Unlocking the agricultural systems
The example of agroecological research and innovation systems

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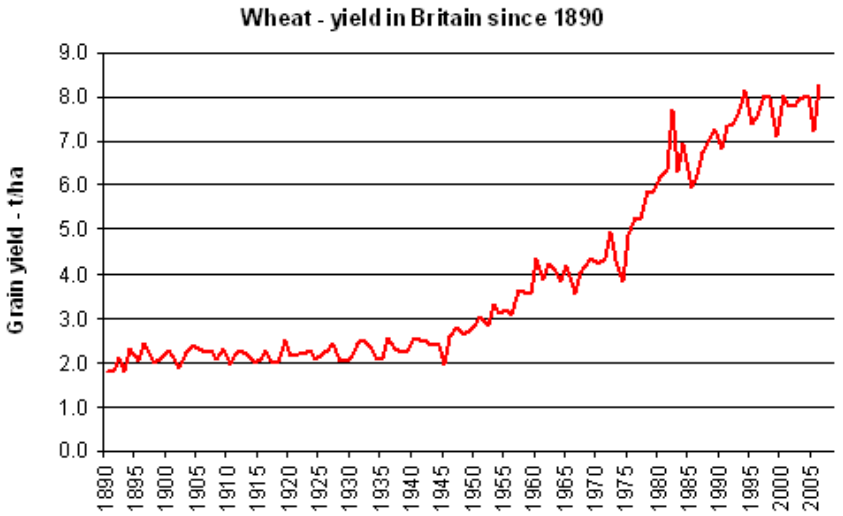
Classic vision of innovation : boost farming systems productivity

PLOT

- **Development of new varieties and new machinery**
- **Better use of inputs**
- **Main goal : increase of productivity and efficiency**
  - impact on productivity -> increase yield
  - impact on sustainability -> decrease impact



source : ukagriculture.com

From XXth to XXIst century
A triple agenda

- Food systems must ensure the availability of food for everyone
- Agriculture must develop in ways that increase the incomes of smallholders
- Agriculture must not compromise its ability to satisfy future needs

Right to food

Equity

Sustainabiliy

Report submitted by the Special Rapporteur on the right tofood, Olivier De Schutter (UN, 2010)

source : De Schutter, 2010

How to meet these challenges ?

- **upgrade from yield to income, welfare and ecosystems services**
  - From field to farm and food system.

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- **upgrade from yield to income, welfare and ecosystems services**
  - from plot/field to farm/system.
- **think about trade-offs between productivity and sustainability**
  - from maximisation to optimisation

Trade-offs are the reality of biological systems
We have to decide our priorities and accept trade-offs
Triple win (eco, social, envi) is an utopy

Examples of trade-offs

- income/labor
- yield/cost
- quantity/quality
- yield/price
- resilience/speculation
- farm/post farm share

How to meet these challenges ?

- **upgrade from yield to income, welfare and ecosystems services**
  - from plot/field to farm/system.
- **think about trade-offs between productivity and sustainability**
  - from maximisation to optimisation
- **take advantage of the the specificities of system approaches**

Specificities of system approach

- **System approach**
  - **A question of method**
  - Focus on interactions
  - Address the issue of complexity
  - Able to accomodate a diversity of prospective scenarios

Example of system approach

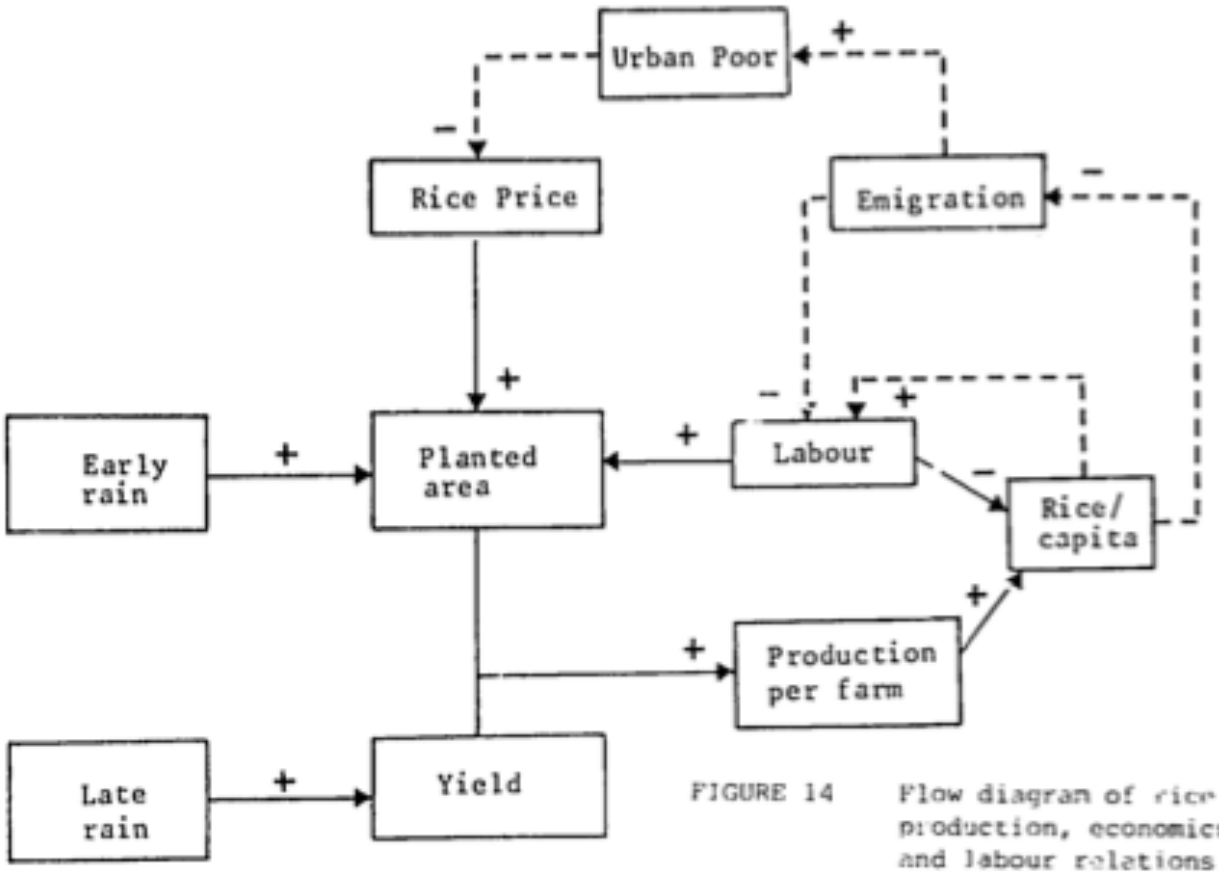


FIGURE 14 Flow diagram of rice production, economics and labour relations for Northeast Thailand

35

source : Conway, Agroecosystem analysis, 1983

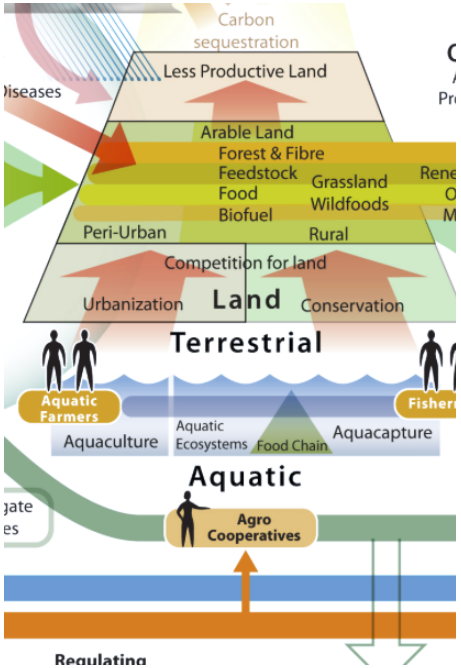
Specificities of system approach

- **System approach**
  - **A question of method**
  - Focus on interactions
  - Address the issue of complexity
  - Able to accomodate a diversity of prospective scenarios
- **System-wide scale**
  - **A question of scale**
  - Widening the scope
    - A more comprehensive understanding of reality
    - More degrees of freedom for trade-offs
  - Prerequisite for a multi-actor process of innovation

Shifts

- **Change of indicators**
  - from yield to income and welfare
  - sustainability indicators
- **Importance of farmer's decision**
  - Drivers of farmer's decision are at the value chain level

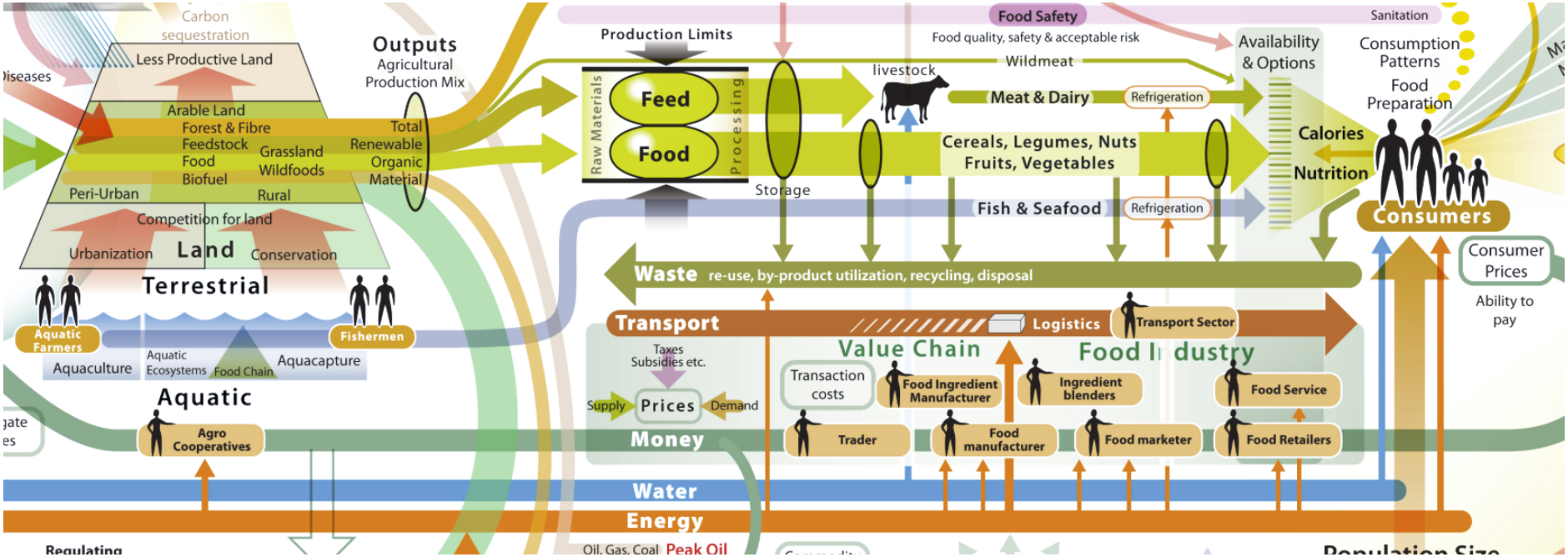
source : shiftn.com



Shifts

- **Change of indicators**
  - from yield to income and welfare
  - sustainability indicators
- **Importance of farmer's decision**
  - Most of the drivers of farmer's decision are at the value chain level

source : shiftn.com



More challenges ...

... More options

From XXth to XXIst century

- **More challenges …**
  - access to sufficient and healthy food for all
  - insure a fair income to farmers
  - make farming systems sustainable in the future

From XXth to XXIst century

- **More challenges ...**
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- **... more options**
  - sustainable intensification of conventional systems
  - organic farming
  - agroecology

A diversity of pathways

Sustainable intensification

What Beth needs is access to the technology, skills and resources that can help her get more from her land.

As one of the world's leading agricultural companies, Syngenta is committed to helping farmers access the world **to raise yields while conserving water, soil and ecosystems**.It's all part of what we call the Good Growth Plan.

Agroecology : principles inspiring practices

FARM

- **Agroecology is based on principles**
  - sun, soil and water as the main drivers of agricultural production
  - recycling, limitation of impacts, parsimonious use of energy

    —> t**ake advantages of ecosystem services**
  - Autonomy of decision of farmers

    —> **shift from a plot to a system level : the farm**

    —> **from maximisation to optimisation**
- **Socio-economic principles**
  - fair trade, cooperation, support of customers …

    —> **gaining in economic autonomy to have the opportunity to build on ecosystem services and insure food sovereignty,**

Agroecology uses **ecological concepts and principles for the design and management of sustainable agroecosystems** where external inputs are replaced by natural processes such as natural soil fertility and biological control (Altieri 1995)

source : Stassart et al., 2012 ; Dumont et al., 2016

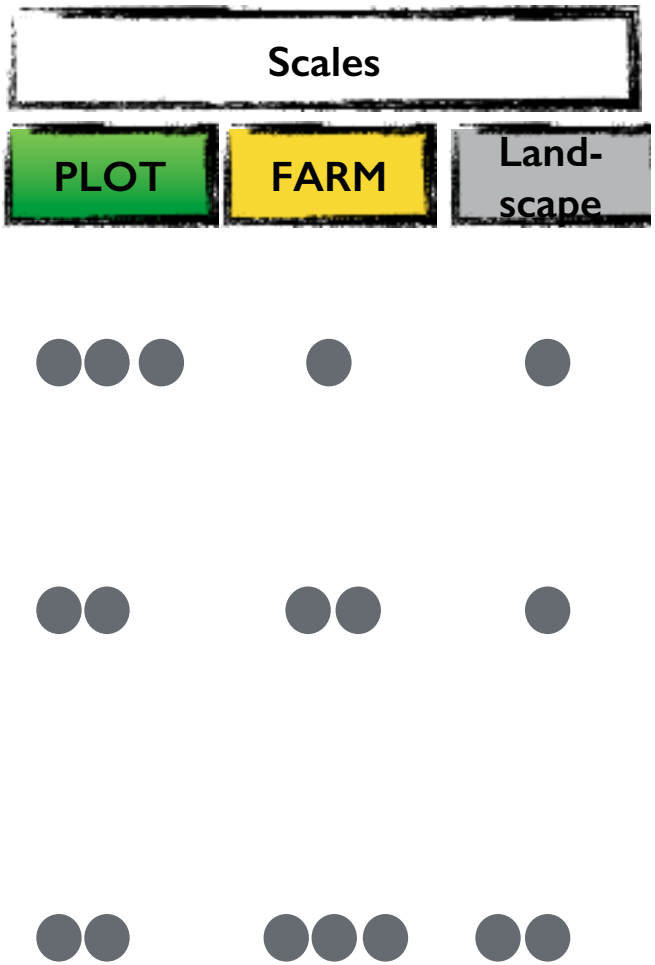
Principles

- **Plant nutrition**
  - Enhance recycling of biomass
  - Optimize nutrient availability
  - Balance nutrient flows
- **Soil management**
  - Securing favorable soil conditions for plant growth
  - Manage organic matter
  - Enhance soil biotic activity
- **Parsimony in ressource use**
  - Minimize losses of resources
  - Microclimate management, water harvesting and soil management through increased soil cover
- **Genetic diversity**
  - Species and genetic diversification
- **Biological control**
  - Enhance beneficial biological interactions and synergisms among agrobiodiversity components
  - Promote key ecological processes and services

Practices

- **Agroforestry**
- **Conservation agriculture**
- **Organic farming**
- **Biological control**
- **Crop-livestock integration**

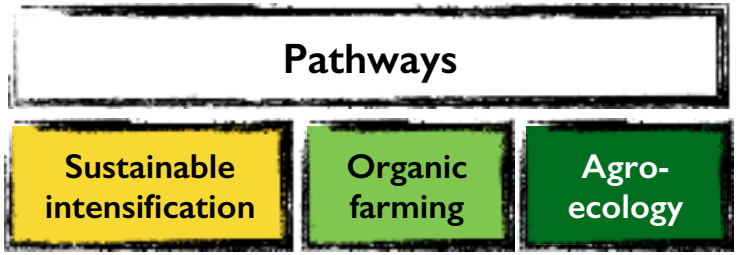
The nature of innovation



- **Efficiency**
  - increase the benefit/cost ratio
  - example : fertilizers, precision farming, …
- **Substitution**
  - substitute low impact inputs to high impact inputs
  - example : organic manure, biological control,
- **Redesign**
  - reconfigure the farming system to take full advantage of ecosystem services
  - example : permaculture, agroforestry, …

source : Hill &McRae, 1995 - Lamine, 2011

The nature of innovation



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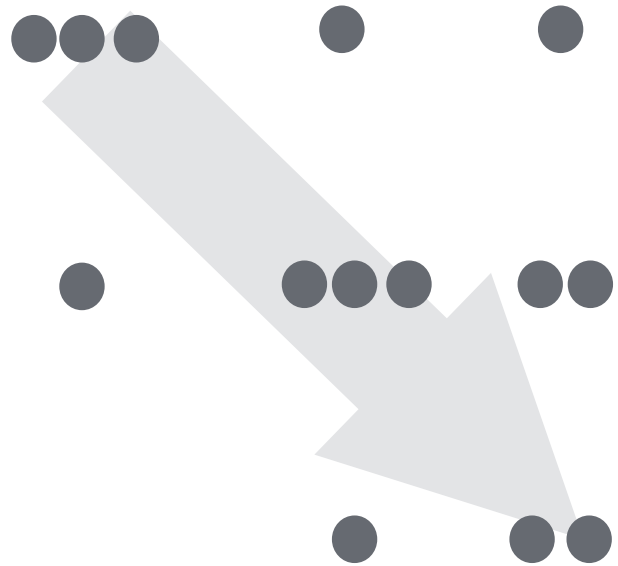


How to implement new options ?

Relevant innovations for sustainability are not implemented : why ?

- **State of the art**
  - agroecological practices are known but poorly implemented
  - the most sustainable systems are weakly invested by research
  - the minimal requirements of a sustainable horizon are not clearly stated
    - what is the equivalent of the 2°C threshold for agriculture ?
- **Exemples of lock-ins**
  - use of chemical pesticides
  - associations of cereals and legumes
  - dairy production & standardisation
  - …

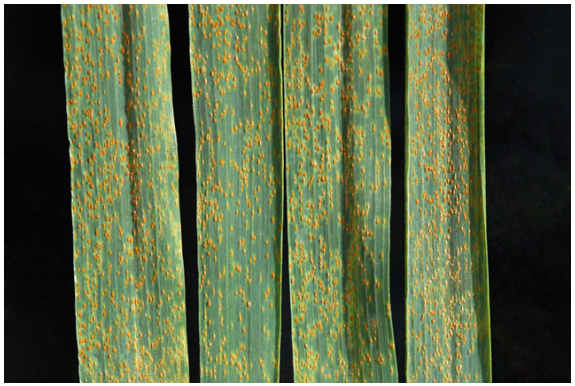
Ecophyto 2018

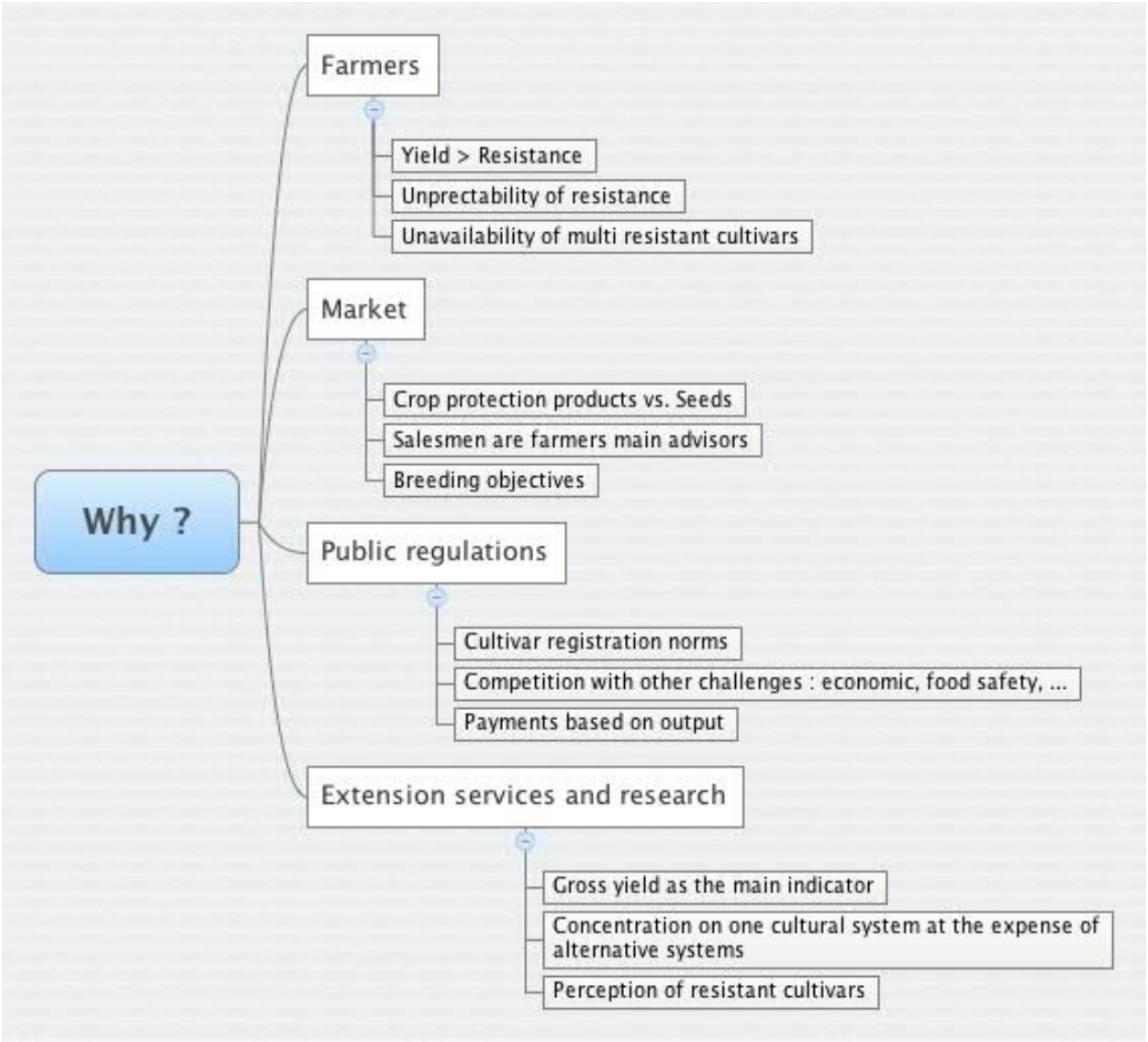
- **Target : - 50 % of pesticide use from 2008 to 2018**
- **Annual budget : 40 Mio €**
- **Results : 2009-2013 : +13 %**

- **Action based on good practices at plot and farm level**
- **Demonstration farms (Dephy network)**
  - 2012 : - 7 %
  - 2013 : - 12 %
- **Ecophyto II : more money (70 Mio €) for the same actions**

Fungus disease in wheat

- **mixtures of variety vs. fungicides**





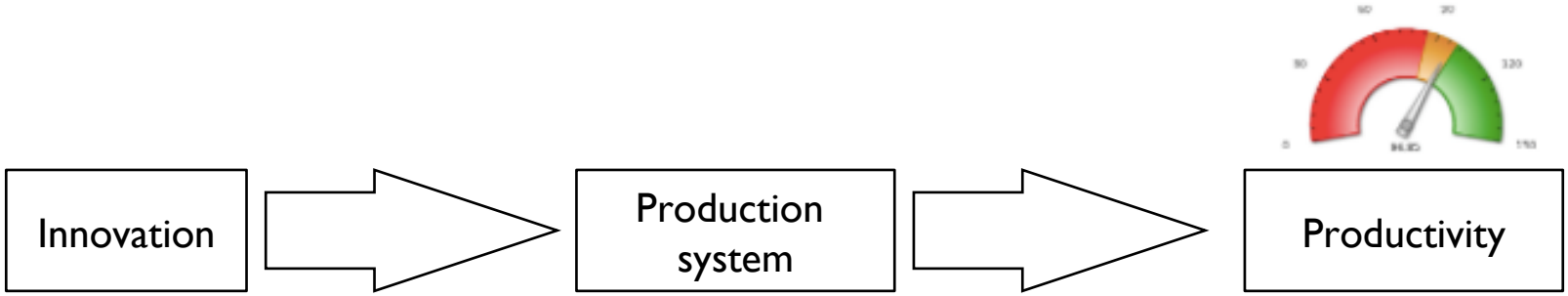
source : Vanloqueren et al, 2008

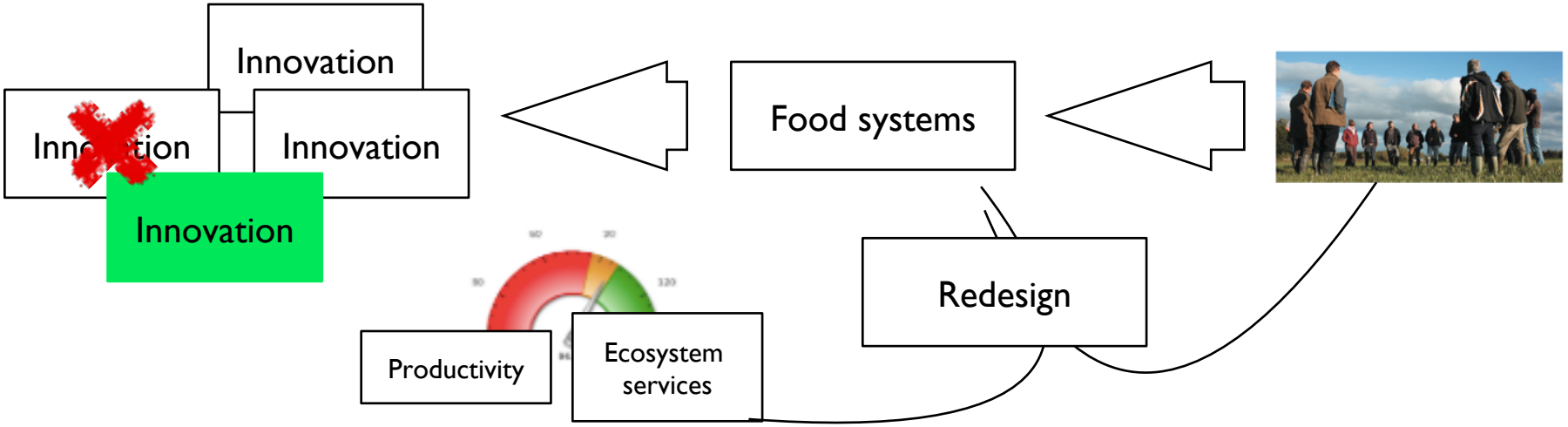
Most of the innovations are already available but not implemented : why ?

- **Factor of lock-ins**
  - related to process
    - path dependency, complexity, competition between pathways
  - related to actors
    - Matthew's effect, lobbies, vision of efficiency and progress …
  - related to system
    - lack of vision on the co-existence of systems and the mechanisms of transition

source : Vanloqueren & Baret, 2009

Conclusion : from silver bullet to learning process





Key elements for unlocking (1/2)

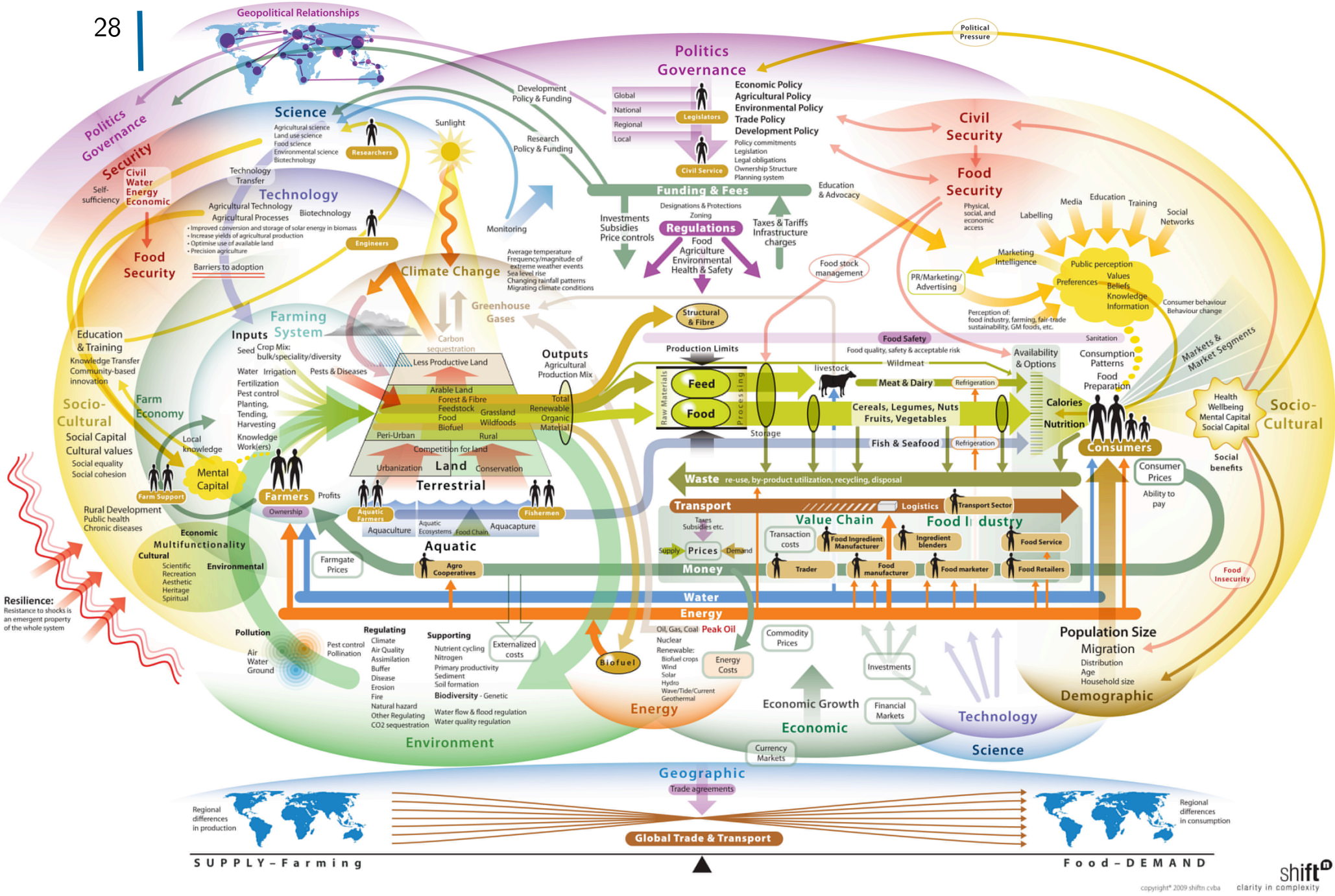
- A participatory multi-actor approach of innovation
- An acknowledgment of the diversity of pathways
- A shift from plot to farm and food systems
- Integration of cultural dimension & education

Key elements for unlocking (2/2)

- **A significant funding of research for alternative systems**
  - **New pathways means new assessment methods and new experts**
  - **Share of funding for organic farming research is decreasing at EU level ***
- **A prospective approach of agriculture to get out of path dependency**
- **More emphasis on system approaches**

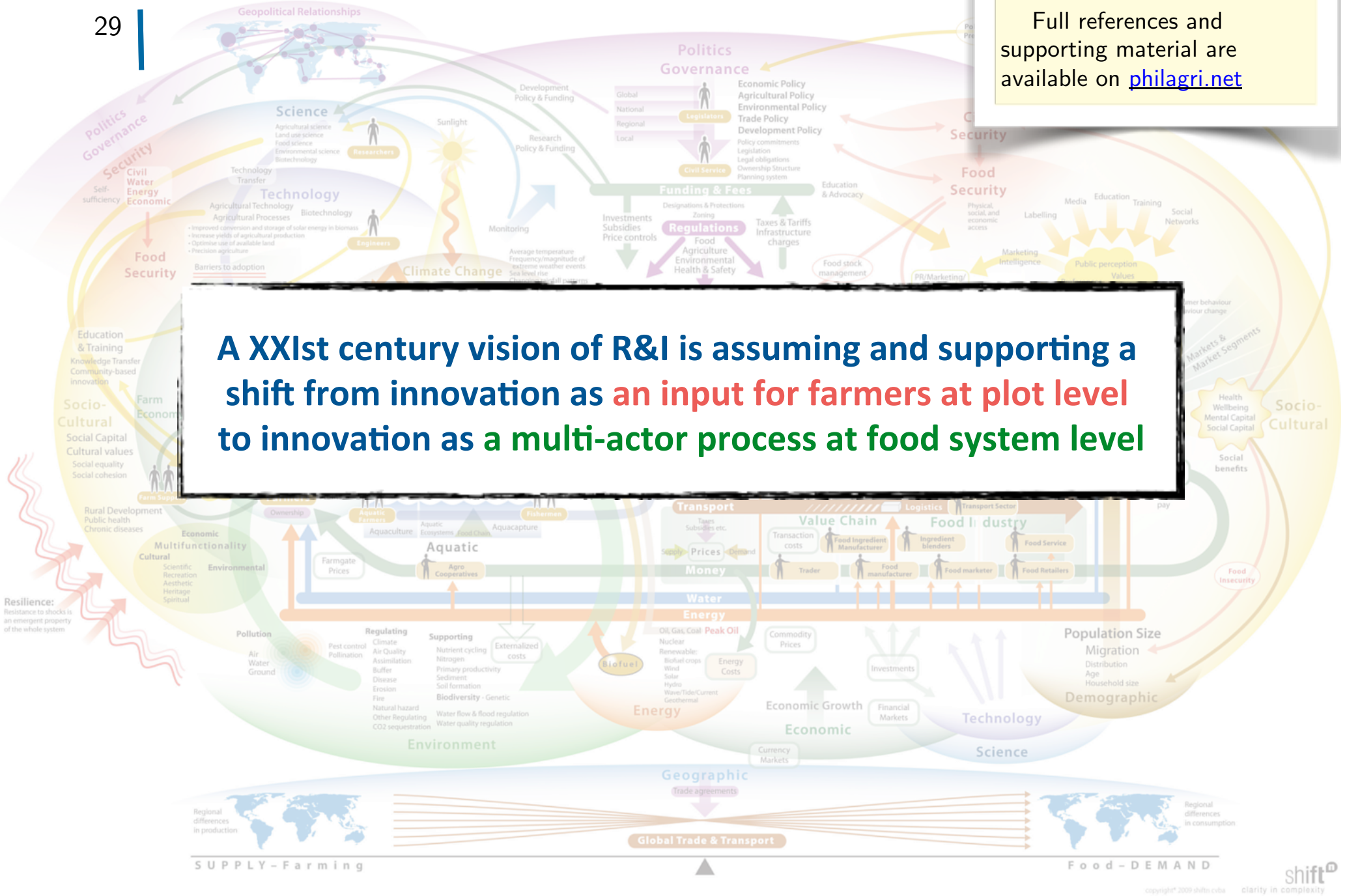
* Research for transition : What kind of research do we need to make European farming and food systems sustainable?

Global Food System Map



shiftn clarity in complexity

Full references and supporting material are available on philagri.net



A XXIst century vision of R&I is assuming and supporting a shift from innovation as an input for farmers at plot level to innovation as a multi-actor process at food system level

Geneva airport
Advertisement for a bank