A new perspective on Water-Energy-Food Systems, in support of Sustainable Development Goal 2.

MAGIC Webshop for the EEA, 2nd June 2020

- Welcome to the webinar! We will start at 14:15 CEST.
- All participants are muted on entry. However, ensure your audio system is connected, (VOIP or phone), so you can hear us, and to allow discussion later. Connecting your video is optional but can aid the later discussion.

- Use the **Q&A function** to note any questions or topics to discuss later. Once the discussion starts, you can also ask verbally.

- For any problems – e.g. connections, difficulty in hearing speakers – write to the host Kerry Waylen using the **chat function.**
- Most options can be found by hovering your mouse over the bottom of the page (depending on how you connected). A guide to webex is at www.hutton.ac.uk/about/facilities/conferencing/webex

The James Hutton Institute

MAGIC NEXUS

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689669.

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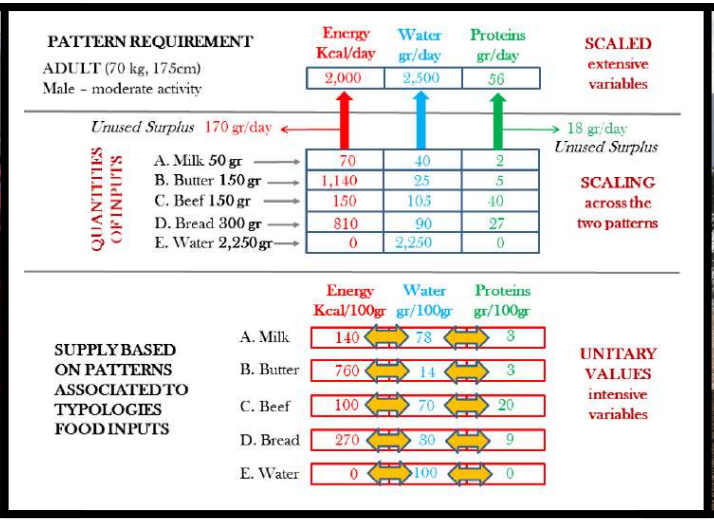

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Agenda for today's webshop

14:00 – 14:30	**Introduction to the MAGIC Approach** Introduction to ourselves and MAGIC project Introduction to Quantitative Story Telling and Societal Metabolism approach
14:30 – 15:00	**A perspective on SDG2** Analysing agricultural sustainability in terms of environmental flows within EU Analysing agricultural sustainability in terms of consequences beyond the EU Considering nutrition, food security & hunger
15:00 – 15:00	**Discussion** Queries and discussion on method and its application to SDG2 Implications for understanding and governing agri-food systems

Note

- Recording webinar – happy to share with participants (won't be made public).
- Notes on discussion will inform our research outputs.

The James Hutton Institute

www.hutton.ac.uk

- Research to understand and tackle global issues related to food and environmental security.
- Interdisciplinary ethos – ecologists, hydrologists, biochemists, data scientists, agronomists, sociologists, geographers, economists…
- Based in Scotland, with 2 main bases in Aberdeen and Dundee, with more than 500 staff.
- One of the Scottish Government's main research providers in environmental, crop and food sciences, also several H2020 projects.

Keith

Kerry

Kirsty

Alba

Alice

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Purpose of Webshop

- **Why we are interested in discussing this with you:**

Understand how MAGIC's approach might be useful to your work

Help us with implications and language to use in our final report

- **What to expect:**

Not a conventional webinar

Discuss approaches to tame complexity & illustrate problems

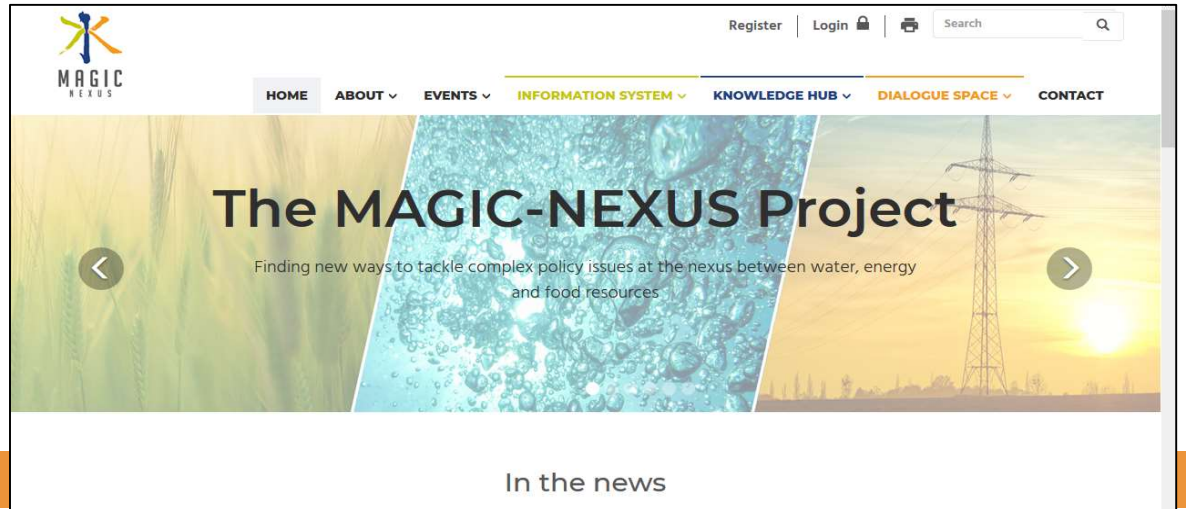
Welcome robust discussion and constructive suggestions

Introducing MAGIC

- H2020 project “Moving Towards Adaptive Governance in Complexity: Informing Nexus Security” 2016-2020, www.magic-nexus.eu

- A Nexus Cluster project (water-energy-food systems)
  - Also analyses of circular economy, energy and innovations

- Objectives: “Increased understanding of how water management, food and biodiversity EU policies are linked together, and to climate and sustainability goals”.



Why Adaptive Governance in Complexity?

Appreciate that problems – and responses – are part of complex socio-ecological systems

Policy coherence key to sustainable development[1]
- e.g. agriculture underpins SDG2, also 13, 15,etc…

Resulting challenges
- Need to assess implications of any policy across multiple domains
- Need consistency - approaches that can operationalise sustainability assessment for a variety of systems
- Need to reflect on assumptions or implicit framings (e.g. efficiency as a solution)

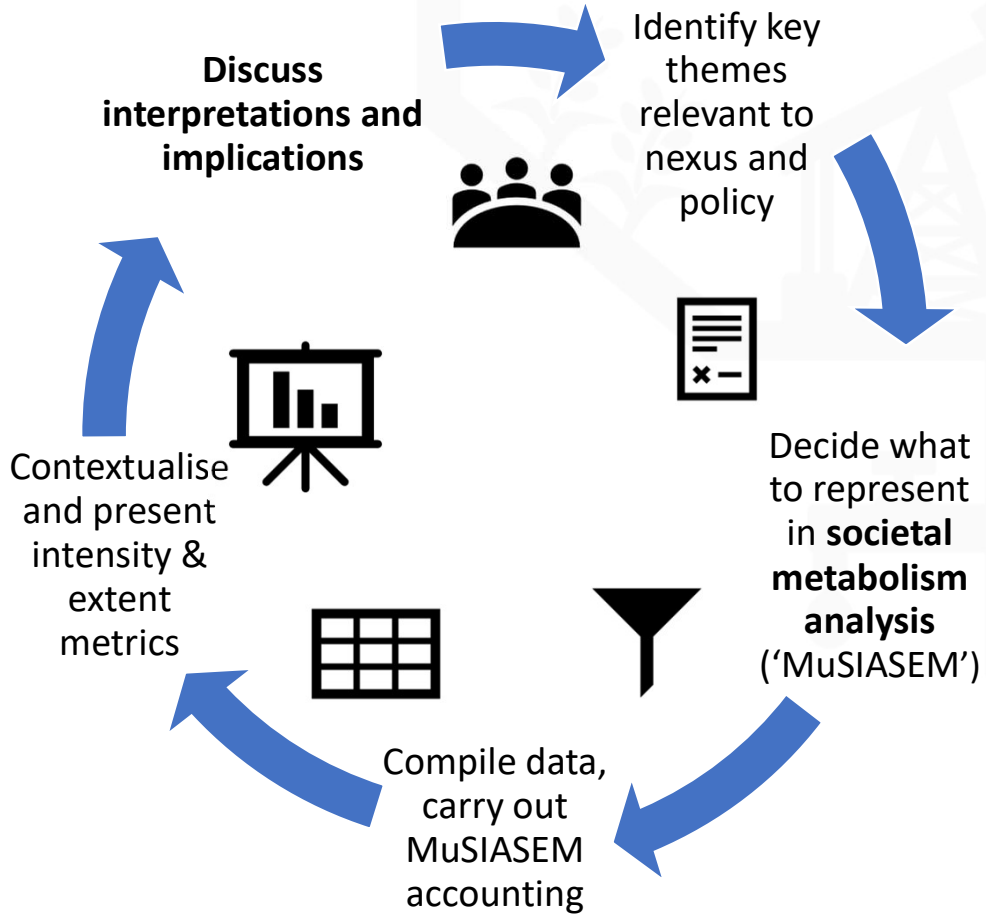
Must avoid resorting to partial views or "useful fictions"[2] in order to cope with "overwhelming systems"[3]

1. European Commission (2019). SWD(2019) 20 final. Commission staff working document. *2019 EU report on Policy Coherence for Development*. https://ec.europa.eu/europeaid/sites/devco/files/swd_2019_20_pcdreport.pdf
2. *Thinking fast and slow.* D. Kahneman (2011), Penguin
3. *Wickedness and the anatomy of complexity*. C. Andersson & P. Tornberg (2018), Futures, 95, 117-138

Using metrics to tell stories about policies

MAGIC responds to policy-relevant themes, claims and issues*

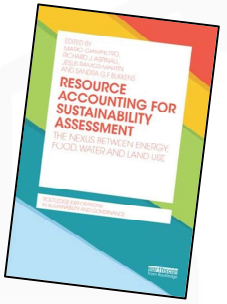
SDG2 focus reflects prior analysis and interaction with policy stakeholders



*This is what we call '**Quantitative Story Telling**' – the overall transdisciplinary process of deciding who to work with, how to focus application of MuSIASEM and with whom to discuss the implications. See https://magic-nexus.eu/content/what-quantitative-story-telling for more information

“MuSIASEM”

The specific accounting framework used in MAGIC is MuSIASEM “Multi-scale Integrated Analysis of Societal and Ecosystem Metabolism”



More information:

- 2-page briefing on MuSIASEM– see http://magic-nexus.eu/sites/default/files/files_documents_repository/societal-metabolism-via-musiasem_0.pdf
- Giampietro, M., Aspinall, R.J., Ramos-Martin, J., Bukkens, S., 2014. *Resource Accounting for Sustainability Assessment: The Nexus between Energy, Food, Water and Land use.* Routledge https://www.routledge.com/Resource-Accounting-for-Sustainability-Assessment-The-Nexus-between-Energy/Giampietro-Aspinall-Ramos-Martin-Bukkens/p/book/9780415720595

Why use Societal Metabolism accounting?

- Builds holistic view
  - Connects across topics, dis… lin… … without reducing different insights to com…
  - Recognise both biophysica… …l limits
  - Move across scales – local to …, …t losing interconnections
  - Look across systems – production, supply, consumption, without losing interconnections

Difference to other approaches

- Insights
  - Characterise "Metabolic patterns" of society and systems – help flag where societal processes may be unsustainable in long-term
  - Compare different aspects of system – geographically *(e.g. regions)* or functionally *(e.g. different farm types)*

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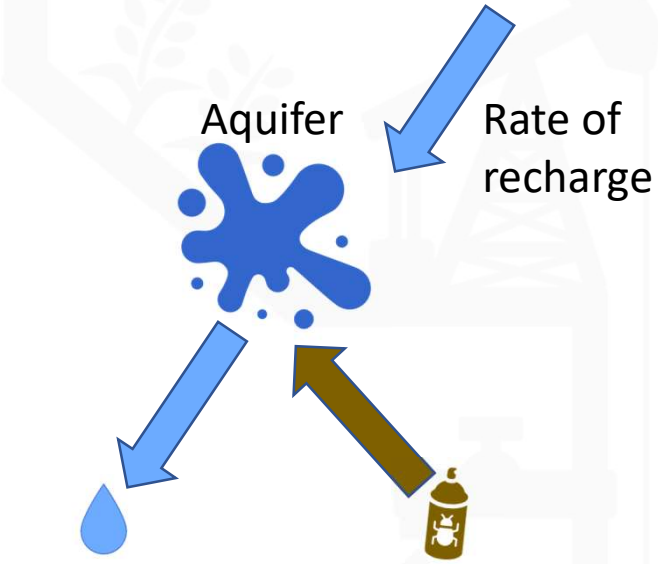
“Funds & Flows” key to Societal Metabolism

Funds

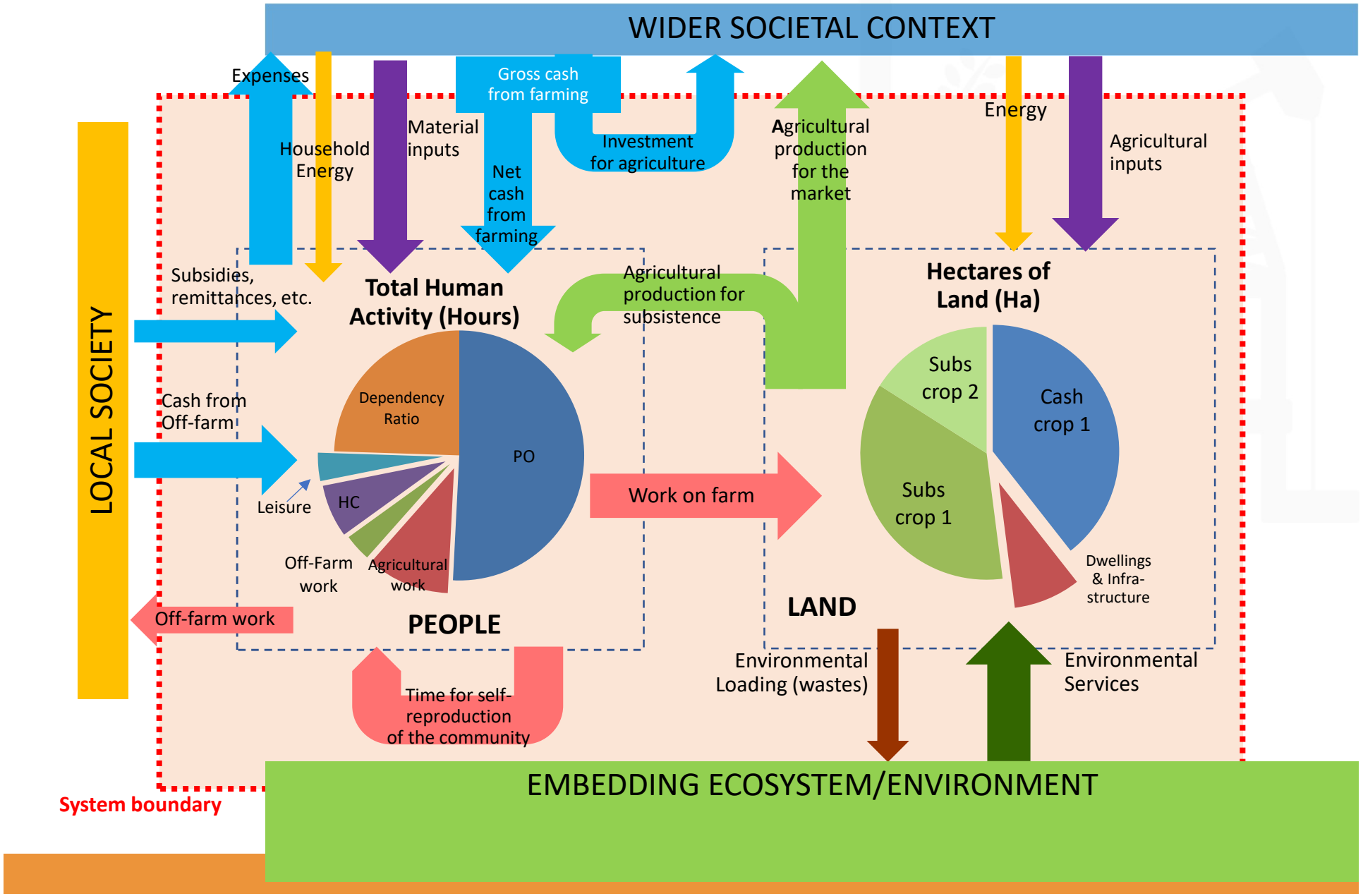
- Remain within the system (define its identity, need to be maintained)
- Examples – from environment and society
  - Land
  - People’s time
  - Infrastructures
- Special case of funds when non-renewable – **Stocks**

Flows

- Resources entering or leaving system
- Examples – from environment and society
  - Nutrients
  - Energy carriers
  - Money
- Special case of flows when lacking utility – **Wastes** (account for to check circularity)



“Simple” example of societal metabolism…



Metrics used to consider SDG2

- Extent
  Absolute size of fund or flow (physical or financial)
  e.g. area of land used to produce tomatoes
- Intensity
  Rate of flow /fund (per area, per capita, per hour, per €)
  e.g. rate of water extraction per hectare of land used for tomato growing

Must consider individually and together

- Problem that matter: both 'concentration' (i.e. local soil contamination) and 'magnitude' (i.e. low-level but widescale GHG emissions)
- Checks on potential solutions: i.e. Improved efficiency may not lead to an overall decrease in resource use*

*Polimeni, J.M., Mayumi, K., Giampietro, M., 2010. *Jevons' Paradox and the Myth of Resource Efficiency Improvements*. Earthscan Publications Ltd.

Attention to system openness for SDG2

Only possible to understand system sustainability by also considering the resources crossing a system boundary

- Dependencies have implications for food, energy and water security
- Imports – flows in
  - Kinds of imports – livestock feed
  - Virtual land, water, GHG emissions etc.
- Exports – flows out
  - Exported agricultural goods
  - Pollution and wastes

We can strengthen understanding of consequences beyond a system (e.g. externalisation beyond EU) by analogy

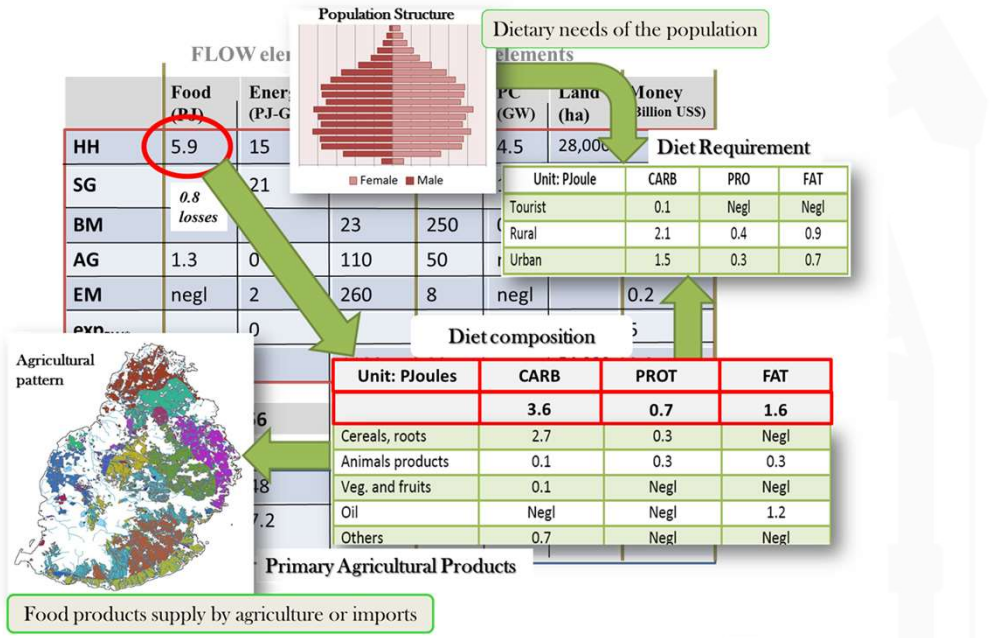
- if we were to re-internalise current inputs
  e.g. if EU were to grow all its own livestock feed
- this doesn't tell us the actual impacts
  Challenge - hard to precisely quantify

Type of insights we will present

Metrics organised into technical matrices – coherent and consistent way to organise.

Allows us to debate

- Biophysically feasible?
- Technologically and economically viable?
- Desirable?



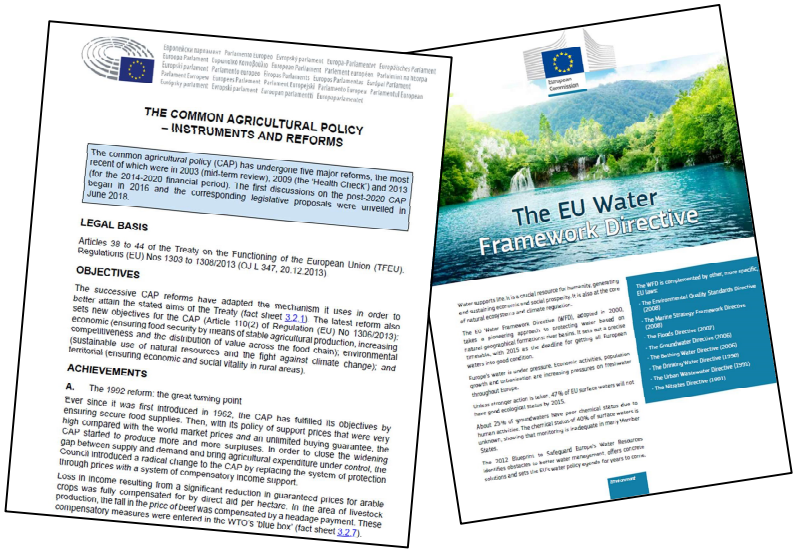
Lots of visual options - but try to highlight both intensity and extent metrics.

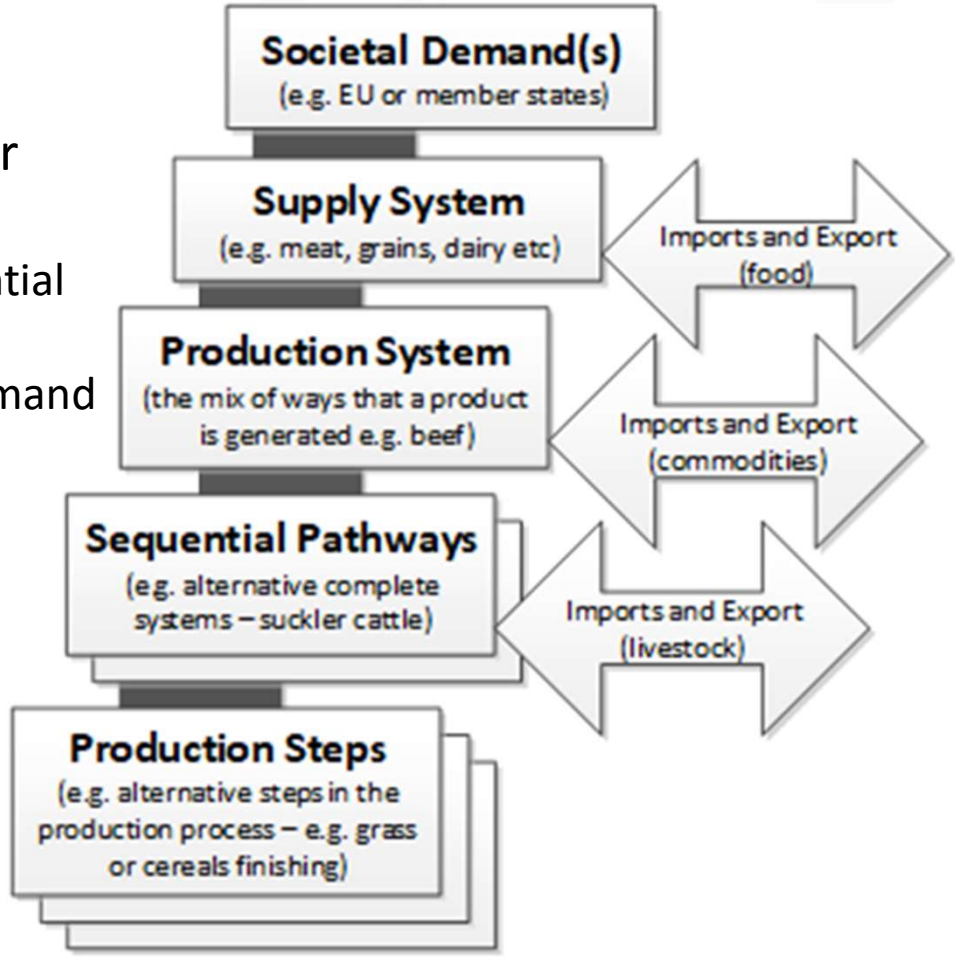
Need contextualisation to understand how pressures create impacts in different settings.

e.g. Maximum sustainable rate of water extraction depends on particular aquifer

SDG2 requires looking across systems

- Focus on different levels has implications for analysis
- Potential interventions ALSO differ e.g. current agri-food policies
  - CAP & WFD mostly relate to sequential pathways & production systems.
  - No EU policy relating to societal demand (food policy?)





Summary of the approach used

Quantitative Story Telling

- Helps co-construct issues and interpret it with those working on sustainability policy

Societal Metabolism Accounting via MuSIASEM

- Helps understand metabolism of societal processes, and interconnections between systems.
- Can be used to understand sustainability of current systems and to consider 'what if' questions
- Value depends on how its application is focused & framed

More information on methodology & examples

- Examples of applications across a range of policy domains in the MAGIC document repository including policy case studies

Questions for clarification?

A new perspective on SDG2 via Societal Metabolism Analysis

K.B. Matthews[a], K.L. Blackstock[a], K.A. Waylen[a], A. Juárez-Bourke[a], D.G. Miller[a], D. Wardell-Johnson[a], M. Rivington[a], A. Renner[b], J. Cadillo, M. Ripa[b] and M. Giampietro[b,c]

[a] The James Hutton Institute, Aberdeen, Scotland, [b] Institut de Ciència i Tecnologia Ambientals, Universitat Autonoma de Barcelona, Catalunya, [c]Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Catalunya

SUSTAINABLE DEVELOPMENT GOAL 2

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- Shared policy ambitions – EU and SDGs
- CAP post 2020 objectives link to many SDGs
- Not only about CAP – other policies goals' and instruments
  - Water Framework, Natura 2000
  - Energy, Circular Economy, Climate Change
- The SDGs need coherent approaches to consumption as well as production – a systemic agri-food policy
  - Forthcoming Farm to Fork Strategy
- Interactions between policy objectives, implementation and outcomes increasingly complex

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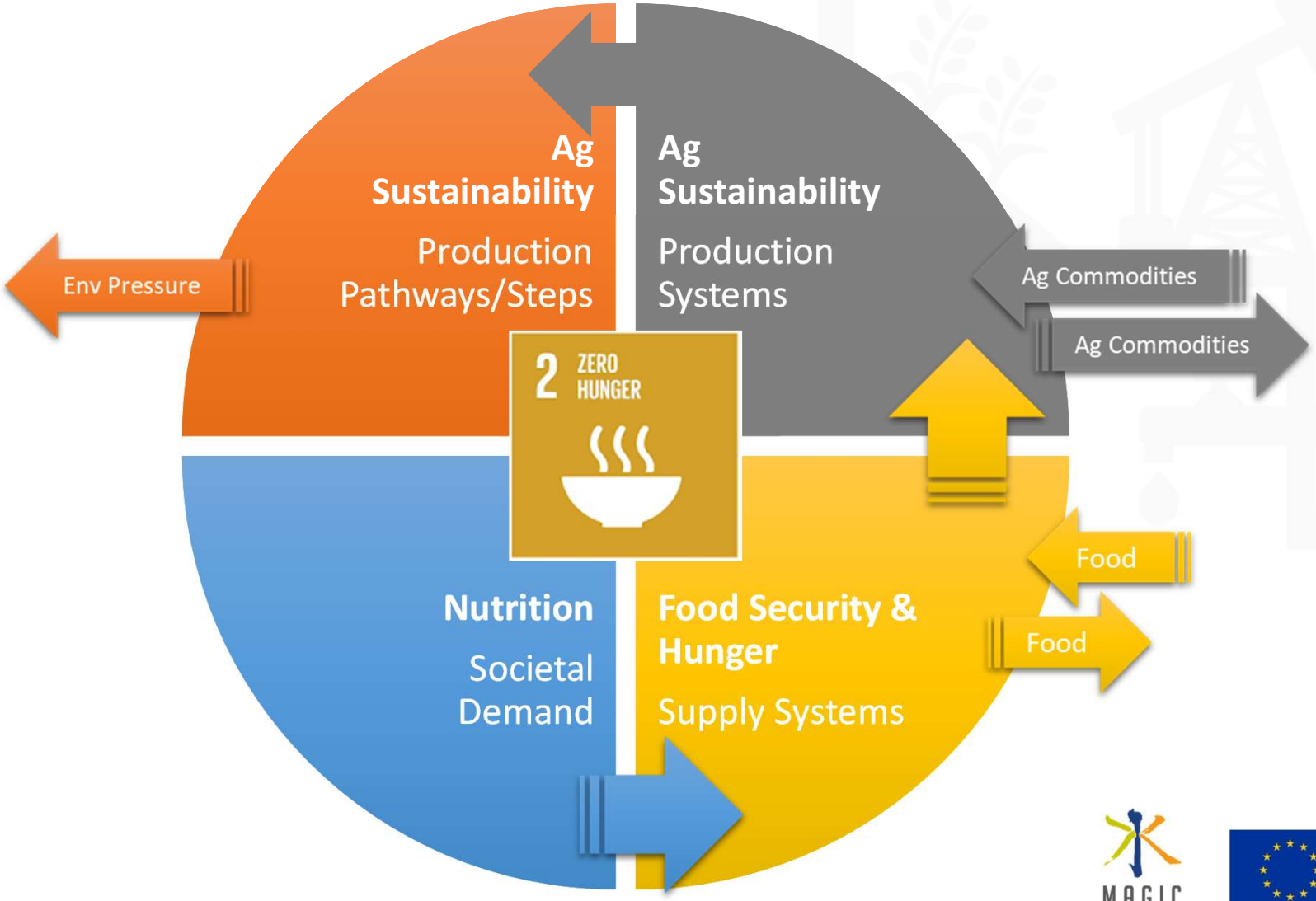
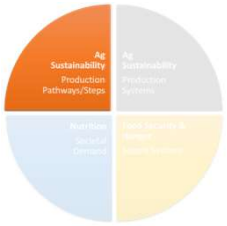
SDG2 and Societal Metabolism Analysis



SDG2 – Overview of results slides



- How data shapes the analysis
- Pressures and impacts on European environment associated with agricultural production pathways.
  - Soils, Waters & Biodiversity
- Pressures and impacts associated with imported inputs and commodities (e.g. soya feed) supporting Europe's agriculture
- Supply systems
  - Embodied Energy
  - Social Consequences
- Nutrition
  - Connecting commodities and diets

How data shapes the analysis

- Exploitation of data from Farm Accounts Data Network (FADN)
  - detailed variables (4800+)
  - survey
  - physical quantities and €-based **Steps/Pathways ➲**
  - Farm Types (FT 14) as **Production Systems**
    - Mix of activities – flows
    - Mix of land, labour, capital – funds
  - FT and Regions (FADN) combined
    - Mix of sequential pathways/steps
  - Limits on completeness and time series – 2013 “discontinuity”

Barley Total area under production	in ha
Barley Production	in tonnes
Barley Sales quantity	in tonnes
Barley Total output	in EUR
Barley Farm consumption	in EUR
Barley Farm use	in EUR
Barley Sales value	in EUR
Barley Opening value	in EUR
Barley Closing value	in EUR

Barley GMO	in ha
Barley. Irrigated crop total area under production	in ha
Barley Energy crop total area under production	in ha

Characterising systems and their pressures

														Extent	Intensity	
Member State	Farms No. (000')	UAA (ha)	Time (000' h)	Arable %	Pasture %	Live-stock Nos.	Stocking Rate LU/ha	N kg/ha	P kg/ha	CProt €/ha	Energy €/ha	Mach €/hr	All Subs (€ '000)	All Subs €/ha	All Subs €/h
Austria	143	34	3.8	69%	26%	28	0.8	54	14	81	155	23	20	593	5
Belgium	58	50	5.1	61%	36%	139	2.8	110	11	187	268	16	20	408	4
Bulgaria	126	52	6.7	83%	11%	59	1.1	77	14	67	138	7	20	381	3
Croatia	162	16	3.3	49%	42%	11	0.7	55	24	64	102	12	8	478	2
Cyprus	21	10	2.9	83%	1%	5	0.5	58	35	105	272	19	5	555	2
Czech Republic	35	155	12.1	71%	26%	154	1.0	89	18	98	209	9	84	546	7
Denmark	57	91	4.8	90%	7%	136	1.5	84	31	117	242	37	34	371	7
Estonia	15	96	4.2	68%	29%	65	0.7	43	12	26	109	16	24	253	6
Finland	73	64	3.3	92%	8%	42	0.7	55	8	31	395	26	61	964	18
France	603	87	3.6	67%	30%	74	0.9	85	18	111	128	20	32	365	9
Germany	375	170	7.3	77%	23%	117	0.7	99	16	98	184	26	68	398	9
Greece	687	10	2.6	59%	21%	6	0.6	79	34	110	226	8	7	652	3
Hungary	205	43	4.3	75%	19%	29	0.7	67	22	92	182	9	19	455	5
Ireland	173	58	2.5	29%	71%	58	1.0	102	12	62	70	18	21	363	8
Italy	1,065	23	3.3	59%	29%	43	1.9	47	26	84	223	6	9	400	3
Latvia	49	56	3.2	68%	29%	14	0.2	49	19	37	85	8	14	259	4
Lithuania	122	42	4.1	74%	21%	37	0.9	76	24	44	100	9	10	241	2
Luxembourg	3	74	3.9	49%	49%	87	1.2	107	8	79	114	43	47	636	12
Malta	6	3	3.4	90%	0%	35	12.1	30	5	162	1596	11	4	1,489	1
Netherlands	99	33	5.8	65%	31%	135	4.1	103	7	333	622	24	15	452	3
Poland	1,477	20	4.0	77%	18%	21	1.1	94	33	66	179	7	6	310	2
Portugal	191	26	3.0	45%	35%	11	0.4	25	13	68	100	5	9	346	3
Romania	2,268	10	3.3	83%	11%	11	1.1	80	50	62	144	3	3	281	1
Slovakia	7	551	24.8	64%	36%	159	0.3	56	12	66	123	8	182	330	7
Slovenia	87	10	2.2	43%	45%	13	1.4	49	19	76	280	13	8	882	4
Spain	837	54	3.7	45%	39%	61	1.1	31	18	53	106	5	14	265	4
Sweden	56	115	4.2	88%	12%	131	1.1	65	18	52	213	47	50	436	12
United Kingdom	195	142	8.1	43%	56%	160	1.1	79	17	81	140	17	35	248	4
Grand Total	**9,195**	**63**	**4.4**	**66%**	**30%**	**61**	**1.0**	**75**	**18**	**87**	**163**	**14**	**24**	**375**	**5**

Legend - Individual lines are average businesses, Farm nos. are the number of businesses represented, UAA is the utilised agricultural area, N is nitrogen fertiliser, P is phosphorous fertiliser, Cprot is crop protection, Mach is machinery, Subs are subsidies.

Sectoral comparisons

- Highlight contrasts in the mix of Production Systems
  - Balance of labour and machinery
  - Balance of inputs (and outputs)
  - Mix of land uses – diversity vs. specialisation
  - Extents of pathways – geographic, production
  - Intensity of pathways – per ha or per kg of product

- Farmtypes ⇨ Member States ⇨ Regions (FADN) ⇨ ...
  - Comparisons of Production Systems, Pathways or Steps used at progressively finer levels of detail
  - Balance of level of detail against the breadth of view

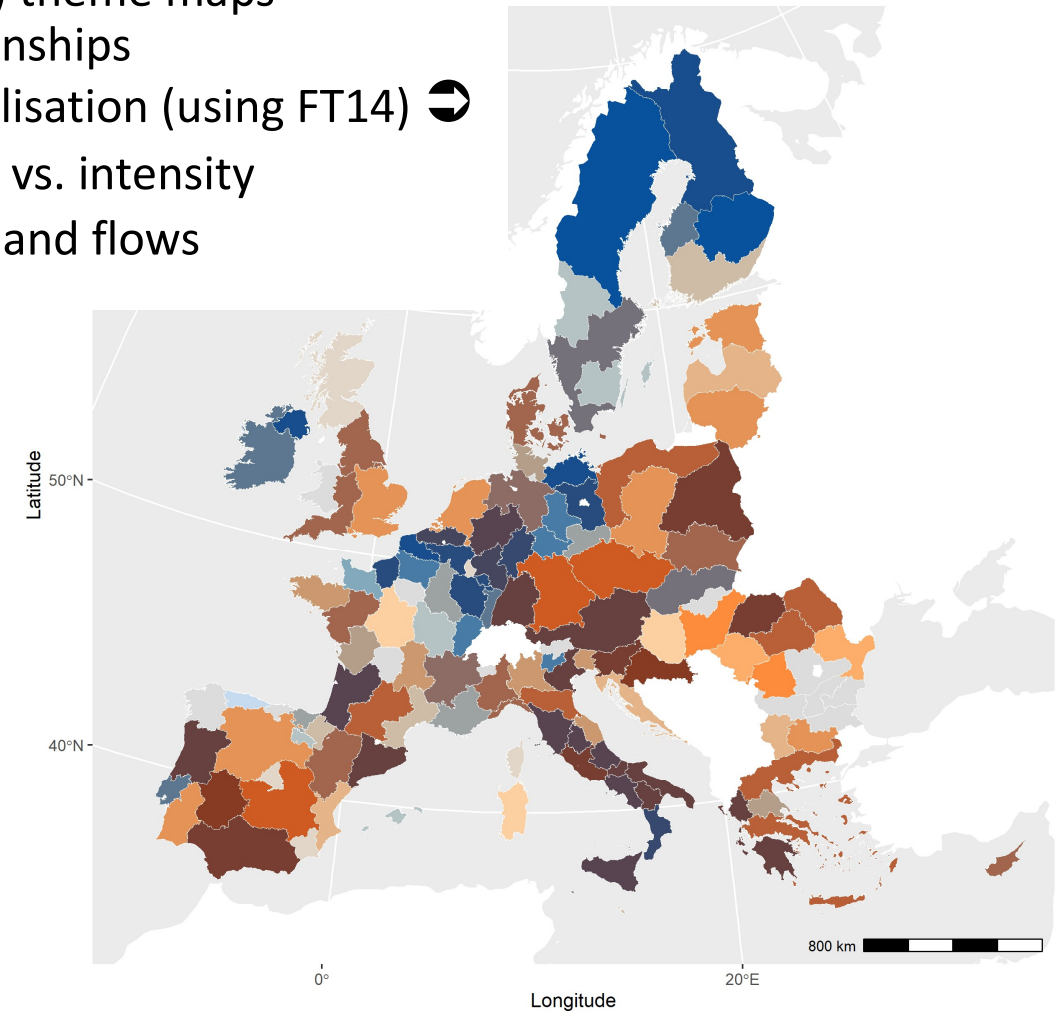
- Working with mixes – necessary but remains challenging

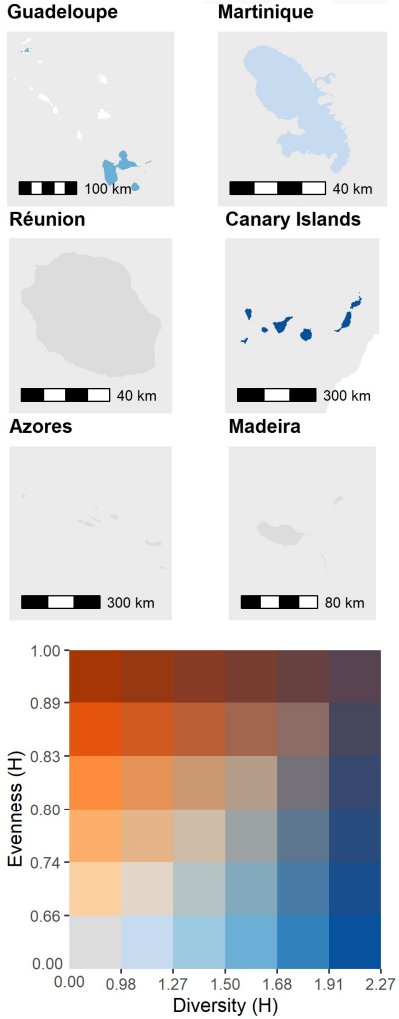
Geographical Analysis

- Concern with Impacts on the Biosphere
- Member State ⇨ Region (FADN) ⇨ Farmtype Mix ⇨ Farmtype
  - How pressures get translated into consequences for biosphere
  - How to operate at region/landscape scale
  - Issues of attribution, causality, uncertainty etc – but still need to make policy
- Discuss pressures arising from mix of Farmtypes
  - Trade-offs and their long term viability
  - Discussion through a boundary object
  - Experimental…
- Adding geography into the social metabolism analysis

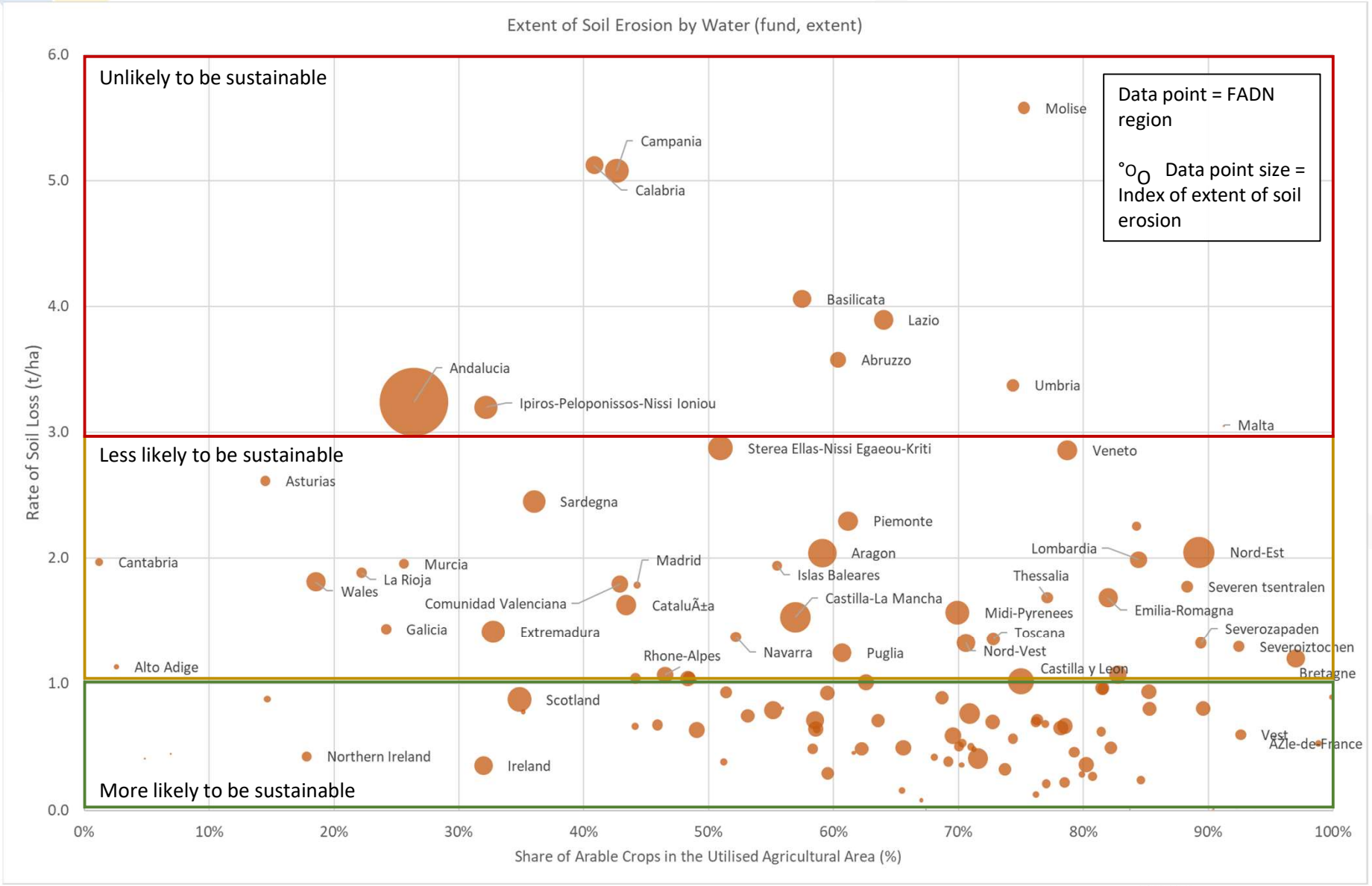
Geographical representations of SMA

- Experimenting
  - 2 (& 3) theme maps – relationships
    Specialisation (using FT14) ➲
  - Extent vs. intensity
  - Funds and flows

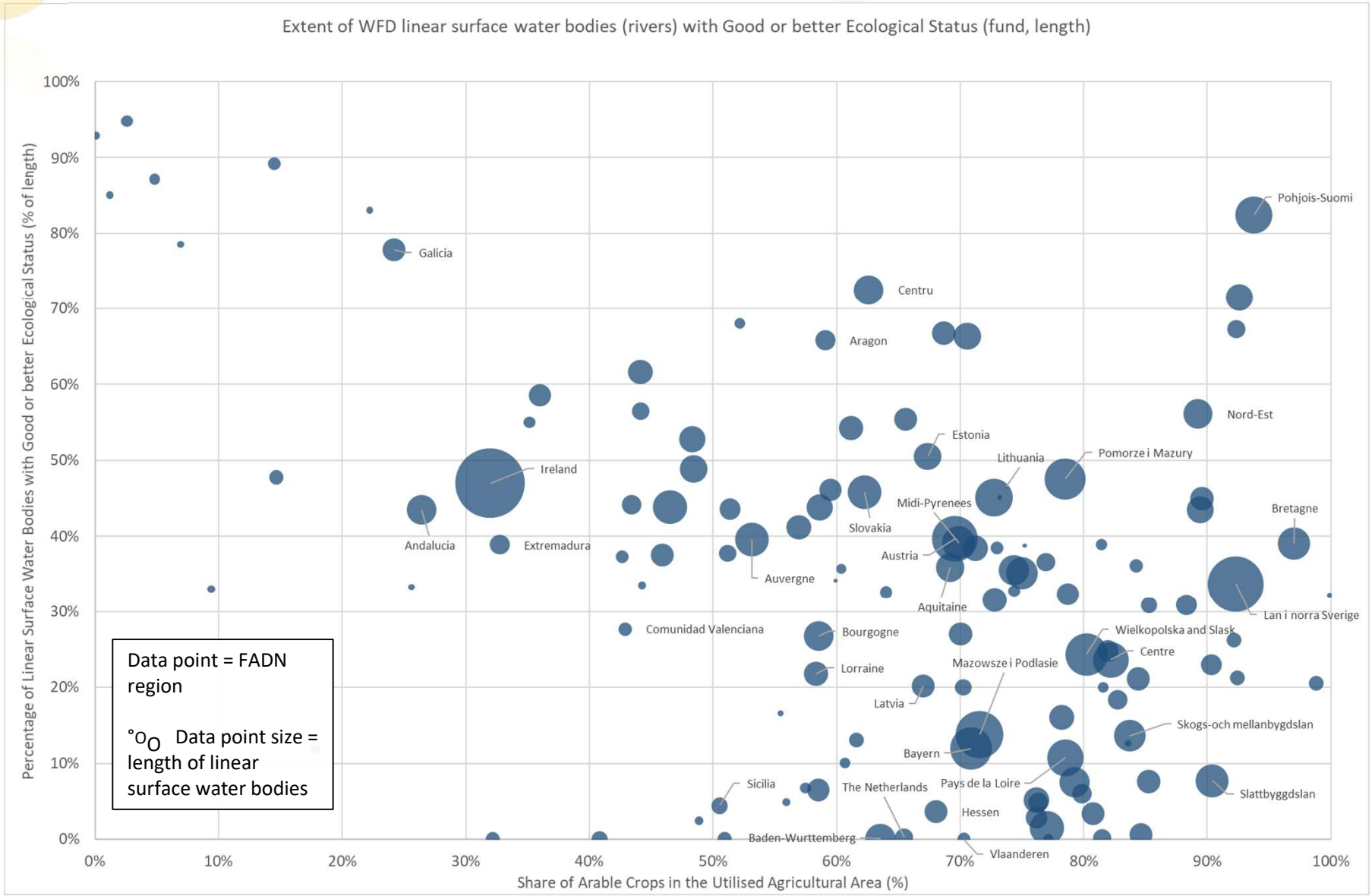




Environmental pressure and soils



Environmental pressures and rivers



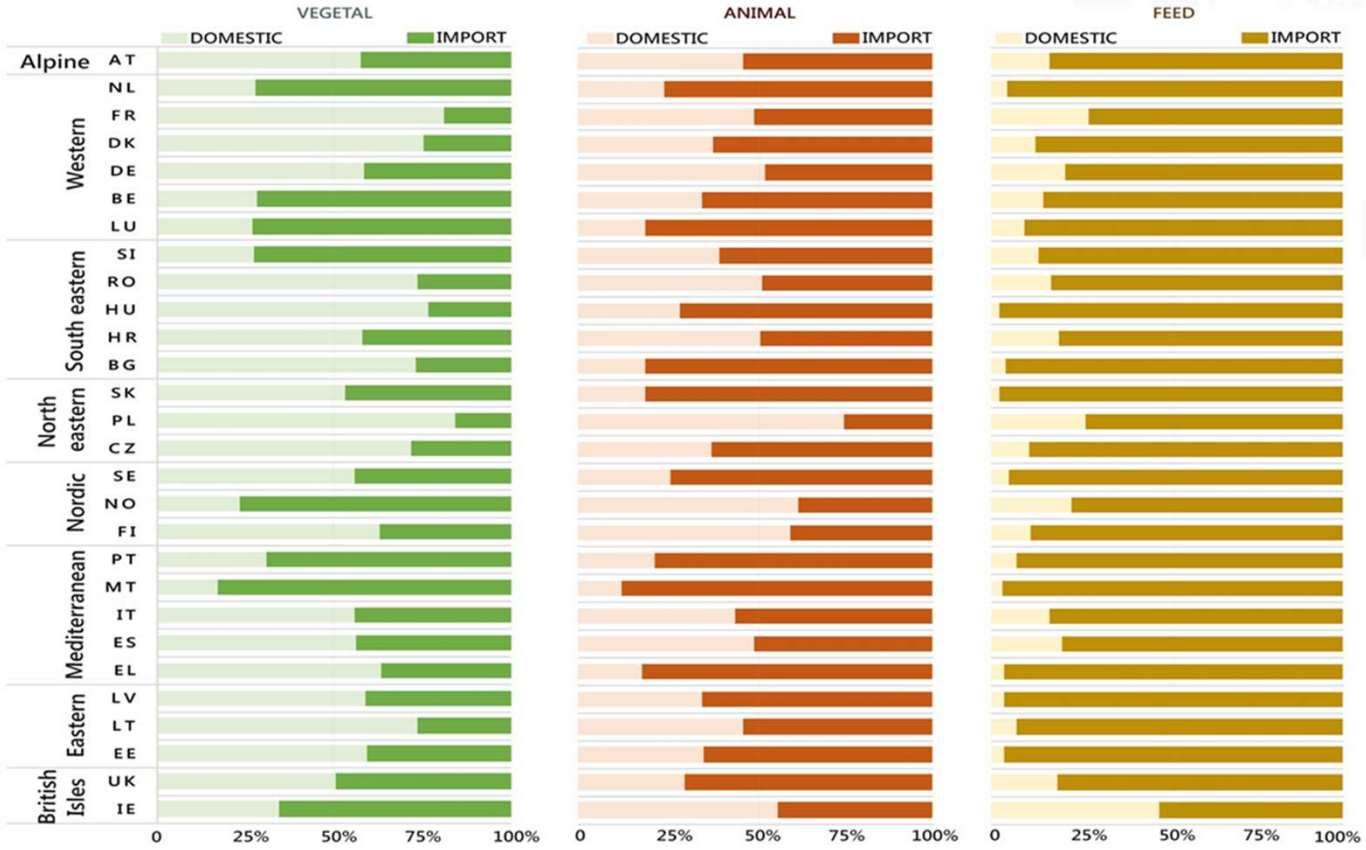
Water – final users and uses

- Balance of use between and within regions
- Contrasts in the nature of the water being used (amount and ratios)
- Greater dependence of some systems on blue water
- Not feasible to undertake activities in some regions without the embodied water in feeds

Water Use (cubic metres)	Green Water (all)	Green Water (local Agric)	Green Water (imported feed)	Blue Water (all)	Blue Water (local Agric)	Blue Water (imported feed)
(BEL) Belgium	**27,772,665**	**9,253,478**	**18,519,188**	**1,909,651**	**472,318**	**1,437,332**
(0341) Vlaanderen	**15,732,566**	**5,424,953**	**10,307,613**	**1,079,849**	**278,432**	**801,417**
(15) Specialist COP	-	-	-	-	-	-
(16) Specialist other fieldcrops	2,887,706	2,447,226	440,480	134,836	100,616	34,220
(20) Specialist horticulture	157,748	104,037	53,711	14,905	10,735	4,171
(36) Specialist orchards - fruits	392,907	392,907	-	25,567	25,567	-
(38) Permanent crops combined	-	-	-	-	-	-
(45) Specialist milk	2,976,743	214,645	2,762,098	226,165	11,690	214,475
(48) Specialist sheep and goats	-	-	-	-	-	-
(49) Specialist cattle	2,551,641	169,233	2,382,408	196,817	11,821	184,996
(50) Specialist granivores	706,157	325,270	380,887	59,019	28,807	30,211
(60) Mixed crops	-	-	-	-	-	-
(70) Mixed livestock	2,845,015	555,139	2,289,876	204,292	26,126	178,167
(80) Mixed crops and livestock	3,214,649	1,216,495	1,998,153	218,248	63,070	155,177
(0343) Wallonie	**12,040,100**	**3,828,525**	**8,211,575**	**829,801**	**193,886**	**635,915**
(ESP) Spain	**110,424,848**	**30,483,965**	**79,940,883**	**15,929,642**	**4,143,865**	**11,785,776**
(0575) Andalucia	**14,013,329**	**3,090,310**	**10,923,020**	**2,000,067**	**390,367**	**1,609,700**
(15) Specialist COP	462,008	461,283	725	75,789	75,685	104
(16) Specialist other fieldcrops	1,059,590	1,056,981	2,609	116,871	116,495	375
(20) Specialist horticulture	145,162	145,017	145	21,166	21,145	21
(35) Specialist wine	322,655	322,655	-	61,646	61,646	-
(36) Specialist orchards - fruits	473,586	473,586	-	39,862	39,862	-
(37) Specialist olives	19,518	11,663	7,855	2,490	1,337	1,153
(38) Permanent crops combined	214,760	214,760	-	30,753	30,753	-
(45) Specialist milk	4,037,594	9,729	4,027,865	597,282	1,316	595,966
(48) Specialist sheep and goats	1,099,837	28,841	1,070,995	157,375	3,071	154,303
(49) Specialist cattle	3,228,191	51,986	3,176,205	474,581	4,599	469,982
(50) Specialist granivores	66,094	4,228	61,866	10,477	393	10,084
(60) Mixed crops	163,216	163,216	-	19,145	19,145	-
(70) Mixed livestock	2,031,905	59,846	1,972,059	295,323	5,448	289,875
(80) Mixed crops and livestock	689,214	86,520	602,694	97,308	9,473	87,836

Externalisation – linking to trade

- The balance of domestic and imported materials for three categories of agricultural commodities (2012)



- Use of non-EU funds "Virtual" or "Embodied"
- Allows for greater concentration of resources per ha / per person, in EU livestock systems.

- Trade active between EU member states but also with rest-of-the-world. Dependence on external sources of livestock feeds.

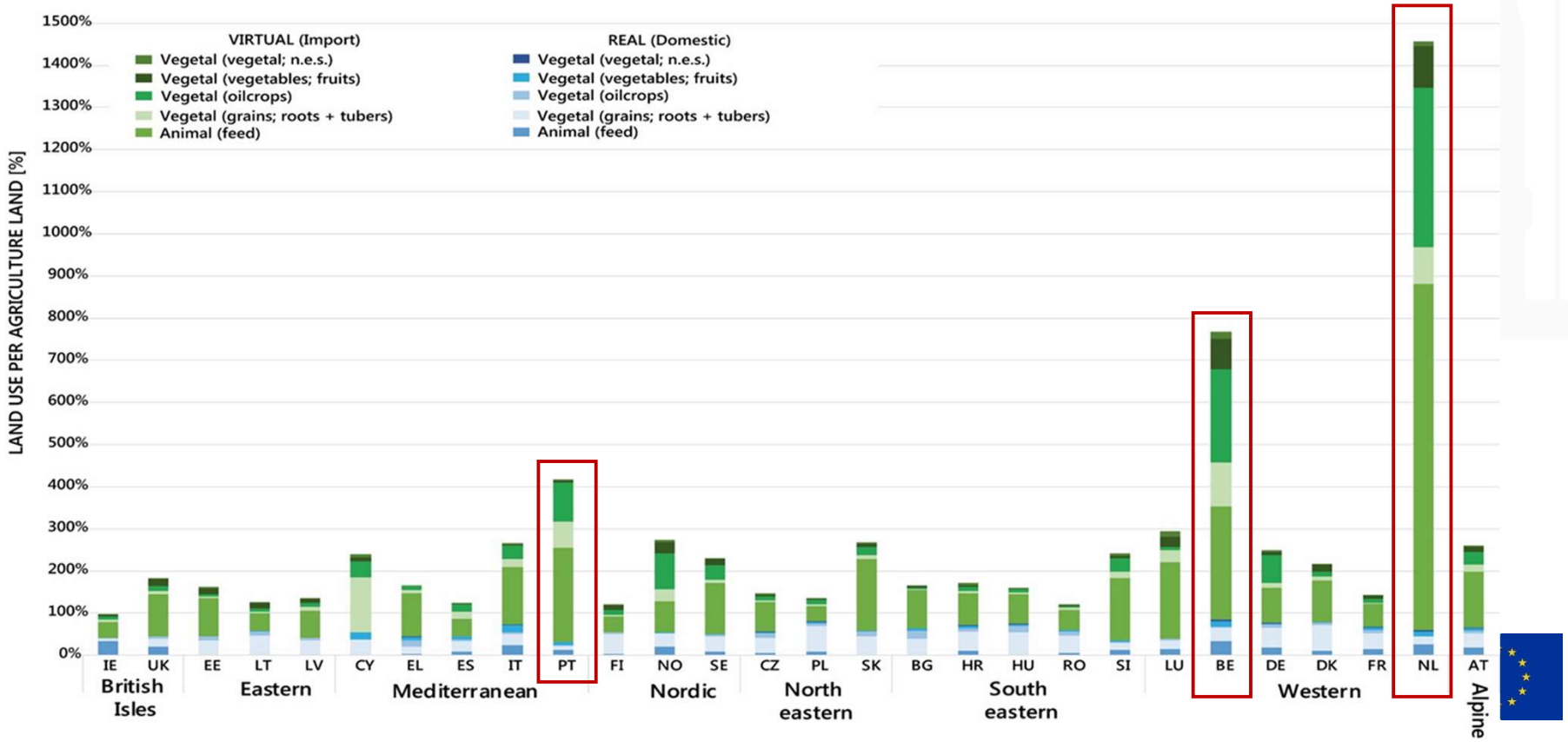
Renner A., et al. (2019) **Environmental pressure of the European agricultural system: An exercise in biophysical anticipation** Submitted to Ecosystems Services

Externalisation - environmental pressure

What are the implications for land of re-internalizing imports –

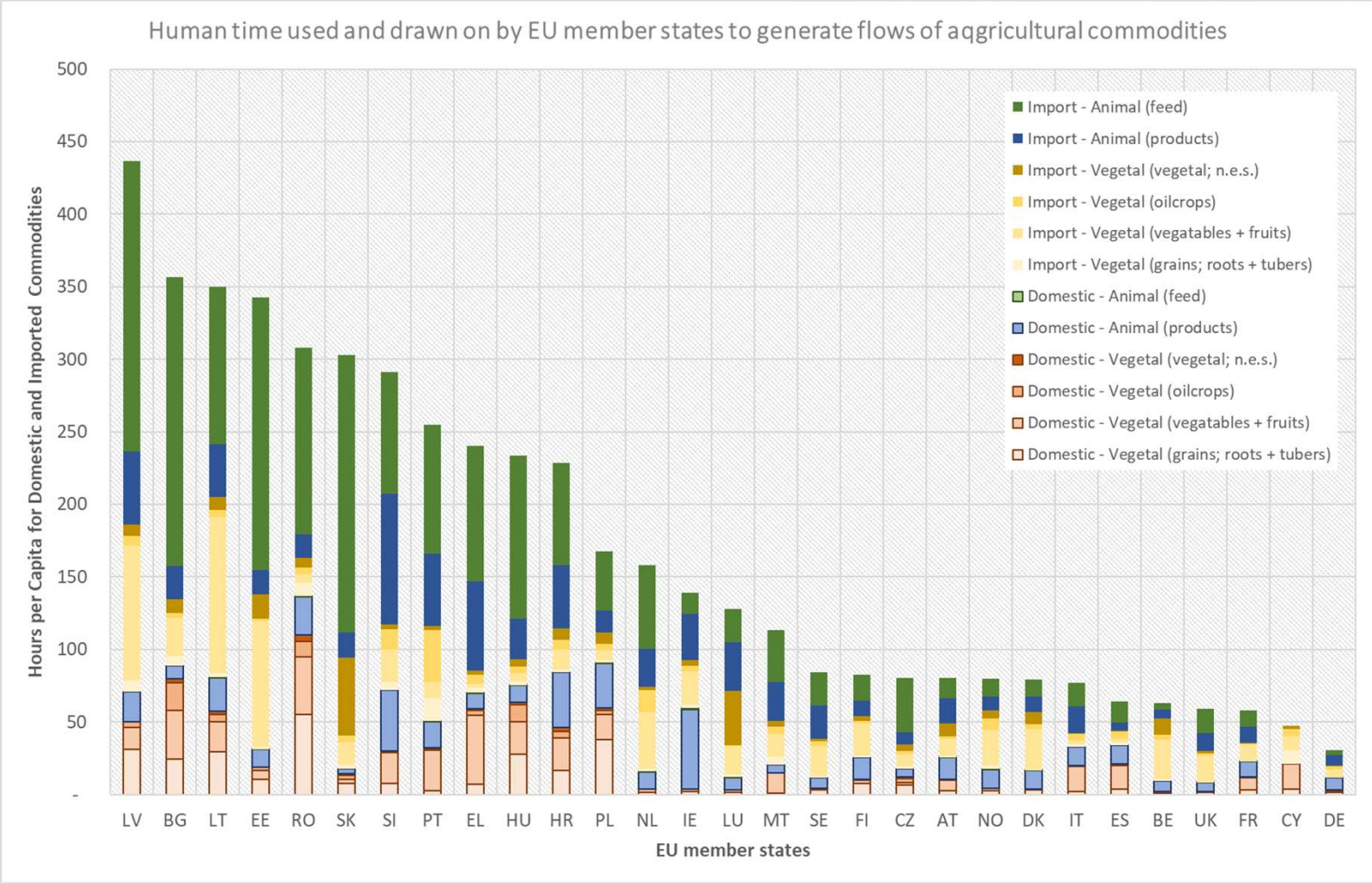
- Feasibility, food security, economic security

But also real impacts where produced – local environment, welfare etc



Externalisation - social pressures (working time)

Reinternalization raises questions of how much time (labour) would be needed
Mass of imports not only factor – mediated by nature of production systems in place ➲



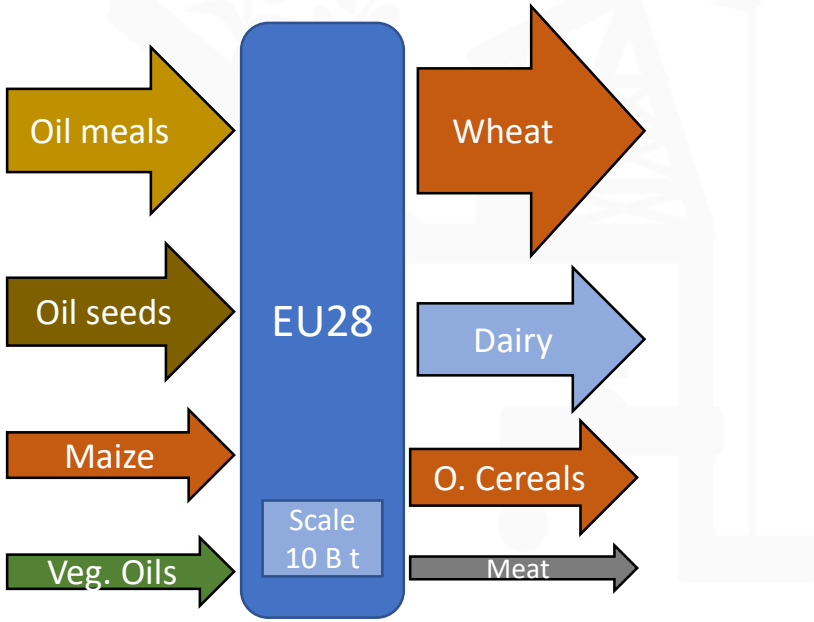
Food Security and Hunger

Supply Systems

End use of outputs

Importance of trade

- Within EU transfers – MS level – granularity challenge (scenarios)
- Beyond EU - imports and exports – role in food availability ➲
- Citizens access to affordable food? In EU and beyond?
- Embodied energy in processing, transport, retail (80%) – sectoral linkages*
- Use of land to provide non-food materials (C storage, energy, plastics, building materials etc)



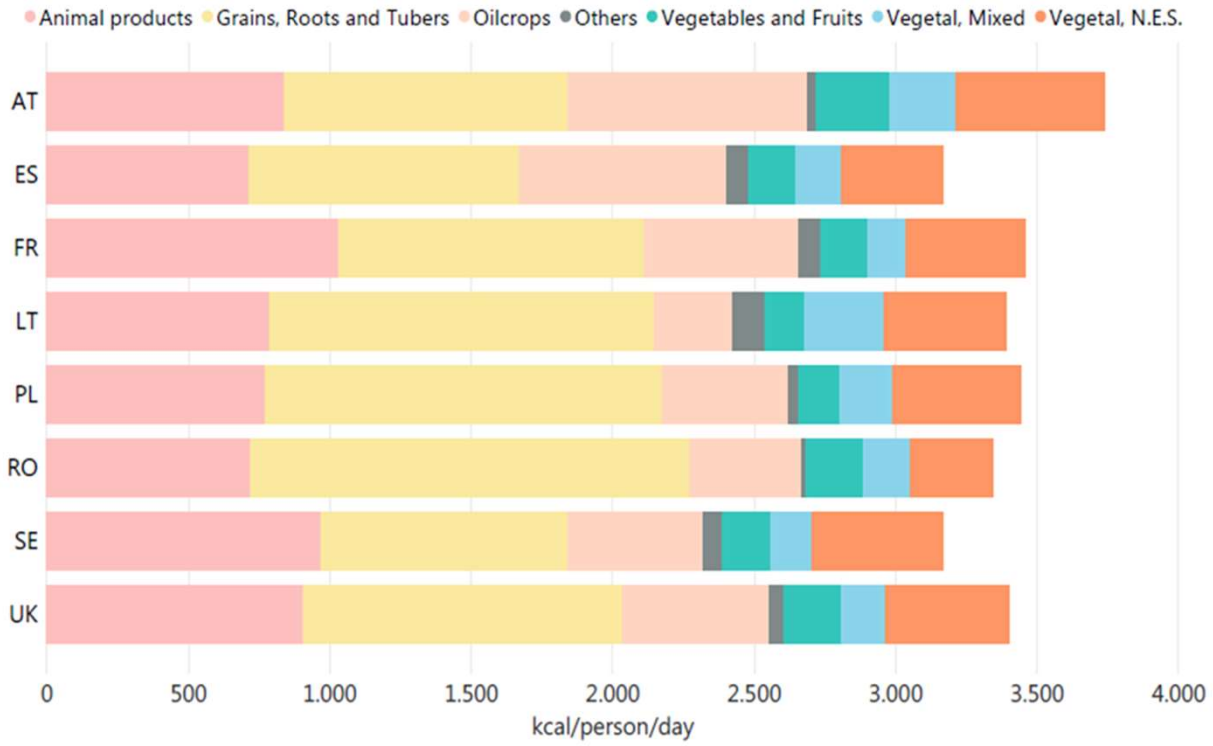
*links to other parts of MAGIC http://magic-nexus.eu/policy-case-studies
European Futures for Energy Efficiency (EUFORIE) https://sites.utu.fi/euforie/

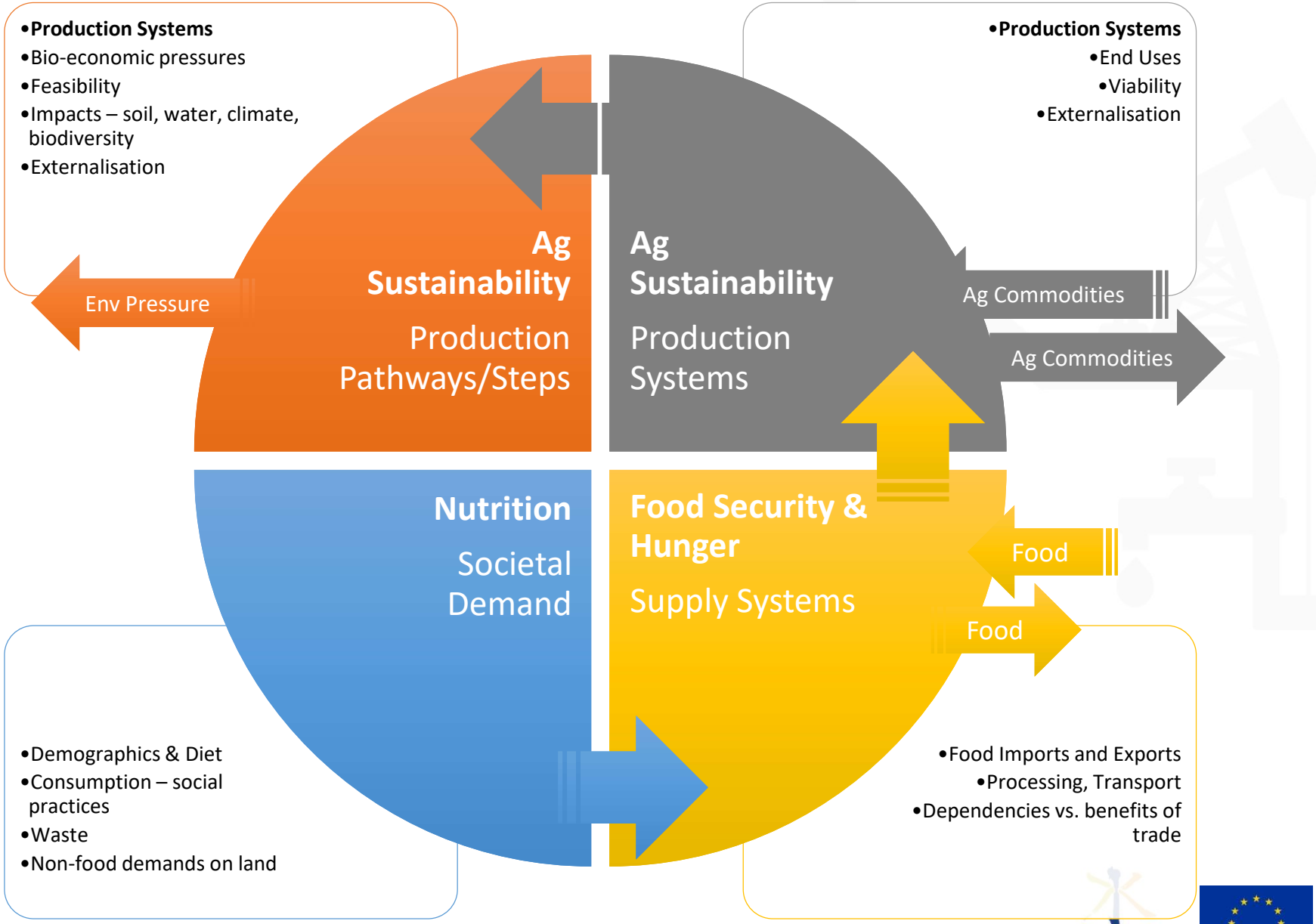
Nutrition - Societal Demand

Nutrition

Demographics and Diet choices - size and composition of demand ➲

- Mediation of biophysical need by the social and cultural – e.g. time on shopping and cooking
- Waste – linking to circular economy (and households)
- Over consumption




•Production Systems
•Bio-economic pressures
•Feasibility
•Impacts – soil, water, climate, biodiversity
•Externalisation
Env Pressure
Ag Sustainability
Production Pathways/Steps
•Production Systems
•End Uses
•Viability
•Externalisation
Ag Sustainability
Production Systems
Ag Commodities
Ag Commodities
Nutrition
Societal Demand
Food Security & Hunger
Supply Systems
Food
Food
•Demographics & Diet
•Consumption – social practices
•Waste
•Non-food demands on land
•Food Imports and Exports
•Processing, Transport
•Dependencies vs. benefits of trade

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Conclusions and Implications: Our view

- European agri-food system needs to change to be sustainable
  - Environmental pressures unlikely to be sustainable within and beyond EU
  - Are these justified by social outcomes of agri-food system?
  - Language of Green Deal (biodiversity **and** climate crisis, social justice)

"The Green Deal… aims to reconcile the economy with our planet, to reconcile the way we produce and the way we consume with our planet and to make it work for our people".

Others agree we need different approaches & to consider openness

"Isolated, piecemeal approaches have proven to be ineffective. We need to formulate strategies that are comprehensive and integrated".

"The EU needs to systematically track …spillovers and assess the impact of European policies on other countries"

Institute for European Environmental Policy

MAGIC NEXUS

Conclusions and Implications: Our view

- Need methods such MuSIASEM to complement existing metrics
  - Understanding *extent* as well as *intensity* is useful
  - Connecting production and consumption – Farm to Fork Strategy

- Policy may need to change to better support SDGs – not yet truly coherent
  - Confirms importance of policy coherence[1] e.g. CAP in support of WFD
    - Importance of energy intersection with CAP
    - Policy across all levels not just focussed at production steps
  - Missing policy(s)? Supports idea of EU food policy?

- Others have suggested change is needed: what is stopping change?
  - Have found previous EU actors expected policy recommendations from us
  - You are more expert than us on policy…. What is your view?

1. European Commission (2019). SWD(2019) 20 final. Commission staff working document. *2019 EU report on Policy Coherence for Development*. https://ec.europa.eu/europeaid/sites/devco/files/swd_2019_20_pcdreport.pdf

Over to you: Questions and Feedback

Comments or Questions for us?

Views on implications of this work?

- European agri-food system sustainable?
- What is desirable about the current agri-food system?

- What needs to change (incl. Policy or policy gaps)?
- What impedes change?

- Is MuSIASEM an interesting method?
- Pros and cons versus other analytic approaches?

Our next steps and outputs

- Recording and slides available to participants on request
  - Would you be happy with us sharing the recording more widely?
  - Short report will go on webpage and be shared with you.

- MAGIC Deliverable 5.1 – full report in July 2020
  - Results elaborated but also insights from stakeholders
  - Use feedback form and email to discuss points further

- Final Policy Conference potentially in September 2020

Thank you!

Kerry.Waylen@Hutton.ac.uk
Keith.Matthews@Hutton.ac.uk
Kirsty.Blackstock@Hutton.ac.uk

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