GHG emissions in French suckler cattle and meat sheep production systems: what variability and what factors to explain?

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what variability and what factors to explain?

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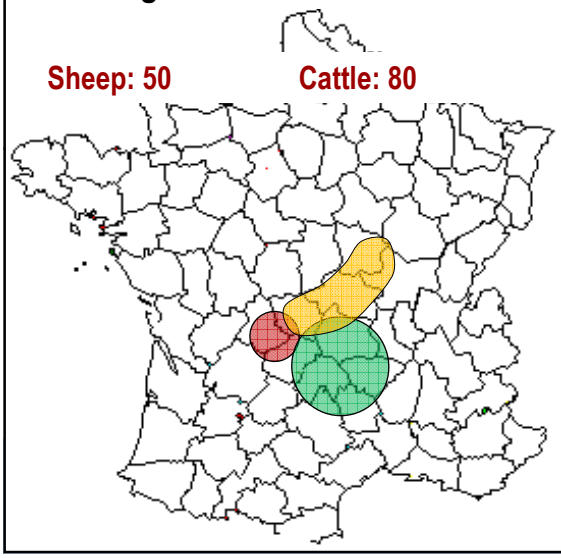
Material and methods

Long term farm networks



Models (farm approach)

OSTRAL (sheep)
Opt'INRA (cattle)

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Methodology

LCA method to assess emissions
Storage in pasture taken into account

	C t./ha/year *Benoit, Veysset, Dollé, 2009 d'après Arrouays 2002*	C t./ha/year European Commision Joint Research Center GGEL report 2010	CO_2 t./ha/year
Permanent pastures	0.350	0.237	= C * 44/12
Temporary pastures	0.500		
Range-lands	0.200		
Ploughed pastures (pastures -> crop)	-1.000		
Arable land: Cultivated Grassland		0.115	
Arable land: Annual Crop		-0.589	

Sheep for meat production

Study based on 10 contrasted farming systems

Systems are modeled (OSTRAL)

- Typical cases to standardize "age", equipment, social contributions etc.
- Extrapolate flock size for experimental farms and correct experimental biases

Sheep for meat production

10 farming systems

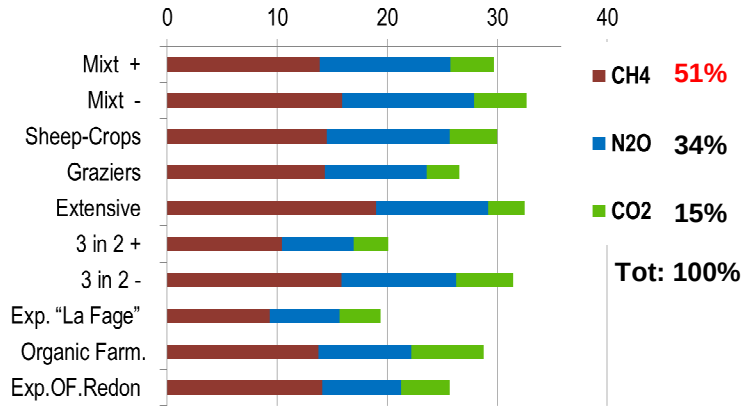
	Systems		Ewes	Ha AA (crops)
Plain	Mixt +	Mixt crop-livestock farming system ; common system and rather efficient	647	130 (37)
	Mixt -	Comparable to previous case, but lower technical efficiency	481	100 (25)
	Sheep-Crops	Lambing rather in autumn, much concentrates	229	165 (133)
	Graziers	Lambing in spring, much grass in feeding	639	120 (3)
	Extensive	Extensive management and low ewe productivity	346	148 (72)
Mountain	3 in 2 +	High ewe productivity (lambing acceleration)	600	69 (0)
	3 in 2 -	As 3 in 2 + but less successful	573	69 (5)
	Exp. "La Fage" INRA	Productive flock (breed Romane); spring lambing ; harsh environment ; 16 ha arable land	330	296 (0)
	Organic	Ewe productivity in the average; rather harsh environment	260	78 (6)
	Exp. Organic INRA Redon	120 ewes flock extrapolated to 500; productive and self sufficient (feeding) system	500	113 (5)

Sheep for meat production

Gross GHG emissions per kilo carcass: CO_2, CH_4 et N_2O

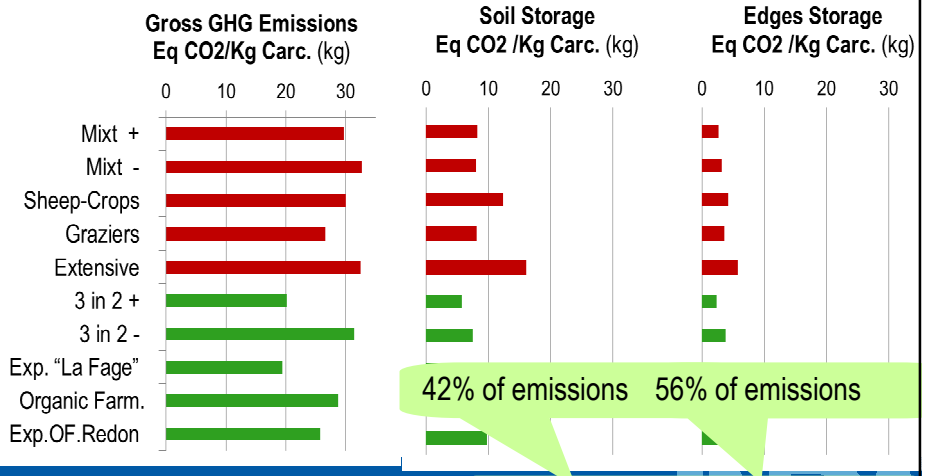
CO_2, CH_4 et N_2O : Eq CO_2/Kg carc (kg)

Tot = 27.7 EqCO_2/kg c.



Sheep for meat production

Total gross GHG emissions and compensations with storage (soil and edges)



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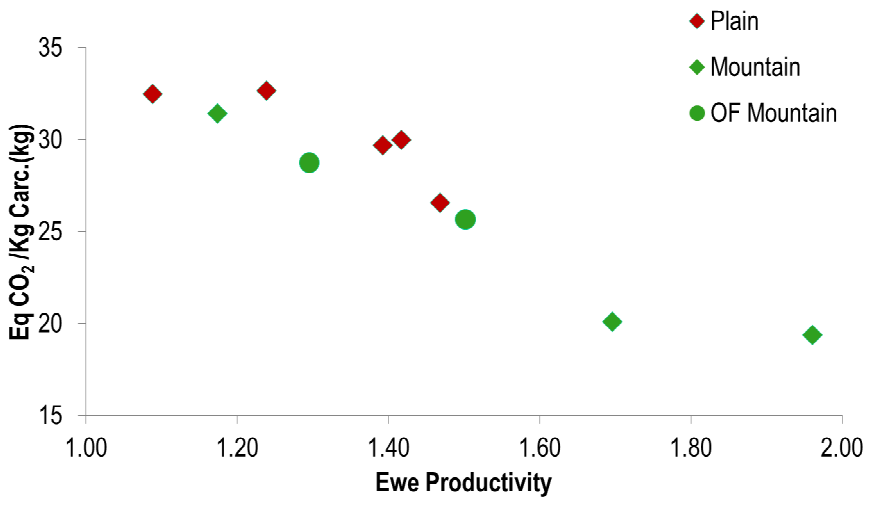
Main factor for CO_2 emissions (1)
Ewe productivity



(1)

Suckler cattle farming systems

- 3 types of specialised Charolais beef farms:

Opt'INRA outputs: optimized results	A: calf-to-weanling 100% grassland farm	B: calf-to-beef. Beef steers production	C: calf-to-beef. Intensive baby beef production
Farm area ha	100	125	155
Fodder area ha *(including maize)*	100 *(0)*	109.2 *(1.8)*	119.2 *(11.0)*
Cereals home-consumed ha *(% UFA)*	0	15.8 *(13%)*	35.8 *(23%)*
Number of calvings	73	68	107
Stocking rate (LU/ha UFA)	1.07	1.04	1.24
Males sold type	Weaners	Steers+Weaners	Baby Beef
Heifers sold type	Store Heifers	Beef Heifers	Beef Heifers
Live Weight produced kg/LU	327	316	360
Live Weight produced kg/ha UFA	351	330	447
Concentrates kg/LU	473	743	1 248

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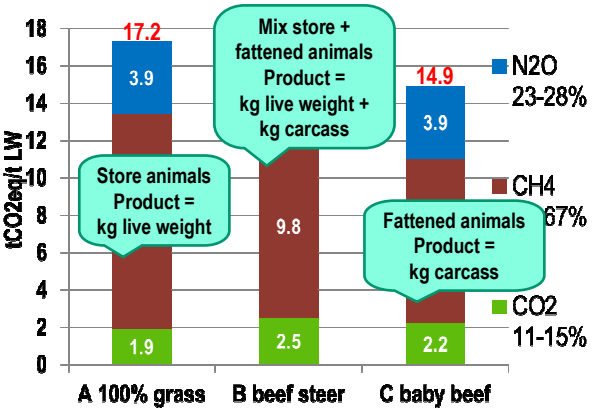
Gross GHG emissions
tCO_2eq / ton live weight produced



Methane CH_4
> 65% of total GHG emissions for calf-to-weanling systems
≈ 60% of total GHG emissions for calf-to-beef systems.

Cows are the biggest driver of GHG emissions in the herd
The most intensive system =
↗LW produced per cow
↘ CH_4 per t. of LW produced

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Suckler cattle farming systems

Carbon sequestration
Net GHG emissions

	A: (calf-to-weanling 100% grassland farm)	B: (calf-to-beef. Beef steers production)	C: (calf-to-beef. Intensive baby beef)
Gross GHG emissions téqCO_2/t.LW	17.2	16.9	14.9
Pastures ha / t.LW	2.85	2.60	1.56
C offset % gross GHG emissions *(JRC GGEL report)*	21% *(14%)*	19% *(7%)*	13% *(-1%)*
Net GHG emissions téqCO_2/t.LW *(JRC GGEL report)*	13.6 *(14.8)*	13.6 *(15.7)*	12.9 *(15.1)*

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Conclusion

- **CH_4 emissions**
  - Sheep for meat: 50% GHGs
  - Suckler cattle: 60% GHGs
- **Sheep:**
  - **an increase in Ewe Productivity** = ↘ **GHGs / kg carc** by dilution of CH_4 emissions on more kilo of carcass produced
  - Ewe productivity: main factor for high net income; the second factor is grass self sufficiency, that is the decisive criteria for low non renewable energy consumption
- **Suckler cattle**
  - **Calf-to-beef systems more efficient** than calf-to weanling systems
  - **BUT**, calf-to-beef systems **use less grass and more concentrates and fertilizers**

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Conclusion

- **Intensive and self sufficient systems** for low negative environmental impact, good economic results, and low sensitivity to price volatility
- **Sequestration** can reach **50% of the emissions**
  - is higher when the **stocking rate is low**
  - **is higher with grassland systems**
- **Diversity of livestock products: allocations?**
- **Need to improve tools to assess C sequestration at farm scale**
- **Other environmental impacts of breeding systems**
  - **in particular on non arable lands (maintenance of open landscape)**
  - **Biodiversity**
  - **Rural development**