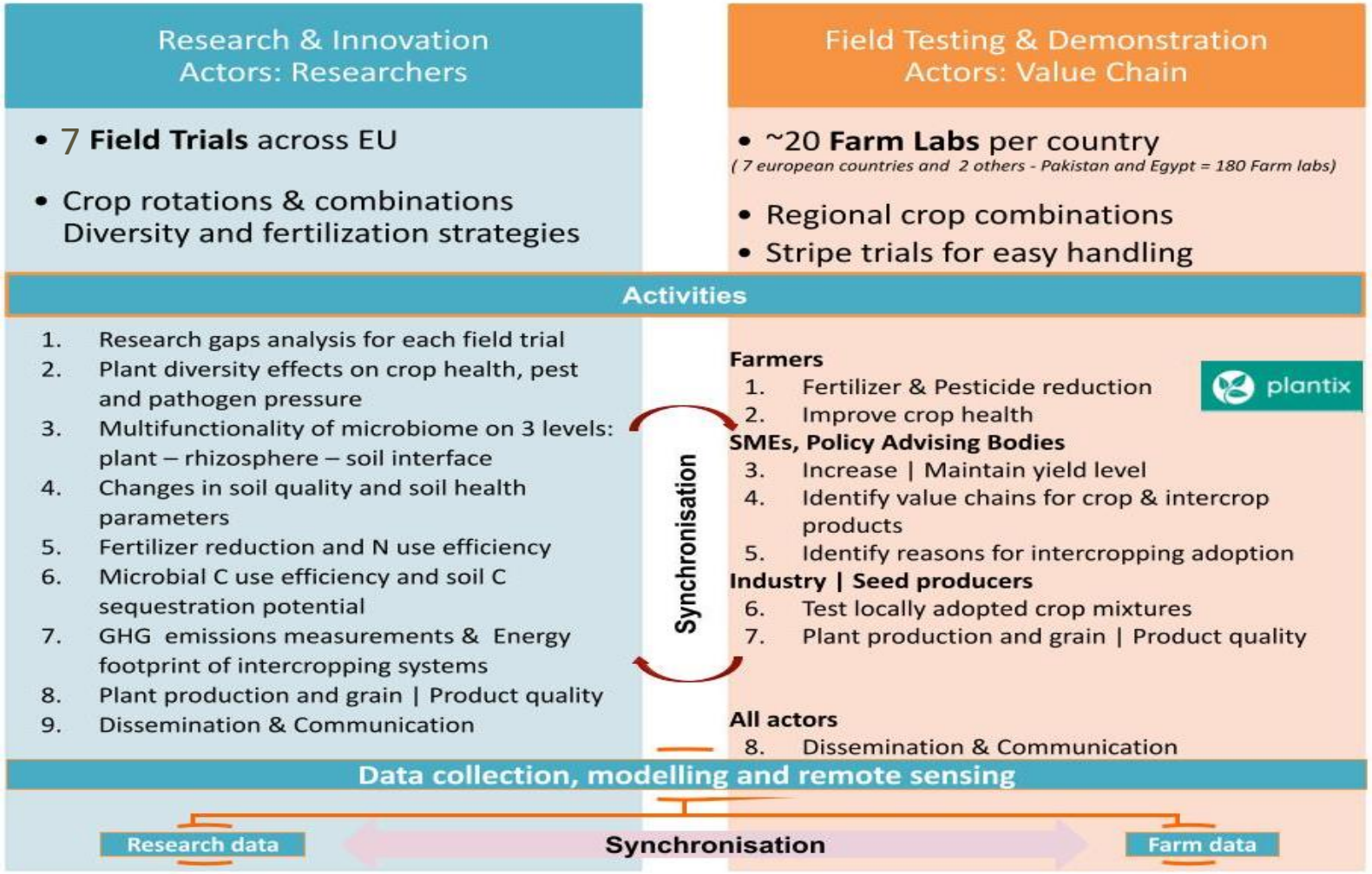
1. Pilot demonstration (research field trials) and on-farm living labs for optimisation of legume-cereal intercropping (WP3, WP4, WP5).



Planned activities and synchronisation of research and on farm field trials

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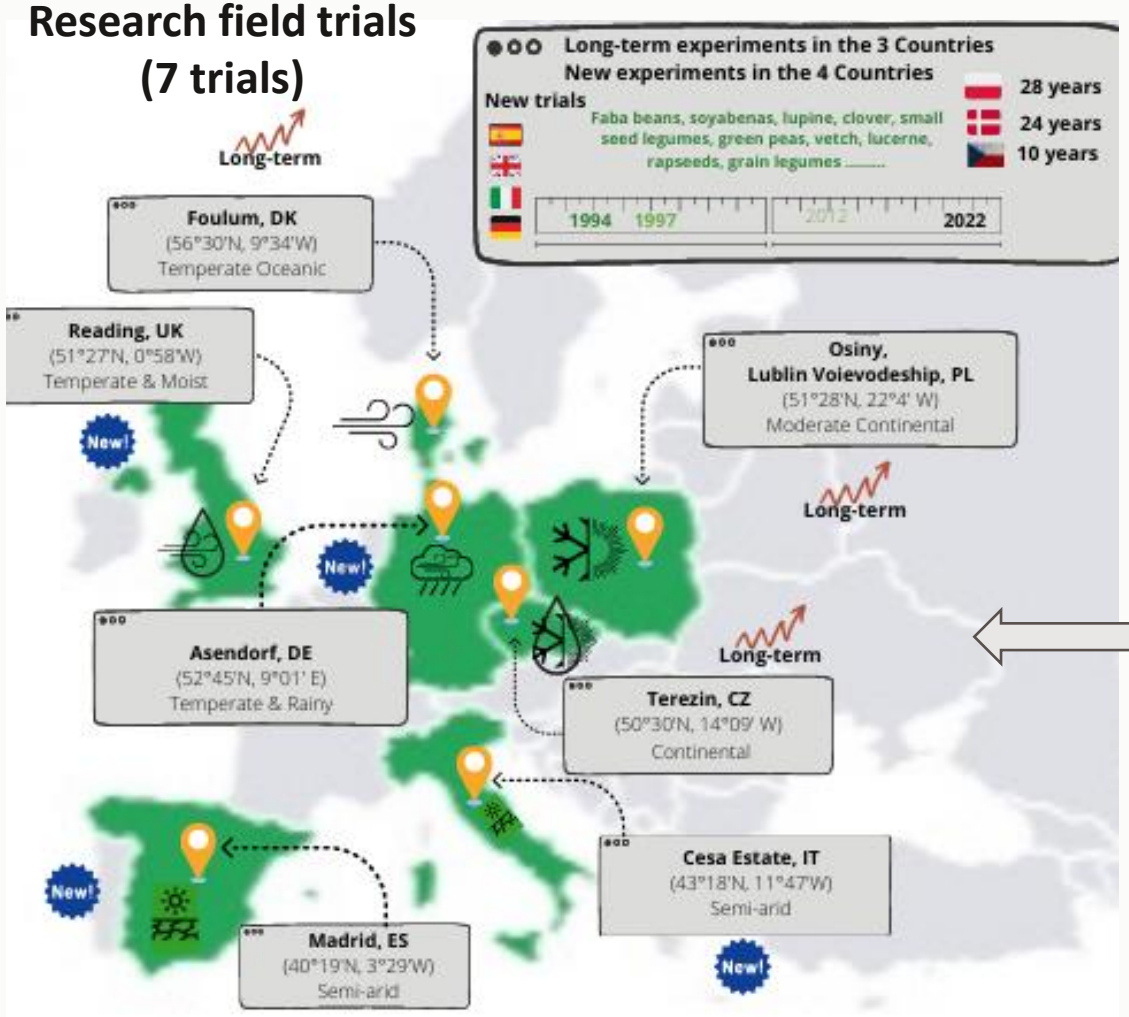
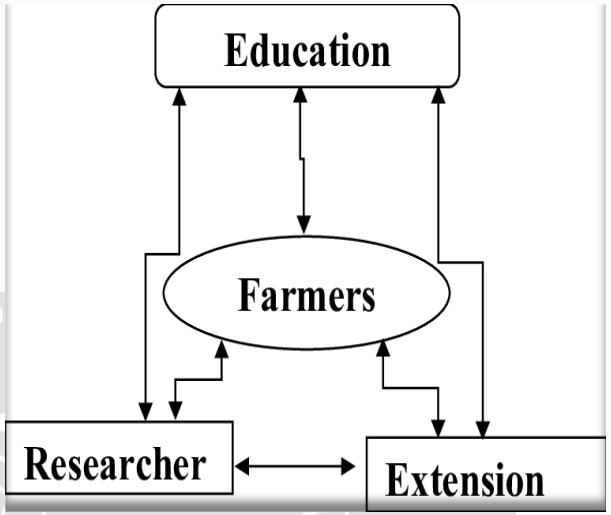
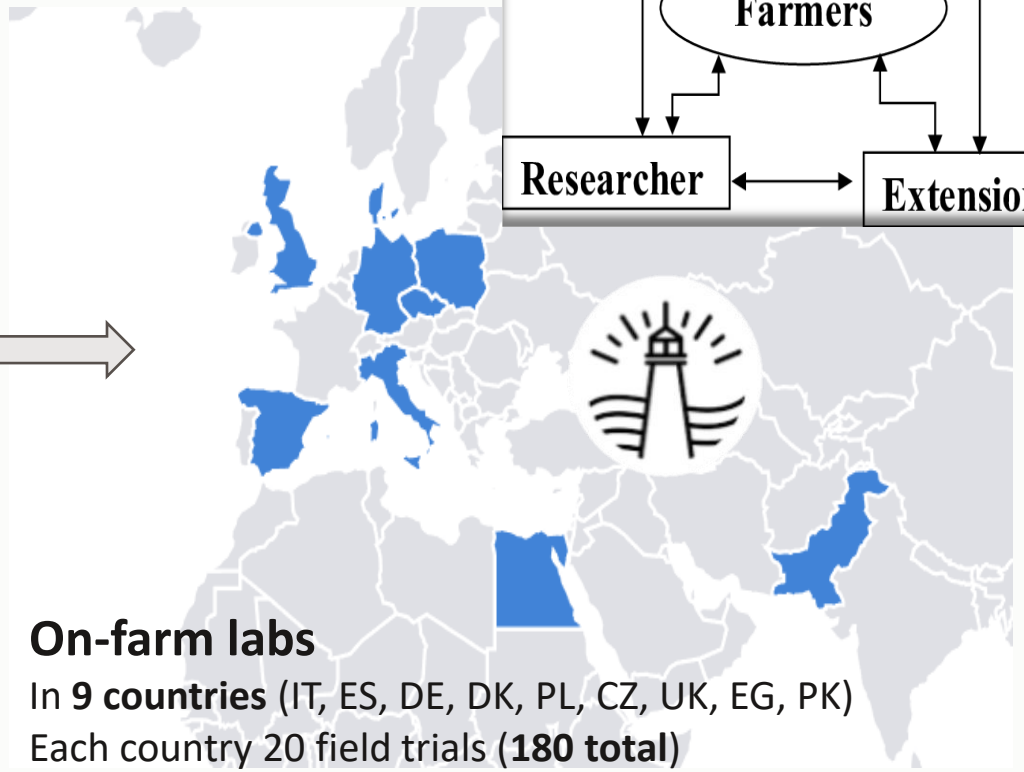
1. Pilot demonstration (research field trials) and on-farm living labs for optimisation of legume-cereal intercropping.

Research field trials (7 trials)





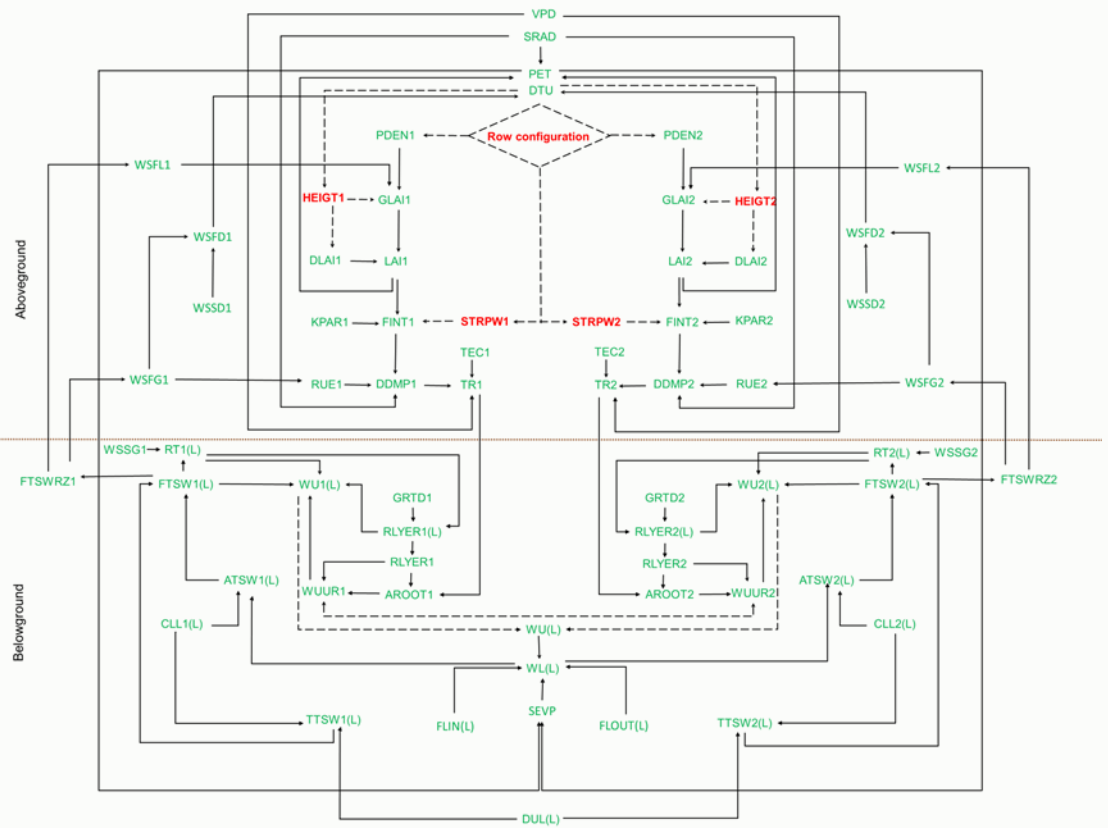


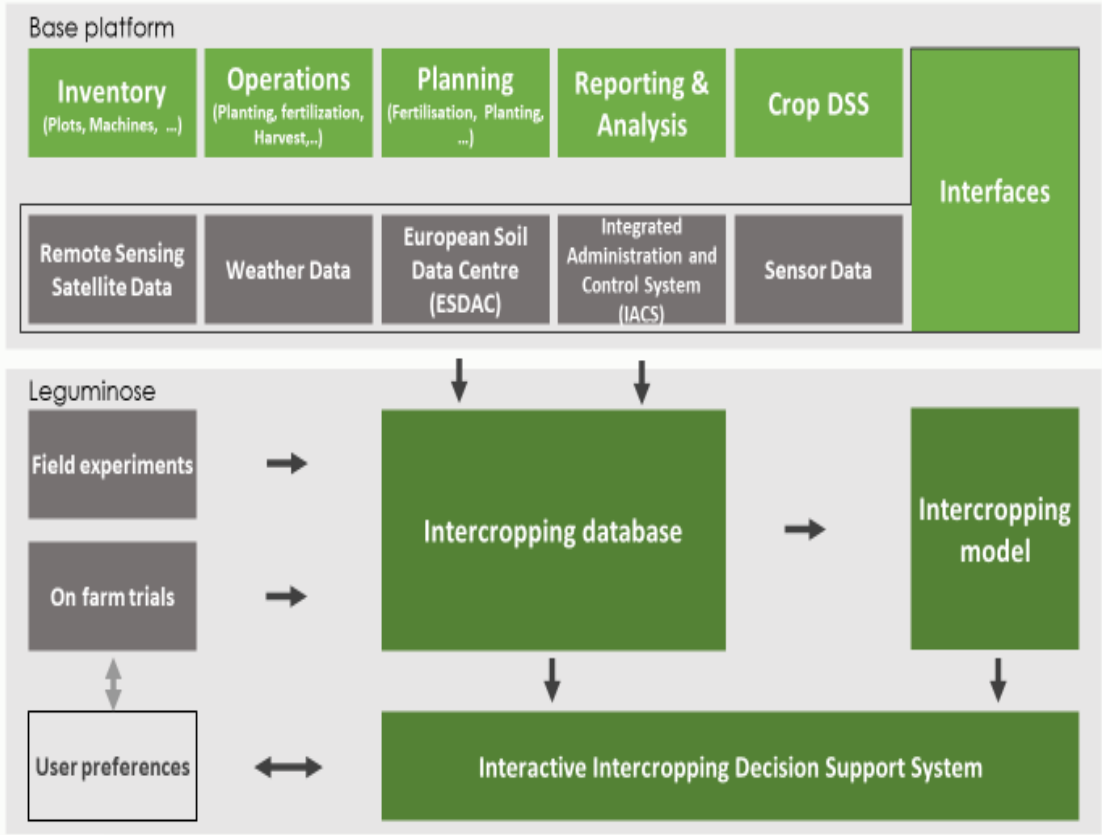
On-farm labs

In **9 countries** (IT, ES, DE, DK, PL, CZ, UK, EG, PK)
Each country 20 field trials (**180 total**)

Funded by the European Union

2. Modelling above- and below-ground dynamics of intercrops (i-crop mode) and developing an interactive web-based platform for assisting decision-making on intercropping at a European scale.





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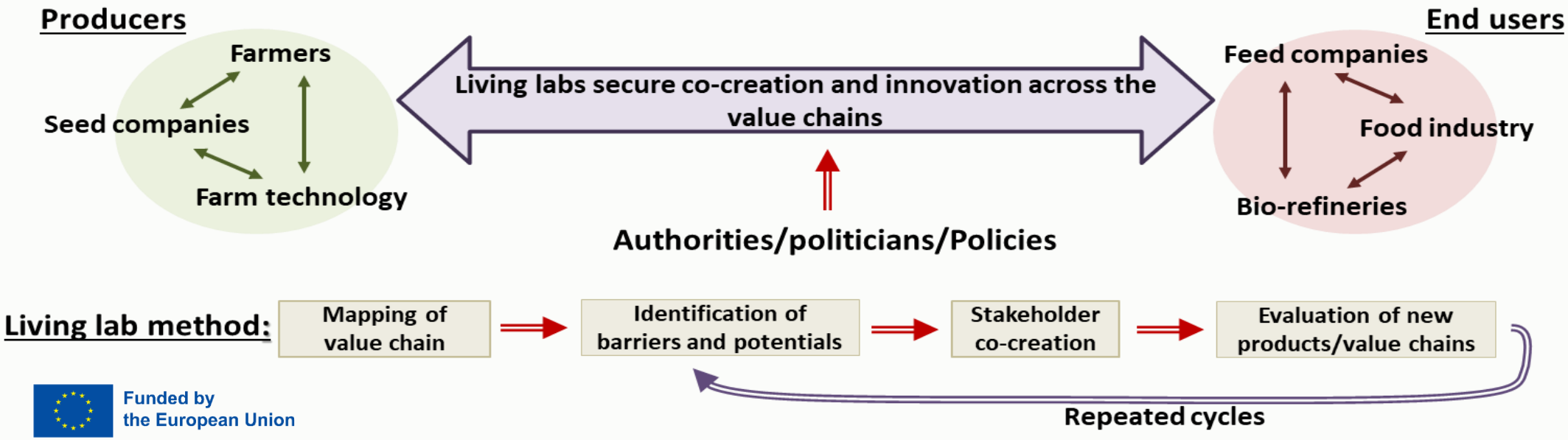
3. Socioeconomic impacts and sustainability of the proposed strategies across Europe and beyond (WP2 and WP7).

Multi actor participatory approach to identify barriers for intercropping

- Creating Innovation partnerships
- identifying barriers and motivation of stakeholders towards intercropping and for co-creation of species mixtures/combinations for on-farm living lab field trials that reflect local priorities

Explore the economic incentives and framework conditions that promote intercropping by farmers and value chain actors

- Evaluation of economic stability at farm level
- Connecting intercropping with consumer demand and business models
- Policy analysis to promote intercropping
- Exploitation roadmap



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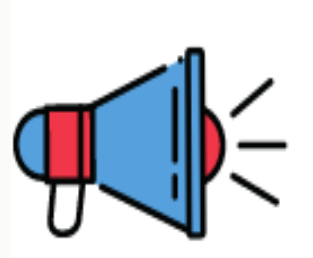
4. Outreach activities (WP8).



Develop and implement appropriate strategies for dissemination, communication and stakeholder engagement

- To raise awareness and inform about the project, its relevance and results to all relevant stakeholders
- To disseminate the project results
- To engage with farmers and other stakeholders and train them on the LEGUMINOSE solutions.

@Leguminose_EU

leguminose.eu

Leguminose Project

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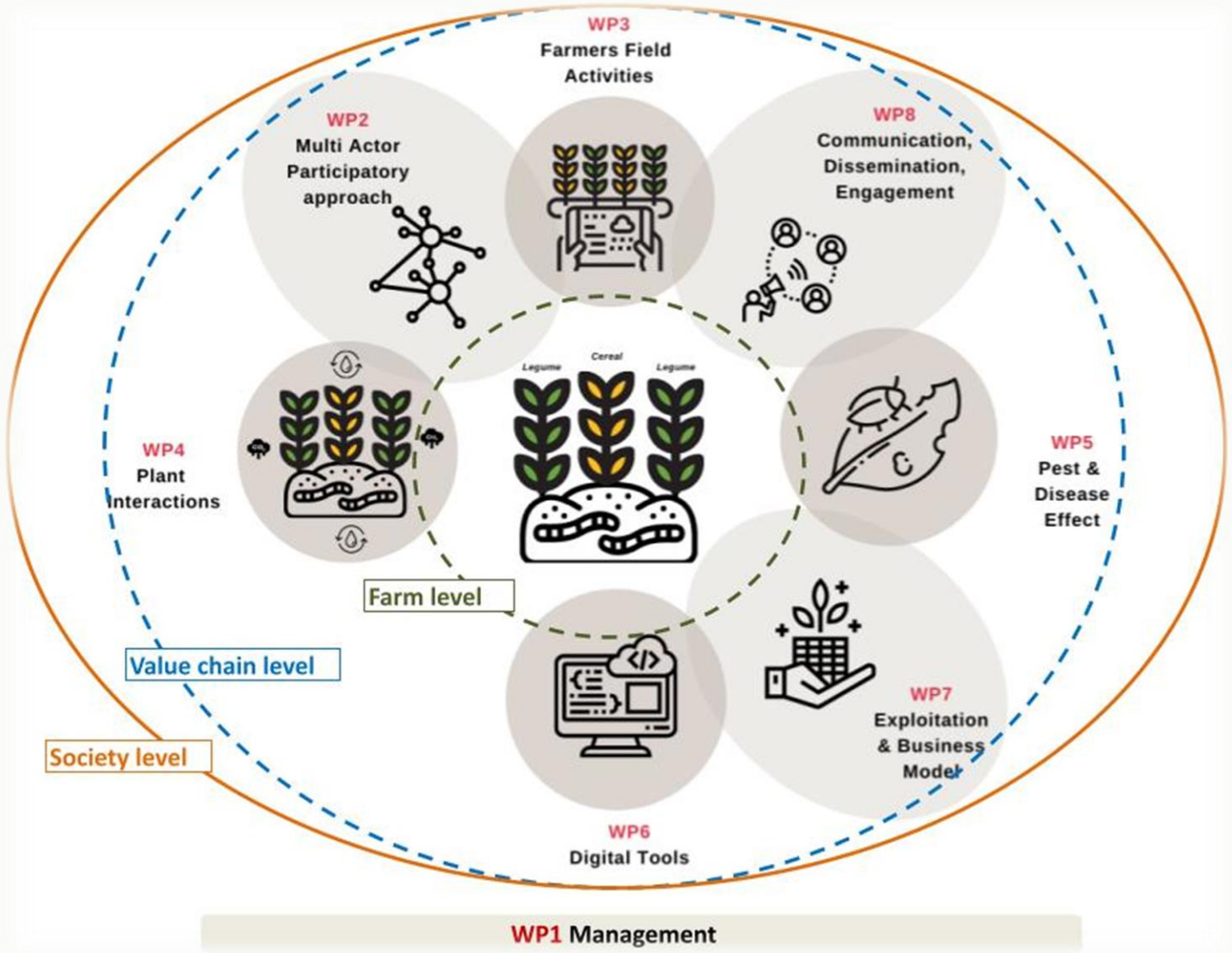
Work packages: an overview



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Summary

Aim

Elucidate the suite of intercropping benefits beyond yield and N cycling and support the implementation of sustainable cropping systems by delineating avenues for environmental, economic and social gains

Methodology

- Pilot field trails & living labs
- Remote sensing and modeling
- Socio-economic analyses
- Outreach activities

Key results

- Reduce the use of N fertilizers and pesticides
- increase farmers' awareness and willingness to use intercropping
- Intercropping as Climate smart farming system
- increase intercropping land use area

Impacts

Ecosystem level

- Improved above and belowground cycles
- enhanced efficiency of intercrop as phylogenetic control
- interplay of above-belowground traders
- Improved soil health

Environmental level

- GHGs reduction
- reduced soil degradation
- Sustainable agriculture
- Increased biodiversity

Socio-economic level

- Living labs for behavior change
- Co-design and co-development
- Market education, new tools
- Societal awareness
- Policies and whitepapers

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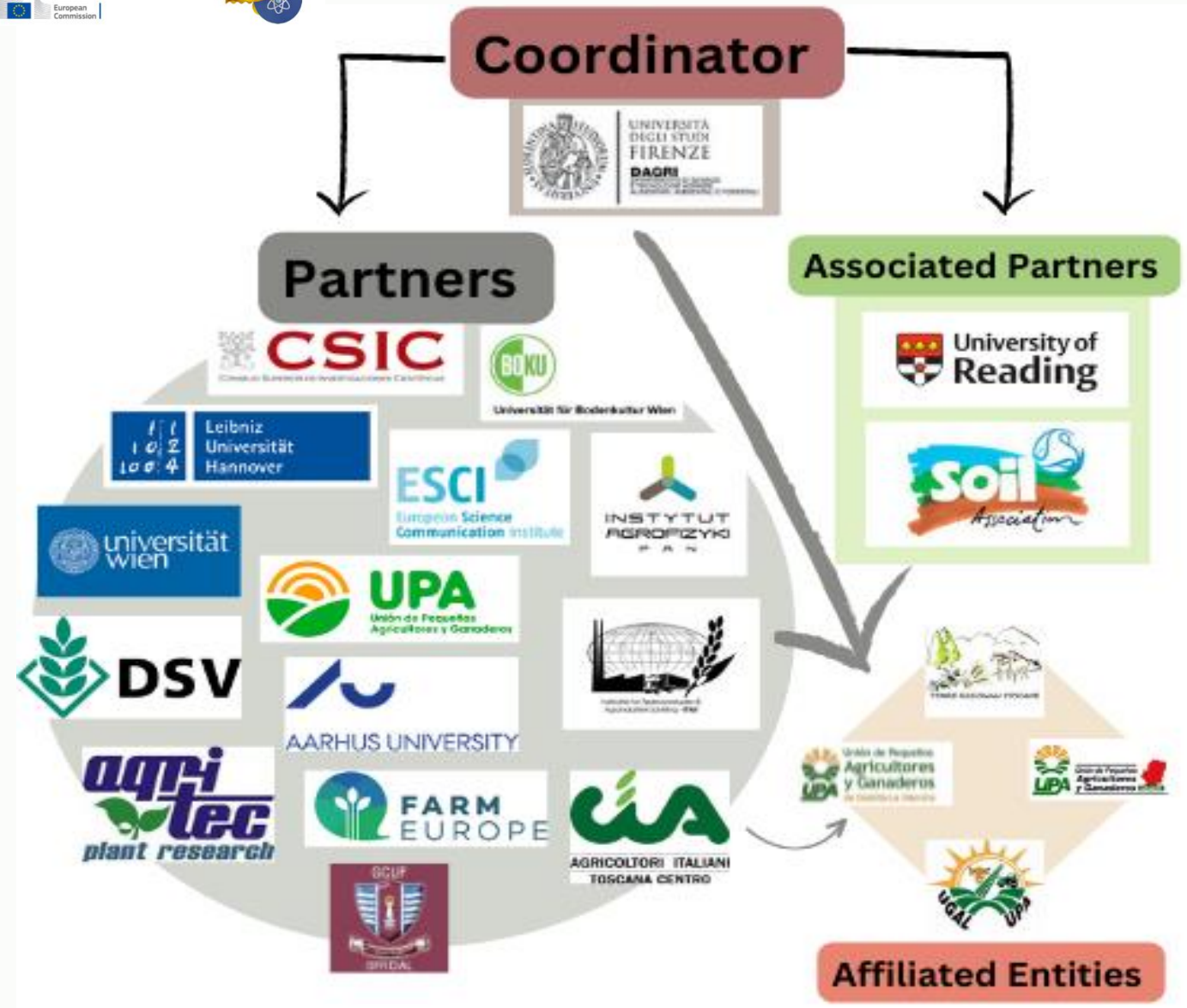
The consortium



Partnership of 21 institutions

(different sectors)

15 partners

(8 EU countries & Pakistan)

2 Associated Partners

(UK)

4 Affiliated entities

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Priliminary results

Established living labs and legume-cereal intercrop mixtures

Current state of confirmed farm labs (state 31st of October 2023) is **132**, marked in the map

Around **45** different legume-cereal combination have been chosen. The most selected combinations are wheat – Chickpea, Wheat – Peas, Barley – Peas, Barley – Vetch, Barley – Chickpea etc

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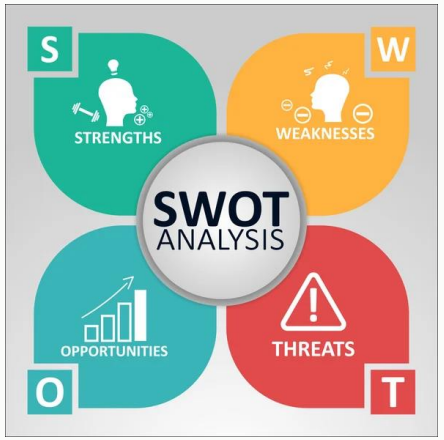
Priliminary results

Synthesis of barriers and opportunities of intercropping

(based on focus groups in seven European countries (Czech Republic, Denmark, Germany, Italy, Poland, Spain, and the United Kingdom) as well as Egypt and Pakistan)



	Strengths	Weaknesses	Opportunities	Threats
Knowledge & Technology	Supportive technologies (n=2)	Crop management challenges (n=8) Inadequate and costly equipment/technology (n=6) Unknown timing of seeding and synchronizing harvest (n=5) Inconsistent product/poor implementation (n=3)	Innovative machinery & techniques (n=3) Promising research (n=2)	New weed, disease, virus & pest control issues (n=5) Unavailability of suitable seedstock (n=4) Lack of appropriate equipment/technology (n=3) New gaps in management knowledge (n=2) Lack of research for management in specific local conditions (n=2)
Environment	Reduce fertilizers, pesticides & alternative controls (n=10) Soil health (n=9) Biodiversity (n=8) Resilience, adaptability & yield stability (n=8) Nitrogen fixation & carbon storage (n=6) Erosion prevention (n=3) Plant health (n=2), Water efficiency (n=2)	Unavailable region-specific crop varieties, potential for interspecies competition (n=3) Deficient soil organic matter (n=2)	Reduce fertilizer use (n=6) Increase plant protein (n=4) Regenerative agriculture & biodiversity (n=4) Soil health & fertility (n=3) OM & C sequestration (n=3) Climate-resilient agriculture (n=3) Reduce plant diseases, pesticide resistant pests & plants (n=3)	Limited water availability to support 2+ crops (n=4) Risk of climate change (n=4)
Political			Governmental support for intercropping (n=5)	Government regulations and policies (n=4)
Social		Farmers risk perception & lack of management experience (n=6) Additional time and complication (n=4)	Stakeholder interaction, workshops and training (n=3)	Farmer low adoption (n=3)
Economic	Farm profitability and income diversification (n=6) Increased yields (n=5) More high-protein feed (n=2)	Inability to sell profitably (n=8) Additional costs for seed separation, labor and cultivation (n=2)	New markets for a quality local product (n=5) Quality livestock feeds (n=3) Reduce inputs costs (n=2)	Lack of markets & prices (n=6) New costs & complication (n=3) Commercializing new crop markets (n=3)

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Priliminary results

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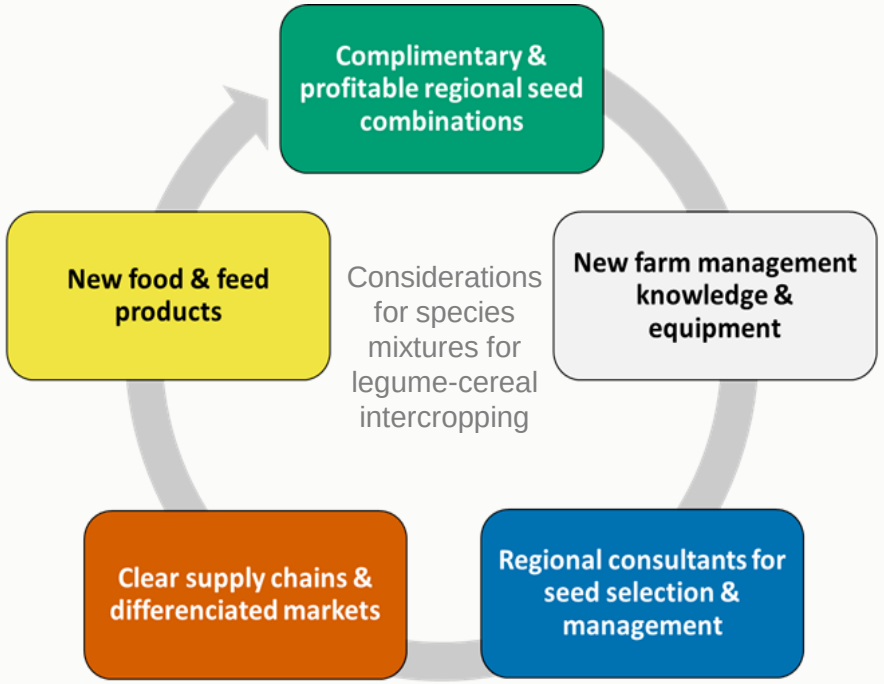

Intercropping Strategies

1. Develop new farmer led advice, education & training systems

Research advice
- Crop sorting
- Plant density
- Crop nutrient needs
- Selecting compatible crop combinations
- Best management for pests, disease & weeds
- Develop new techniques & machinery

Community advice
- Farmer groups and networks
- Peer-to-peer knowledge exchange platform
- Crop associations by production area
- Rural development programmes
- Local consultants
- Industry expertise

Farmer education & training
- Demonstrations
- Public awareness campaigns
- Training programs
- Tutorials such as short movies, podcasts or webinars

2. Build networks to increase stakeholder communication
- Policy makers, researchers & farmers
- Governmental organizations connecting with stakeholder groups & structures
- Farmers and researchers connecting with seed suppliers, machinery producers & contractors
- Networks connecting producers, traders, mills and industry & consumers

3. Increase access & adaptability of policies and governance
- Advocate for legislature & regulations promoting intercropping
- Utilize the current Common Agricultural Policy incentives
- Update Land Parcel Identification System to include crop combinations
- Create new subsidy policies

4. Support market demand for intercropped products
- Develop new high-protein plant-based human food products
  - Breakfast flakes, flours, pasta with mixed cereal grains and legumes
  - Protein bars or shakes
- Develop pet food lines
- Expand quality livestock feed formulations & incorporate livestock onto more farms

5. Test and facilitate farm-scale economic feasibility
- Clear pricing structure with premiums for main crops
- Consistent method to value a co-product
- Commercialize supply chains
- Integrate mixed and separated products
- On-farm value addition
- Organic protein

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Priliminary results

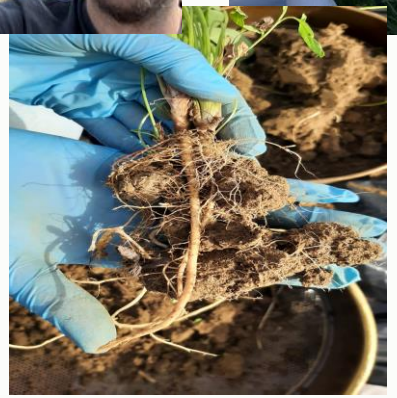
Sampling Campaign

(Digging deep: Sampling European soils to explore the benefits of intercropping)

Cesa, Italy
Viborg, Denmark
Assendorf, Germany
Šumperk, Czech Republic
Osiny, Poland

Our exhilarating sampling campaign took us through the scenic landscapes of five different countries. Our team, led by Shamina, Norman, and Magdalena, worked diligently to collect soil and plant root samples at four research field site. Let's recap our thrilling journey across Europe, exploring the fascinating world of intercropping.





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Thank you

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Call for abstract

Lead convener:
S.I. PATHAN – Università degli Studi di Firenze,ITALY
Co-convener:
N. GENTSCH – Leibniz Universität Hannover, GERMANY
G. PIETRAMELLARA – Università degli Studi di Firenze, ITALY

Session ID: 133435
Optimization of plant-soil-microbe interaction under crop diversification

Link to the conference and abstract submission; https://lnkd.in/dVeqEUPV

Abstract submission deadline: **January 15, 2024**