



How to solve the problem of scales to improve the efficiency in livestock production?

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The efficiency in livestock production

- Animals are not directly a limiting resource: they are secondary processors of primary biomass
- The efficiency of their conversion of biomass in animal products is essential:
 - To preserve resources
 - To increase competitiveness
 - To reduce the environmental impacts
- How to increase efficiency in livestock production to be sure to reduce competition of animal with edible food and to reduce environmental impacts?

The different scales of the problem

Territory,
country

Farms

Animal...

Resources,
Impacts

Decisions
= possible actions!

knowledge
Biological or physical processes

At what scale do we have to study and to solve the problems?

A back-and-forth between emergence and reduction

"The macroscopic properties (of a system) differ radically from those of its constituents; yet they made thereunder, and it is the transition from one scale to the other, which gives rise to new behaviors."

Roger Ballian (HS Sciences et Avenir Juillet 2005)

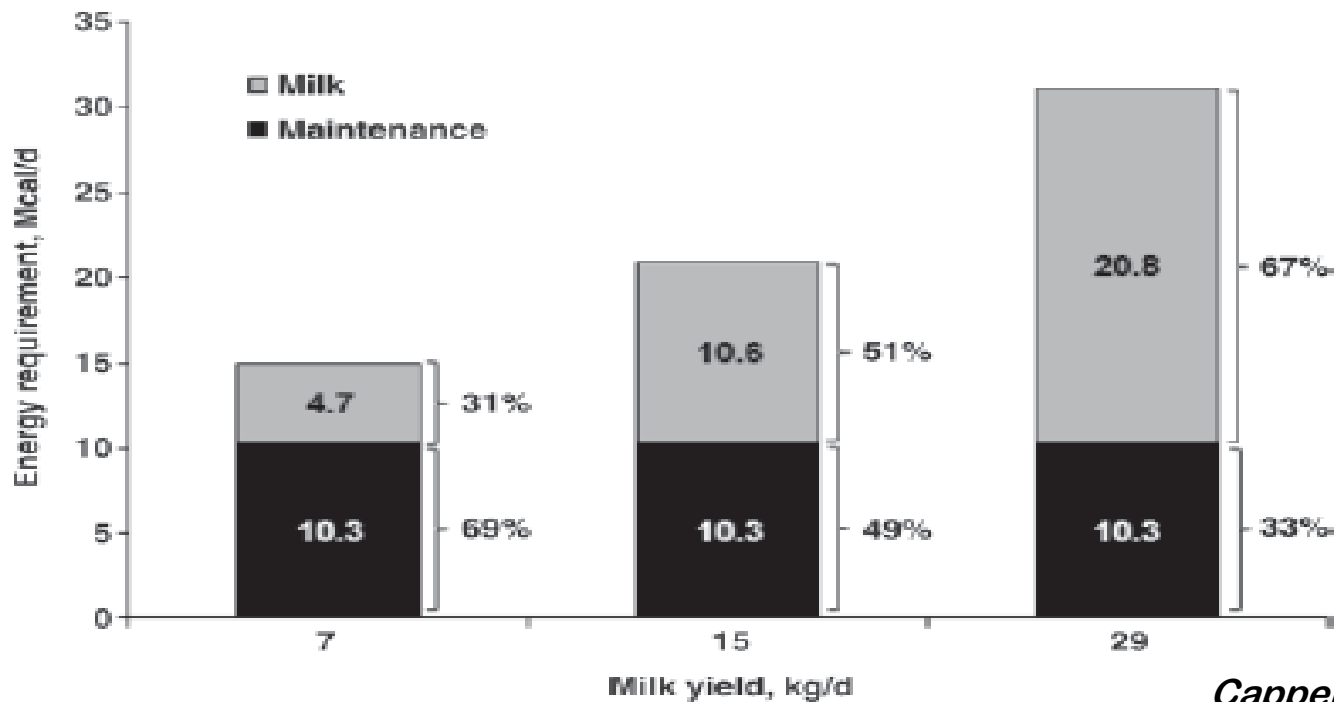
1/ The risk to extrapolate conclusions from one scale to another: Example of greenhouse gas emissions (GHG) in cattle production

2/ A proposal of strategy to face the new efficiency challenge

The risk to extrapolate conclusions from one scale to another: Example of GHG in cattle production

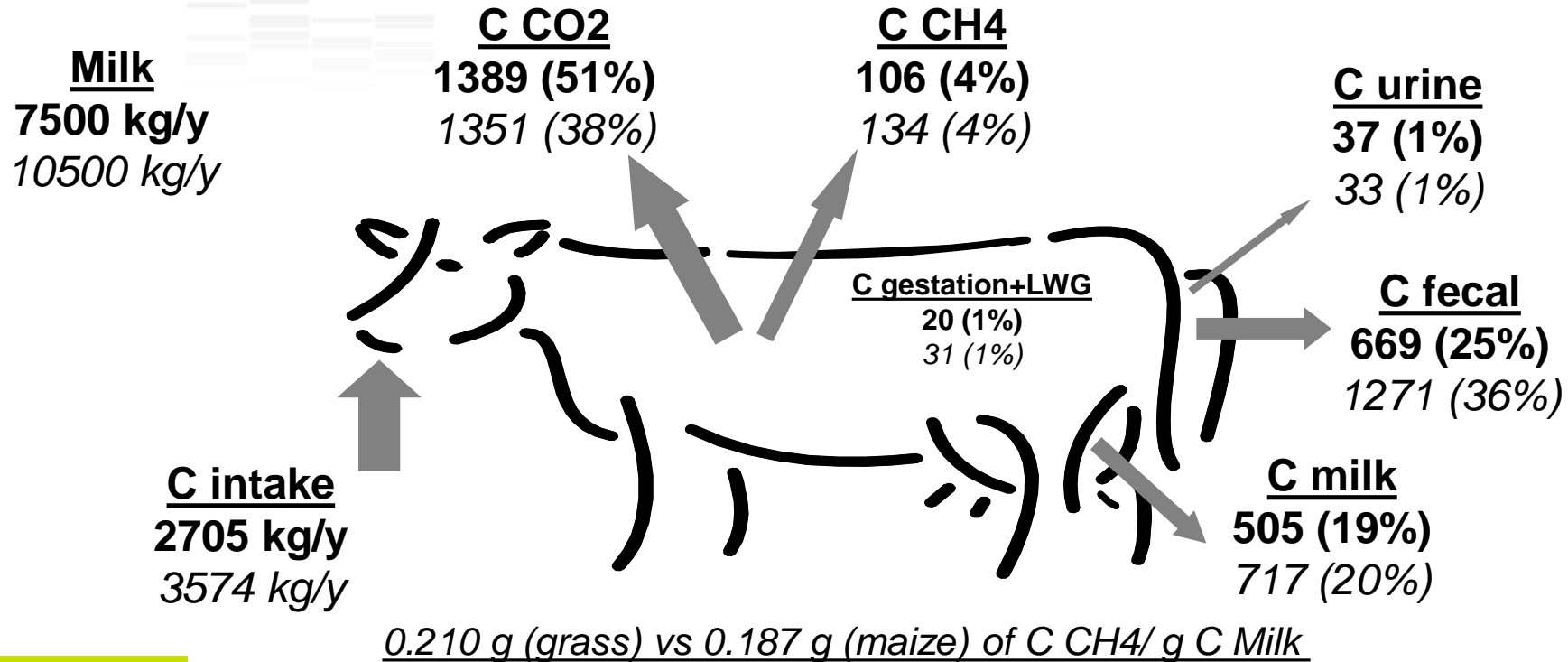


High producing dairy cows are more efficient: they dilute the maintenance cost with more milk



Capper et al, 2009

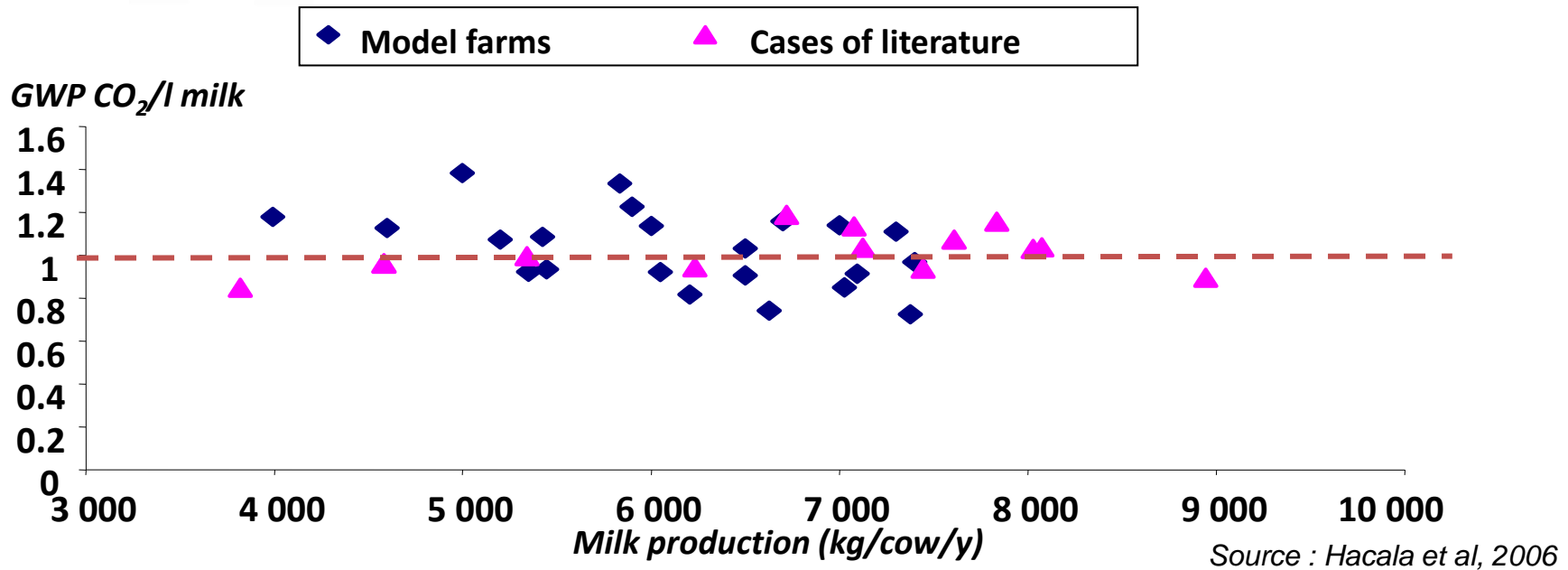
Annual C balance of a dairy cows in a grass based system and in maize based system



Conclusion at animal level

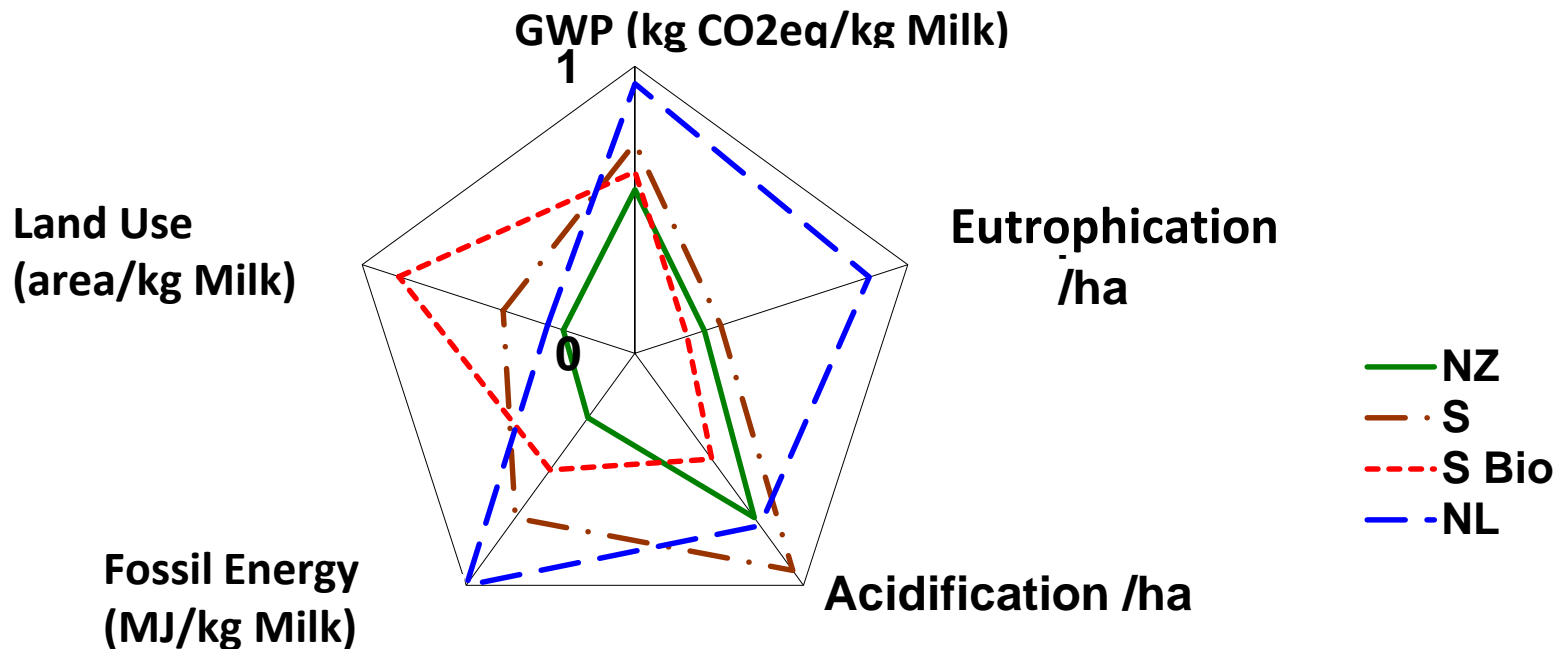
- Using high producing cows seems to improve the efficiency and to reduce the emissions
- Maize silage based diets well supplemented seems a good option
 - to increase the efficiency of C use/kg of milk
 - To reduce the decoupling of C in the effluent
- **Global impact =? reduction per cow * number of cows**
- Do we have to promote dairy systems with high producing dairy cows fed corn as the best option?

At farm scale, no evidence of a benefit of higher milk production per cow on GHG



Source : Hacala et al, 2006

LCA: different trade-offs, but a good assesment of NZ grazing systems

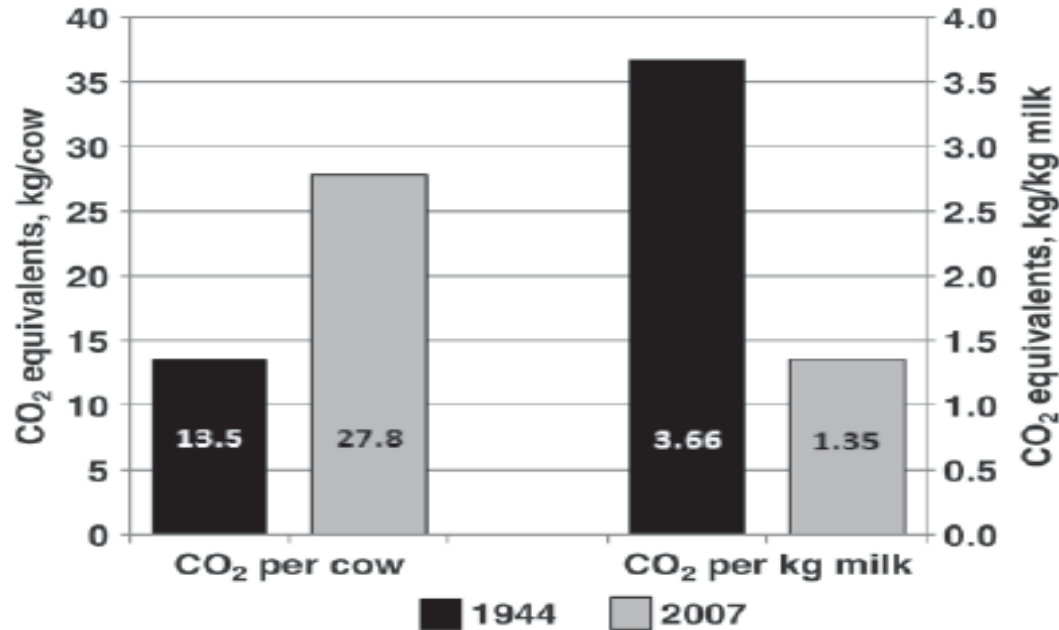


Adapted from Basset-Mens et al. 2008

Conclusion at farm level

- Conclusion at farm scale does not support the conclusion at animal scale
 - GHG emissions are not really improved with higher milk production
 - Low producing animals fed with grass LCA seems better (case of NZ systems)
 - Methane emissions is the main but not the only one GHG
- Is it still true at larger scale?

Carbon footprint: the increase in milk yield reduces by more than 3 the GWP impact



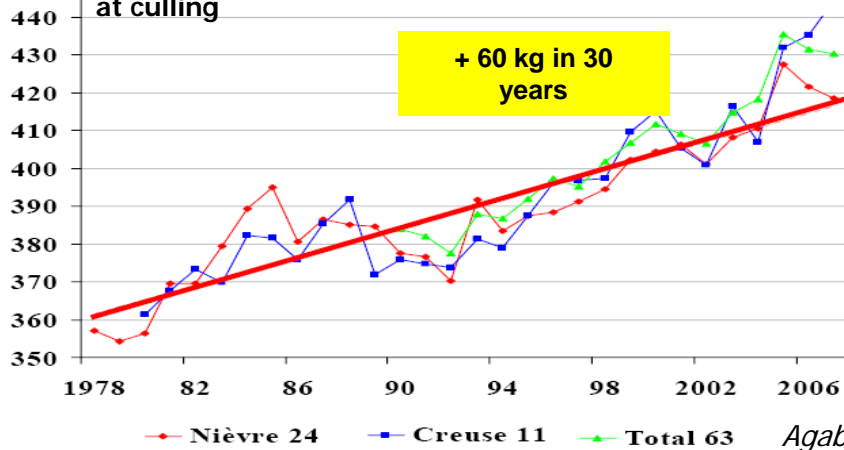
Capper et al, 2009

Specialisation and intensification of cattle production without changing the global Meat / Milk ratio

Two cattle breeds more specialized and more productive

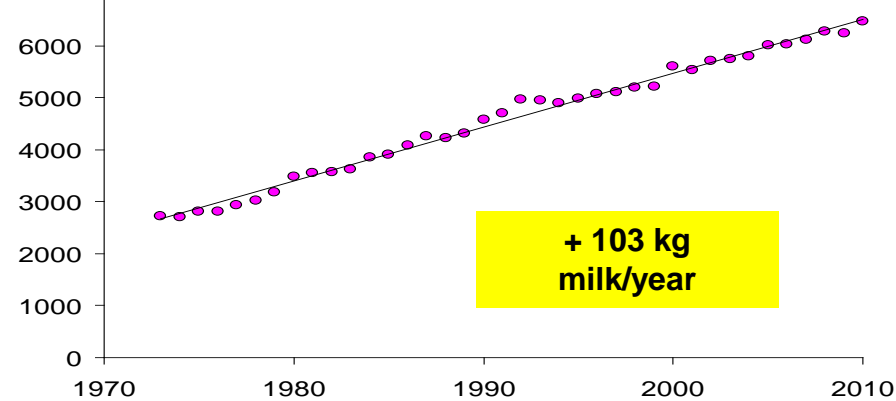


Carcass weight of Charolaises at culling



Agabriel, 2010

Milk / cow / year

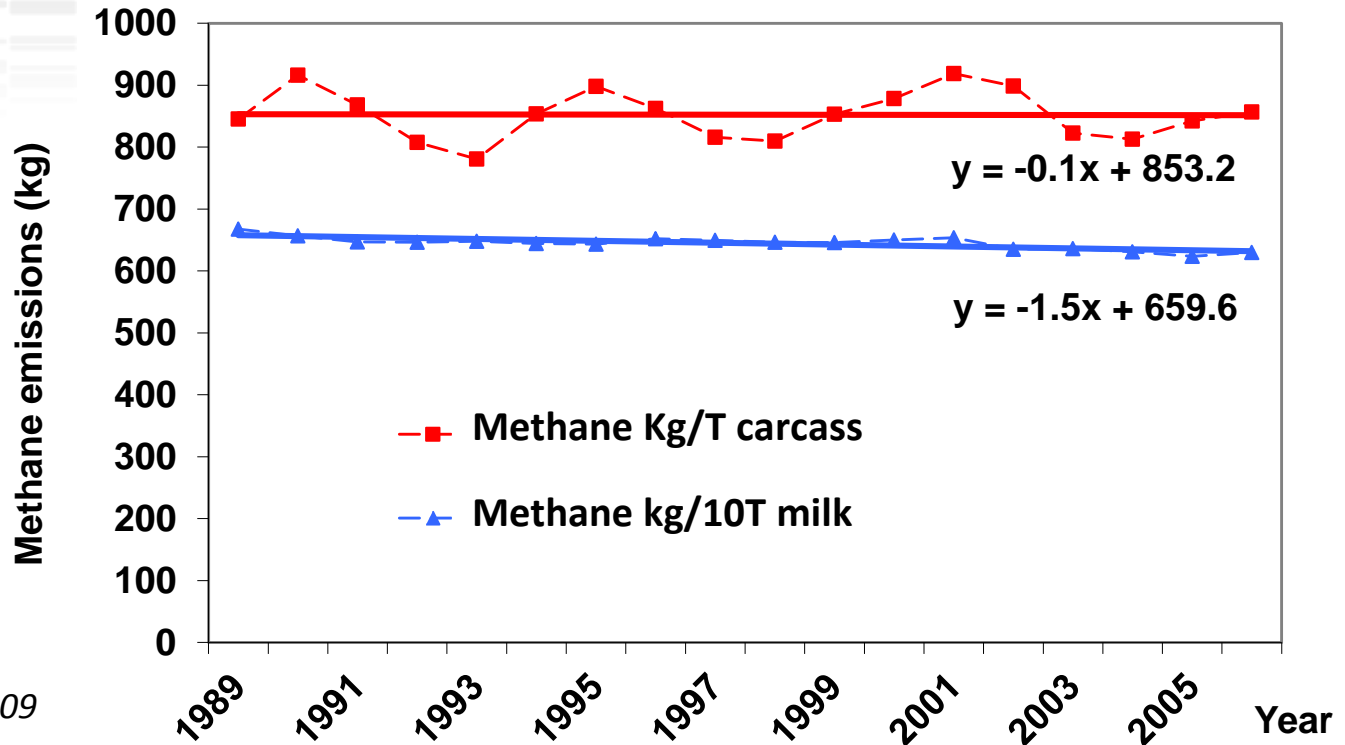


Données Eurostat

Methane emissions by French cattle

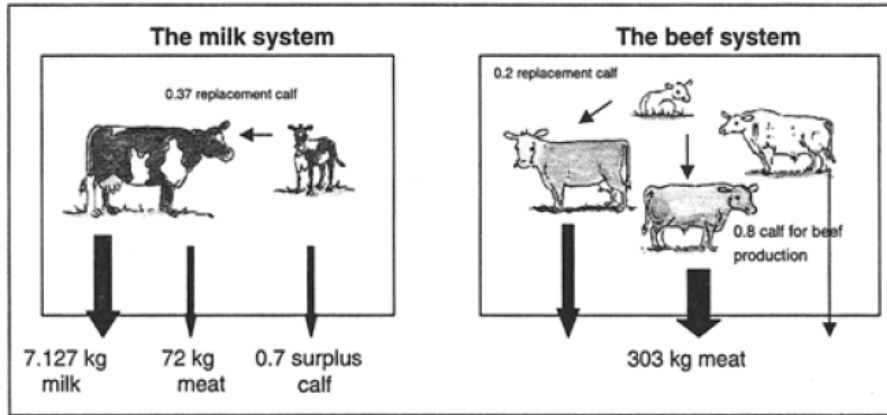
What's wrong?

Where is there reduction by 3 expected?

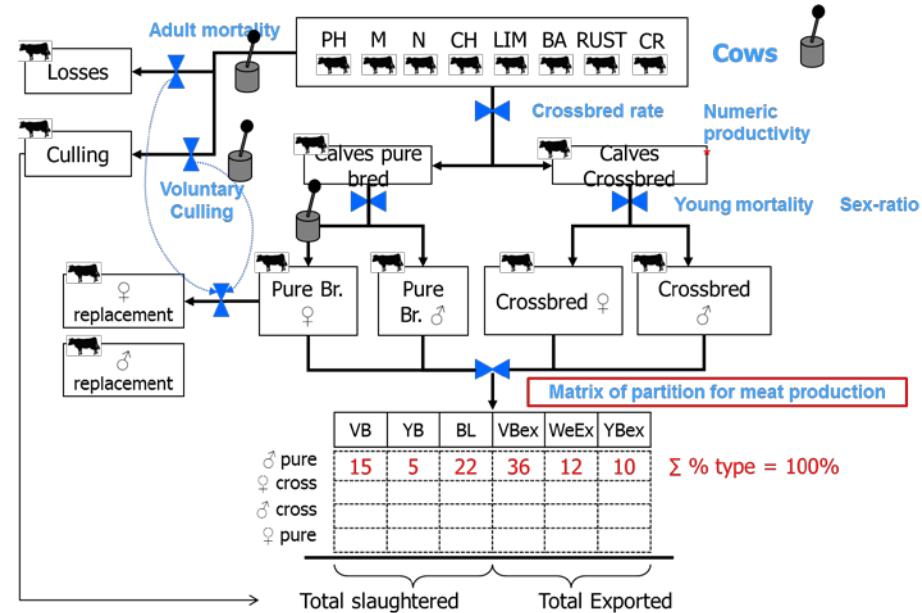


Pflimlin et al. 2009

The system expansion explains the loss of expected benefit

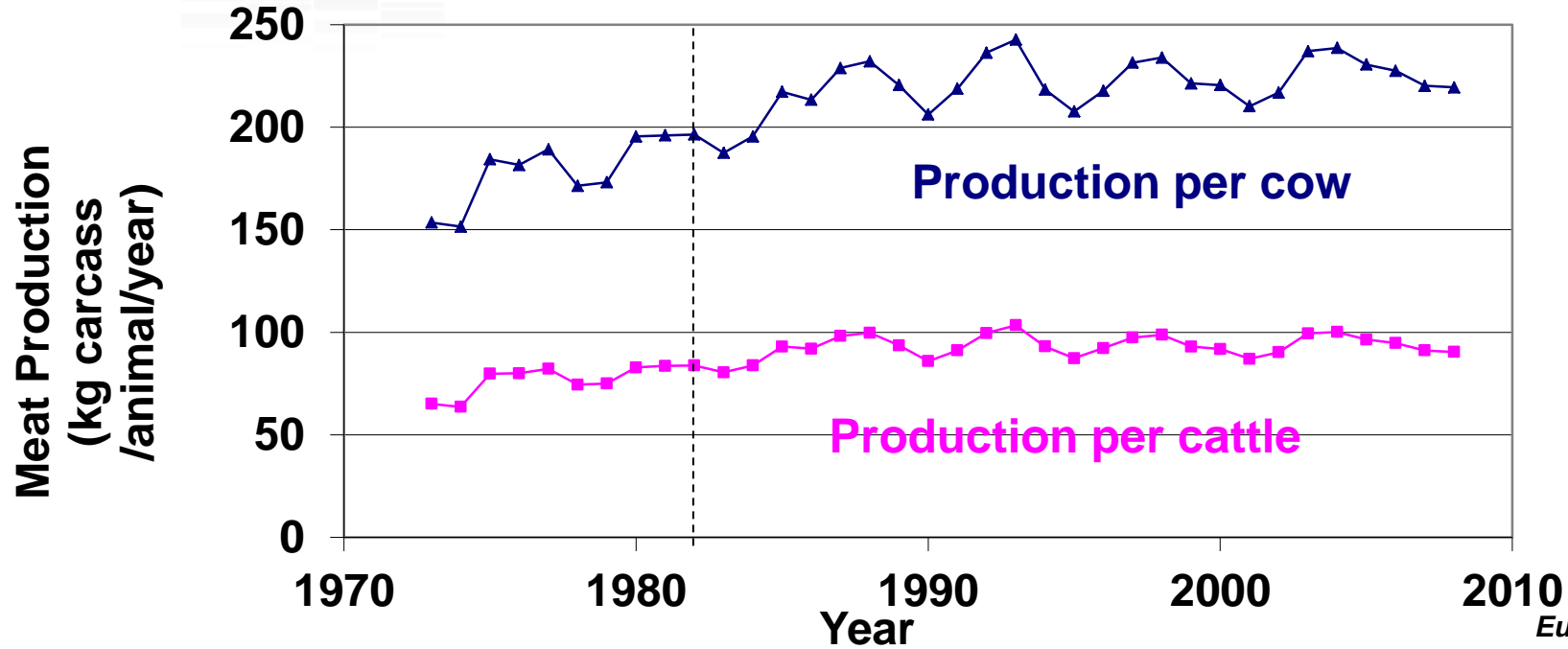


Cederberg et Stadig, 2003



Puillet et al., 2014

The specialization did not significantly affect the global meat production per cattle or per cow



Eurostats 2009

Conclusion on scales and GHG emissions

- Even if the impact is global for GHG, the findings across the animal are not conclusive at larger scales (see also Zehetmeier et al. 2012)
- Dairy specialization does not necessarily improve GHG emissions contrary to what is often written
- The improvement in meat production could be better than the improvement of the milk production
- Same type of demonstration can be done with N emission
- How to improve: Approach bottom-up or top-down?



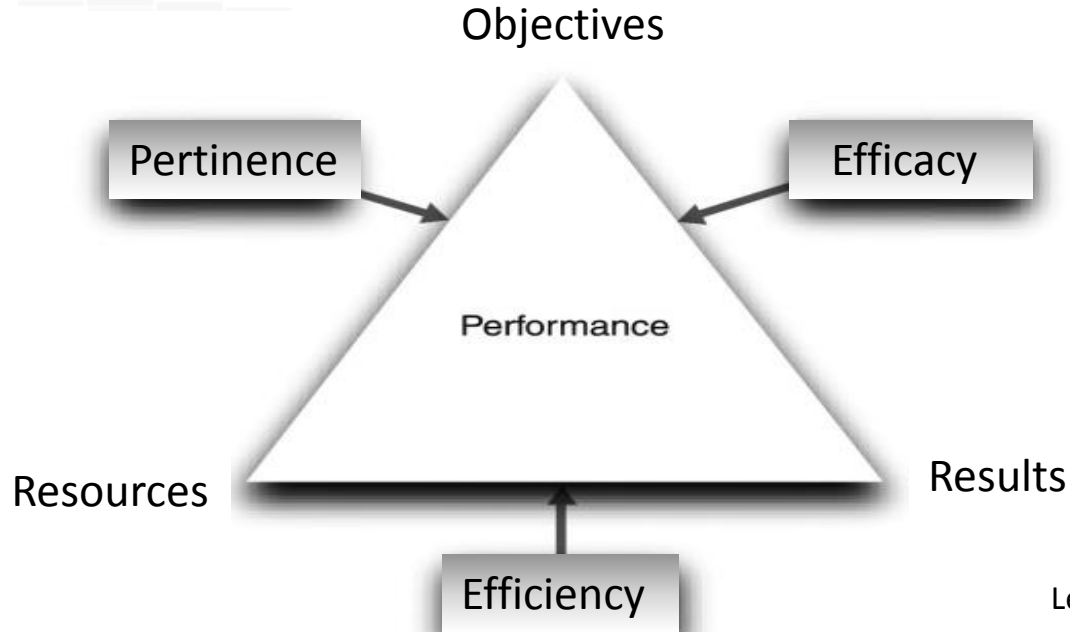
A proposal of strategy to face the new efficiency challenge



The complexity of the challenge

- Take into account the limits of available resources and the problem of their allocation
- Take into account the diversity of objectives
- Take into account the direct and indirect interdependence of systems
- Take into account the dynamics
- Integrate social mechanisms

How to optimise the performance of the global feed (food) system?



Le système alimentaire mondial
(Jean-Louis Rastoin, Gérard Ghers, 2010, QUAE Ed.)

Consequence on the strategy

1/ Pertinence: Determine the best allocation of resources to maximise their valorisation and satisfy the multiple goals of a region, according to its potentiality and resilience capacities.

→ From high level of organisation to low levels. How o decline global efficiency?

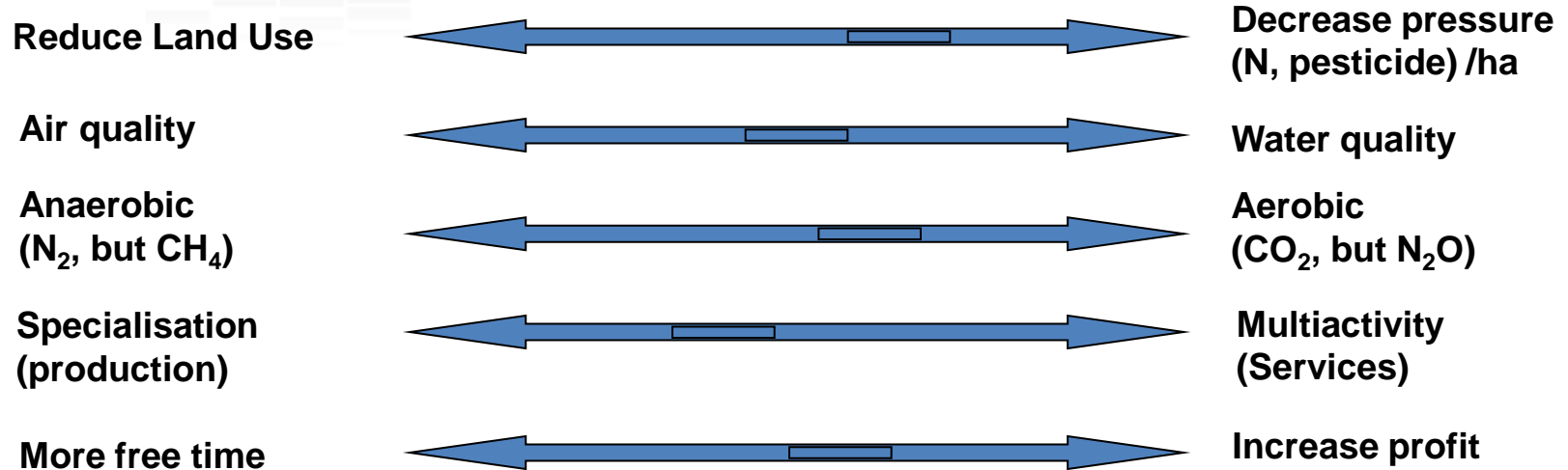
2/ Efficiency: According to this allocation of resources, increase the efficiency of each system in each context

→ Low levels of organisation. How to optimize systems?

3/ Efficacy: Verify the results obtained are consistent with the overall goals, develop pertinent indicators to assess it.

→ From low levels of organisation to high level to verify the global efficiency.

Optimal solution faced to a set of dilemmas



...

• **No global answer**

• **The context is essential, a balance is required between systems**

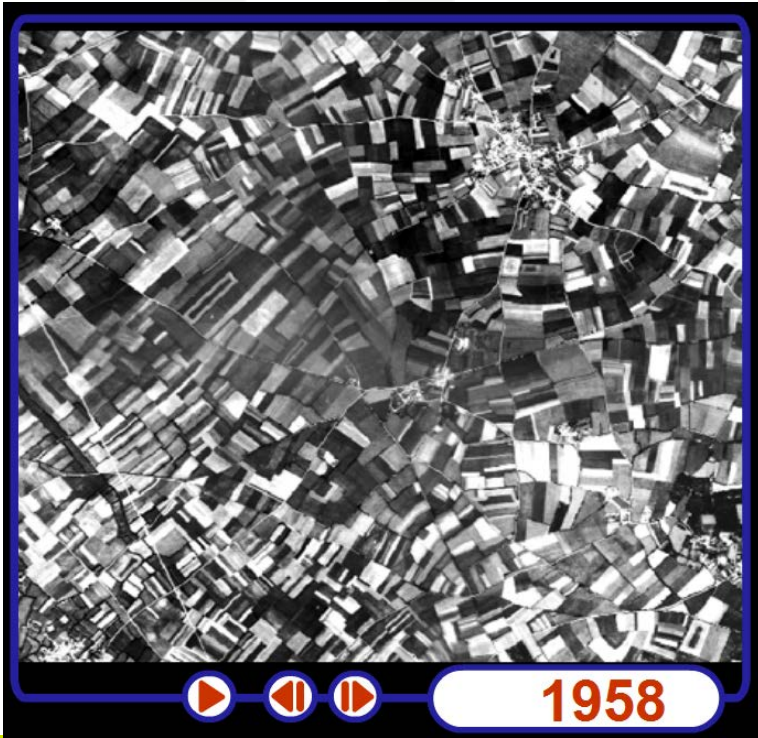
Why maximising the efficiency of each system before fixing the specific objectives is risky?

- The best resources gives generally the best performance to each system and often the best efficiency
- But the best resources are limited:
 - Area of arable land is limited, its increase will be associated to C de-sequestration
 - Increase in production per ha could be associated with negative side effect
- If each system maximises its efficiency do not guaranty to maximes the performance of the whole system
 - Competition between productions on the best resources
 - Specialisation of regions can imbalance the different dilemmas and generate some problems of sustainability (soil air and water quality, biodiversity, vulnerability)
- A maximisation of the regional objectives could give different answers than the addition of the best livestock or crop systems optimised independently

The specialisation of a region is visible and could affect its sustainability



And it can totally change the landscape of a region

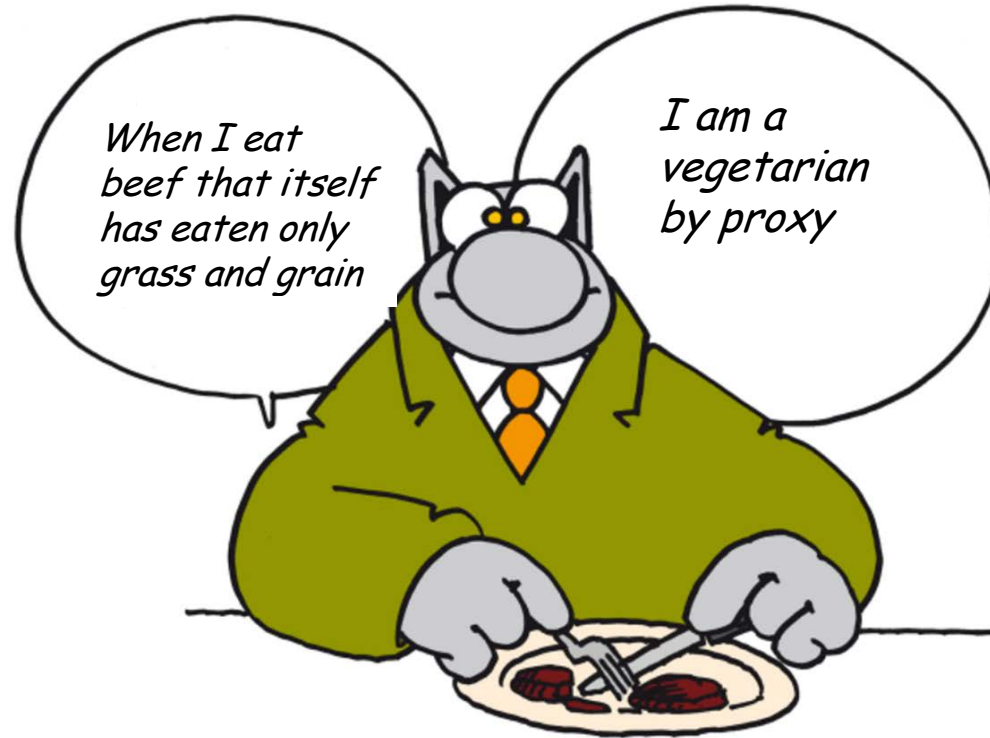


Animation : Alban Thomas, Centre d'Etudes Biologiques de Chizé - UPR 1934 CNRScc
P. FAVERDIN EAAP 66th annual meeting Warsaw –1st september 2015

Conclusions, open to discussion

- *This is not because a solution is true at a level of organization, it will be at a higher level (systemic):
Beware of simplistic upscaling approaches*
- *If you think this is the case, check it!*
- *Before to promote a solution to improve a system, consider all the consequences induced*
- *Science is “upscaling oriented” and aggregates knowledge.
Also think global to decline for local*
- *Triangle of performance: a promising way to structure new projects*
- *How to balance regional priorities and industries priorities?*

Thank you for your attention



Philippe Gelück