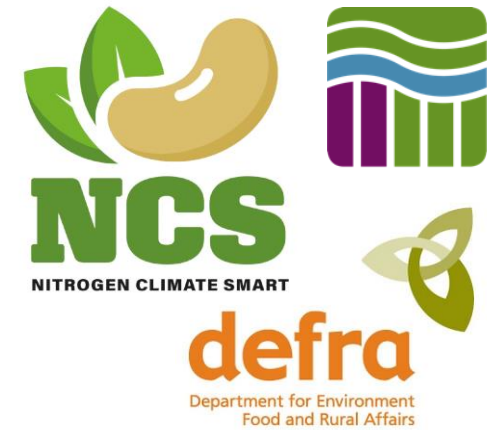


Nitrogen efficient plants for Climate Smart cropping systems (NCS)



ACHIEVE THE BEST FROM PULSE CROPS - REDUCING CARBON EMISSIONS

Farmer-led research programme - 18 industry and research partners

See www.ncsproject.co.uk for more information.





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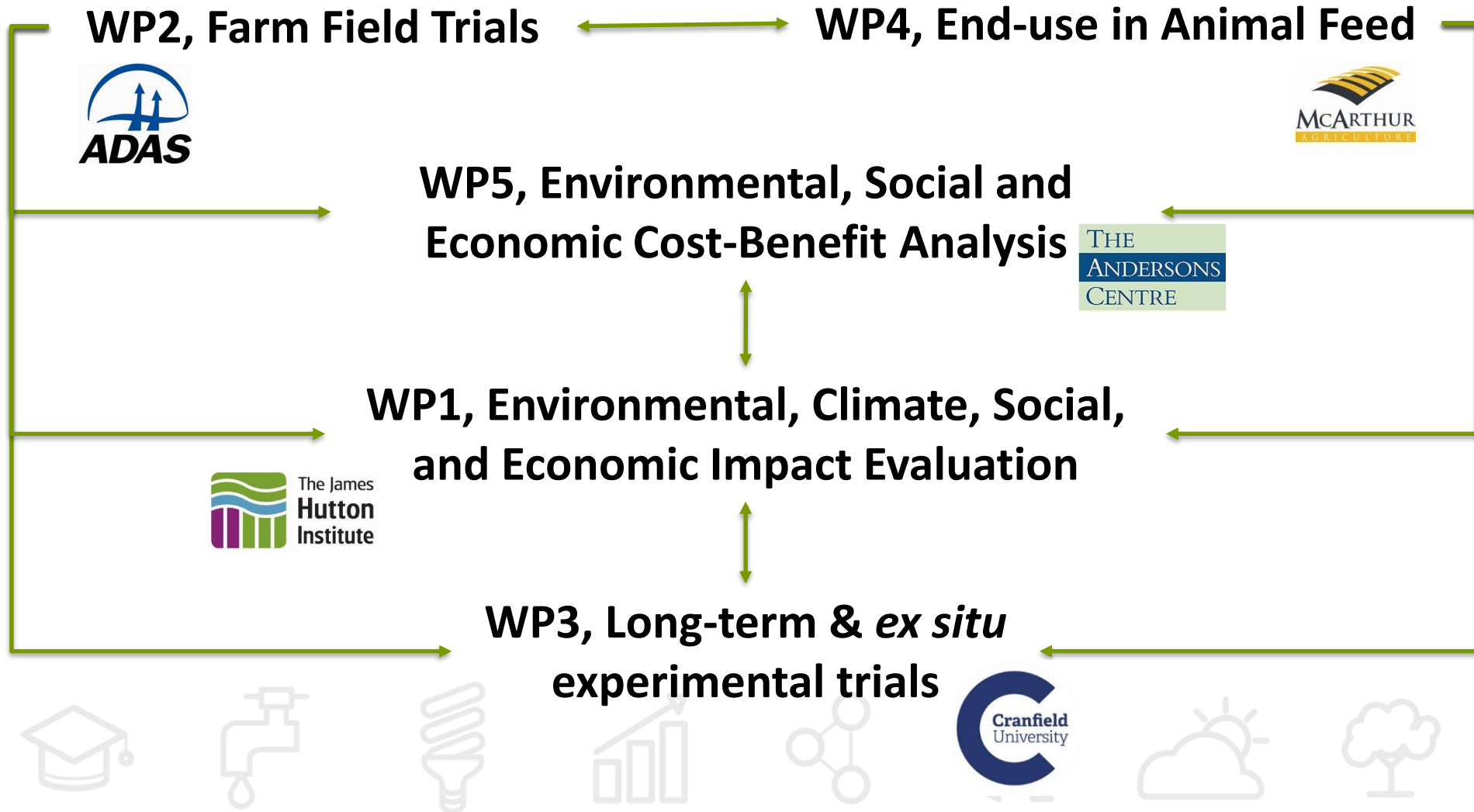
Main aim of the NCS Project

- **Reduce GHG emissions of UK agriculture by 1.5Mt CO₂e per annum**
 - 54% of the maximum potential for the industry
- **Replacing 50% of imported soyabean meal (SBM) with homegrown protein**
 - Home-grown feed alone could deliver a 0.7MT CO₂e reduction for UK Agriculture
 - This is ~25% of 2.8MT CO₂e max./potential reduction (Defra Agri Climate Report, '21)
- **Supporting national food system sustainability and resilience**
 - As domestic production would replace the import of 1.8MT of imported SBM



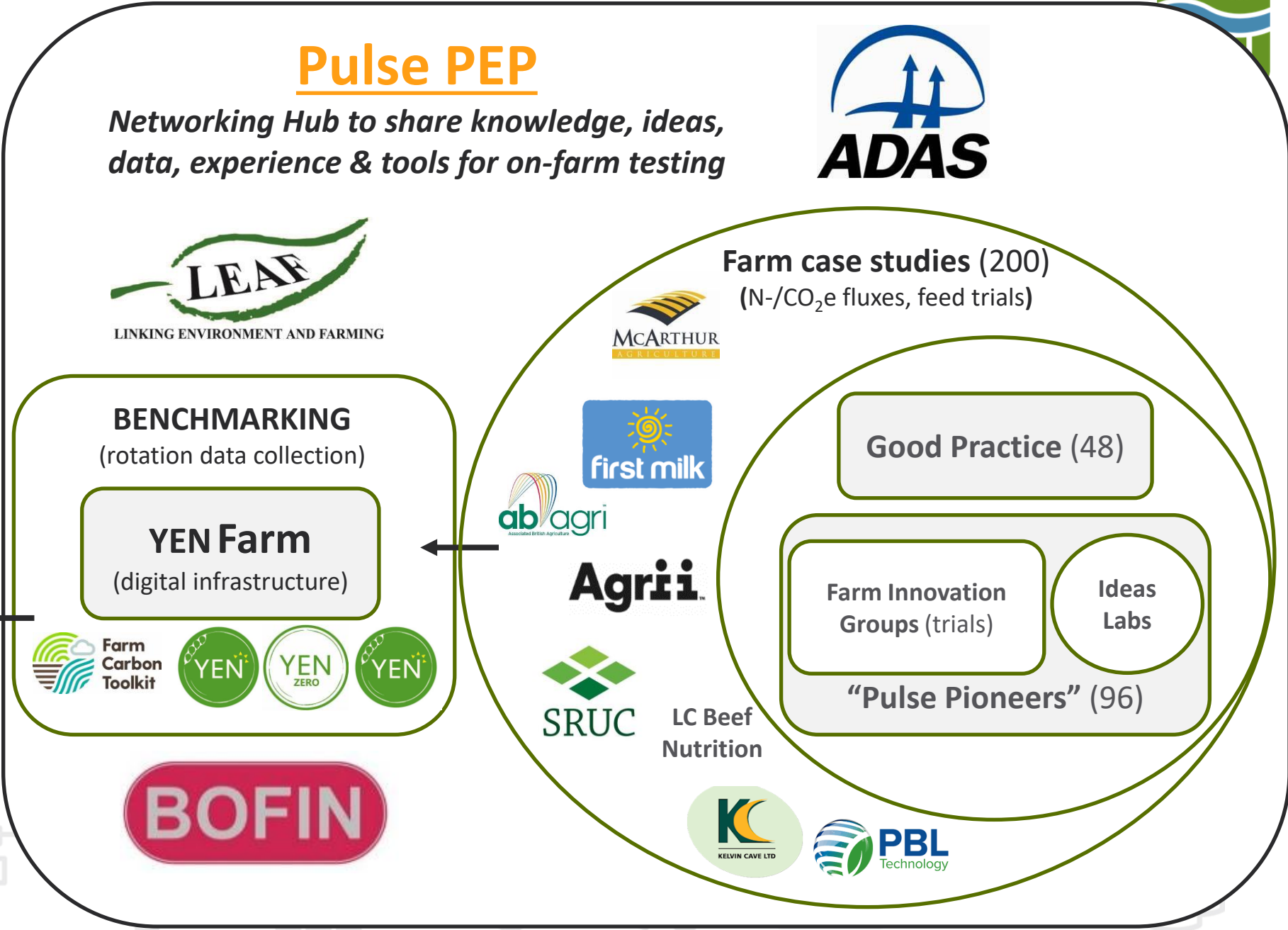
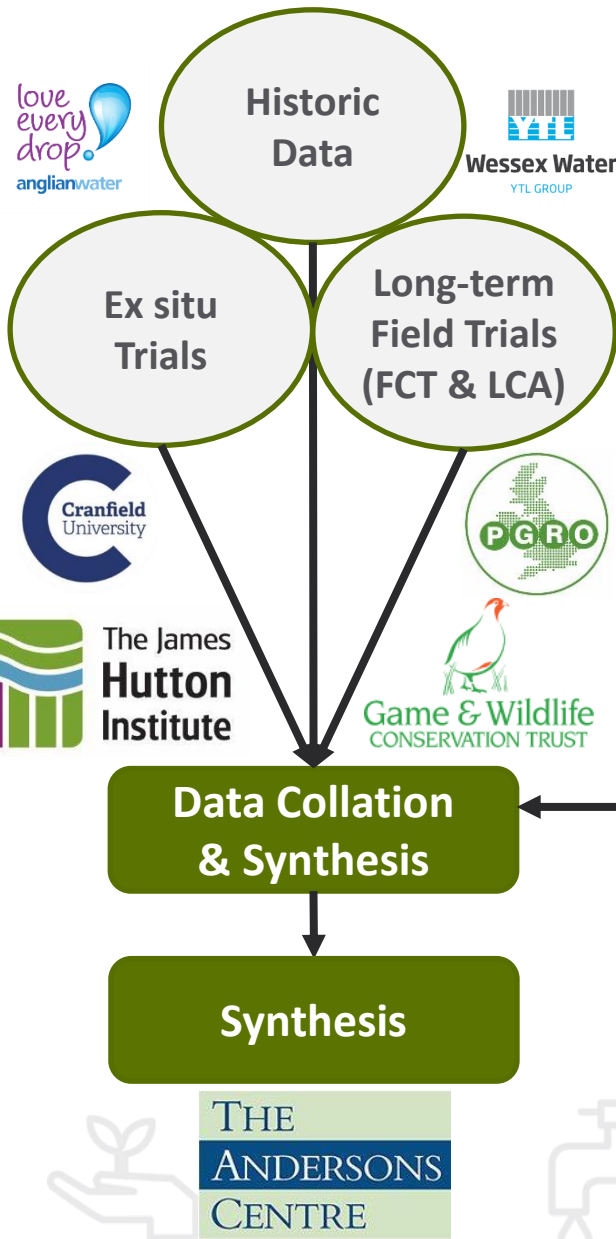
Work package (WP) structure

WP6, Community Engagement
WP7, Coordination
BOFIN



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PGRO Experimental platform

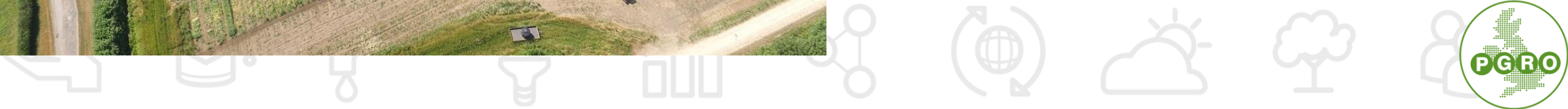
Dyson Farms, Stubton, Lincolnshire



- Approximately 10 ha
- Includes variety, efficacy, intercropping, nutrient, minor crops, pest, disease and weed management trials, IPM
- Part of a large commercial farm (Dyson Farming) and rotated as part of the farm rotation (cereals, potatoes, field beans, oilseed rape, CS).
- Conventional tillage



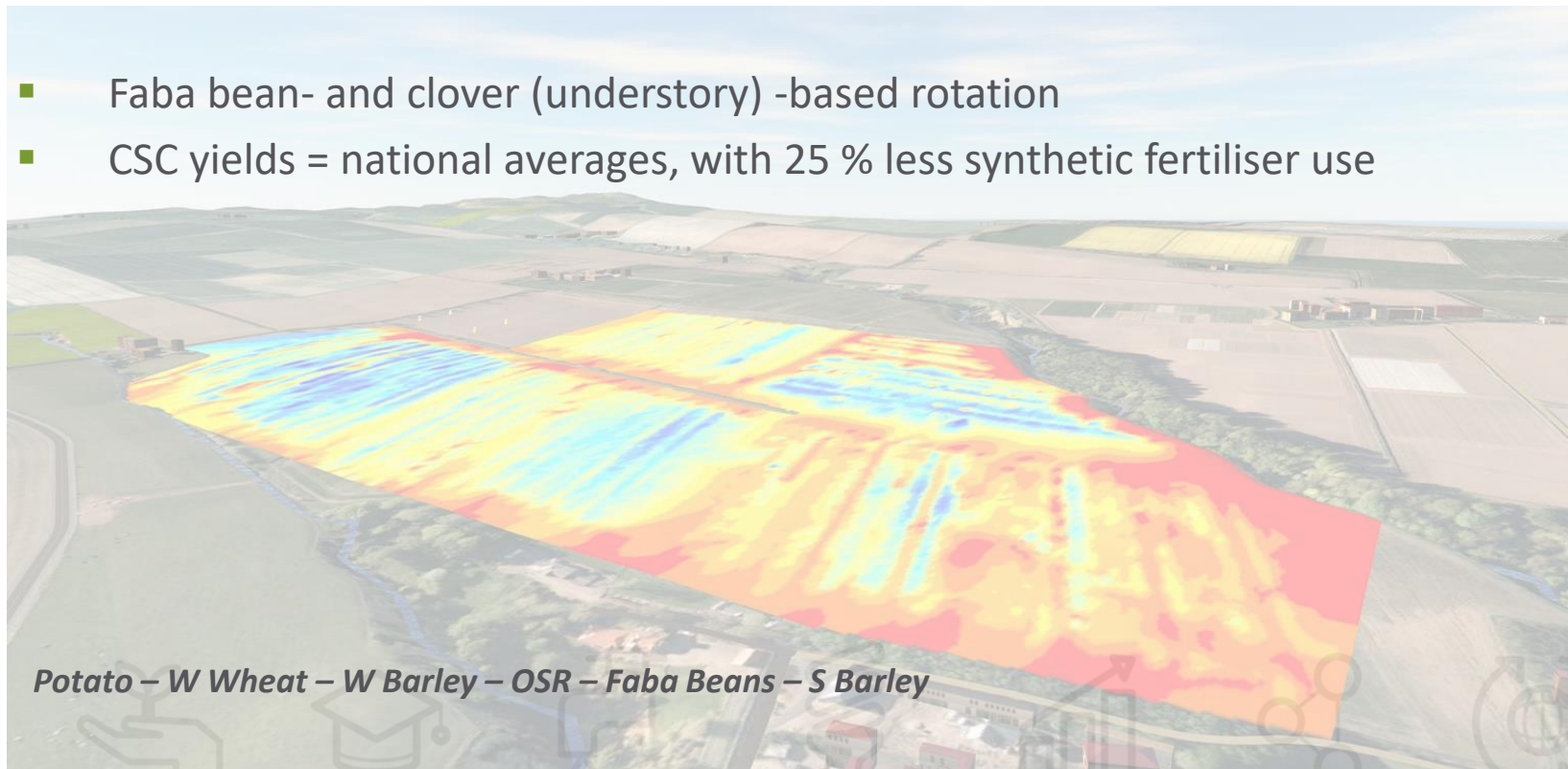
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Centre for Sustainable Cropping (CSC)

- A long-term (from 2009) farm scale crop rotation, 42 ha, 6 fields/crops, open access resource
- For each field split-design, conventional- or integrated-management on each ½ field
- 300 systems function indicators e.g. crop yields, soil, biodiversity, GHG, economics, etc
- Faba bean and clover (understory) based rotation with reduced synthetic fertiliser use

- Faba bean- and clover (understory) -based rotation
- CSC yields = national averages, with 25 % less synthetic fertiliser use



Potato – W Wheat – W Barley – OSR – Faba Beans – S Barley



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Soil quality and crop nutrition

- Conservation tillage
- High soil organic matter inputs
- Cover cropping
- Biological Nitrogen Fixation
- Precision Nitrogen Supply

Non-crop arable biodiversity protected

- Integrated Pest Management
- In-field weed biodiversity conserved
- Wildflower margins

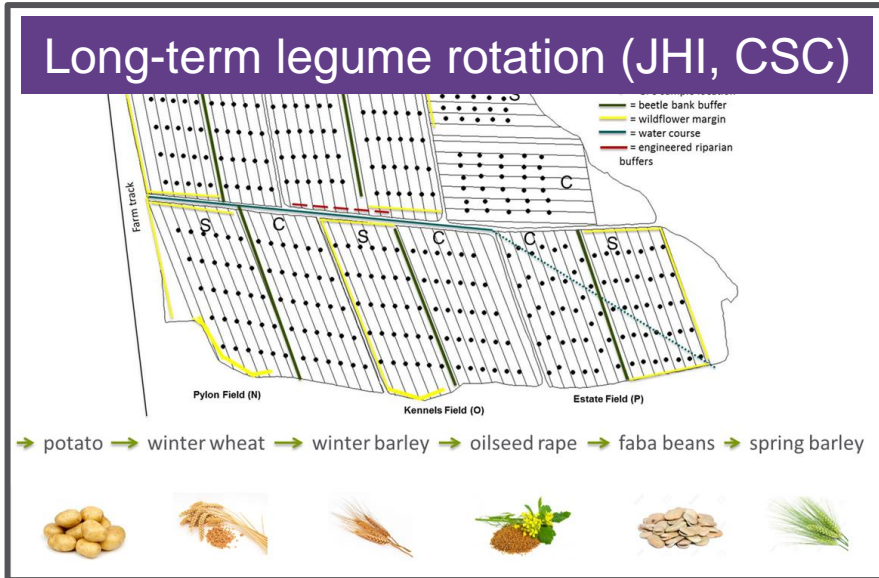
Water management

- NbS for mitigate flood and drought risk

Resilience to climate change



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Soil
samples

Controlled climate trials (resilience testing)

Control Temp 1 Drought 1 Extreme 1

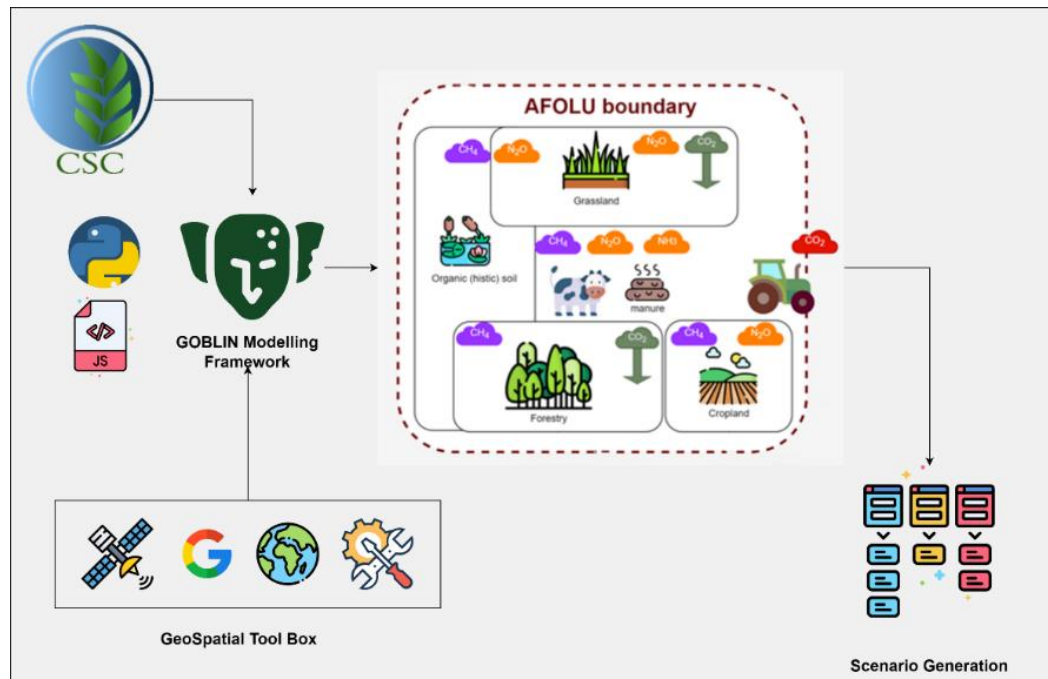
GHG emissions, N mineralisation, soil microbiology, organic matter, above ground biomass



LCA of cropped systems across scales

Advanced LCAs: pulse-based crop rotations (field level), and modelling land-use scenarios (up-scaling)

- Life Cycle Analysis (LCA) – **ecosystem impact** analysis of CSC
- Integrate Ecosystem Services – **ecosystem function** into CSC-LCA
- Impacts of upscaling faba bean cropping (develop ‘CropGOBLIN’)
‘General Overview for a Backcasting approach of Livestock Intensification’
- **GOBLIN Modelling Framework**
 - Integrated land use assessment model
 - assessing environmental impacts of NbS
- **Data Integration**
 - field level CSC data
 - Ecoinvent, Agri-Footprint
- **Develop “CropGOBLIN”**
 - Land use (cropped system) scenario generation
 - Use spatial tools e.g. Google Earth Engine, GIS
 - Land use capability data bases

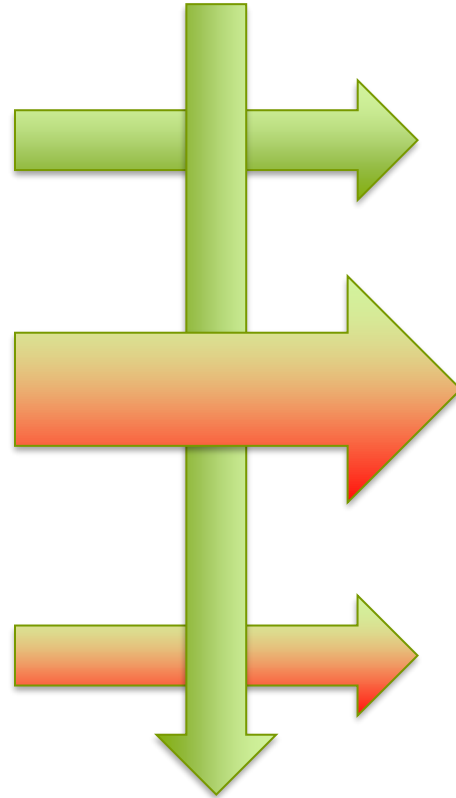


Umut Kartal - Registered for a PhD

Dr Colm Duffy, NUI Galway

- GOBLIN background: Duffy et al. (2022a, b)
- [Geoscientific Model Development](#), [Nature Sustainability](#)

WP 4, End-uses in animal feed



LC Beef Nutrition



Farm Carbon Toolkit

Synthesis existing academic and industry knowledge

Evaluate animal performance, economic viability, and CO₂e mitigation

Develop best practise protocols (production, harvest, preservation, formulation, feeding)

WP5, Environmental, Social and Economic Cost-Benefit Analysis



Main Objectives

1. **Establish the best-case scenario(s):** to best harmonise environmental *and* financial RoI for the grower
2. **Carbon Cost-Benefit Analysis:** increased domestic pulse production & new livestock diets

Delivery Pipeline

- **Financial and environmental performance indicators identified**
- **Socioeconomic Cost-Benefit Analysis:** wider UK value chain & social (public health) impacts
- **Feasibility Report:** of optimal pathways (rotations, feed formulations from WPs2-4)
- **Policy Report:** including elaboration of necessary 'levers', and impacts (on Govt. revenue)



Other related parallel projects



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Scottish Government, Rural and Environment Science and Analytical Services Division (RESAS), Strategic Research Programme (SRP)



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- *The impact of novel crops and farming practices on the Scottish agricultural landscape.*
- *Increasing fruit and vegetable production for sustainable, healthy, affordable diets and secure jobs.*
- *Towards carbon positive through improved farming.*

Other Projects (ending 24 – 27)

- **'LegumES', Valorising and harmonising the ecosystem services provided by legumes** - EC (2024-28), Coordinator.  
- **'Novel forage legume-based swards'** - (2023-27), WP Lead – **TBA – (BBC) release pending.**
- **NCS, Nitrogen efficient plants for climate smart arable cropping systems** - DEFRA (2023-27), WP Lead.  
- **MARINADE, Maximising protein yield using legume mixtures**, Hannah Dairy Research Foundation (2022-24), PI.  
- **EC-ECONUTRI, Tech. for ecologically sustainable nutrient management** - EC, (2022-26), WP Lead.  
- **GCFaH, Global community food & health**, National Institute of Health Research - NIHR (2021-25), Co-investigator.  
- **EC-RADIANT, Realising dynamic value chains for underutilised crops** - EC, (2021-25), Deputy Coordinator.  
- **EC-FRAMEWORK, Biodiversity sensitive farming**, EC (2019-24), Co-investigator.  



Informative Projects - concluded 2015-23

- [Esme Fairbairn Foundation – SEAMS](#), Sustainability in education and agriculture using **mixtures**, Co-I (2018-23).
- [EC - TRUE](#), identifying and implementing **legume-based feed- and food-systems**, Coordinator (2017-22).
- [EC - Plant Teams](#), **Intercropping**, Executive (Coordination) Exec. Comm. (2017-22).
- [Beans4Feeds](#), developing **air fractionated faba bean protein for feed**, Innovate UK, WP Lead (2012-16).
- [EC - Legume Futures](#), valorising legume-supported cropped systems, WP Lead (2011-15).





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Life Cycle Developer
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Molecular Ecologist,
Plant-microbe Interactions

Prof. Euan James
Plant-microbe Interactions,
Biological Nitrogen Fixation

Dr Fanny Tran
Projects Manager

6 Staff

Dr Pete Iannetta
Research Leader,
Head of Ecological Food Systems

Dr Francesc Ferrando Molina (2017-21)
Developing elite-rhizobia inoculants
(Uni. Stirling, PGRO, Leg. Tech. Ltd)

Dr Kirsty Black (2014-21)
Brewing and distilling pulses
(Abertay University, Arbikie Distillery)

Grace Wardell (2018-23)
CTP, soybean inoculants
(Sheffield University, PlantWorks Ltd)

Rafael Duarte (2021-25)
Pulses for soil- & gut-health
(University Catholica Porto)

Tamanna Jithesh (2022-26)
Faba bean nutrition
(Harper Adams Uni., PGRO)

Nurainie Wan Ismail (2022-28)
Pulses for integrated pest management
(Edinburgh Uni., JHI, Uni. Coventry)

Studentship TBI (2024-28)
CTP, [pulse x pulse] intercrops
(Cranfield Uni., PGRO)

5 (6) PhD Students

Ecological Food Systems
(Agroecology Sub-group, 11)



Pete Iannetta



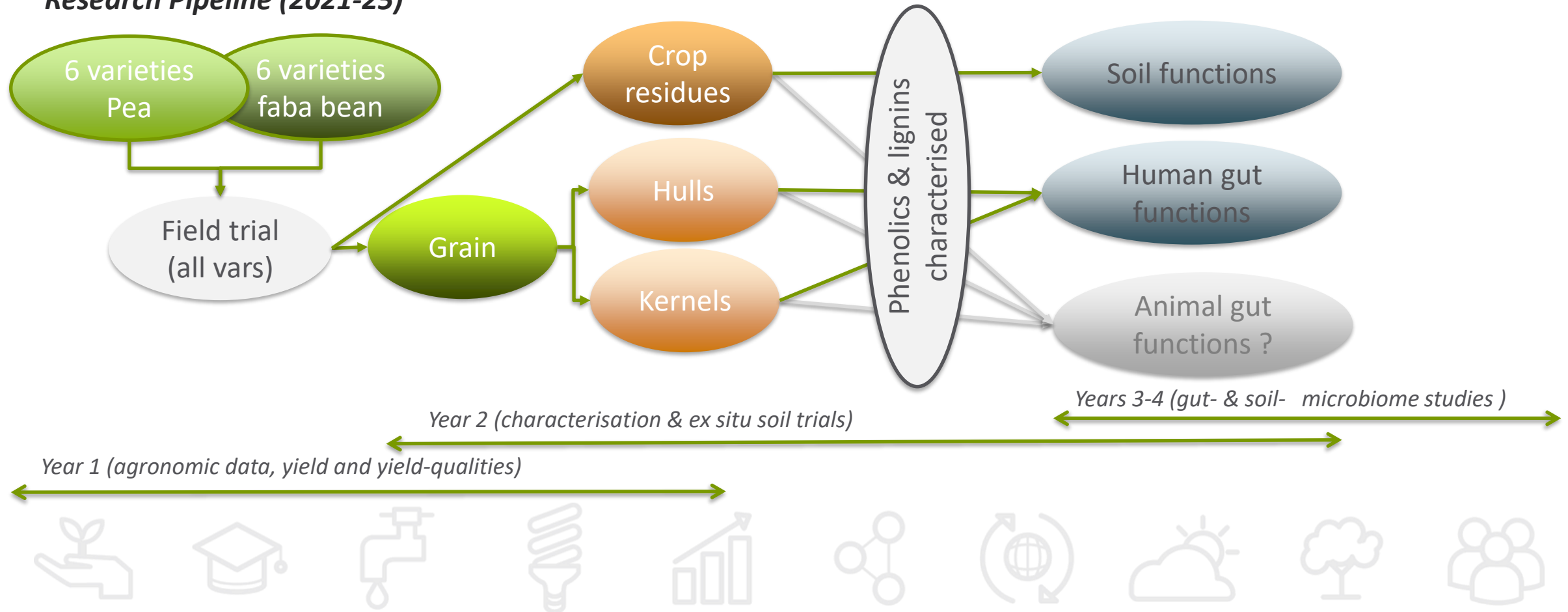
@AgroEcoAtJHI



More than a meat- or synthetic nitrogen fertiliser-substitute: *legume phytochemicals as determinants of 'One Health'*

Rafael D.C. Duarte, Ana M. Gomes, Marta W. Vasconcelos, Pietro P. M. Iannetta

Research Pipeline (2021-25)





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