Comparing outcomes of three GHG emission calculation tools applied on dairy production systems

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Introduction

- Increasing importance of mitigating GHGs in dairy farming
- Many GHG emission accounting tools, used for monitoring farm performance and effectiveness of mitigation strategies
- Most tools use international standards for GHG accounting to ensure level playing field (e.g. IPCC, PEFCR)
- To what extend are tools yielding comparable outcomes?

Aim

- To compare outcomes of three LCA calculation tools for estimation of cradle-to-farm gate GHG emissions from dairy production systems
- Agrecalc (UK), CAP'2ER-level 1 (FR), ANCA (NL, 'KringloopWijzer')

Materials and methods

- 3 dairy farms: Lithuania, Poland, and the Netherlands
- Data collected in farm visit by local researcher in March 2021, for reference year 2020 (part of NL data collected automatically)
- Data entry in common recording sheet to enhance similarity of data in tools, data validation by WUR
- Data entry in tools (by local researcher in Agrecalc online tool and ANCA software, by French institute IDELE for CAP'2ER)

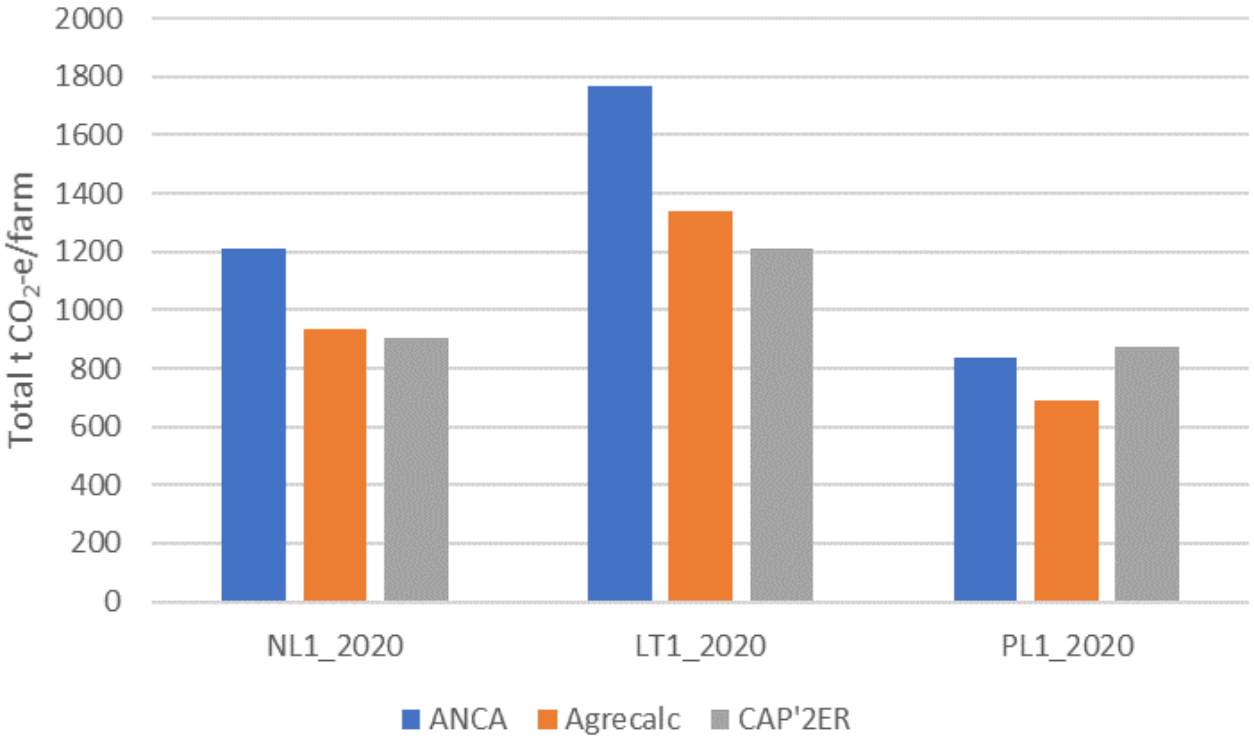
Some information about the tools

	Standards	System boundaries	GWP characterization (CO2:CH4:N2O)	Allocation method milk/LW	Feed database used	Tier level
Agrecalc	IPCC 2006 PAS2050:2011	Cradle-farm gate	1:25:298	Biophysical	FeedPrint v2015	Enteric: Tier 2 Soil: Tier 1
CAP'2ER	IPCC 2006 EMEP 2013	Cradle-farm gate	1:25:298	Biophysical	Ecoalim V7/ Agribalyse 3.0	Enteric: Tier 3 Soil: Tier 1
ANCA	IPCC 2006 PAS2050:2011 PEFCR 2018	Cradle-farm gate	1:34/36.75:298	Biophysical	GFLI/ FeedPrint v2020	Enteric: Tier 3 Soil: Tier 1/ Tier 2

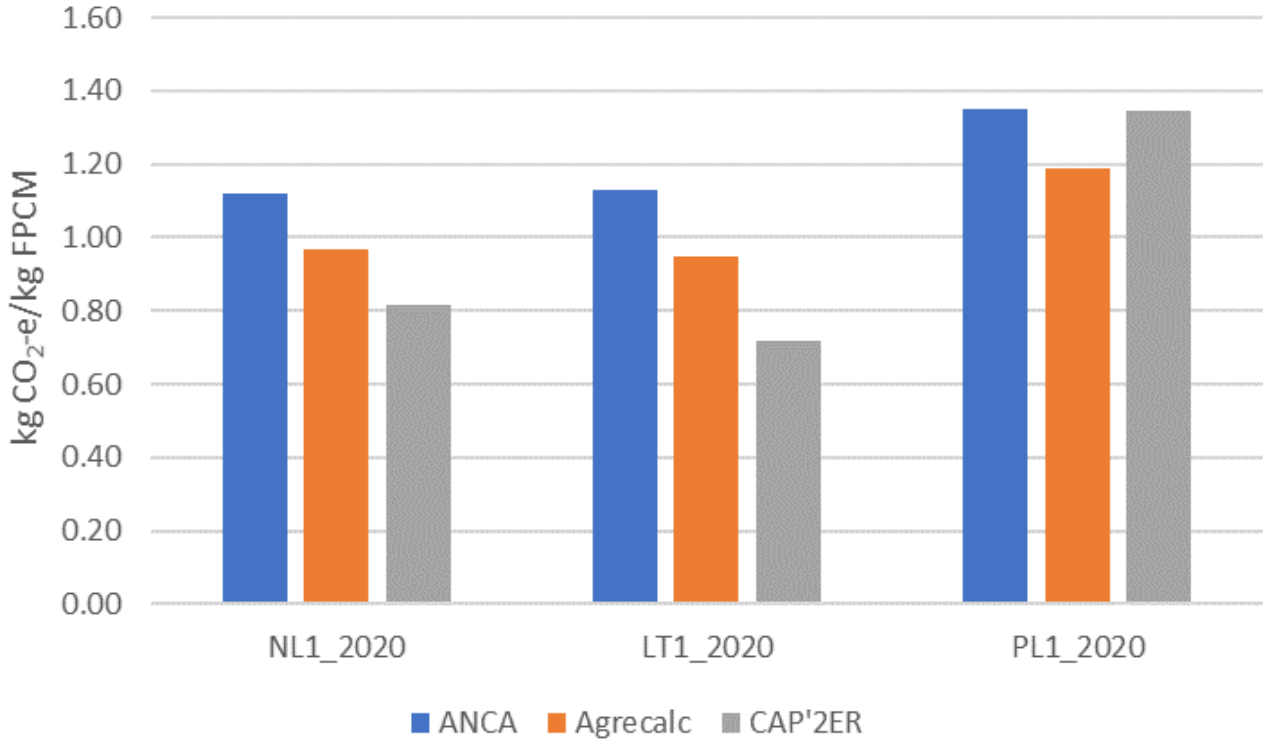
General farm characteristics

	NL1	LT1	PL1
Farm type	Dairy	Mixed (dairy, arable crops)	Dairy
Cows (hd)	82	126	54
Soil	sand	peat, mineral soil	peat, clay
Milk/cow (kg)	10,291	9,722	10,021
Milk/ha (kg)	15,333	4,627	10,569
Housing	Cubicle housing	Cubicle housing	Cubicle housing
Grazing	grazing	zero-grazing	zero-grazing
Feed ration (imported feed underlined)	fresh grass, grass silage, maize silage, straw, soya meal, concentrates, minerals	grass silage, maize silage, straw, grain, soya meal, rape meal, beet pulp, concentrates	grass silage, hay, maize silage, alfalfa, grains, beet pulp, brewer's grain, soya meal, rape meal, oats, bran, urea, minerals

Results: total GHG emissions per farm



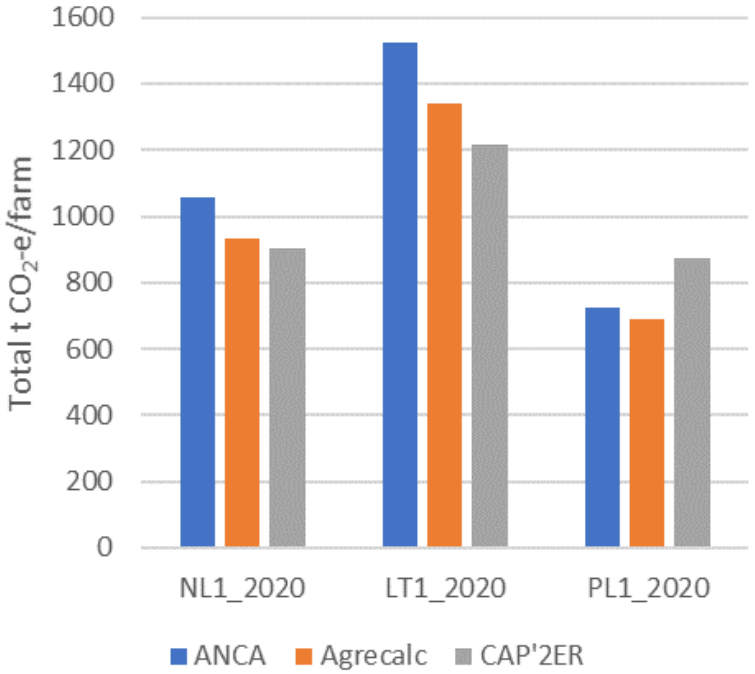
Results: GHG emission intensity

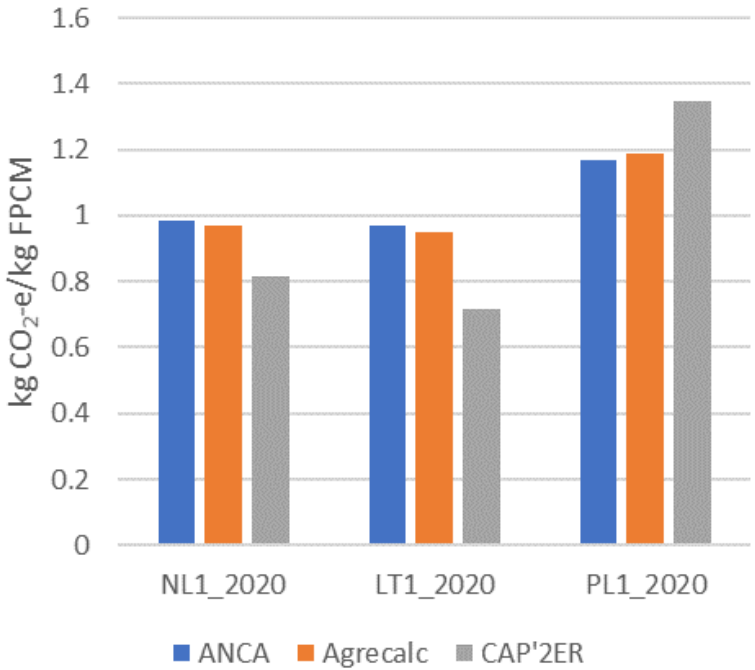


(FPCM=fat and protein corrected milk)

What is causing these differences? (i)

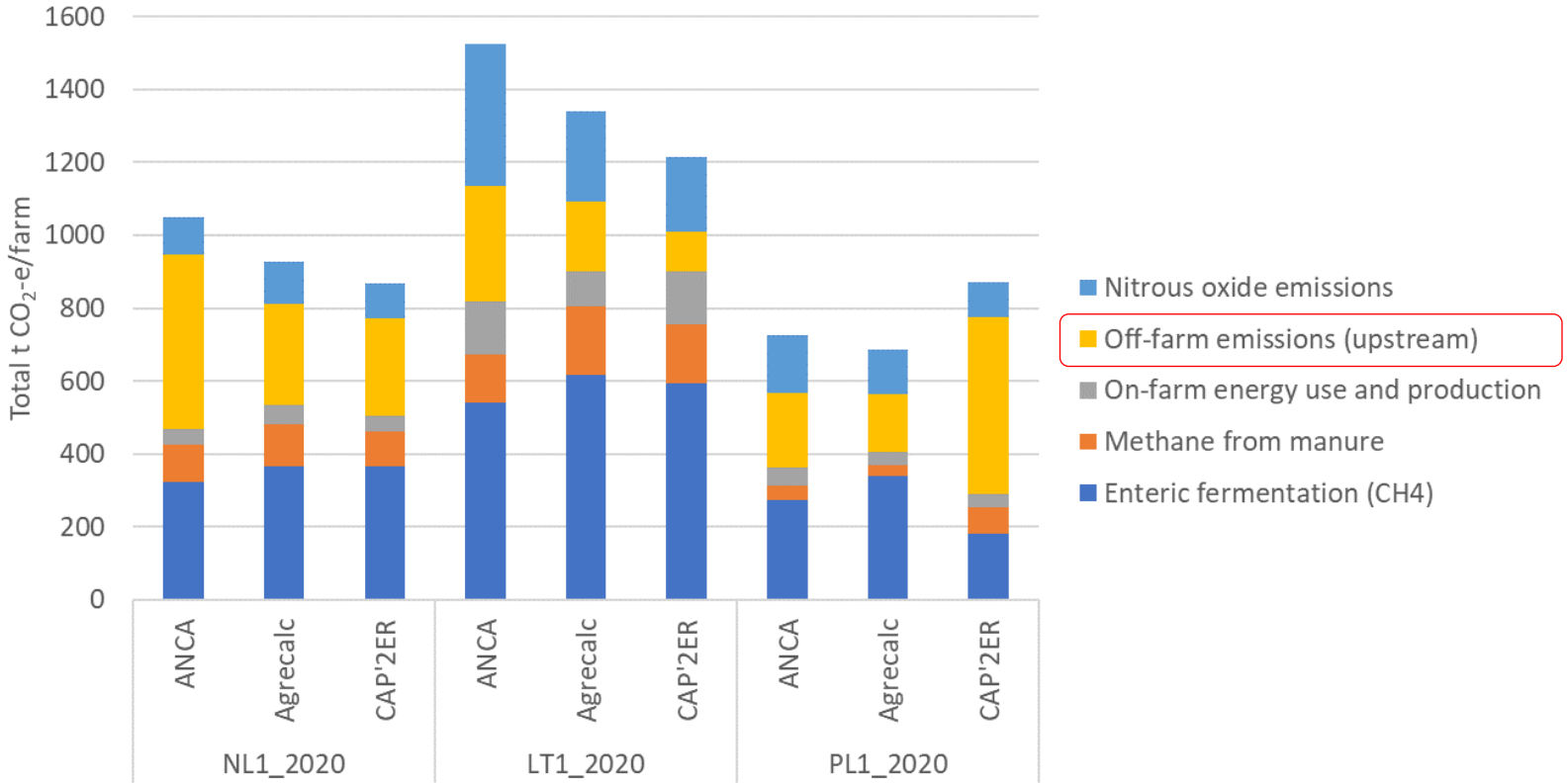
Results when using the same GWP factor for biogenic CH_4 (25 kg CO_2):





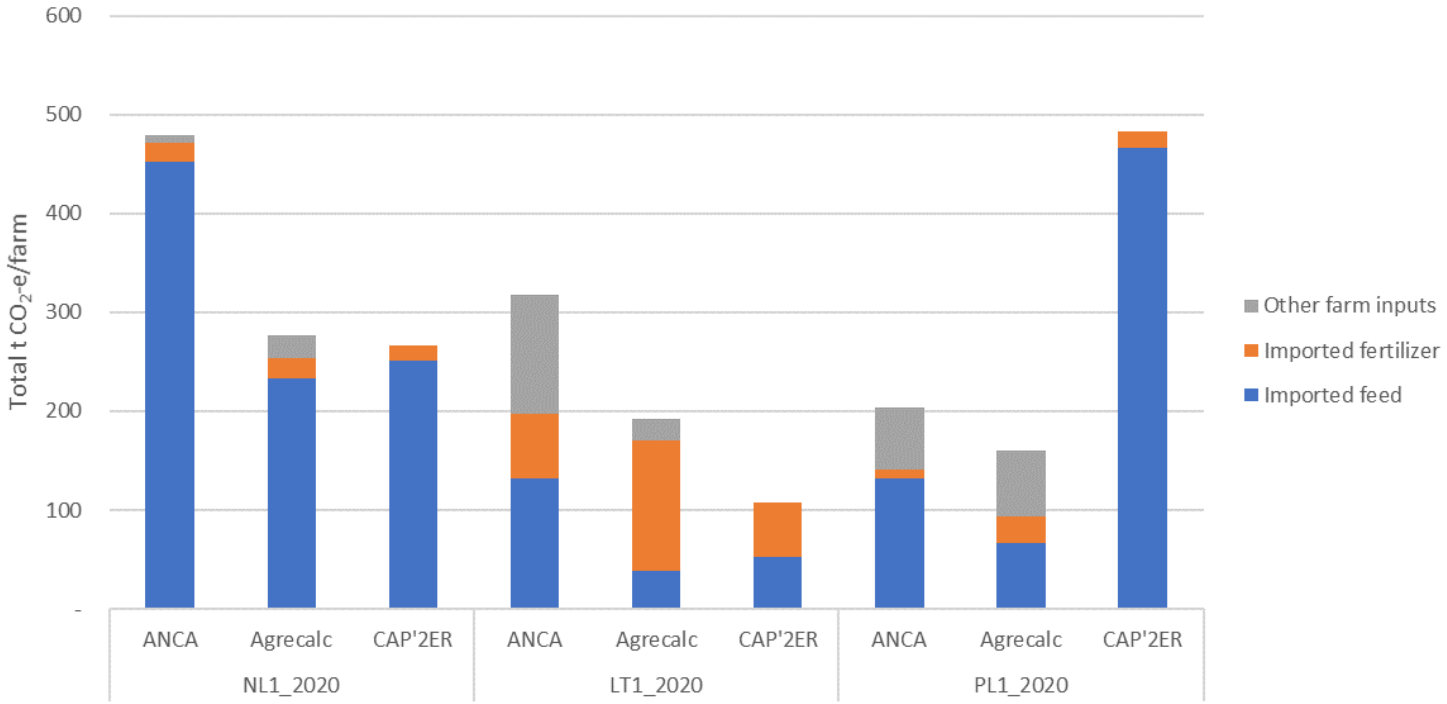
What is causing these differences? (ii)

Results according to types and sources of emissions:



What is causing these differences? (iii)

Sources of off-farm emissions (upstream)



Discussion

- Limitations:
  - Country-specific background data used (e.g. electricity-mix, soil N2O)
  - Quality of input data (human work)
- Differences in upstream emissions from imported feed:
  - Feed LCA database used
  - Feed ingredients available in the tool
- Differences in enteric methane emissions:
  - GWP characterization factor CH_4
  - Calculated herd feed intake and composition, feed stock information
  - (Not Tier 2 vs. Tier 3)

Conclusions

- GHG calculation tools showed differences in outcomes
- Largest absolute differences were found for off-farm emissions
- Further harmonization is needed in methods and background data to reduce differences in outcomes
    - Particularly LCA feed databases used, feeds listed in tools
- Be aware of potential bias of applying country-own tools in other countries (background data, quality of inputted data)

Thank you

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