Climate Care Cattle farming – visionary aspects

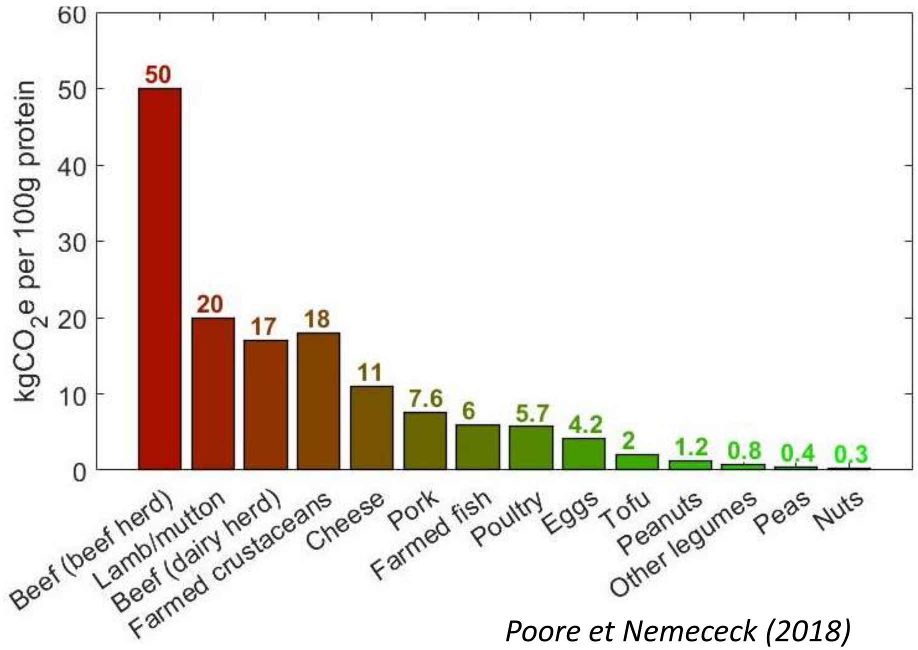
Visionary aspects of dealing with C in dairy systems and C storage

J-L Peyraud, C Brocas, K Klumpp, X Vergé, N Edouard

LCA have consistently shown the impacts of livestock

- **High impact of Animal based products,**
- **The impacts of the lowest-impact animal products exceed average impacts of plant proteins (GHG emissions, eutrophication, acidification and frequently land use),**
- **High variation among both products and producers.**

Kg CO_2-eq / 100 g protéine



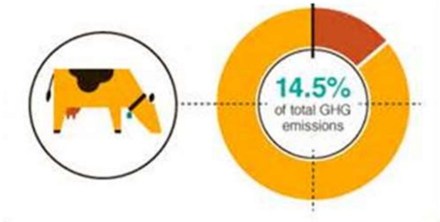
Poore et Nemececk (2018)

- ***Maybe simplistic, but reminds us that we need to find ways of improving the sustainability of livestock farming***

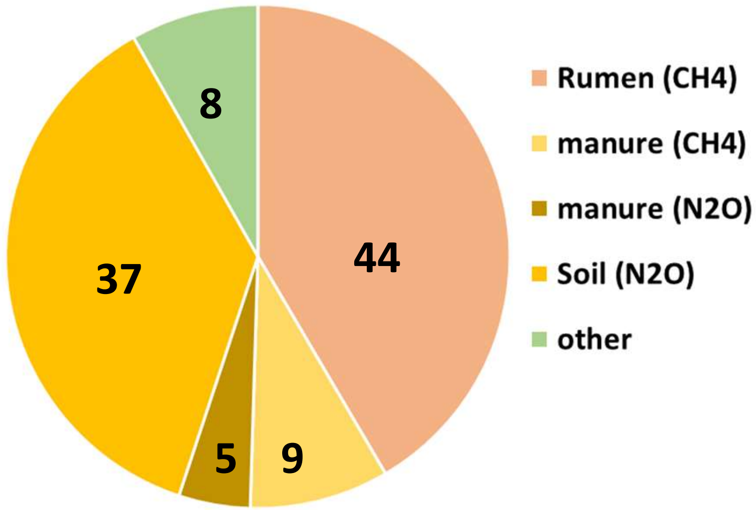
On farm GHG emission of European Livestock sector

Livestock emissions ($Gt\ CO_2$-eq)	
Europe	0.25
World	8.1

Food and Agriculture Organization of the United Nations *(FAO, 2019)*



Sectors	% total
Agriculture	10
Livestock	*6*
Industry	38
Transport	21
Tertiary	12



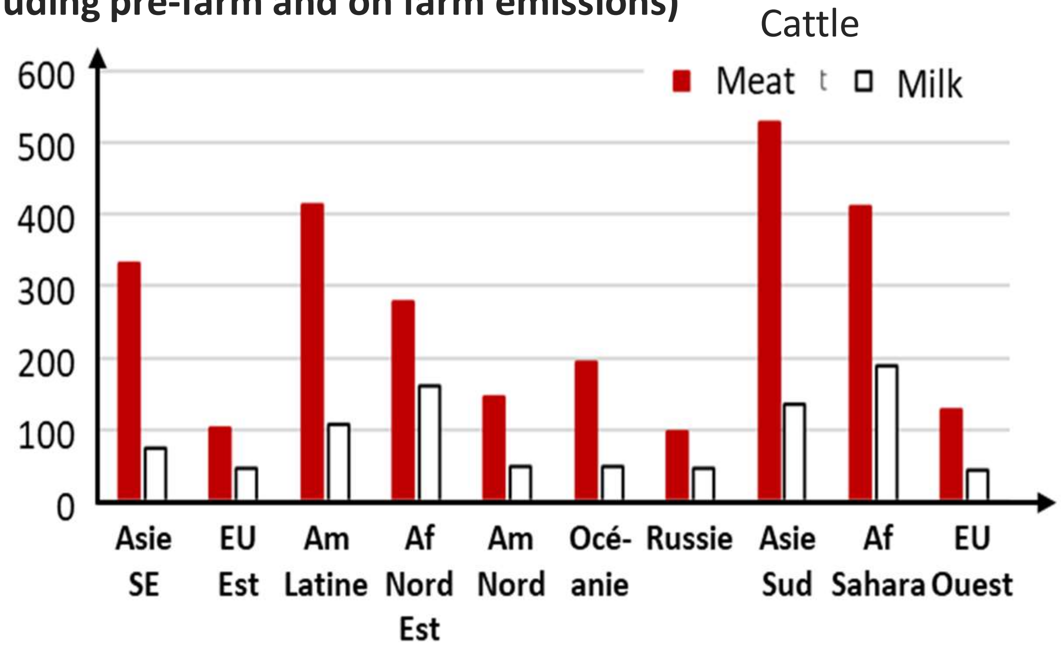
European Environment Agency, (2019) – mean 2003-2018

- **Further emission arise outside of EU. Globally livestock represents 85% of EU Agricultural emission,**
- **Enteric CH_4 and soil N_2O emissions are major issues.**

Emissions intensities of the European livestock sector

- EU livestock systems are efficient

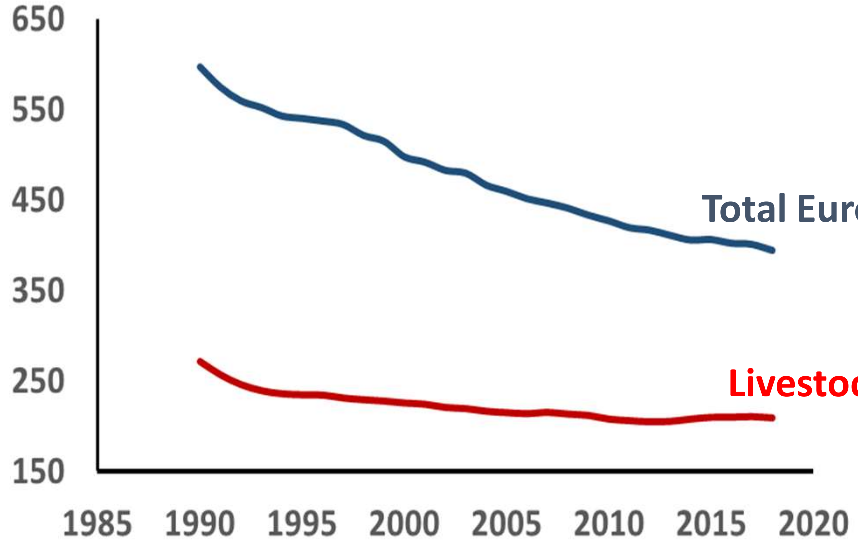
Emission (kg eq-CO2 / kg protein)
(including pre-farm and on farm emissions)



Peyraud and Mc Leod, 2020 (Adapted from FAO data, 2017)

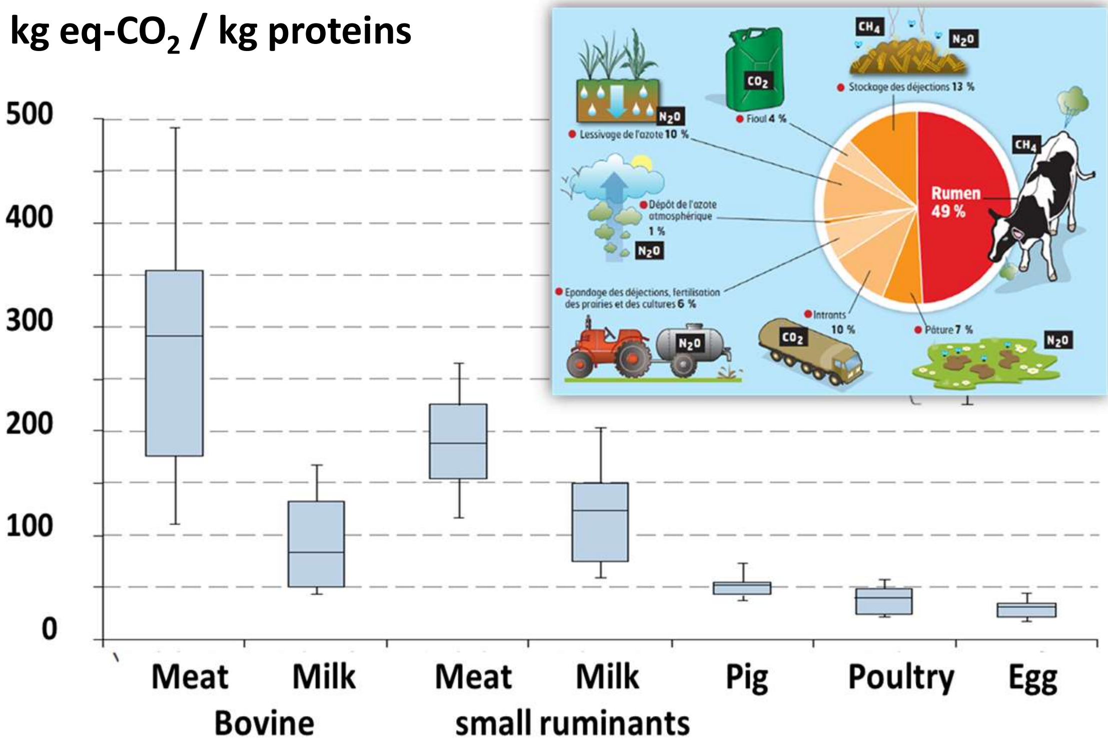
- But progress is slow compared to other sectors

CH_4 (Tg/year)



European Environment Agency, 2019

GHG mitigation options : farm gate approach



From Gerber et al., 2013

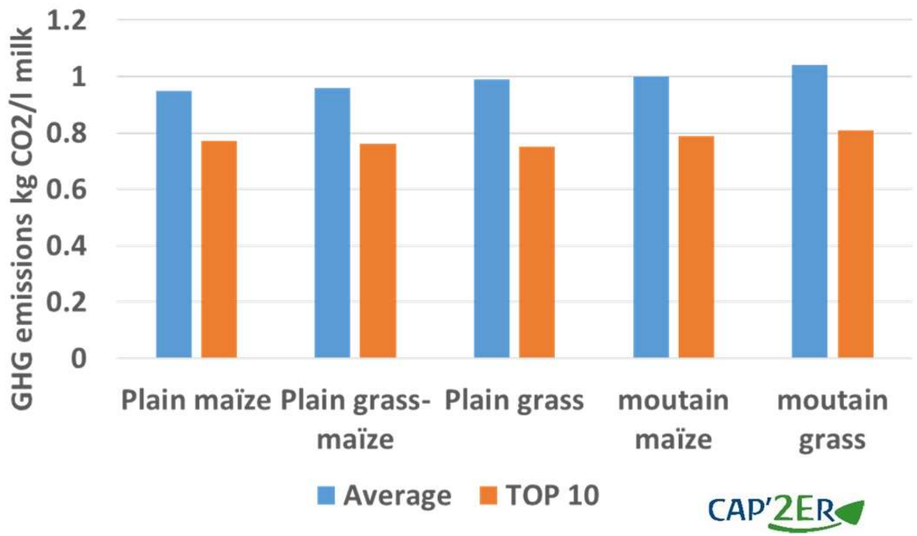
Efficiency	Low emitting animals Feeding practices Herd management Animal health
Resource recycling	Smart use of manure Manure bio-refinery Use of plant by-products
Nature based solutions	Feed (legumes, LULUC) Energy production (manure) Soil C storage

GHG mitigation options at farm gate : the French case

- **A 19% gap between average and best performing systems**

Maize based dairy systems	Average	Top 10
GHG (kg eq CO_2/L milk)	0.95*	0.77

0.87 for net emission after considering Soil C sequestration

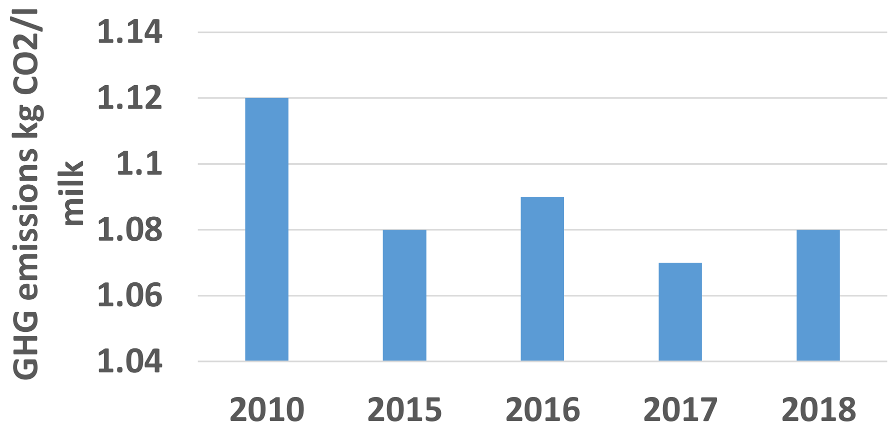


Source : CAP'2ER® 2013-2019

- **National Strategy of low Carbon : 40% decrease in 2030/1990**

The dairy sector is on track… but stagnation

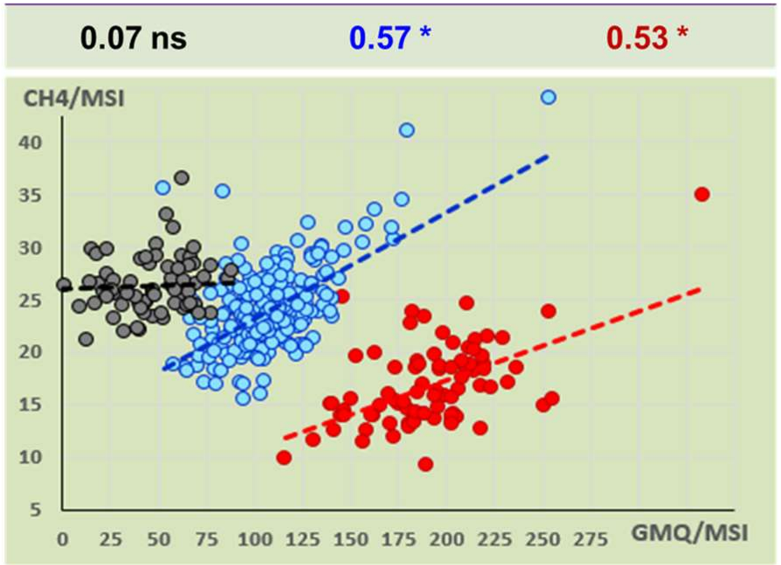
LA FERME LAITIÈRE BAS CARBONE



A perspective of 20% reduction by optimisation of the dairy systems

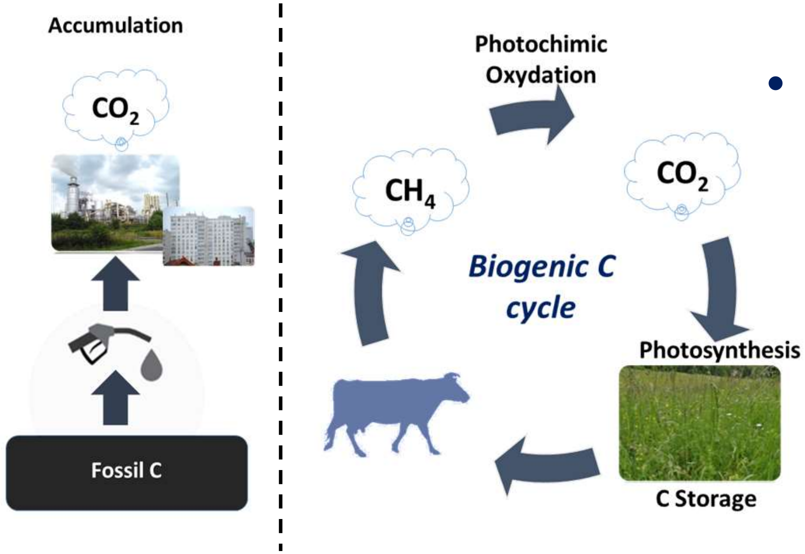
GHG mitigation options: reducing enteric methane (animal genetics and feeding practices)

- It is difficult to reduce enteric methane
- Genetic pathway: Antagonism with digestive efficiency ?
- Feed additives: - 15 to - 30% but high cost and few products are on the market
- Higher forage quality: - 5%, very important in developing countries
- Accounting in the national accounts?



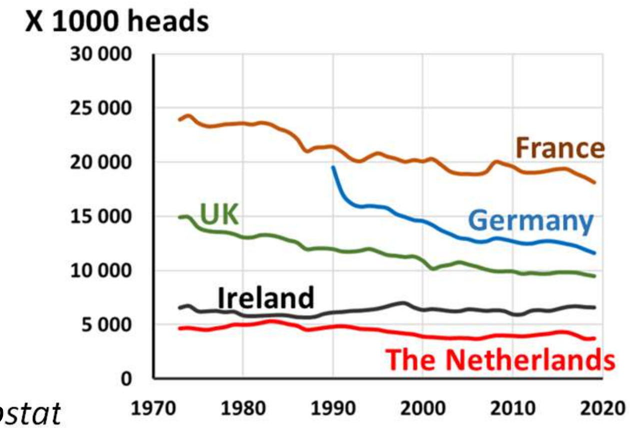
74 génisses (Foin) **252 génises** (Ensilage Herbe) **81 taurillons** (Pellets)

Is cow methane to blamed for global warming?



- **Fate of CH_4 : the calculation of CO_2-eq misrepresents the role of CH_4 in global warming**
  - CH_4 is part of a natural cycle
  - CH_4 is a short life (10 y) vs CO_2 and N_20 are long live pollutants
  - CH_4 do not accumulate in the atmosphere if the rate of emission is constant or decrease: no additional warming!
  - N_2O and CO_2 accumulate even if the rate of emission decline

- **What consequences?**
  - Reducing CH_4 emissions will have a very important short-term effect (≈storage of C as planting trees): an opportunity for the ruminant to reach climate neutrality
  - Reduce emissions intensity and reduce the number of ruminants (large cattle)



Peyraud, non published, from Eurostat

GHG mitigation options: The national French herd

- **Fewer animals to produce the same amount of milk :**
  - Advancing age at first calving or optimize milk production :
    - - 3% if dairy heifers calving at 24 vs 29 months
    - - 5% if milk prod. increase from 8600 vs 9500 l of milk (but feed/food competition),

- **Produce more meat from the dairy herd** : dual purpose breeds, cross sexing

Calf to beef system :
12 - 14 kg eq-CO_2/kg CE

Young bull from dairy herd :
5 – 7 kg kg eq-CO_2/kg CE

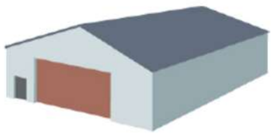
Dollé et al, 2015

- **Substitution :**
    - - 7% Soybean meal substitution by rapeseed meal

GHG (and NH_3) mitigation options: manure management

- **Manure management first target is often NH3 mitigation**

Contribution to FR national emissions *Citepa 2016*		
	Agricultural sector	Cattle sector
Ammonia NH_3	**98 %**	**42 %**
Green House Gases	**17 %**	**11 %**



Housing

27 %

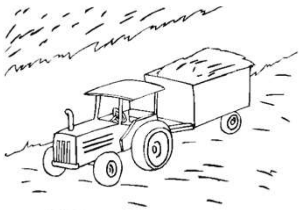
51 %

(including enteric CH_4)

Storage

26 %

10 %



Spreading

32 %

8 %

Grazing

15 %

7 %

Best practices for NH_3 mitigation:

Frequency and efficiency of scraping, avoiding urine-faeces mixing

Up to -30 % NH_3

Covering storage tanks

Up to -80 % NH_3

Acidifying manure

Up to -80 % NH_3

Burying manure soon after spreading

From -30% NH_3 24h after spreading

To -90% NH_3 right after spreading

Henning L. et al 2011; Martin et al. 2013; CITEPA 2019

GHG (and NH_3) mitigation options: manure management

- **Some of the best practices for NH_3 mitigation…**
  - Covering storage tanks → *(!) Potential reverse effect: increase manure t° by 1 or 2°C and then CH_4 emissions*
    → *But decrease the volume of liquid manure to spread by avoiding rain water accumulations => mitigate CO_2 emissions by lowering the use of diesel*
  - Better use of organic resource → *Lower the use of chemical fertilizers (↘ N_2O)*

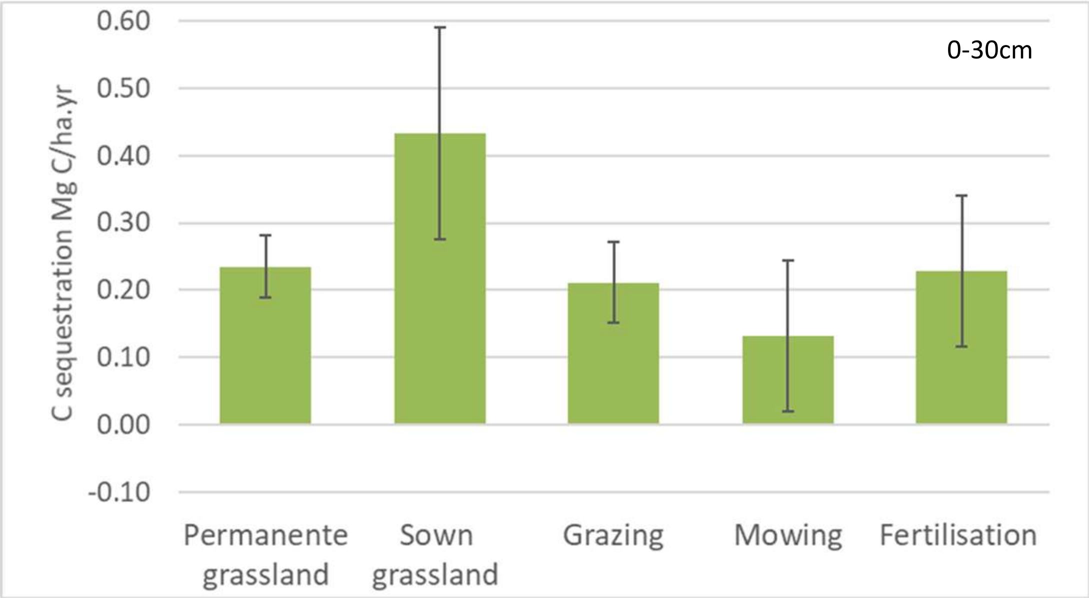
- **… also efficient for GHG reduction**

Other practices:

- Methane recovering from covered tanks or from fermenters to replace fossil energies
- Decreasing the storage duration to avoid methane productions
- Empty manure tanks before the warmer season to avoid high level of fermentation

GHG mitigation option: soil C storage

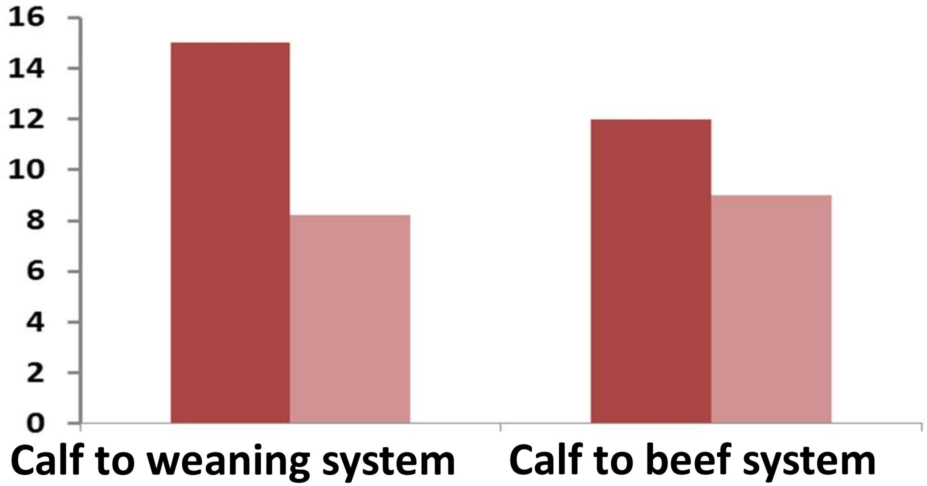
Soil based analyses mean : 230 (±50) kg /ha/year



- **Considerable variations related to climate, management and vegetation type**

EsCo 4p1000, INRAE, Pellerin et al. 2019

C footprint (kg eq CO2/viande)



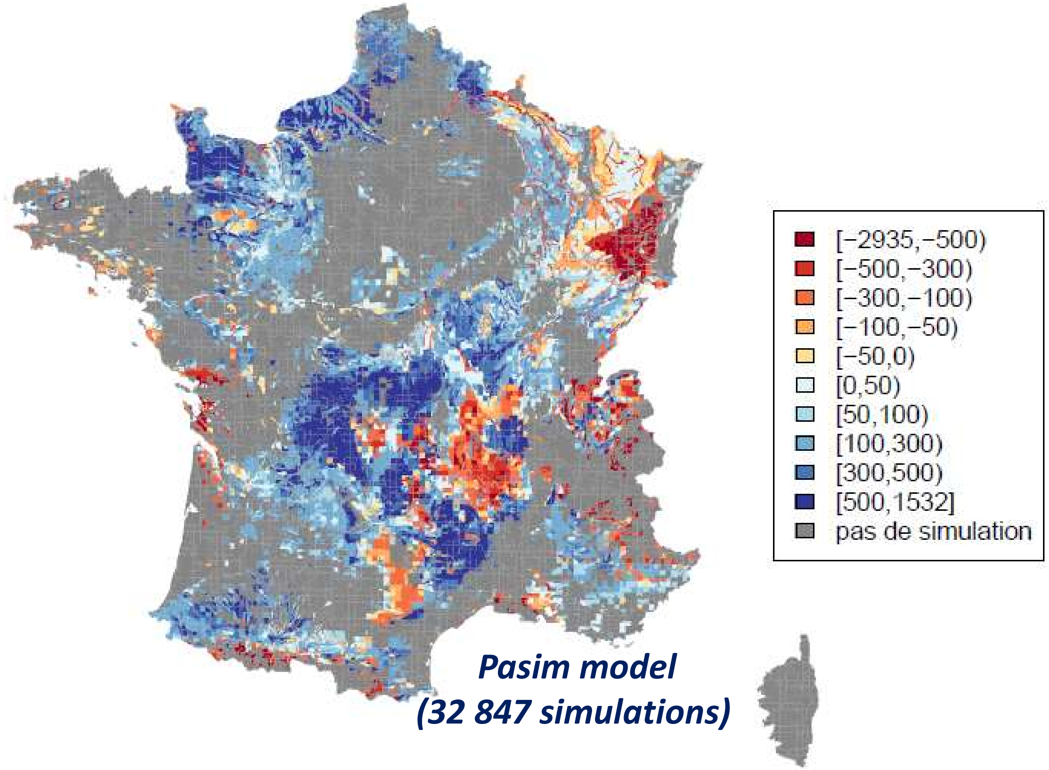
- **C Sequestration represents compensation in a range of 20 to 60% of gross C footprint**

GHG mitigation option: soil C storage

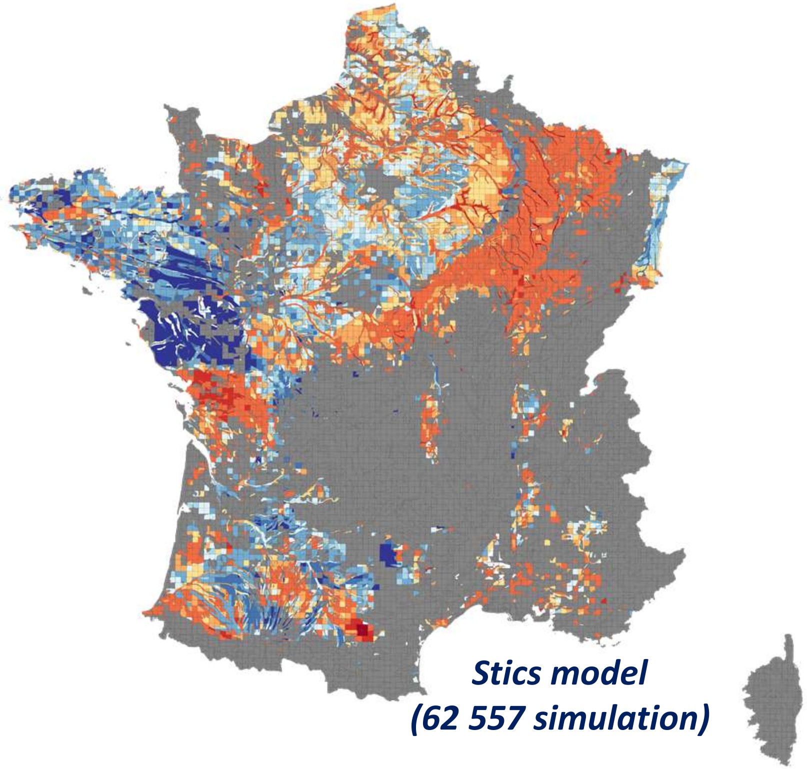
Modelling exercice 1km2 French 4P1000 study (Pellerin et al., 2019)

Sequestration potential
(kgC/ha/an)

Permanent grasslands



Cropland &
sown Grassland



kg C $ha^{-1}yr^{-1}$

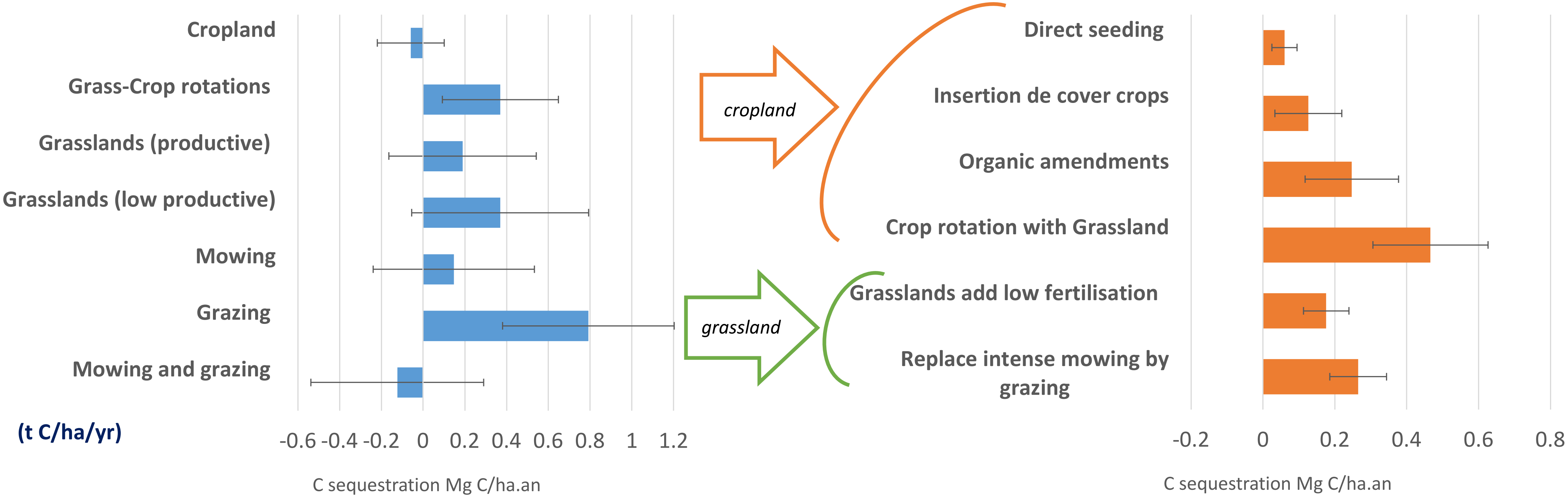
Grassland : +212 (±524)

Cropland: -59 (±160)   Crop & Grass rotation : +370 (±278)

GHG mitigation option: soil C storage

Current national C sequestration potential

Additional C sequestration potential for promising levers



Considerable variations related to climate, management and vegetation type

Large potential for a number of levers => need to define regional « Good Management » practices

Modelling exercice French 4P1000 study (Pellerin et al., 2019)

Some conclusions

- Some efforts already led to a reduction of the dairy sector C footprint
- High sequestration potential from grasslands and crop & grass rotations
- Still some room for “best management practices” and mitigation potential
- Practices that should be applied in a systemic perspective (interactions, reverse effects, compensations…)
- To go really further, it will be necessary to reduce the production!