

Territorial management of natural resources : Challenges for the Anthropocene

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The notion of anthropocene

Significant human effects on the environment

- ❑ Climate change
- ❑ Biodiversity losses
 - ❑ Farmland birds, pollinators, soil micro-organisms
 - ❑ Large-size terrestrial and marine organisms
- ❑ Soils degradation
- ❑ Air and Water pollution
- With possible, future, large-scale, disruptive social consequences ?

Social consequences of the anthropocene

- ❑ Agriculture
 - ❑ Unpredictable and varying climate, aridification
 - ❑ Concerns about soil fertility, pollination, biological control of weeds and pests
- ❑ Other economic activities
 - ❑ Major losses, linked to heat and cold waves, floods, health consequences, people relocation...
- ❑ Increasing possibilities of social and military conflicts
- Agriculture is at the forefront of causes and consequences of the anthropocene

Three major challenges for European agriculture in the anthropocene ?

- **Food access, Healthy diets (Quantity and Quality)**
 - Production resilience facing unpredictable future global change
 - *'The risk posed by poor diets to mortality and morbidity is now greater than the combined risks of unsafe sex, alcohol, drug and tobacco use', (Nature 2016, 537, 617)*
- **Satisfactory and full-filling livelihoods for farmers**
 - What should be the objectives in regards to number of jobs, hence labor productivity ?
- **Providing ecosystem services**
 - Air and water purification
 - Climate regulation, Local and global (carbon storage)
 - Disturbance mitigation
- Is a triple win possible ?

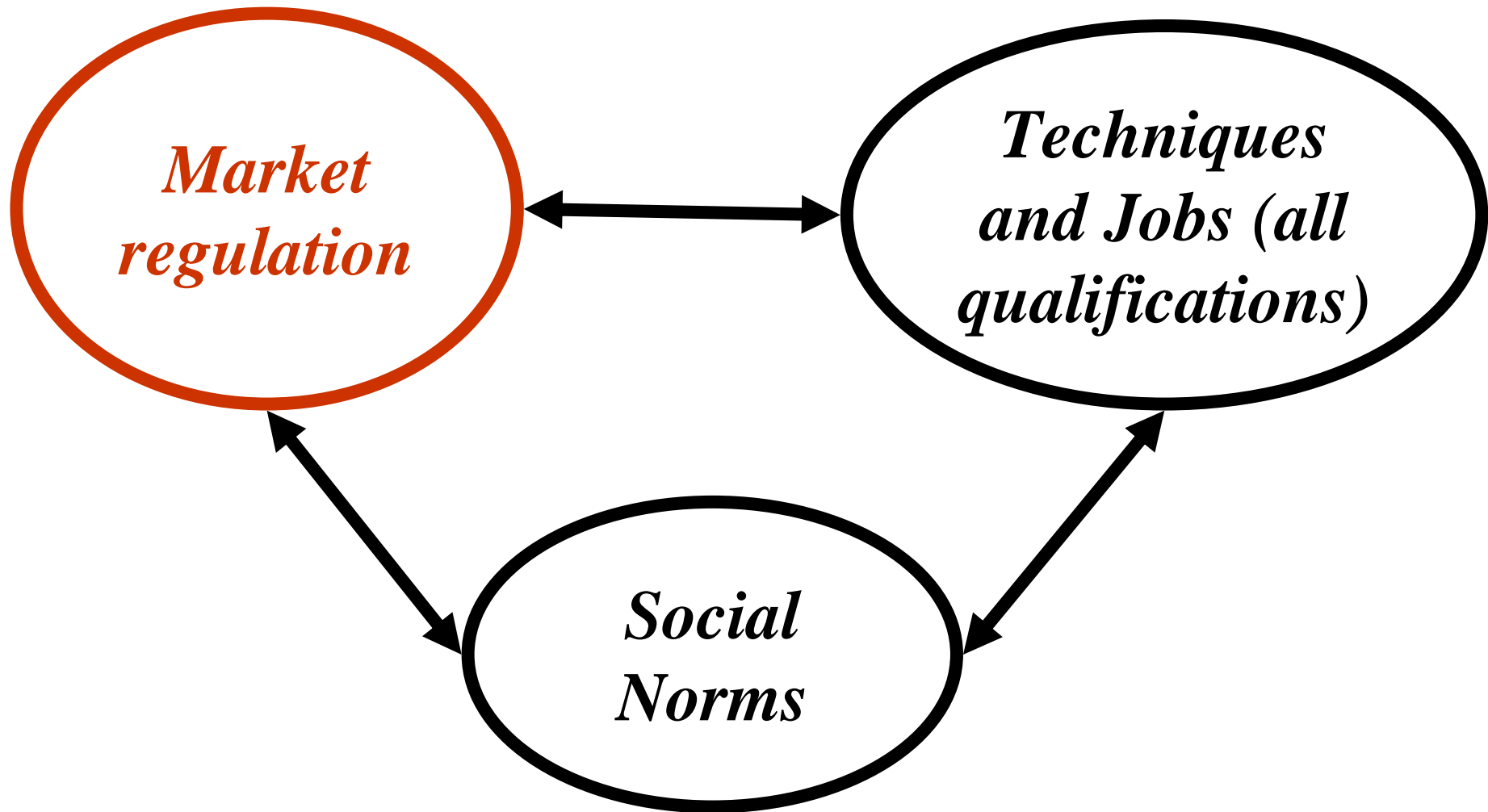
Triple win : the arguments in favor of

- Multifunctional landscapes,
- Diversified Farming System



- Providing a diversity of ecosystem services (from climate regulation to Biological control of weeds, pests)
- *Adapted to unpredictable, fast, environmental and social changes*
 - Due to higher biological and social diversity

Three challenges for multi-functional landscapes and diversified farming System



Economic challenges

Two questions :

- Are multi-functional landscapes and Diversified Farming System an important economic issue ?
- Do they need new economic regulations to extend ?

Comparing economic efficiency
of mono and multi-functional
landscapes : UK, 2060

(Bateman et al.
2013)



*Massive Collective Benefits
(at least, more than 20
Billions euros per year)*

'National security'

- Emphasis on Agricultural Production (monofunctional landscapes)
- Environmental regulation is weakened

'Nature at work'

- Emphasis on multi-functional landscapes
- Maintenance of ecosystem services

Diversified farming systems : Towards a green economy ?

Three tenets

- **The rules of business must be changed**
 - ‘As biological species evolve in response to natural environment, business has to adapt to the anthropocene’ (P. Sukhdev, Head of UNEP, TEEB)
- **Porter hypothesis**
 - Environmental regulations can induce efficiency, encourage innovations that improve commercial competitiveness, provide economic value (higher benefits for high quality agriculture)
- **Relevance of Market-based instruments** (subsidies, quotas, taxes), more efficient than prohibitions, laws

Payments for ecosystem services : market-based instruments as a new source of revenues for farmers ?



The case of water purification, where cities pay farmers to improve water quality

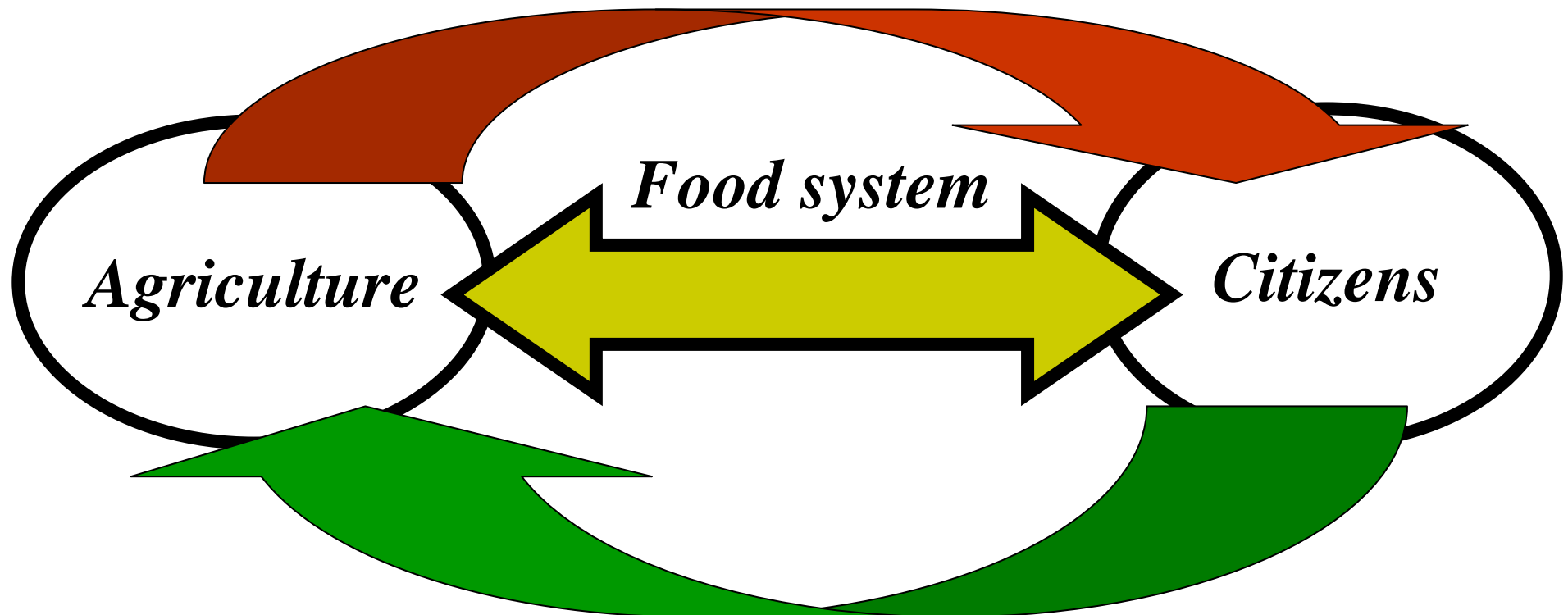
□ New York, Beijing; in Europe : Munchen...

A win-win contract

- Can increase significantly farmers' revenues (more than 50 % in the case of Beijing)
- Providing high quality water to urbans at low cost (6 times less costly than artificial purification in the case of New York)

Diversified farming systems : a new social contract between agriculture and society ?

Providing ecosystem services

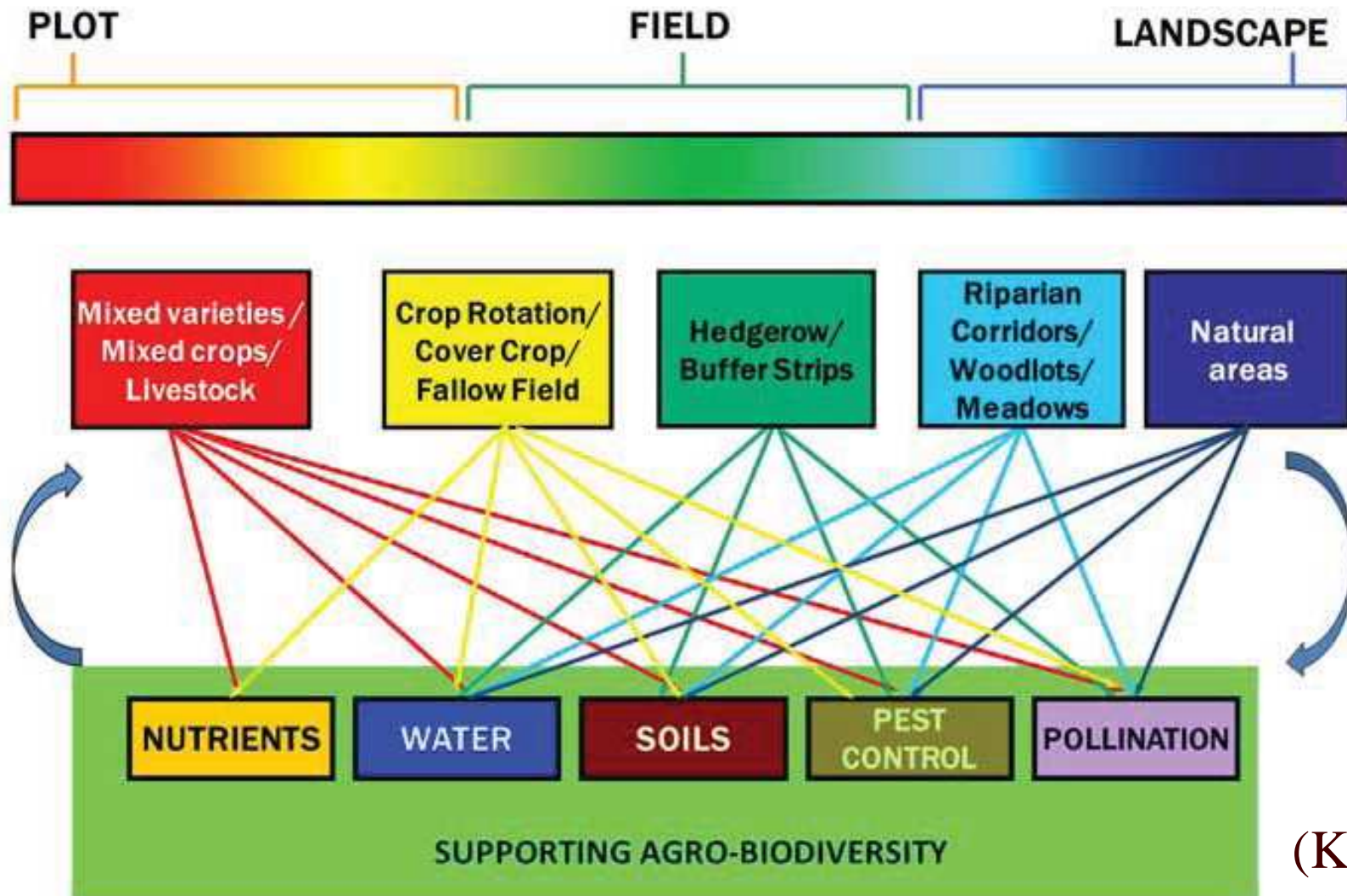


Payments for ecosystem services

Technical challenges

What are the issues ?

What sort of Techniques for diversified farming systems in multi-functional landscapes ?



(Kremen et al. 2012)

Techniques for diversified farming systems : challenges for economic actors, companies ?

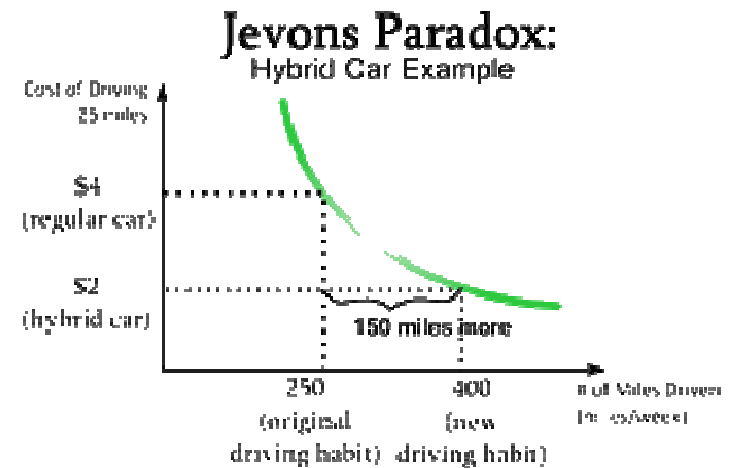
Soil fertility, Pests control

- Managing soil, plant and animal microbiomes (composition, diversity and abundance), weed and pest predators communities
- **Going from providing goods to providing services ?**

Plant Breeding

- Local breeds, adapted to local needs
- Mixed varieties, mixed crops, adapted to unpredictable climate
- Relevance of additional genetic diversity (old varieties, sexually compatible species...)
- **Farmers seed systems, participatory plant breeding : new selection schemes, associating companies and farmers ?**

Relations between social rules and the kind of technical developments



Social rules determine technologies developed, through their relative advantages

□ Plant breeding, weed and pest control....

New rules, Social incentives, based on

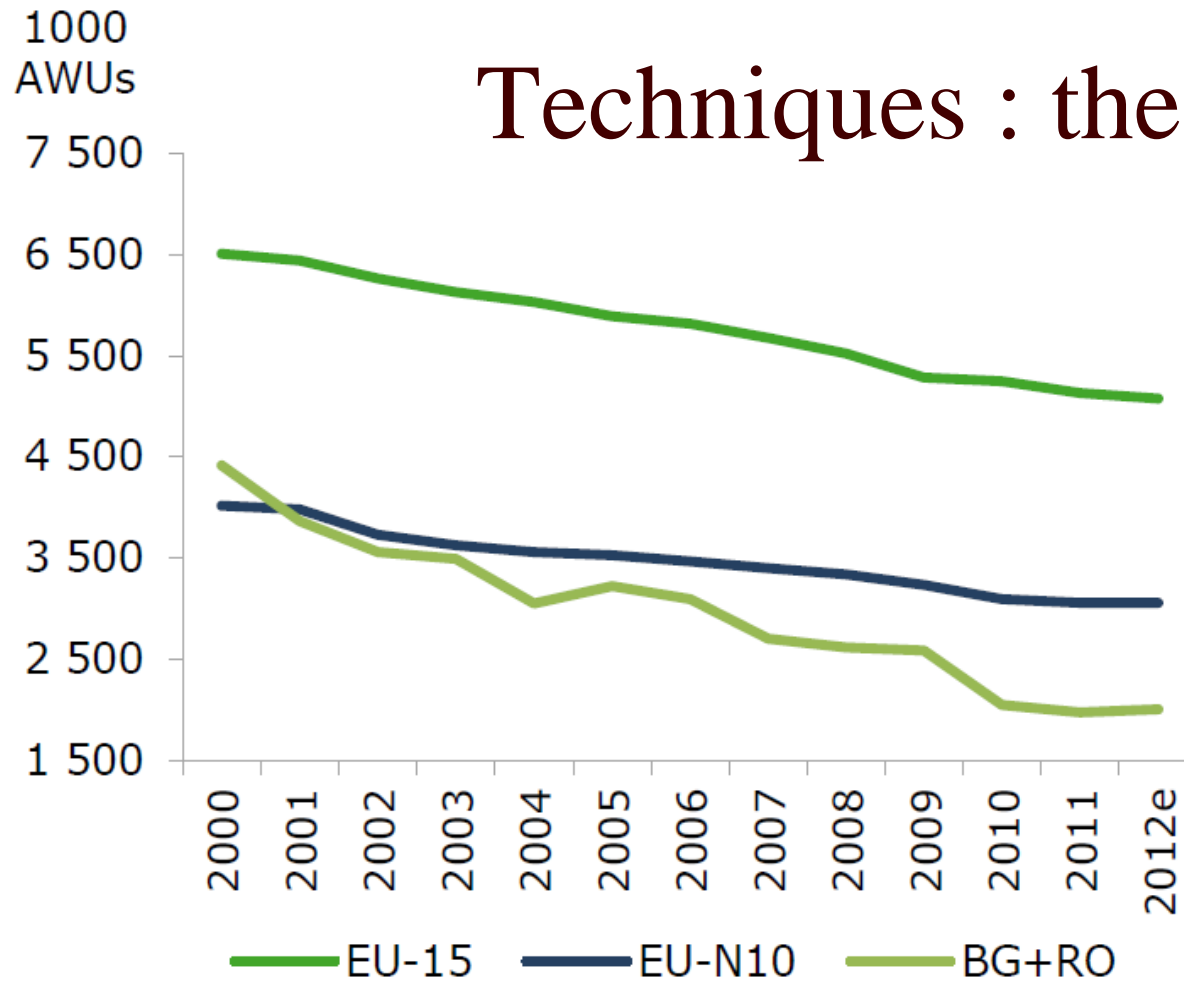
□ Life Cycle Assessment performances

■ Are drones a relevant technique (energy use, emissions, competing with other beneficial uses of batteries..) ?

□ **And** Impact on demand : mind Jevons paradox !

■ Technological progress increasing resource efficiency can lead to an **increase** of the consumption of that resource

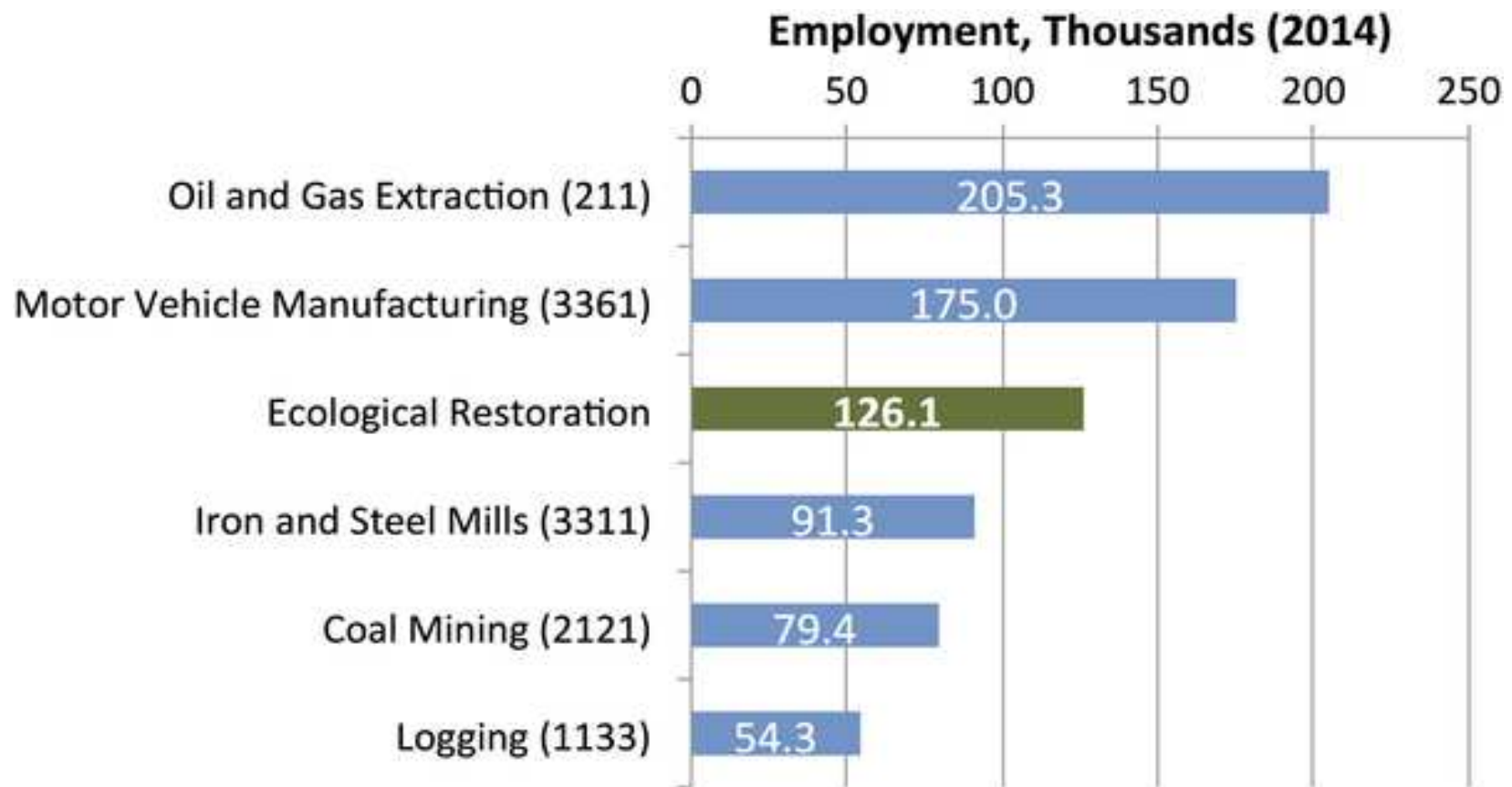
Techniques : the job question



4.8 millions jobs lost in European Agriculture since 2000 (70% in the new MS, 93% corresponding to non-salaried workers)

➤ What effects of diversified farming systems on jobs ?

USA : Direct jobs in ecological restoration of multifunctional landscapes versus selected carbon intensive industries, 2014



BenDor T, et al.(2015)

Citizens, consumers :
what about social
norms ?



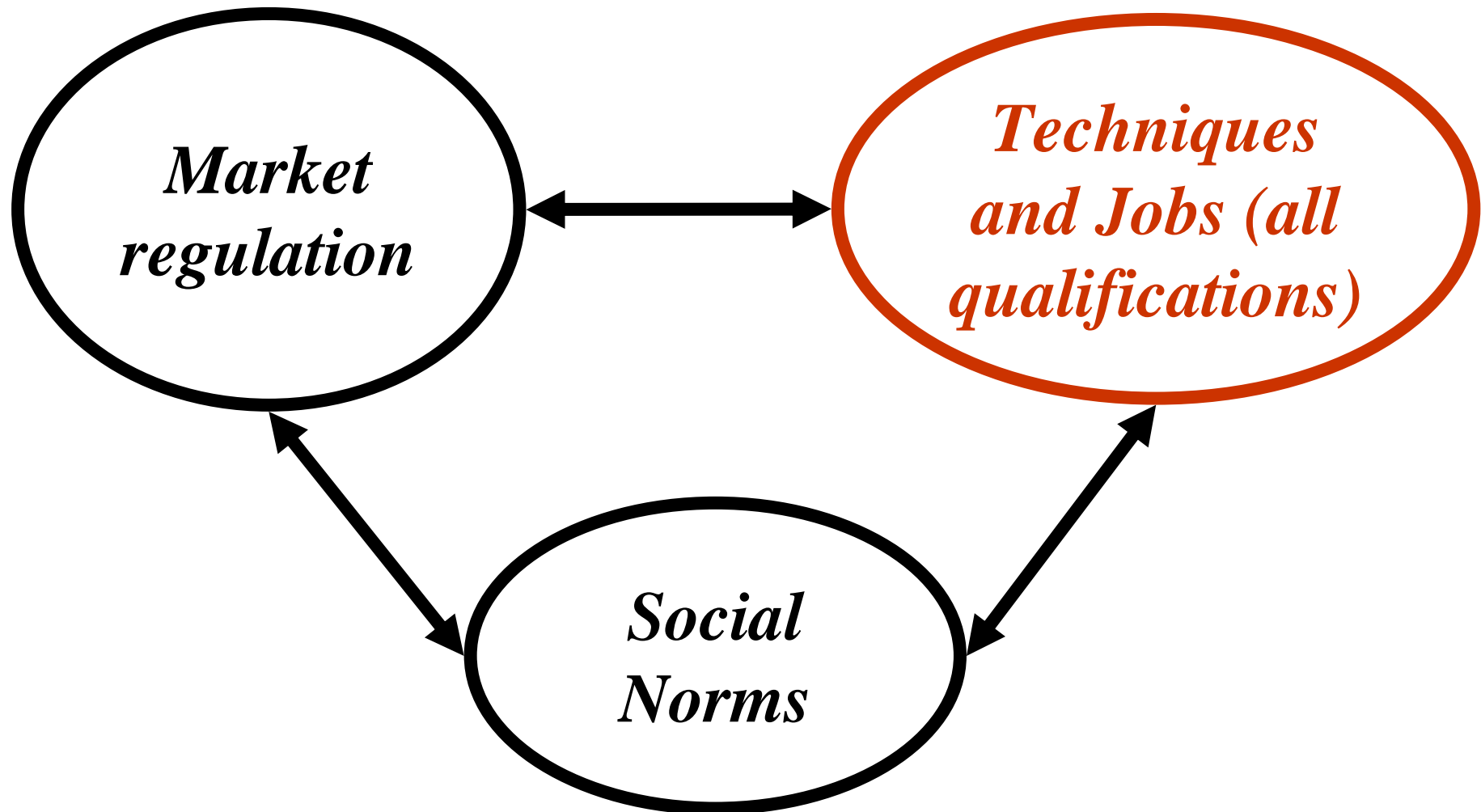
Slow Food®



Social norms can change rapidly, crossing tipping-points
(through social mimetism, conformism). In regards to :

- Choices in regards to food price versus quality
- Diets
 - From present income-dependent to mediterranean, pescetarian..
- Concerns about environmental and social impacts

Conclusion : three related challenges for
agriculture in the anthropocene



References

Economic importance of multifunctional landscapes

- Bateman, I., et al. 2013. Science 341, 45-50

Payments for Ecosystem services

- Grolleau and McCann. Ecological economics, 2012
- Zhen et al. PNAS, 2013

Porter hypothesis

- Rassier and Earnhart, 2015. Ecological Economics, 112, 129-140

Interactions between diversity-driven territorial policies and markets mechanisms

- Desquilbet M., Dorin B., and Couvet D. 2016. Environmental Modeling and Assessment

Social norms

- Nyborg et al., Science, 2016

Diets and environmental effects

- Tilman and Clark, Nature, 2014

Technologies :

beware of Jevons paradox

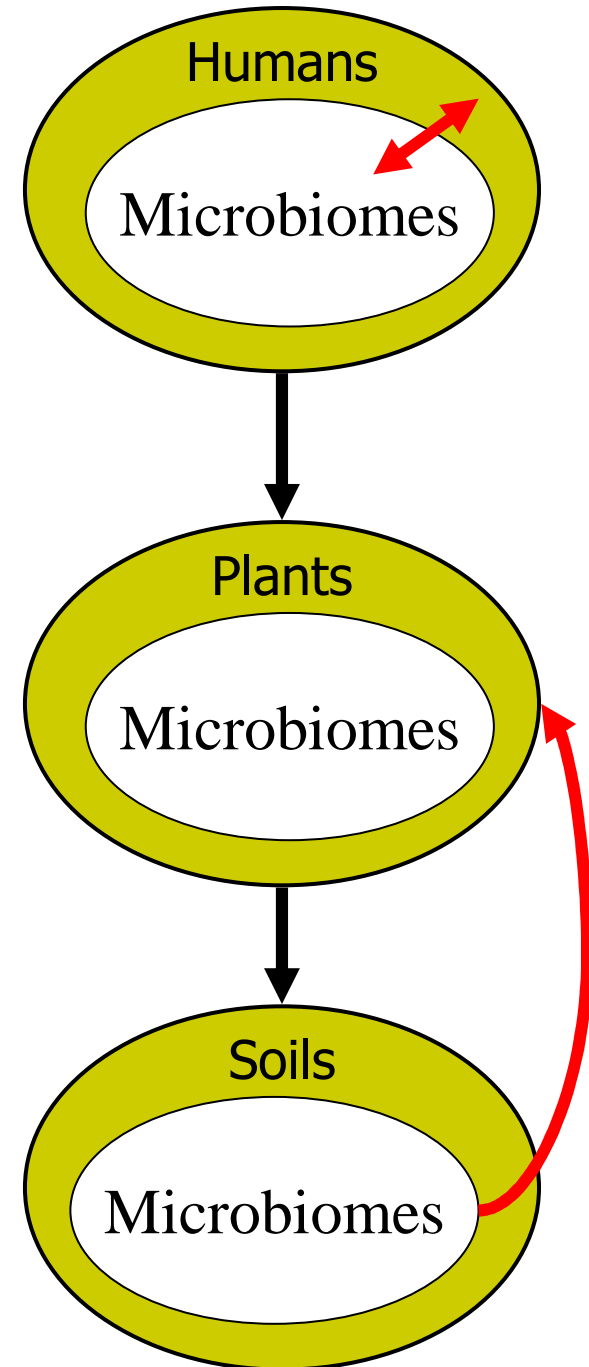
- Technological progress increases the efficiency with which a resource is used (reducing the amount necessary for any one use)
 - The rate of consumption of that resource rises because of increasing demand !
 - 1865 : higher efficiency of coal-use led to the increased consumption of coal in a wide range of industries

The importance of micro-organisms

More than 99 % of individuals, species

Relationships between :

- Soil microbiomes and Plant composition (vitamins, oligo-elements, flavonoids in tomatoes)
- Humans and their microbiomes
 - Digestive system
 - Immunity system regulation



Monofunctional agricultural landscape



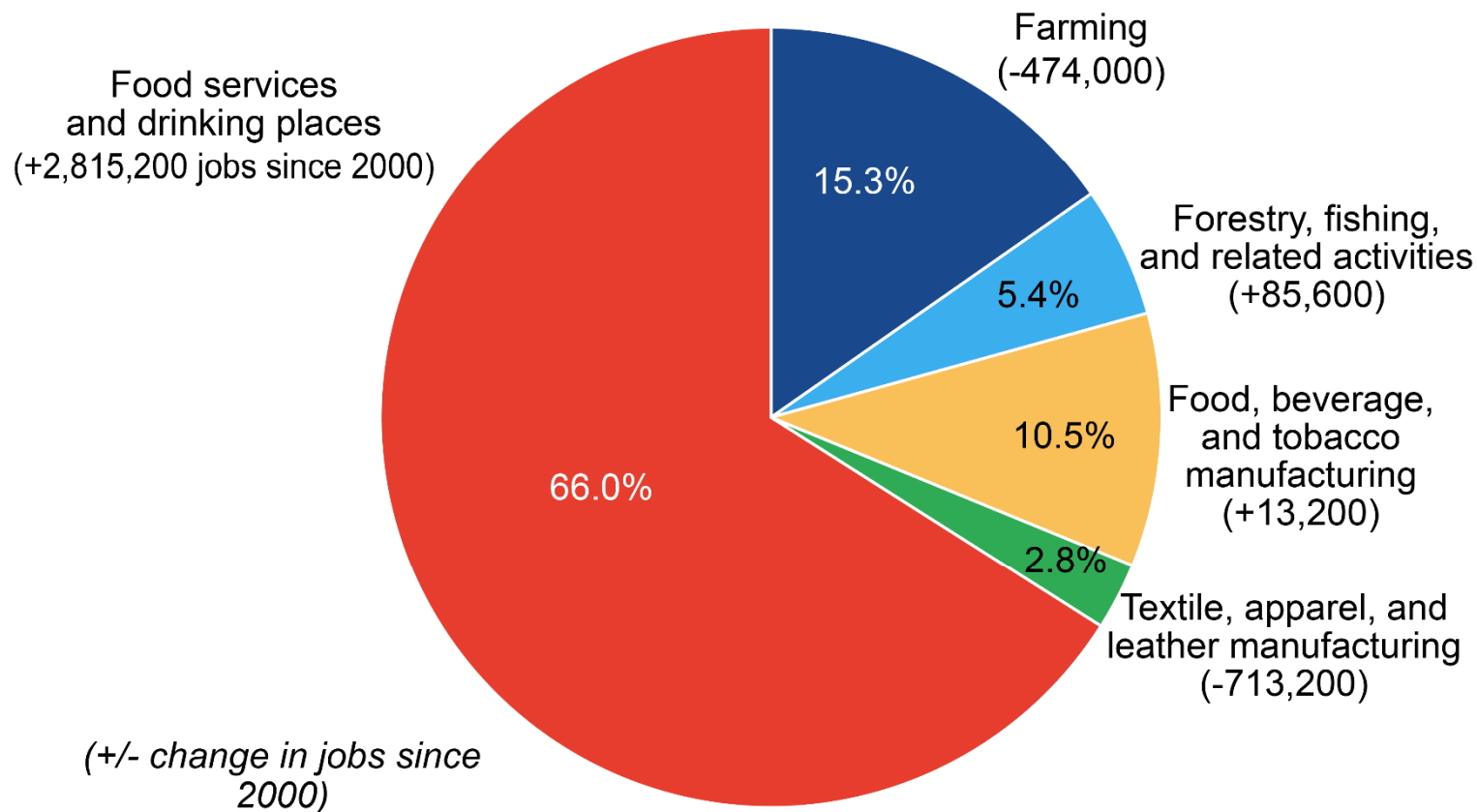
- Very efficient in regards to labor and capital productivity



THE ANTHROPOCENE

Employment* in agriculture and related industries, 2014

17.3 million jobs
(9.3 percent of U.S. employment)



*Full- and part-time jobs.

Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of Economic Analysis.

Relationships between environmental impacts and diets

