MIXED

EFFICIENT AND RESILIENT
MIXED FARMING & AGROFORESTRY

Modelling transitions from specialised farms to MiFAS.

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Assessing the performance of mixed farming systems

WP5

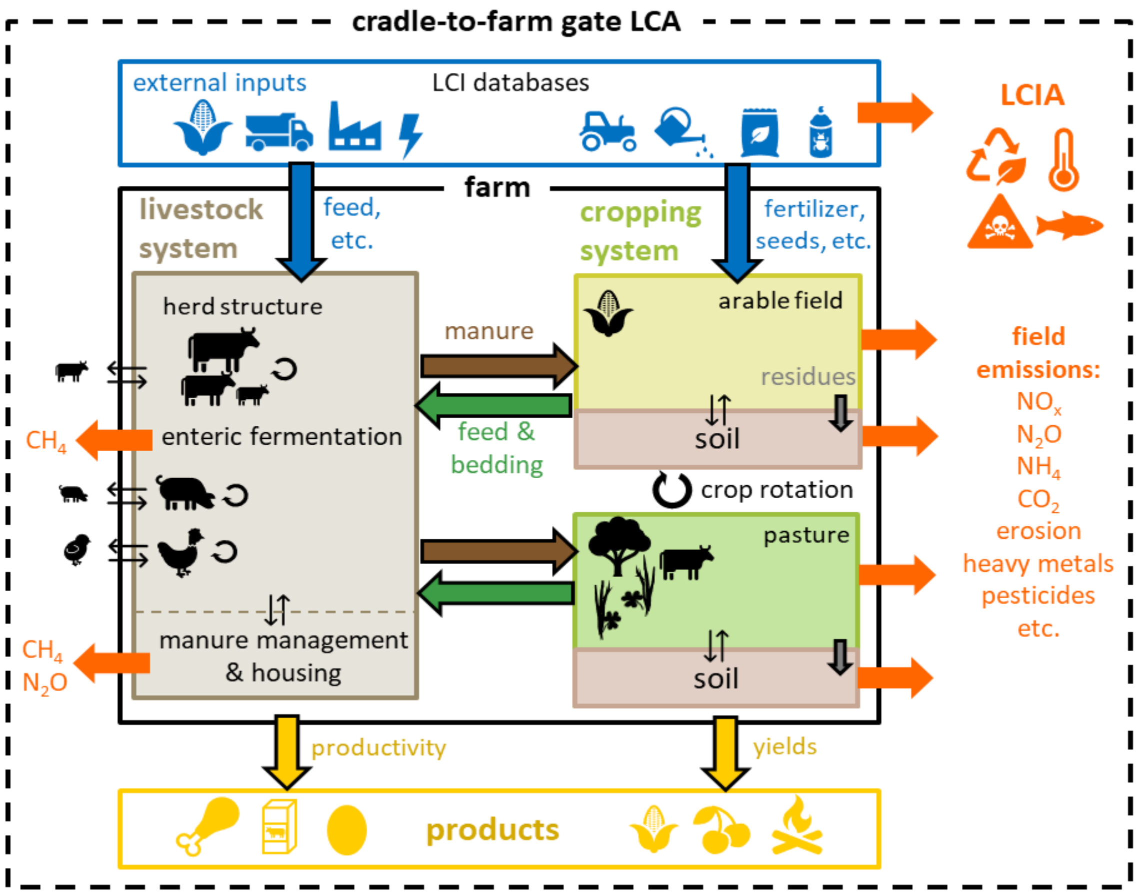
1. Data collected through the farm networks;
   - Data from around 50 (*very diverse*) farms
   - Farms grouped according to characteristics:
     - Integrated crops and livestock **(ICL)**
     - Integrated crops or livestock and trees **(ICLF)**
     - Specialised arable **(SA)**
     - Specialised livestock **(SL)**

2. Modelling transition of typical farm systems

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862357

Use of FarmLCA modelling tool

- Integrated farm system model and LCA calculation
- Model developed in MIXED to allow multiple products, e.g. winter grazing of cereals, grazing under fruit trees etc
- Allows flexible farm system design and assessment



Graphical representation of the FarmLCA tool and the fam gate boundary approach it adopts. (from de Baan et al., 2024)

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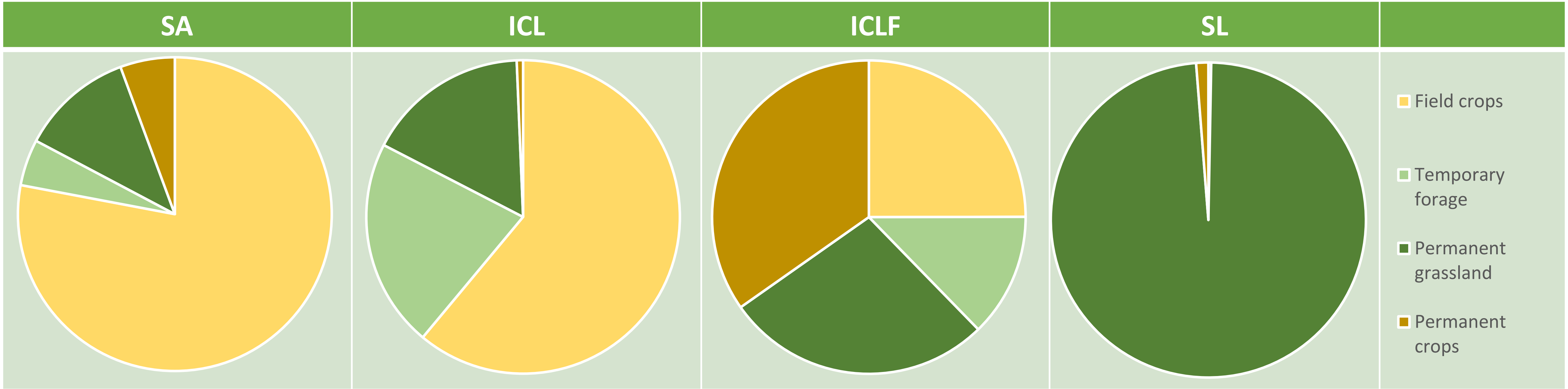
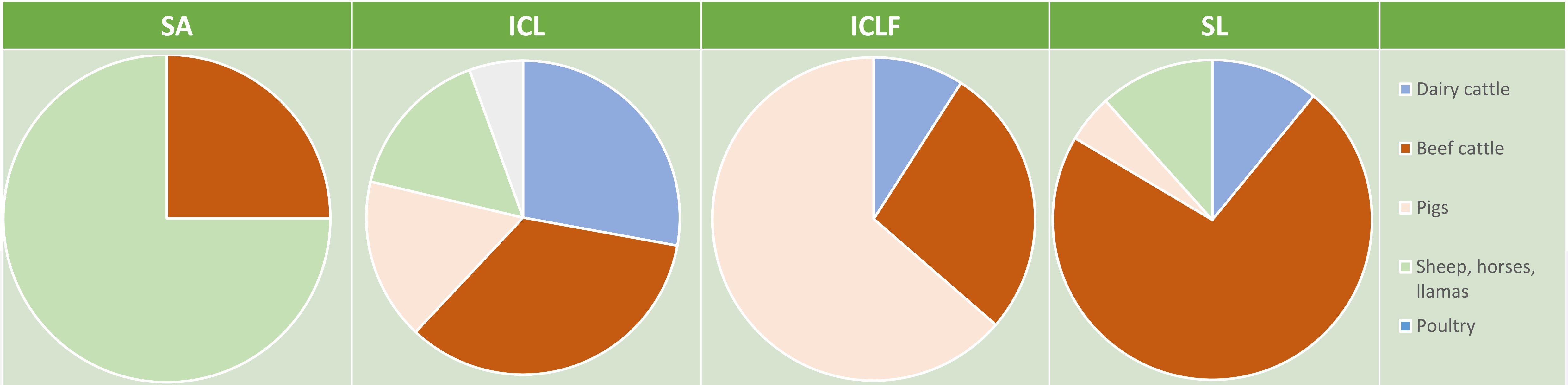
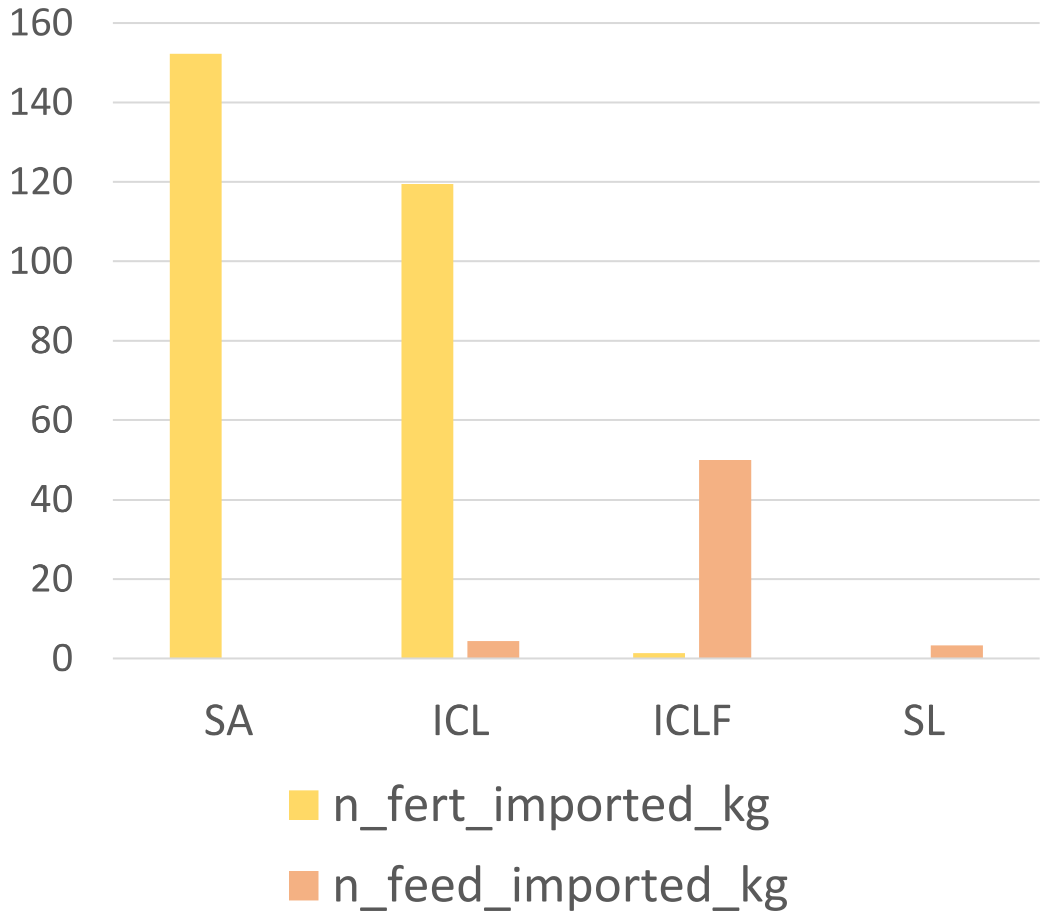
1. Real farm data - Land use and livestock proportions

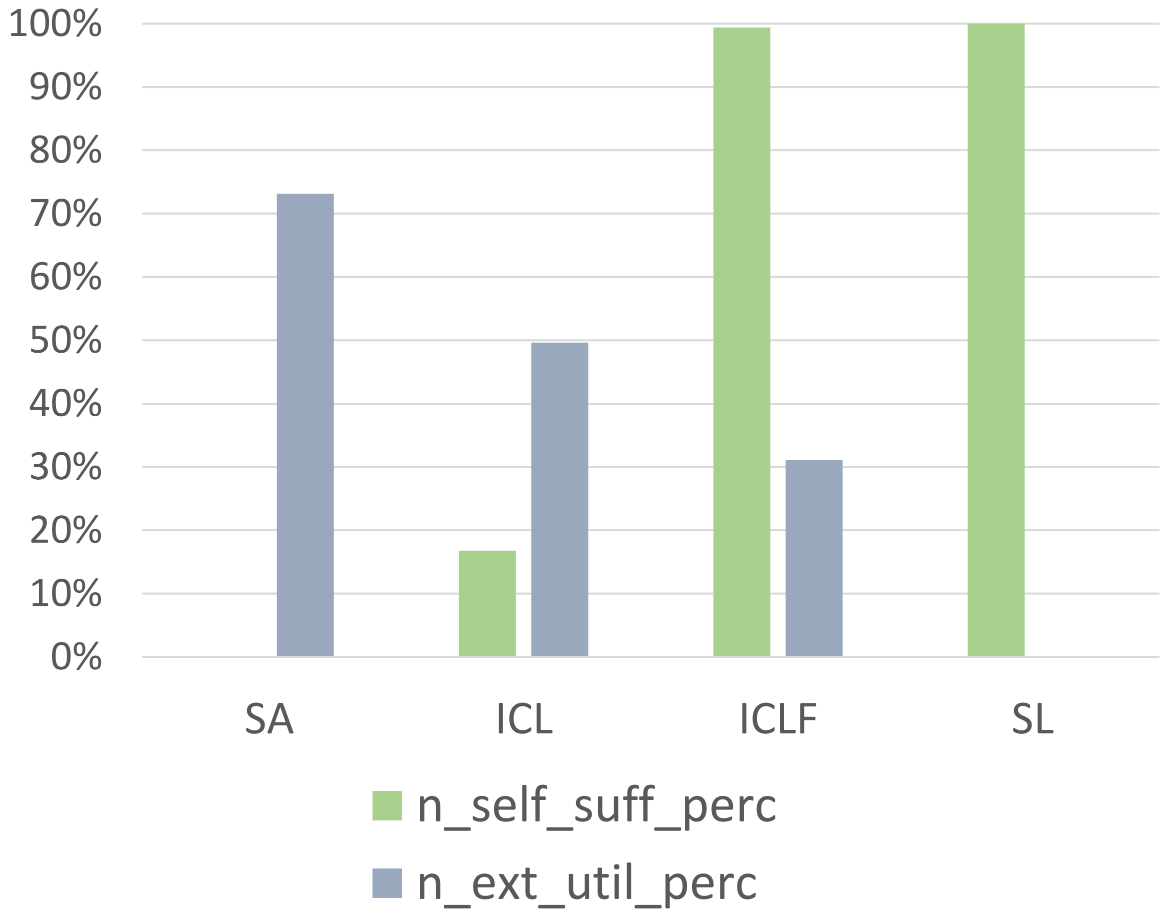




Nitrogen imports as fertiliser or feed



Nitrogen utilisation & self-sufficiency



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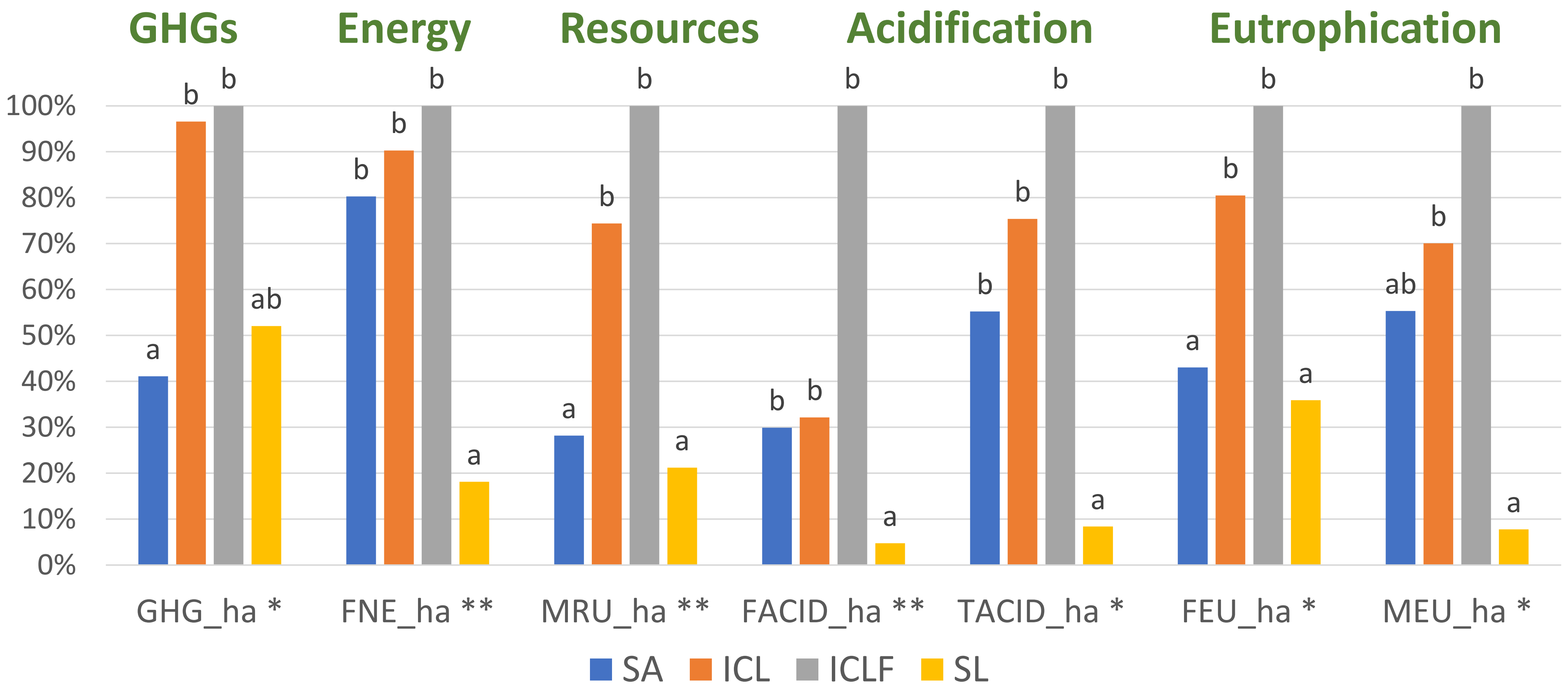
Environmental impacts (indexed results: per hectare)



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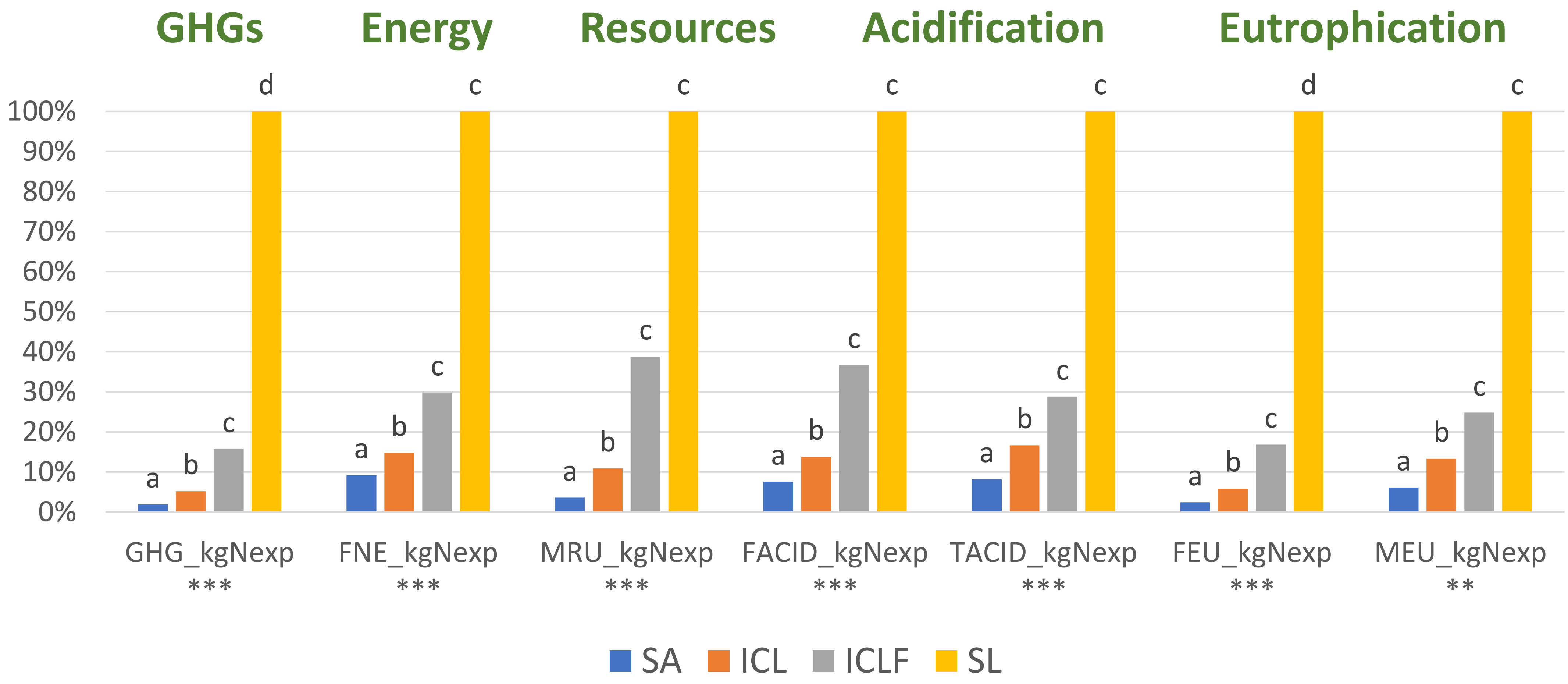
Environmental impacts (indexed results: per kg N exported)



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Results

- Network farms were highly diverse and we lacked a real control
- We were able to improve the assignment of impacts between trees and land cover (grass or crops) through better allocation
- Methods to assess them require further improvement, especially regarding residues, interaction effects, e.g. trees and livestock
- Impacts are very related to the specific situation on the farm, and driven by intensity of farming more than any particular features
- Potential for GHG reduction through soil or biomass increases exist but impact likely to be small (and may be non-permanent)

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2. Modelling approach to assess MiFAS adoption by specialized farms

- Use of "typical" FADN farms to assess MiFAS strategy adoption
  - Provides "control" situation, but assumptions may not be "realistic"…
- Scotland (UK) – Cropping farm (with some beef) > Mixed (integrated beef finishing) > MiFAS (trees in pasture)
- Poland – Cropping farm > Mixed (integrated laying hens) > MiFAS (alley cropping with temporary pasture)
- France – Pig farm > Mixed (integrated feed production) > MiFAS (outdoor pig production, including temporary leys, trees?)
- Germany – Dairy farm > Mixed (integrated fed production) > MiFAS (energy trees as alley crops)

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Scottish (UK) cropping farm changes

- MIXED:
  - Added forage legumes and field peas to rotation
  - Reduced N fertiliser imports (-30% overall)
  - Straw utilised as bedding and manure spread on arable fields
  - More solid manure rather than slurry (lower N emissions)
  - No purchased feeds
- MIFAS:
  - Sheep graze winter cereals (reduced concentrate and winter grass/hay)
  - Added nut trees to permanent pasture for C-sequestration and a new crop

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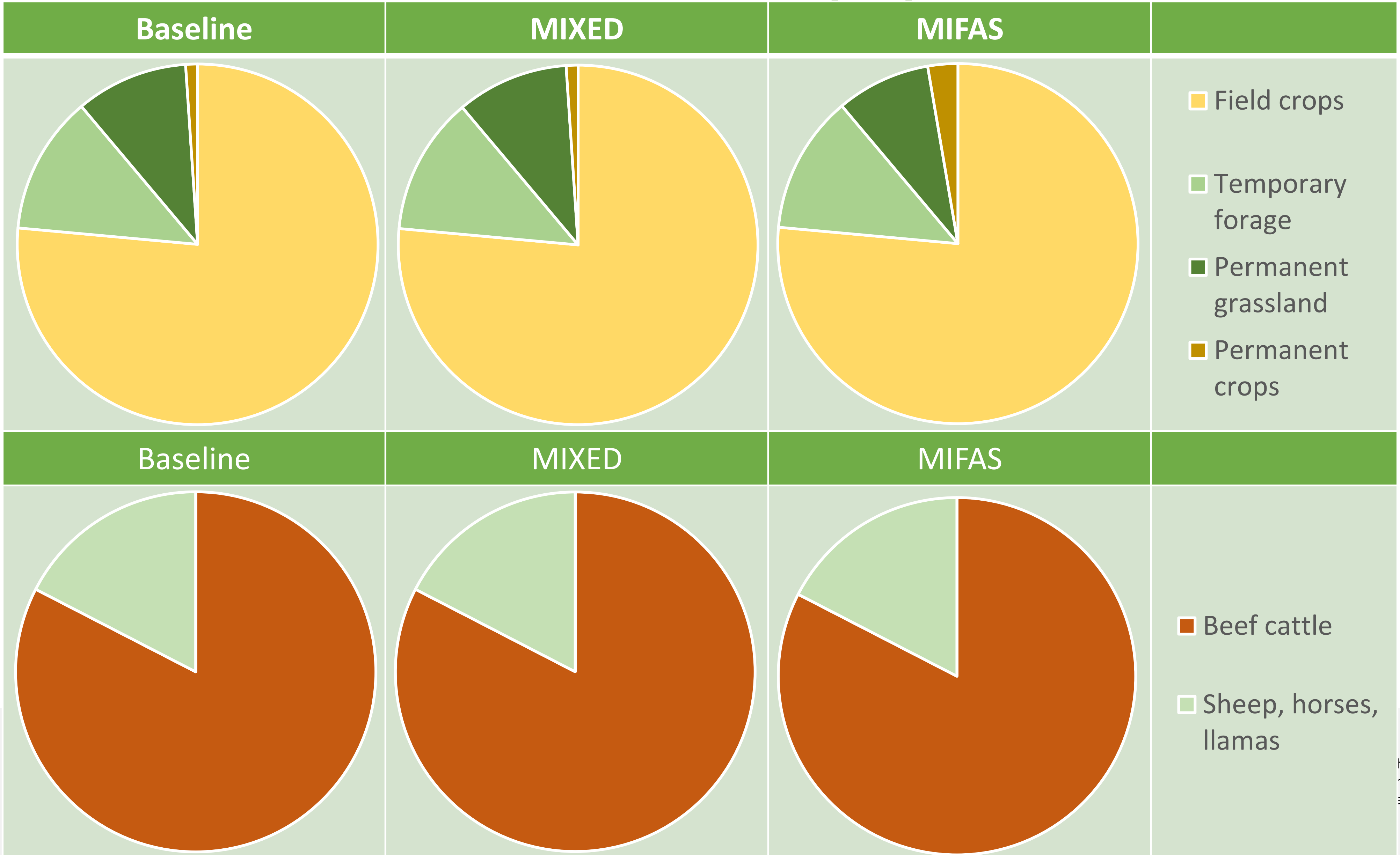
Scotland - Land use and livestock proportions



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Environmental Impacts – per hectare

	Without soil/biomass C impacts			With soil/biomass C impacts		
	UK_base	UK_MIXED	UK_MIFAS	UK_base_C	UK_MIXED_C	UK_MIFAS_C
Climate change, short term	100%	90%	90%	100%	90%	88%
Fossil and nuclear energy use	100%	85%	85%	100%	85%	85%
Mineral resources use	100%	93%	93%	100%	93%	93%
Freshwater acidification	100%	92%	91%	100%	92%	91%
Terrestrial acidification	100%	93%	93%	100%	93%	93%
Freshwater eutrophication	100%	96%	96%	100%	96%	96%
Marine eutrophication	100%	78%	74%	100%	78%	74%

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Environmental Impacts – per kg N exported

	Without soil/biomass C impacts			With soil/biomass C impacts		
	UK_base	UK_MIXED	UK_MIFAS	UK_base_C	UK_MIXED_C	UK_MIFAS_C
Climate change, short term	100%	87%	85%	100%	87%	82%
Fossil and nuclear energy use	100%	82%	80%	100%	82%	80%
Mineral resources use	100%	90%	87%	100%	90%	87%
Freshwater acidification	100%	88%	86%	100%	88%	86%
Terrestrial acidification	100%	90%	87%	100%	90%	87%
Freshwater eutrophication	100%	93%	90%	100%	93%	90%
Marine eutrophication	100%	75%	70%	100%	75%	70%

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Initial findings from modelling results…

- All impacts reduced
- Per kg of nitrogen exported impacts reduced further due to increased N output
- Energy and nitrogen impacts reduced due to fertiliser reductions
- Economics improve due to cost savings (fert, feed)
- Use of legumes (grain and forage) a key part in improving performance
- Sheep grazing of winter cereals allowed for reduced winter feed use

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Takeaways

- Intensive livestock generates high emissions (even with mixed farming) – so little opportunity for “additional” livestock in cropping systems
- “MIXED” might reduce emissions when resources are optimally utilised, e.g. winter cereal grazing replaces purchased concentrates
- “MIFAS” biomass C-sequestration potential as new plantings, but markets and productivity uncertain in many regions
- LCA can only assess certain indicators, others, e.g. biodiversity, animal welfare not well covered.
- Strategies such as AF will not solve all issues, but a **whole farm approach** to reducing impacts through **reduction and efficient use of fertilisers and feeds**

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Thank you to all the MIXED partners for data collection and feedback

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Thank you!

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