

➤ Agrifood systems and coupled innovation

Caroline Pénicaud

2025 August 28

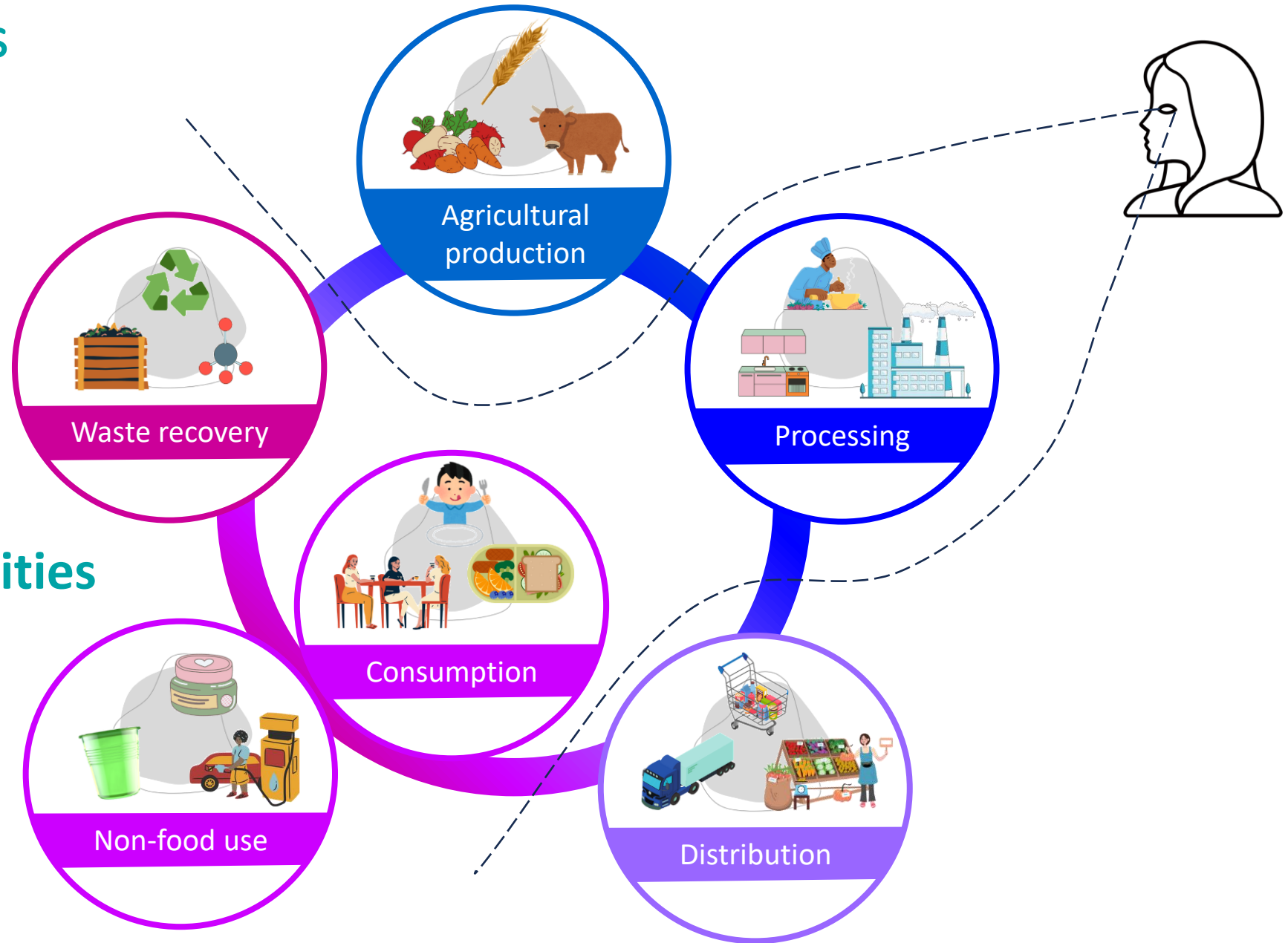


> Agrifood systems

The way people organize themselves, in space and time, to obtain and consume food

Malassis 1994

Many interrelated activities
Many stakeholders
Many value chains
From local to global



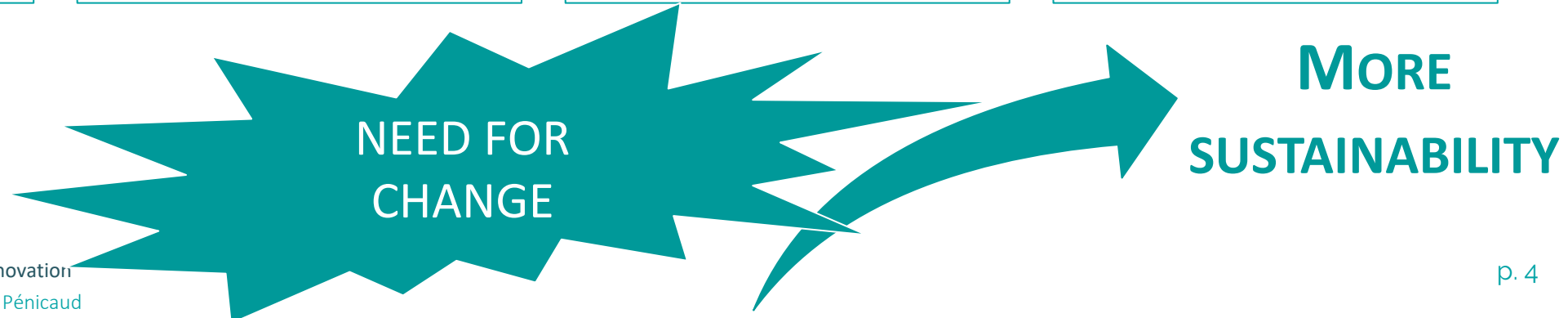
➤ Dominant agrifood systems



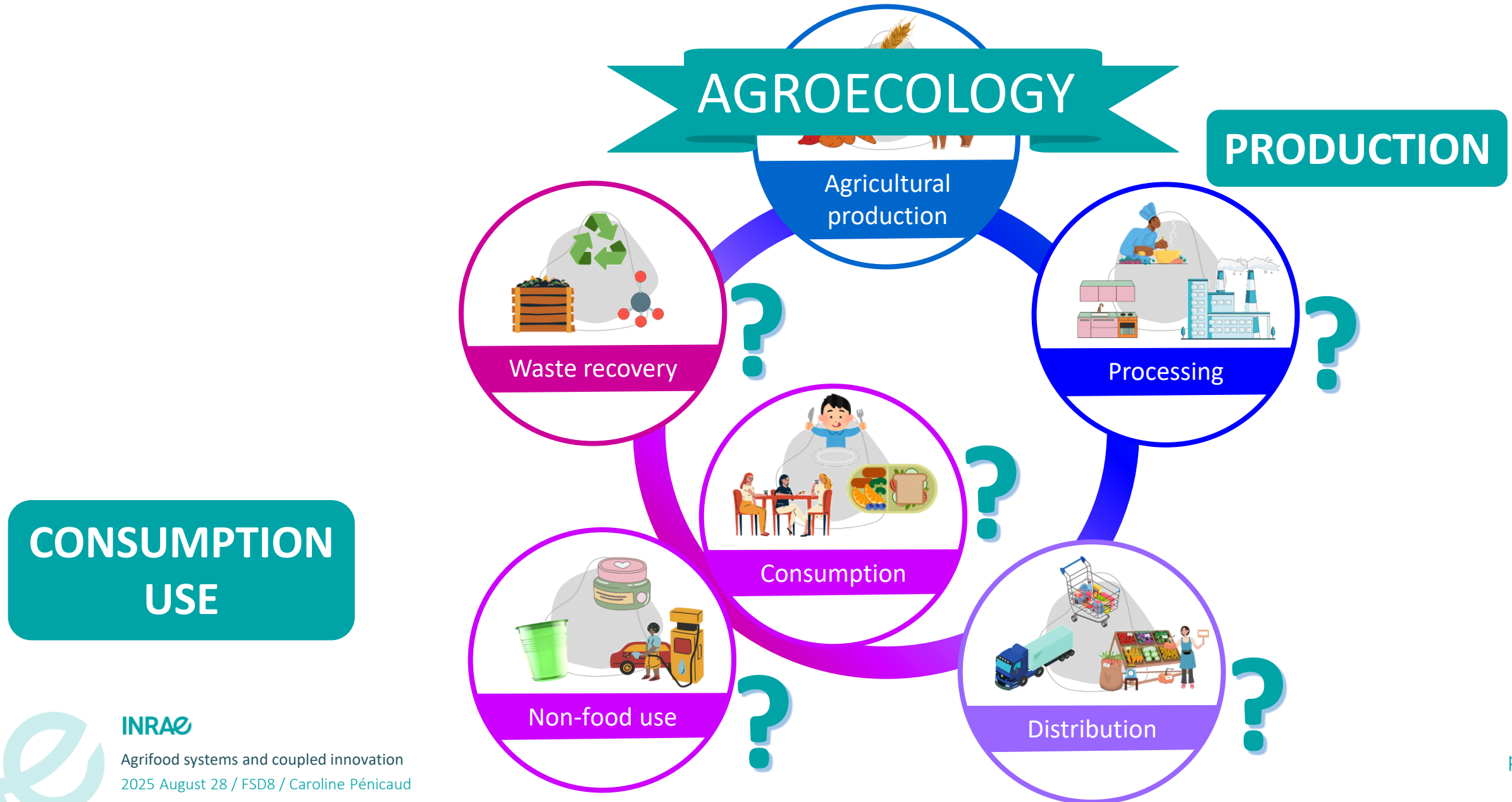
- ✓ Significant production volumes
- ✓ Economies of scale
- ✓ Low prices
- ✓ Controlled logistics
- ✓ Significant and stable economic activity
- ✓ Offer in response to consumer expectations
- ✓ Food safety

➤ Dominant agrifood systems

ENVIRONMENT	SOCIAL	HUMAN HEALTH	ECONOMY
✗ 25-30 % environmental impacts due to the agrifood systems ✗ Climate ✗ Biodiversity ✗ Pollutions ✗ Agriculture ✗ Losses and wastes ✗ Cold chain ✗ Packaging / plastic	✗ Decline in rural employment ✗ Poverty and social exclusion among farmers ✗ Precarious contracts for workers ✗ Loss of consumer confidence in their food	✗ Obesity ✗ Diabete ✗ Malnutrition ✗ Exposure to endocrine disruptors ✗ « Ultraprocessed » food	✗ Farmers' situation unsustainable ✗ Other actors: highly contrasted situations ✗ Food industry: 1% of companies generate more than 50% of sales ✗ Inequitable distribution of income between actors



➤ Dominant agrifood systems: need for change towards more sustainability



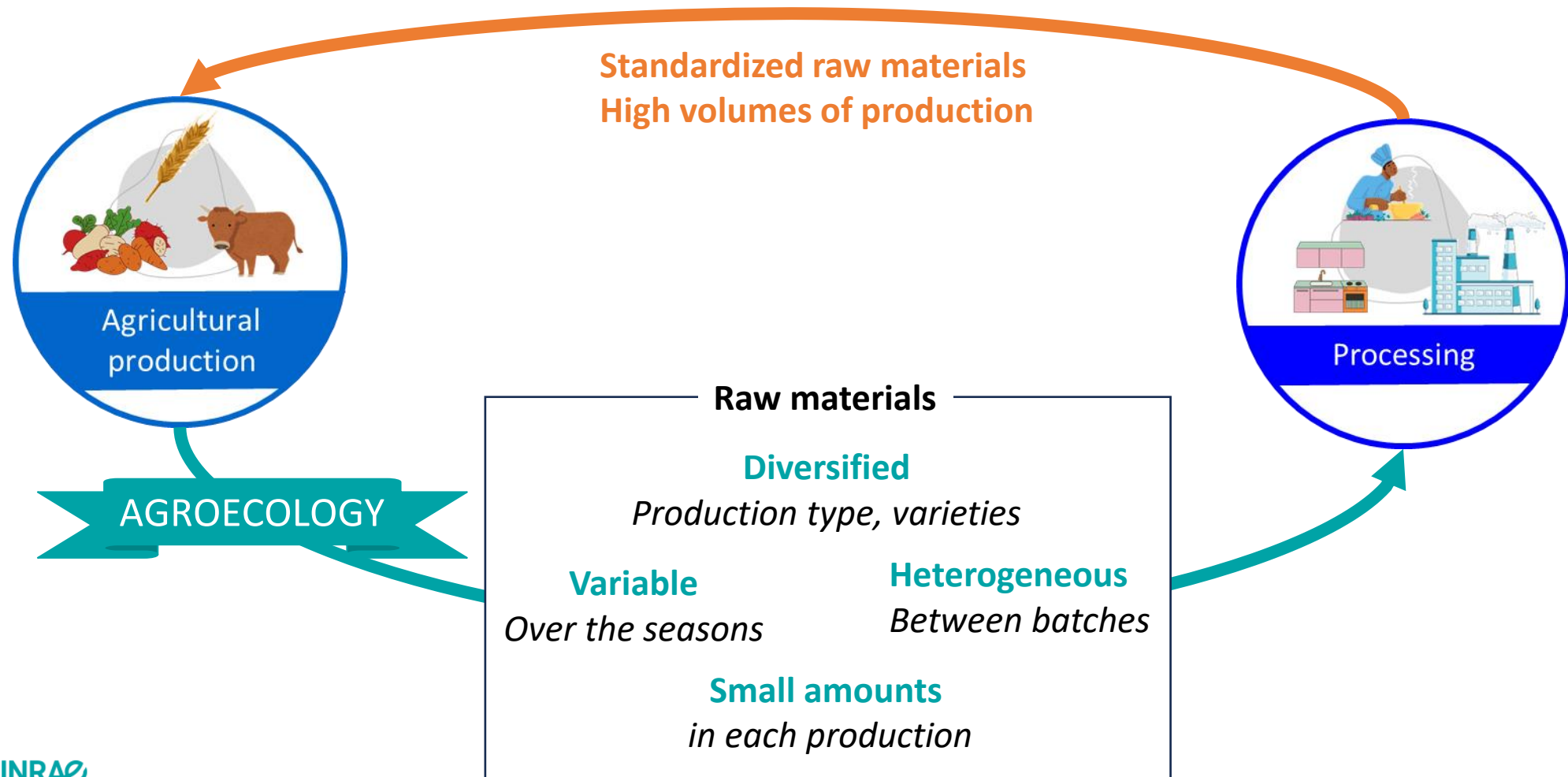


➤ Adaptation to agroecology

Focus on 4 main ideas

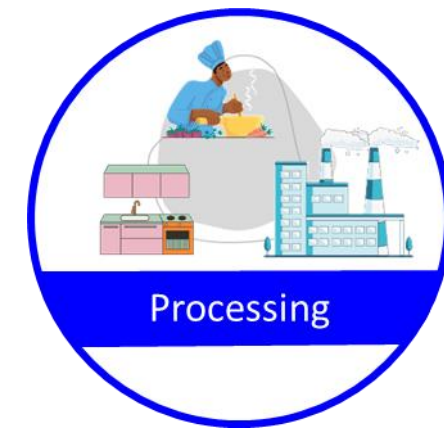
➤ Adapting processing to different raw materials

Agroecology = game changer in the relationship between agriculture and processing



➤ Adapting processing to different raw materials

Designing new processes / new process working conditions



Vegetable workshop



Canning workshops



Slaughterhouse



Mill



Small scale

Low tech

Frugality

Flexibility

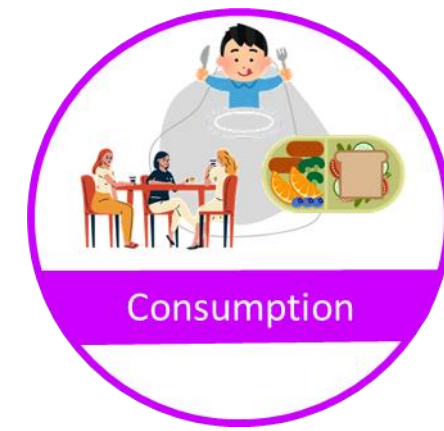
Modularity

Coupled operations

Inspiration from South?

➤ Encouraging change in consumption patterns

Designing consumption recommendations



Scientific recommendations

National recommendations



From Willet et al. 2019



Meat consumption

- ✓ Especially red meat

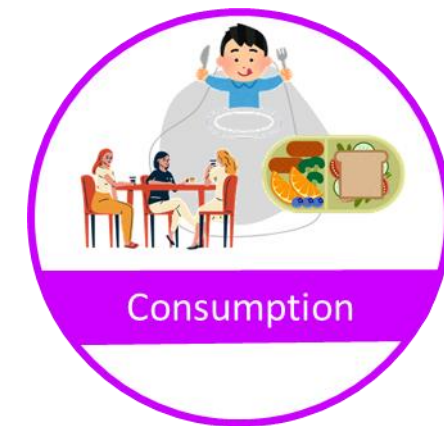
Pulse consumption

- ✓ Protein, fibers, micronutrients
- ✓ Agronomic benefits

AGROECOLOGY

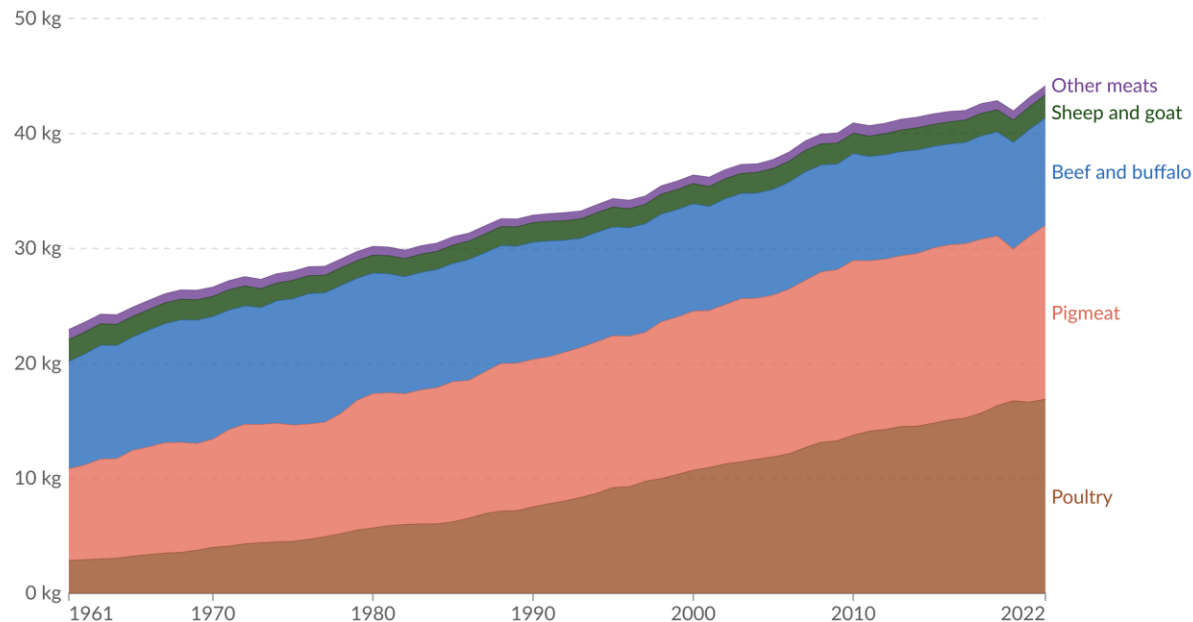
➤ Encouraging change in consumption patterns

Consumption trends



Per capita meat consumption by type, World, 1961 to 2022

Per capita meat consumption is broken down by types of meat, and is measured in kilograms per person per year.



Data source: Food and Agriculture Organization of the United Nations (2024)

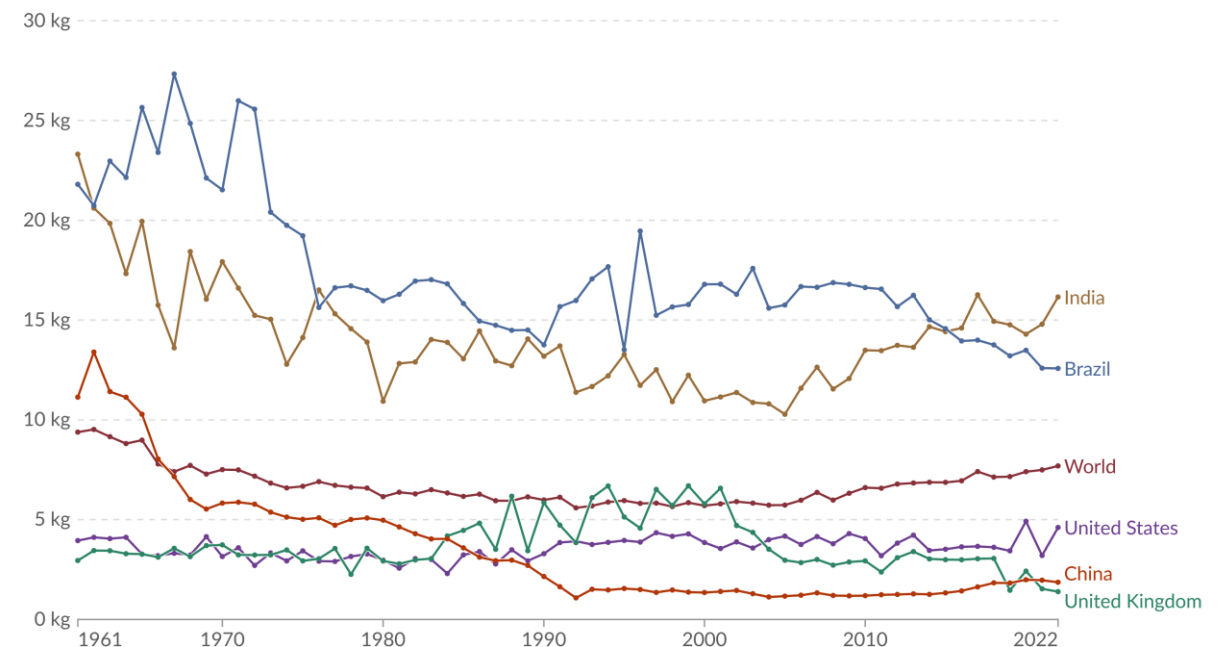
OurWorldinData.org/meat-production | CC BY

Note: Data does not include fish and seafood. Figures show meat supply and do not correct for waste at the household level and, so they may not directly reflect the quantity of food consumed by a given individual.

Our World
in Data

Pulses used for direct human food per capita, 1961 to 2022

Quantity that is allocated for direct consumption as human food, rather than allocation to animal feed or industrial uses. Pulses are the edible seeds of plants in the legume family.



Data source: Food and Agriculture Organization of the United Nations (2024)

Note: FAOSTAT applies a methodological change from the year 2010 onwards.

CC BY

Our World
in Data



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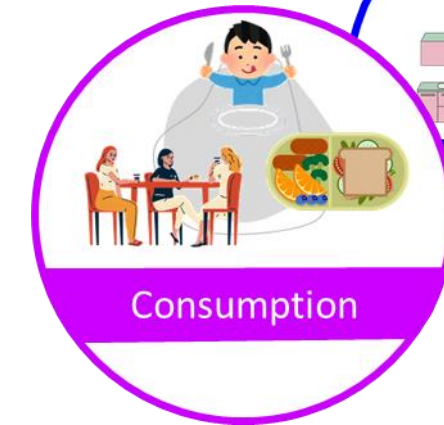
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➤ From processing to consumer to favor consumption

Designing new food products - Case of pulses

Pulse processability?
Product properties?
Product acceptance by consumers?
Product impacts? Health, environment
Product design?



Multi-country
11%

31457
patent families
2013-2024

Inpi, 2025

9% annual growth

Plant-based proteins

INKA

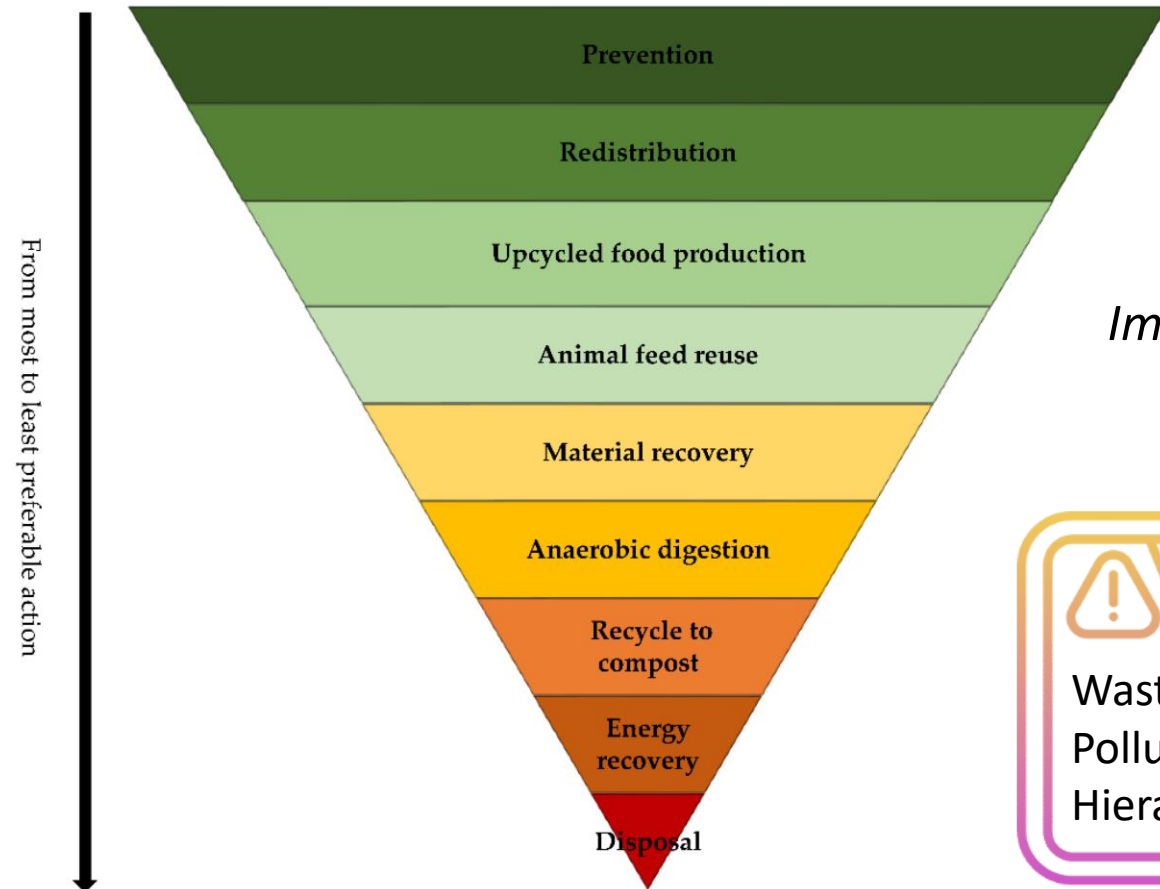
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17372
scientific
publications
since 2013



> Closing the loops

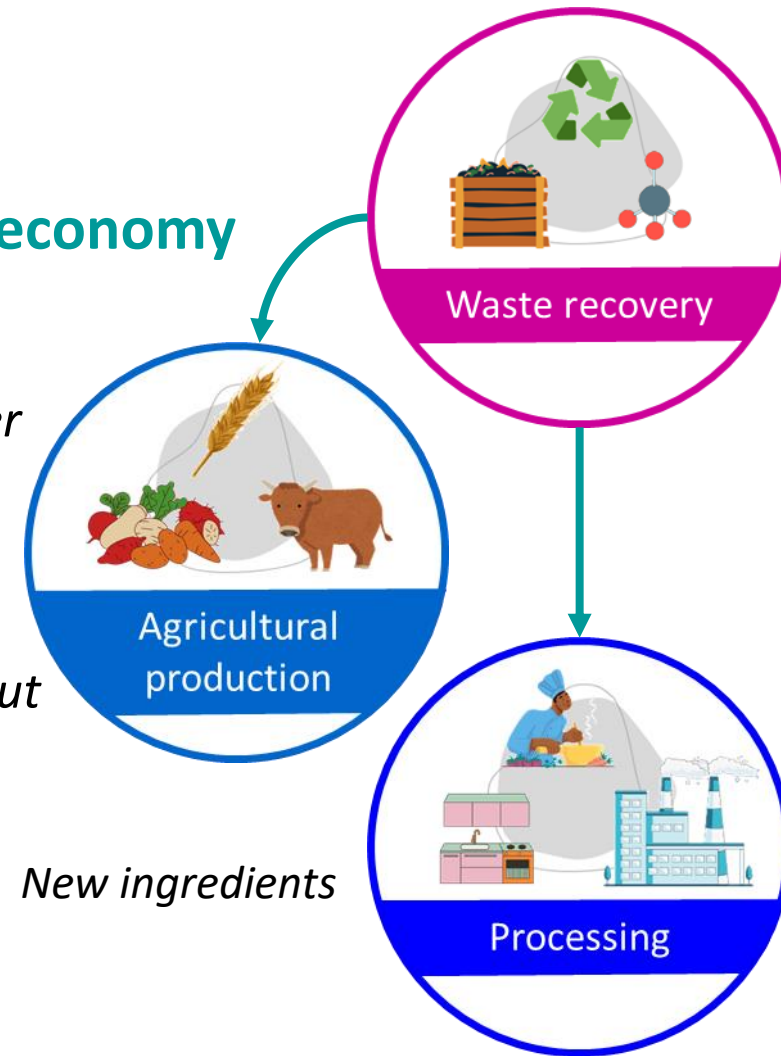
Designing new valorization routes



Moshtaghian et al. 2021

Circular economy

Input of organic matter
✗ crop protection products
Improvement of soil structure
Energy input



Closing the loops should be seen as a tool, not an end in itself

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➤ Interest and limits of these approaches



- ❖ Many changes required: good to act at all levels
- ❖ Each scientific discipline can provide skills/expertise within its perimeter



- ❖ Impacts of these actions on the agrifood system as a whole?
- ❖ Sufficient to join these actions?
- ❖ Toward agrifood systems as a whole?

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➤ Rethinking agrifood systems together

Focus on coupled innovation

➤ Coupled innovation

Interconnected innovation processes from agriculture and food sectors to manage the complex interrelations between them, and contribute to a systemic transition towards more sustainable agrifood systems *Meynard et al. 2017*



An example of the Qualisol cooperative's drive to stimulate the production and consumption of legumes

Agronomic innovation:
lentil-wheat combination
to increase wheat protein
content while respecting
the environment



Innovation in consulting: setting
up an adapted
consulting
organization



Digital innovation:
development of a
tool for farm cost
accounting, taking
multi-year results
into account

Technological innovation: acquisition of
an optical sorter and
integration into the
collection-storage chain



Organizational innovation:
organization of lentils
bagging and delivery



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➤ Need for a different frame of thinking

Many interrelated activities
Many stakeholders
Many value chains
From local to global

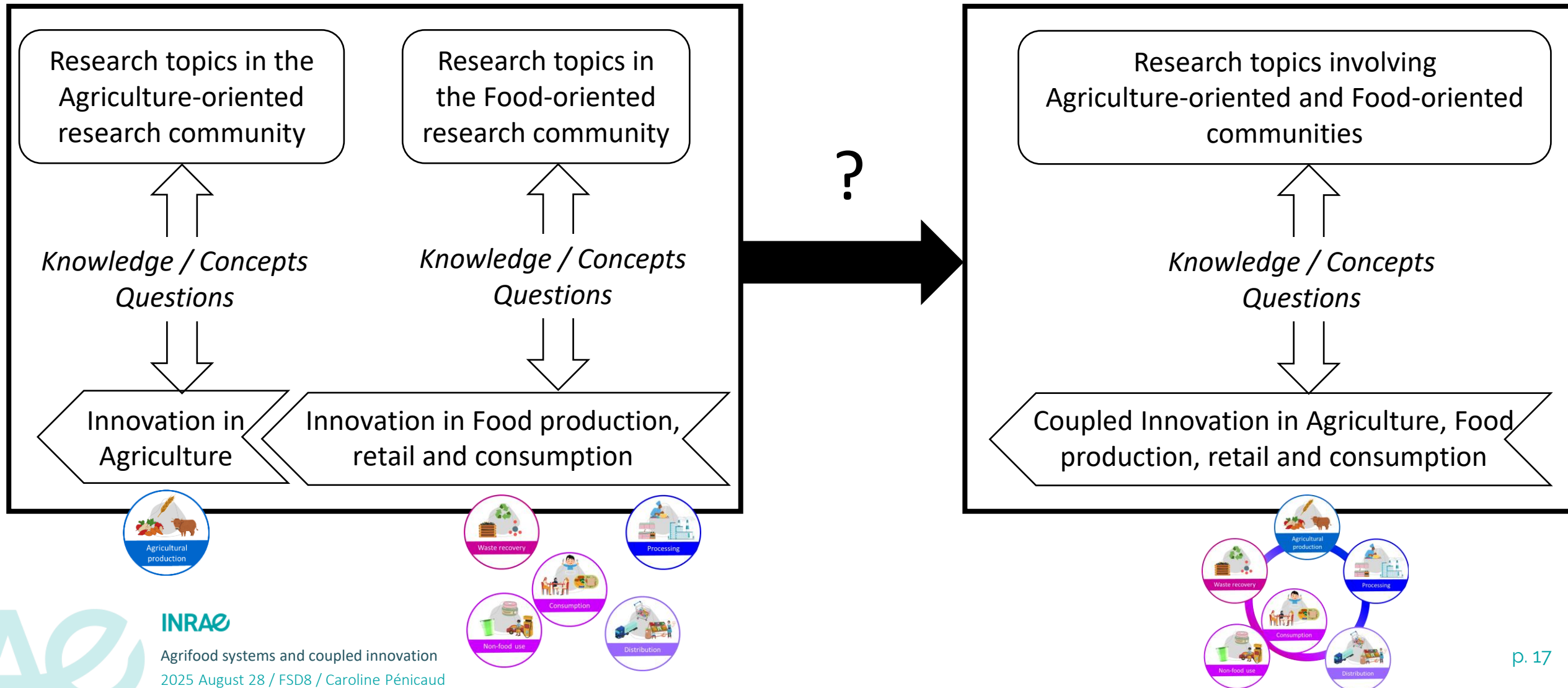
Job specialization
Innovation segmentation

*Even in the scientific communities
related to these diverse activities...*



➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021



➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021

Challenges

- ❖ Overcoming traditional divisions: what research is needed to support the transition to more sustainable agrifood systems?
- ❖ Reflect together on transition and innovation, to identify the fields of knowledge that are lacking

Objective

- Establish a method for identifying research themes
- ✓ involving both the agriculture and food communities
 - ✓ original
 - ✓ that aim to support the transition to more sustainable agrifood systems



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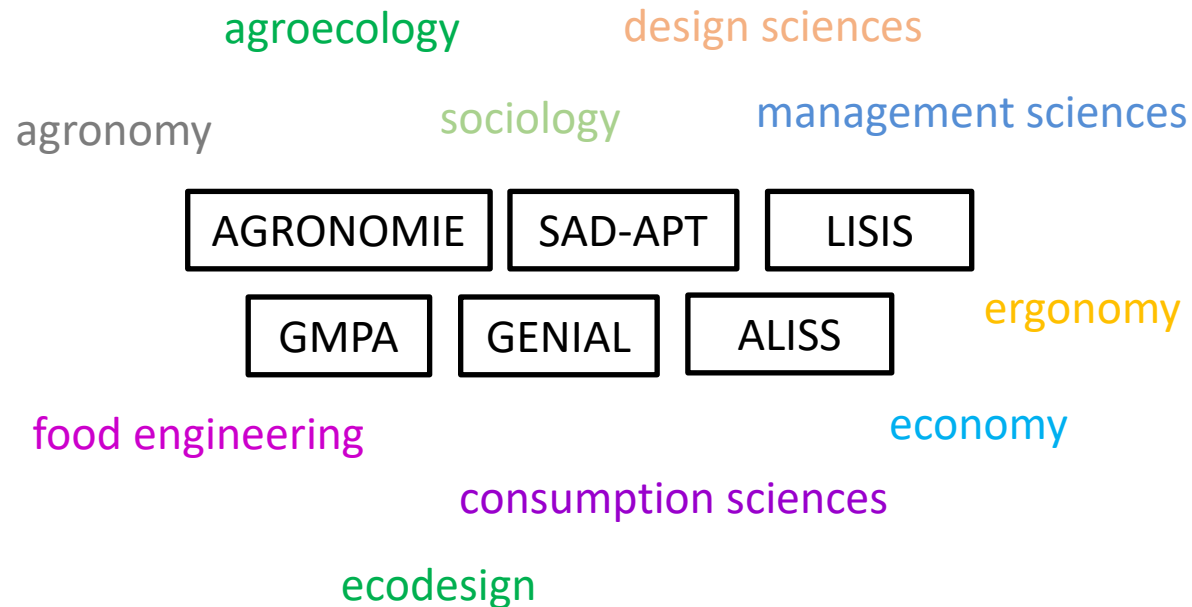
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➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021



**In Paris-Saclay research units:
complementary fields of expertise covering the agrifood system**



Agroecology building

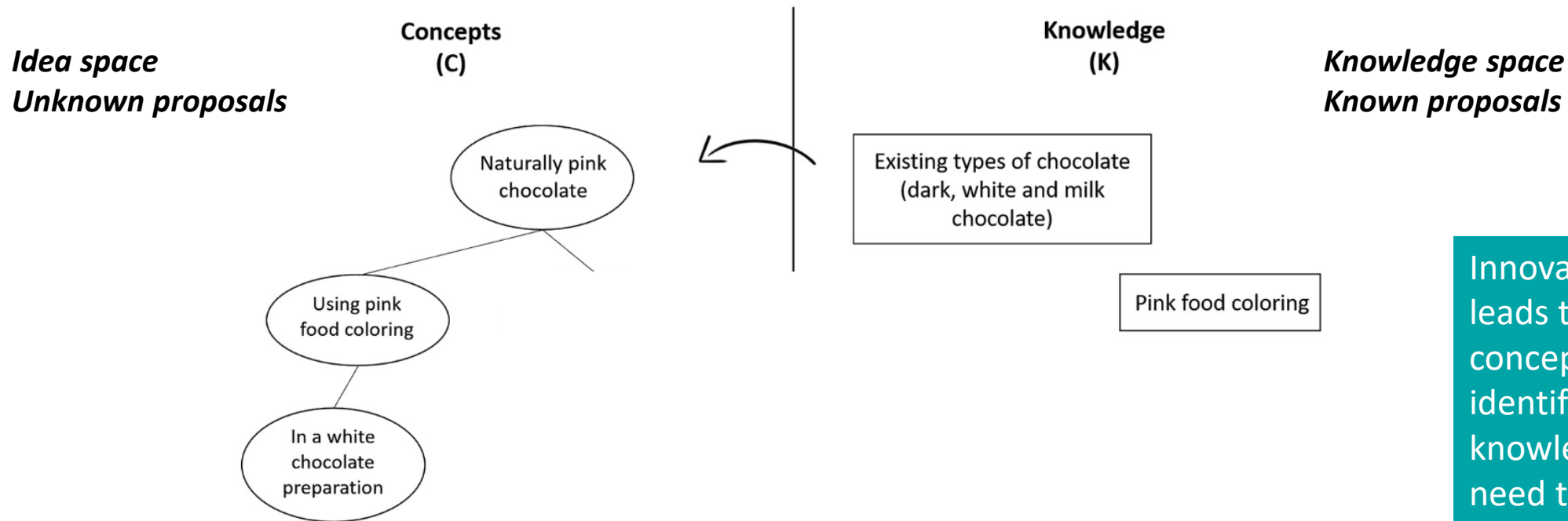
« Food » building



➤ Designing a research agenda linking agriculture-food domains

An approach based on CK theory *Hatchuel & Weil, 2009*

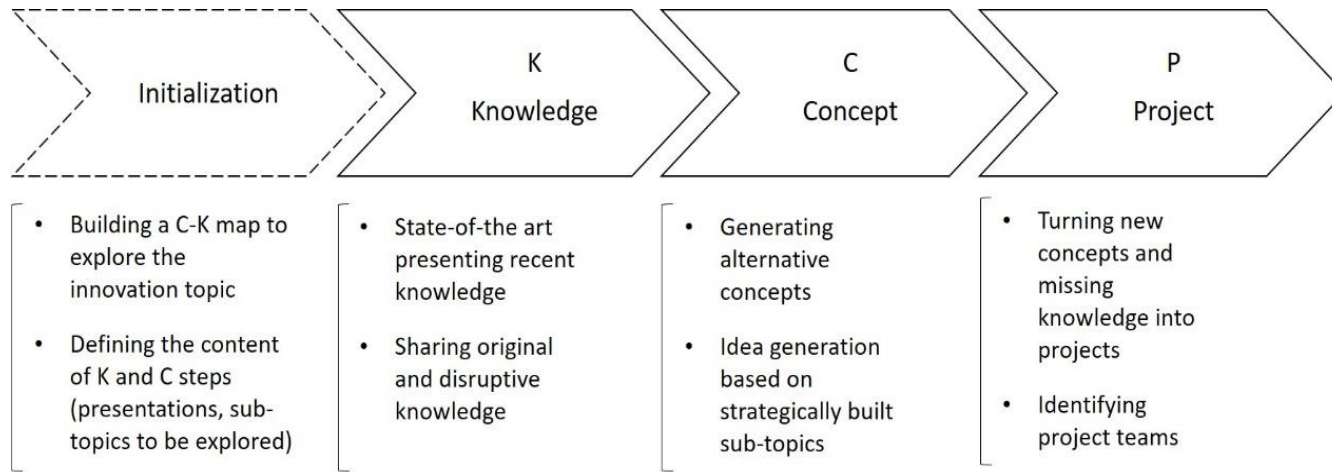
Innovation emerges from a dialogue between the space of concepts C and the space of knowledge K: the evolution of concepts is based on knowledge, and makes it possible to identify the knowledge that will be needed to go further (joint expansion of the two spaces)



Innovative design thus leads to innovation concepts, but also to the identification of knowledge gaps that need to be filled in order to refine the concepts

➤ Designing a research agenda linking agriculture-food domains

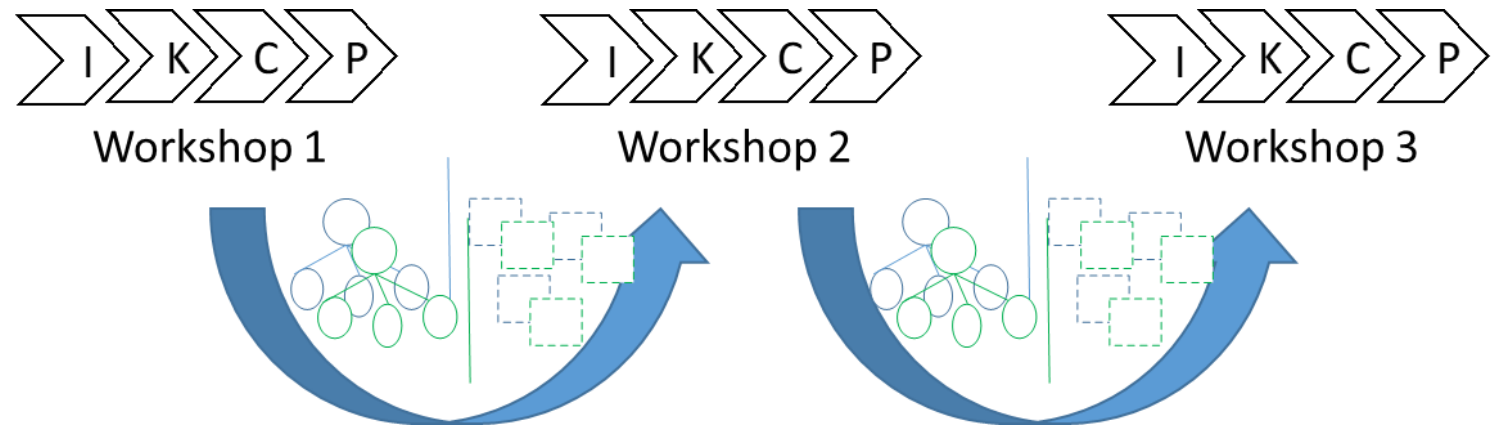
Brun et al. 2021 - Method: KCP workshops + matching-building



These methods meet three needs:

- ✓ Creating new disruptions
- ✓ Avoiding fixation
- ✓ Collectively exploring new, desirable unknowns

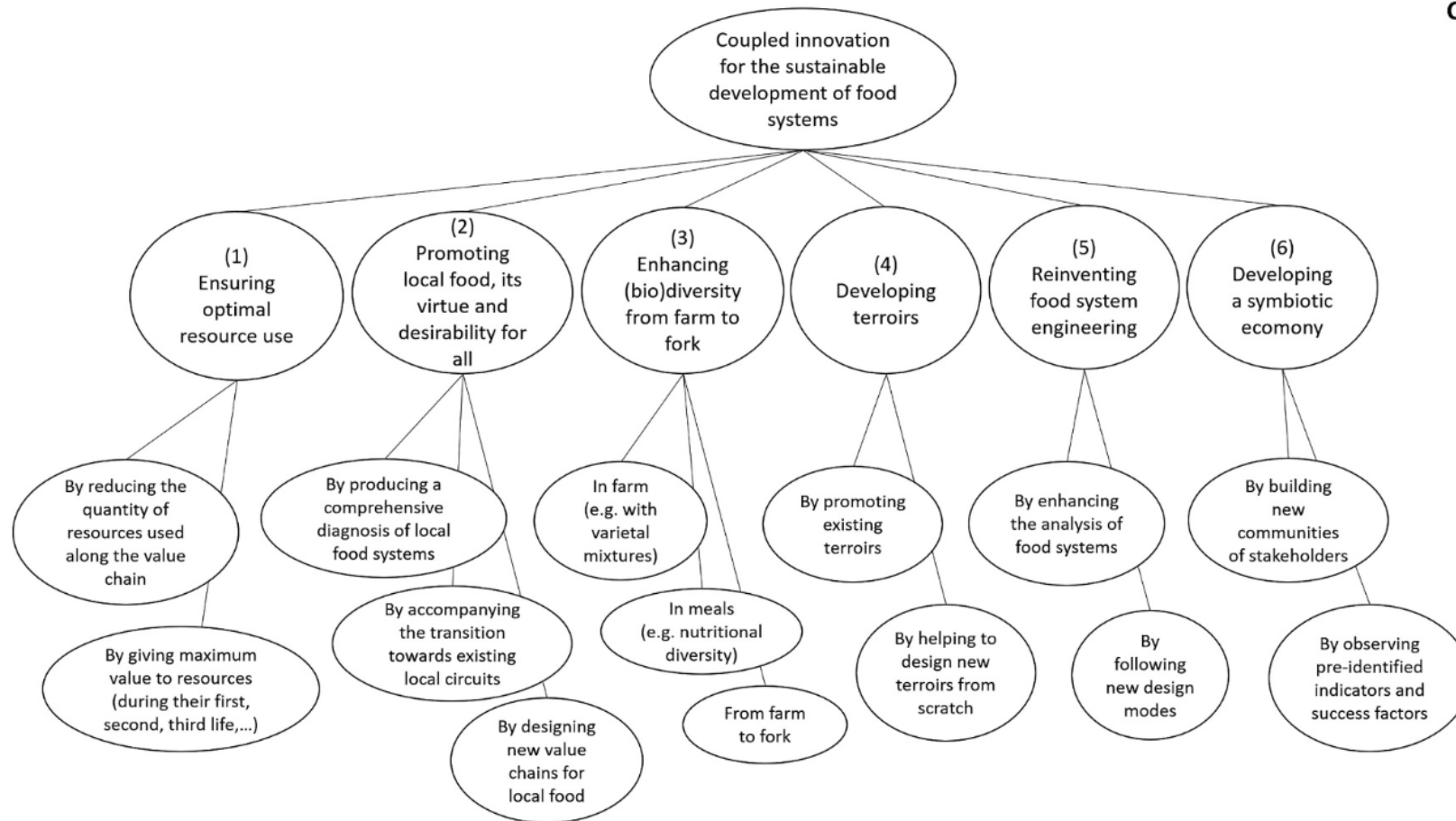
Matching-Building:
Enrich exploration by identifying the intersections between the C-K profiles of different partners, and their distinct reasoning



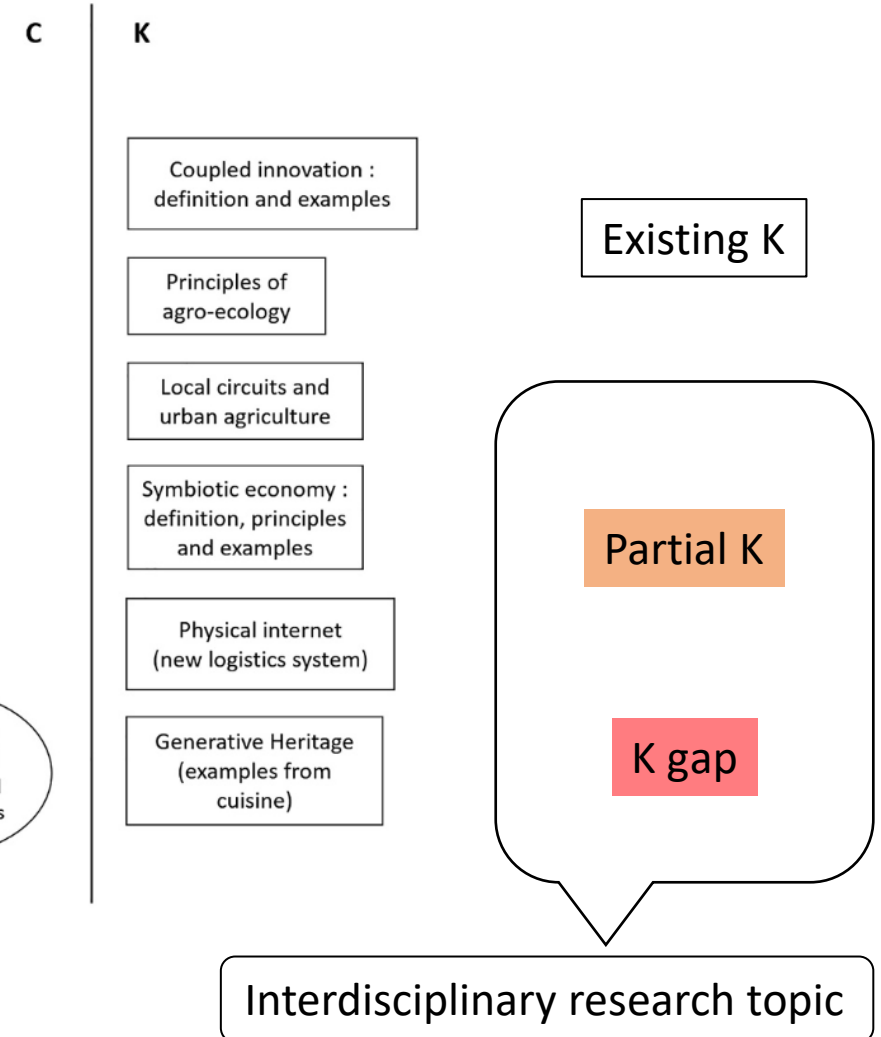
10-15 participants / workshop

➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021 - Final CK map



Dozens of concepts per C route



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➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021 – Results: 20 research topics

Recycling and engineering of waste from food systems for a variety of uses

Assessment and management of the naturalness of food products, from farm to fork

Local food as a source of confidence and desirability: effects of production and processing modes, traceability, social link

Territorialized Food Systems: new ways of linking production and consumption

Small-scale processing technologies, sociotechnical conditions for their development

Tension between innovation and tradition in a historical terroir

Sustainability of terroirs associated with Geographical Indications

Invention of new terroirs and new typical products regarding sustainability issues

Production and cooking of foods with exceptional taste

Ecosystem services of multi-species mixtures, from farm to fork

Diversity of agronomic and culinary practices of hobby gardeners

Effects of biodiversity of endogenous microorganisms on agricultural production and food engineering

Method for the diagnosis of a food system, in order to determine the points to be improved and the fields of innovation to be explored

Multi-actor devices and methods to design and assess coupled innovations

Public policies to promote the emergence and development of coupled innovation

Indicators to assess and foster transition of food systems

Innovative technologies, jobs and skills for a symbiotic economy

Articulation between food, ecological and energy transitions on different scales

Tensions and synergies between 0 waste, 0 pesticide, 0 antibiotic and 0 additive

Training and information on the agriculture-food-health relationship within agrifood systems



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➤ Designing a research agenda linking agriculture-food domains

Brun et al. 2021 – Results: 20 research topics

Comparison with 25 scientific papers
identifying research priorities for
more sustainable food systems

6 topics cited by >25% of the papers
Importance validated by the literature

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Comparison with 25 scientific papers
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9 topics cited by 1-4 papers
Poorly identified in the literature

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Brun et al. 2021 – Results: 20 research topics

Comparison with 25 scientific papers
identifying research priorities for
more sustainable food systems

5 topics never cited
Very original

Diversity of agronomic and culinary practices of hobby gardeners

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production and food engineering

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Invention of new terroirs and new typical products regarding sustainability
issues

Production and cooking of foods with exceptional taste



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➤ Resulting interdisciplinary projects

✓ Coordinated by workshop participants with broader project partners than those of the workshops



PeriUrbanWasteEng – Towards the engineering of agricultural and food waste in an increasingly urbanized peri-urban area: how to transform it (or not) for what diversity of uses?
(2021-2022)
Coord. : V. Athès & C. Pénicaud (SayFood)

SayFood

Agronomie

SAD-APT

PROSE

ECOSYS

ALISS



Innov'co – Coupled innovations between agriculture, processing and collective catering for a sustainable and organic food
(2023-2025)
Coord. : Margot Leclère (Agronomie)

Agronomie

SayFood

Ecocert

Un Plus Bio



ICAD – Coupled innovation and food sustainability
(2022-2026)
Coord. : G. Yannou-Le Bris (SayFood)

SayFood

Agronomie

SAD-APT

Terre et Cité



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➤ Resulting interdisciplinary projects

✓ Include one or more of the research themes arising from the workshops, in whole or in part



PeriUrbanWasteEng – Towards the engineering of agricultural and food waste in an increasingly urbanized peri-urban area: how to transform it (or not) for what diversity of uses?
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Territorialized Food Systems: new ways of linking production and consumption

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ICAD – Coupled innovation and food sustainability
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➤ Take home messages

➤ Take home messages



- ✓ Moving agrifood systems towards more sustainability can be approached in many ways, **from the highly disciplinary to the very systemic**
- ✓ While improving agricultural practices is a major step forward, **reconnecting agriculture and food** is an under-explored lever
- ✓ **Coupled innovation** is a promising avenue for this reconnection
 - ✓ Territorialized food systems
 - ✓ Collective catering
- ✓ Avenue for future research: Feel free to explore the research topics identified!