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➤ Environmental and economic assessment of a French free-range chicken production system

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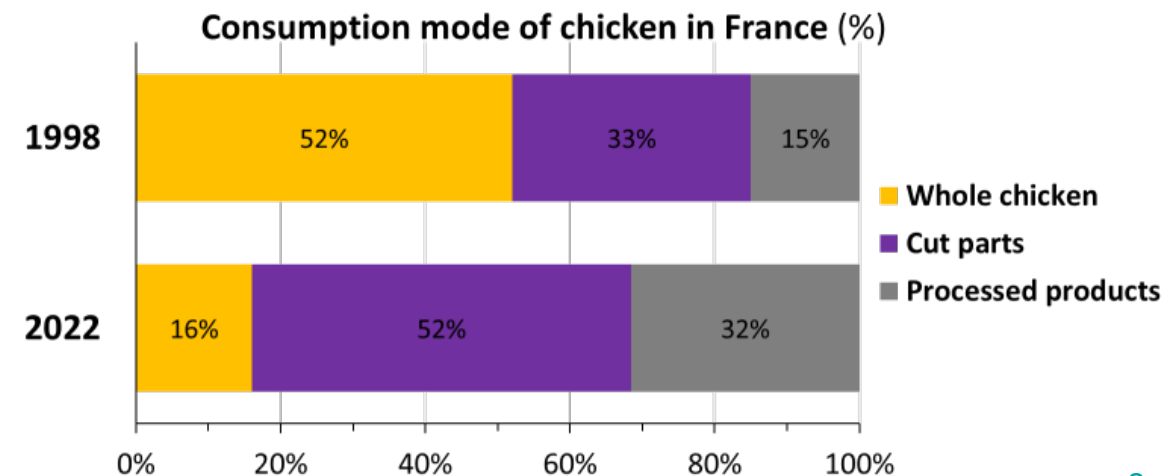
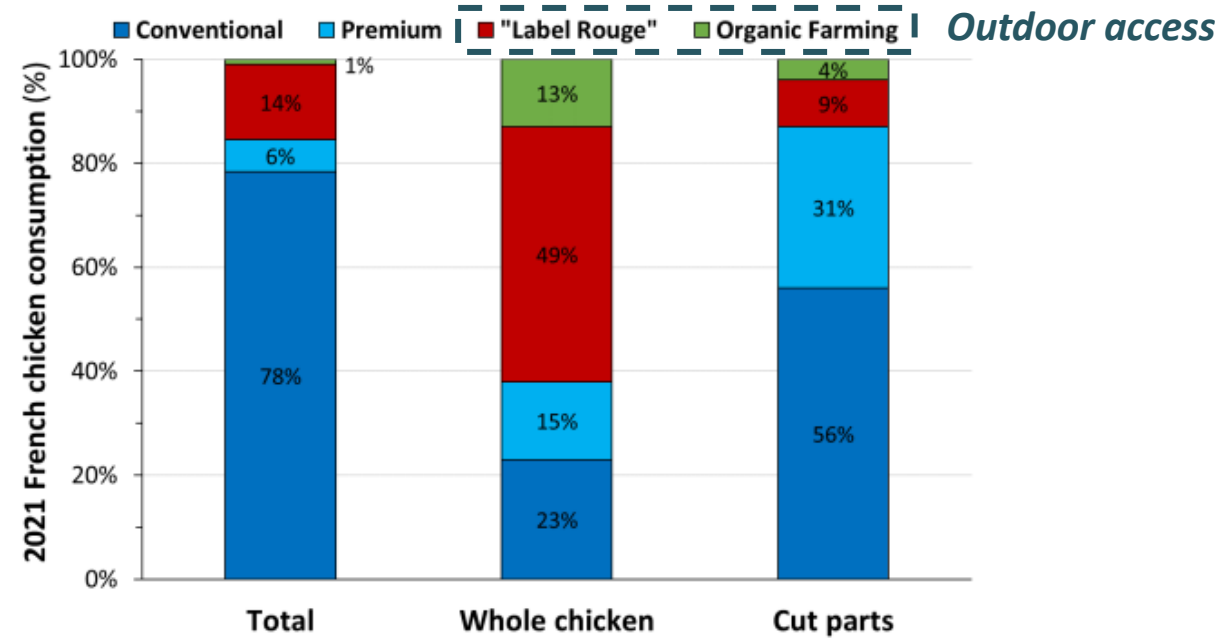
➤ Chicken meat: A highly segmented market in France

Extensive systems with outdoor access:

- ≈15% of total chicken consumption
- Meat mostly sold as whole chicken (tradition, taste...)
- Still a niche market for cut parts (price)

Consumption habits are changing:

- 1998: >50% as whole chicken
- 2022: >50% as cut parts



➤ “Label Rouge” chicken: A typical/traditional French production

“Label Rouge” (LR), an official sign of quality since 1965:

- **≈140 chicken products registered at the National Institute of Origin & Quality (INAO)** (over a total of ≈420 products)
- **Sensory and organoleptic analyses** (higher quality vs. conventional products)
- **Frequently associated to a Protected Geographical Indication** (35 for chicken)



Each product is associated with technical specifications:



Animals

- **Minimal slaughter age** (≥ 81 d)
- **Slow-growing strains** (≤ 28 g/d)



Housing

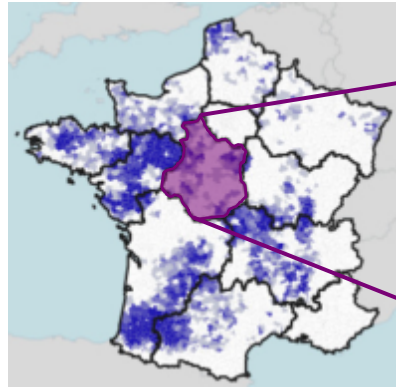
- **Animal density** (11 birds/m²)
- **Outdoor access** (2-4 m²/bird)
- **Maximal farm size** (4 x 400 m²)



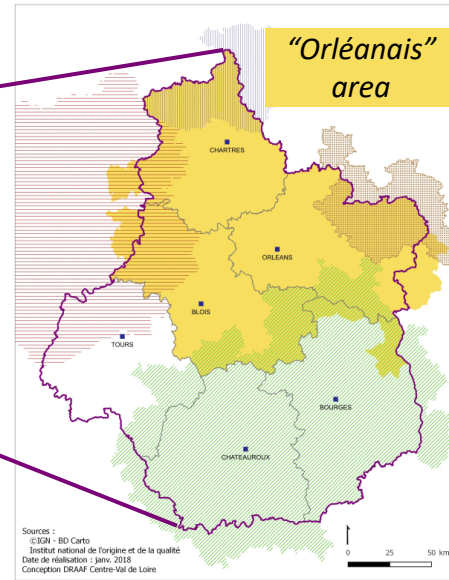
Feed

- **100% vegetal/mineral feed**
- **≥ 70% of cereals**

➤ The “Orléanais” LR, a small value chain searching for improvement margins



5039 LR poultry farms in France in 2020



A production located in the “Centre” of France

Key figures:

- ≈ 20 000 km²
- ≈ 120 farmers
- ≈ 3200 t per year (<3% French LR chicken)

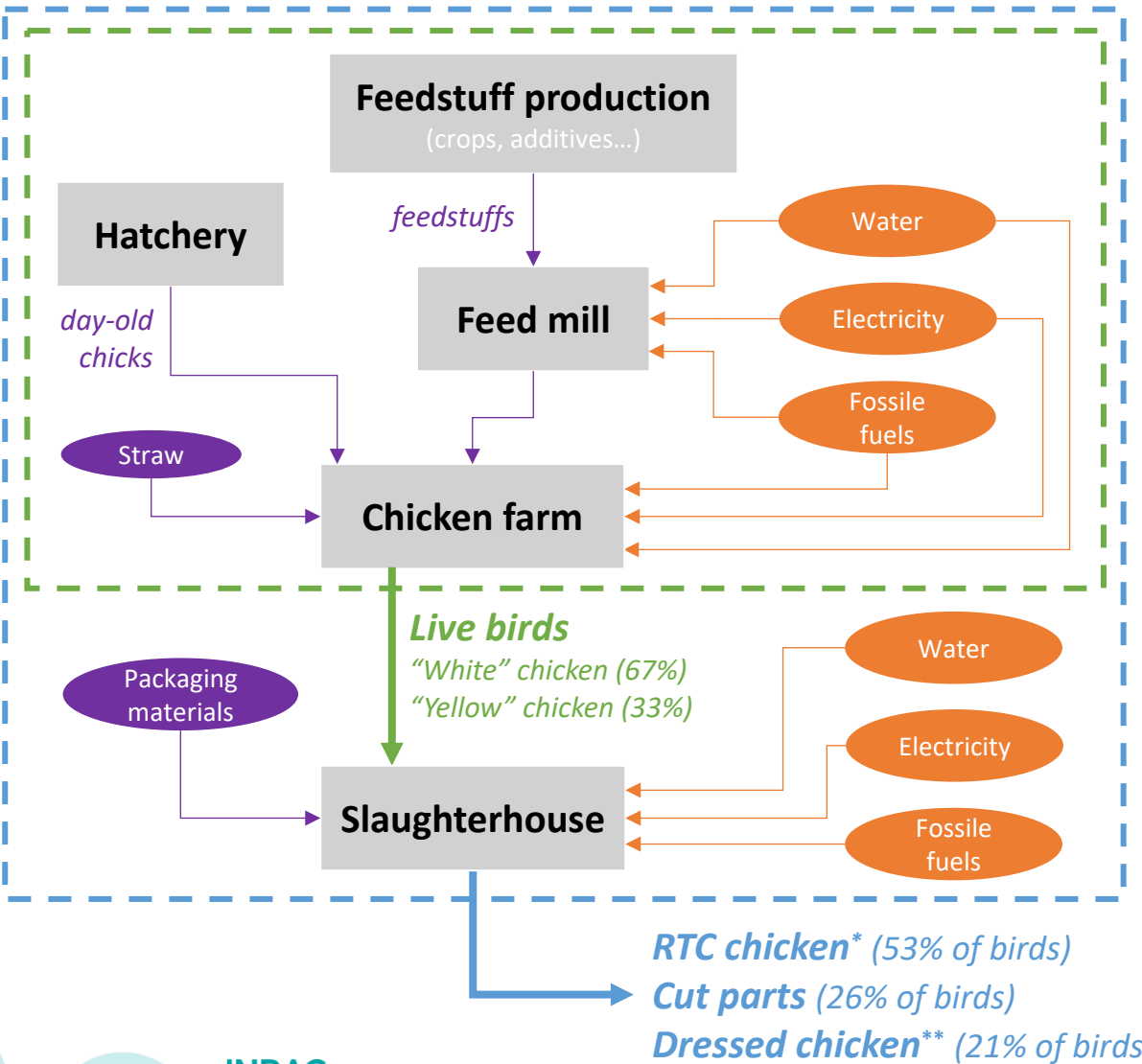


⇒ A lack of competitiveness & many sustainability issues to be tackled (climate change, societal expectations, consumer demands...)



⇒ Assessment of environmental & economic performance to identify hotspots & improvement margins

➤ M&M: Environmental impact assessment ⇒ Life Cycle Analysis (LCA)



Environmental impacts:

- Climate change (CC; kg CO₂-eq)
- Cumulated energy demand (CED; MJ)
- Acidification (AC; kg SO₂-eq)
- Eutrophication (kg PO₄³⁻-eq)
- Land occupation (LO; m².y)

Functional units = 1 kg of:

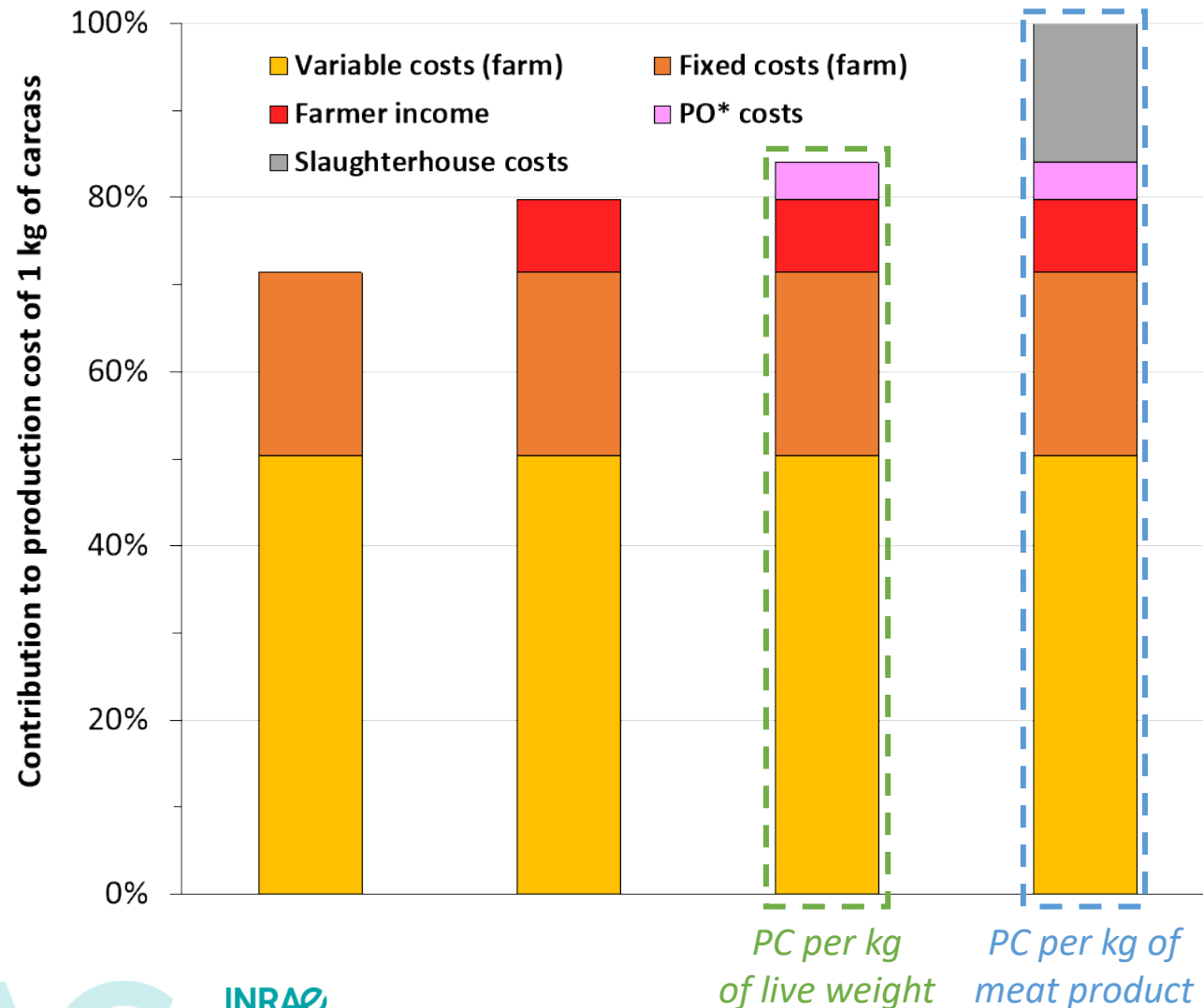
- live weight “at farm gate”
 - RTC chicken*
 - breast meat
 - leg (with bone & skin)
- “at slaughterhouse gate”
(with economic allocation)

Data sources:

- Surveys (value chain operators)
- Databases (EcoAlim V7, Agribalyse V3, Ecoinvent V3)
- Models (N & P excretion, gas emissions)
- Literature & French technical references
- Expert knowledge



➤ M&M: Economic performance ⇒ Production costs (PC)



Cost breakdown:

- Farm variable costs: feed, chicks, water, energy...
- Farm fixed costs: amortization, financial costs...
- Farmer income: 2x France's minimum wage
- PO* costs: logistics, administrative...
- Slaughterhouse costs: slaughtering, cutting, packaging...

Production costs in € per kg of:

- live weight "at farm gate"
- RTC chicken**, breast meat & leg (with bone+skin) "at slaughterhouse gate"

Data sources:

- Surveys (value chain operators)
- Databases
- Literature & French technical references
- Expert knowledge

➤ Results: LCA impacts

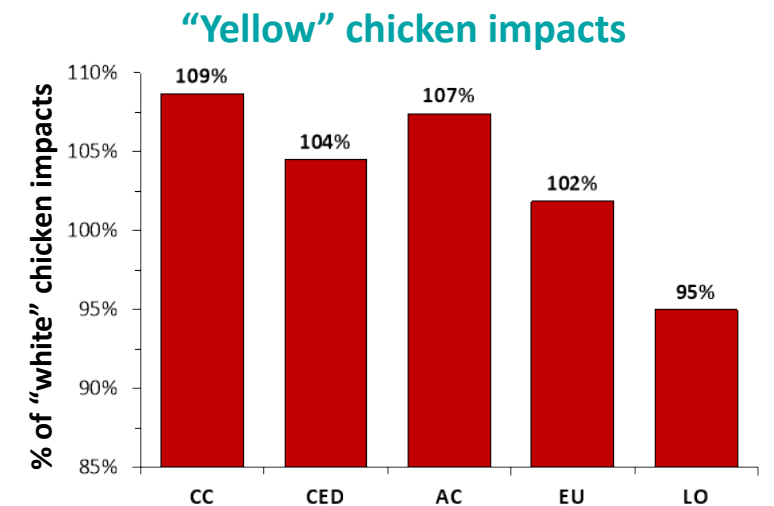
	Current study (67% "white" + 33% "yellow" chickens)			
per kg of	live weight	RTC* chicken	breast meat	leg
CC (kg CO ₂ -eq)	2.49	3.65	8.61	4.96
CED (MJ)	26.3	42.2	99.4	57.2
AC (kg SO ₂ -eq)	0.045	0.065	0.152	0.088
EU (kg PO ₄ ³⁻ -eq)	0.019	0.026	0.062	0.036
LO (m ² .y)	4.45	6.44	15.17	8.74
<i>Economic allocation factor</i>		51%	17%	10%

CC: Climate Change; CED: Cumulative Energy Demand; AC: Acidification; EU: Eutrophication; LO: Land Occupation

- ⇒ **Impacts lower** than in Prudêncio da Silva *et al.* (↗ feed efficiency), **except for LO** (↗ wheat & ↘ soybean meal/corn in our feeds)
- ⇒ **Impacts of breast meat & leg 3.5x & 2x higher** (vs. impacts at farm gate)
- ⇒ **Impacts of "yellow" chicken 2-9% higher** than for "white chicken", **except for LO** (↗ corn & soybean meal in "yellow" chicken feeds)

Prudêncio da Silva <i>et al.</i> (2014)	
/kg live weight	/kg RTC* chicken
2.70	4.02
29.5	46.4
0.047	0.069
0.019	0.030
3.90	5.78

LR chicken produced in South-Western France



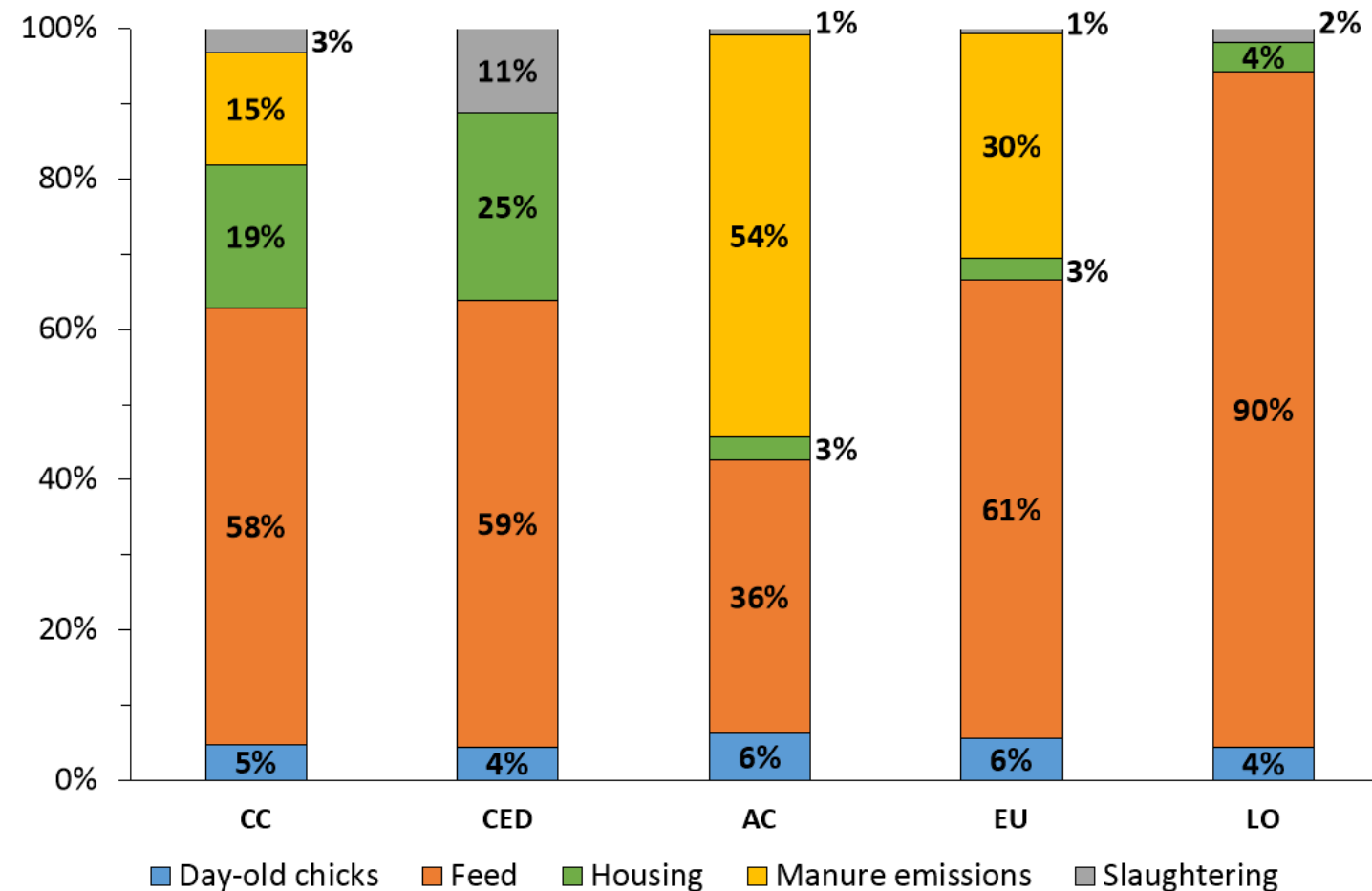
INRAE

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*RTC = ready-to-cook chicken

➤ Results: Contribution of production stages to impacts of 1 kg of carcass



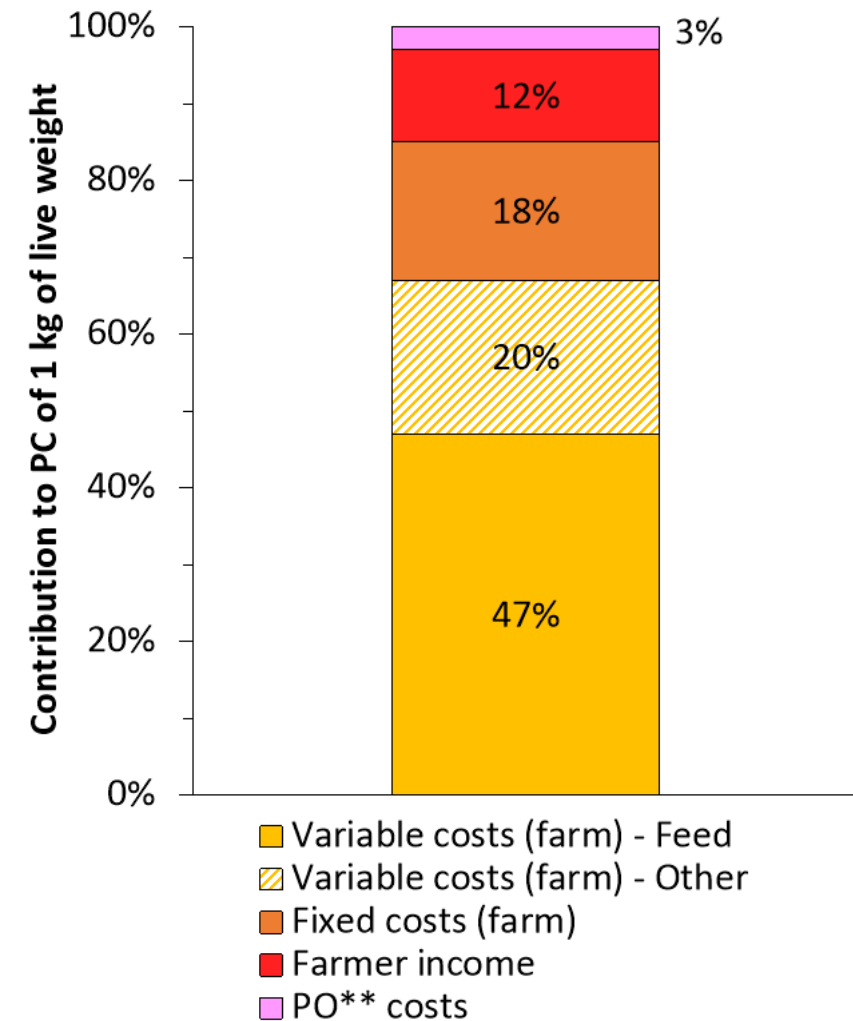
- ⇒ Importance of feed production (36-90%)
- ⇒ Large contribution of manure emissions to local impacts (AC & EU)
- ⇒ Low/very low contribution of slaughtering stage to final impacts (consistent with Prudêncio da Silva *et al.*, 2014)



➤ Results: Productions costs in 2021

€ per kg of	live weight	RTC* chicken	breast meat	leg
Current study	2.07	4.62	12.46	4.62
<i>French references</i>				
¹ ITAVI, 2022	2.13 ¹	4.16 ²	9.89 ²	
² Rungis International Market, 2021				

- ⇒ **PC consistent with French references** (per kg of live weight and RTC)
- ⇒ **+25% for PC of breast meat PC compared to French reference**
(but uncertainty on costs for slaughtering/cutting due to data availability)
- ⇒ **Feed = 1st cost** (/kg of live weight), but **lower contribution than in conventional production** (≈ 58% in 2021)



> Conclusions

First environmental/economic references for this small value-chain

⇒ Identification of hotspots for further improvements

Available data & tools (R scripts) for quick simulations

⇒ Testing new strategies (*e.g.* feed) and update of references (annual?)

Confirmed importance of feed efficiency & meat yields on final economic & environmental performances

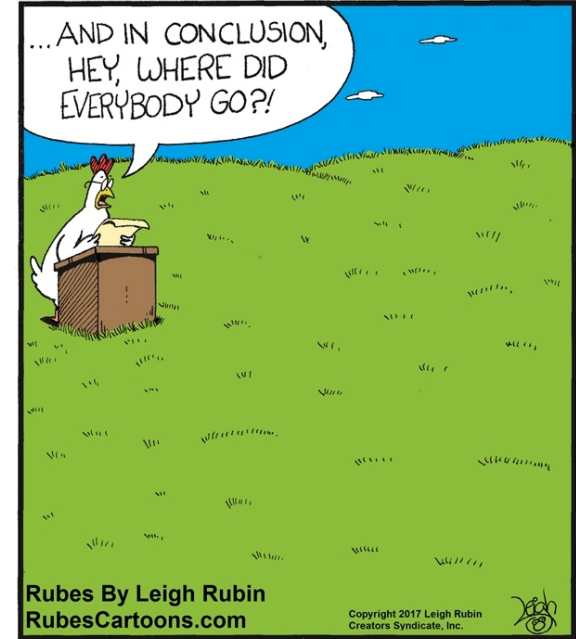
⇒ Economic & environmental implications of new genetic selection schemes (growth, feed efficiency, yields, behaviour , adaptation to climate change...)





➤ Thank you! / Merci !

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At the first-ever free-range chicken symposium

Special thanks!



Organizing & scientific committees



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