To quote this work:

Mathieu VIGNE, Natasha CAUMARTIN, Jérémie WELLER and Claire AUBRON, 2019. Impacts of the Indian dairy farming development on global environment: Fossil energy use and GHG emissions in contrasted production systems, International seminar "Milk and Dairy in India's Development Path. Lessons, challenges and perspectives", India International Centre, New Delhi, 17-18 December. Impacts of the Indian dairy farming development on global environment: Fossil energy use and GHG emissions in contrasted production systems

M. Vigne, N. Caumartin, J. Weller, C. Aubron





Questioning & Objectives



Dairy intensification and impacts on global environment

Among the project questionings

What are the extent and consequences of the decline in multifunctional livestock for the ecosystems?



Dairy intensification and impacts on global environment

Among the project questionings

WP2

What are the extent and consequences of the decline in multifunctional livestock for the ecosystems?

→ = specialization linked to intensification (↗ inputs and productivity)

What are the impacts of such intensification in terms of **fossil resources consumption** and **greenhouse gas emissions**?



Objectives of the study



Assessing fossil energy use (FEu) and greenhouse gases emissions (GHGe) of dairy contrasted livestock systems in India

Understanding the **impact of dairy intensification** on global environmental impacts

Identifying the main factors driving FEu and GHGe

Material and Methods



Highlighting dairy production systems diversity to adress intensification & specialization

8 production systems among all agrarian diagnosis crossing different factors



Highlighting dairy production systems diversity to adress intensification & specialization



Highlighting dairy production systems diversity to adress intensification & specialization





From « craddle to farm gate » Indirect and Direct FEu & 3 main GHG





From « craddle to farm gate » Indirect and Direct FEu & 3 main GHG





IPCC 2006 & 2019 refinement (Tier1/2)

From « craddle to farm gate »

Indirect and Direct FEu & 3 main GHG

Two indicators

✓ MJ (FEu) or kgCO2eq (GHGe) .female⁻¹.production cycle⁻¹

 Σ (FE or GHG_{Industrial inputs}) + Σ (FE or GHG_{Feeding crops}) + Σ (FE or GHG_{Production phase})

From « craddle to farm gate »

Indirect and Direct FEu & 3 main GHG

Two indicators

- ✓ MJ (FEu) or kgCO2eq (GHGe) .female⁻¹.production cycle⁻¹
- ✓ MJ (FEu) and kgCO2eq (GHGe) .kgFPCM⁻¹

 Σ (FE or GHG_{Industrial inputs}) + Σ (FE or GHG_{Feeding crops}) + Σ (FE or GHG_{Production phase})

Milk production (*kgFPCM*)

From « craddle to farm gate »

Indirect and Direct FEu & 3 main GHG

Two indicators

- ✓ MJ (FEu) or kgCO2eq (GHGe) .female⁻¹.production cycle⁻¹
- ✓ MJ (FEu) and kgCO2eq (GHGe) .kgFPCM⁻¹

Economic allocation at two levels: Crops & Animal

Economic allocation at two levels: Crops & Animal



Economic allocation at two levels: Crops & Animal



Results



Impacts of intensification on GHGe



---GHG (kgCO2eq.female-1.yr-1)

Increase of GHG emissions per female per cycle ...

Impacts of intensification on GHGe



Increase of GHG emissions per female per cycle ... and decrease per tFPCM up to ~2tCO₂eq

Impacts of intensification on GHGe

In accordance with literature...



- ✓ Gerber *et al.* (2013)
 (South Asia) : **5.5** (cow)
 and **3.2** (buffalo)
 kgCO2eq.kgFPCM⁻¹
- ✓ Garg *et al.* (2016) (Anand district, Gujarat): 2.2
 kgCO2eq.kgFPCM⁻¹

Impacts of intensification on FEu



Discussions & Conclusions



How Green & White revolution drove FE overuse in Indian dairy systems?

Indirectly through **feeding systems**

Straws > 55% of FEu

Fuel and electricity use for irrigation Synthetic fertilization for crops Mechanisation

⇒ Higher FE costs of residues





Conclusions and Perspectives

At PS level, **intensification** led to :

- ↗ GHGe per female ... but ↘ per kgFCPM
- Overuse of FE
- ⇒ How to reach sustainable intensification of Indian dairy systems (not only N losses and FEu but also GHGe or water use, ...)?

At **upper level** (village, mandal, district,...), how loss of multifunctionality and potential decrease in PS interactions have been substituted (grazing vs feed concentrates, manure vs synthetic fertilizers, dung cake vs NRE, animal draft vs mechanization, ...)?

What's the **environmental impacts of such dynamics** (external inputs dependence, e.g. Petlad study)?



Thank you for your attention

