




TRansition paths to sUstainable legume-based systems in EEurope

  TRansition paths to sUstainable legume based systems in Europe (TRUE)

-  @TrueLegumes
-  @prgoresearch
-  @AgroEcoAtJHI



www.true-project.eu



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Please Tweet

- #TRUELegumes
- #EcoTechIsBioTech
- #LegTechIsBioTech

- @pgroresearch
- @EUAgri
- @DEFRA
- @SEFARIscot
- @JamesHuttonInst



TRansition paths to sUstainable legume-based systems in Europe (TRUE)

- *An H2020-Sustainable Food Security (SFS), innovation action*
- *24 partner project, €5m*
- *Equal balance of academic and non-academic partners*
- *Started on April 1st 2017, for 4y*
- www.true-project.eu



The Partners



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No	Participant organisation name (and acronym)	Country	Organisation Type
1 (C)	The James Hutton Institute (JHI)	UK	RTO
2	Coventry University (CU)	UK	University
3	Stockbridge Technology Centre (STC)	UK	SME
4	Scotland's Rural College (SRUC)	UK	HEI
5	Kenya Forestry Research Institute (KEFRI)	Kenya	RTO
6	Universidade Catolica Portuguesa (UCP)	Portugal	University
7	Universitaet Hohenheim (UHOH)	Germany	University
8	Agricultural University of Athens (AUA)	Greece	University
9	IFAU APS (IFAU)	Denmark	SME
10	Regionalna Razvojna Agencija Medimurje (REDEA)	Croatia	Development Agency
11	Bangor University (BU)	UK	University
12	Trinity College Dublin (TCD)	Ireland	University
13	Processors and Growers Research Organisation (PGRO)	UK	SME
14	Institut Jozef Stefan (JSI)	Slovenia	HEI
15	IGV Institut Fur Getreideverarbeitung Gmbh (IGV)	Germany	Commercial SME
16	ESSRG Kft (ESSRG)	Hungary	SME
17	Agri Kulti Kft (AK)	Hungary	SME
18	Alfred-Wegener-Institut (AWI)	Germany	RTO
19	Slow Food Deutschland e.V. (SF)	Germany	Social Enterprise
20	Arbikie Distilling Ltd (ADL)	UK	SME
21	Agriculture And Food Development Authority (TEAG)	Ireland	RTO
22	Sociedade Agrícola do Freixo do Meio, Lda (FDM)	Portugal	SME
23	Eurest -Sociedade Europeia De Restaurantes Lda (EUR)	Portugal	Commercial Enterprise
24	Solintagro SL (SOL)	Spain	SME





The James Hutton Institute



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Stockbridge
Technology Centre



Slow Food®
Deutschland e.V.

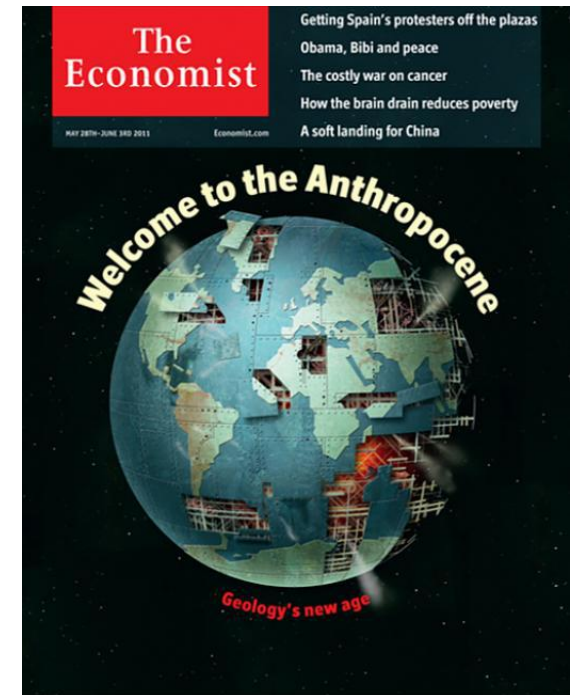


Eurest



Welcome to the ANTHROPCENE

- An epoch proposed by Prof. Paul Jozef Crutzen
- Atmospheric chemist, Nobel Prize Winner
- **based on negative impact of humans on the Earth's geology**, including
 - biodiversity loss and species extinction
 - biogeography (species distributions/evolution)
 - climate change
 - geomorphology (drainage patterns)
 - stratigraphy (sedimentological record)
 - fossil record (techno-fossils)
 - trace elements
- Suggested periods for initiation include
 - **the industrial revolution / Haber-Bosch 1909**
 - **neolithic times and rise of agriculture**



Waters *et al.*, (2016) *Science* **351**.



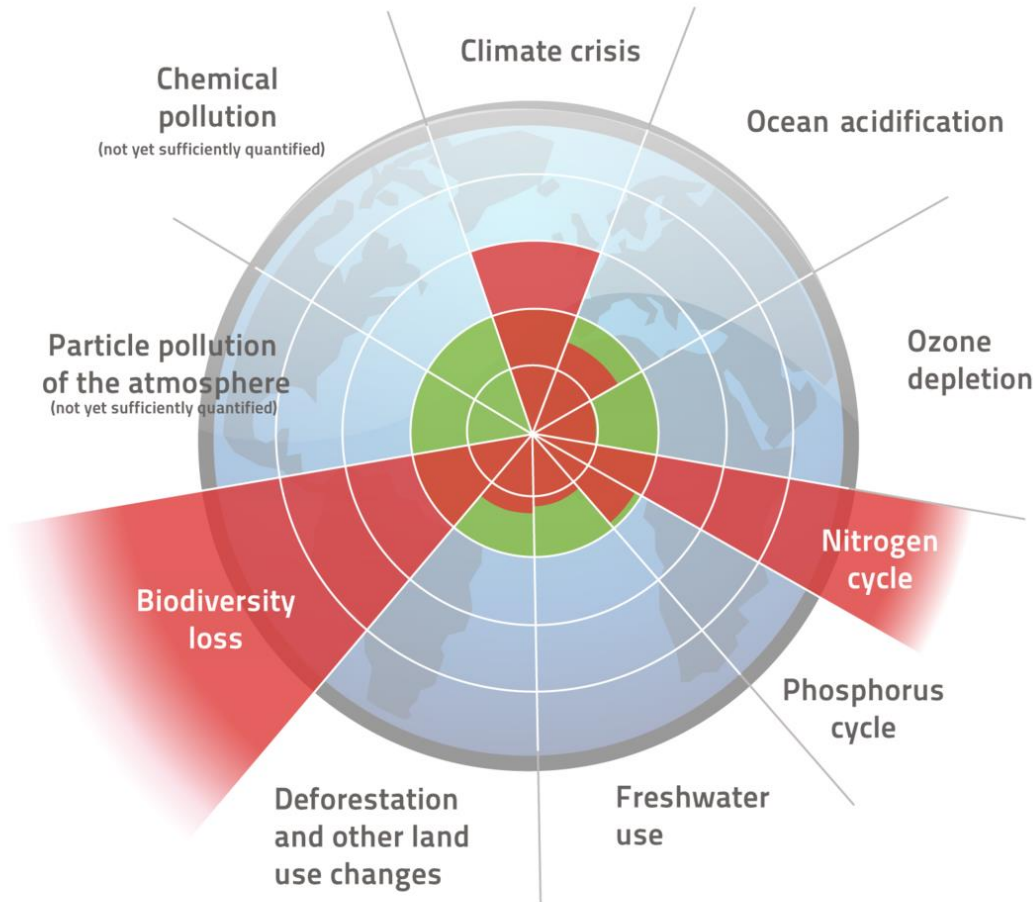
The impacts of discouraging natural chemical cycling



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Planetary Boundaries

after Johan Rockström, Stockholm Resilience Centre et al. 2009



“Planetary
Boundaries”
are exceeded

Rockström et al., (2009). A safe operating space for humanity. *Nature* **461**, 472.

-  Safe planetary boundary / guide rail according to the authors
-  Scientific observation until 2009

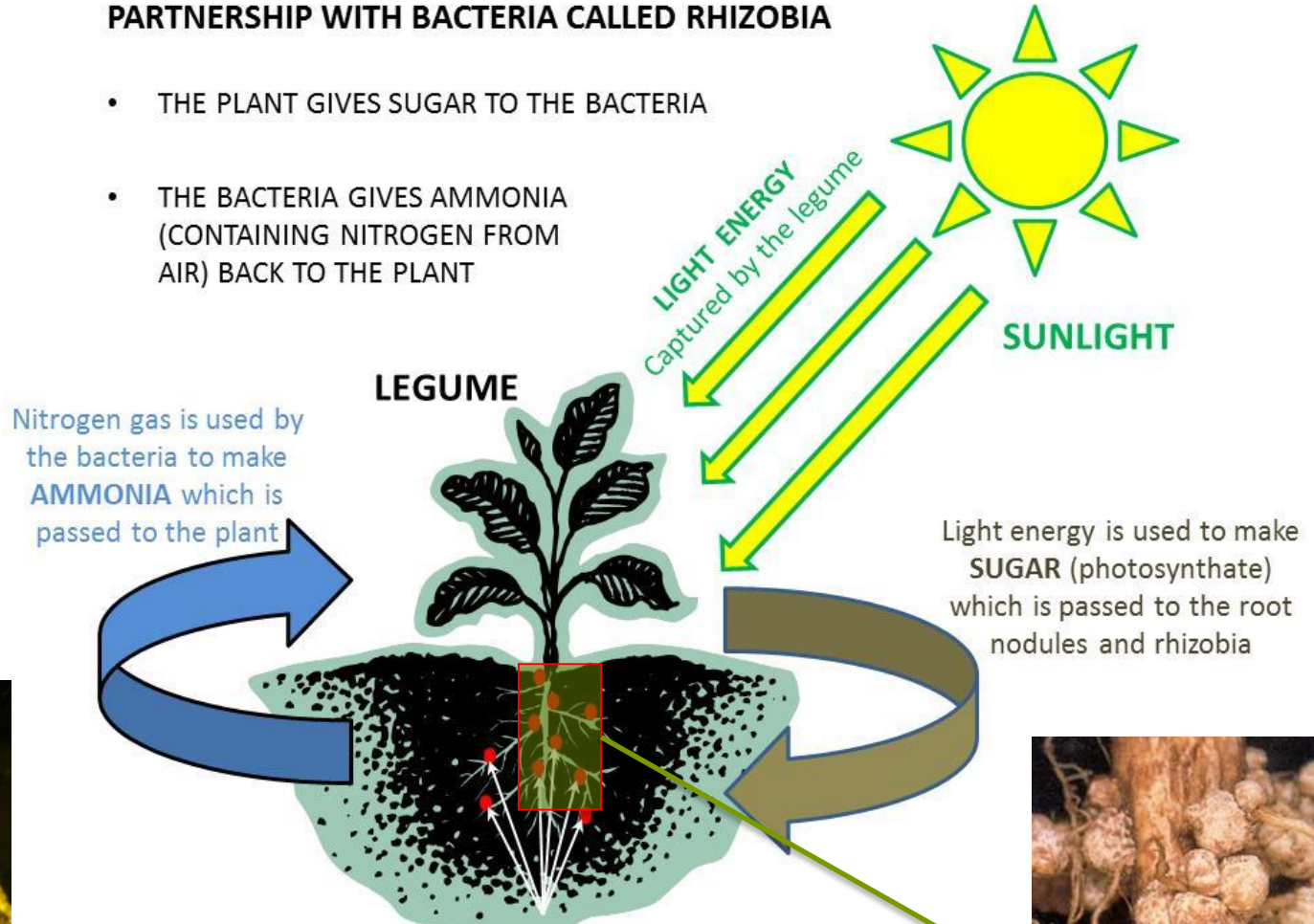


LEGUMES & BIOLOGICAL NITROGEN FIXATION

BIOLOGICAL NITROGEN FIXATION BY LEGUMES RELIES ON A SYMBIOSIS OF PARTNERSHIP WITH BACTERIA CALLED RHIZOBIA

- THE PLANT GIVES SUGAR TO THE BACTERIA
- THE BACTERIA GIVES AMMONIA (CONTAINING NITROGEN FROM AIR) BACK TO THE PLANT

**LEGUMES
NEED NO
NITROGEN
FERTILISER!**



PLANT BLOOD (leghaemoglobin) in the ROOT NODULES traps OXYGEN so that bacteria may use the energy from SUGAR (photosynthate) to make AMMONIA



International trade in reactive nitrogen

The nitrogen crisis is a protein crisis

Un-healthy EU27 dependencies

- N fertiliser use = 10m t y⁻¹
- 23% of N fertiliser is imported
- Imported gas = 62% (2006-10)
- **Imported protein = 70% (42Mt, 2009)**

Large inequality in N-fertiliser use

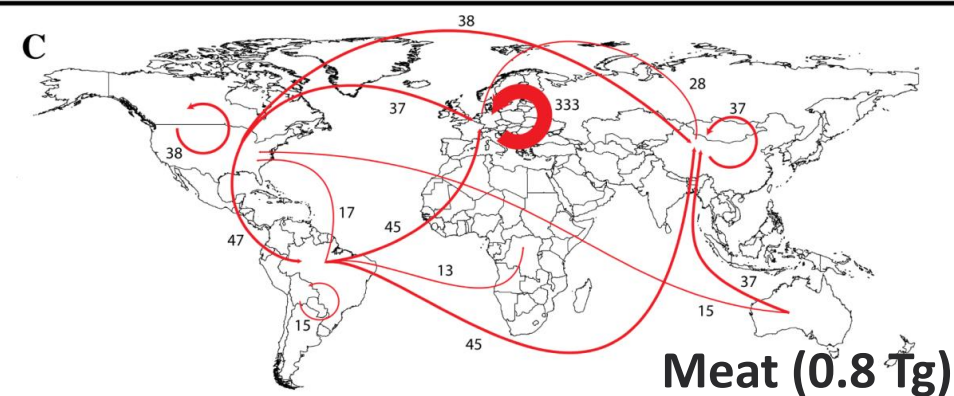
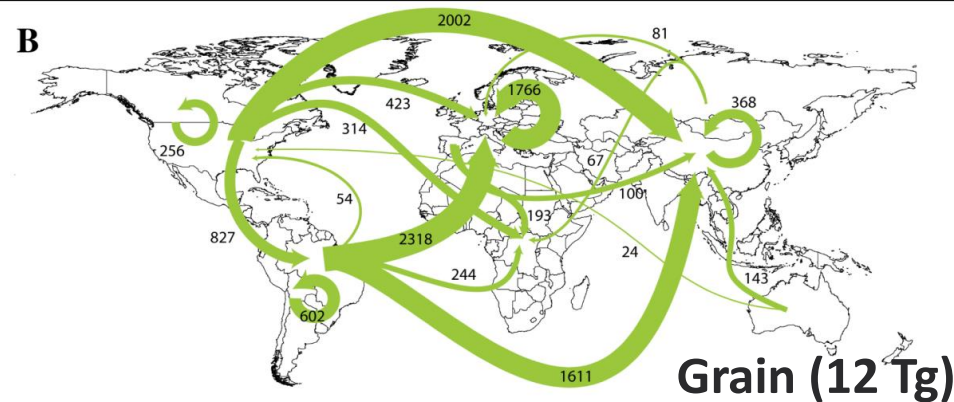
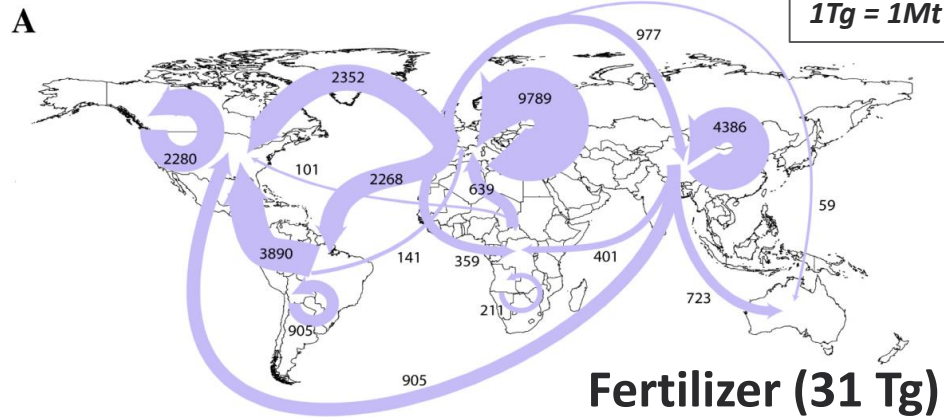
- N demand set to increase

Yet there are solutions

- **LEGUME supported cropped systems**
- on near pH neutral soils
- organic production (legumes)
- 5% less productive than conventional

Erismann *et al.*, (2008). *Nature Geosci.* **1**, 636.

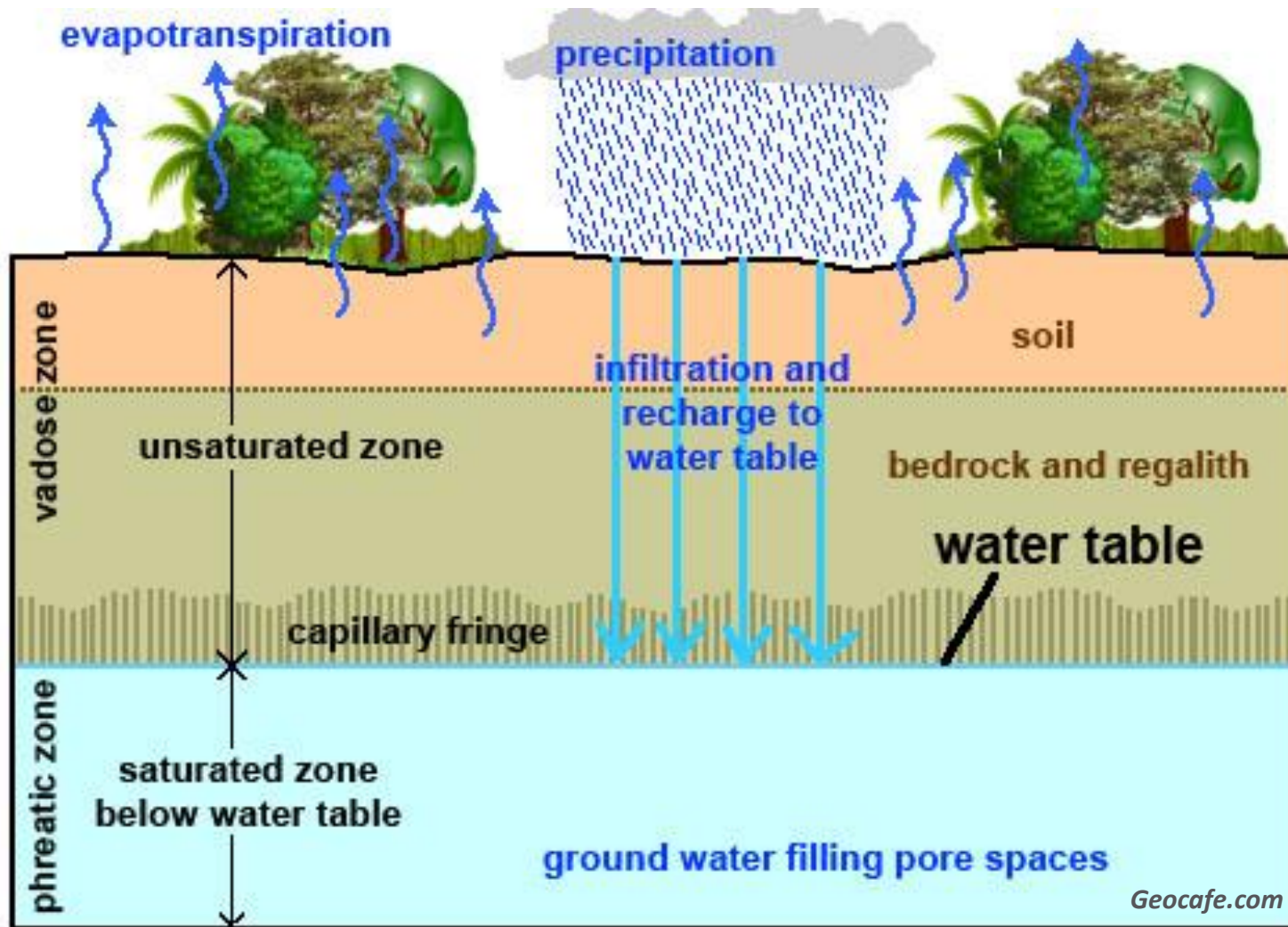
Seufert *et al.*, (2012) *Nature* **485**, 229.



Galloway *et al.*, (2008). *Science* **320**, 889.



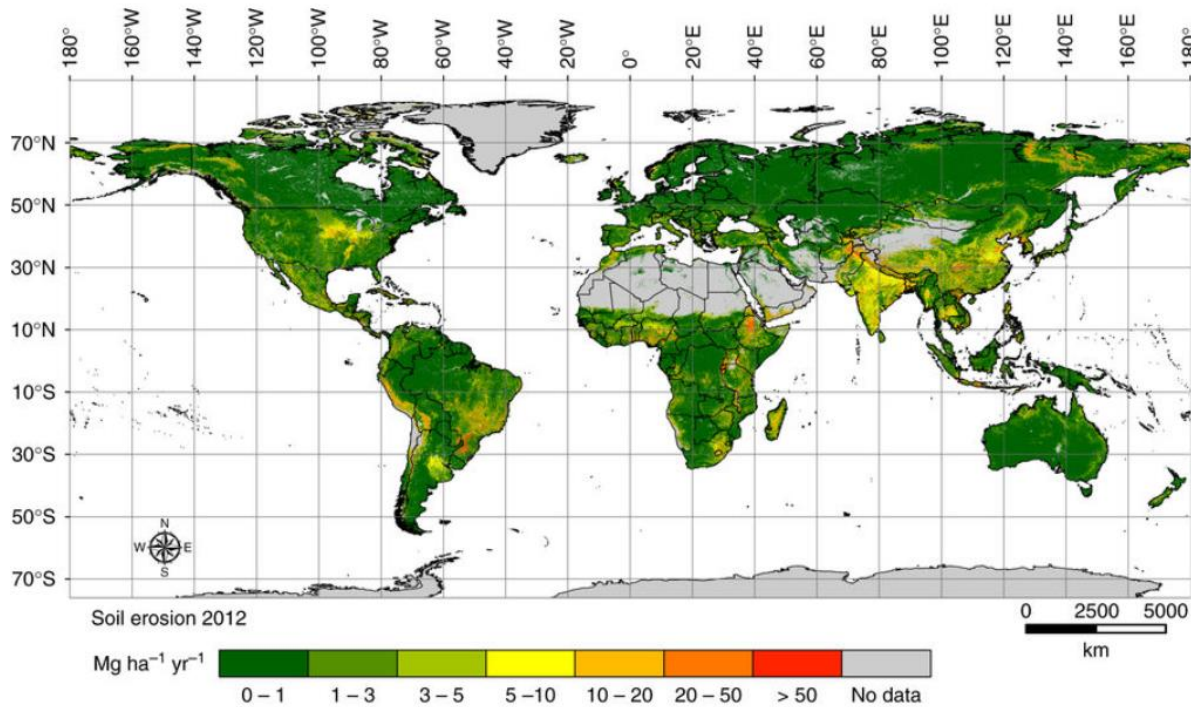
The nitrate “time-bomb”



Fertiliser N losses need to be as close to zero as possible



Least developed economies will suffer most from direct impacts of soil erosion



Conservation agriculture to combat soil erosion

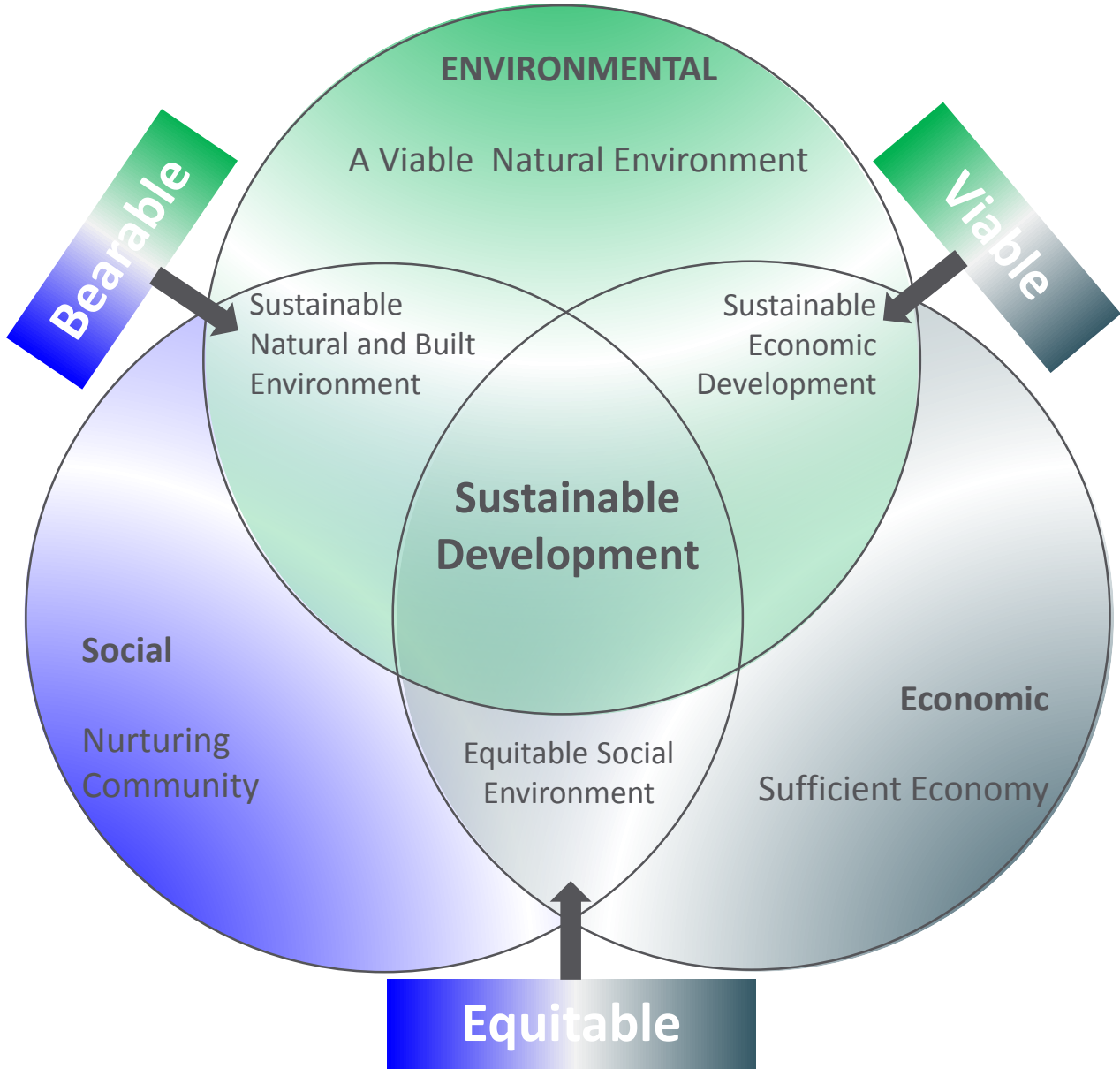
- Conservation agriculture:
- minimise soil disturbance;
 - protect the soil;
 - diverse rotations (legumes)

<https://www.4p1000.org/>

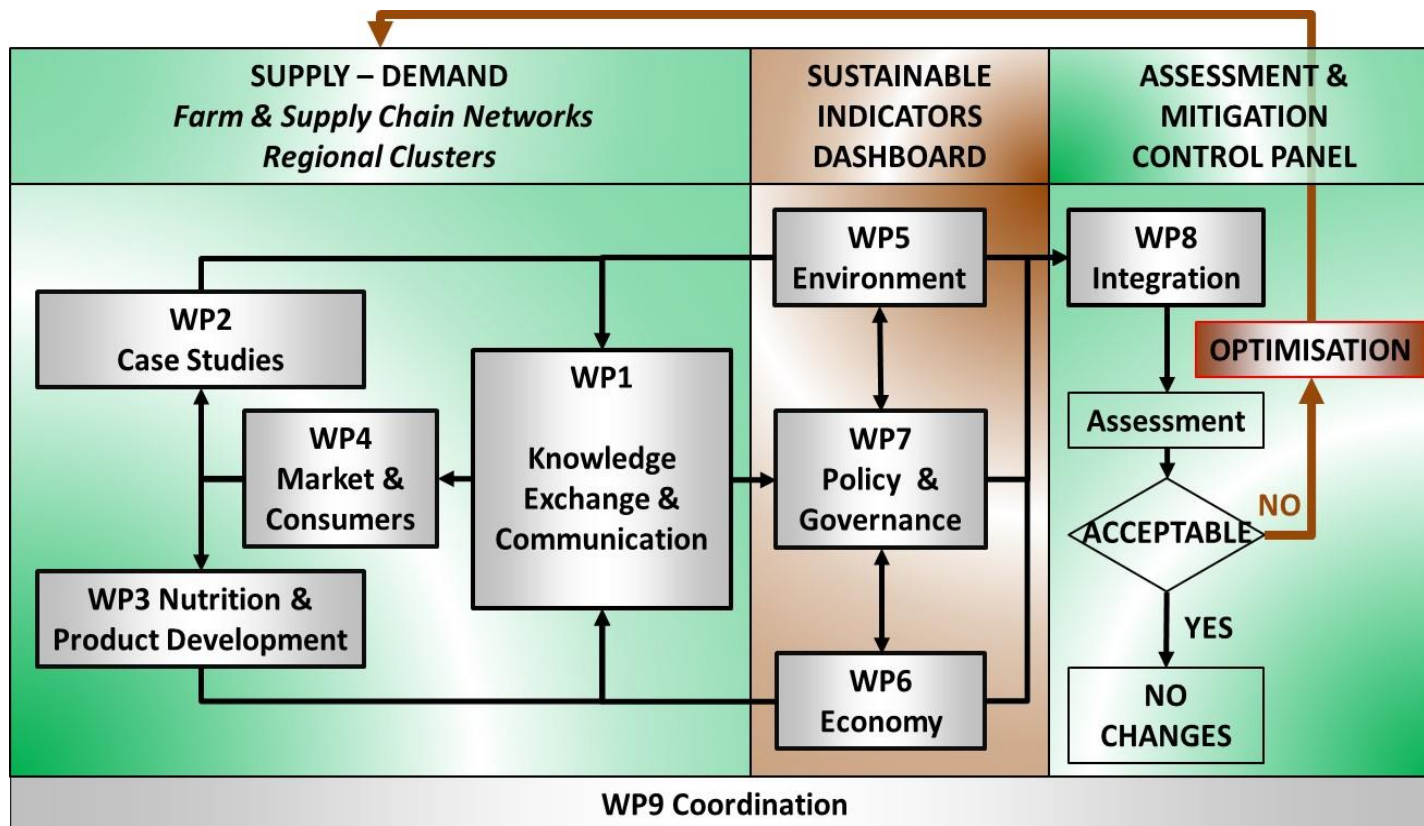
Borelli et al., (2017) An assessment of the global impact of 21st century land use change on soil erosion. *Nature Communications* 8, 2013.



TRUE: rational focused upon understanding and managing the 'Three Pillars of Sustainability'



WP Data-management and -flow



Flow of information and knowledge in TRUE, from definition of the 24 case studies (left), quantification of sustainability (centre) and synthesis and decision support (right).



8 Objectives: one for each WP

Objective 1: Facilitate knowledge exchange

- Universitaet Hohenheim, UHOH, University
- *Develop a blue-print for co-production of knowledge*

Objective 2: Demonstrate the factors that contribute to successful transitions

- Agricultural University of Athens, AUA, University
- *Relevant and meaningful Sustainable Development Indicators (SDIs)*

Objective 3: Develop novel food and non-food uses

- Universidade Catolica Portuguesa, UCP, University
- *Develop appropriate food and feed products regions/cropping systems*

Objective 4: Investigate international markets and trade

- IFAU APS (IFAU), Denmark, SME
- *Guidelines: legume consumption for employment and economic growth*
- *EU infrastructure-map for processing and trading*



8 Objectives: one for each WP

Objective 5: Inventory data - environmental intensity of production systems

- Trinity College Dublin (TCD), University
- *Life Cycle Analyses (LCA) of novel legumes rotations and diet change*

Objective 6: Determine economic performance across scales (con. & org.)

- Scotland's Rural College (SRUC), UK, HEI
- *Accounting yield and price risks of legume-based cropped systems*

Objective 7: Enable policies, legislation and regulatory systems

- ESSRG Kft (ESSRG), Hungary, SME
- *EU-policy linkages (on nutrition) to inform product development/uptake*

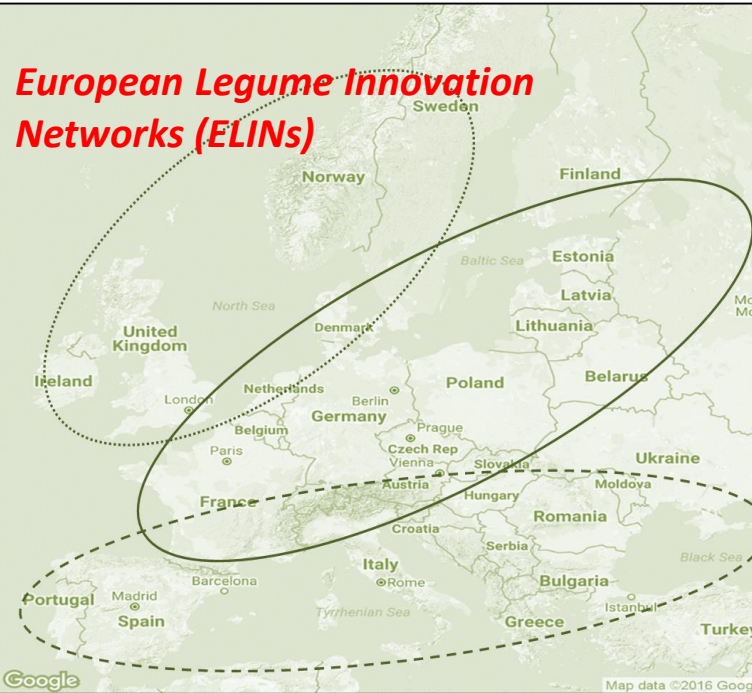
Objective 8: Develop decision support tools (growers – policy makers)

- Institut Jozef Stefan (JSI), Slovenia, SME
- *User friendly decision support tools for sustainability pillars*

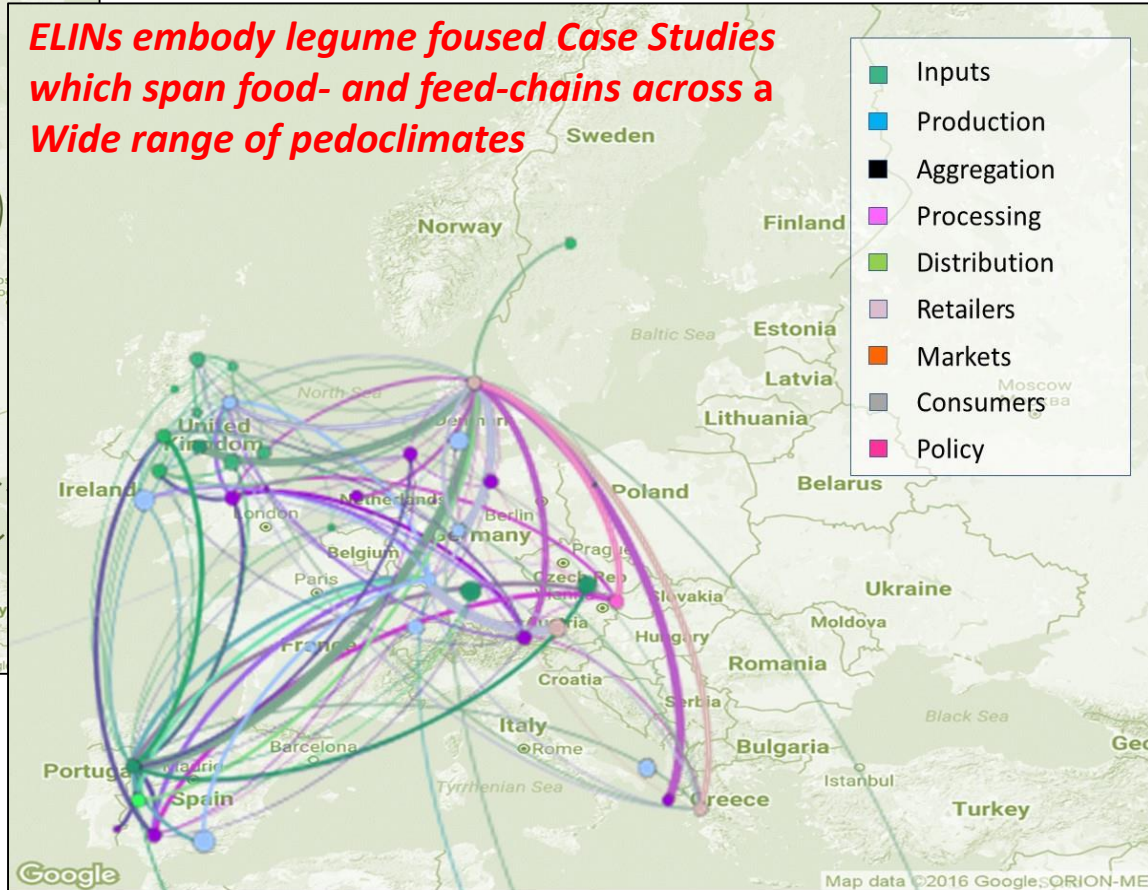


TRUE multi-stakeholder networks

European Legume Innovation Networks (ELINs)



ELINs embody legume focused Case Studies which span food- and feed-chains across a Wide range of pedoclimates



The Intercontinental Advisory Board (9)

Robert Boddey, Professor Soil Science & Biological Nitrogen Fixation, Embrapa Agrobiologia, Rio de Janeiro, Brazil.

- Also offers a case studies perspective on studies in Ghana.

Laurence Carmichael, Dr. Coordinator WHO-Centre Healthy Urban Environments, Uni. West England, Bristol, UK.

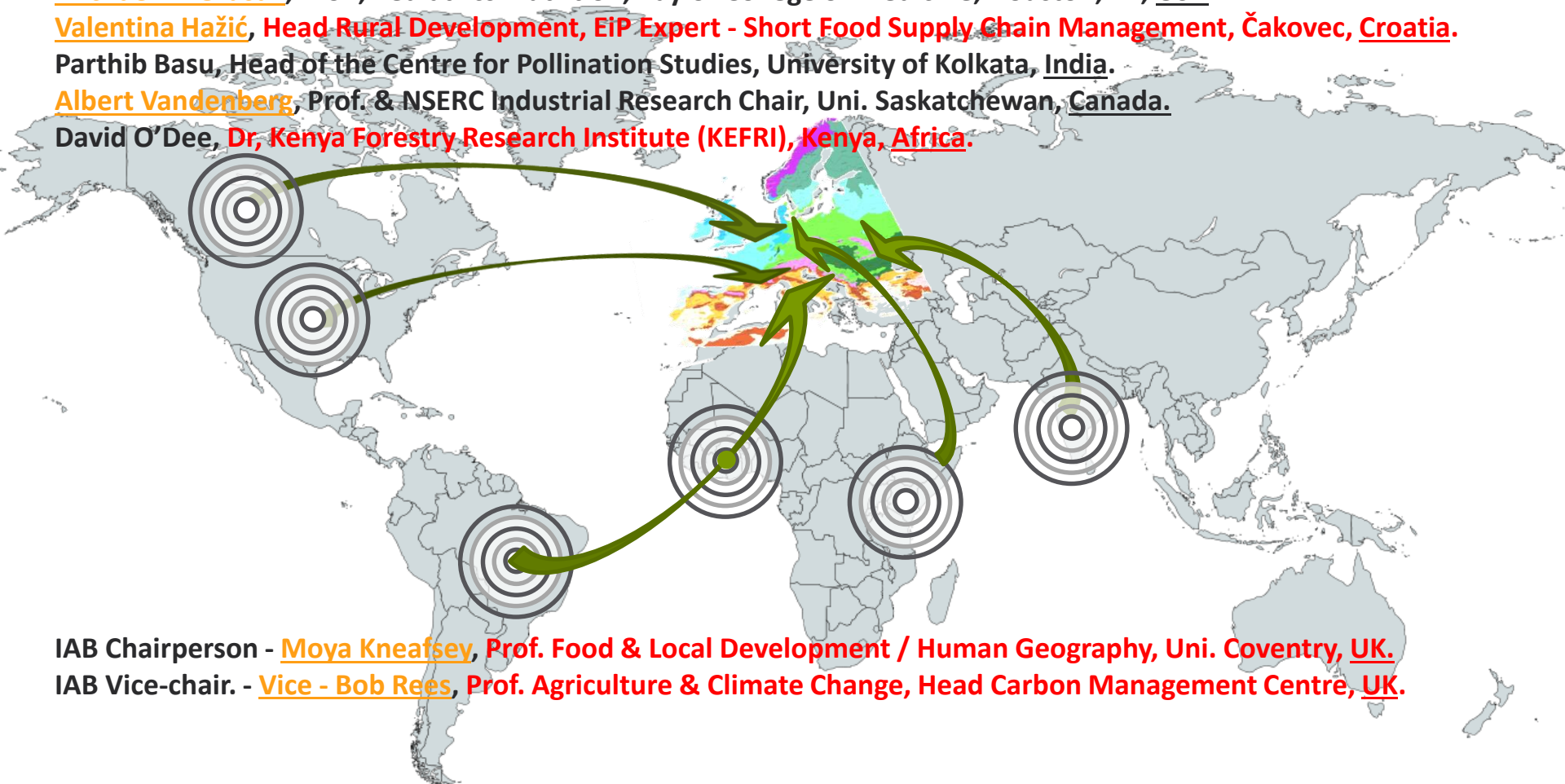
Michael A. Grusak, Prof., Pediatrics-Nutrition, Baylor College of Medicine, Houston, TX, USA.

Valentina Hažić, **Head Rural Development, EiP Expert - Short Food Supply Chain Management, Čakovec, Croatia.**

Parthib Basu, Head of the Centre for Pollination Studies, University of Kolkata, India.

Albert Vandenberg, Prof. & NSERC Industrial Research Chair, Uni. Saskatchewan, Canada.

David O'Dee, **Dr, Kenya Forestry Research Institute (KEFRI), Kenya, Africa.**



IAB Chairperson - Moya Kneafsey, Prof. Food & Local Development / Human Geography, Uni. Coventry, UK.

IAB Vice-chair. - Vice - Bob Rees, Prof. Agriculture & Climate Change, Head Carbon Management Centre, UK.

Primary Impacts

Main Impacts

1. **Enable sustainable legume-based cropping systems and agri-food and feed chains**
2. **Increase the competitiveness of legume crops** across agri-food and -feed chains
3. **Reduce the environmental impact** of food- & feed-production and processing
4. **Integrated support for EU policies:** CAP, Water Framework, IPCC, *etc*
5. **Strengthen co-innovation:** help build multi-stakeholders (transdisciplinary) community

Additional Impacts

6. **Optimise water and nutrient use efficiency** - reducing the environmental impact
7. **Enhance innovation capacity:** for EU, local and global markets
8. **Create new market opportunities:** strengthen competitiveness and growth of SMEs
9. **Wider benefits for society** (more than GDP): culture, positive behavioural change
10. **Legacy:** evidence and resources (database, decision tools, media), **'Pulse Europe'**



Agroecology

- subgroup of Ecological Sciences (19 staff)

Post-Doctoral Scientists (5)

Carolyn Mitchell, Plant-insect interactions

Gaynor Malloch, Mol. biologist

Gillian Banks, Agronomist

Marta Maluk, Mol. biologist

Richard Dye, Ecological modelling

Research Assistants (6)

EU-Project Facilitator (TBA)

Linda Ford, Field & glasshouse tech.

Linda Nell, Field tech.

Mark Young, IT & data-basing

Paul Neave, Field tech.

Nora Quesada Pizaro, Landscape modelling

Principal Investigators (8)

Alison Karley, Plant-insect interactions

Cathy Hawes, Field ecologist

Euan James, Plant-microbe interactions

Geoff Squire, Ecologist

Graham Begg, Ecological modelling

Pietro Iannetta, Agroecology/mol. ecol.

Philip White, Plant nutrition

Tracy valentine, Root-soil biologist





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www.true-project.eu

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@TrueLegumes



te.iannetta@hutton.ac.uk

@AgroEcoAtJHI



Scottish Government
Riaghaltas na h-Alba
gov.scot



Examples of the legume-focused innovations planned within TRUE

Dr. Pietro (Pete) Iannetta, Agroecologist

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@AgroEcoAtJHI



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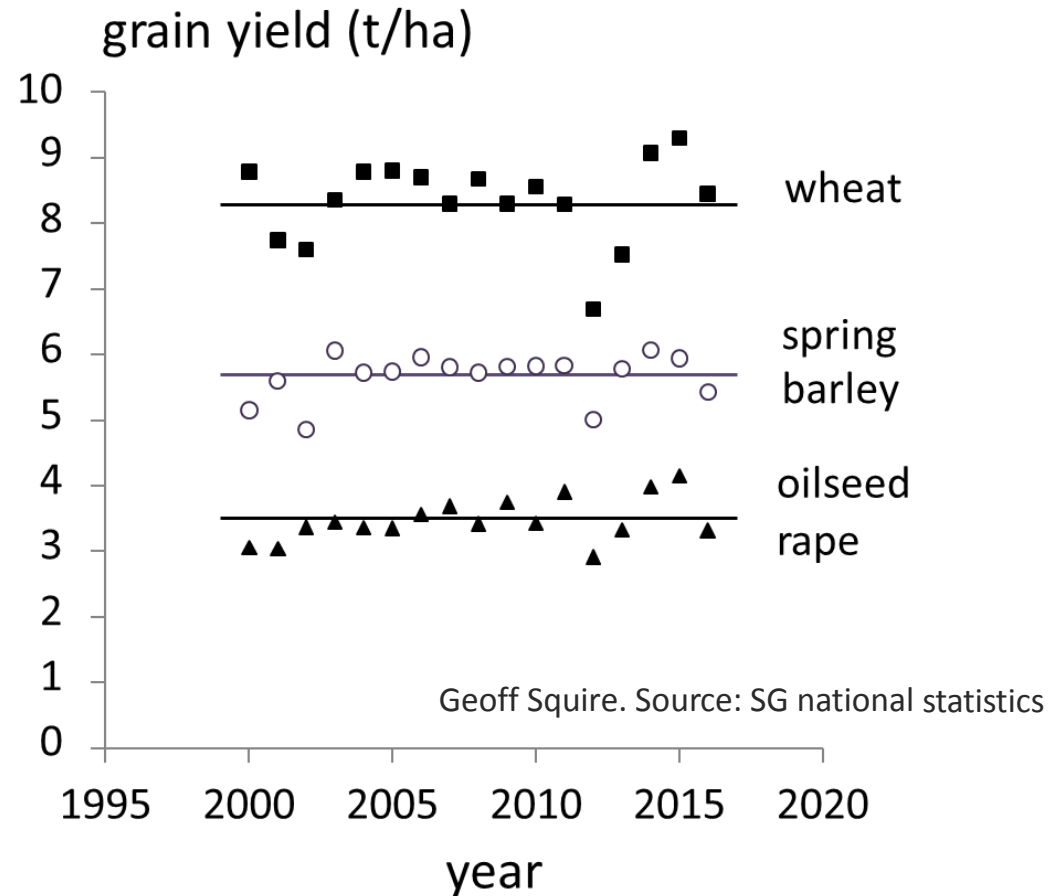
- **#TRUELegumes**
- **#EcoTechIsBioTech**
- **#LegTechIsBioTech**

- **@pgroresearch**
- **@EUAgri**
- **@DEFRA**
- **@SEFARIscot**
- **@JamesHuttonInst**



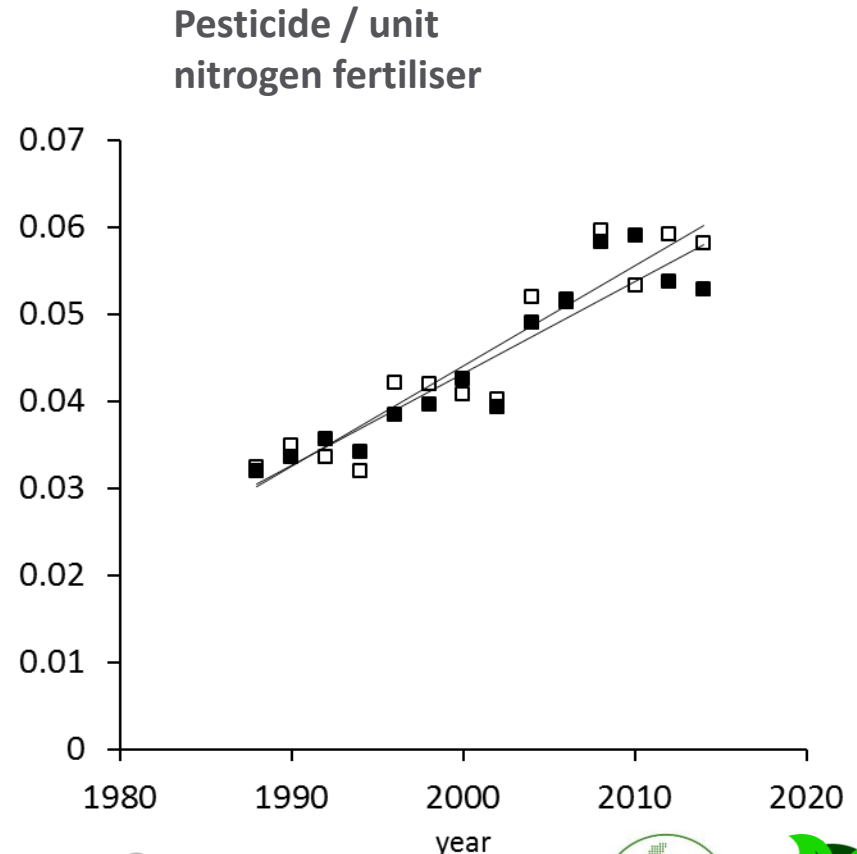
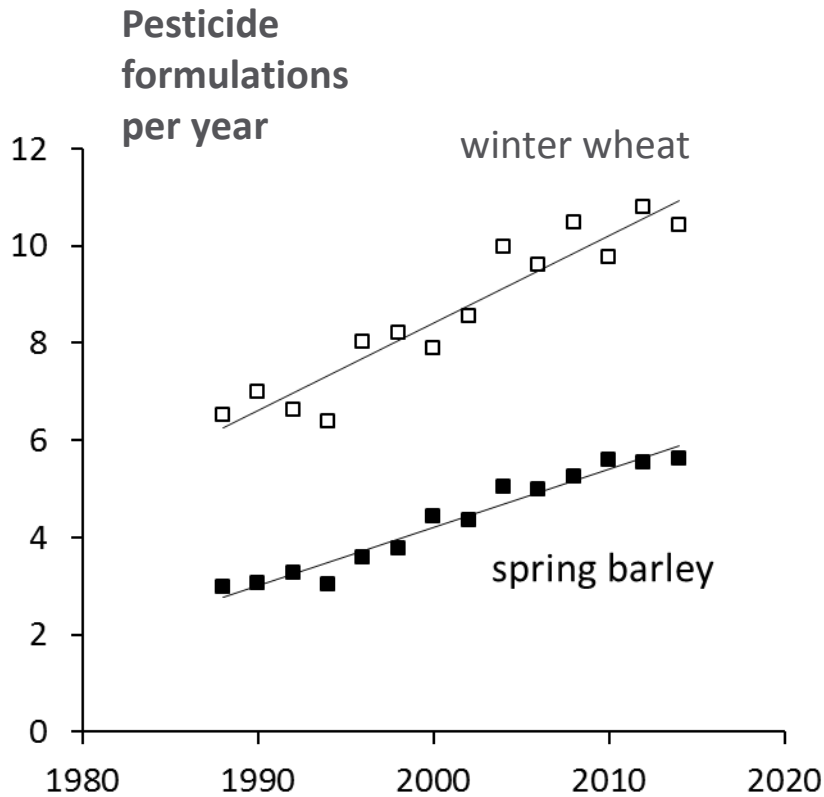
Production challenges

- Output static
- Declining efficiency
- Growing farmer concerns hint at instability



While national yields flat-line...

Crops that get more nitrogen need more pesticide





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Where are we now?

long term trajectories in inputs and crop yield

- Grain output peaked in the late 1980s despite innovation
- N fertiliser and pesticide = major pollutants
- No indication of any reduction in pesticide or N usage

LEGUMES ARE PRINCIPLE MEANS OF DISRUPTING OUR DEPENDENCE ON NITROGEN AND PESTICIDE

- The proportion of N fixation crops in the rotation is very low
- Legumes mainly for animal feed, and only 2-4% of acreage (70 y)
- Legume inclusion is very low compared to world leaders in sustainable ag.

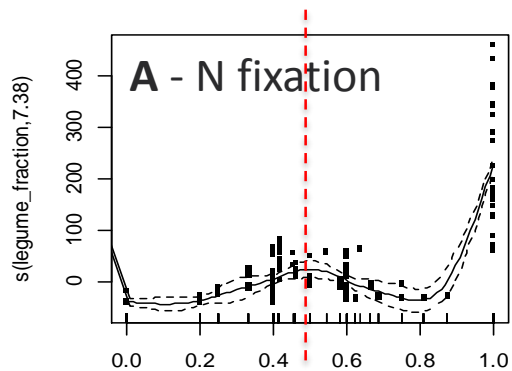


Legume (BNF) supported systems need not compromise yield

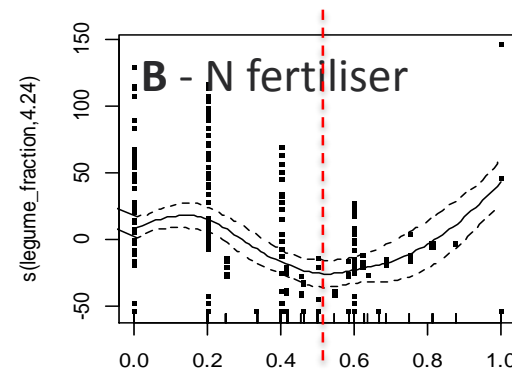
An analysis of legume supported crop rotations

At 50% legume inclusion

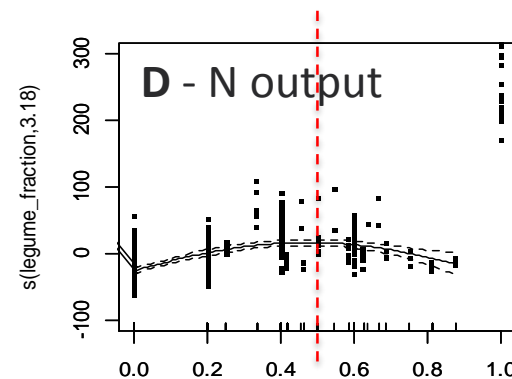
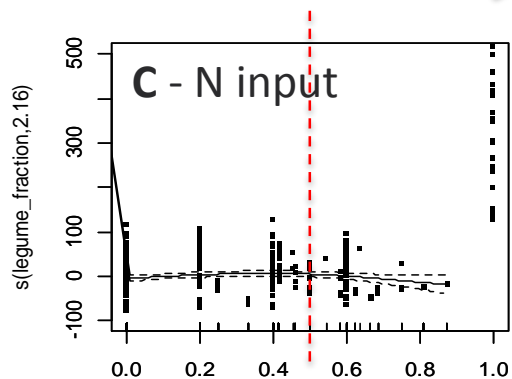
- A) BNF fixation peaked
- B) inorganic N use lowest
- C) N input greatest
- D) N output peaked



No years All years



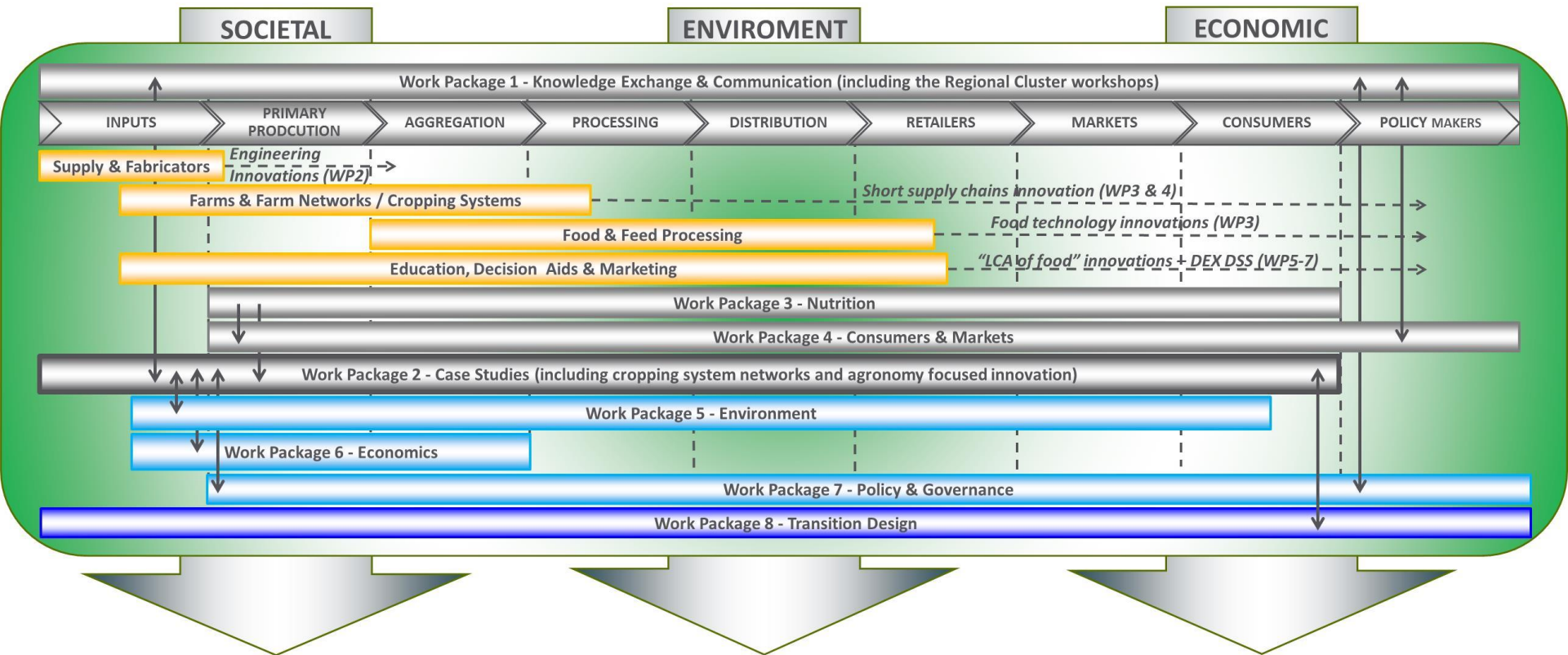
No years All years



Proportion of whole-rotation with legumes



TRUE activities span the supply chain, and have a high TRL (technology readiness level)



The Partners



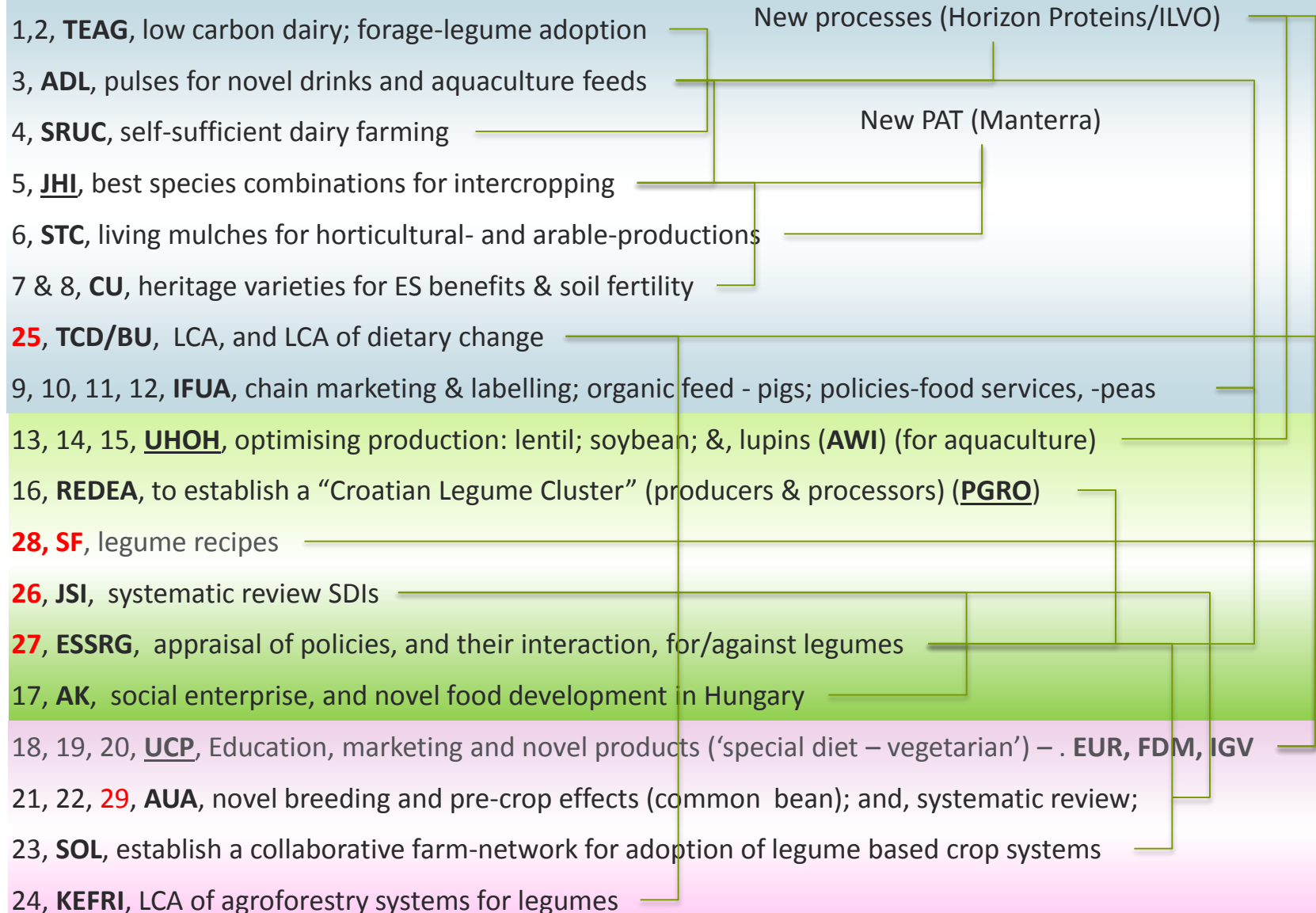
No	Participant organisation name (and acronym)	
1 (C)	The James Hutton Institute (JHI, UK)	Intercropping for brewing, distilling, whole crop forage & AD
2	Coventry University (CU, UK)	Nutritional profiling of heritage faba beans. Vegan production systems.
3	Stockbridge Technology Centre (STC, UK)	Use of clover-based living mulches (direct & strip tillage, Manterra Ltd.)
4	Scotland's Rural College (SRUC, UK)	Dairy system design. Farm & behaviour modelling. Life Cycle Analysis
5	Kenya Forestry Research Institute (KEFRI, KE)	Agroforestry based production and processing of cowpea
6	Universidade Catolica Portuguesa (UCP, PT)	Nutritional analysis of novel cropping & legume based food and feed products
7	Universitaet Hohenheim (UHOH, DE)	Spatial analysis of legume cropping in the UK. Lentil & soybean field studies
8	Agricultural University of Athens (AUA, GR)	Organic & aquaculture based production. Novel pulses. Elite inoculum.
9	IFAU APS (IFAU, DK)	Pea production. Organic pig feed. Green public procurement. Routes to market
10	Regionalna Razvojna Agencija Medimurje (REDEA)	Developing a LIN and linked example Case Studies in Croatia
11	Bangor University (BU, UK)	Life Cycle Analysis methods and tools for legume-based value chains (Food Print)
12	Trinity College Dublin (TCD, IR)	Sustainable diet indicators: nutrient density x envir.- impact indices
13	Processors and Growers Research Organisation (PGRO, UK)	Stakeholder engagement. ELIN Strategy. Development of PULSE EUROPE
14	Institut Jozef Stefan (JSI, SL)	Design a prototype Decision Support System to resolve impacts: society, env. & econ.
15	IGV Institut Fur Getreideverarbeitung Gmbh (IGV, DE)	Pulse extrusion. Milling. Fractionation. Product development.
16	ESSRG Kft (ESSRG, HU)	Critical appraisal of policies and development of new governance-based solutions
17	Agri Kulti Kft (AK, HU)	Novel legumes food production - short supply-chain case study
18	Alfred-Wegener-Institut (AWI, DE)	Pulses for aquaculture bass & shrimps (e.g. lupin and faba bean coproducts)
19	Slow Food Deutschland e.V. (SF, DE)	TRUE Food Print : legume recipes to encourage sustainable diets
20	Arbikie Distilling Ltd (ADL, UK)	Intercropping and novel processing to improving profitability of short supply-chain
21	Agriculture And Food Development Authority (TEAG, IR)	Low carbon system of dairy production. TEAGASC Clover discussion group.
22	Sociedade Agrícola do Freixo do Meio, Lda (FDM, PT)	The economics of self-sufficient production, processing and retailing
23	Eurest -Sociedade Europeia De Restaurantes Lda (EUR, PT)	Expanding "Choose beans" & development and testing novel legume foods
24	Solintagro SL (SOL, ES)	Screening for breeding: heritage varieties disease resistance & stress tolerance



Case studies are highly interconnected – *highly interactive & co-innovative*



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ELIN	Country	Case Study Number	Resident Worpackage(s)	Actor [sub-contractor]	Farm Network Type	Main Cultivation Practice	Legume Crops	Legume Crop Use
Atlantic	IE	1	2	Teagasc (RTO)	Livestock	Con	Clover	Feed
		2				Org		
	GB	3		Arbikie (SME) [Barney's Beer, SME; ILVO, RTO]	Arable	Org	Faba bean	Food, Feed
							Pea	
		4		SRUC (ACAD)	Mixed	Con	Clover	Feed
							Faba bean	
		5		JHI (RTO)	Arable	Con, Int	Forages	Feed, Energy
		6		STC (SME) [Manterra, SME]			Con, Org	Clover
						Lucerne		
		7		CU (ACAD)		Hort	Veg/Org	Faba bean
	Pea							
	Common bean							
8	CU (ACAD)	Hort	Veg/Org	Forages (misc)		Green Manure		
				Bean meal				
				Pea meal				
DK	9	IFAU (SME)	Quality Chain	Con, Org	Lentil	Food		
					Pea			
					Faba bean			
	10	IFAU (SME)	Quality Chain	Org	French bean			
					Lupin			
11	IFAU (SME)	Quality Chain	Con, Org	Faba bean				
				Soybean				
12	IFAU (SME)	Quality Chain	Con, Org	Lupin				
					Lentil			
					Pea			



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ELIN	Country	Case Study Number	Resident Work package(s)	Partner	Farm Network Type	Main Cultivation Practice	Legume Crops	Legume Crop Use
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Continental	DE	13	2	UHOH (ACAD)	Mixed	Con, Org	Lentil	Food Type
		14				Mixed	Soybean	Food Feed
		15		AWI (RTO)	Arable	Org	Lupin	Feed
	HR	16	2	REDEA (GOV)	Policy	Misc.	Misc.	Misc.
	HU	17	2	Agri Kulti (SME)	Farm & QC	Con, Org	Beans (misc)	Food



ELIN	Country	Case Study Number	Resident Work package(s)	Actor [sub-contractor]	Farm Network Type	Main Cultivation Practice	Legume Crops	Legume Crop Use	
Mediterranean	PT	18	3	Freixo do Meio (SME)	Farm	Org	Common bean	Food, Feed	
							Lupin		
							Lentil		
		19		Eurest (IND)	QC	Con	Chickpea		
							Common bean		
							Faba bean		
	20	UCP (ACAD) [Palmeiro Foods, IND]	QC	Con	Soybean				
					Lentil				
					Common bean				
	GR	21	2	AUA (ACAD)	Hort	Org (hydro)	Common bean	Food	
		22			Arable	Con, Org			
	ES	23	2	Solintagro (SME)	Arable	Con	Chickpea		Food, Feed
							Pea		
							Lentil		
KE	24	2	KEFRI (RTO)	Silvo-arable	Con, Org	Faba bean			
						Common bean			
						Cowpea			





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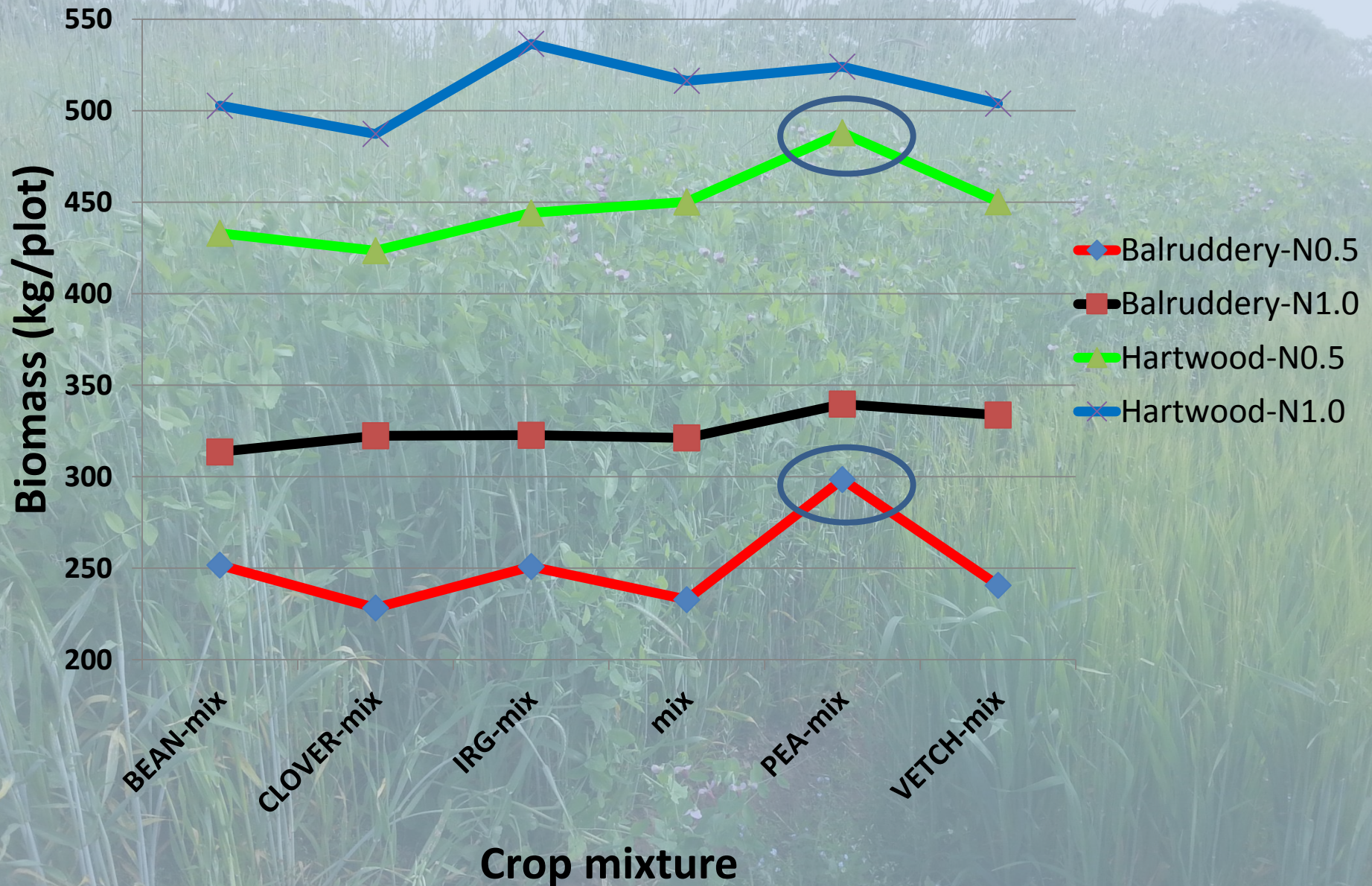
ELIN	Country	Case Study No	Work package(s)	Actor [Sub-contractor]	Activity (TRL)	Main Products	Input/Suppliers	Producers	Processors	Markets	Consumers	Legume Crops
Continental	DE	13	2	UHOH (ACAD)	Assess structure/profit short supply chains (3-6)	Grain products						Lentil
		14				Tofu, feed					Soybean	
		15		AWI (RTO)	Organic lupins for aquaculture feeds (6)	Bass, salmon, shrimp					Lupin	
	HR	16	2	REDEA (GOV)	Policy for sustainable development (8-9)	Sustainability policy						Misc.
	HU	17	2	Agri Kulti (SME)	Sustainable short supply chains delivering novel legume products to reconnect producers and urban consumers (8-9)	Pulse based foods						Beans (misc)
												Pea
												Lentils



ELIN	Country	Case Study No	Work package(s)	Actor [Sub-contractor]	Activity (TRL)	Main Products	Input/Suppliers	Producers	Processors	Markets	Consumers	Legume Crops	
Mediterranean	PT	18	3	Freixo do Meio (SME)	Ancient & heritage variety screening for higher nutritive value (4)	Greenpods, grain, grain products						Common bean	
												Lupin	
												Lentil	
								Chickpea					
								Common bean					
								Faba bean					
		19	3	Eurest (IND)	Consumers - legume dishes (4-6)	Menu design & recipe books							Soybean
											Lentil		
											Common bean		
											Lentil		
	20	3	UCP (ACAD) [Palmeiro Foods, IND]	Processors - snack and convenience foods (4-6)	Inc. purees & symbiotic yogurts							Common bean	
											Lentil		
												Chickpea	
												Pea	
	GR	21	2	AUA (ACAD)	Novel grafted types - high yield (5-6)	Food), germplasm						Common bean	
					22		Elite inoculum – inc. yield & profit (7-8)	Grain - food & feed					
	ES	23	2	Solintagro (SME)	Breeding for high production and NUE Mediterranean agroecological pedoclimatic stresses (3-5)	Grain, elite germplasm						Pea	
												Lentil	
												Faba bean	
	KE	24	2	KEFRI (RTO)	Silvo-arable production & supply chain characterisation (8-9)	Grain, grain products						Common bean	
												Cowpea	



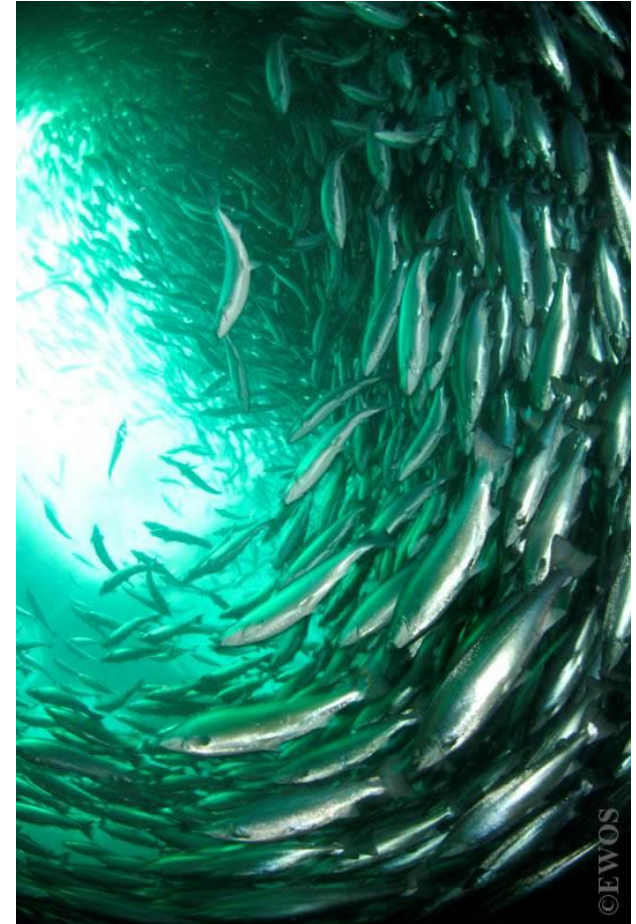
Legume supported agronomy targeted to land classes,.... and markets



Salmon farming in the Scotland: *the potential of field beans*

Scottish Salmon

- Scotland's second largest export
- **£600m at farm gate**
- Feed Conversion 1.25
- Salmon feed high in grain legume protein
- **To serve just Scottish aquaculture beans need grown 1/12 (~8% of rotation)**
- **Faba bean concentrates (50%+) required**



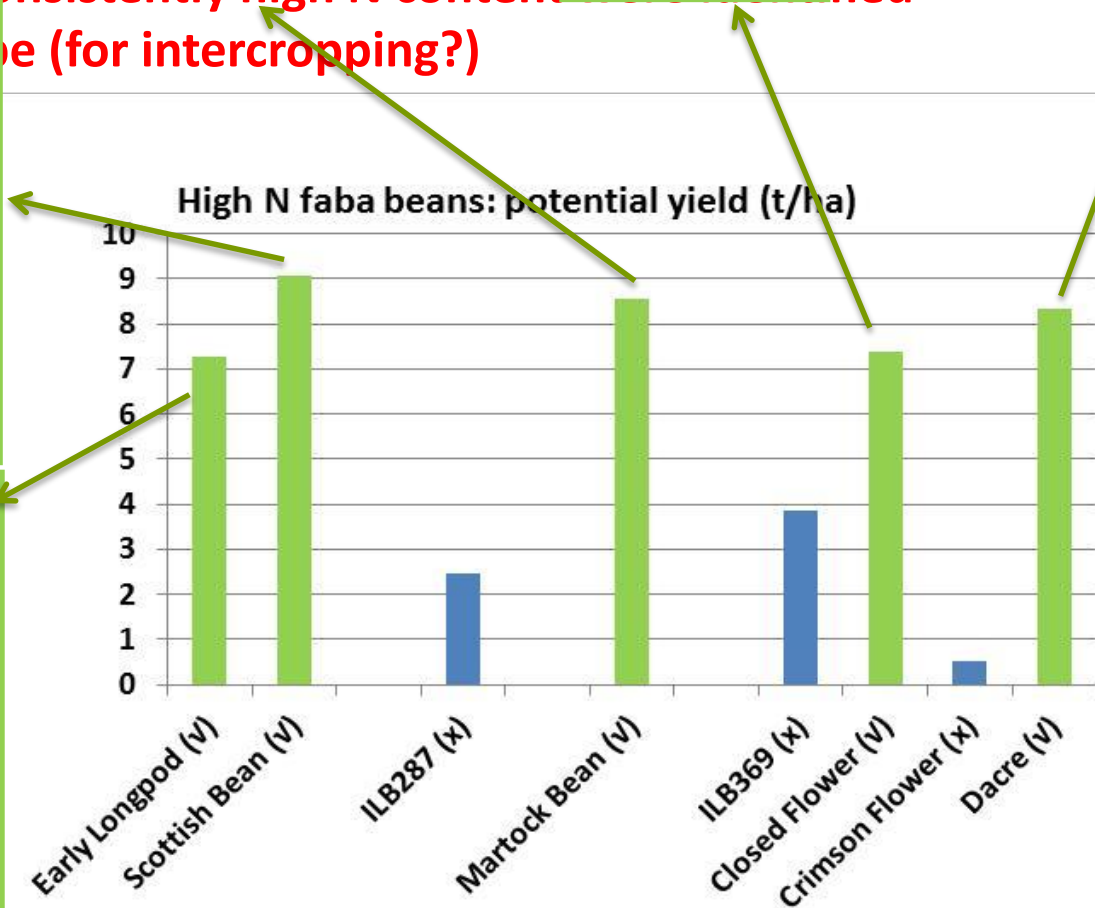
Breeding

- germplasm

- Germplasm
- 239 genotypes
- Seven lines with consistently high N content
- Early and late maturity (for intercropping?)



Protein
Early_Lo
ILB_287
ILB_369
Closed_
Martock
Dacre
Crimson



Faba bean Official Ales

- Edin.Inter.Sci.Fest. 2015 & '17
- Limagrain (Cereals 2017)



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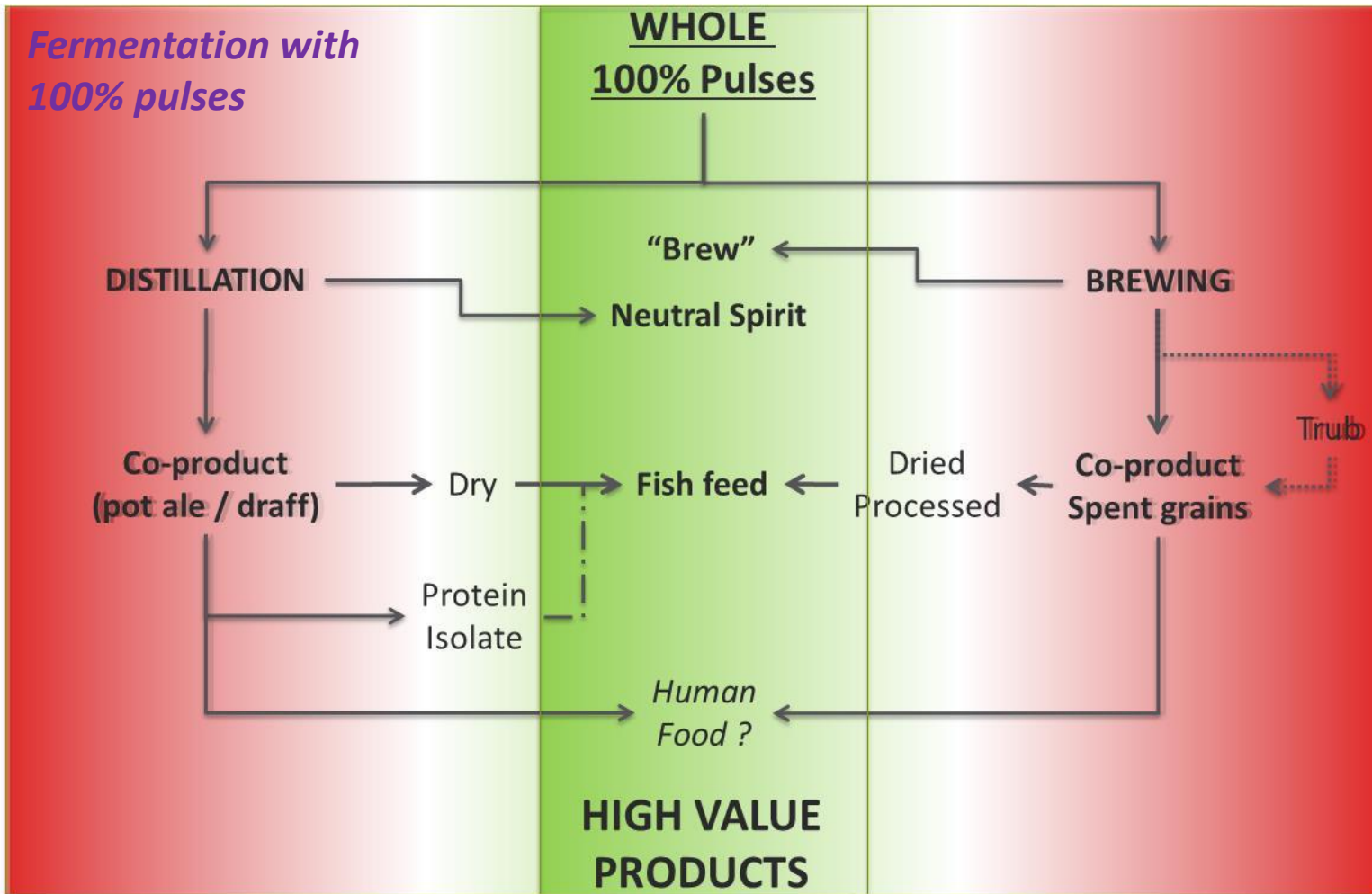
- 100% faba bean ale in production
- High protein co-products remain to be exploited



Legumes: a 'disruptive technology'



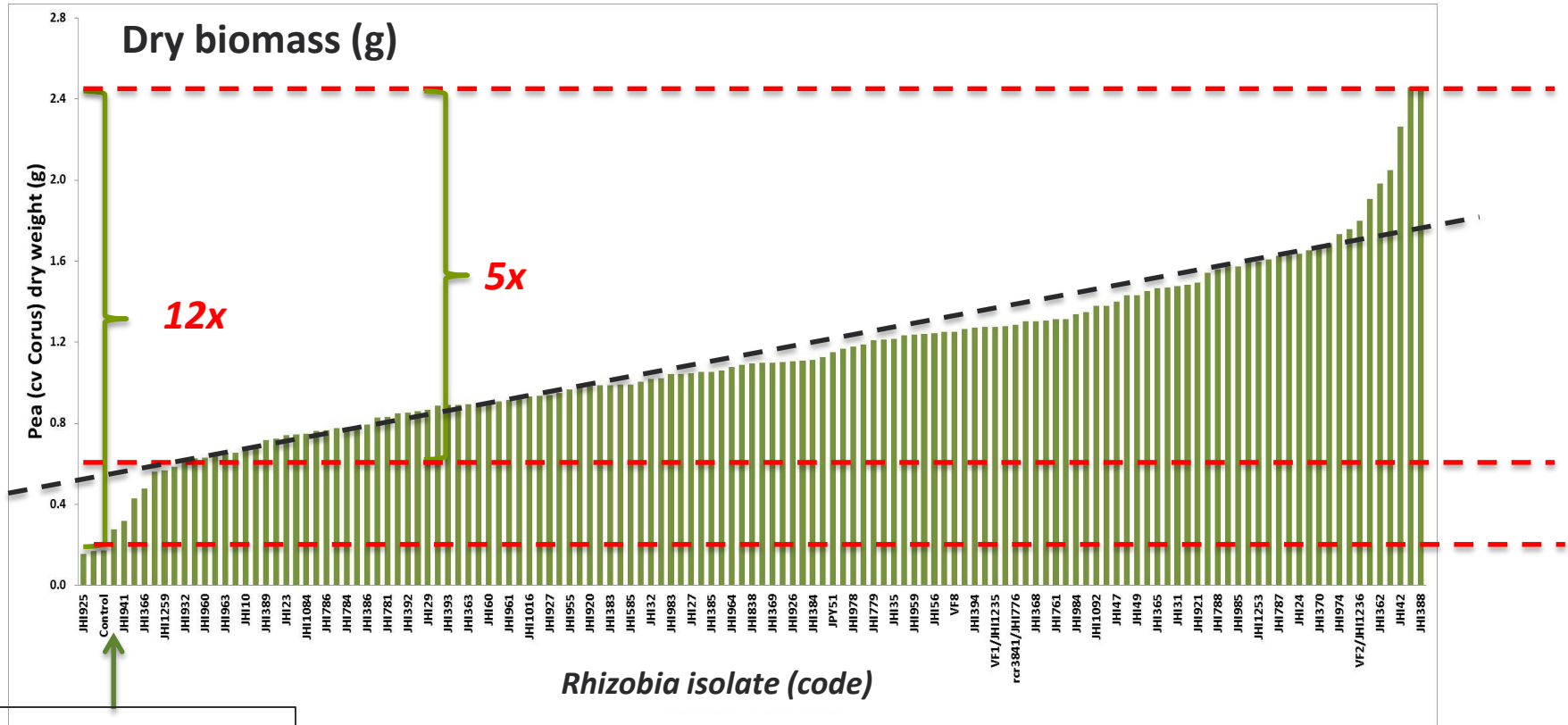
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Greenhouse screen of elite rhizobia (pea cv. Corus biomass increase 0-60d)



Existing commercial isolates

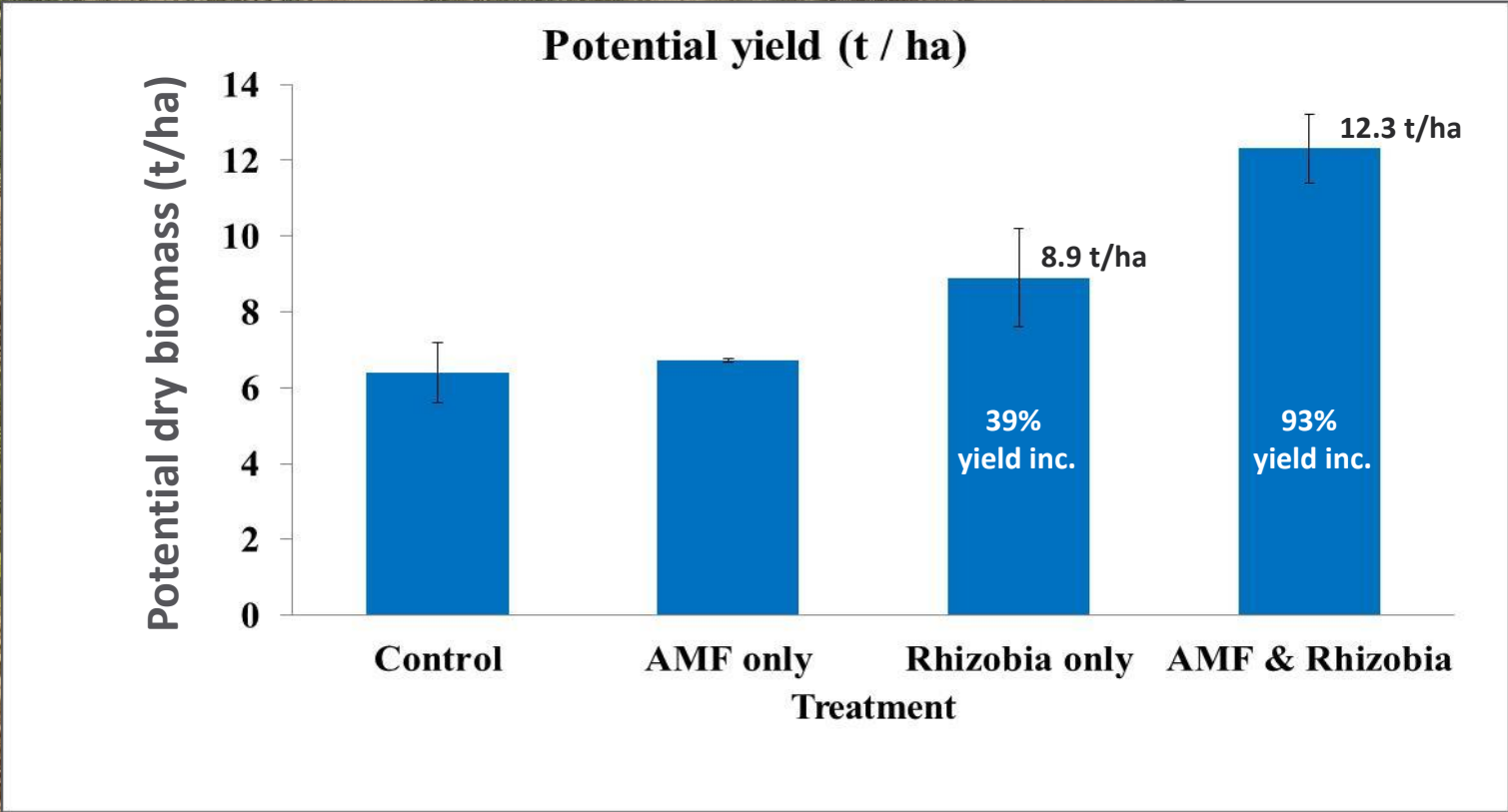


Non-traditional crop options:

- soybean in UK, even Scotland



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Some history & acknowledgements

(just a 'snap-shot')



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Legume
Futures



Limagrain
United Kingdom



Innovate UK
Technology Strategy Board



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marineharvest
excellence in seafood

EWOS®



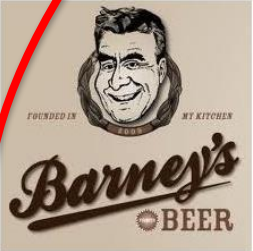
Institute of Brewing & Distilling



UNIVERSITY of
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The James Hutton Institute is supported by the Scottish Government

TRUE is funded by the European Unions Horizon 2020 Research and Innovation Sustainable Food Systems (SFS) Programme, Grant Agreement 727973

www.true-project.eu

TRUE@hutton.ac.uk

  TRansition paths to sUstainable legume based systems in Europe (TRUE)

 @TrueLegumes

pete.iannetta@hutton.ac.uk

 @AgroEcoAtJHI





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gov.scot



Policies for sustainable food systems

  TRansition paths to sUstainable legume based systems in Europe (TRUE)

-  @TrueLegumes
-  @prgoresearch
-  @AgroEcoAtJHI



www.true-project.eu



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Please Tweet

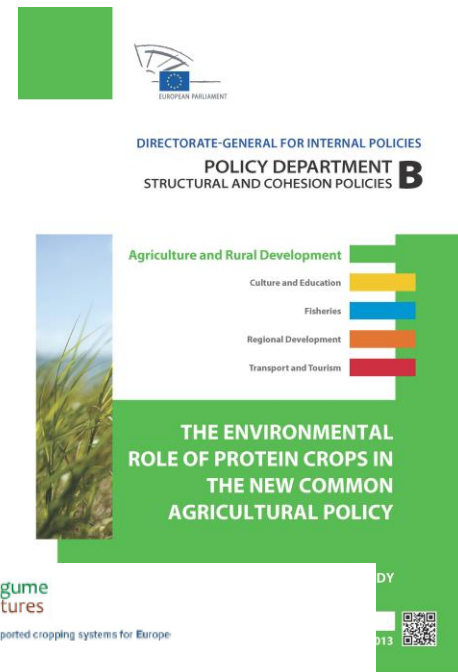
- **#TRUELegumeDiet**
- **#TRUESustainableDiet**
- **#LegTechIsBioTech**

- **@pgroresearch**
- **@EUAgri**
- **@DEFRA**
- **@SEFARIs Scot**
- **@JamesHuttonInst**



Which policies would help increase production?

- **Beus et al 2013:**
 - integrated farming
 - greening measures (CAP?)
 - investment in suitable research
 - constraints N fertiliser use (which?)
- **Funding to develop capacities?**
 - Precision ag. technology
 - Small-/medium-scale processing machinery
- **Helming et al. & Topp et al. 2014**
 - www.legumefutures.eu (reports)
 - international trade



Legume Futures Report 4.5
Impacts of legume-related policy scenarios

Compiled by:
John Helming, Tom Kuhlman, Vincent Linderhof, Diti Oudendag (LEI)

23 February 2014



Legume-supported cropping systems for Europe (Legume Futures)
is a collaborative research project funded from the European Union's Seventh Programme
for research, technological development and demonstration under grant number 245216
www.legumefutures.eu



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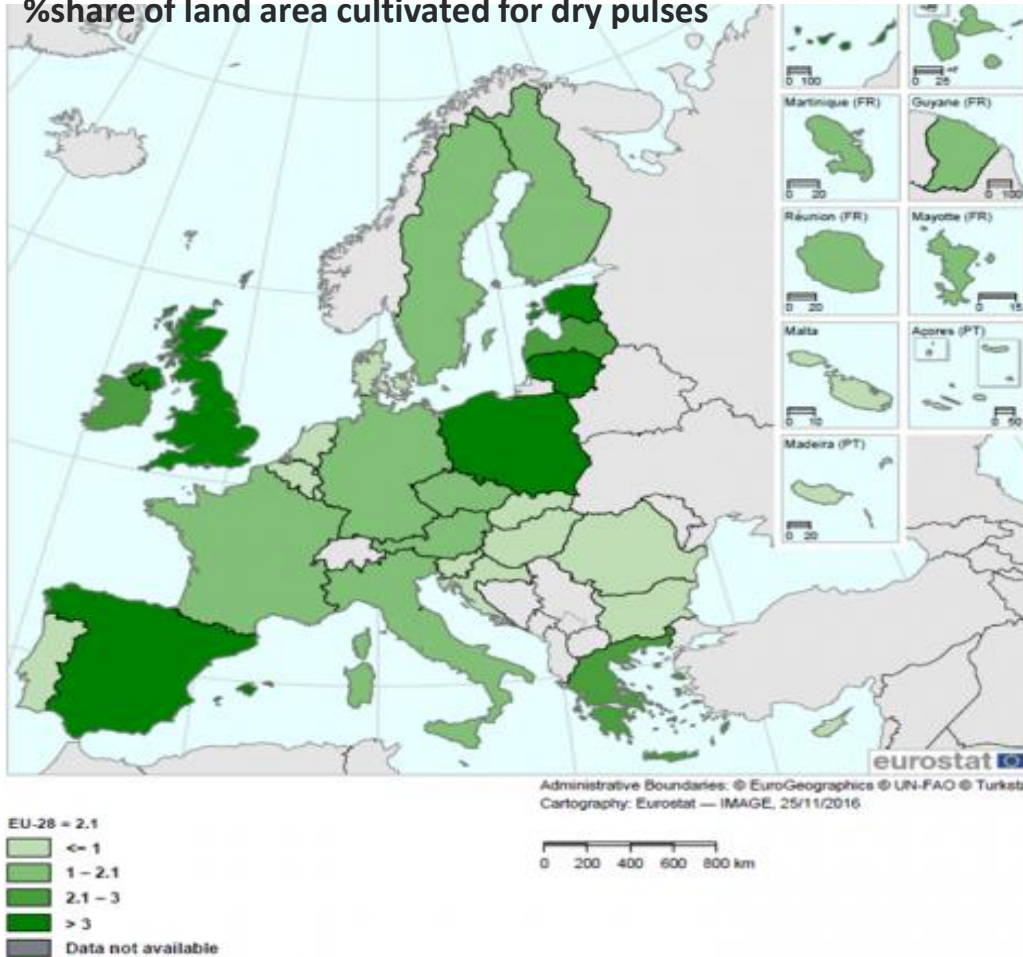


EU legume markets



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%share of land area cultivated for dry pulses



Market forces and structure

- Resilient to dynamics?
- Local or global? Balance?
- Supply chains structure?
- Ensure profitability?

Market drivers

- Influence consumer demand?
- Better balance feed- and food markets?
- Exploit business opportunities?

Why is the % of legume cultivation so low in Europe?

Where are national protein budgets and strategies?

Source: Eurostat (online data code: apro_acs_a)



Legumes: agents to resolve the critical issues: the environment and human health crises

The simple emphasis on production (sustainable intensification) is not acceptable

Society must increase its focus on sustainable consumption

- Global food systems, locally and globally = biggest 21st century challenge
- Lack of diversity (polarisation) in production, operations, crops and biodiversity
 - excessive use of N and pesticides *etc* (for a low number of commodities)
- Polarisation of production encourages polarised food- and feed chains
- Polarised food- and feed-chains encourages polarised consumption
- Major health issues are also prevalent:
 - 1980 – 2017 obesity doubled (30% of global population)
 - 30% of global population suffer nutrient deficiencies (\neq same 30% obese)
- Global agriculture 25-30% of GHGs: nitrogen pollution
- 5th Assessment Report IPCC highlighted potential of consumption shifts to combat GHG (<https://ipcc.ch/report/ar5/>)



Policy supporting legume-production has failed to increase legume-based diets

- **But - legumes promote debate of food system policy**
 - Meat analogues (e.g. www.impossiblefoods.com)
 - #IYP2016 (<http://www.fao.org/pulses-2016/en/>)
 - The 'Protein Transition' movement (away from meat)
 - www.forumforthefuture.org/project/protein-challenge-2040/overview (affordable & healthy)
 - Green Protein Alliance (www.greenproteinalliance.nl/)
 - FOOD2030 Policy Framework –
 - transform and future-proof our food systems
- **Policy Paradox**
 - Soya Declaration (July 17, 2017 – boost soy in EU)
 - **However, which policies could help the transition?**
 - **What has been done in other countries?**

CAP reform: From sustainable feed to sustainable food

DISCLAIMER: All opinions in this column reflect the views of the authors, not of EURACTIV.com PLC.



Europe's imports of soy from Brazil contribute to deforestation, loss of biodiversity and food insecurity. (Lima Pix/Flickr)

The German-Hungarian 'Soya Declaration' finally gets us talking about what matters in CAP reform, write Olivier De Schutter, Oscar Rivas and Karin Nansen.

Olivier De Schutter is UN special rapporteur on the Right to Food (2008-2014) and co-chair of the International Panel of Experts on Sustainable Food Systems (IPES-Food). Oscar Rivas, former Environment Minister of Paraguay. Karin Nansen, chair of Friends of the Earth International & founding member of REDES/ Friends of Earth Uruguay



The transitioning from polarised cropping: - *barley in Scotland as a Case Study*

- ~55% of the Scottish arable area is cultivated with mainly spring barley
 - ***This is a 'crop sequence' not a crop rotation in the intended holistic sense***
- ~½ is malted for use in the brewing & distilling
 - Beer and whisky production contribute **£10 billion** UK annual tax revenue
- ~½ is used for animal feed or meat production
 - Scottish meat export value ~£80 million
 - ~½ is used for animal feed or meat production
- ***Can INTERCROPPING with legumes 'green' barley production?***



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Major impact can be quickly achieved *via* integration of legume-supported cropping into a polarised food system

If just UK barley was intercropped,....
....and in terms of accounting units which are tangible

Equivalent No. cars removed from the /year	Intercropping barley contribution to total CO ₂ e of UK Agric.
176,000	0.8%

UK agriculture ~ 12% of total UK emissions 54 Mt CO₂e

The savings listed here probably underestimated

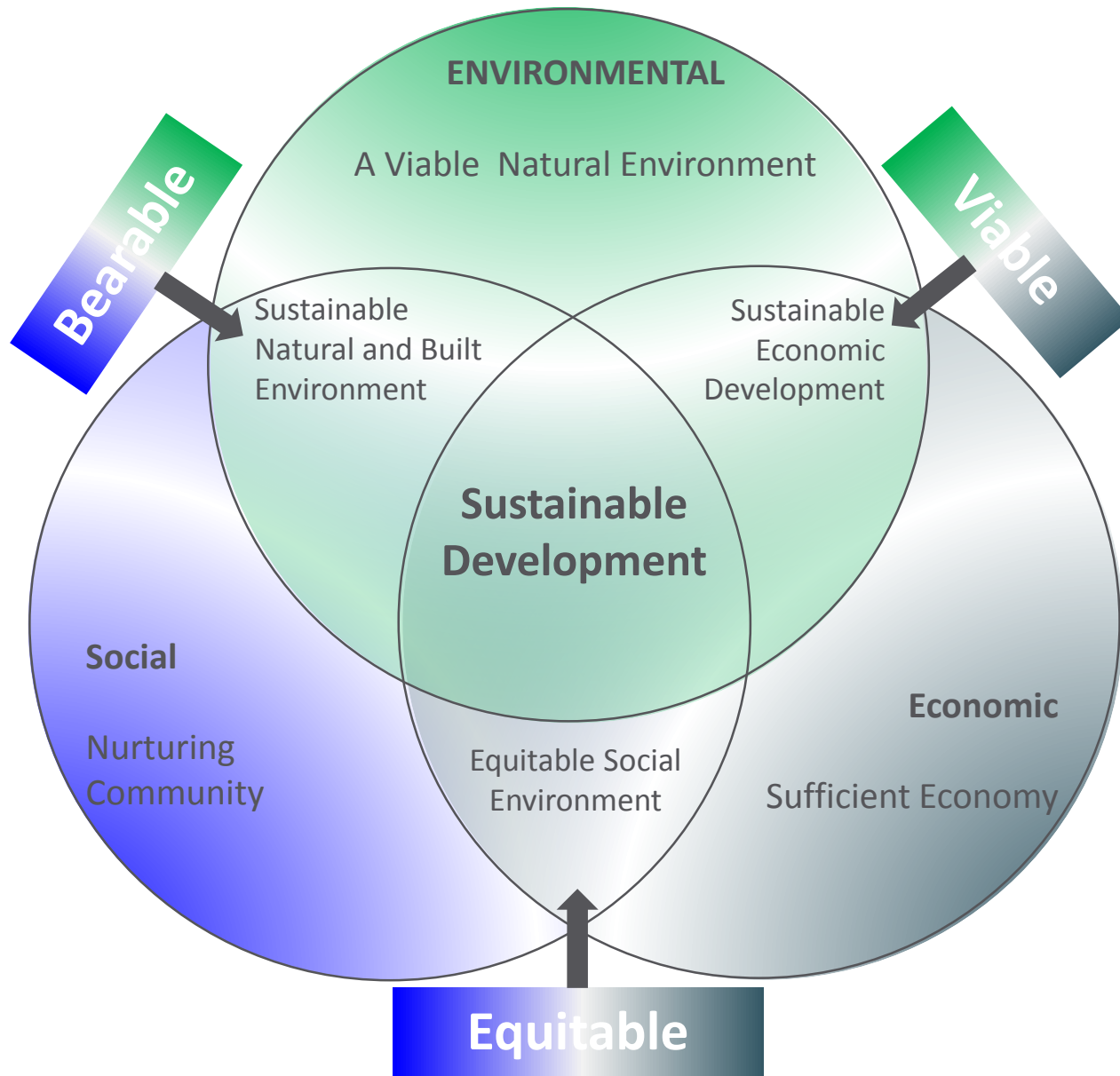
- Fertiliser price is low (saving would be higher in future)
- Reduced pesticide applications of intercropping are not accounted
- Increased yield and yield qualities of intercropping are not accounted
- Improved soil qualities are not accounted



The 'Three Pillars of Sustainability'



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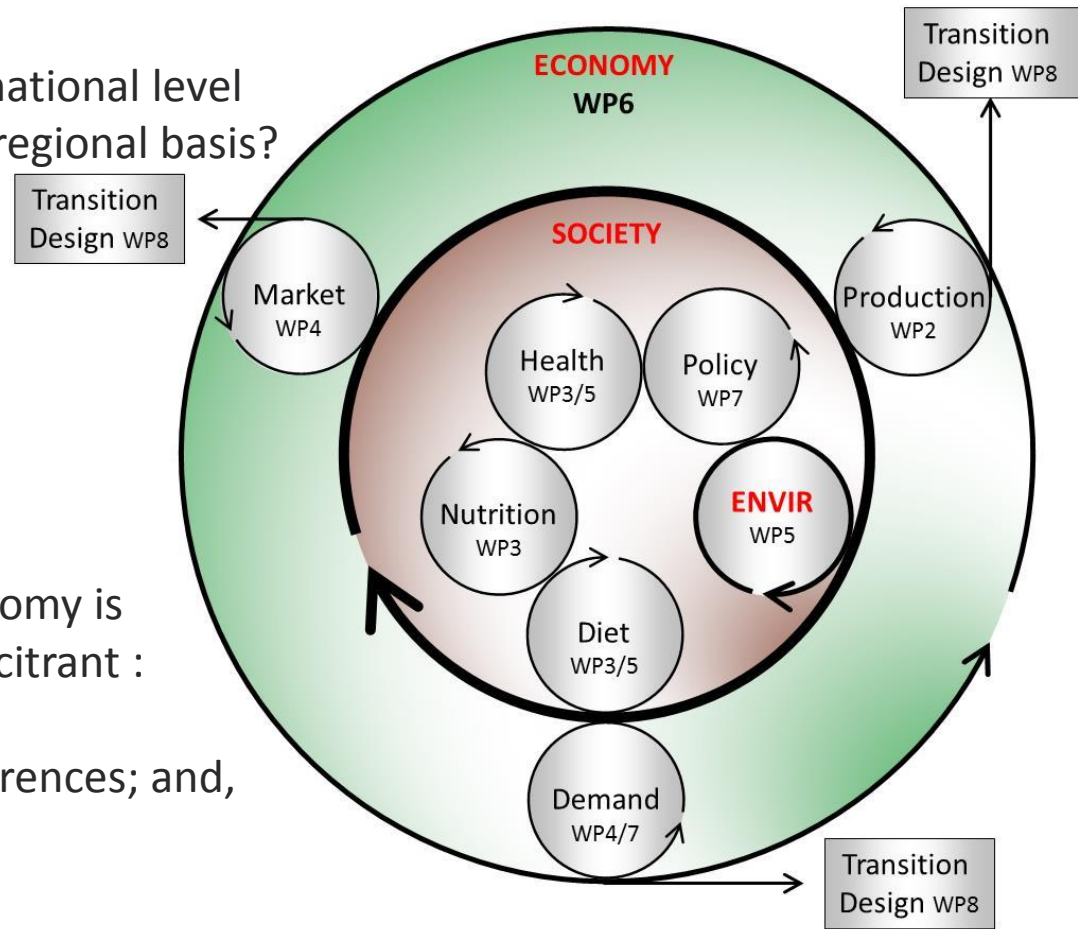
TRUE has developing a mechanistic framework to help manage the three pillars to help address:

how do we harmonise the society and economy?

Food policies are rarely effective on a national level
Does this approach need applied on a regional basis?

Can we simply apply best-fit options?

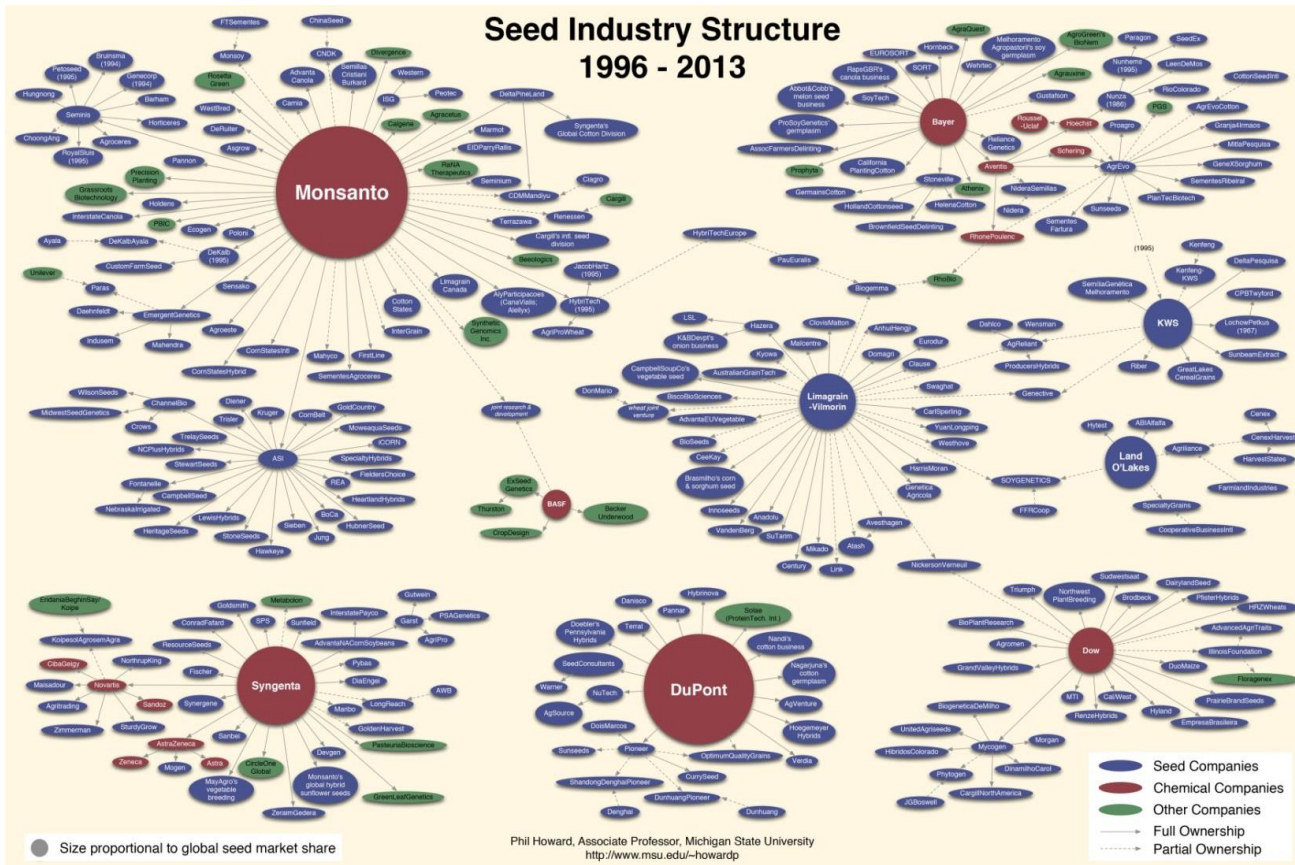
- The inner wheel for Society can be determined scientifically.
- However, harmonising society-economy is challenging, these aspects are recalcitrant :
 - history/tradition;
 - local palate culinary preferences; and,
 - social values.



Are there “elephants in the room?”



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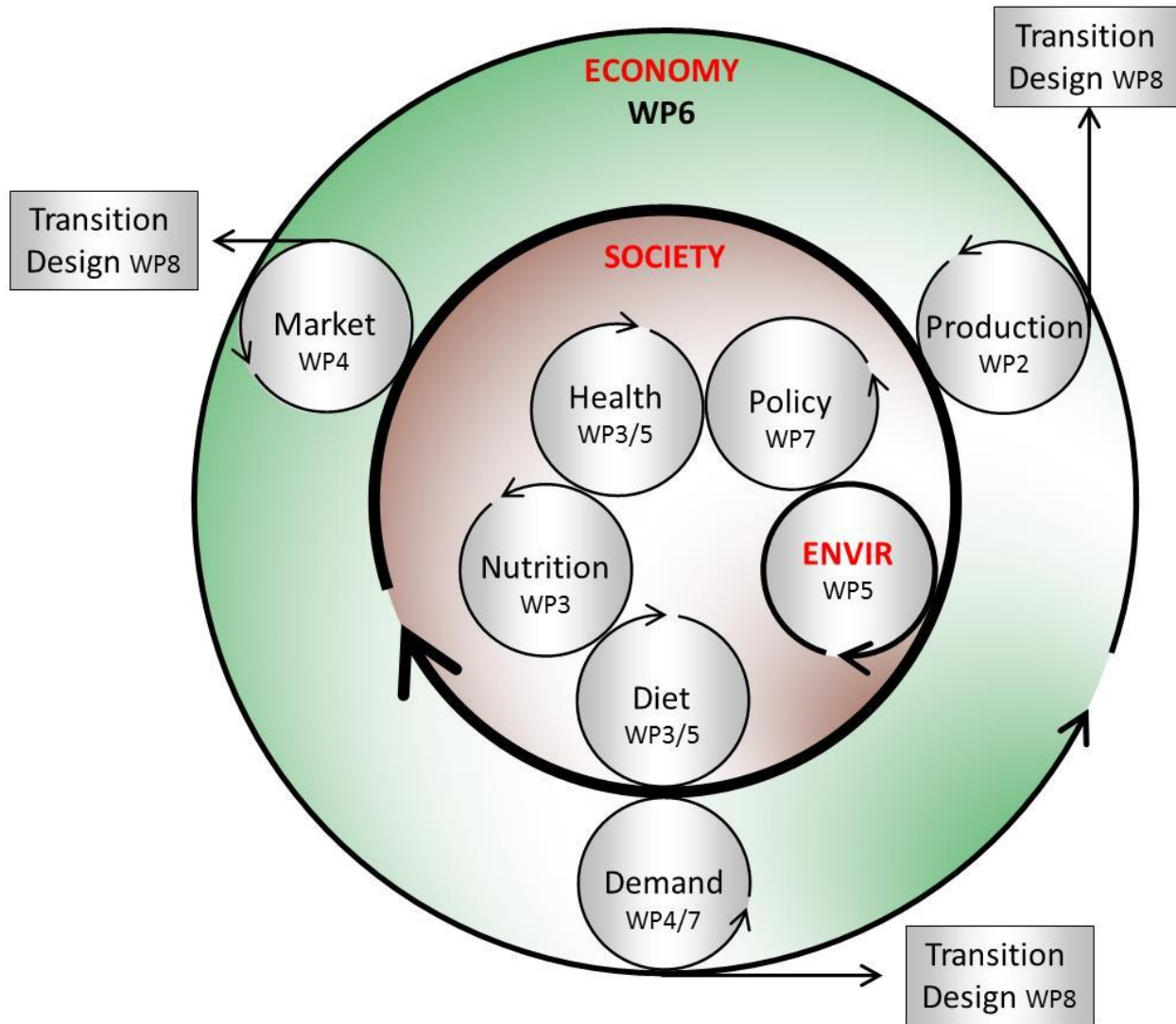


- There are six main players in the global “*seed*” market
- These stakeholders are mainly agrichemical companies
- ***Might this limit positive behavioural change?***



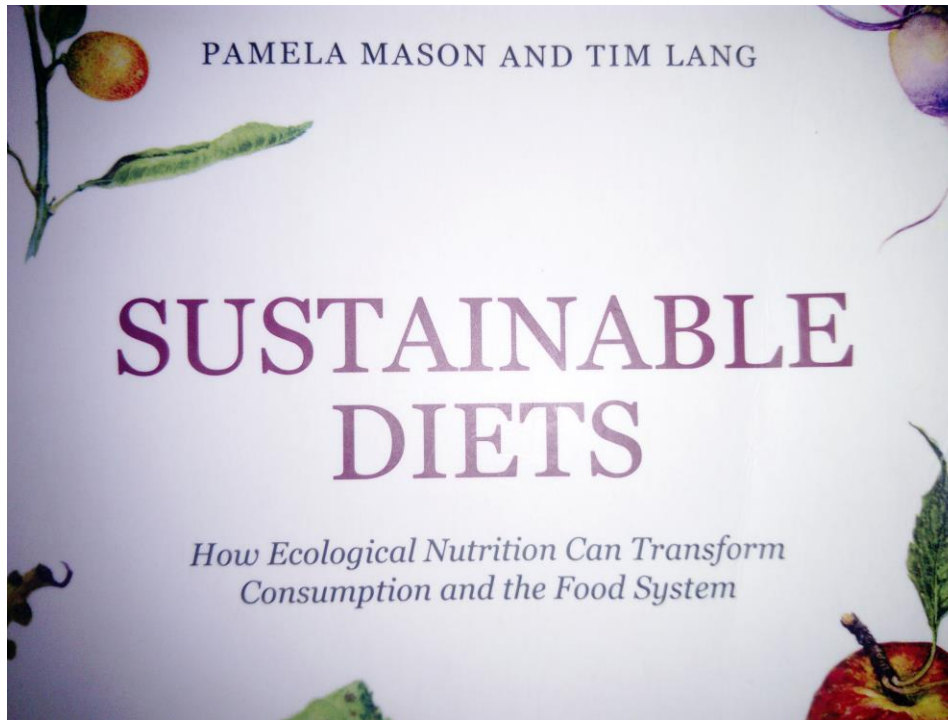


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Sustainable Diets

- The same year that TRUE was funded (2017), and quite independently the book “Sustainable Diets” was published by Pamela Mason & Tim Lang (Earthscan, Routledge)



- The book builds upon concepts of “**Ecological Public Health**”

- The book proposes activity in 6 main focal areas to help realise sustainable food systems:

1. Health
2. Environment
3. Culture & society
4. Food quality
5. Economics
6. Policy

A sustainable diet is one which is good for you, society and the environment

However, this great book is not explicit about the role and potential of legumes: TRUE is.

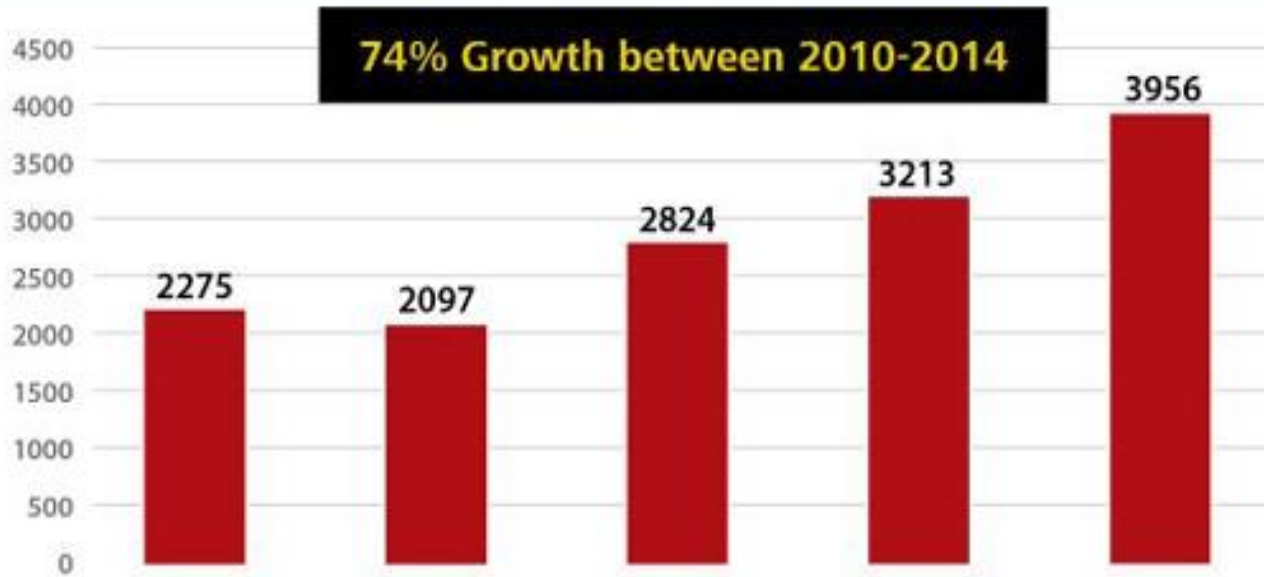




Pulse Ingredient Product Launches



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Top Categories: bakery, meals, snacks, processed fish/meats/egg, soup, dogfood, meal replacements



Source: Innova Market Insights January 2015 (US & Canada)



Which policies would help increase consumption?

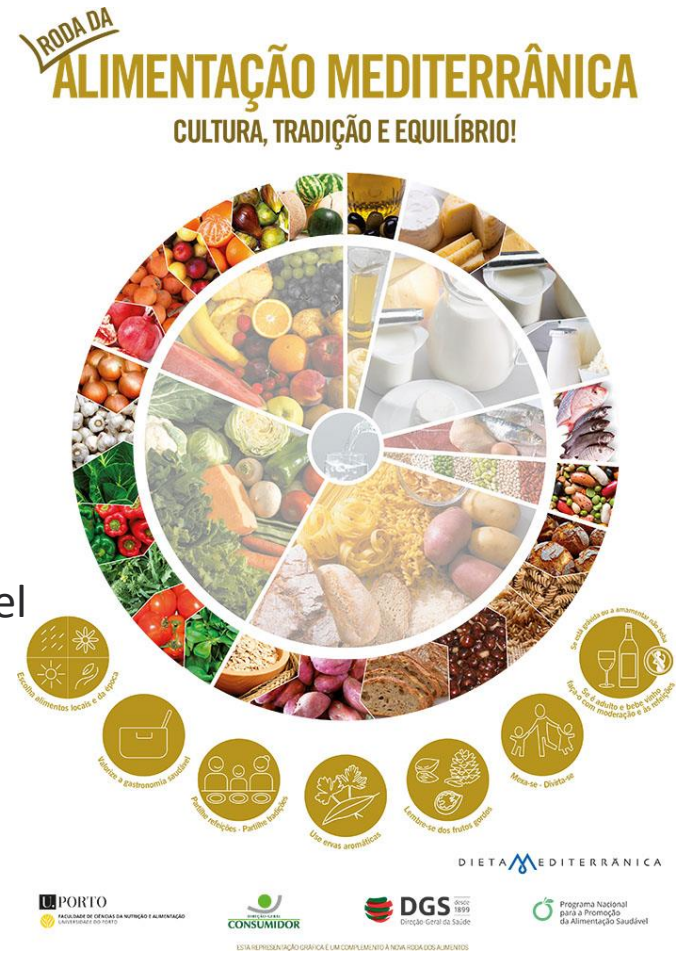


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- **Public procurement:**
 - Schools
 - Local authority canteens

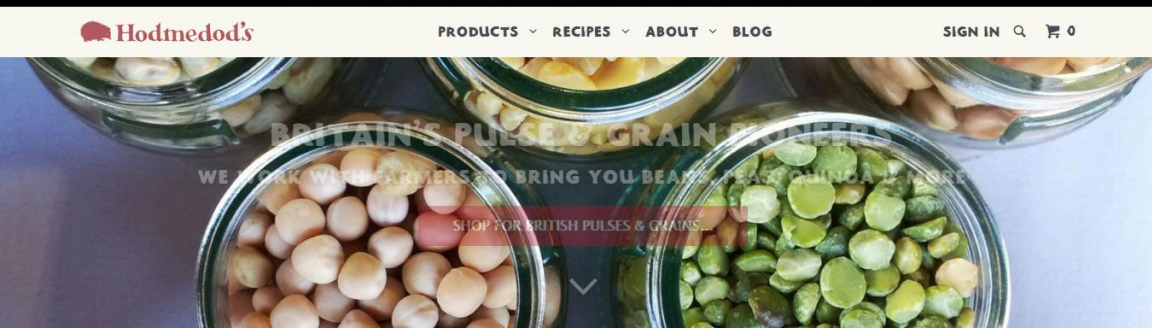
- **Improve capacities for local producers and processors**
 - “CAP” to support local short supply chains

- **At what level?**
 - National policies are too timid
 - Effective policy can be delivered as city/regional level of governance



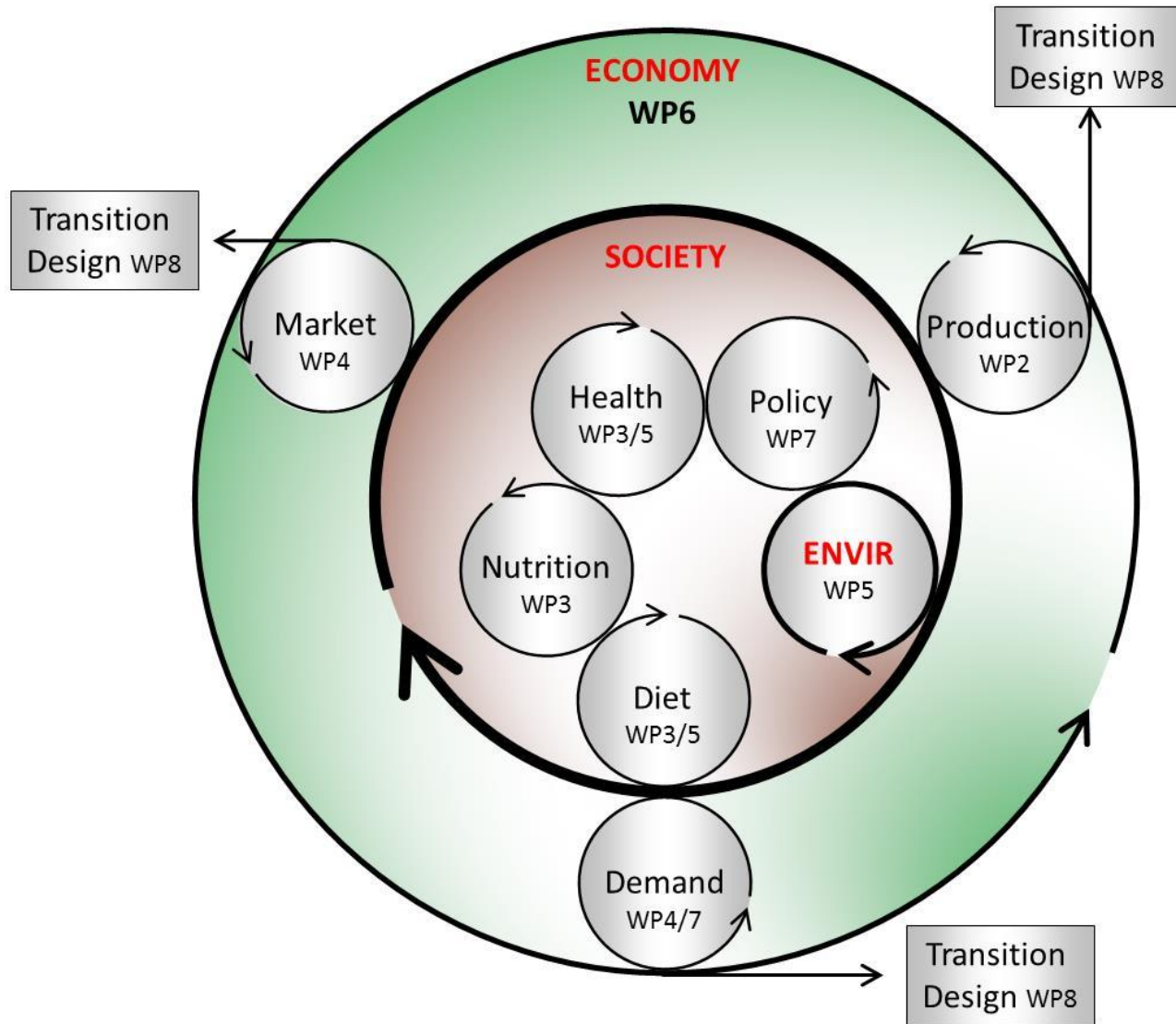
Pulse & Grain Pioneers in UK: high quality, nutritious

FREE UK DELIVERY ON ALL ORDERS OVER £30 - FROM JUST £3.50 FOR SMALLER ORDERS





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FAO-UN Sustainable Development Goals (SDGs): other metrics to monitor food-system sustainability

- 17 SDGs
- 167 *sustainable development indicators (SDIs)*
- ***SDIs for sustainable supported food- and feed-networks remain to be defined***



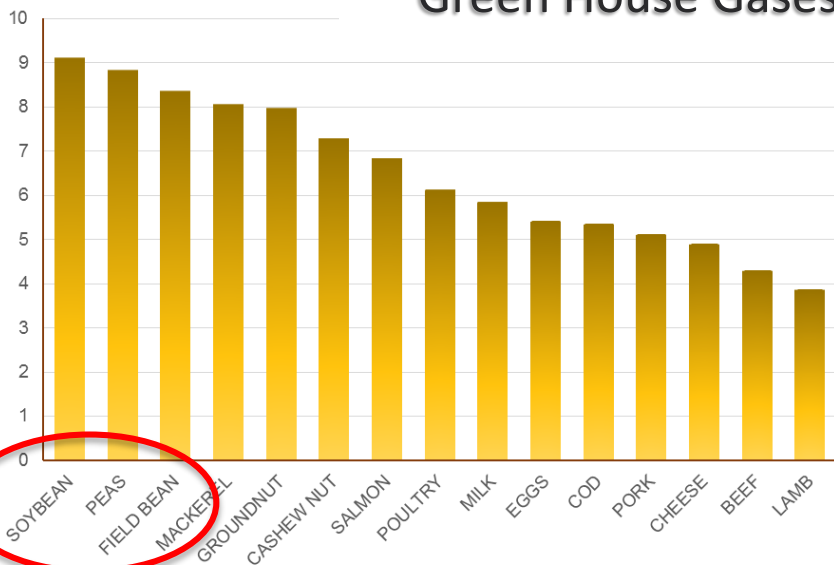
SUSTAINABLE DEVELOPMENT GOALS



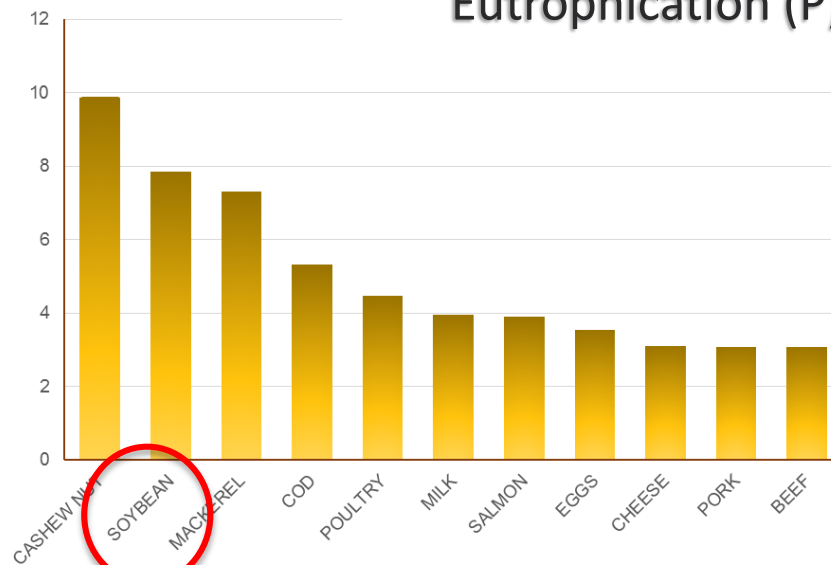
TRUE: new metrics to inform sustainable dietary guidelines (NDEI)

Nutrient density (ND) analysis x environmental impact (E) index (I; standardised by weight) for commodities across their production and processing pathways and (NDEI, standardised LOG 13:3)

Green House Gases



Eutrophication (P)



This approach will be developed: NDEI/ha

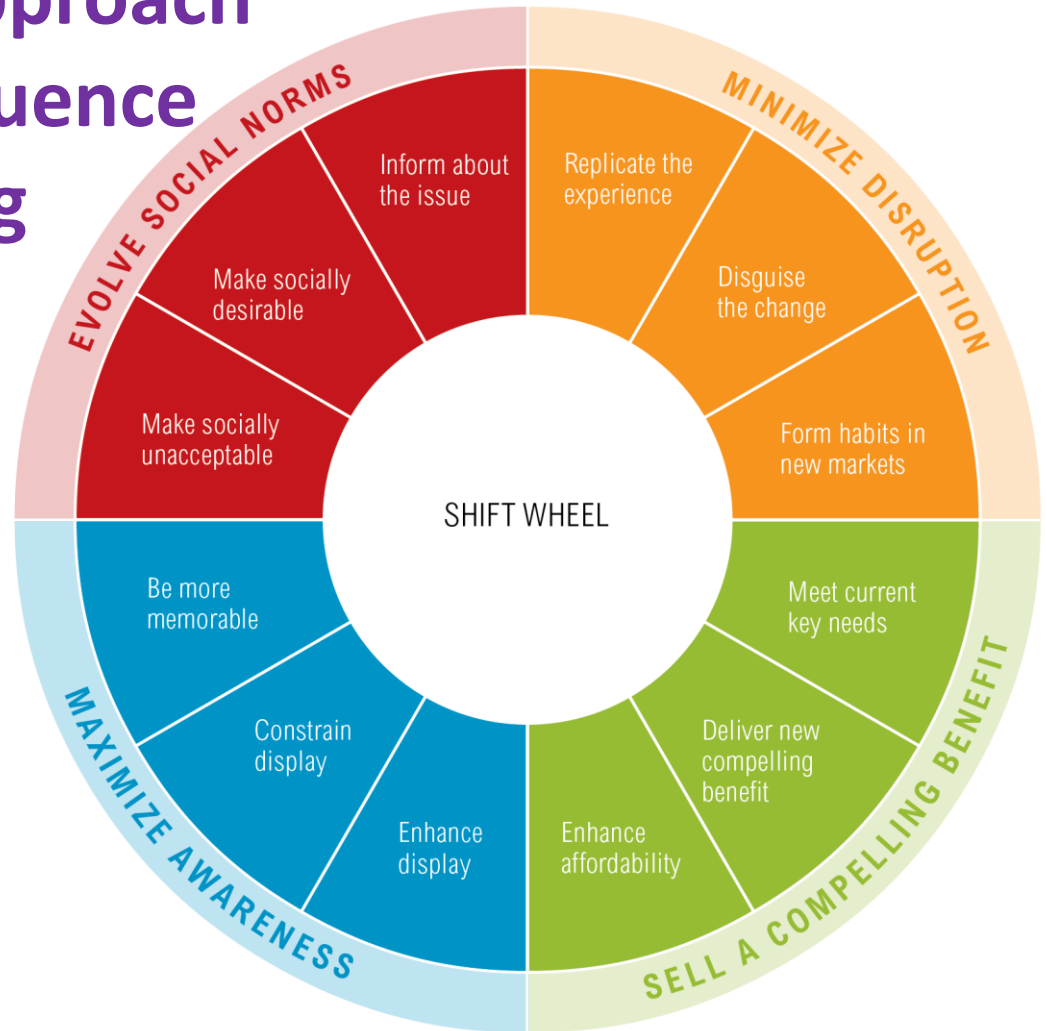


Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



The Shift Wheel: Changing Consumer Purchasing

A multifaceted approach is required to influence food culture along more-positive transitions paths



wri.org/shiftingdiets



WORLD RESOURCES INSTITUTE

What, who and how should we engage to positively influence food-system policy?



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“Pulse Europe”: can you contribute?

- **A science-industry-policy interface**
 - Who should it members be?
 - What will its constitution be?
 - Review evidence base?
 - Report on transitions states towards sustainable diets?
 - Offer synthesis and recommendations on legume exploitation?
 - Ensure transdisciplinary practice coinnovation?
 - Offer recommendations on new governance solutions?
- How and where will it operate to ensure long-lasting and effective legacy?





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Legumes are the cornerstone for our transition to better environment & public health

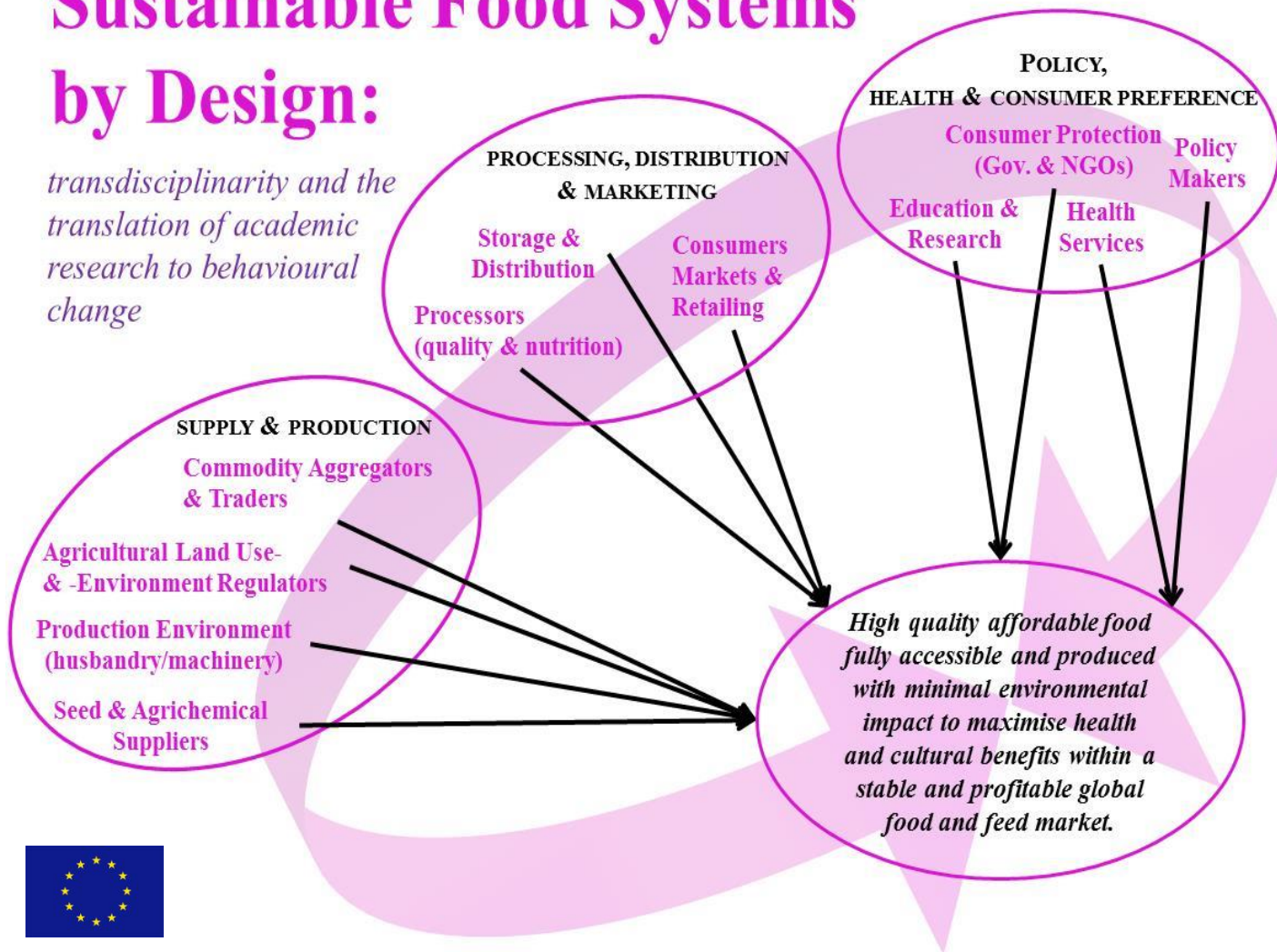
- what may be the most effective policies?
- by what means are they best realised?



A “Research Topic” launched by *Frontiers in Plant Science (Plant Nutrition)*

Sustainable Food Systems by Design:

*transdisciplinarity and the
translation of academic
research to behavioural
change*





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