LEGVALUE Project (started in 2017)
http://www.legvalue.eu

Session 3 - Integration of plant proteins in food and feed systems

Why and how to promote more diversified protein plants as pulses in agrifood systems ?

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ODYCEE Research team on knowledge and innovation dynamics in value chains and territories

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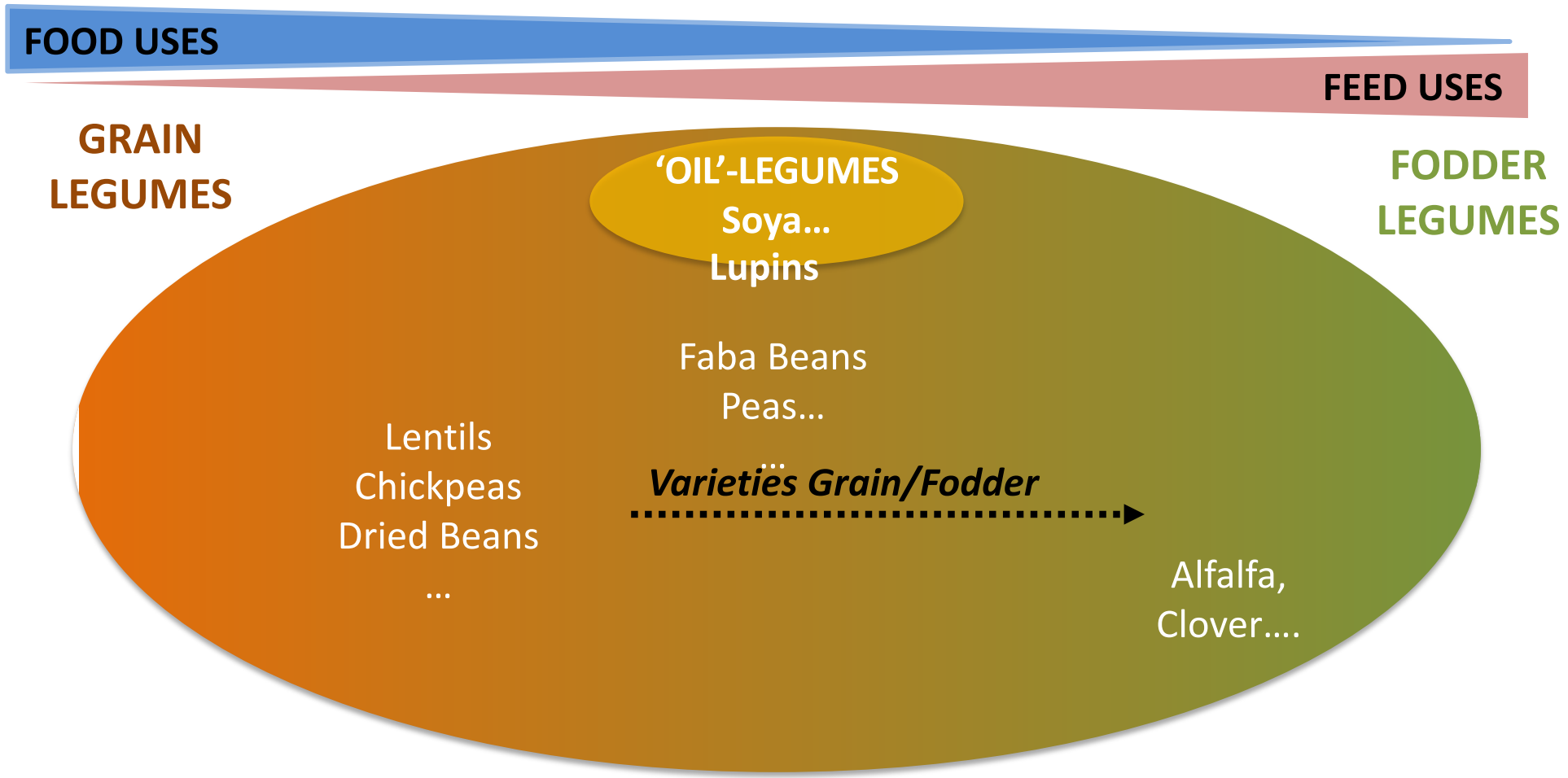
Workshop « Research & Innovation in Plant Proteins »
Brussels 24&24 April 2018

LEGUMES CLASSIFICATION

Legumes: plants fixing atmospheric nitrogen through symbiosis with soil bacteria to produce protein-rich plants >18% protein content (dry weight).

Europe, various terms : protein crops, (dried) pulses, fodders, soya (oil-protein-seed)…

Australia, Canada, USA : **pulses** are grain-legumes for food/feed, excluding legumes rich in oil like soybeans.



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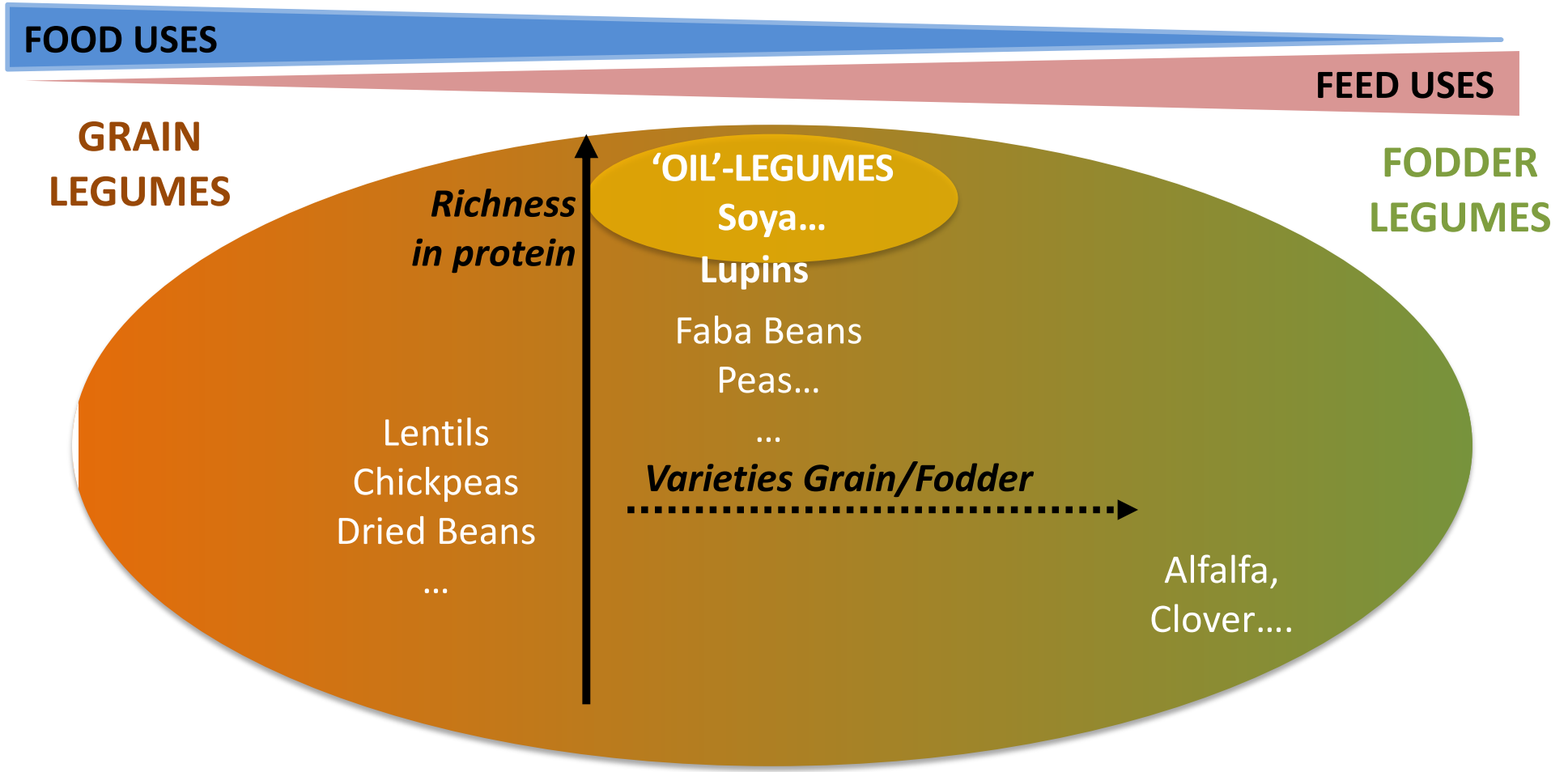

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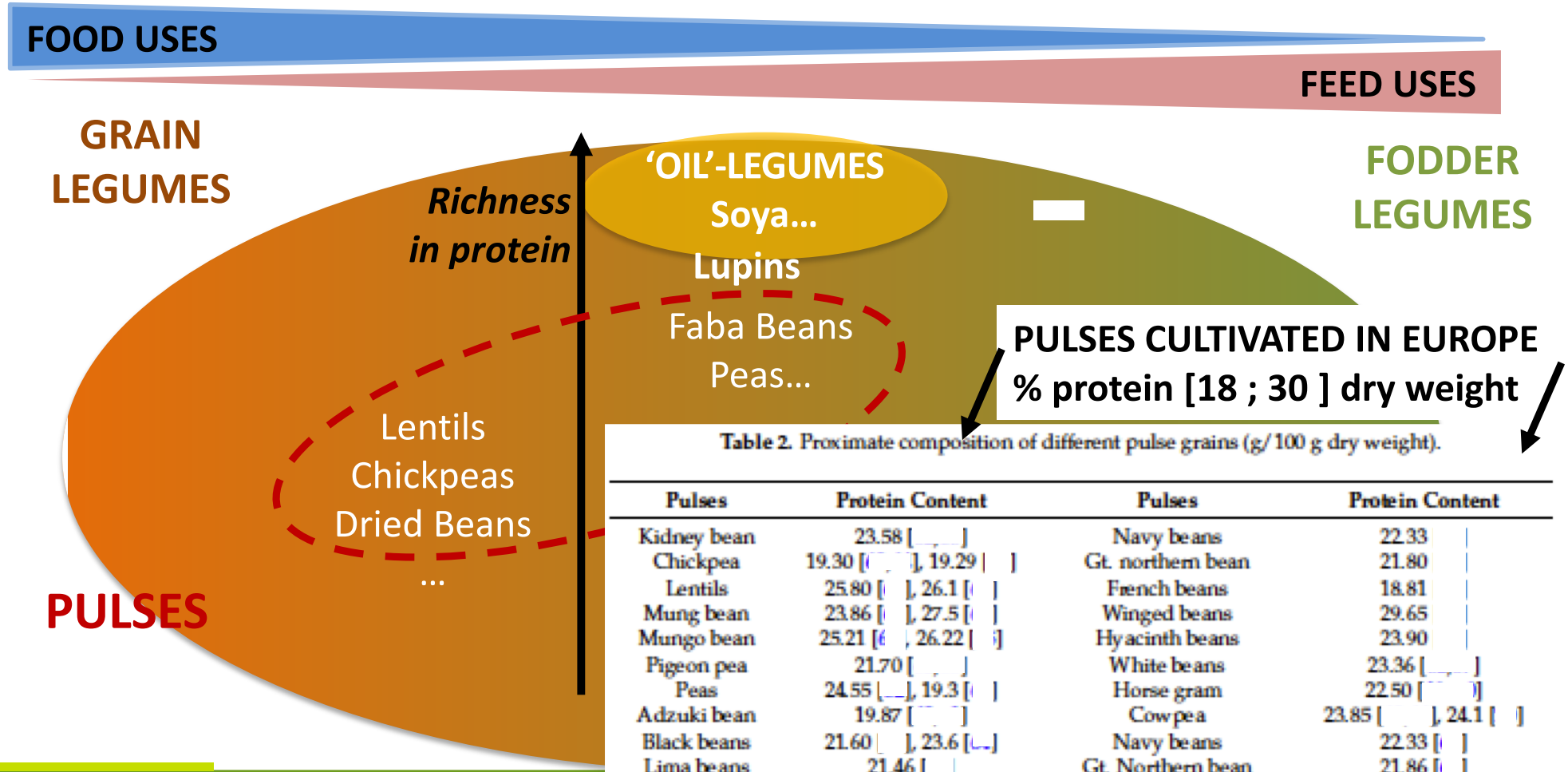


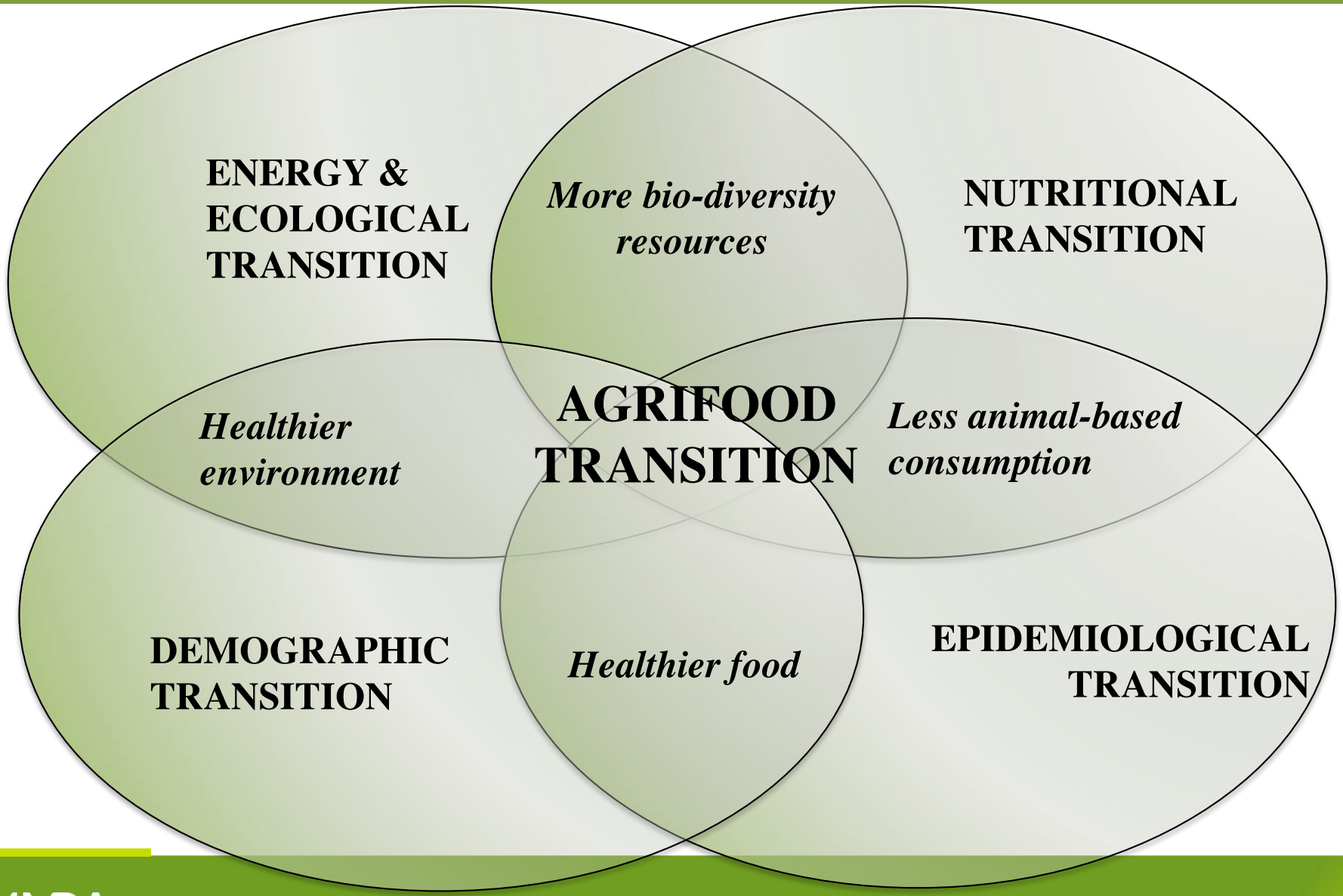
PULSES CULTIVATED IN EUROPE
% protein [18 ; 30] dry weight

Table 2. Proximate composition of different pulse grains (g/100 g dry weight).

Pulses	Protein Content	Pulses	Protein Content
Kidney bean	23.58 [ ]	Navy beans	22.33 [ ]
Chickpea	19.30 [ ], 19.29 [ ]	Gt. northern bean	21.80 [ ]
Lentils	25.80 [ ], 26.1 [ ]	French beans	18.81 [ ]
Mung bean	23.86 [ ], 27.5 [ ]	Winged beans	29.65 [ ]
Mungo bean	25.21 [ ], 26.22 [ ]	Hyacinth beans	23.90 [ ]
Pigeon pea	21.70 [ ]	White beans	23.36 [ ]
Peas	24.55 [ ], 19.3 [ ]	Horse gram	22.50 [ ]
Adzuki bean	19.87 [ ]	Cowpea	23.85 [ ], 24.1 [ ]
Black beans	21.60 [ ], 23.6 [ ]	Navy beans	22.33 [ ]
Lima beans	21.46 [ ]	Gt. Northern bean	21.86 [ ]

In Henchion et al., 2017

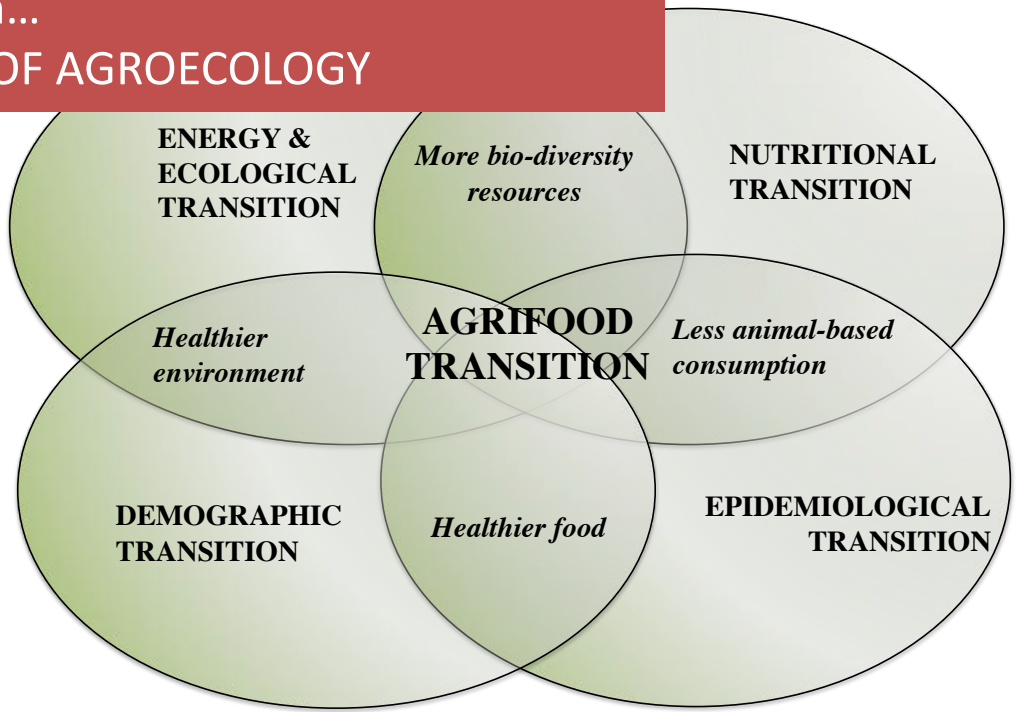
SUSTAINABILITY AGRIFOOD TRANSITION
= interconnected transitions & challenges



PULSES = a key pillar of sustainability agrifood transition

Ecosystems services from pulses/legumes :

↘ nitrogen need = ↘ GHG
↗ soil fertility and water efficiency
↗ crop diversification = ↘ pesticides
↗ pollination…
→ A PILLAR OF AGROECOLOGY



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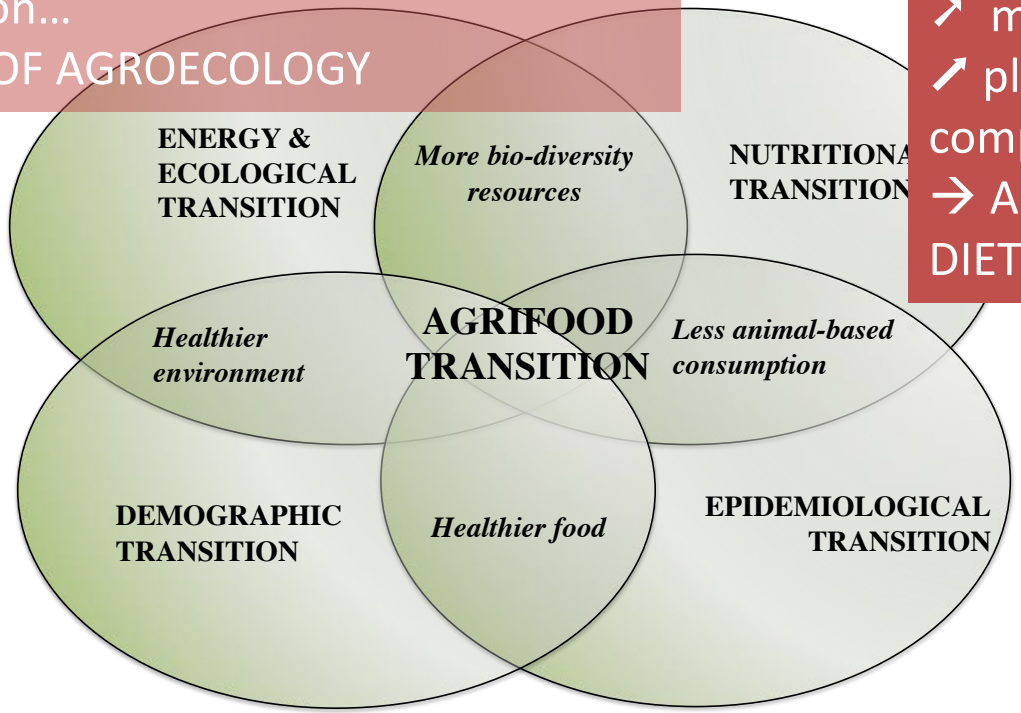

Pulses nutritional properties for food:

↗ fiber intake without gluten problem
↗ micronutrients diversity intake…
↗ plant-based protein intake, complementarity with cereals
→ A PILLAR OF LOW ANIMAL-BASED DIETS

PULSES = a key pillar of sustainability agrifood transition

Ecosystems services from pulses/legumes :

↘ nitrogen need = ↘ GHG
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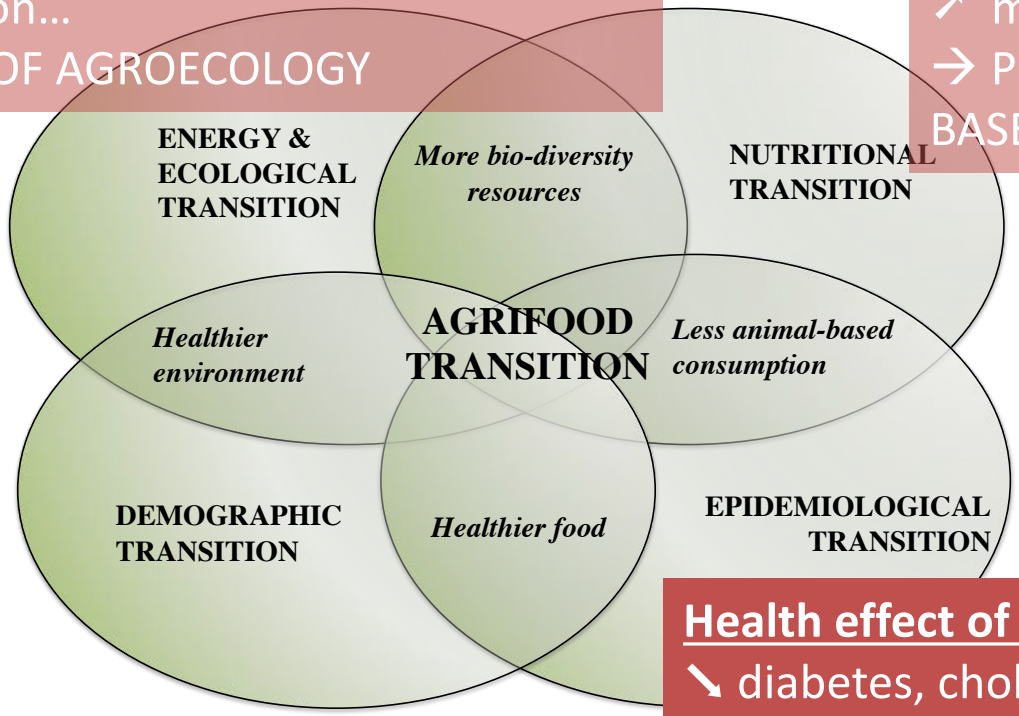
→ A PILLAR OF AGROECOLOGY

Useful nutritional properties for food:

↗ plant-based protein intake, complementarity with cereals
↗ fiber intake without gluten problem
↗ micronutrients diversity intake…
→ PULSES, A PILLAR OF LOW ANIMAL-BASED DIETS



Health effect of regular consumption of pulses:

↘ diabetes, cholesterol..
↘ obesity risk ↘ Scarcopenia…
↘ cancers…
→ HEALTHY FOOD from children to the elderly

PULSES = a key pillar of sustainability agrifood transition

Ecosystems services from legumes :
↘ nitrogen need = ↘ GHG
↗ soil fertility and water efficiency
↗ crop diversification = ↘ pesticides
↗ pollinisation…
→ LEGUMES, A PILLAR OF AGROECOLOGY

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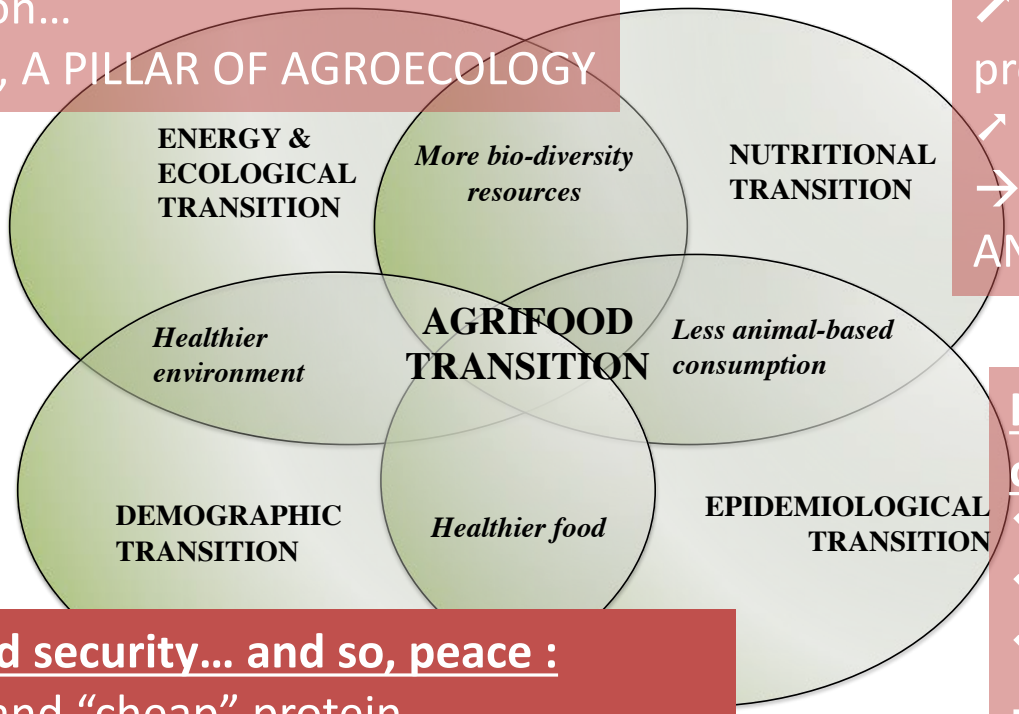


Health effect of regular consumption of pulses:
↘ diabetes, cholesterol…
↘ obesity risk
↘ cancers…
→ A PILLAR OF HEALTHY FOOD from children to eldery

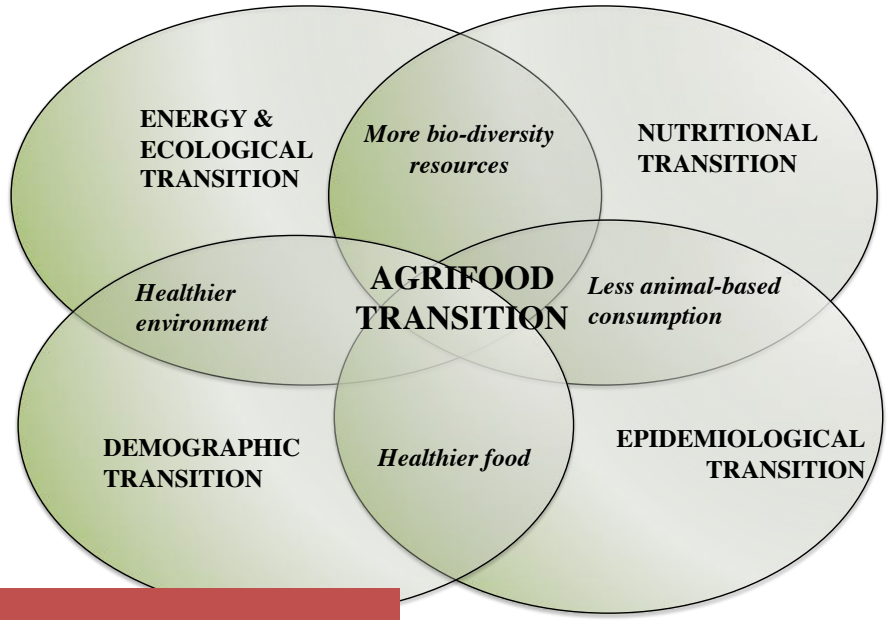
Increase food security… and so, peace :
Sustainable and "cheap" protein
↗ global demand : new export markets
→ in the Mediterranean region : traditional food, European food quality recognized…
→ In India, China : ↗ import of PULSES

PULSES = a key pillar of sustainability agrifood transition

AGROECOLOGY
=
MORE BIODIVERSITY CULTIVATED WITH PULSES

HEALTH FOOD
=
LOW ANIMAL-BASED DIETS
&
HIGH PULSES-BASED DIETS

2016 INTERNATIONAL YEAR OF PULSES



PULSES FOR FOOD SECURITY

BUT FEW PULSES
IN EUROPEAN AGRIFOOD SYSTEMS !

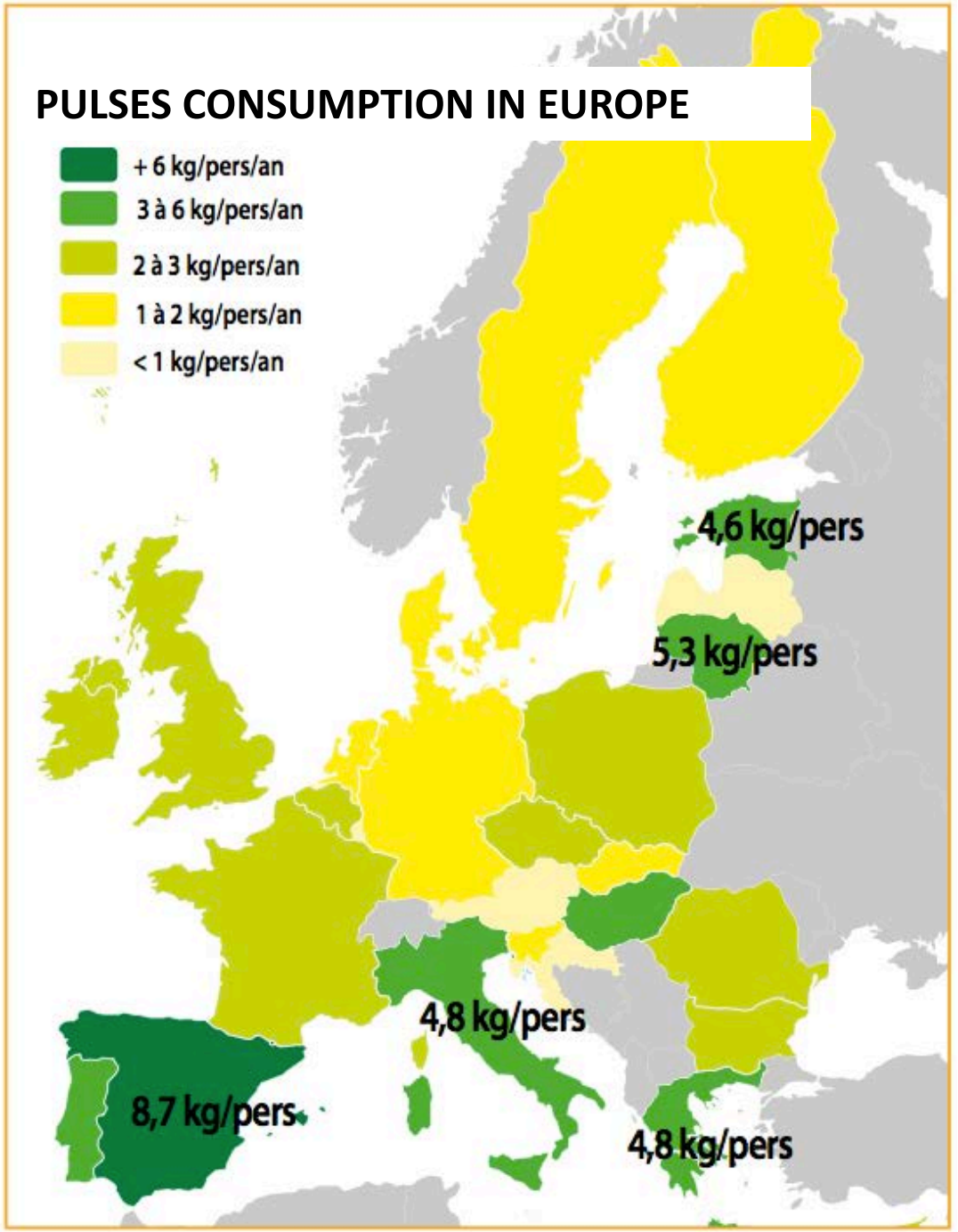
Low food consumption in EUROPE

Cons. Kg/capita/year	2011	
	FRANCE	EUROPE
Pulses	**1,7**	**2,9**
Rice	5	5,2
Potatoes	50	72
Wheat	107	**110**

Agreste stats, OECD stats

Pulses consumption in CANADA

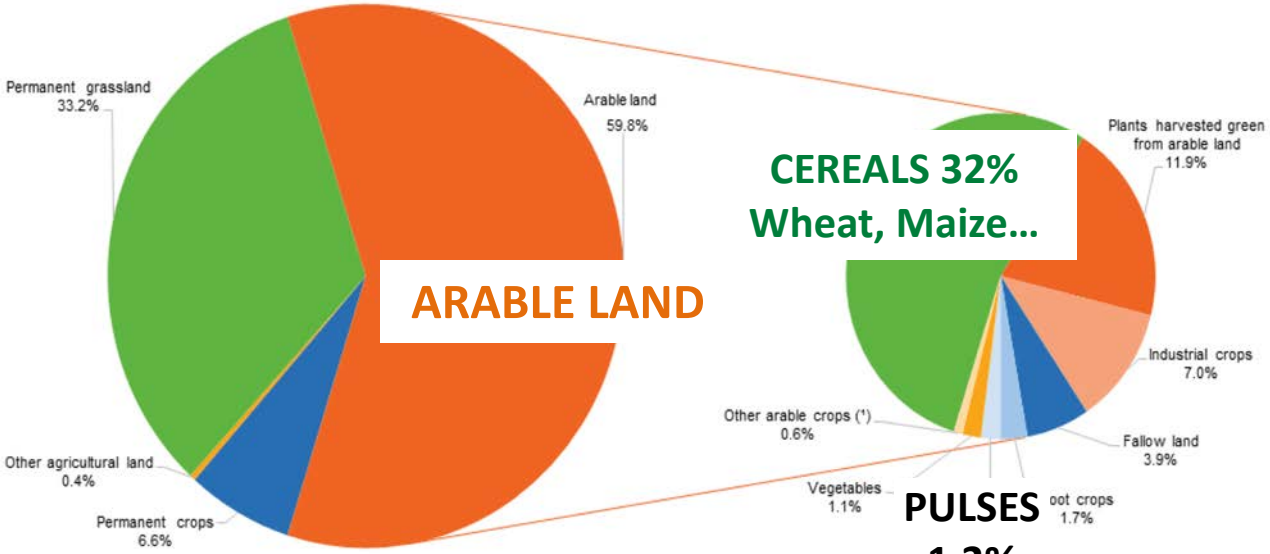
Cons. Kg/capita/year	
1998	5,3
2011	11,4

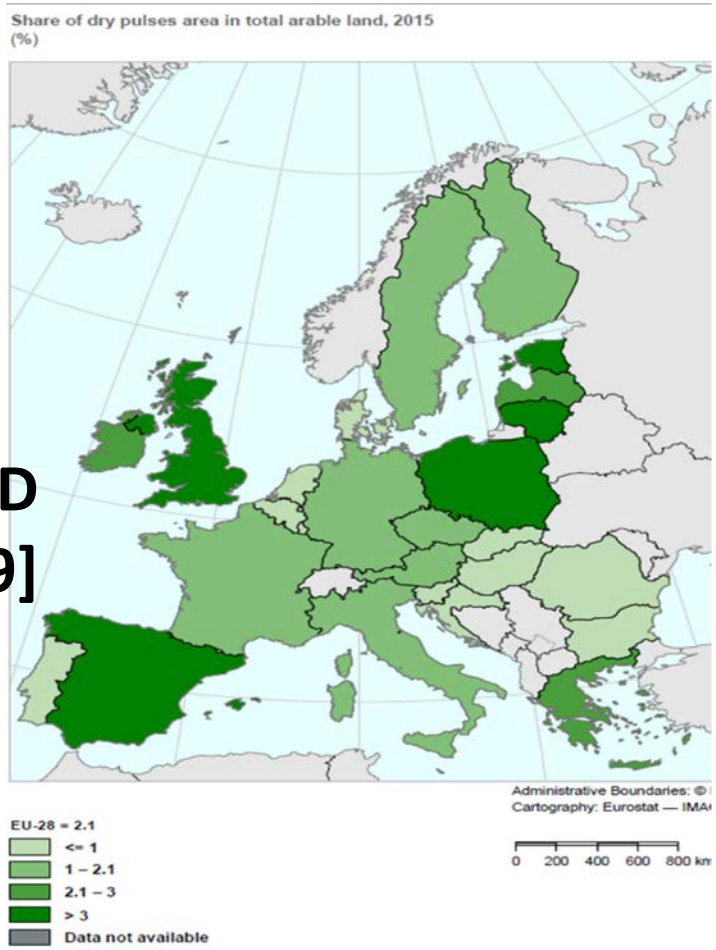


In Métayer, Denhartigh, 2016

INRA SCIENCE & IMPACT

Low production of pulses in EUROPE





% PULSES IN ARABLE LAND
of Europ. countries [<1 ; 3,9]

Max in Spain

EU exports 500 000 tons of pulses
EU imports 1 000 000 tons of pulses

Dry pulses in EU, Eurostat, 2016

”beyond meat” innovations : billion are invested…

La « clean meat », nouvelle utopie de la Silicon Valley

En Californie, des start-up tentent de créer une « viande » moins destructrice pour l'environnement à partir de plantes ou de cellules.

LE MONDE ECONOMIE | 19.04.2018 à 06h52 • Mis à jour le 20.04.2018 à 12h01 |

Par **Chloé Hecketsweiler** (Envoyée spéciale en Californie)

Le Monde.fr

Burger without meat
« Impossible Foods » compagny
in California
13$, APRIL 2018

Le Monde 20th april 2018

… but much less on pulses' innovations

EX: plant-based high process pathways

(beyond meat, ready-to-eat dishes…)

"Considering the plant-based protein products, the increase has been estimated at more than 40% between 2013 and 2018. Representing 7.1 billion in 2013, this market is expected to be € 10 billion in 2018. **Wheat proteins and / or soya are components of more than 90% of new products launched on the market in 2013.** Despite the crushing weight of these plant proteins leader, the growth in demand allows other plant proteins alternatives such as peas and corn to take market share (5% and 3% of new product launches in 2013) "

Translated from Gueguen et al. 2016

« Meat substitutes, derived from non-meat protein sources, are rising quickly in demand, especially in western regions, but also in Asia. Still, pulses only account for a surprisingly low share of the protein used in those products; **soy proteins and wheat protein, as well as egg and dairy protein, make up the majority.** Rabobank forecasts meat substitutes to show a strong future growth, **but by 2025, the use of pulses for these products is forecast to account for only about 2% of all globally consumed pulses.** »

RADOBANK 2017

… but much less on pulses' innovations

EX: plant-based high process pathways

(beyond meat, ready-to-eat dishes…)

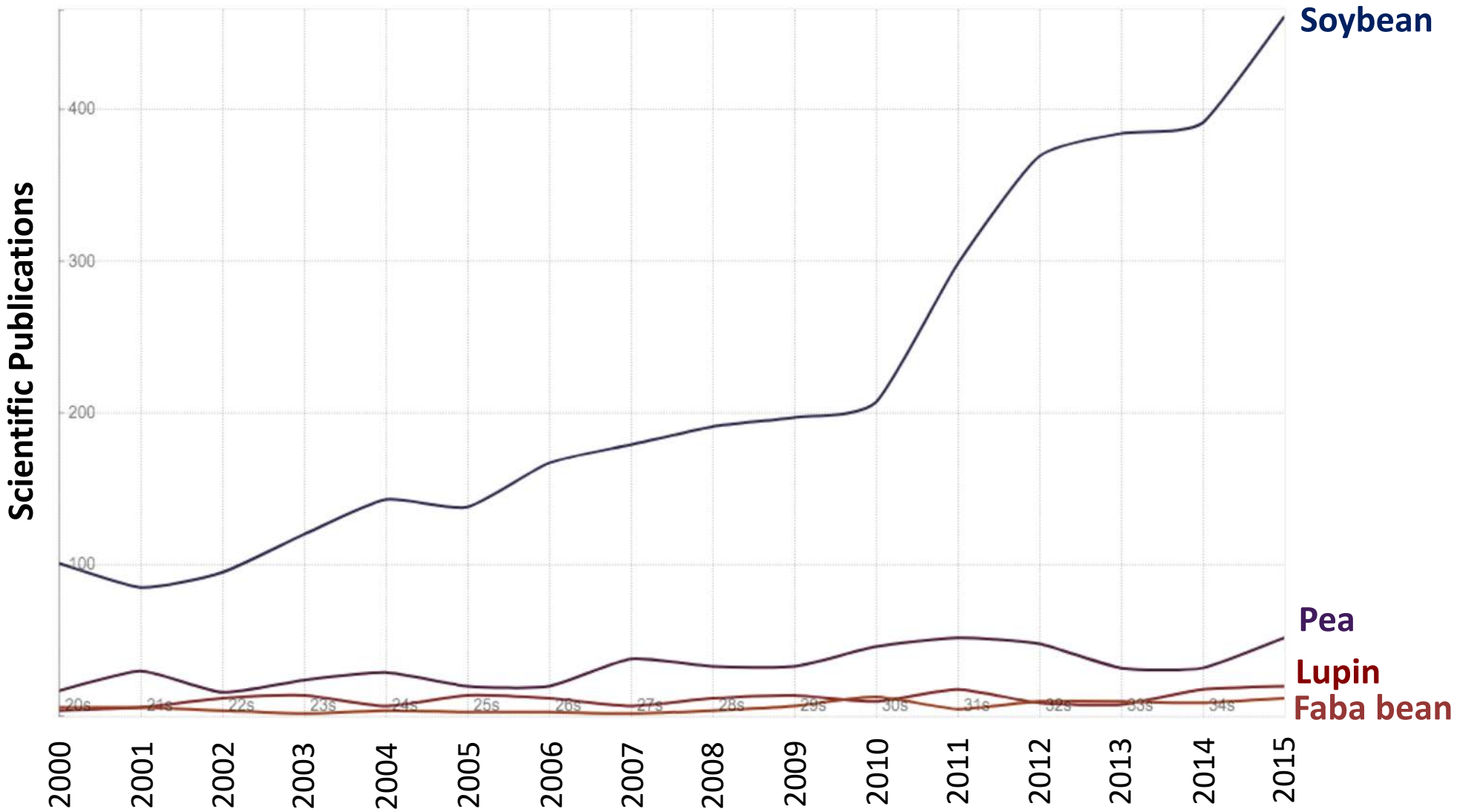
"Considering the plant-based protein products, the increase has been estimated at more than 40% between 2013 and 2018. Representing 7.1 billion in 2013, this market is expected to be € 10 billion in 2018. Wheat proteins and / or soya are components of more than 90% of new products launched on the market in 2013. Despite the crushing weight of these plant proteins leader, the growth in demand allows other plant proteins altern
share
"

→ NO ! NOT SURPRISINGLY !!!

« Meat substitutes, derived from non-meat protein sources, are rising quickly in demand, especially in western regions, but also in Asia. **Still, pulses only account for a surprisingly low share of the protein used in those products**; soy proteins and wheat protein, as well as egg and dairy the majority. eat substitutes to growth, but by ulses for these account for only about 2% of all globally consumed pulses. »

RADOBANK 2017

Soya dominates the scientific knowledge on food sciences



Amongst 4 main grain-leg., soya= 85% of the global scientific literature on food sciences

(2000-2015, Web of Science collection)

INRA SCIENCE & IMPACT

Even if many societal interests, PULSES face a LOCK-IN, hampering their development for more sustainable agrifood systems.

→ **What is lock-in ? How it occurred in Europe ?**

→ **Which policies for change ? Which priorities ?**

Ecological Economics 126 (2016) 152–162

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Why are grain-legumes rarely present in cropping systems despite their environmental and nutritional benefits? Analyzing lock-in in the French agrifood system

Marie-Benoit Magrini [a,*], Marc Anton [b], Célia Cholez [a,c], Guenaelle Corre-Hellou [d], Gérard Duc [e], Marie-Hélène Jeuffroy [f], Jean-Marc Meynard [g], Elise Pelzer [f], Anne-Sophie Voisin [e], Stéphane Walrand [h]

AGRO-ECOSYSTEM DIVERSITY

RECONCILING CONTEMPORARY AGRICULTURE AND ENVIRONMENTAL QUALITY

Edited by
GILLES LEMAIRE
PAULO CÉSAR DE FACCIO CARVALHO
SCOTT KRONBERG
SYLVIE RECOUS

Magrini et al., 2016; 2018 (forthcoming)

INRA SCIENCE & IMPACT

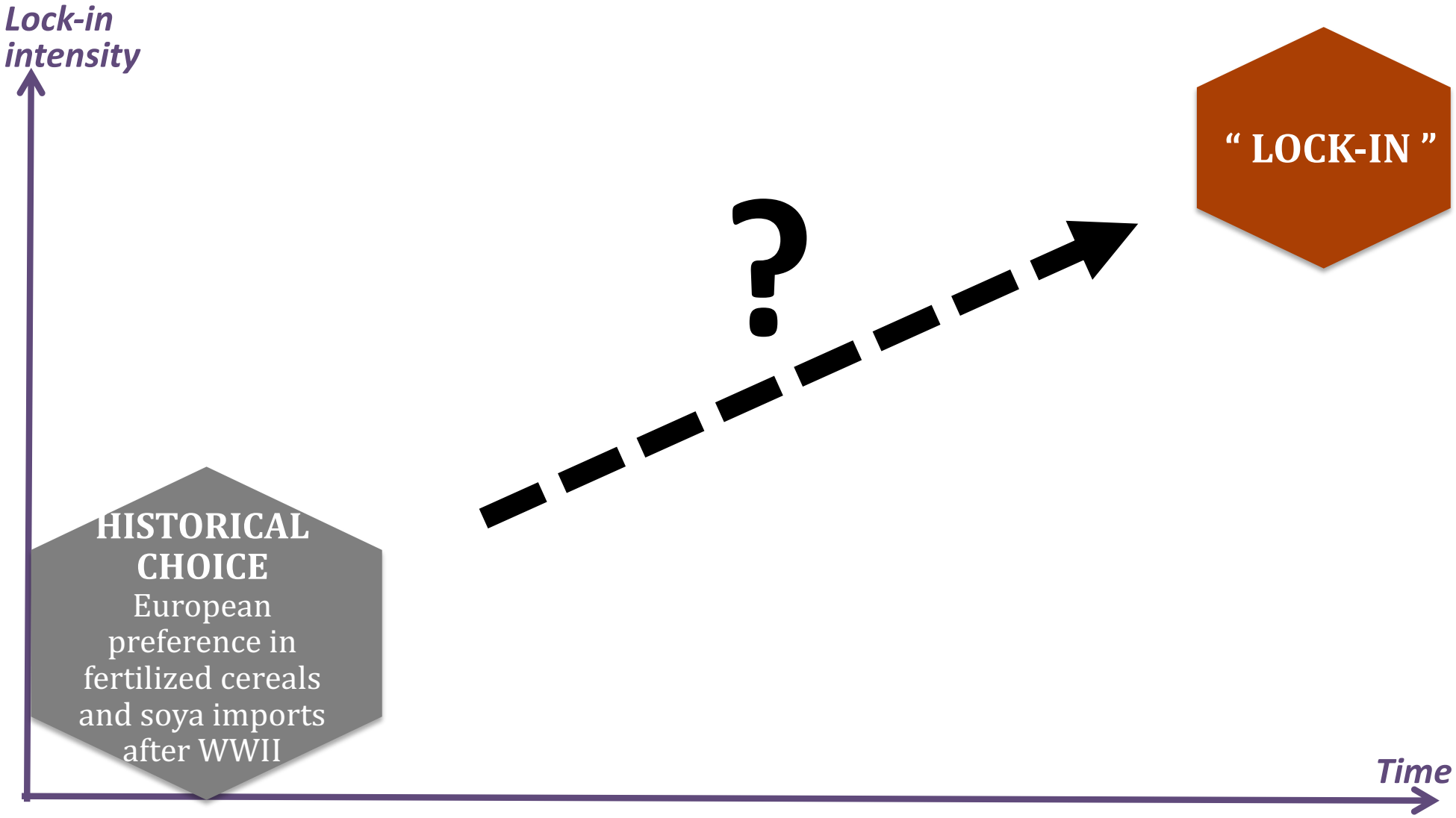
A key-concept : the “Increasing Returns of Adoption”

Concept from evolutionary economics, explaining how a technology gradually ‘dominates’ other alternative technologies .

The founding assumption of this theory is that :
one technology is dominant, not necessarily because it is the best;
but since the initial choice has been reinforced over time, the technology (first-chosen) became more performant compared to other alternatives,
as research and market investment were only done in that one direction.

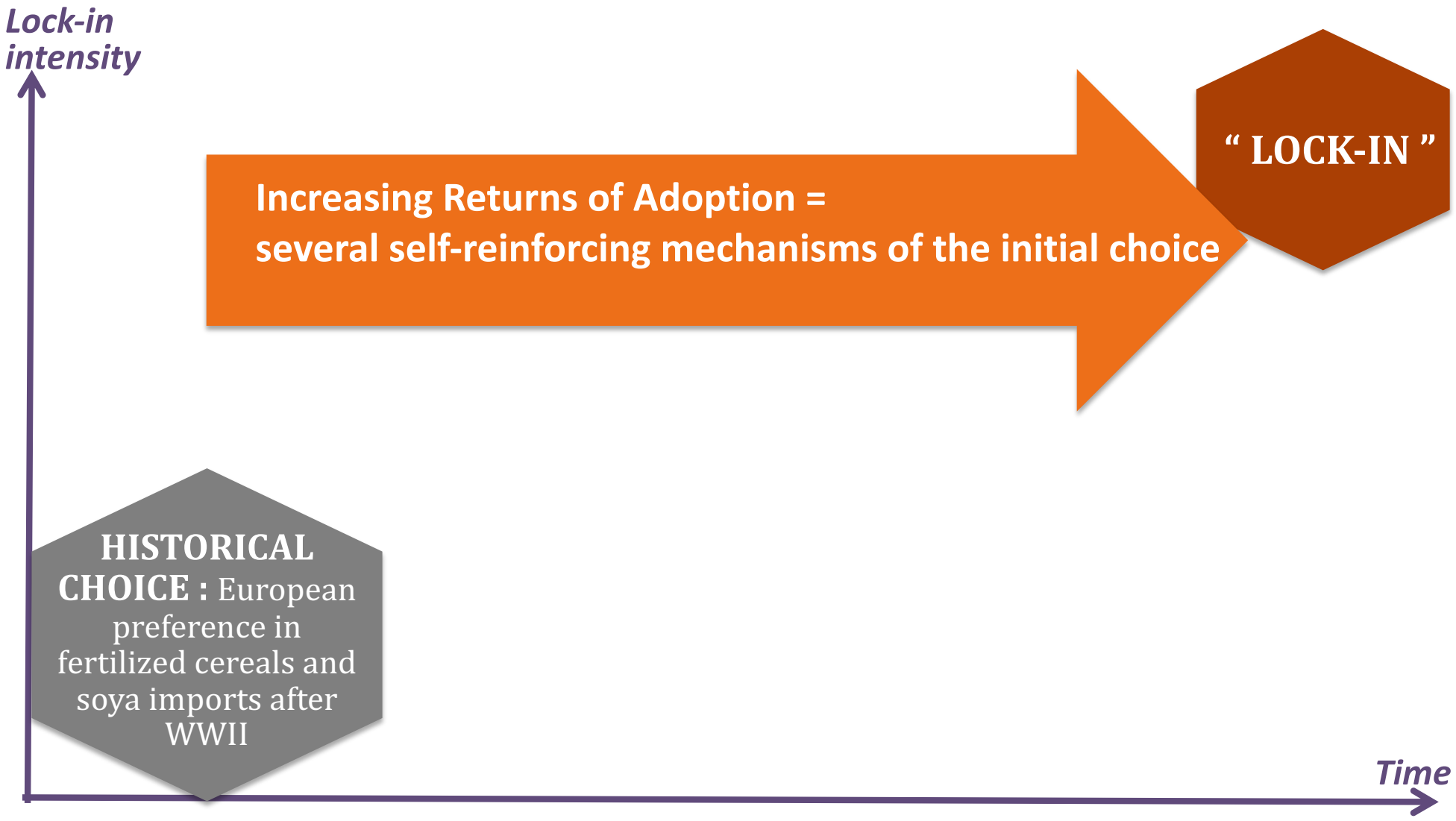
→ One technology is not adopted because it is the best,
but it becomes ”the best” as it has been chosen: path-dependency process

HOW LOCK-IN HAPPENS ?



Adapted from Magrini et al. 2016

THE AGROFOOD SOYA/WHEAT LOCK-IN



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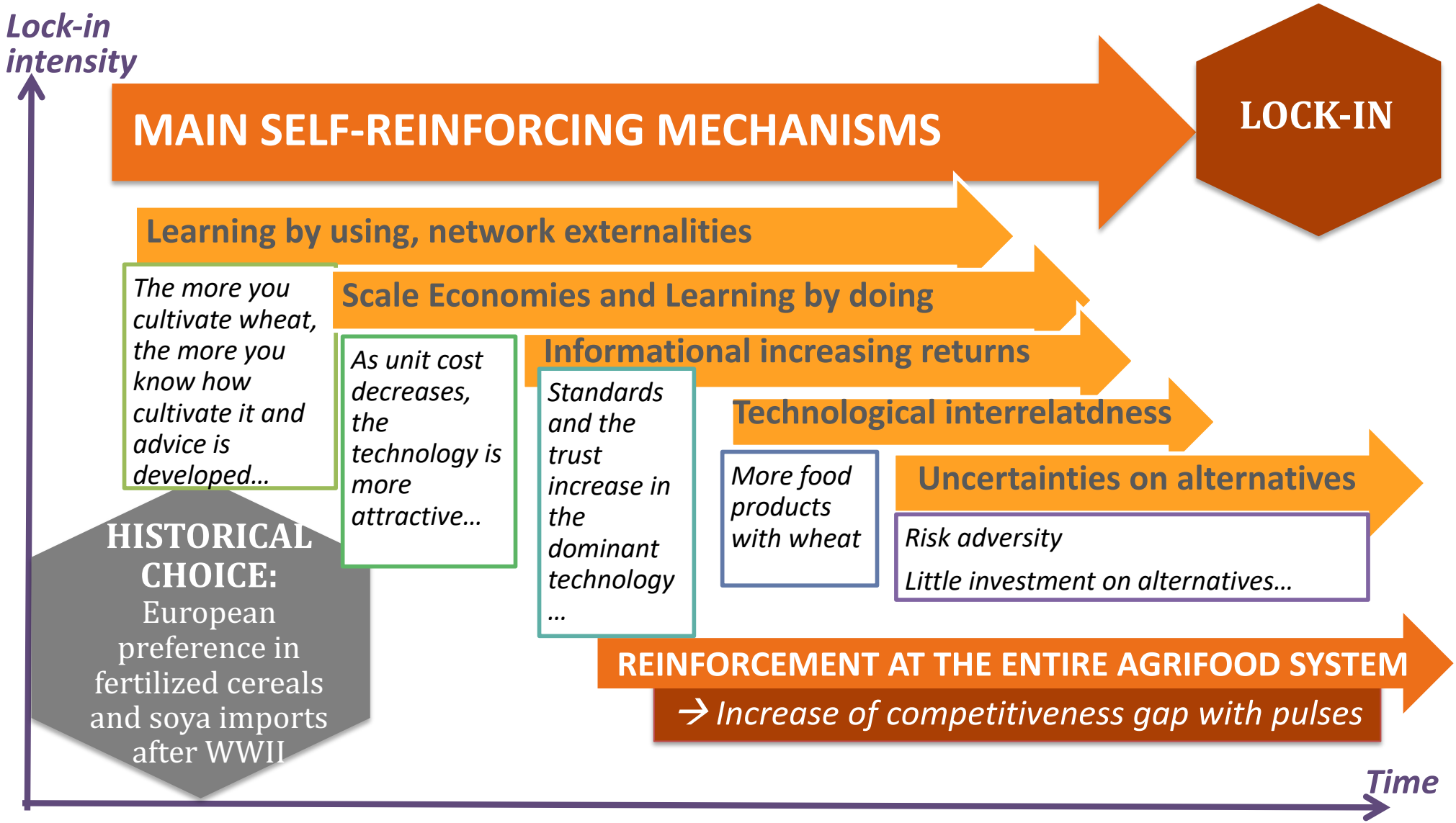
INCREASING RETURNS OF ADOPTION
in favor of wheat in Europe and soya in America



Adapted from Magrini et al. 2016

Main mechanisms of the Increasing Returns of Adoption

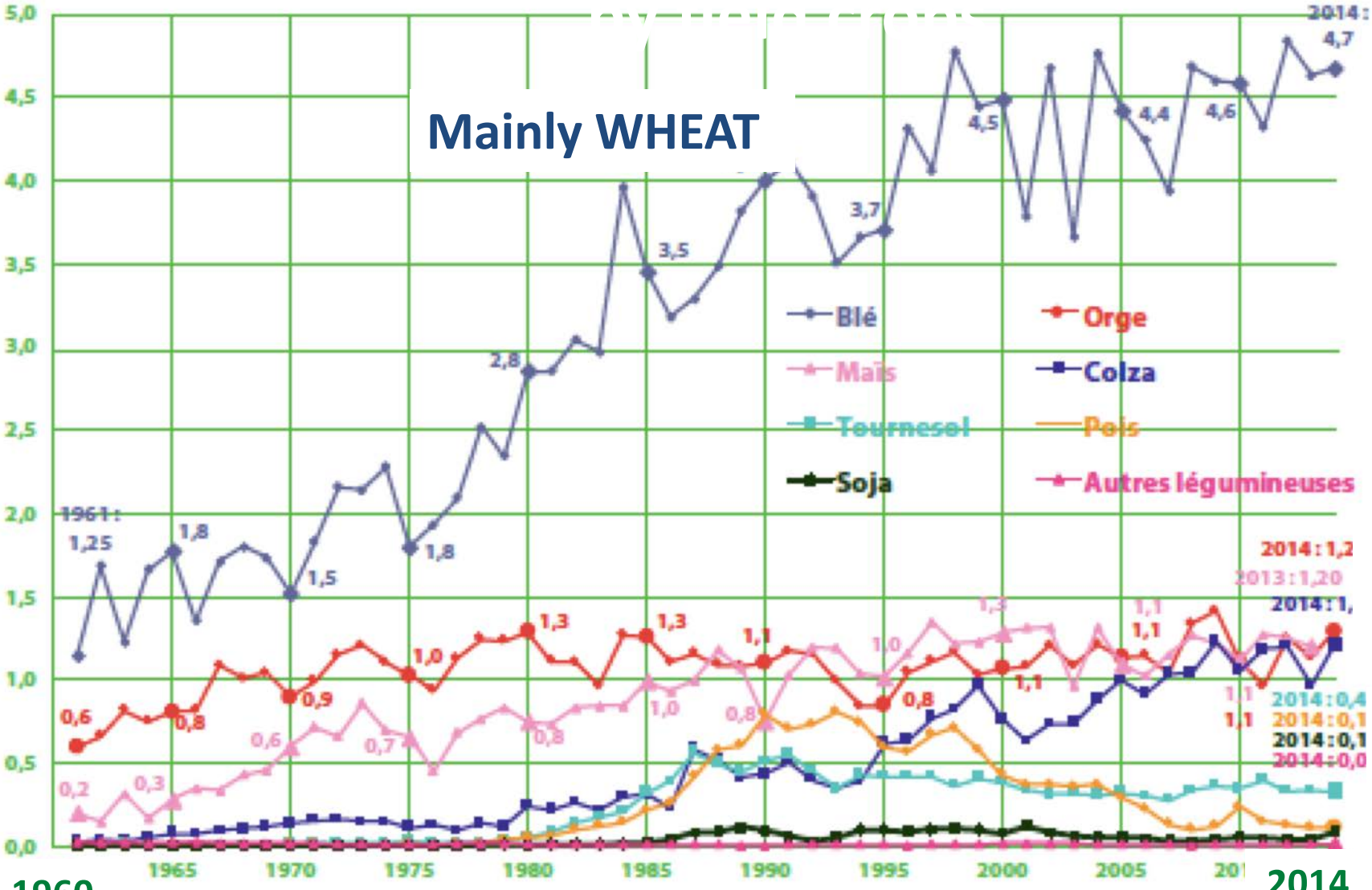
Concept from evolutionary economics, several self-reinforcement mechanisms of initial choice due to social and economic behaviours:

1) **learning by using:** a technology's productive performance increases with users' experience;
2) **network externalities**: the more adopters there are, the better it is for other users to adopt that technology to take advantage of additional products and services that are developed to be compatible with the dominant technology;
3) **scale economies and economies from learning by doing:** the unit cost of production decreases over time as a result of volume and improved technology, making the technology even more attractive;
4) **informational increasing returns**: the more a technology is used, the more it is known and understood, thus encouraging other users to adopt it;
5) **technological interrelatedness:** other technologies and production standards are established in line with the dominant technology.
6) **Institutional relatedness :** rules, standards, supports… are built in favor of the major technology
7) **Adaptive expectations :** beliefs and narratives that reinforce the idea that alternatives are not possible…
8) …

→ One technology is not adopted because it is the best, but it becomes "the best" as it has been chosen : path-dependency

In Magrini et al. 2016, 2017, forthcoming 2018

The French case : the evolution of protein production among flied crops



New dev. RAPESEED

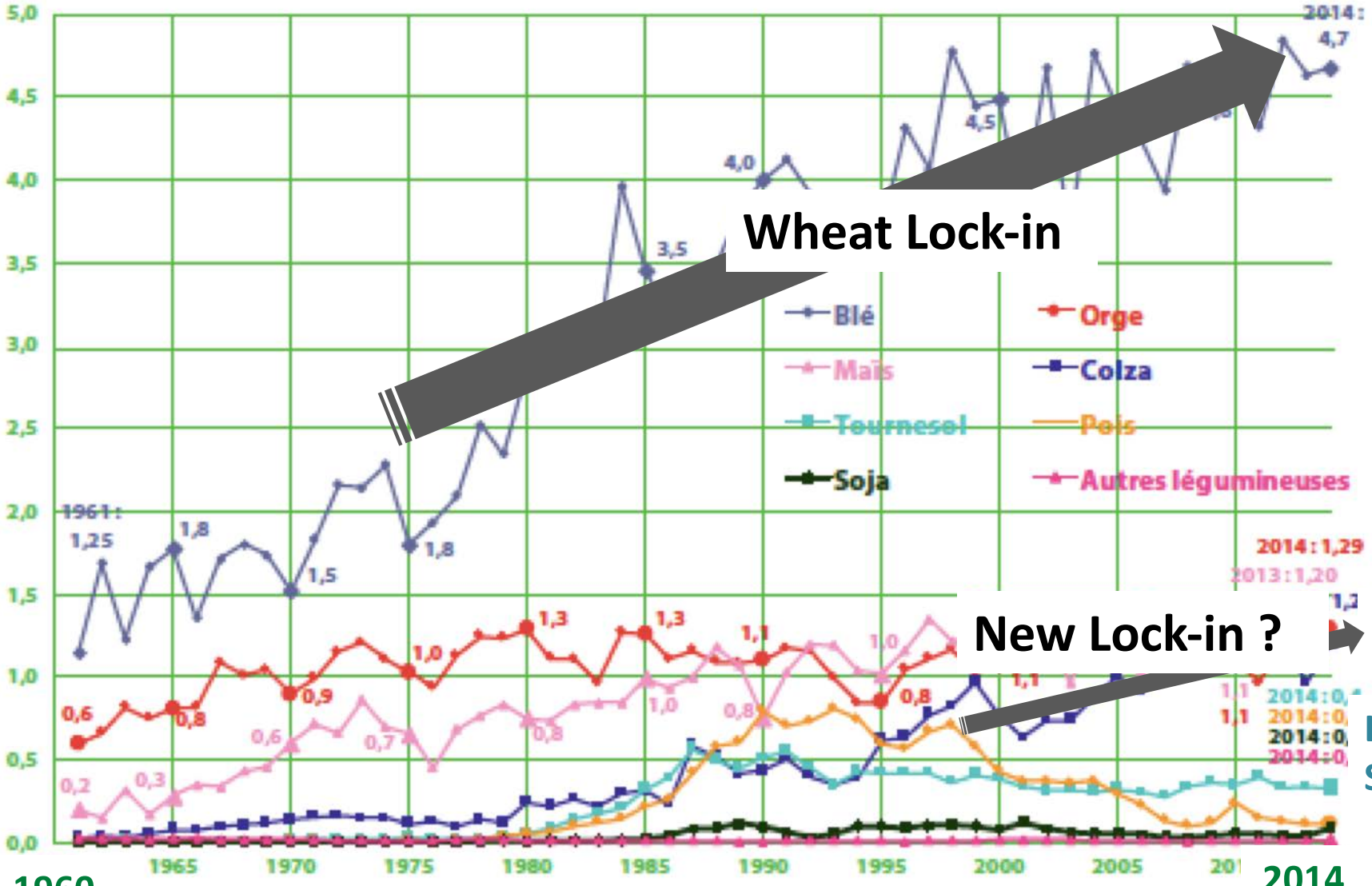
Little dev. SUNFLOWER

Soya

Other grain-legumes

In Jeuffroy et al. 2017

French case : the evolution of protein production by field crops



RAPESEED

Little dev. SUNFLOWER

Soya

Other grain-legumes

In Jeuffroy et al. 2017

What actions must be taken to “un-lock” ?

→ How to reduce the competitive gap between major crops and pulses ?

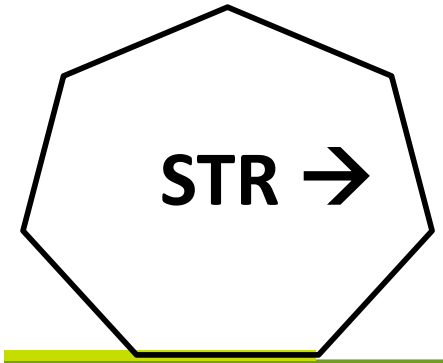
A SYSTEMIC PERSPECTIVE REQUIRED

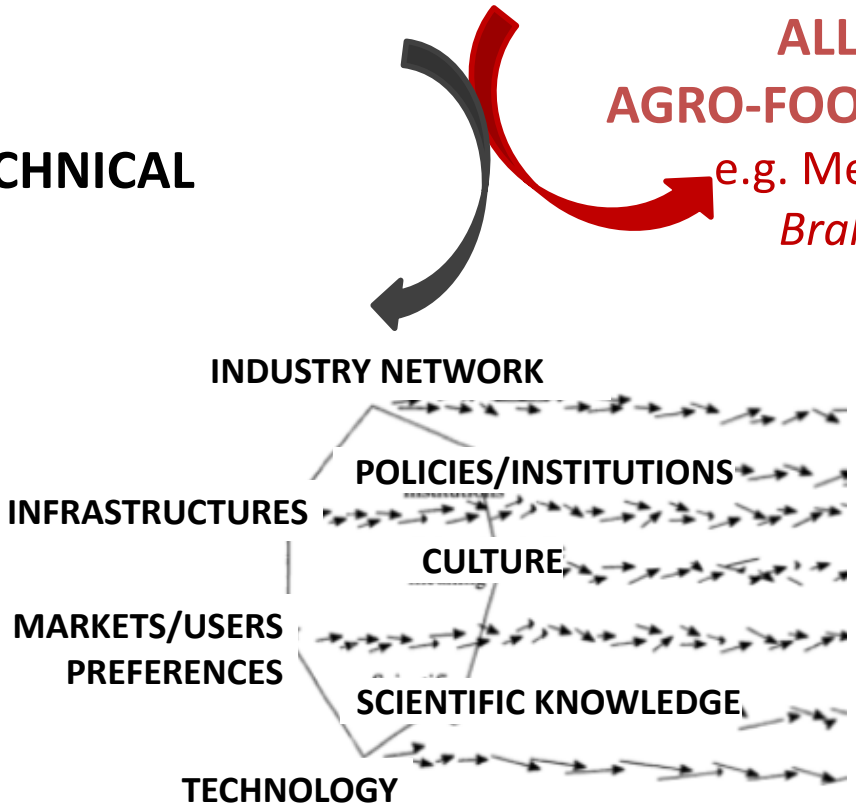
STRUCTURAL CHANGE:

- Long-time path of several changes
- Multi-dimensions, Multi-actors

ALL THE SOCIO-TECHNICAL REGIME: STR

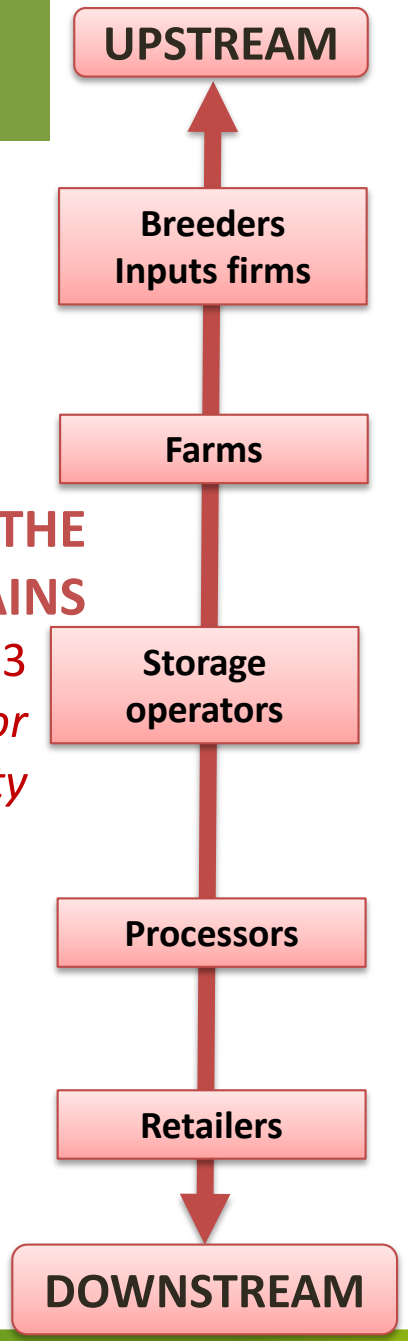
e.g. Geels 2004
Sustainability Transition Studies





ALL STREAMS OF THE AGRO-FOOD SUPPLY CHAINS

e.g. Meynard et al. 2013
Brakes and Levers for crop diversity



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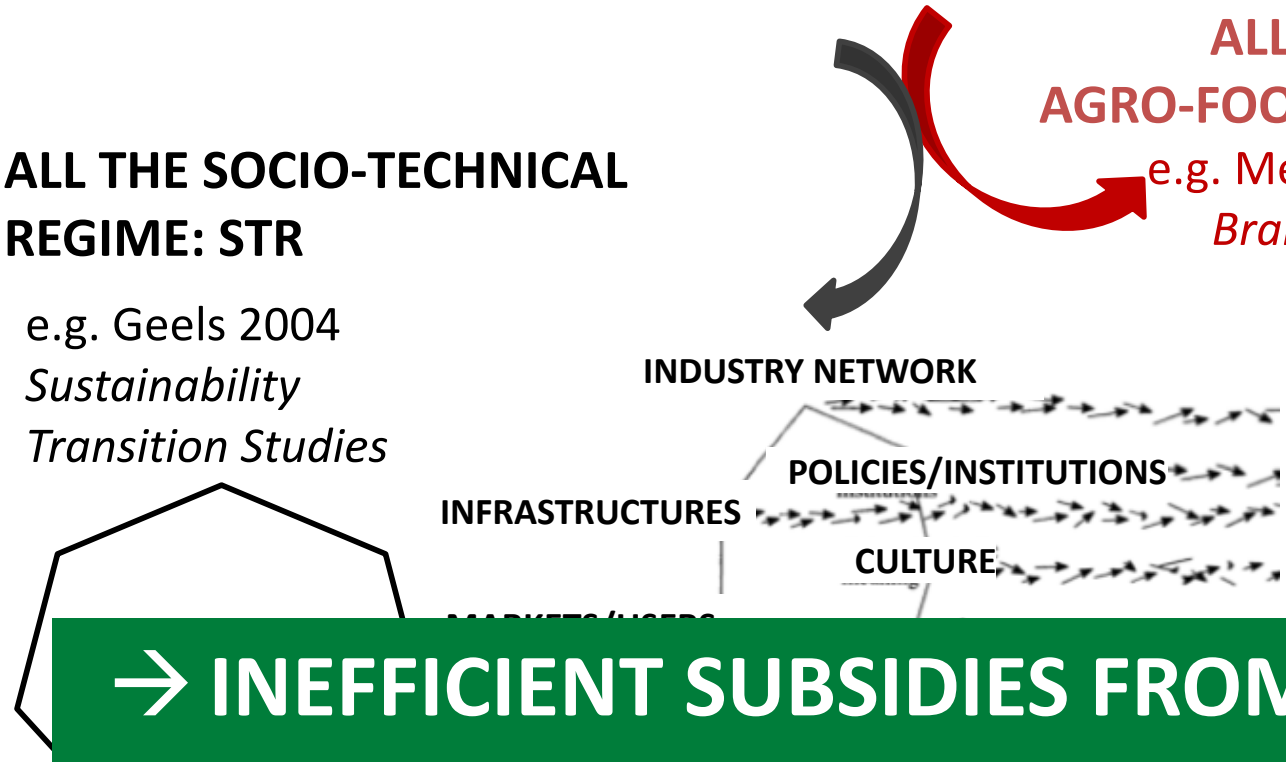

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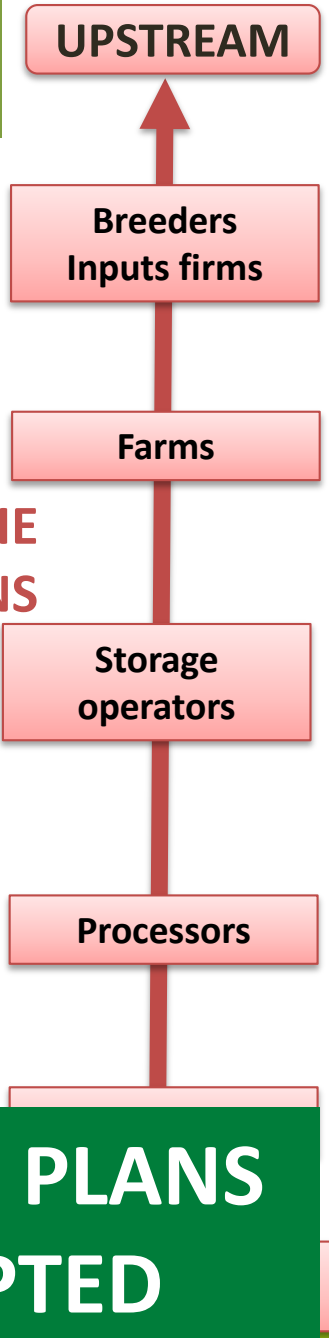


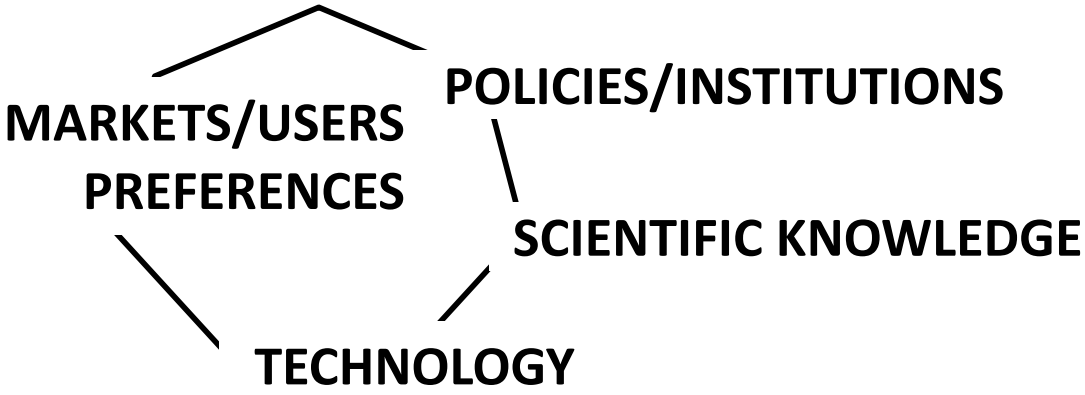
→ INEFFICIENT SUBSIDIES FROM PROTEIN PLANS IF NO STRUCTURAL POLICIES ARE ADOPTED

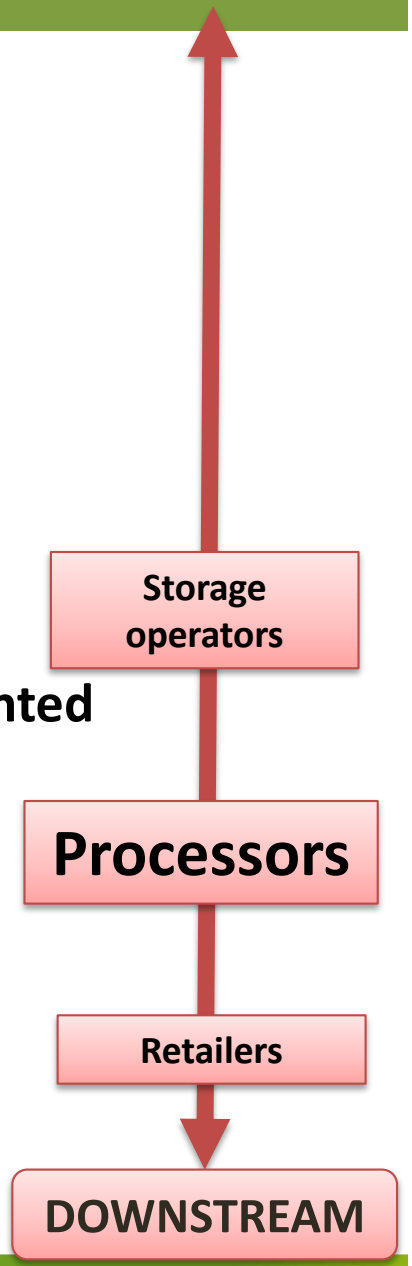
A downstream key = innovation on markets

1. To support pulses food innovation…

Propositions:

- Research programs on processing : **various processing for various users/markets, high & low – processing foods…**
- Open innovation / Fab labs to catch **innovation by using**
- To support “niche network actors” more ‘**radical innovation’-oriented**
- …



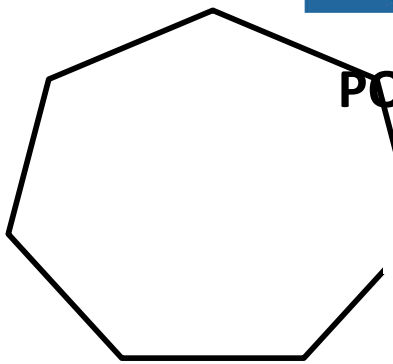


A downstream key = innovation on markets supported by an European nutritional policy

1. **To support pulses food innovation <u>& nutritional education/communication</u>**

Propositions:

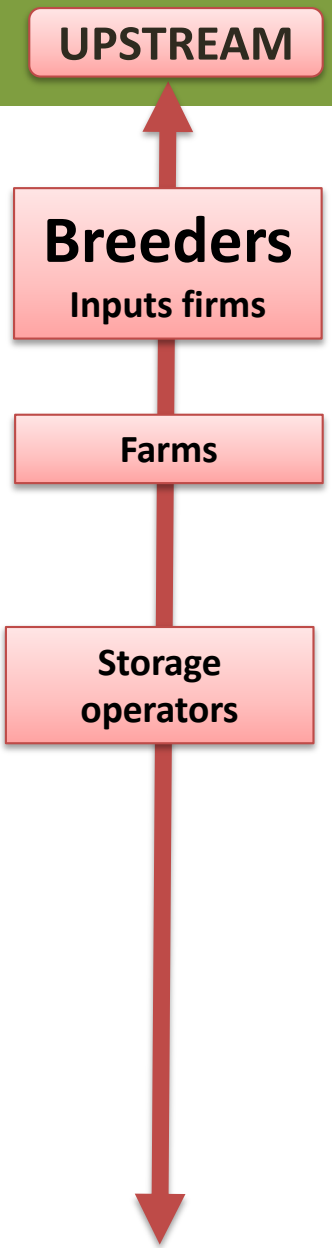
- **To unify nutritional recommendations on pulses**
- **…**



POLICIES/INSTITUTIONS

SCIENTIFIC KNOWLEDGE

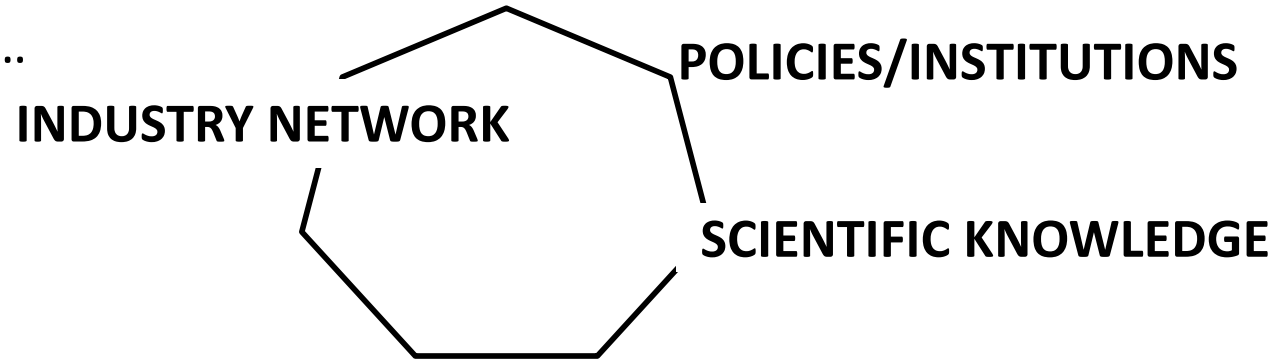
A UPSTREAM KEY = NEW SEEDS



2. How to find financial resources to increase investment in breeding activities ?

Propositions :

- **a redistributive tax between crops** (such as social tax between households)
- to increase **specific public investment on minor crops** (private investment more important on major crops)
- to develop **cooperation between breeders & with public reasearch** on minor seeds adapted to various territories…
- …

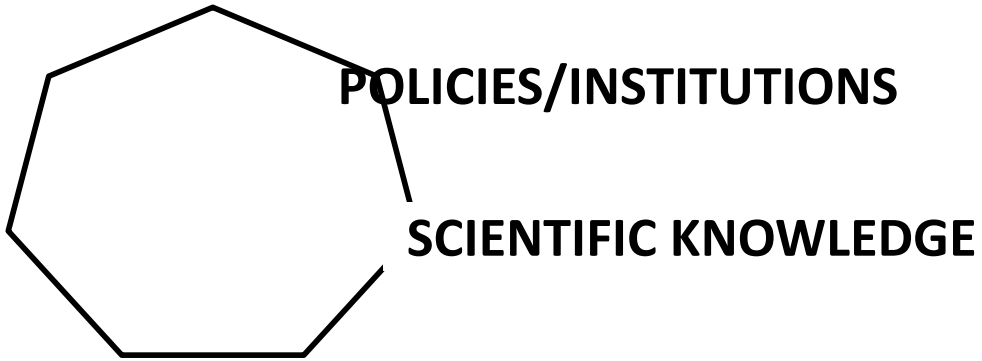


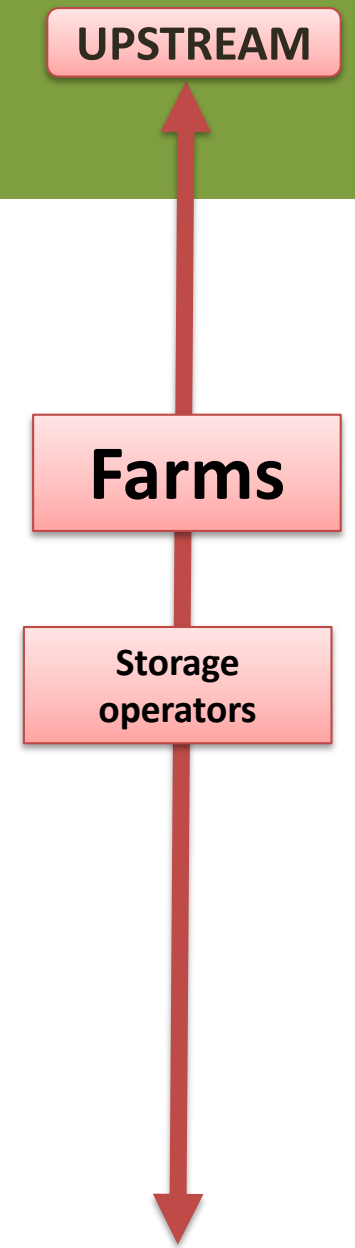
PULSES ECONOMIC BENEFITS ARE UNDER-ESTIMATED

3. How to help farmers in changing practices ?

Propositions:

- To adapt **cost accounting system** to push farmers to calculate intertemporal returns
- To reinforce and interconnect **accounting/agronomic advices**
- …





ECOSYSTEM SERVICES INTEGRATION

4. “additive payment on market” & ”imposed regulation on crop rotation/diversity” for the positive externalities of pulses

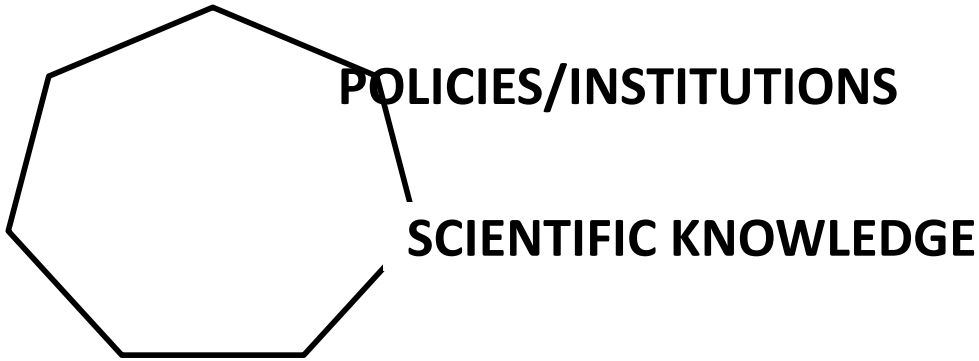
Propositions:

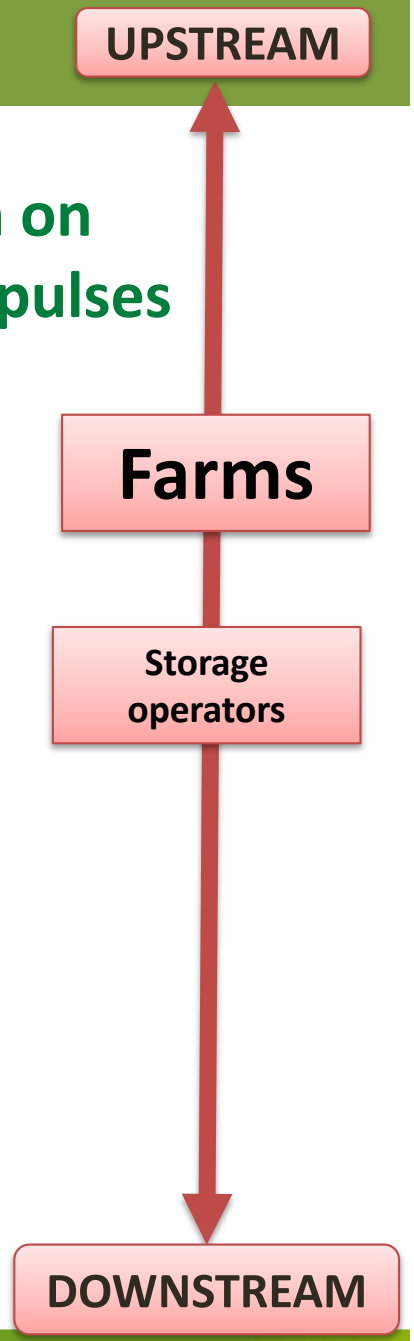
- **Better assessment** of those positive ecosystem services

“field measurement of biological N2 fixation is complex and costly and no methods are available for routine on-farm-use” (Anglade et al. 2015)

& “simple” tool of evaluation

- a **rule on legumes insertion to avoid plant diseases**
- …





CONCLUSION
multiple structural changes to support more pulses

1. Food innovations supported by institutional communication/education on pulses
2. New financial governance of breeding activities
3. New accounting system in agriculture to support good crop rotation management
4. To push farmers to take into account the ecosystem services of legumes/pulses in their decision making
5. ....

→ ALL THAT NEEDS STRONG COORDINATION IN VALUE CHAINS

TO ENGAGE ALL ACTORS IN NEW A LONG-PATH TRAJECTORY

NEW MEETING BETWEEN ALL ACTORS OF THE SUPPLY CHAINS AND RESEARCH

→ **To foster exchanges, knowledge transfer, choices of priorities in research… between all the stakeholders**

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Thanks for your attention

1. Food innovations supported by institutional communication/education on pulses
2. Integration of ecosystem services in decisi… farmers
3. New accounting system in agricultu…e to a… rotation management
4. New financial governance of bree…

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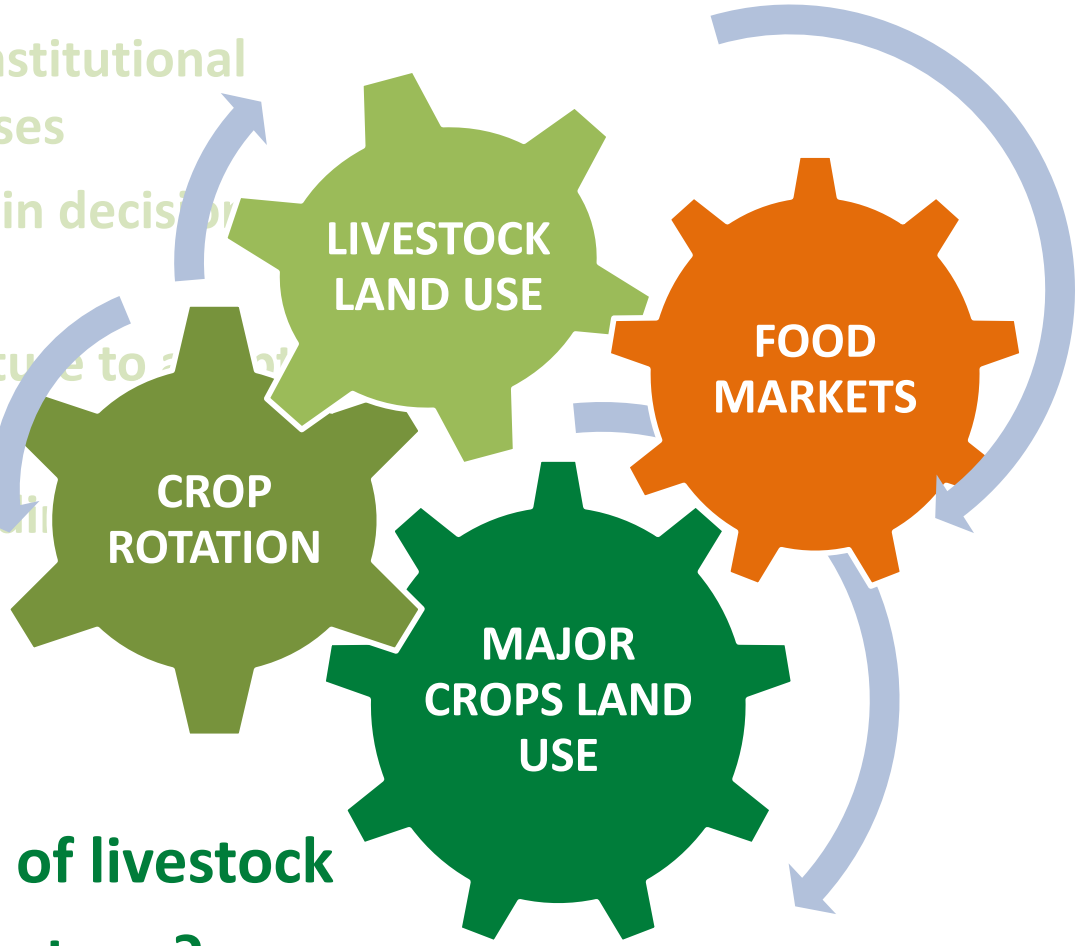

another fundamental question is:

What should be the importance of livestock in the next European agrifood system ?

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