Agricultural systems
by design

8th International Farming System Design Conference
Palaiseau – 25-29 August 2025

AgroParisTech

INRAE

ideas
INITIATIVE FOR DESIGN
IN AGRIFOOD SYSTEMS

Agricultural systems by design

Key-Note

Farming Systems Design for Agroecological Transitions

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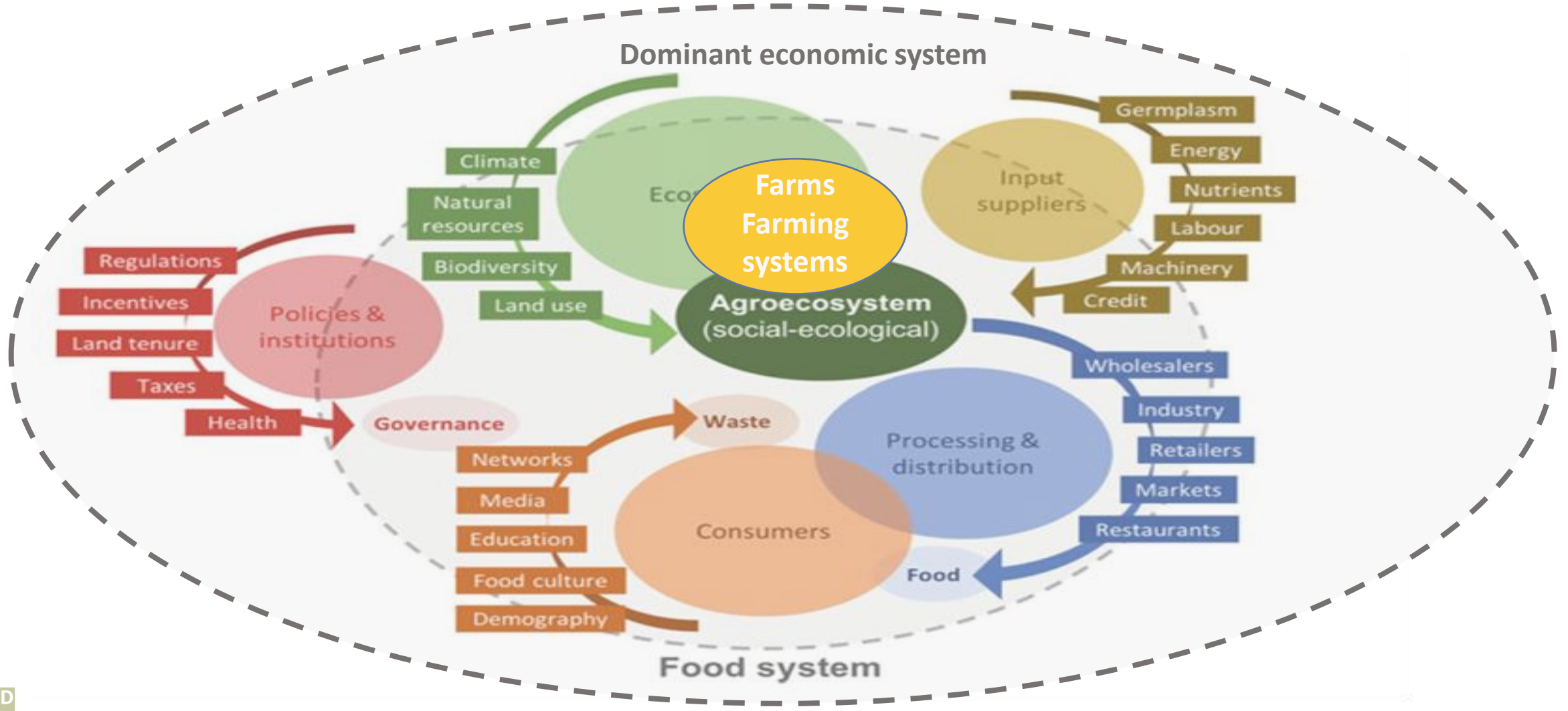
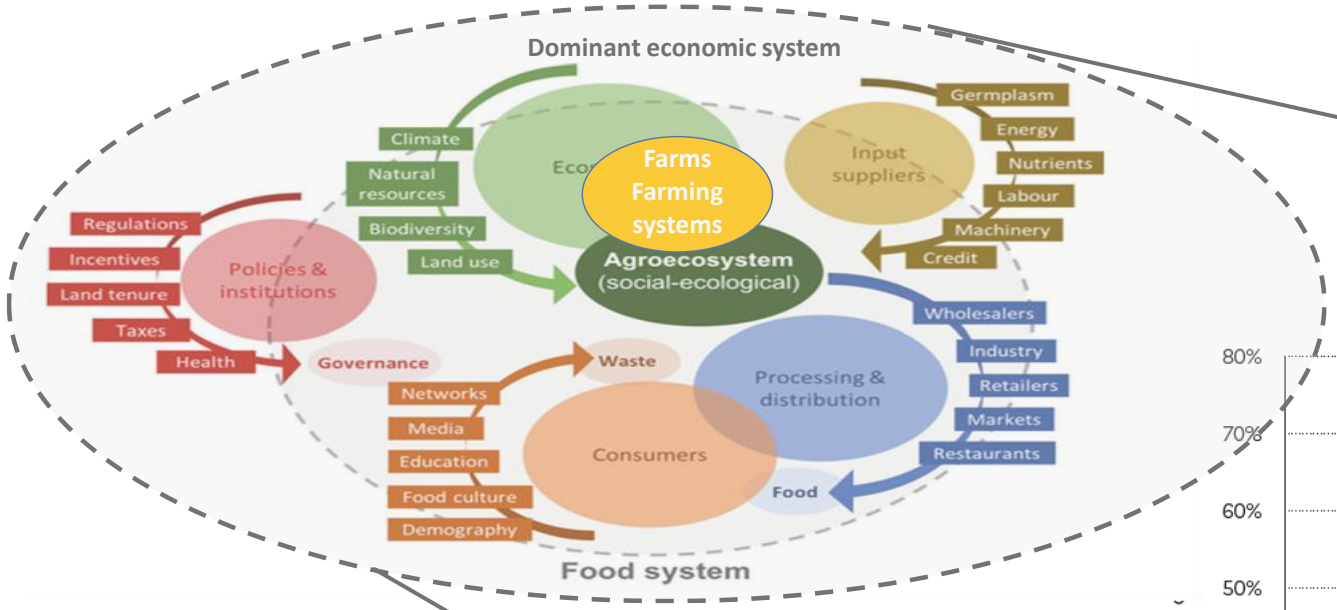
WAGENINGEN UNIVERSITY & RESEARCH

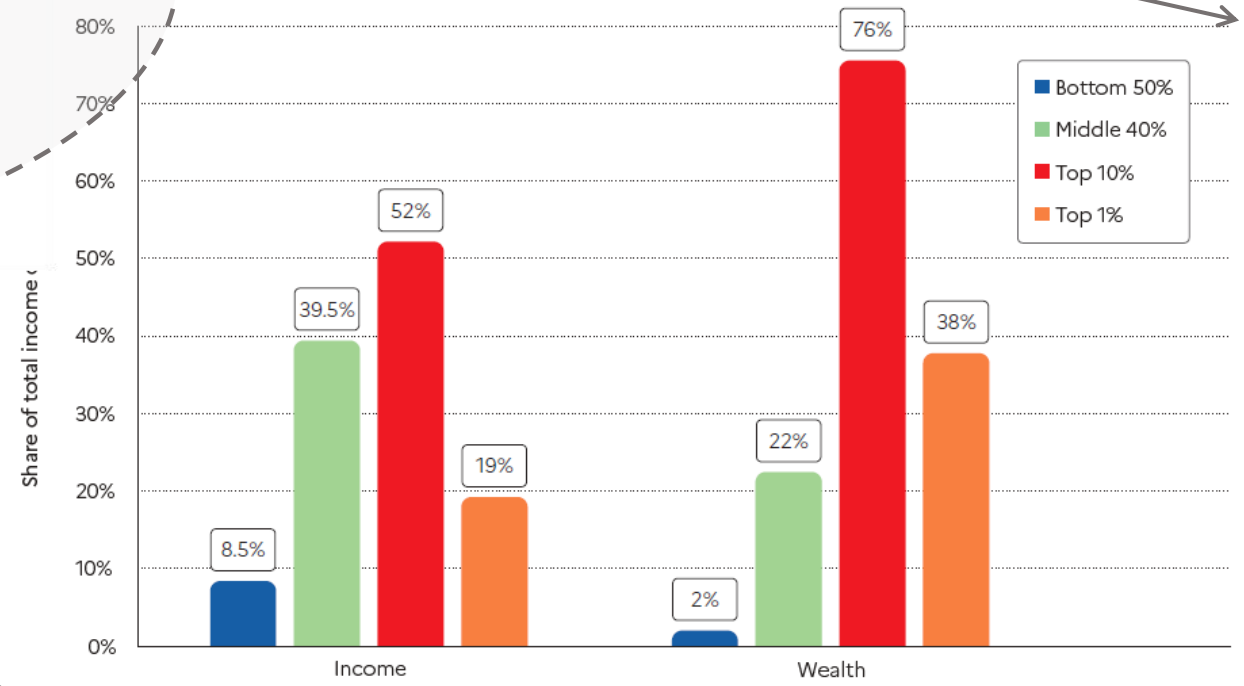
Farms and Farming systems – Food systems – Socio-economic system



(Tittonell, 2023)

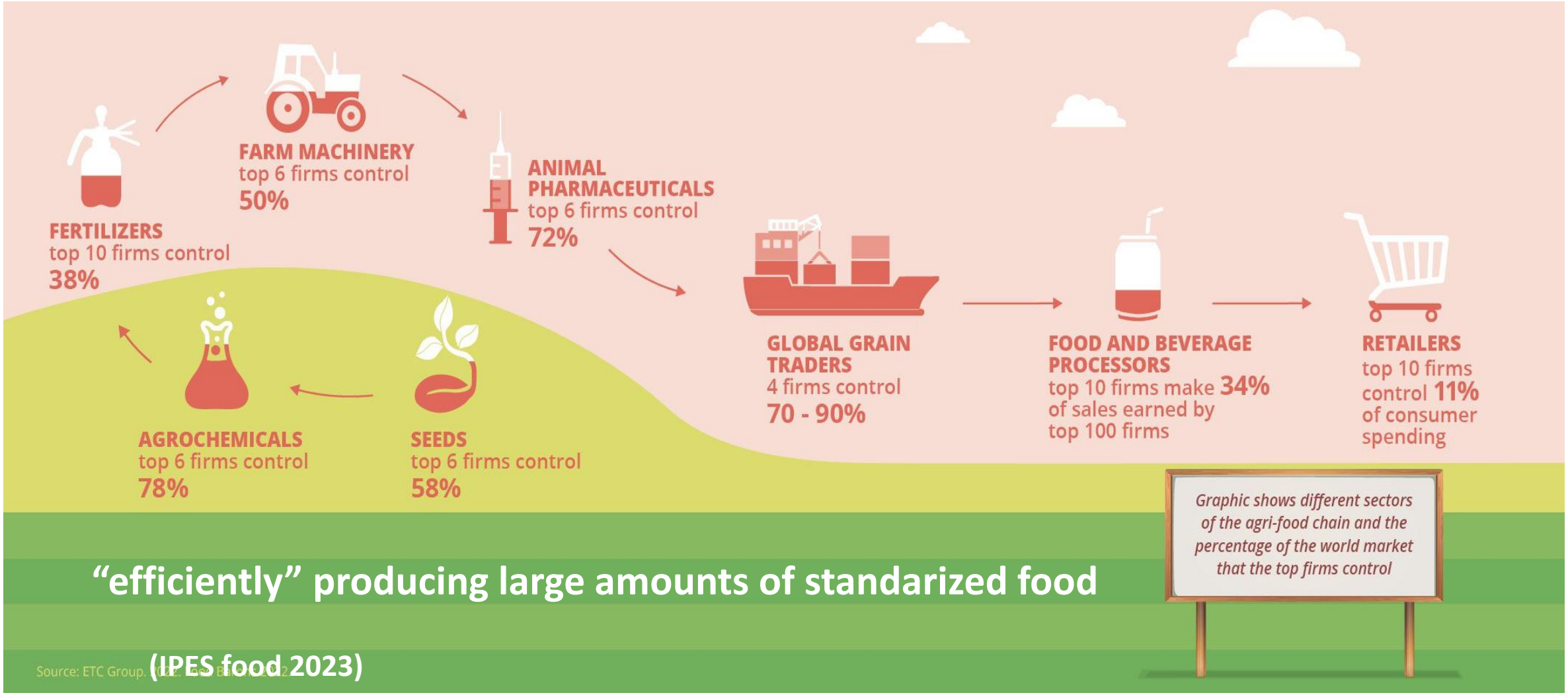
Global inequality in the dominant socio-economic system





(World Inequality Report 2022 https://wir2022.wid.world/)

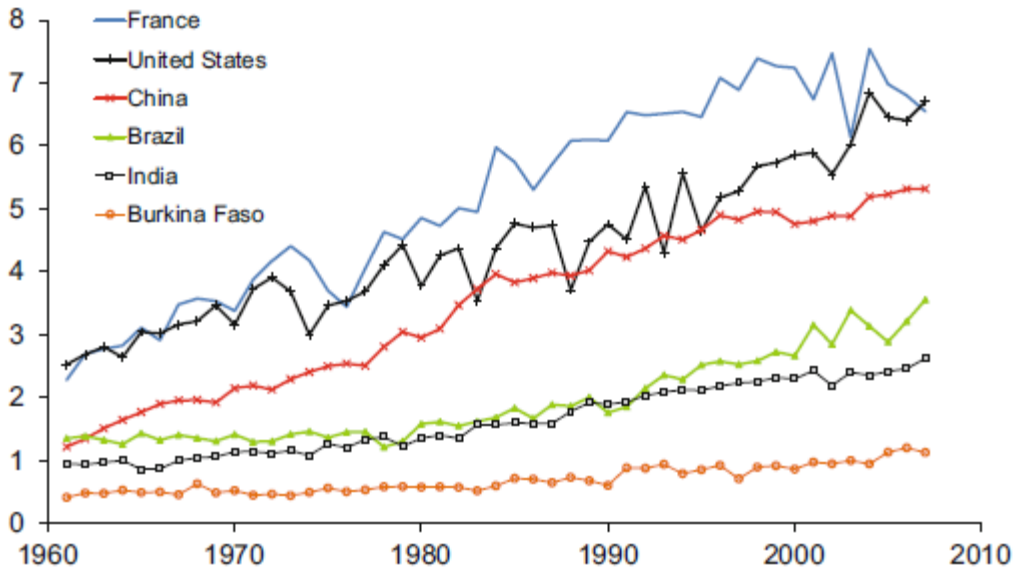
A corporate – food regime



"efficiently" producing large amounts of standarized food

(IPES food 2023)

The consequences of agriculture industrialization



FAOStat

A “great transformation” of food systems…

Five Strategies for a Great Food Transformation

The data are both sufficient and strong enough to warrant immediate action. Delaying action will only increase the likelihood of serious, even disastrous, consequences.

STATEMENT

The Food Systems Summit- A New Deal for People, Planet and Prosperity

Guiding action for **sustainable food systems**

iPES FOOD

Healthy Diets From Sustainable Food Systems

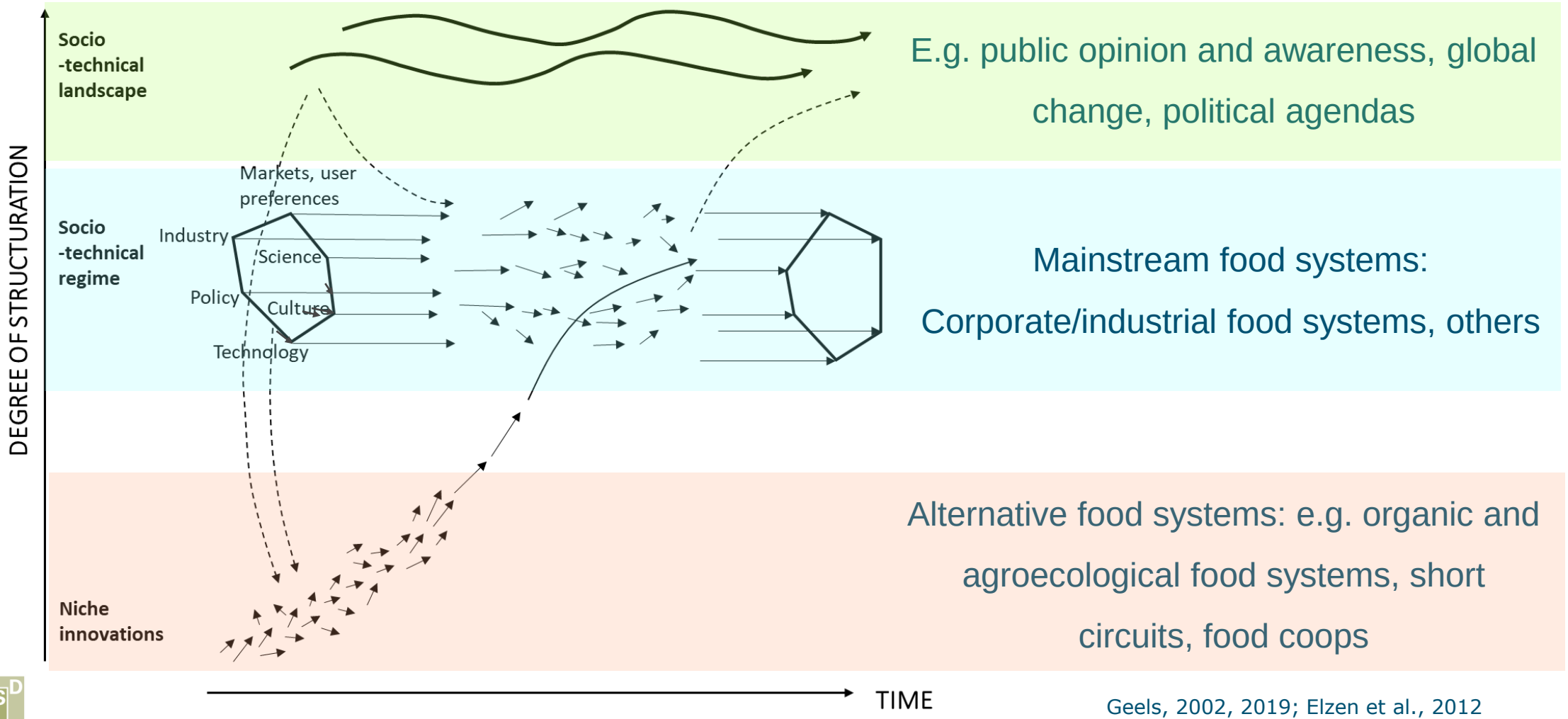
Food Planet Health

EAT

Change may start from many small transformations, attempts, experiences, to which we can contribute as FSD scientists

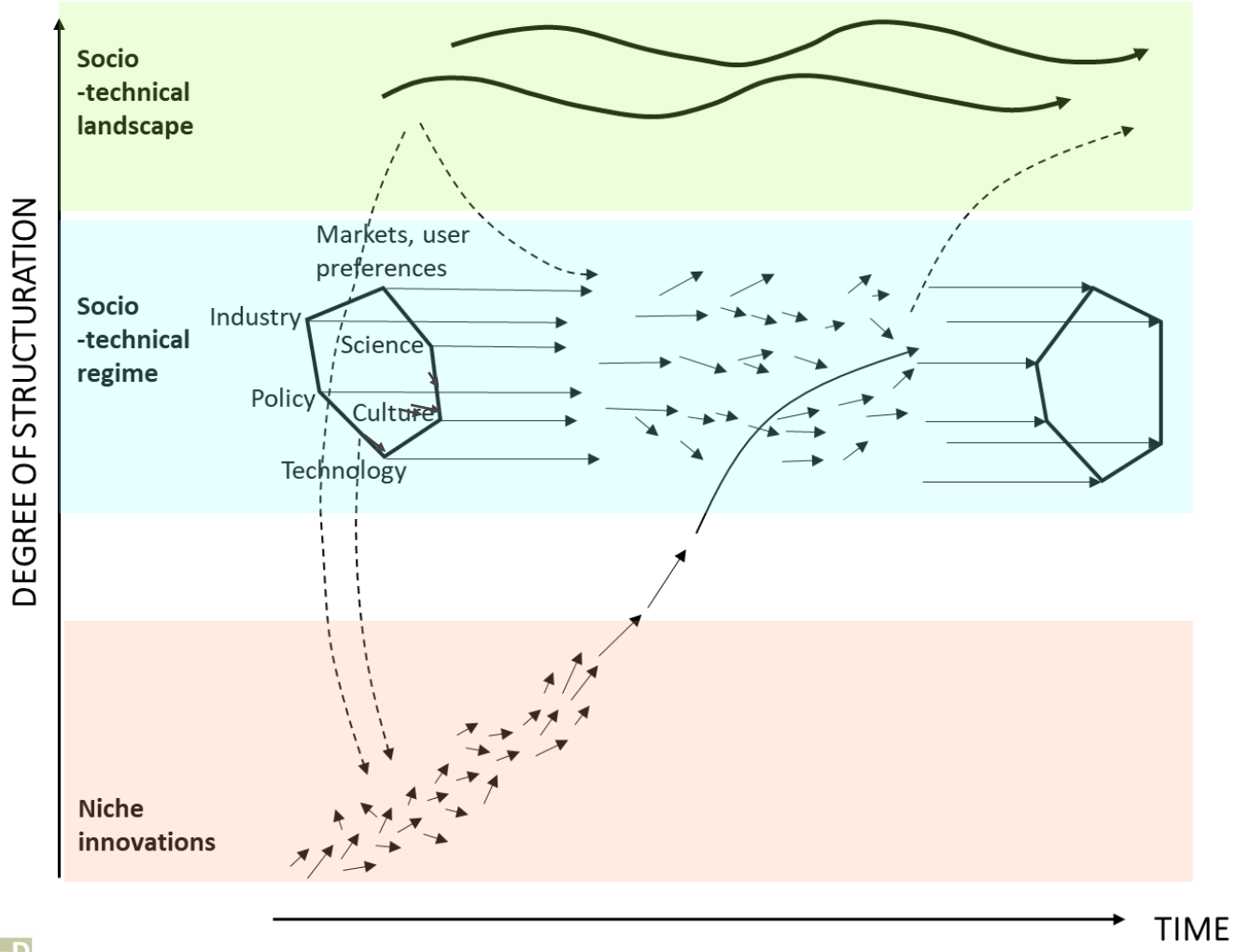
Developing socio-technical and social-ecological niches

Transitions are a gradual, multi-decadal process in which a system shifts from one socio-technical and socio-ecological configuration to another through cumulative changes that include disruptive innovations



Geels, 2002, 2019; Elzen et al., 2012

Developing socio-technical and social-ecological niches



Niches:

"Multi-actor initiatives to develop protected spaces in which radical innovations are designed developed and tested in real life settings"

Learning spaces about:

- How to develop radical system innovations
- Performance of systems innovations
- Socio-cultural fit
- Political feasibility

Geels, 2019

Niches could develop into parallel alternative food networks

Mouvement Inter-Régional des AMAP

National School Feeding Program (PNAE): A Public Policy That Promotes a Learning Framework and a More Sustainable Food System in Rio Grande do Sul, Brazil

The State That Did It First: How Sikkim Went 100% Organic & Changed Indian Farming

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REDE DE AGROECOLOGIA ecoVIDA®

Community Managed Natural Farming in Andhra Pradesh, India

UTT

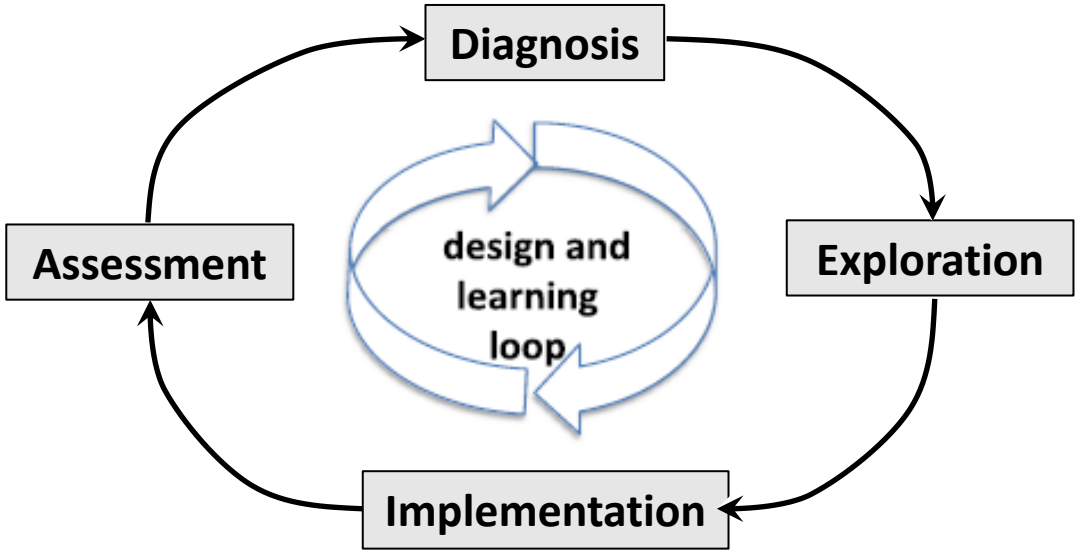
Trabajamos día a día por cambiar el modelo productivo

20 provincias

412 puntos de venta

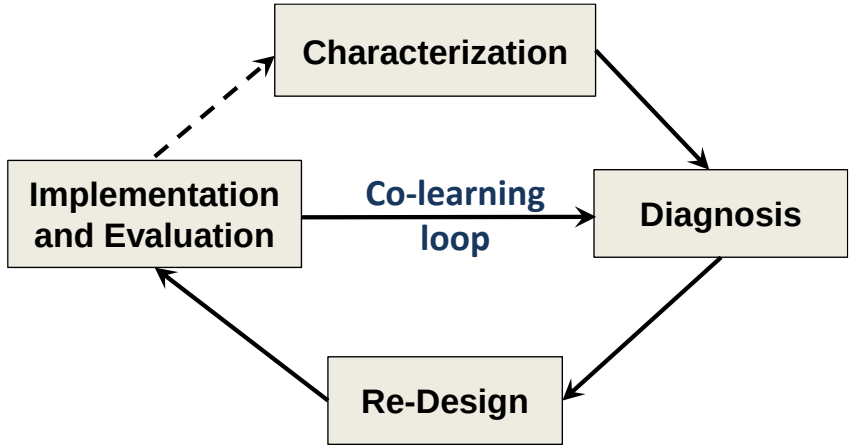
22.334 familias productoras

How can farming systems design contribute to the development of socio-technical and socio-ecological niches?

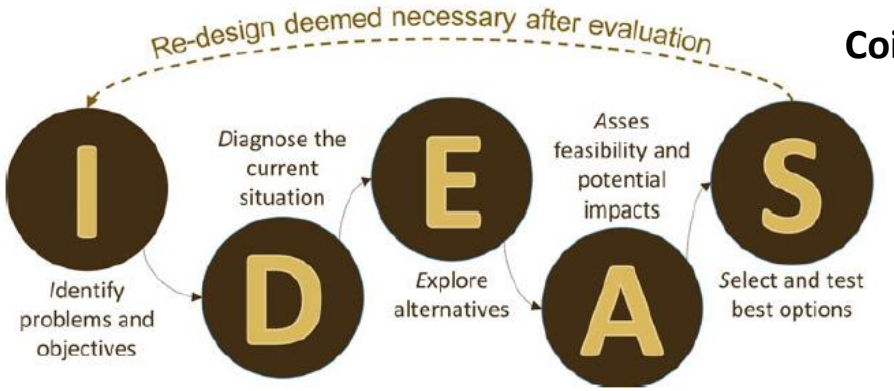


Step by Step approach cycle (Meynard et al,. 2023)

Crafting Actionable Knowledge

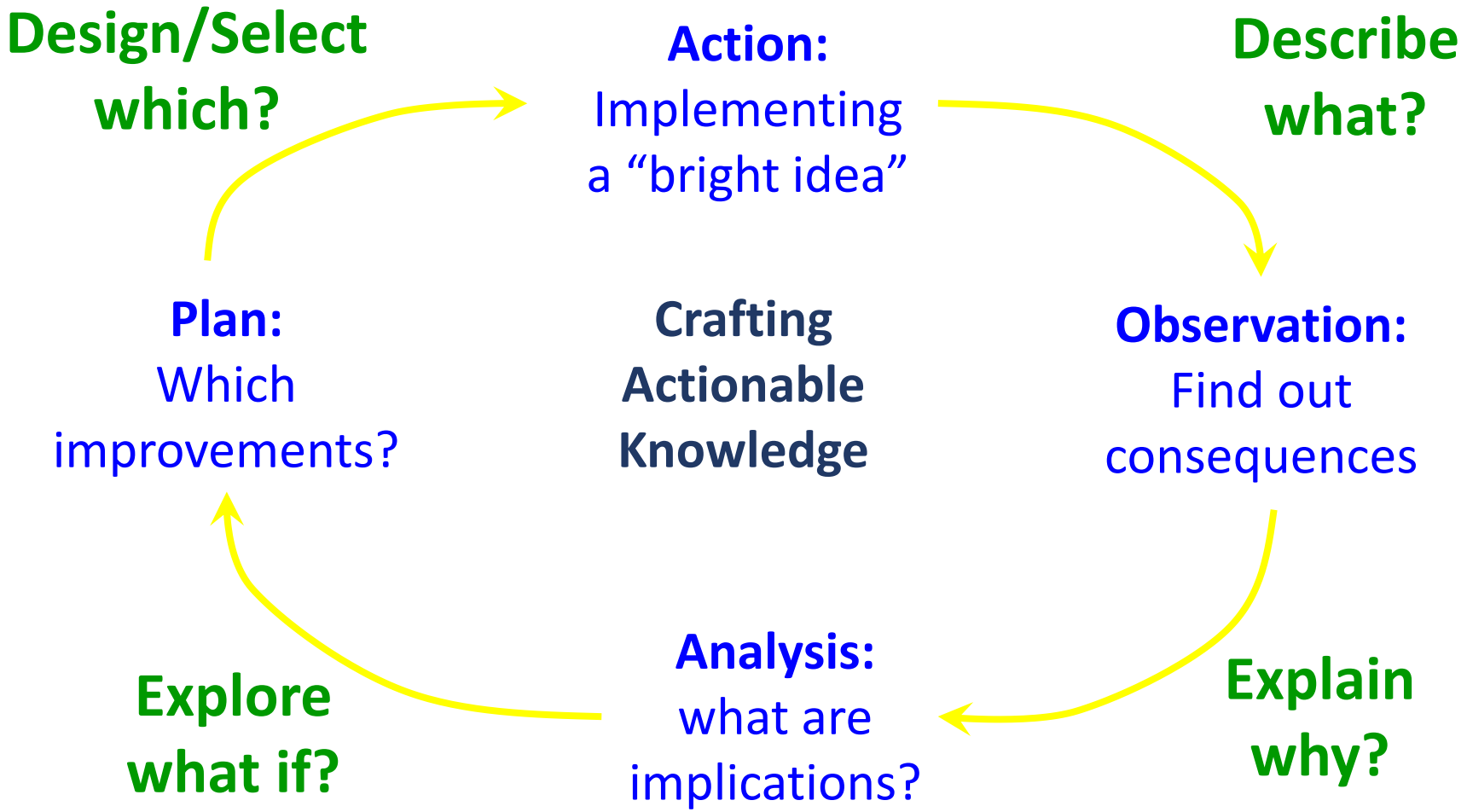


Coinnovation approach cycle (Dogliotti et al,. 2014)



IDEAS cycle for agroecosystems design (Tittonell,. 2023)

How can farming systems design contribute to the development of socio-technical and socio-ecological niches?



(Rossing et al., 2021)

Kolb's 1984 Learning cycle;DEED research cycle (Giller et al., 2008; Descheemaeker et al., 2016)

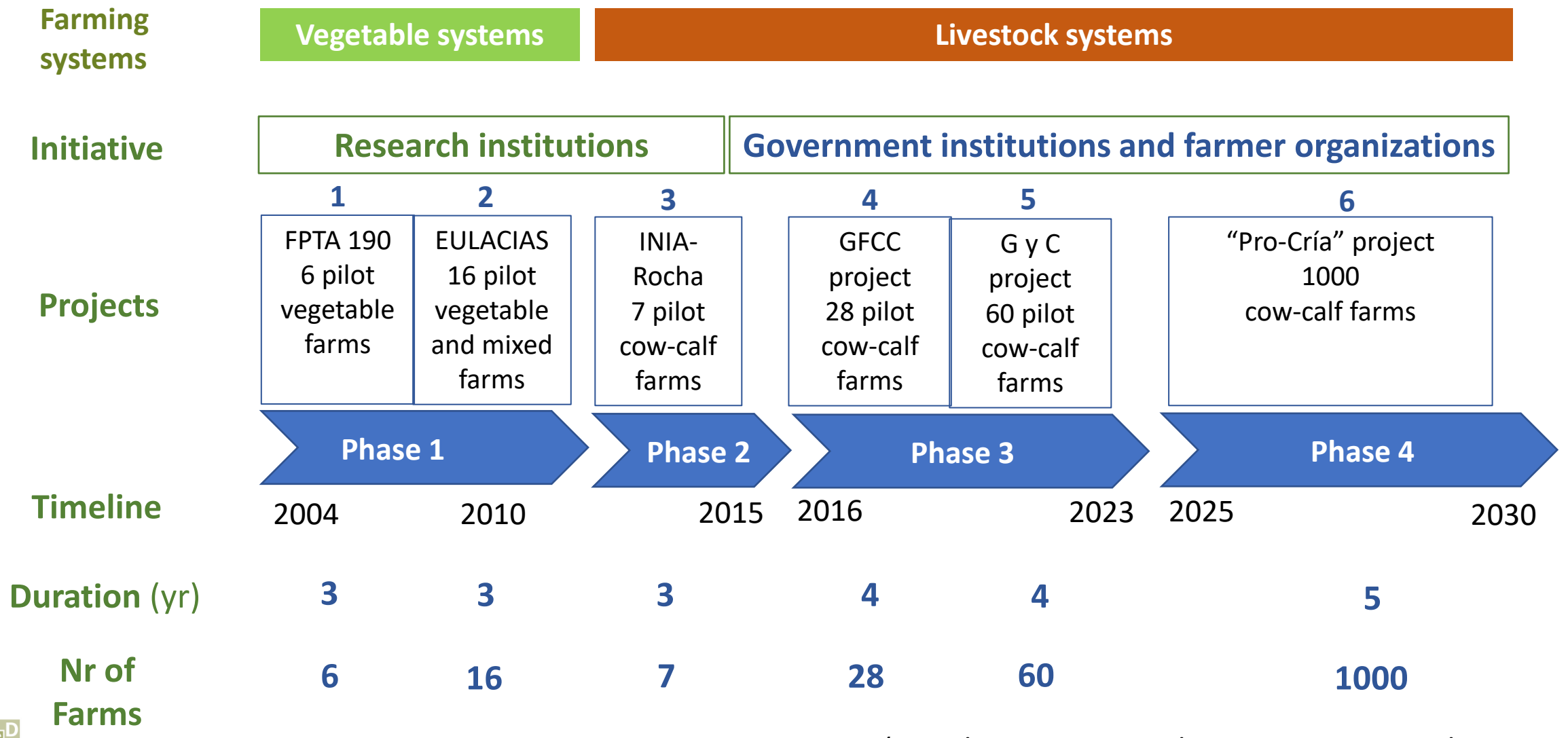
Elements of socio-technical niche formation

Niche development requires (Schot and Geels, 2008):

- ✓ Alignment of expectations and visions of a desirable unknown future among the diversity of participants
- ✓ Building social networks and increasing social support
- ✓ Learning processes producing actionable knowledge in multiple dimensions

This requires a shift from single, independent projects to sequences of situated and related projects allowing **successive iterative learning loops and a growing social basis** (Prost et al., 2023; Meynard et al., 2023; Aguerre and Bianco, 2023)

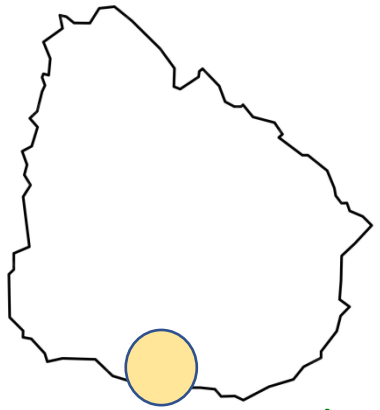
Development of a socio-technical niche: illustration



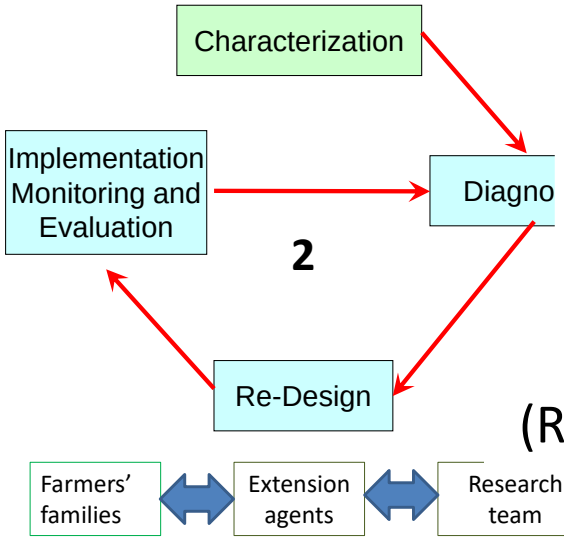
(Based on Rossing et al., 2021; Aguerre and Bianco, 2023)

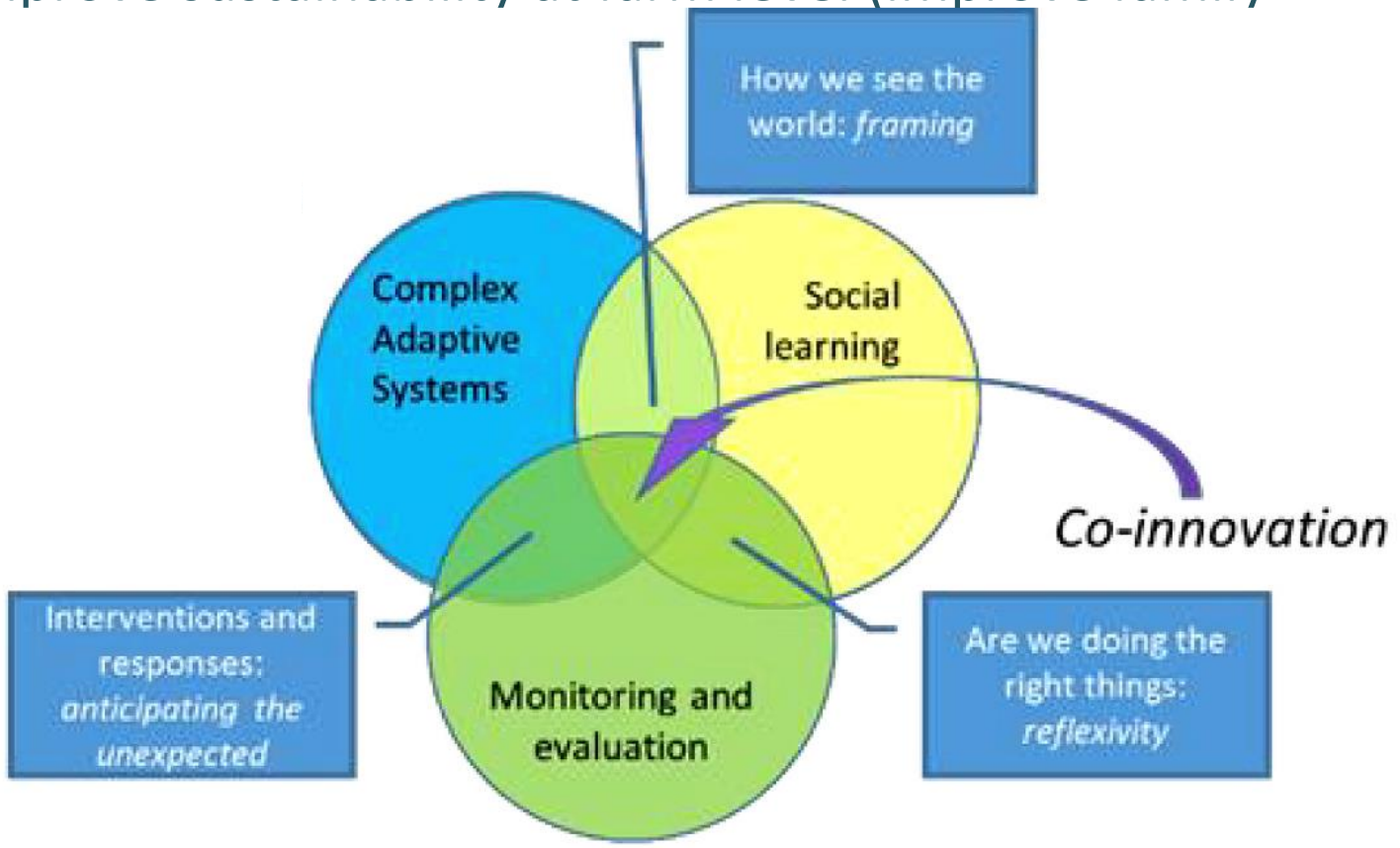
Phase 1: developing the “coinnovation approach”

Vegetable systems: improve sustainability at farm level (improve family income, labour prod



Participa
Farmers
Extension agents
Researche
National Farmers organizati





Three domains of co-innovation

(Rossing et al., 2021; Dogliotti et al., 2014; Albicette et al., 2017)

s
xplorations
vorkshops
nability
mework

l activity plans
oring meetings
s
ussions
t Change stories

Phase 2: adapting to different systems and actors

Beef and sheep systems on natural grasslands: improve sustainability at farm level by introducing ecological intensification practices

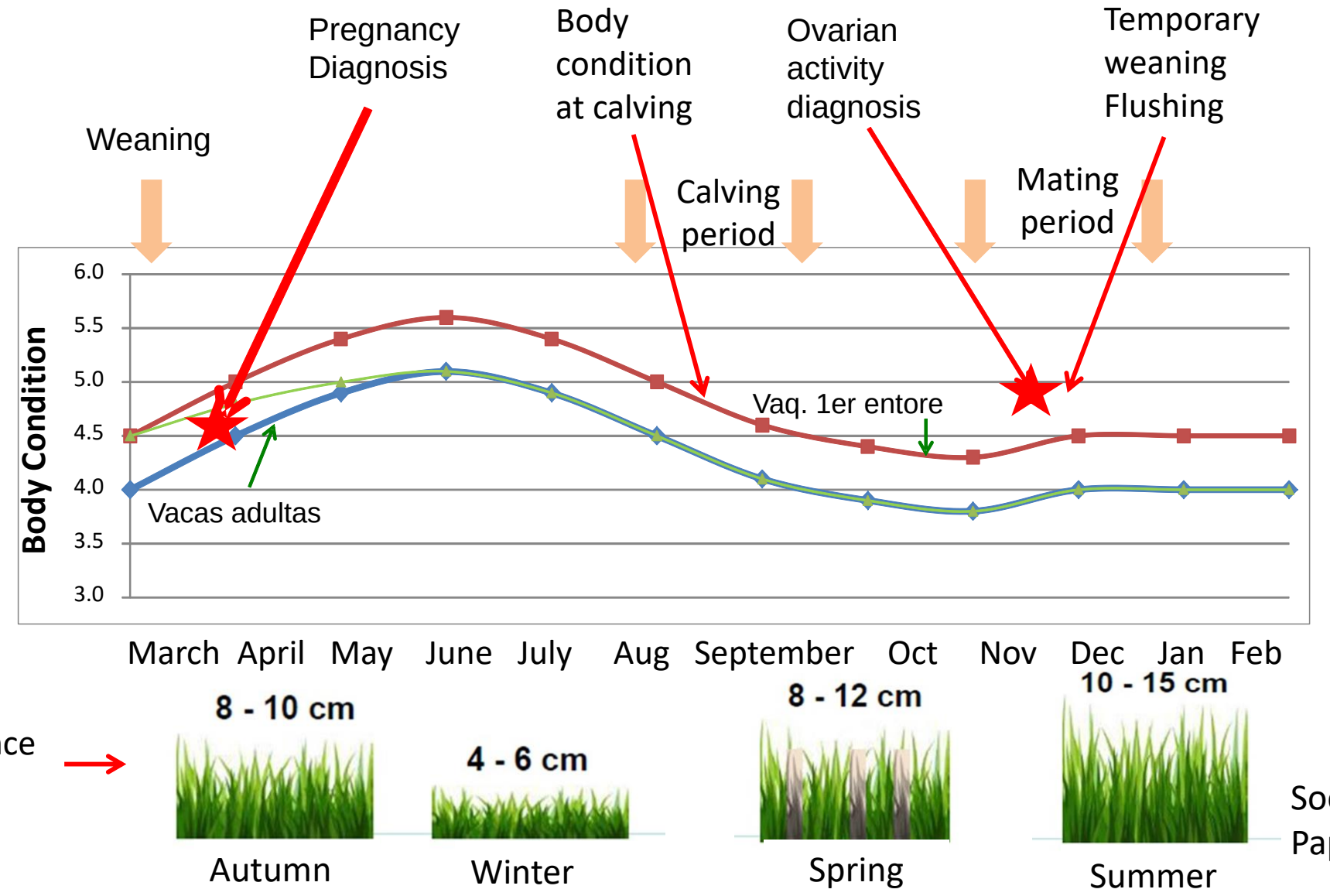
Ecological intensification principles to support sustainability transitions

Diagnosis

Main causes explaining low productivity and profitability and high environmental impact (Paparamborda et al., 2023):

- ✓ Lack of temporal alignment of the processes of gestation, lactation, and mating with the natural cycle of forage production of the native grasslands (Soca and Orcasberro, 1992)
- ✓ Poor control of the grazing intensity across the farm paddocks (Do Carmo et al., 2016)
- ✓ Overgrazing cause negative effects on ecosystem services provision by reducing soil organic carbon (SOC) stocks and the diversity of plants, birds, and mammals and increasing soil erosion and GHG emissions (Modernel et al., 2016)

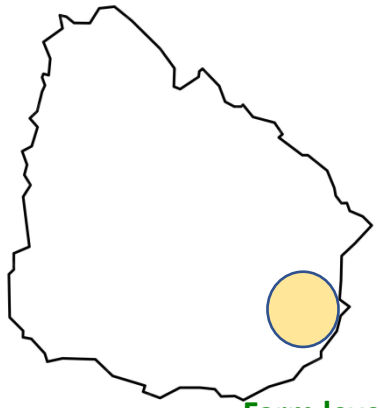
Ecological intensification principles to support sustainability transitions



Soca et al., 2007; 2014
Paparamborda et al., 2023

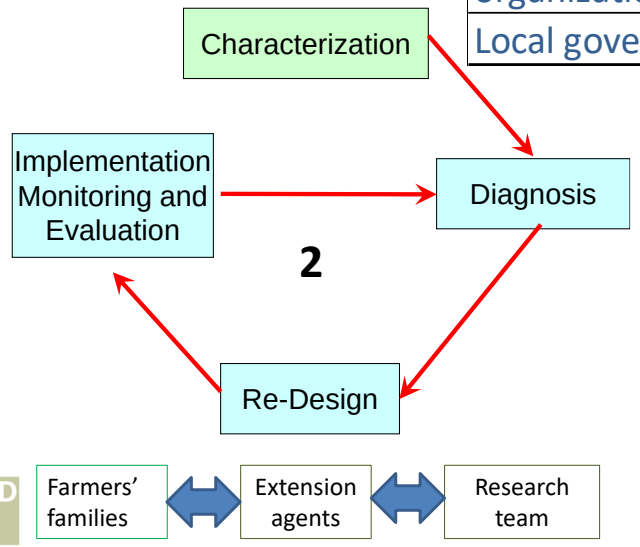
Phase 2: adapting to different systems and actors

Beef and sheep systems on natural grasslands: improve sustainability at farm level by introducing ecological intensification practices



Farm level

Participating actors	
	Project 3
Farmers	10
Extension agents	1
Researchers	13
Local farmers organizations	2
National Farmers organization	1
Local government	1



Funding

Research Institution own funding

Project Leadership

Research institution

Methods and tools

- PIPA workshops
- MESMIS adapted
- Problem trees
- Farm maps and activity plans
- Monthly monitoring meetings
- Open field days
- Case study discussions
- Ecosystem integrity index and other environmental impact indicators
- PasPalum - Farm Model development

Learning outcomes

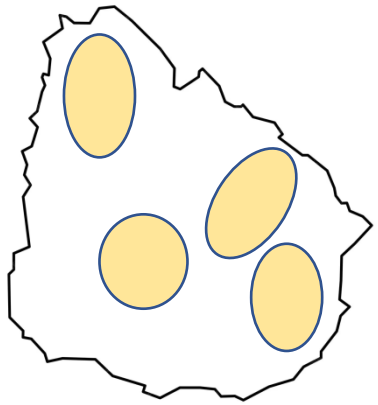
Farm system level changes in structure and management adapted to each case

Extension agents role

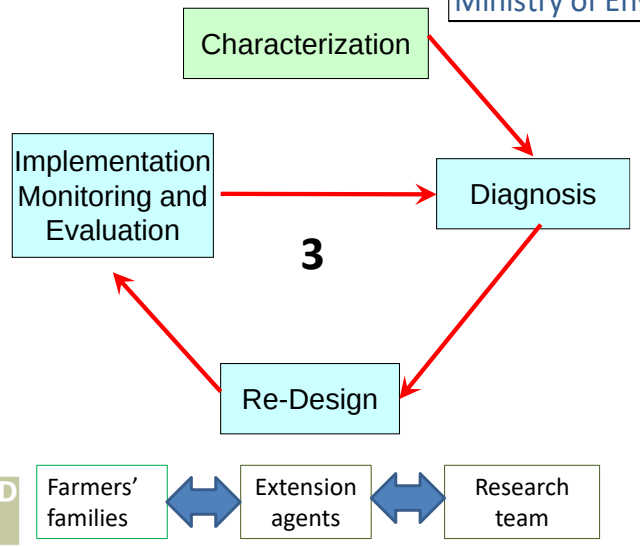
- Involving regional institutional actors in the co-innovation process
- Communication with peripheral actors

Phase 3: scaling and changing initiative

Beef and sheep systems on natural grasslands: improve sustainability, **adaptation to climate change** and **reduction of GHG emission** at farm level by introducing ecological intensification technologies



Farm level



Participating actors		
	Project 4	Project 5
Farmers	40	90
Extension agents	4	11
Researchers	5	10
Local farmers organizations	6	11
National Farmers organization	0	2
Ministry of Agriculture	1	6
Ministry of Environment	0	1

Funding

Government and international funds

Project Leadership

Ministry of Agriculture

Methods and tools

- PIPA workshops
- MESMIS adapted
- Problem trees
- Farm maps and activity plans
- Monthly monitoring meetings
- Open field days
- Case study discussions
- Conceptual model and functional typologies
- Techniques Implementation Index
- New environmental impact assessment methods
- New tools and methods to support extension agents' work

Learning outcomes

- EI strategy and technologies feasible to transform beef&sheep farm systems
- Advisory service to support ecological intensification at farm level
- Governance of multi-actor innovation processes

Examples of tangible results

28% ⬆

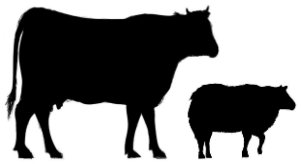
Family income

-2% ⬇

Total Costs

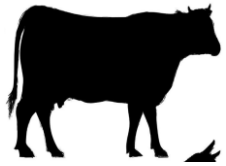
-9% ⬇

Total Labor



-8% ⬇ -24% ⬇

Stocking rates

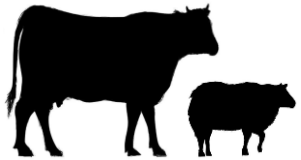


8% ⬆

Beef meat production per ha

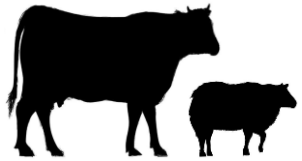
17% ⬆

Sheep meat production per ha



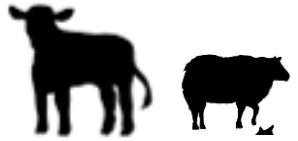
16% ⬆ 57% ⬆

Beef and Sheep meat production per animal



6% ⬆ 13% ⬆

Weaning rates



6% ⬆ 26% ⬆

Weaning weights

Dogliotti et al., 2023

Examples of tangible results

-8% ⬇

Total GHG emissions per ha

-19% ⬇

GHG emissions per kg meat produced

23% ⬆

Herbage height

7,4% ⬆

Plants biodiversity

The level of application of "ecological intensification" practices (Breeding Index) increased by 64%

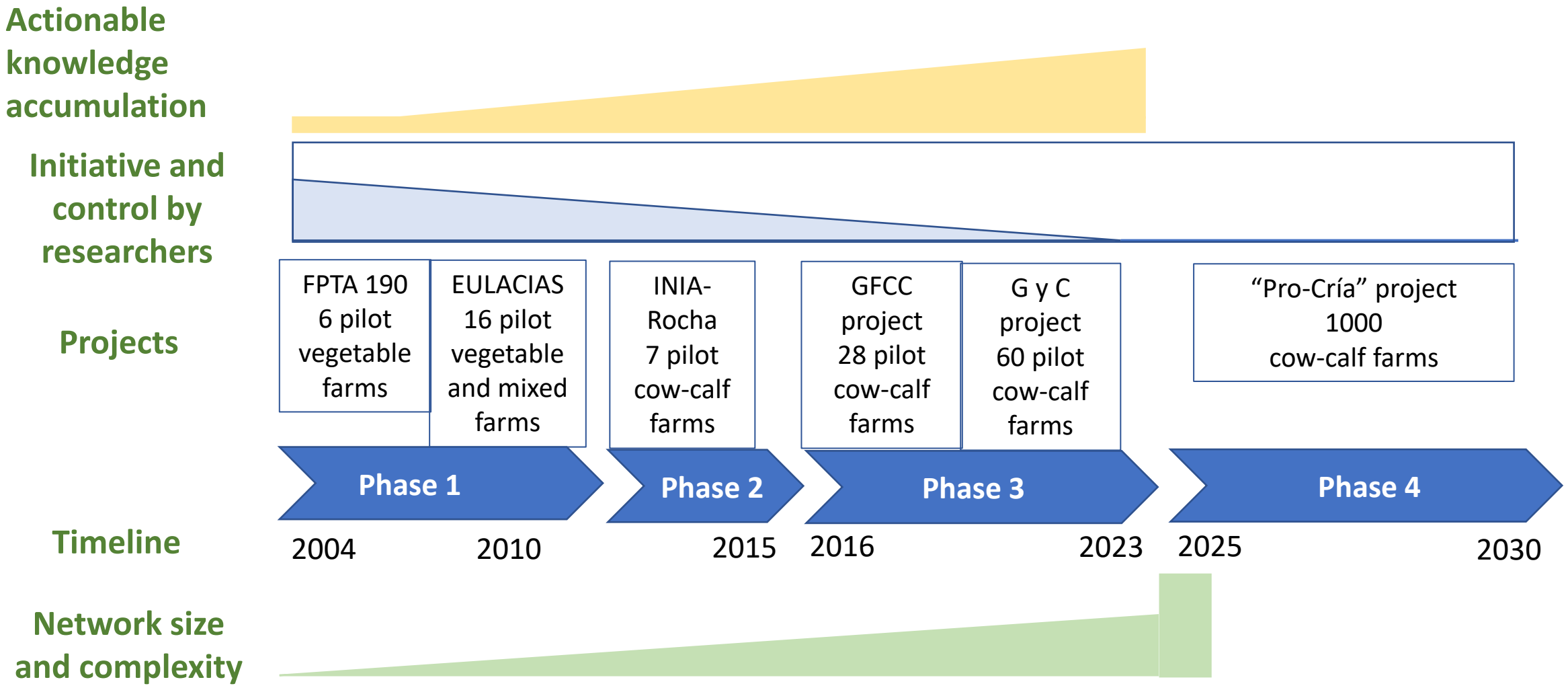
70% of participant farms contracted their extension agent after the project subsidy ended to continue the coinnovation work.

Dogliotti et al., 2023

Phase 4: scaling out

- Focus on scale out the knowledge accumulated during the previous phases
- 1000 farms, 100 extension agents, a complex network of participant actors and institutions
- Aim is not on pushing boundaries of ecological intensification and moving to agroecology
- Role for research in phase 4:
  - Advisory role and support training of extension agents
  - Engagement in critical monitoring and evaluation cycles
  - Development of supporting tools for farmers, advisors and students: the Paspalum model (Ruggia et al, in press), serious games, pasture growth estimation using RS, etc.
  - Pushing boundaries in experimental settings (e.g., Living Labs)

Development of a socio-technical niche: illustration



(Based on Rossing et al., 2021; Aguerre and Bianco, 2023)

Discussion - 1

Niche development involved 3 essential processes

- the development of learning processes through interaction, accumulating knowledge around two main axes: a new way of sustainable farming associated with ecological intensification, and a new way of promoting innovation through research in application contexts associated with co-innovation
- alignment of expectations and the development of a common vision, linked to the sustainable development of family-farming
- creation and expansion of a network of stakeholders, comprising researchers, farmers, extension agents, government institutions, farmers' organizations and other relevant actors

Accumulation across projects was essential for technological learning, network building and institutional success

Aguerre and Bianco (2023)

Discussion - 2

Transformation to agroecology?

- Yes, for on-farm practices and science (although work in progress)
- No, for the wider social-ecological system
  - Farmers are still anonymous suppliers
  - Control remains with processing industry
  - Values created are not rewarded
- How to avoid sole reliance on technology fixes?
- Role transdisciplinary research: Push boundaries in experimental settings (e.g., Living Labs) with coupled innovations, regional food system options, short supply chains, ...
- Opportunities for continued transdisciplinary and transformative work through the new Institute of Sustainability Transitions of Food Systems (ITSSA)

Discussion - 3

Replication and translation to other contexts:

- Expect highly distinct trajectories (Klerkx et al., 2017)
- Starting points may differ:
  - Personal level: agronomic knowledge, systems perspective, felt room and ability to do things differently, financial leeway
  - Institutional level: what is considered a ‘good’ farmer, advisor, scientist by social communities, unions, advisory institutes or companies; is there a systemic perspective?
  - National agricultural innovation system: closeness of organizations and people, political and economic outlook in the country
- Being in the EU: does Horizon Europe foster niches as described here? What are enablers and bottlenecks?

Participants last reflection workshop Project 5: “Ganadería y clima”

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