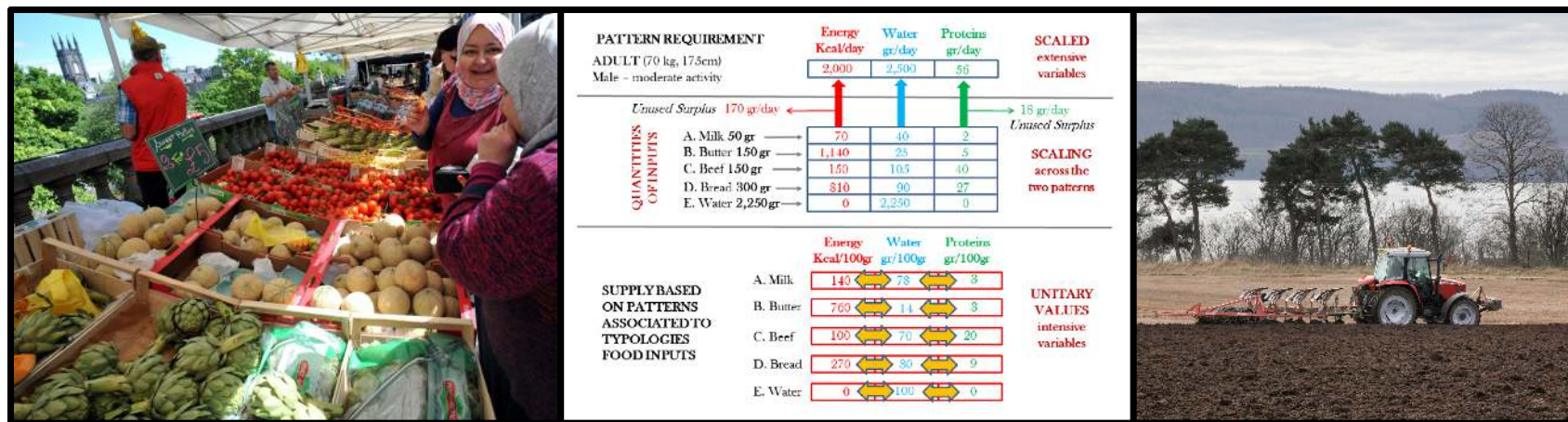


# A systems perspective on sustainable agriculture: the new 'MAGIC' approach

European Parliament 'MAGIC' Breakfast, Brussels, 30<sup>th</sup> January 2020



# A systems perspective on sustainable agriculture – the ‘MAGIC’ approach

Sheila Ritchie, MEP  
Welcome



## The New ‘MAGIC’ Approach

- Dr Kerry Waylen<sup>a</sup>  
Setting the scene and explaining the method
- Prof Mario Giampietro<sup>b</sup>  
Examples and insights from MAGIC
- Dr Keith Matthews<sup>a</sup>  
Implications for sustainability policy and research



<sup>a</sup> The James Hutton Institute, Aberdeen, Scotland

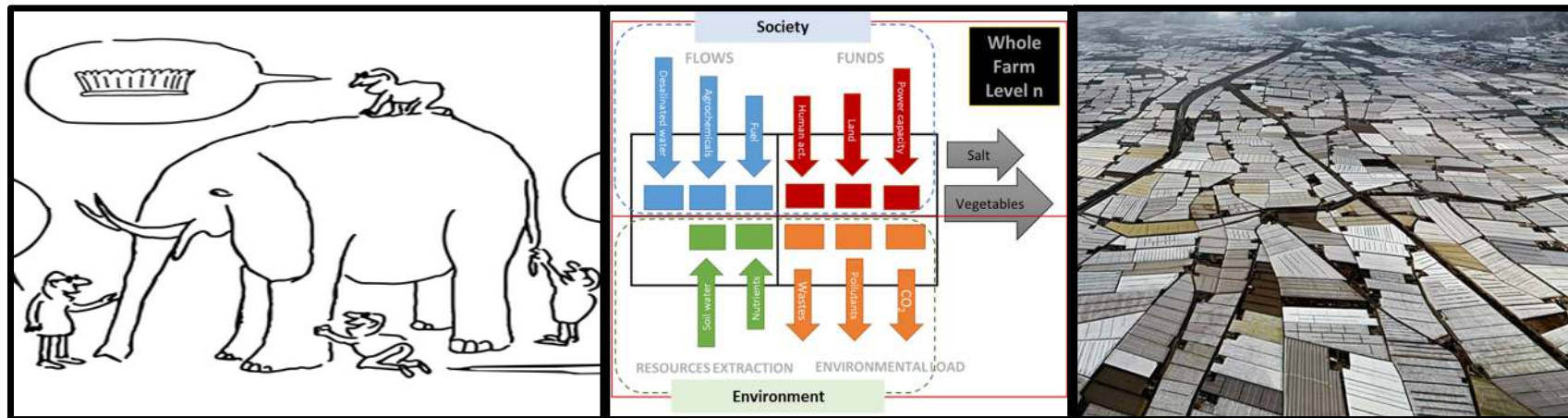
<sup>b</sup> Institut de Ciència i Tecnologia Ambientals,  
Universitat Autònoma de Barcelona, Catalunya &  
Institució Catalana de Recerca i Estudis Avançats  
(ICREA), Barcelona, Catalunya

## Questions and Discussion



# Setting the scene and explaining the method

Kerry Waylen, The James Hutton Institute



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

# Why do we need new perspectives?

Sustainability is a challenge requiring urgent action and entailing all sectors and parts of society



*"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".*

*"The actions required are beyond manifestos"*



We need more integrated approaches to understanding and intervening, and especially to consider of impacts outside of Europe



*"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"*



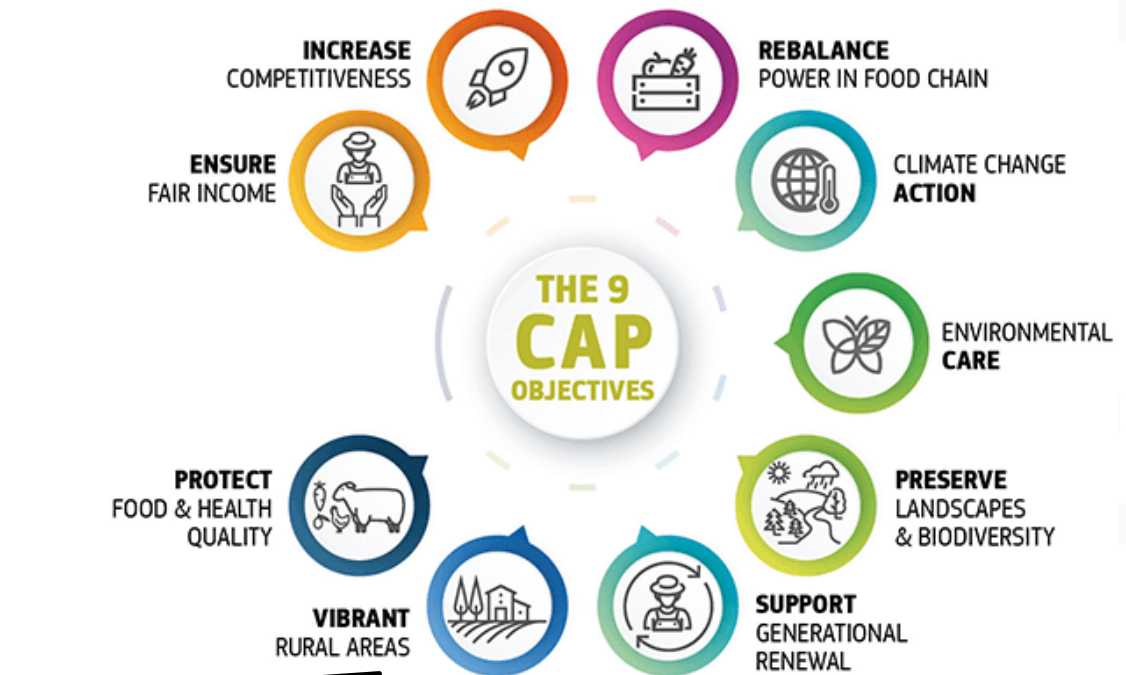


# Why focus on agriculture and food systems?

- Agricultural policy underpins many goals
  - CAP's own future objectives are broad
  - CAP supports policy coherence e.g. WFD
- Sustainable agriculture essential to SDG2 and other SDGs



- Criticism of past effects of CAP
- Growing attention on other parts of food system e.g. Farm to Fork



# What do we need?

## Needs

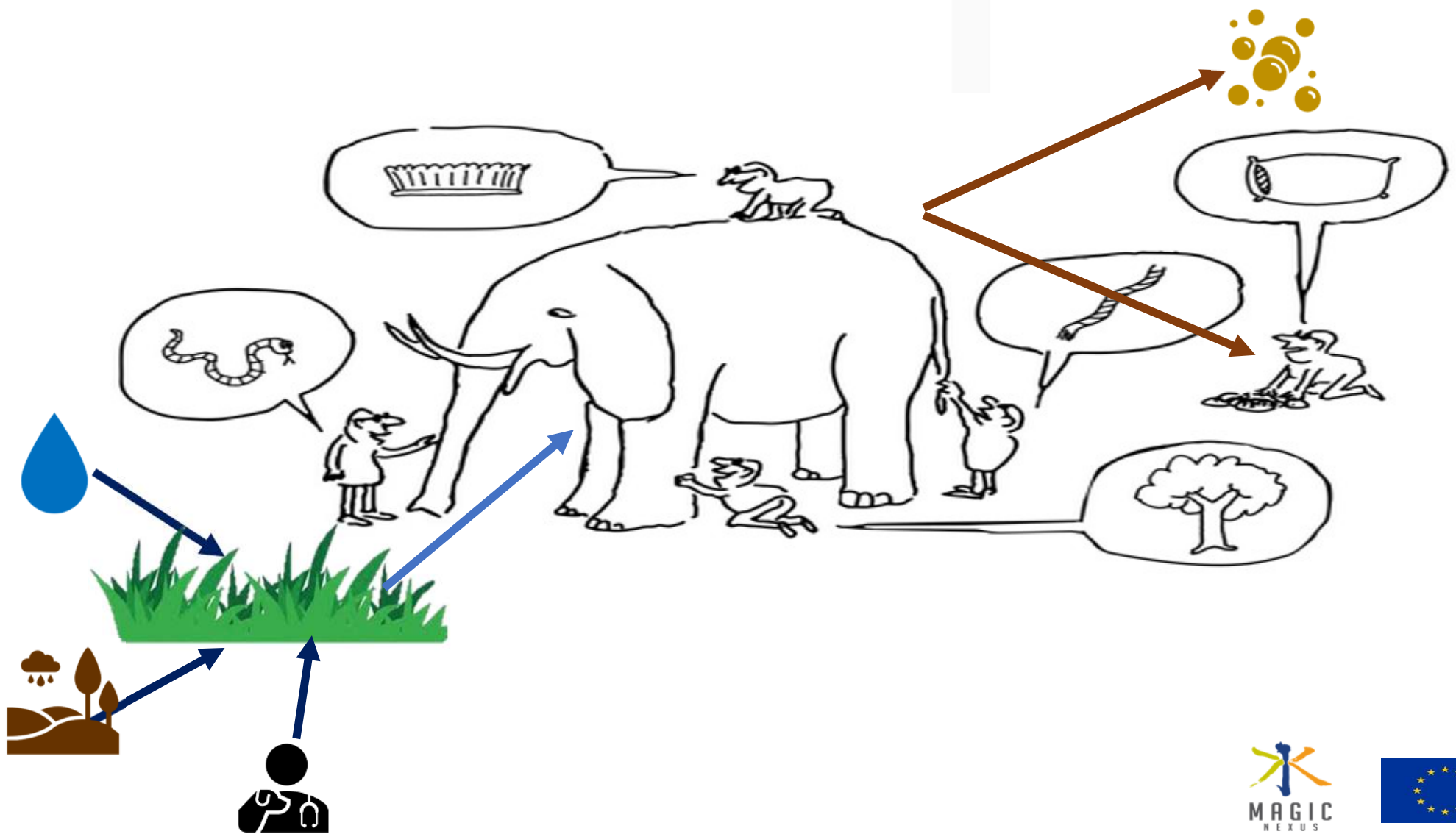
- To assess implications of any decision across multiple domains
- To be consistent when assessing sustainability of different systems
- To reflect on assumptions or implicit framings (e.g. efficiency as a solution)
- To offer & explore ideas for improvements

## To help inform & inspire new ways to act

- We all must avoid resorting to partial views or “useful fictions” in order to cope with “overwhelming systems”
- General systems perspective relevant to all (even if not technical expert)

MAGIC can help.





# Introducing 'MAGIC'

Moving Towards Adaptive Governance in Complexity: Informing Nexus Security"

- H2020, 2016-2020
- A Nexus Cluster project
- 'Nexus' – water, energy, food & environment inextricably interlinked both biophysically and in governance

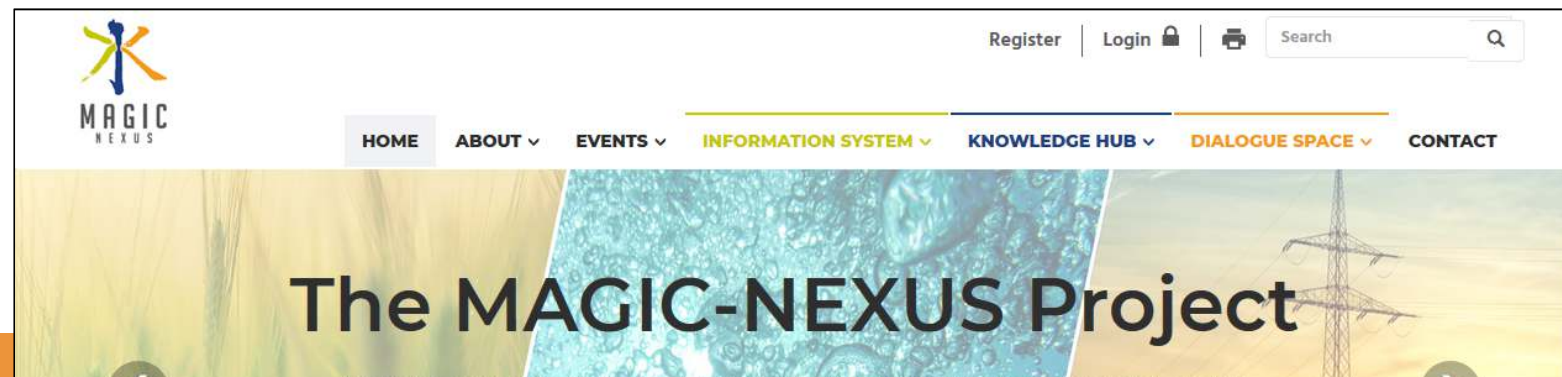


## Objectives

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

[www.magic-nexus.eu](http://www.magic-nexus.eu)

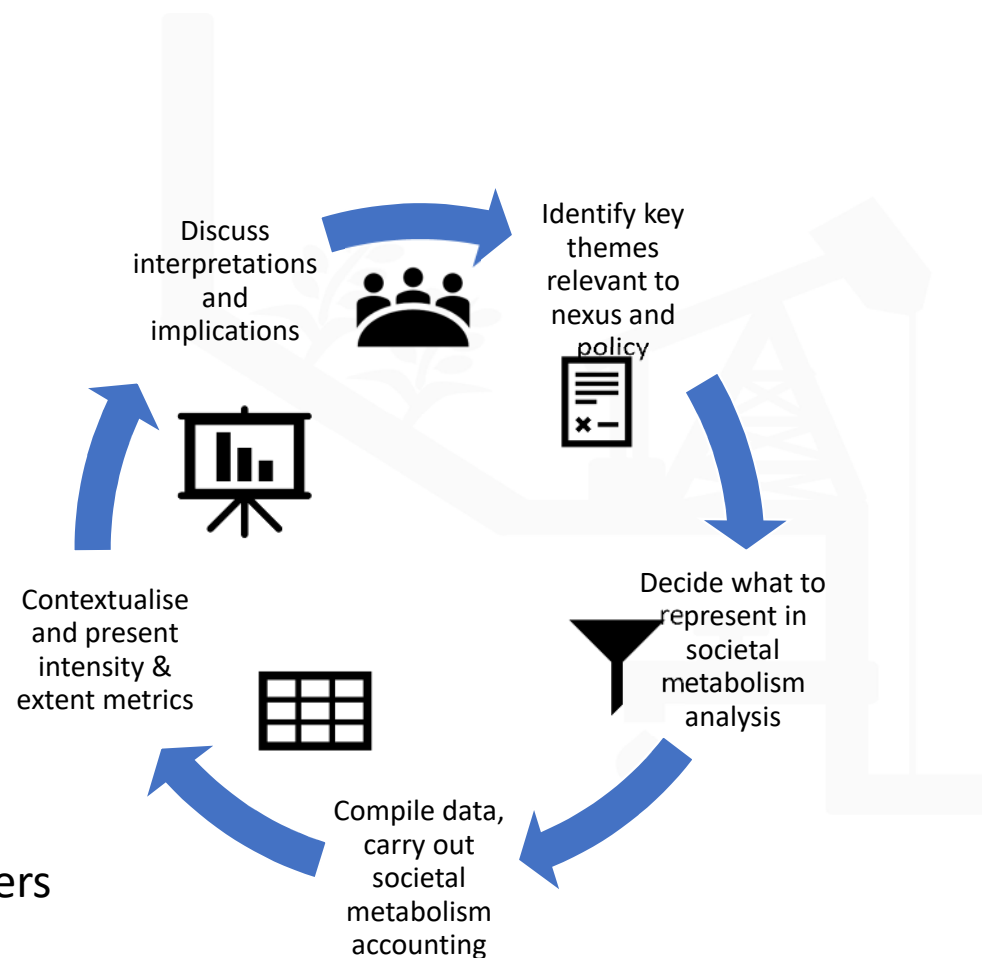
[www.nexuscluster.eu](http://www.nexuscluster.eu)





# MAGIC method

- ‘Quantitative Story-Telling’
- Interdisciplinary:  
Quantitative analysis shaped by  
analysis of policy issues  
– and vice versa
- Transdisciplinary:  
Cycles of analysis & interaction with policy stakeholders



# Policy analysis

- Method – analysis of EU documents, commentary, interviews with policy-makers, focused on 5 policy areas: CAP, WFD, Natura2000, Energy, Circular Economy

- CAP is central

- Resources affect land management outcomes and hence other policies
  - Formal mandate and initiatives to support WFD, Natura 2000 etc

- However,

- More could be done to improve policy coherence e.g. with WFD
  - Gaps – relatively little interaction with Energy and Circular Economy policy
  - Gaps – no soil directive, limited coverage of food supply and consumption

→ Focus applications of quantitative analysis

Examples related to Energy, other parts of agri-food system



# Societal metabolism accounting

- Key concepts

- Funds and Flows

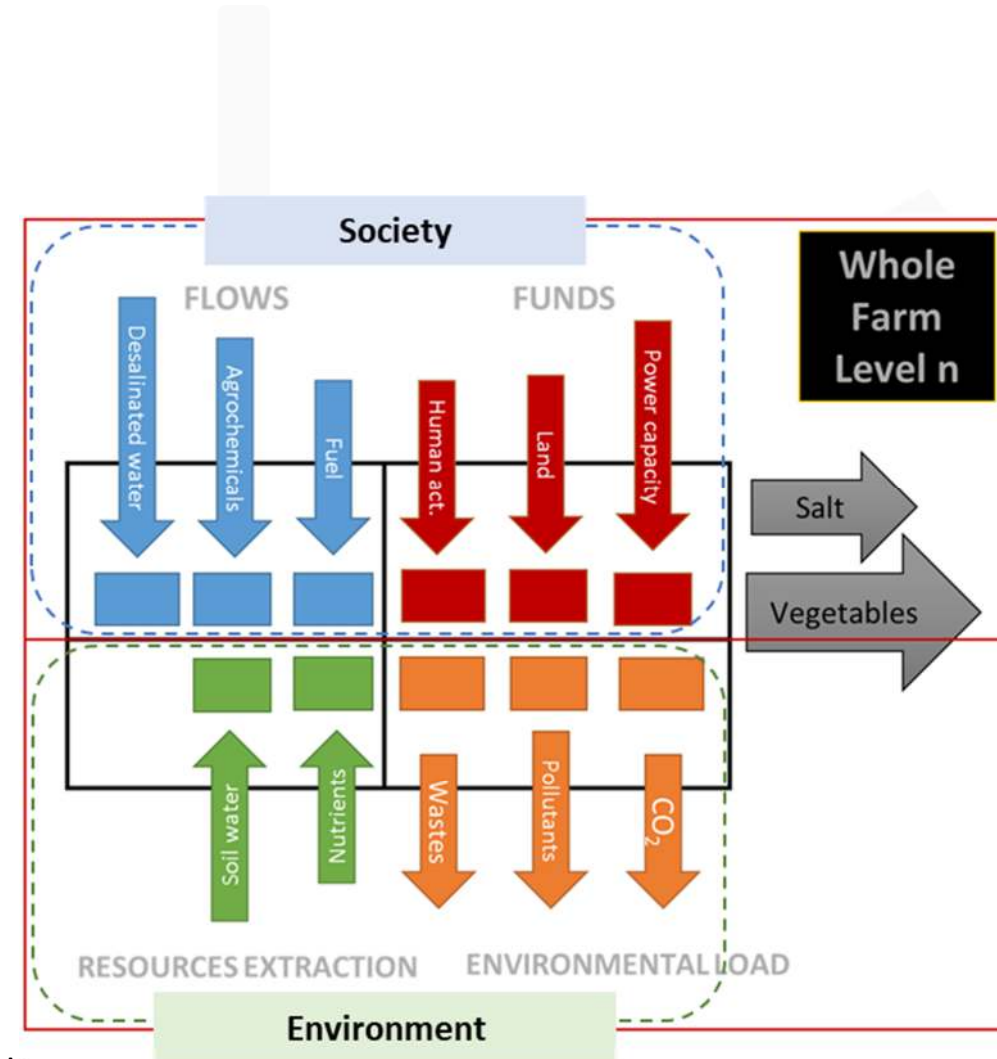
Funds – components of system, relatively invariable unless over-exploited  
e.g. *aquifers, land, workforce, infrastructure*

Flows – resources entering or leaving system  
e.g. *Nutrients, Energy carriers*

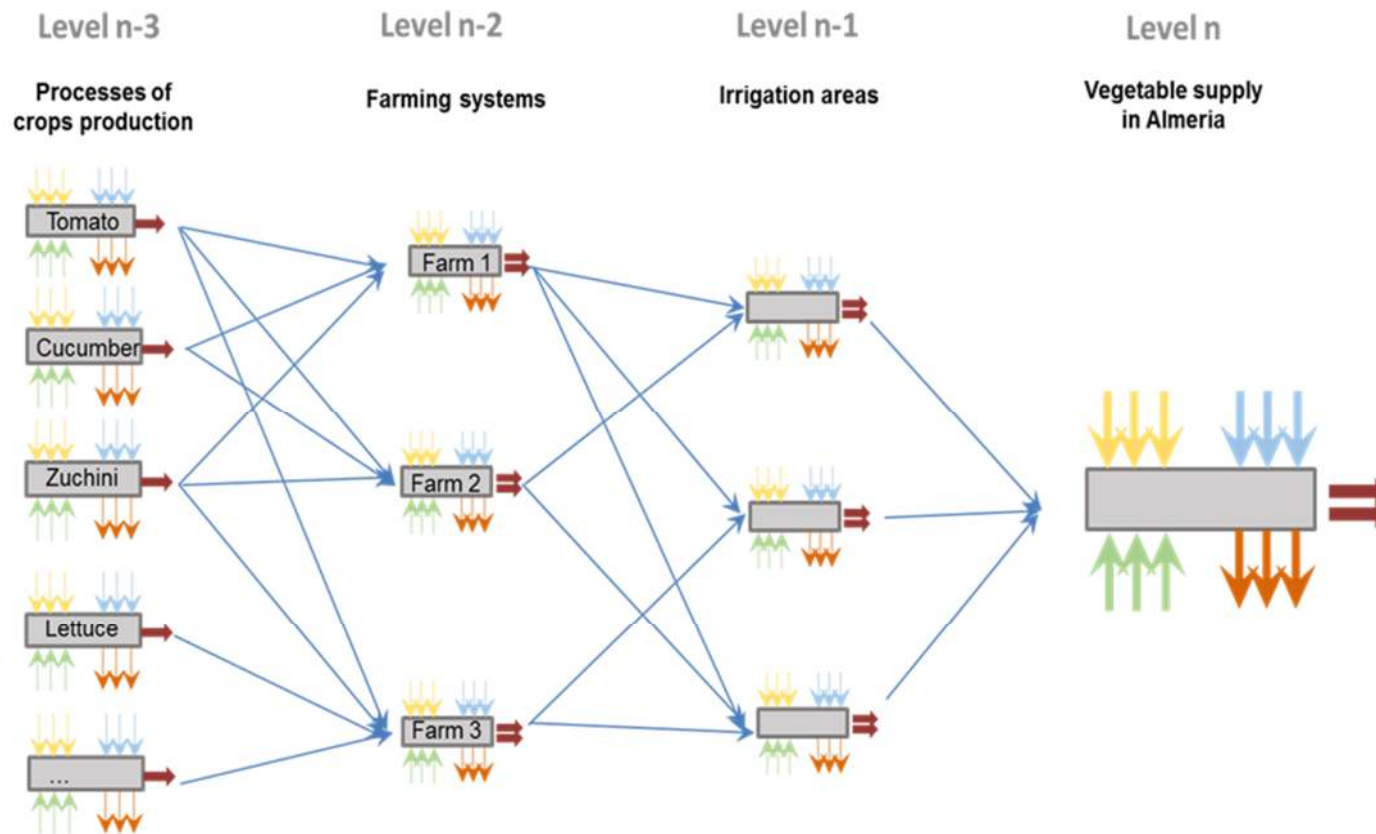
- Funds and flows from environment and society

- Analytic steps

- Identify focal issues to represent
  - Decide key flows and funds
  - Find and assemble different data on flows and funds
  - Connect different units to appraise across scales & levels



*Simplified example of high value cropping using desalinated water derived from wind energy*



*Bottom-up: Determined by lower level characteristics (per unit of land or output)*



*Top-down: Determined by the compatibility between bottom-up scaling of farming typologies and boundary conditions provided by the socio-economic (viability) and the environmental contexts (feasibility)*

- Explore different regions, levels or functional units e.g. different farm types within a region
- Zoom from global to local, potential to move from considering production to food consumption
- Highlight interconnections between systems

# Summary

## MAGIC approach = Quantitative Story-Telling

- Iteratively identifying, analysing and discussing important societal challenges
- Characterise “Metabolic patterns” of society and systems:  
flag where societal processes are unsustainable in long-term
- Highlight interconnections
- Consider ‘what if’ questions  
e.g. “what if we grew more tomatoes”...“what if we ate less dairy”?



## More information on methodology & examples

- 2-page briefings available today and online at [www.magic-nexus.eu](http://www.magic-nexus.eu)
- Examples of applications across a range of policy domains in the MAGIC [document repository](#) including [policy case studies](#)

Examples to follow are snapshots that arise from this perspective





# Examples and insights from MAGIC quantitative story-telling

## *Time to push the 'refresh' button on the narratives about agriculture*

Mario GIAMPIETRO – ICREA Research Professor



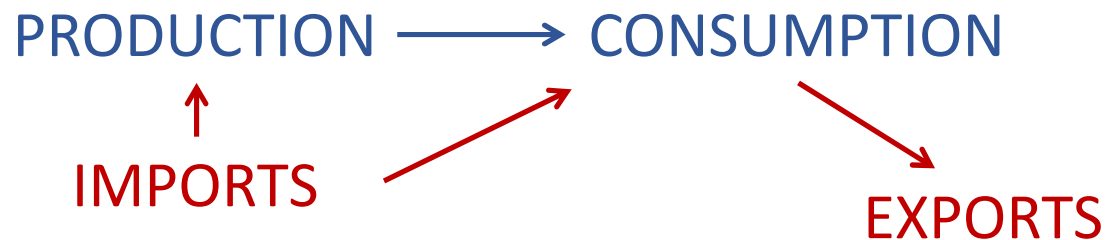
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689669.

## Examples of Quantitative Storytelling

Looking for new perspectives: What if “agriculture” is no longer what it used to be when the CAP was developed?

1. The discussions over the sustainability of agriculture in EU miss the presence of an elephant in the room

**→ today EU agriculture is heavily (and dangerously) depending on externalization**



[HOME](#)[ABOUT](#)[PRODUCTS](#)<https://humboldt.global/top-agricultural-exporters/>

UNCATEGORIZED

## Top 10 Agricultural Exporters

### 1. USA

Although China is the largest agricultural producer overall, the USA exports the most produce. They are the largest corn producer and amongst the largest producers of oats, tomatoes, soybean and spices. Each year the USA agricultural exports are around \$150 billion.

### 2. Netherlands (around 1 Million hectares)

Surprisingly, in second place, the Netherlands is a relatively small country. Their agricultural exports are made up of 3 parts. \$61 billion worth of agricultural products, \$9 billion in agricultural material, knowledge and tech as well as around \$24 billion worth or re-exports which brings in \$94 billion.

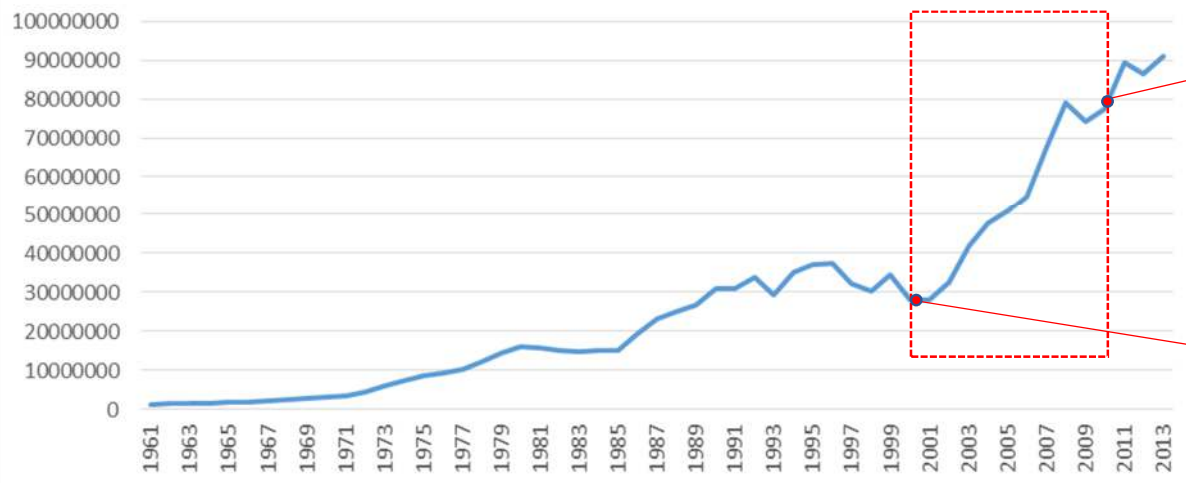
### 8. Canada (around 46 Million hectares)

Canada is right on Spain's heels, bringing in \$49 billion per annum. Their main produce lies in grains such as rye and oats.

# Agribusiness!



Export Value Agriculture Netherlands (1000 US\$)



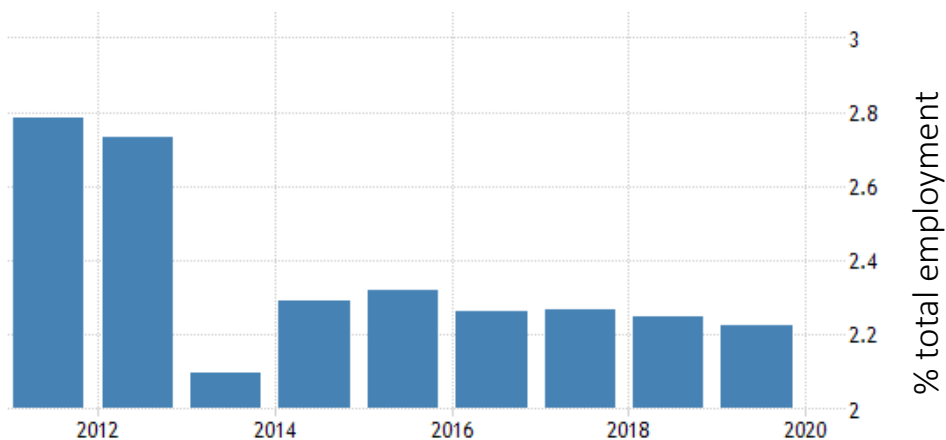
141 410 Annual Work Unit in the year 2010

The labour force fell by 26.9% over 2000-2010

193 540 Annual Work Unit in the year 2000

[Eurostat - Agricultural census in the Netherlands](#)

The value of export tripled



The effects of agribusiness on the reproduction of rural communities

The labour force keeps falling over 2010-2020

Netherlands - Employment In Agriculture

WORLD BANK | TRADINGECONOMICS.COM





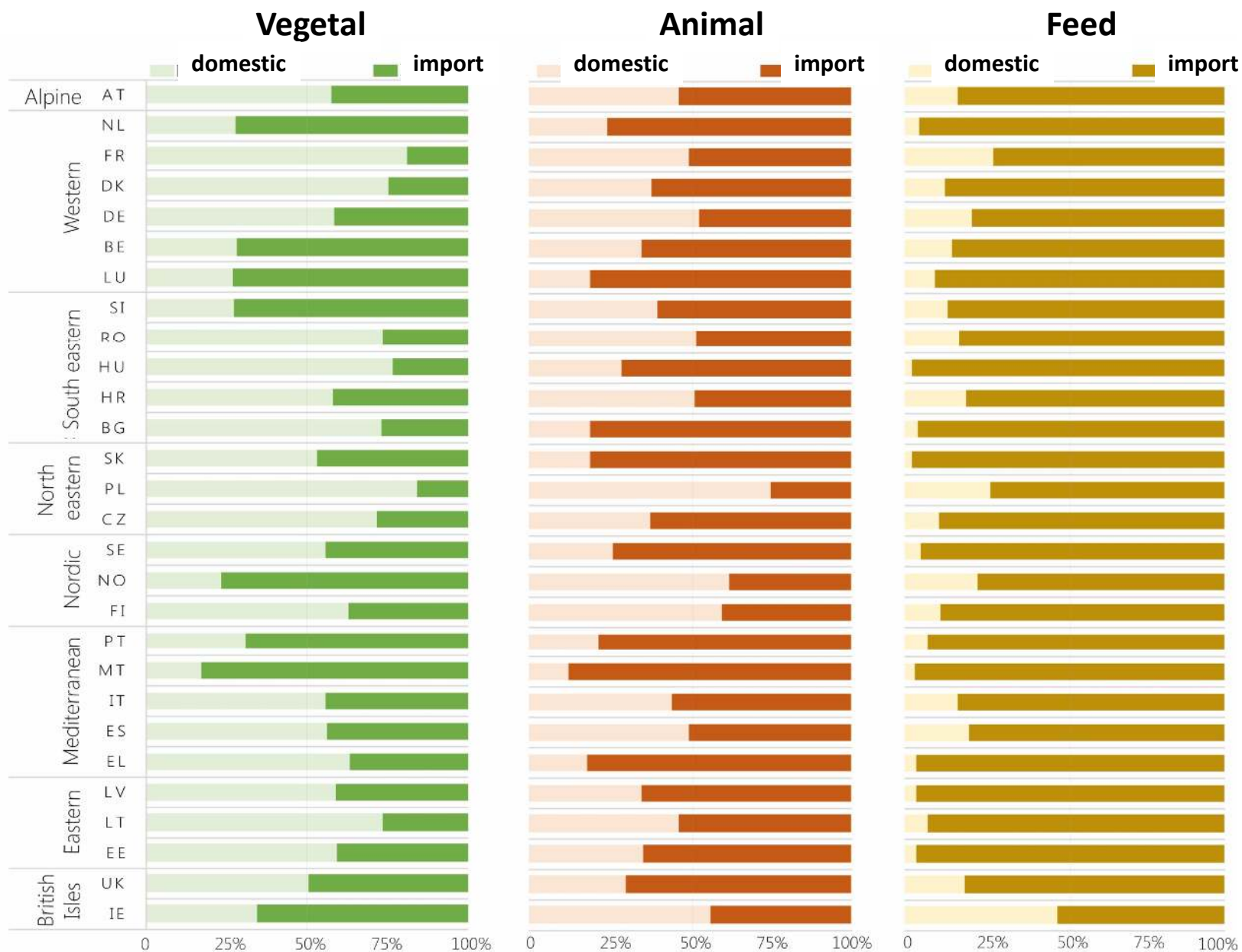
Actual  
supply systems



*Local  
socio-economic  
and environmental  
pressures*

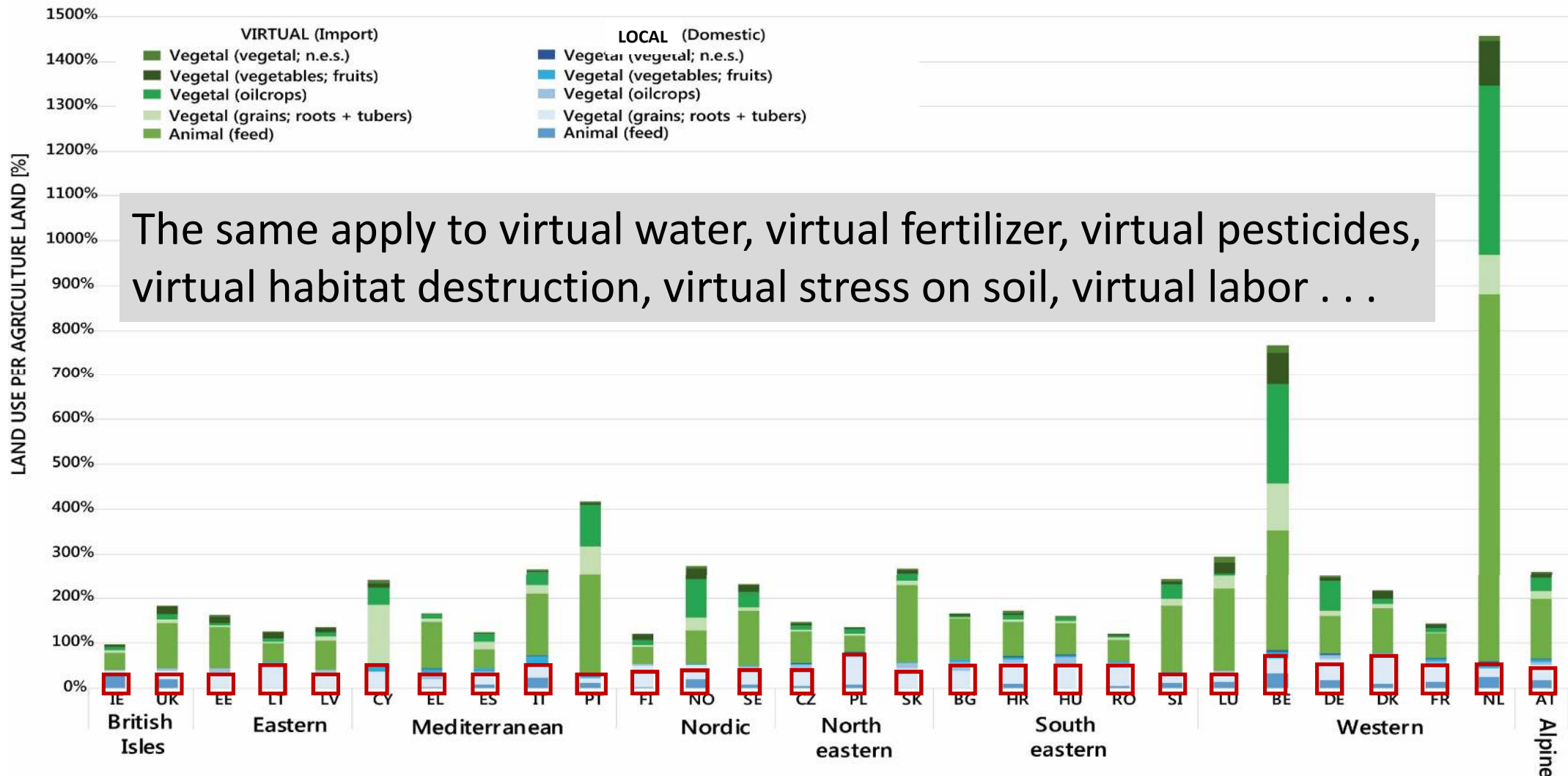






**Externalization  
of production  
in EU agriculture  
by country**

## Local land use (in blue - red box) and externalized use of land (in green) in EU countries



## Global food demand and the sustainable intensification of agriculture

David Tilman<sup>a,1</sup>, Christian Balzer<sup>b</sup>, Jason Hill<sup>c</sup>, and Belinda L. Bafort<sup>a</sup>

<sup>a</sup>Department of Ecology, Evolution, and Behavior, University of Minnesota, St. Paul, MN 55108; <sup>b</sup>Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, CA 93106; and <sup>c</sup>Department of Bioproducts and Biosystems Engineering, University of Minnesota, St. Paul, MN 55108

Contributed by David Tilman, October 12, 2011 (sent for review August 24, 2011)

forecasts a 100-110% increase in global crop demand from 2005 to 2050

OPEN ACCESS Freely available online

## Yield Trends Are Insufficient to Double Global Crop Production by 2050

Deepak K. Ray\*, Nathaniel D. Mueller, Paul C. West, Jonathan A. Foley

Institute on the Environment (IonE), University of Minnesota, Saint Paul, Minnesota, United States of America

How wise is to keep externalizing?  
Can we stop externalizing?

## Commission calls for bioeconomy strategies to be expanded and implemented

By Amanda Lee | EURACTIV.com

29 abr. 2019

Supporters



Measure co-financed by the European Union



Languages: Français | Deutsch

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ENVIRONMENT

## One million species at risk of extinction, UN report warns

A landmark global assessment warns that the window is closing to safeguard biodiversity and a healthy planet. Yet solutions are in sight.

BY STEPHEN LEAHY



PUBLISHED MAY 6, 2019

EU agriculture depends heavily on imported feed which are essential to:  
(i) reduce its impact on the environment; (ii) sustain agro-business; and  
(iii) externalize the request of low-paid labour in agriculture

What if a surge of the global food demand will make in the next decades these imports no longer accessible to EU farmers?

What would be the environmental impact if we had to produce all this feed within Europe?

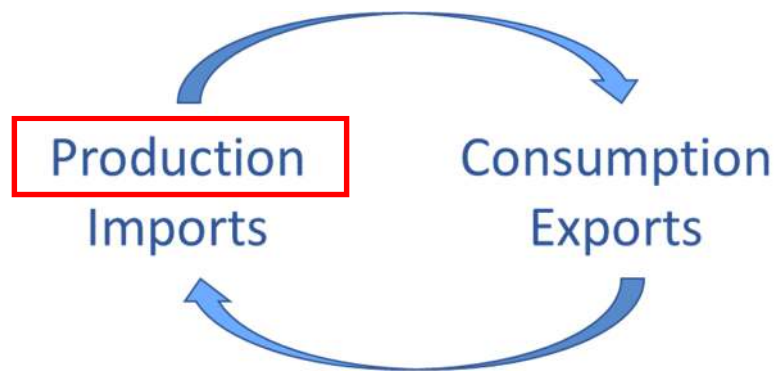
Should we consider more effective narratives to discuss of the factors determining the long-term sustainability of agriculture in the EU?

## Examples of Quantitative Storytelling

Looking for new perspectives: What if “agriculture” is no longer what it used to be when the CAP was developed?

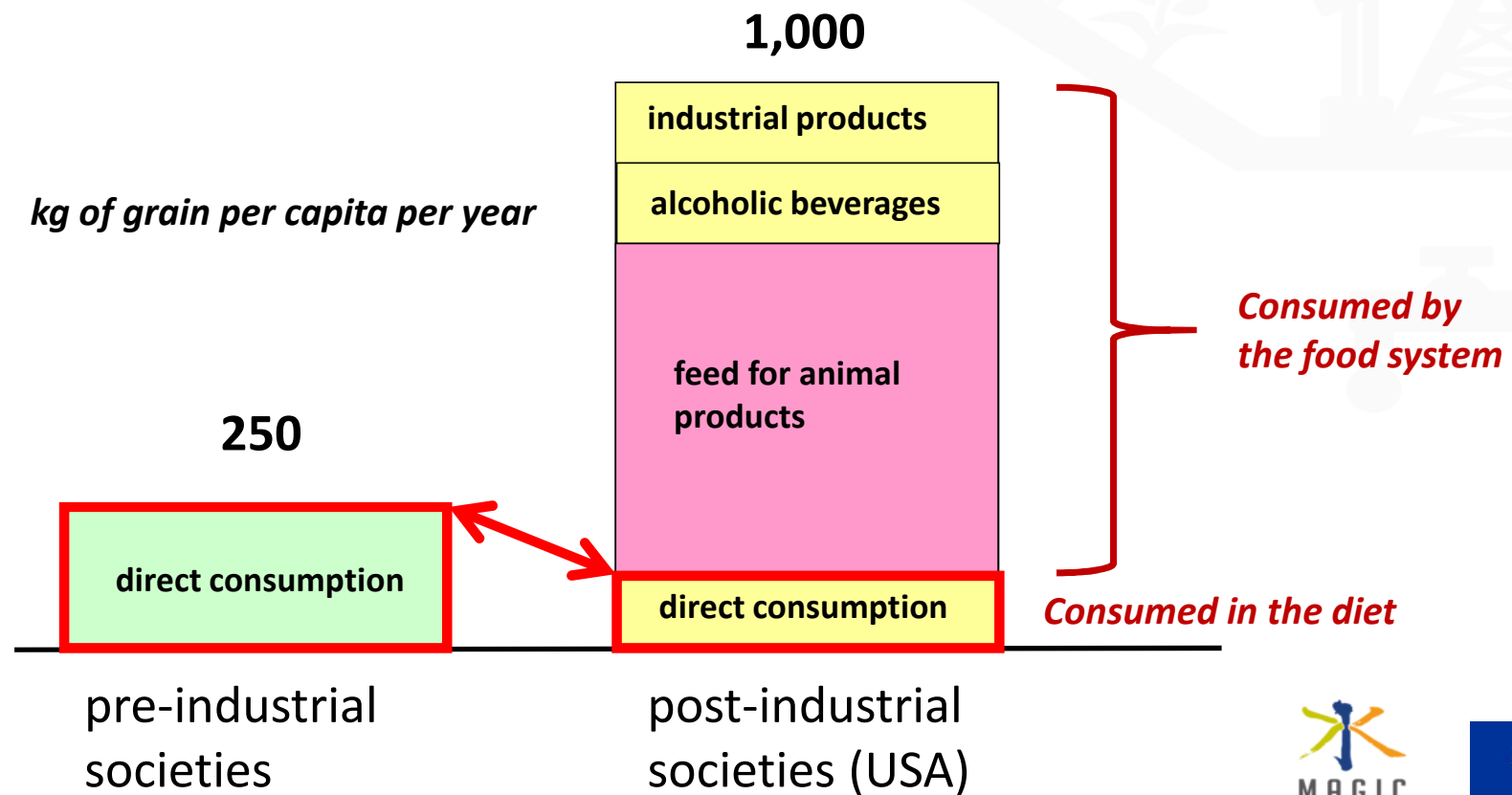
2. Agriculture is a part of the food system getting less and less weight

→ *“Food production” is just a component of a complex food systems*

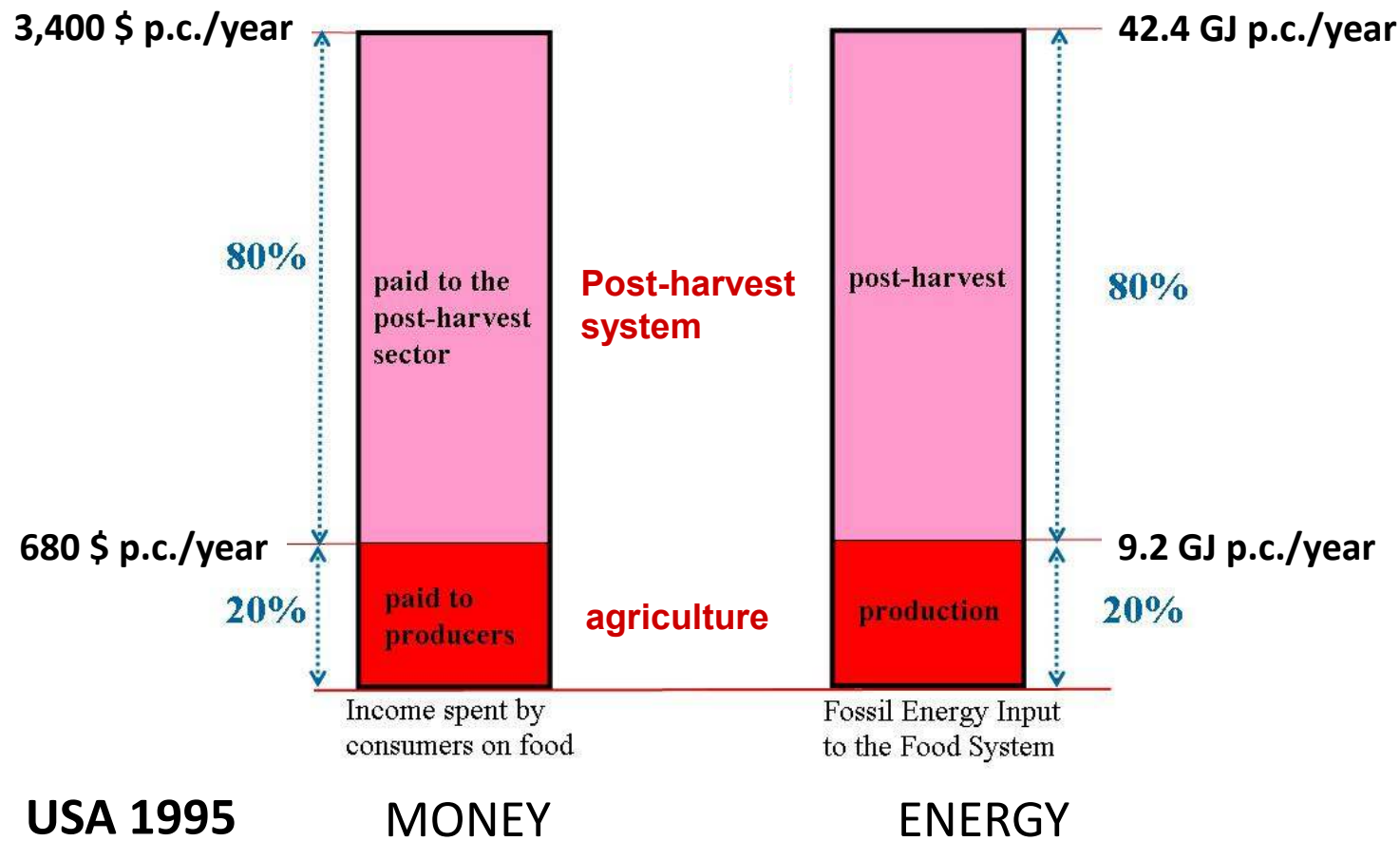




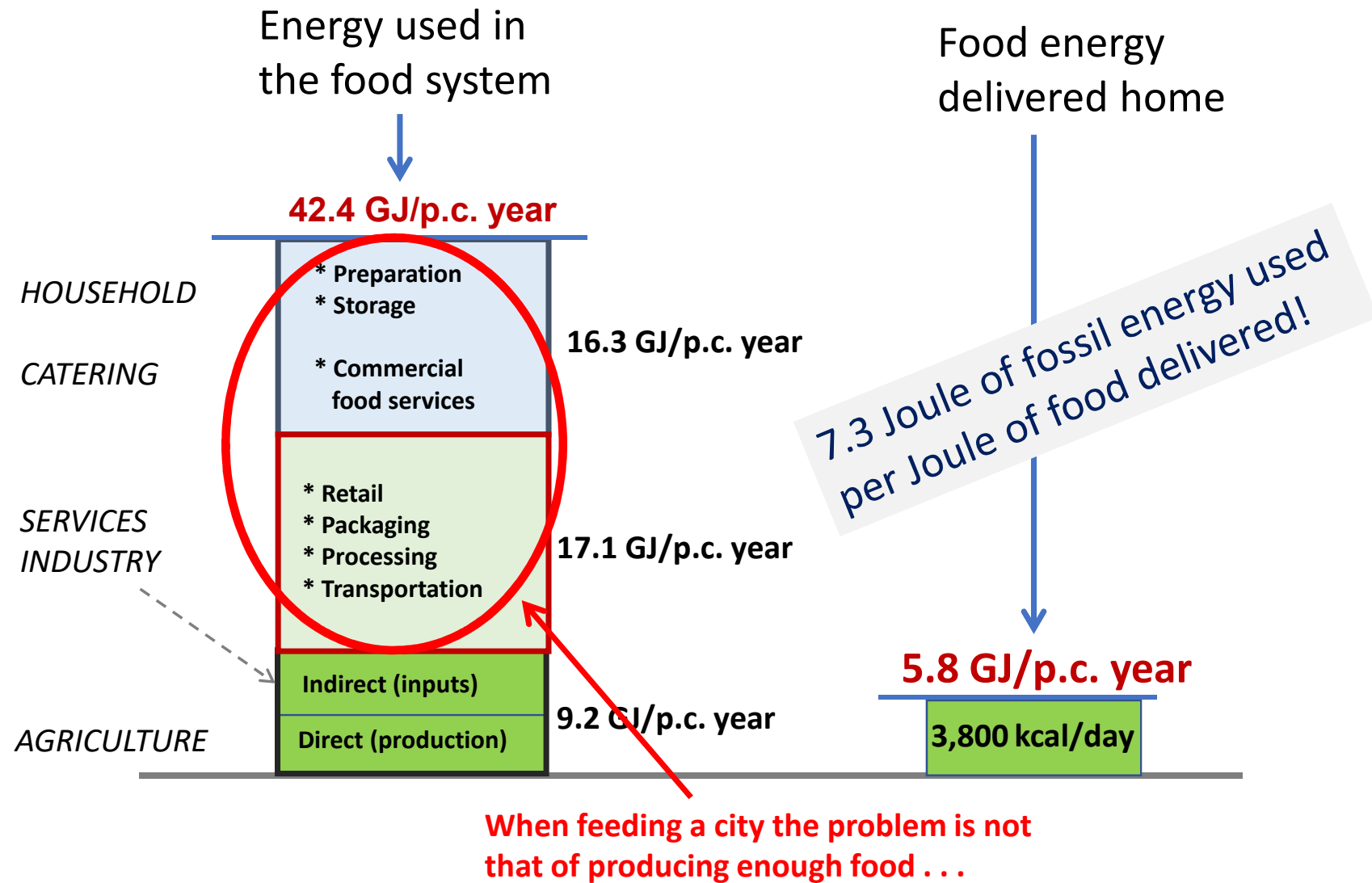
In developed countries, the food system is consuming more food than us!



The costs of the **post-harvest system** (either when assessed in money or in energy) are four times larger than those of **agriculture** . . .



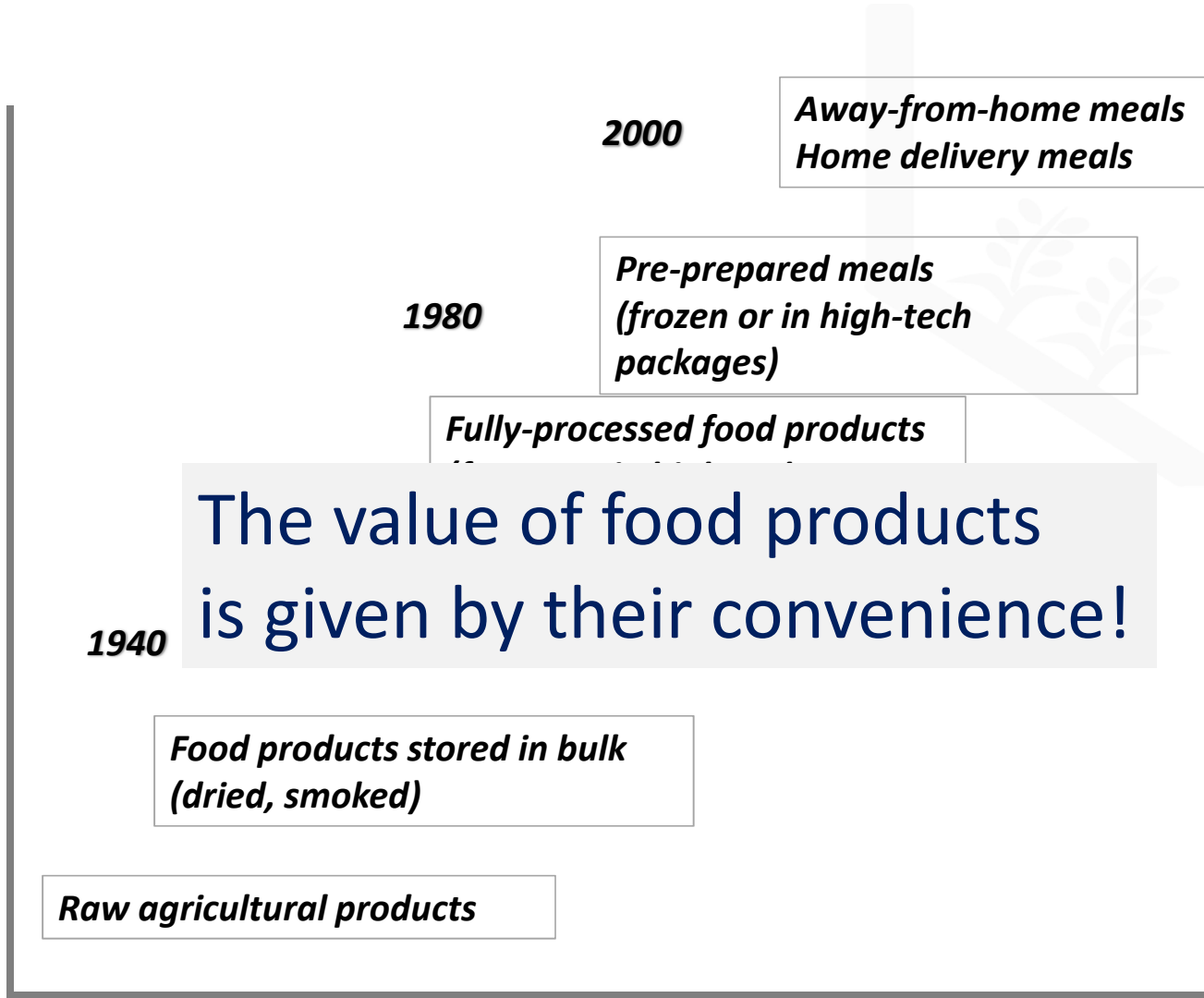
*After Heller M. And Koeleian G. (2000)*



USA 1995

After Heller M. And Koeleian G. (2000)

Energy input used  
in the post-harvest  
sector per unit of  
nutrient



“Convenience of food”



## Post-Harvest sources of costs

Almost the double  
energy costs than  
for food production

- \* Home preparation
- \* Storage
- \* Commercial food services

Almost the double  
energy costs than  
for food production

- \* Retail
- \* Packaging
- \* Processing
- \* Transportation

## Fresh vegetables and fruits

- \* Contain 70-95% of water (low nutrient density)
- \* Very susceptible to mechanical injury (they require sophisticated packaging and careful handling in transport)
- \* Can be damaged when exposed to extremes of temperature (they require controlled environment in their storage)
- \* Susceptible to contaminants introduced after harvest (careful washing procedures, avoid cross-contamination)
- \* Susceptible to rapid product deterioration at the retail stage
- \* **Losses are difficult to assess but they can be very high and relevant because they multiply the “costs” per unit of net supply**

Handling fresh vegetables in urban systems is one of the most energy intensive activities  
Is it certain that a massive move to a vegetarian diet will reduce energy consumption?  
Should we try to understand better the issue, before setting policies and targets?





Asparagus delivered through refrigerated cargos from Peru



Are we capable of comparing  
**in a meaningful way** the  
different pros and cons of  
these two options in relation  
to sustainability?



Livestock moved using a 36 year old  
Truck (property of John Tarrant . . .)



# CONCLUSIONS

Making EU agriculture more sustainable may require a radical change in social practices and not only technological innovations, new regulations and economic incentives – redefine what “agriculture” means in 2020

EU agriculture is now a functional component of a globalized food system, this change has provided some advantages (in terms of added value for those exporting) but it entails several concerns: security, EU sovereignty, reduction of farmers, and ethical issues

Discussions over agricultural policies should be based on a more holistic perspective of the food system (farm to fork) and address the implications of the nexus between energy, water, food, biodiversity for sustainability



# Implications of the MAGIC project for Sustainability Policy and Research

Keith Matthews, The James Hutton Institute



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



## Research - Policy Context

- EU research asks for policy-relevant approaches to characterise and guide interventions in EU & global agri-food systems

The MAGIC project has:

- Tested new methods to study water-energy-food-environment systems
- Demonstrated new systems of accounting to cope with complexity, identify key limits and externalities and quantify trade-offs.
- Worked with stakeholders to suggest analyses that can improve processes of governance
- Used the CAP as a key case-study

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



***“...the place of scientific evidence in policy-making is neither straightforward nor guaranteed...”***

Peter Gluckman et al.

Science 02 Sep 2016:  
Vol. 353, Issue 6303, pp. 969  
DOI: 10.1126/science.aai8837

# Enhancing the value of the data the EU collects

**Principle** – *“measure what we value –  
and not only value what we measure”*

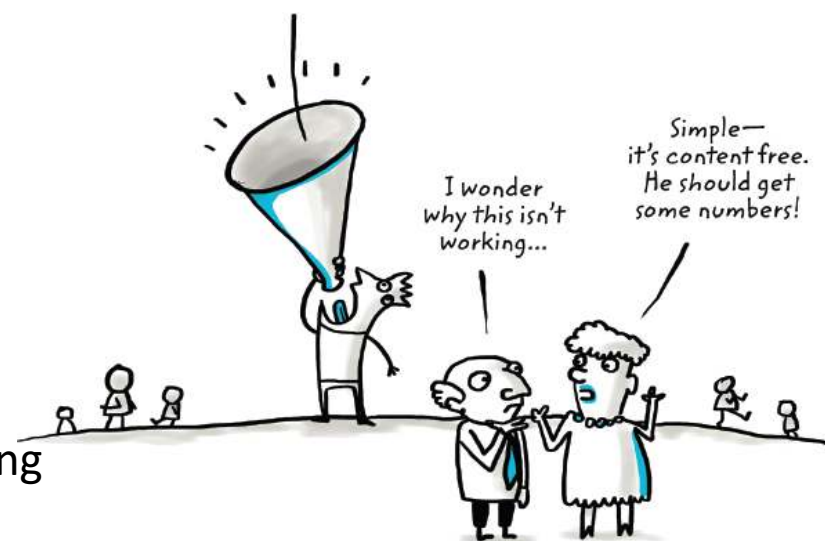
More physical as well as financial aspects –  
e.g. in the Farm Accountancy Data Network (FADN)  
4800+ variables

Tracking - energy, money and waste in the supply chains

More disaggregated - categories – pulp, paper and printing

Extents matter – the same land fund delivering more  
food, energy, carbon stores, building materials...

Superfantastic!!!  
Awesome!!!  
Soooo much better  
than anyone else's!!!





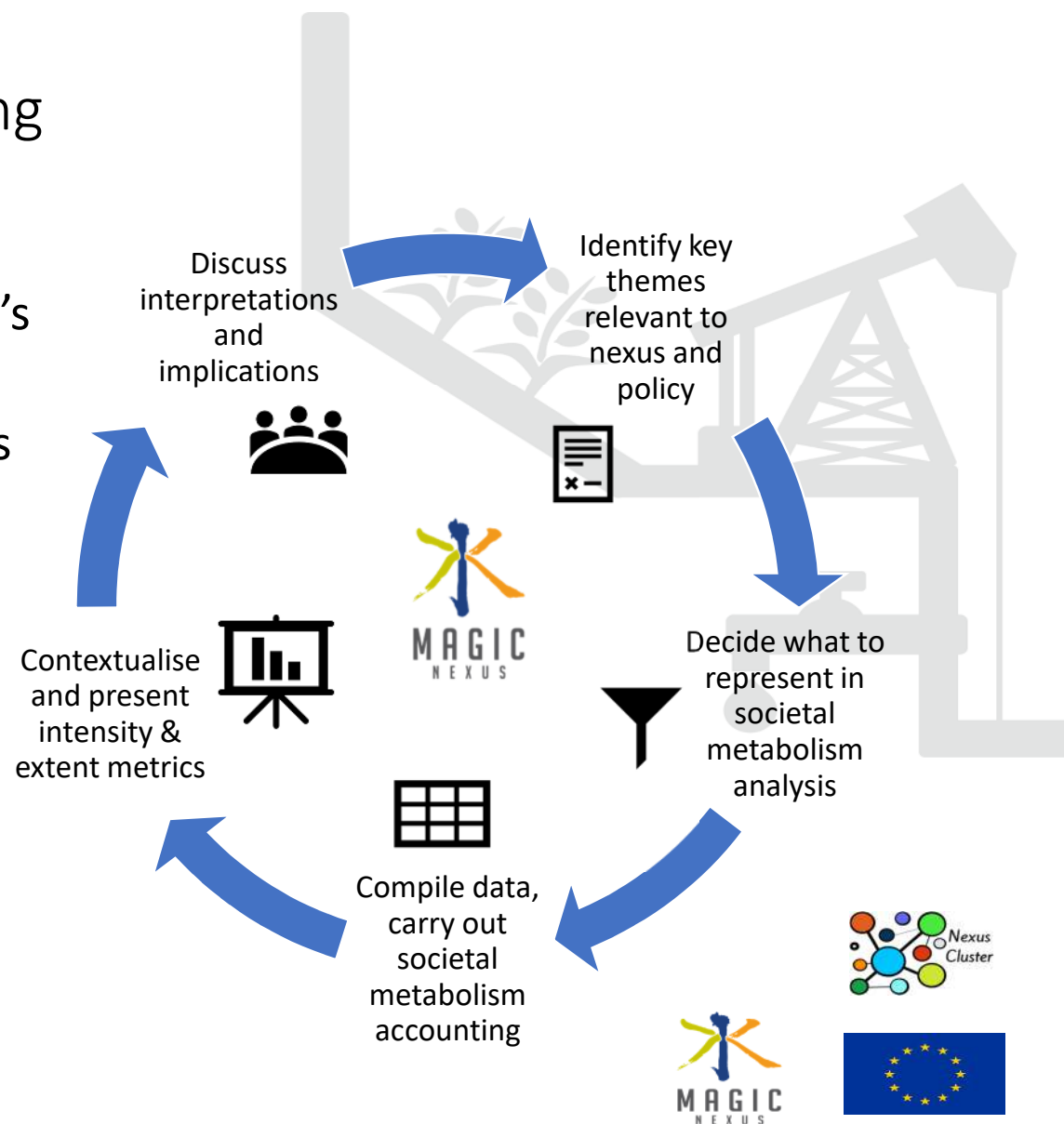
# Reflections on our ways of working

## Societal Metabolism Analysis

- Simplifying assumptions – testing what's left out
- Complexity – harder not easier answers

## Quantitative Story Telling

- Deliberation - reason based
- Integration - feasibility, viability and desirability
- Innovation – beyond technical
- Institutional – social license to act



# Lenses to check the quality of sustainability governance

CONCERNS JUSTIFICATION NARRATIVES	PROBLEMS NORMATIVE NARRATIVES	SOLUTIONS EXPLANATION NARRATIVES
<b>Checking the quality of the framing</b>	<b>Checking the quality of proposals (e.g. policies)</b>	<b>Checking the quality of decision making-processes</b>
What are the problems to be solved?	Are they Feasible? (i.e. compatible with external limits - biosphere)	What information is missing for a better informed decision?
What is the priority or ordering given to multiple concerns?	Are they Viable? (i.e. compatible with internal limits - technosphere)	Can we organize the available information into a more robust decision support tool?
Whose concerns are acknowledged?	What are the gains and losses across the various indicators of performance (impact)	Can we implement processes to allow a robust co-production of knowledge claims and a fairer deliberation?
Who have chosen the given story-telling on concerns?	What are the winners and losers among the various social actors (equity outcomes)	
How/why have they been chosen?		

## CAP Positives

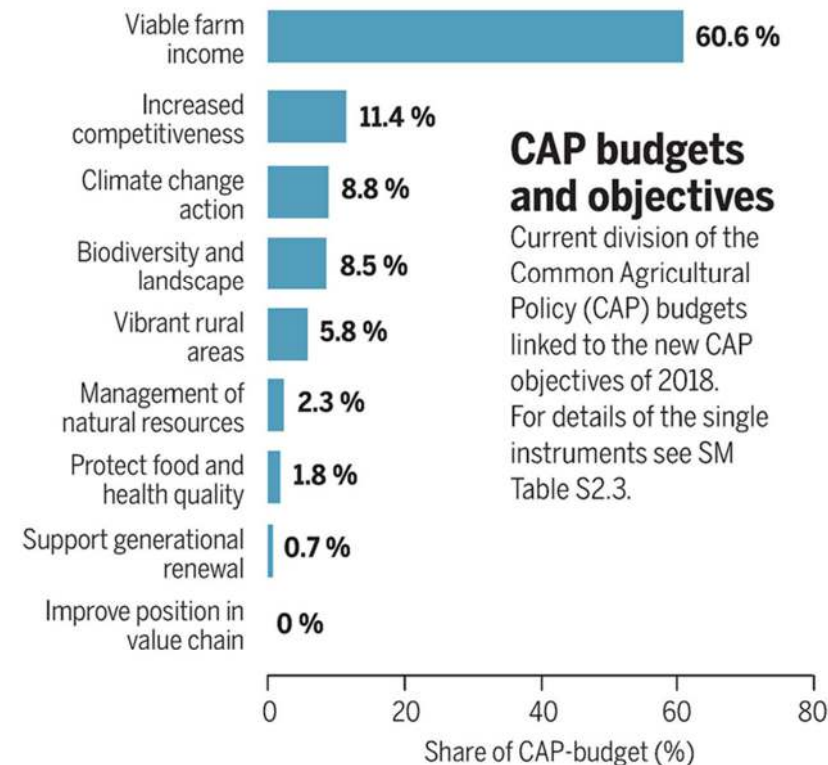
- Evolving elaboration of CAP objectives – a much more holistic discourse
- Institutional change – role of EU Parliament
- CAP wields immense influence via the financial support provided to, and the regulation of agricultural systems but is not a water, energy or food policy (or a WFE nexus policy), yet...



# CAP Challenges

- Translating ambition into outcomes
  - Mechanisms of the CAP
- Considering other market-based mechanisms
- Diversity of agri-food systems – physical and cultural
- Role of member states – objectives into actions
- How the debate is framed
  - What is excluded?
  - Necessary but not sufficient – e.g. efficiency
  - What is evidence? Whose?

Guy Pe'er et al. Science 2019;365:449-451



Data: EU Budget 2017, RDPs 2014-2020

RDP data as of January 24, 2019

Data contains only budget-positions, which could be linked to CAP-objectives

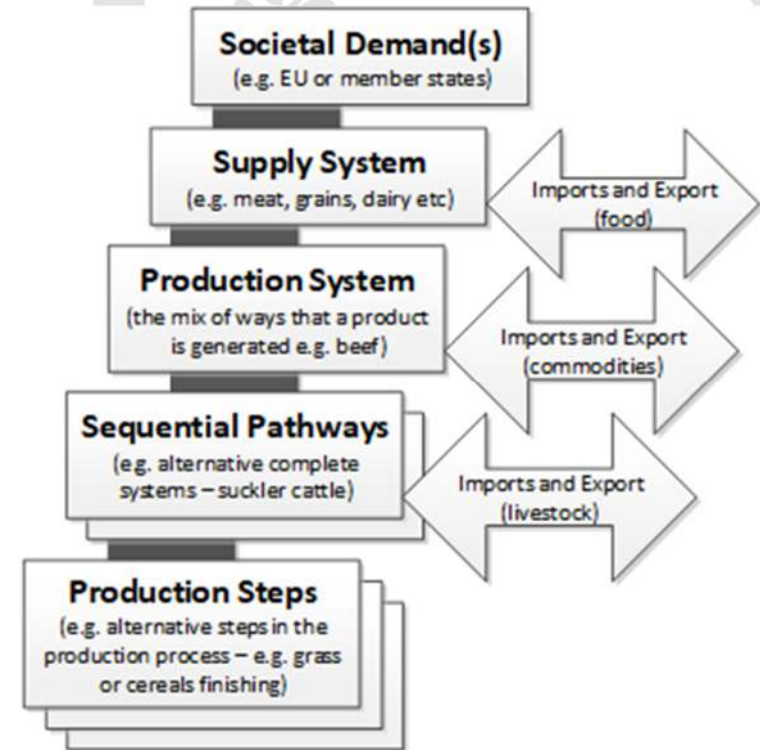
Science  
AAAS

MAGIC  
NEXUS



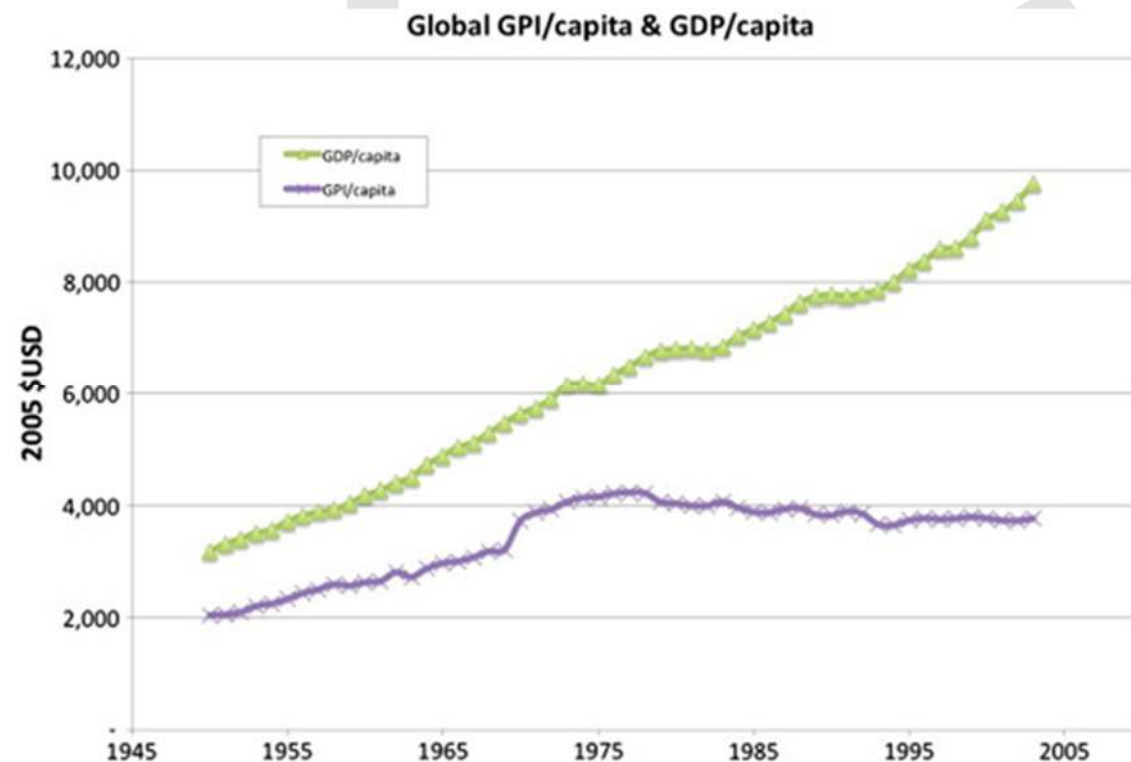
# CAP Opportunities

- Taking a Farm-to-Fork perspective
  - Systemic
  - Integrative
  - Metabolic - stocks, funds & flows
- Who benefits in the supply chain?
- Where are flows of resources used?
- Where externalisation occurs?
  - Production systems – commodities
  - Supply systems – food
- Societal Demand – key role of population and diet (and convenience)



# Linkage to UN SDG's – a beyond EU perspective

- EU agri-food system with a global footprint
  - Imports - resources
  - Exports – role
- SDGs as a framework
  - EU alignment – internal
  - EU influence – expression of values
- Measuring progress in a meaningful way
- Fundamental challenges of a world with very few “new frontiers”





# Conclusions

- Initiatives such as the **Farm to Fork Strategy** within the **EU Green Deal** are seeking to reframe EU policy and redirect resources  
***“Business as usual is no longer an option”***
- We agree with the need to be ambitious and transformative change to improve our health and environment
- Yet Roadmaps, Strategies and Action Plans need to be seen to deliver concrete outcomes – credibility
- There remains a challenge of how to organise governance so that **Concerns, Problems and Solutions** are combined to engage and energise populations - legitimacy



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

The present work reflects only the author's view and the Funding Agency can not be held responsible for any use that may be made of the information it contains.



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