



A preliminary assessment of the carbon footprint of milk production in Morocco



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INTRODUCTION



Zero net carbon emissions by 2050

Livestock as a main source of GHG

FAO report 2006
Livestock's Long Shadow

**18% of global anthropic
GHG emissions**

**7.1 billion tons of
CO₂e/year**

Contested figures

Methods adopted

**Ignoring systems
diversity**



INTRODUCTION

Diversity of dairy systems in Morocco

Lack of references

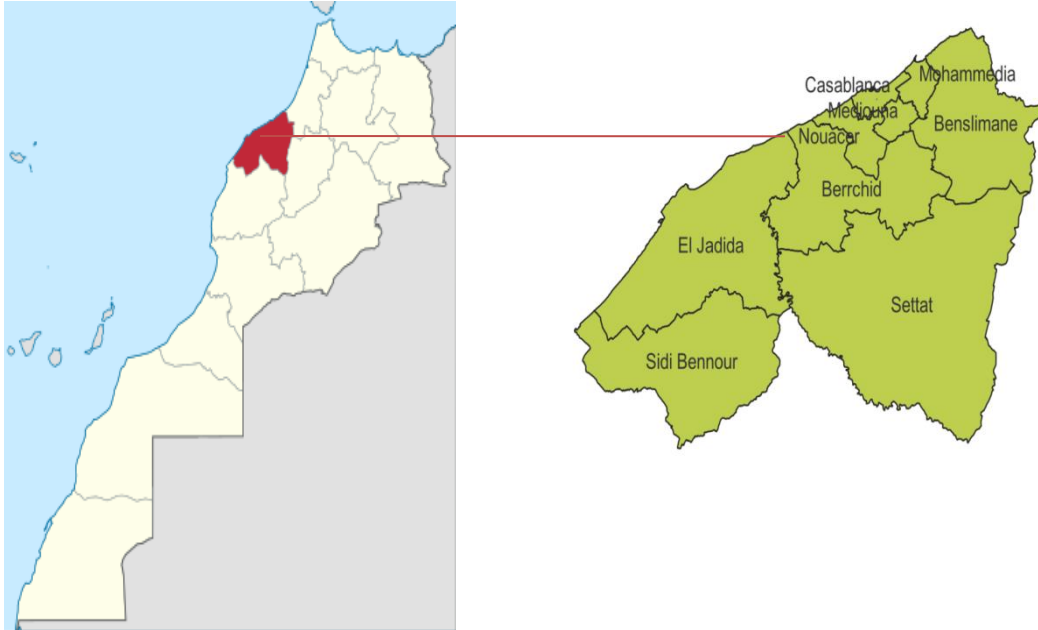
Objectives

- ❑ Main sources of GHG in variable dairy systems representative of diverse realities
- ❑ Variability of GHG emissions among productivity levels and farming practices



METHODOLOGY

Study area and sample



An important region: almost 25% of the national output

Sample

40 dairy farms

Representing the diversity of production systems

Herd size, milk yield per cow, the fodder system and the milk delivery (direct or through collection centers)

(Sraïri et al., 2009)

Four farms' profile

1. **Large farms with endogenous fodder production (LFEF) – N = 9**
2. **Large farms with entirely off-farm feed resources (LFOF) – N = 4**
3. **Smallholder with endogenous fodder production (SFEF) – N = 13**
4. **Smallholder with entirely off-farm feed resources (SFOF) – N = 14**

Tool used and variables measured

Cool Farm Tool (Koltitrace) – App available on the web

Emissions calculation based on: enteric fermentation, feed production, manure management, on-farm energy uses, transport, etc.



METHODOLOGY

Variables measured on an annual basis

- Fodder crops
- Dairy herd and milk characteristics
- Feed characteristics
- Manure management
- On-farm energy uses
- Transport



Craddle to gate farm approach

Calculations based on scientific models with a global implication:

- International Panel on Climate Change (IPCC)
- International Dairy Federation (IDF)
- Department of Environment, Food and Rural Affairs (DEFRA - UK)



Farms' mean structural characteristics

Farm profiles	Arable land (ha)	Milked cows	Milk yield (liters/cow)/year
LFEF	36.1	51	7,742
LFOF	3.8	74	6,943
SFEF	4.0	5	1,801
SFOF	2.3	2	1,864

LFEF: Large farms with endogenous fodder production – Direct deliveries to the dairy processors

LFOF: Large farms with exclusively off-farm feed resources – Direct deliveries to the dairy processors

SFEF: Smallholder farms with endogenous fodder production – Deliveries through collection centers

SFOF: Smallholder farms with exclusively off-farm feed resources – Deliveries through collection centers

A Kruskal-Wallis test used to compare emissions' differences among farm profiles

Cool Farm®

RESULTS

Average carbon footprint per kg of milk in the study sample

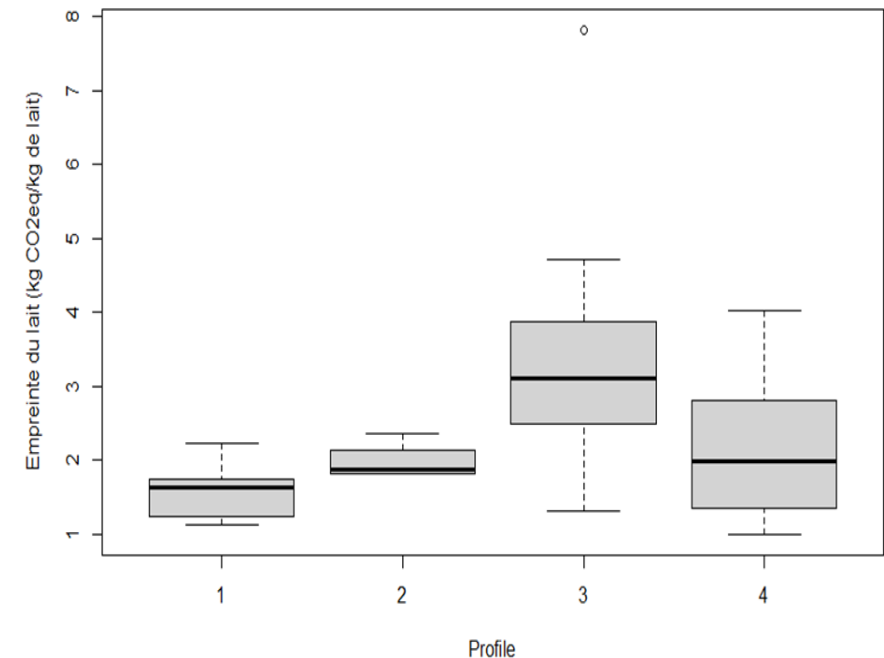
Farm profiles	Carbon footprint (FPCM)
LFEF	1.60 ± 0.38
LFOF	1.98 ± 0.25
SFEF	3.28 ± 1.70
SFOF	2.20 ± 0.93
Overall sample	2.40 ± 1.28

- Mean value very close to references for North Africa: from 2.6 to 3.5 kg CO₂e/liter (FAO-GLEAM)
- Well above global reference: 1.0 kg CO₂e/liter (FAO & GDP, 2022)
- Almost the double of data from developed countries: ≈ 1.3 kg CO₂e/liter (IDF, 2022)
- Important room for improvement...

Large farms: limited and homogenous emissions (≈ 1.5 – 2 kg CO₂e/kg milk)

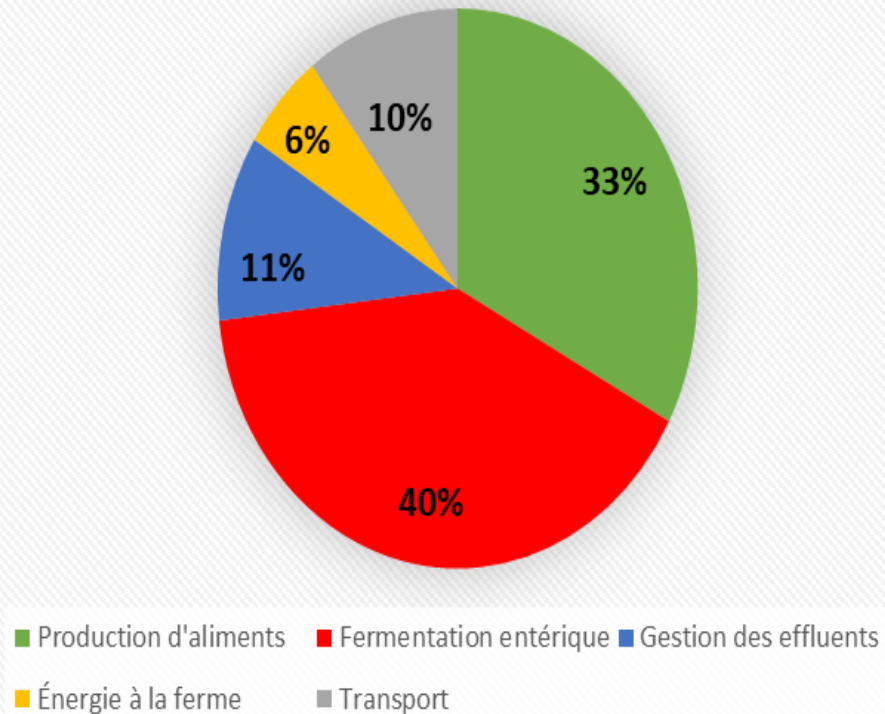
Smallholder farms: higher emissions with a marked variability (3.3 kg CO₂e/kg milk)

Factors involved in such variations: milk yield per cow, cropping practices, manure management, transport etc.

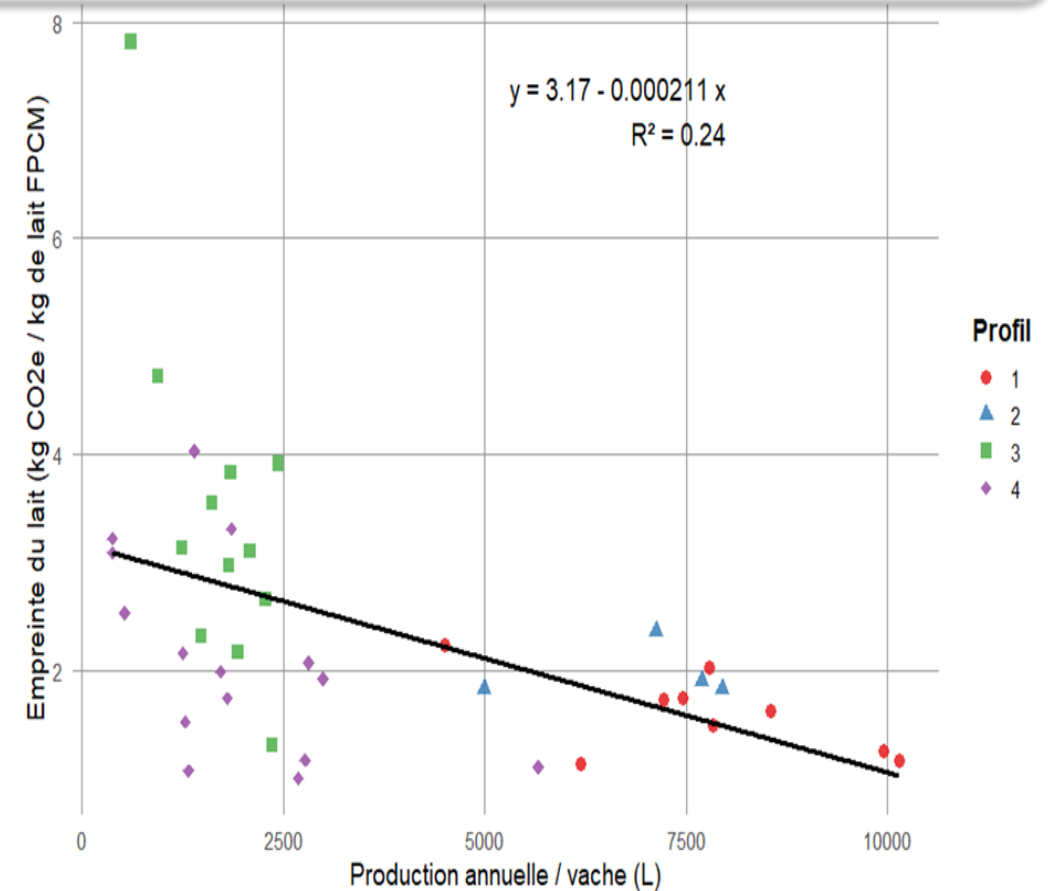


RESULTS

Emissions according to on-farm activities



Emissions and their relationship with the annual milk yield per cow



Correlation indicates that for each improvement of 1,000 liters of the annual milk yield per cow, GHG emissions decrease by 0.21 kg CO₂e/kg de lait FPCM

CONCLUSION

Mean GHG emission levels per kg of milk in Morocco, almost double than international references: many intervention levers

Large farms with important assets (cows, capital, technical extension, etc.) → advanced tools needed: feed additives, digestors, renewable energies, etc.

Smallholder systems (by far the majority): → measures to improve milk yield, balanced diets, feed autonomy and water productivity

Limits of the study

Study sample may not represent all the national situations (different regions and systems)

Data collected based on surveys with farmers dealing with a single day: may miss some of the seasonal variability

Main concern: can farmers already striving with the global change effects (climate, society, prices, etc.) adopt practices that mitigate the dairy activity GHG emissions?





**Thanks for
your
attention**

