

Greenhouse gas mitigation along the dairy production chain via breeding indices

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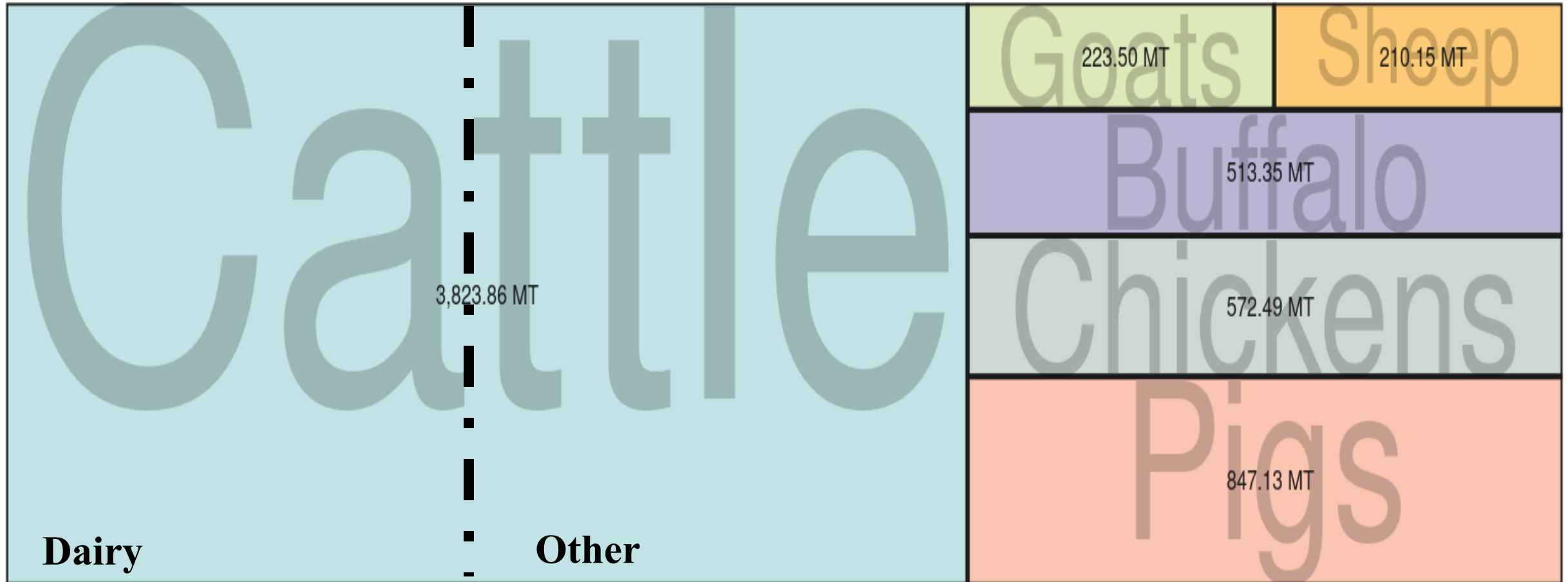
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Rui Shi and Yue Wang contribute equally to this work

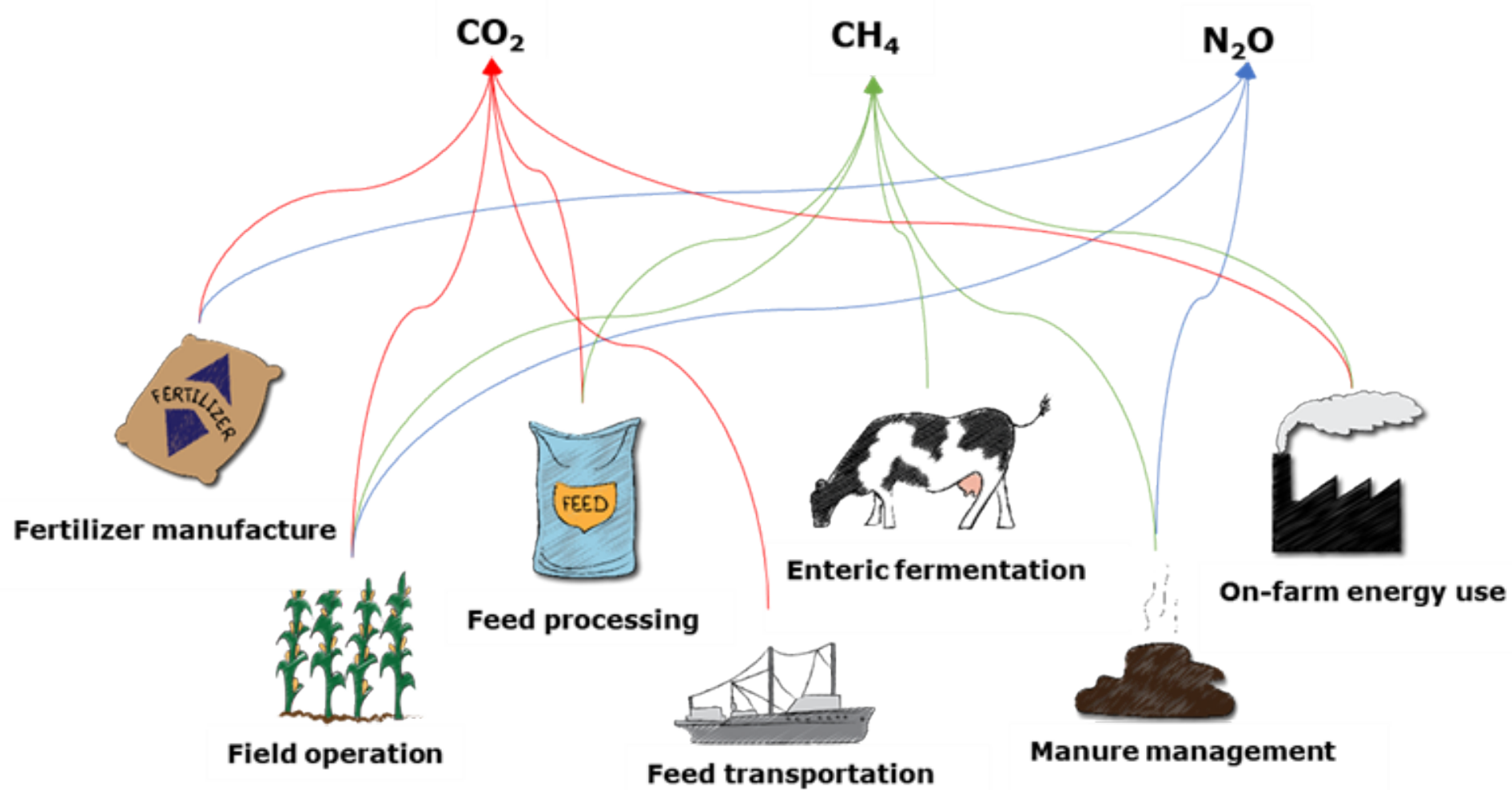


Dairy cattle as a dominant contributor to greenhouse gas (GHG) emissions

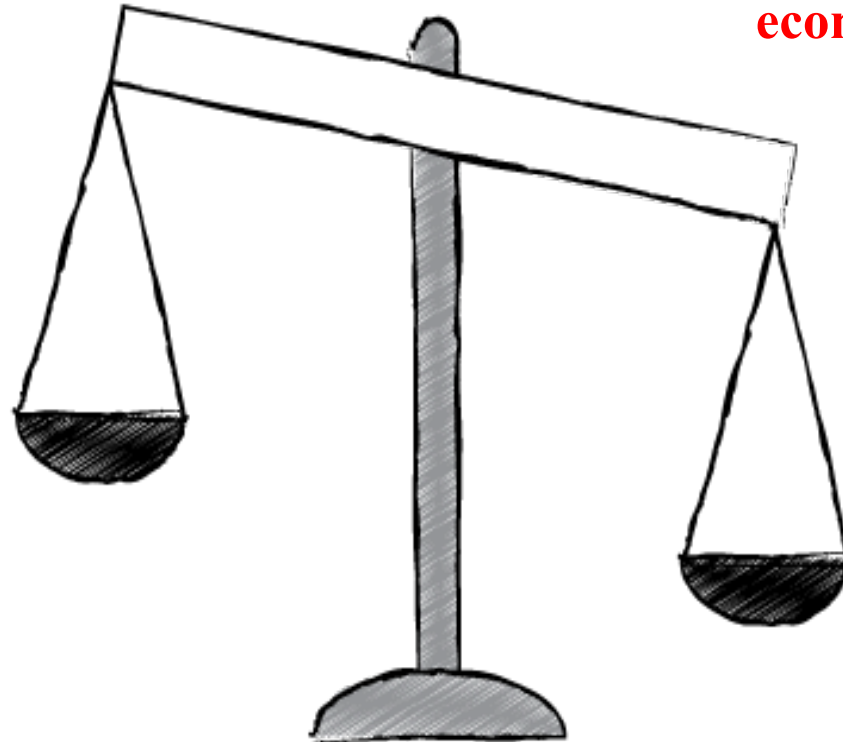


(GLEAM 3.0; Opio et al., 2013)

GHG emissions along the dairy production chain



Breeding as a mitigation option



Breeding goals in practice focus on **maximizing profit** based on the **economic values** of genetic traits



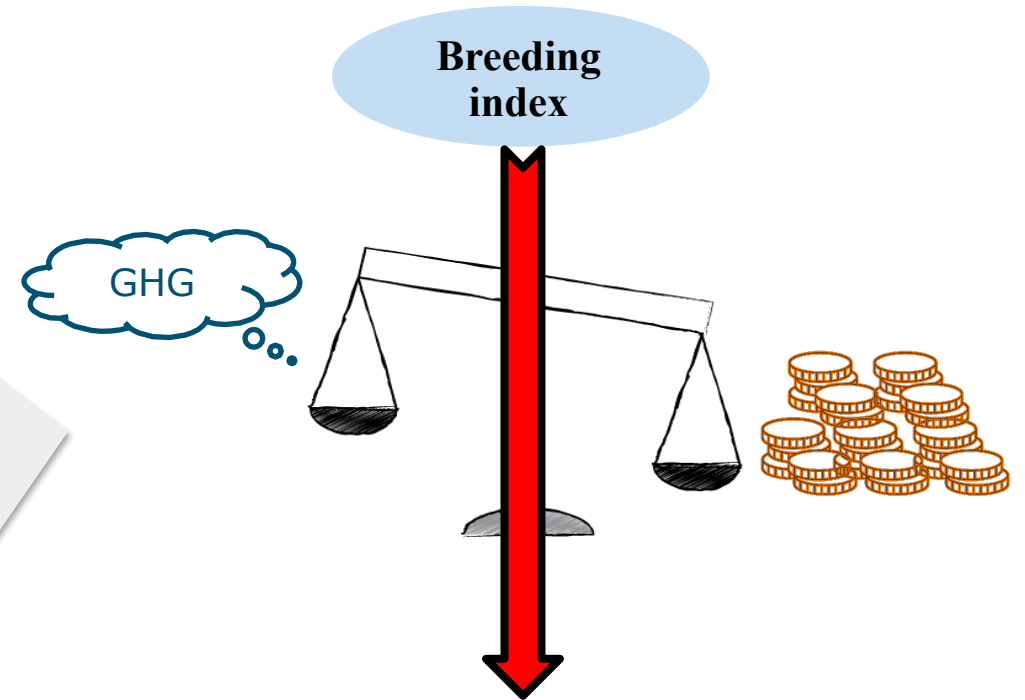
Limited studies on **GHG emission values** of the traits (e.g., Middelhaar et al., 2014; Richardson et al., 2021) **and environmental consequences along the chain** of the breeding indices

Objectives

Assess GHG emissions along the chain from milk production

Determine how the change of genetic traits affect GHG emissions

Develop and compare different breeding indices based on economic or environmental values of traits

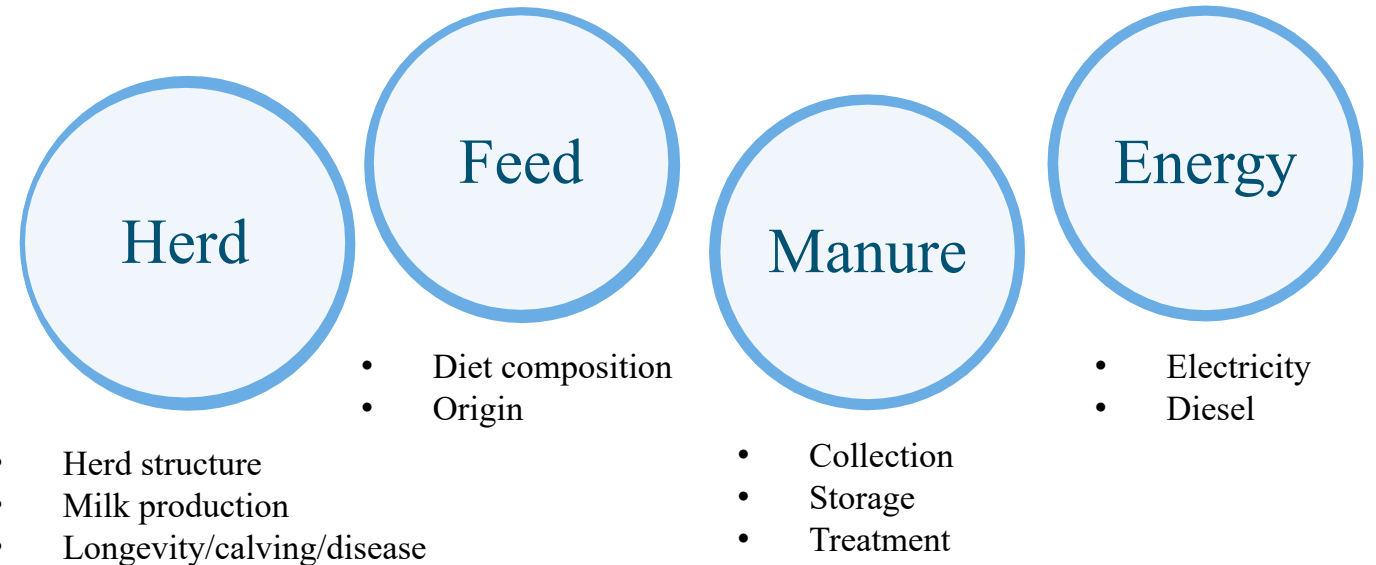


Balance economic and environmental consequences of breeding indices on dairy farming

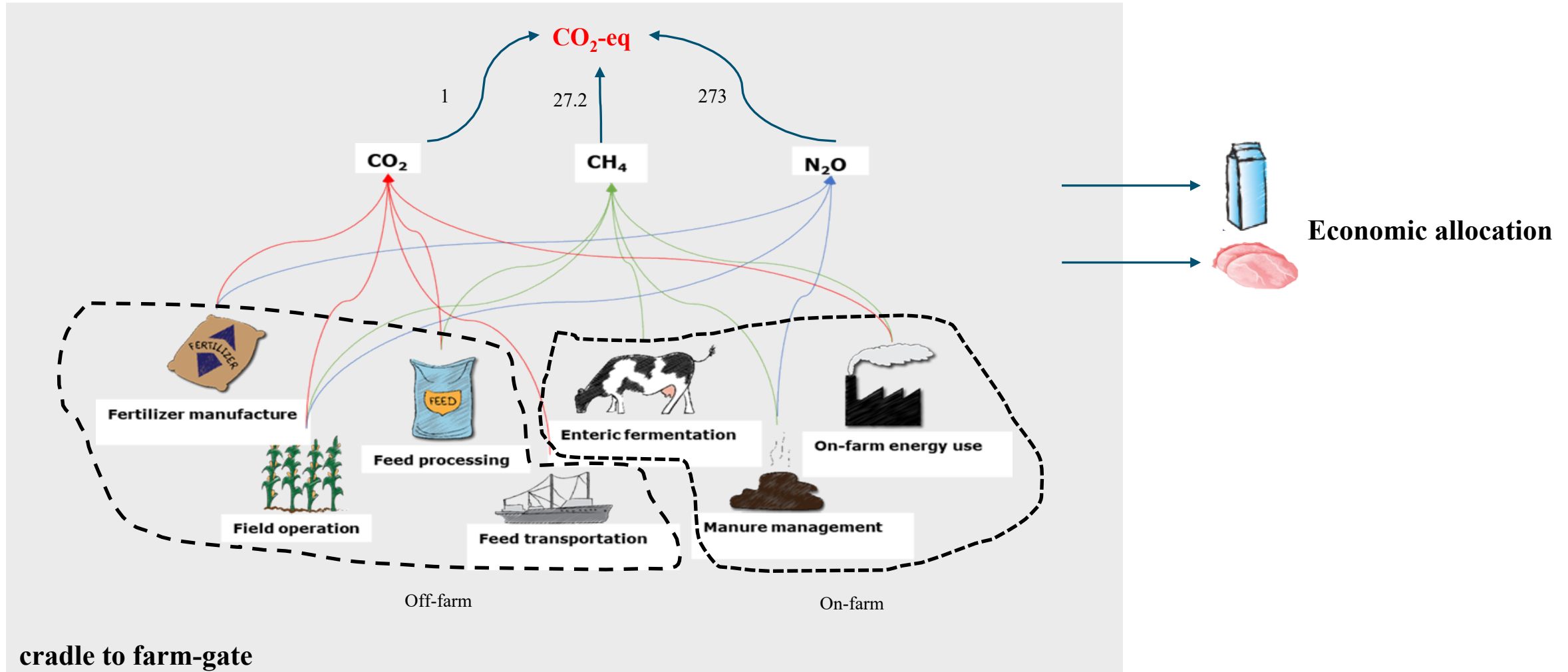
Case study – A typical Chinese dairy farm



- **Beijing, North China**
- **Commercial and landless system**
 - 1500 Holstein-Friesian dairy cows
 - 1400 young stocks
- **Year 2020**

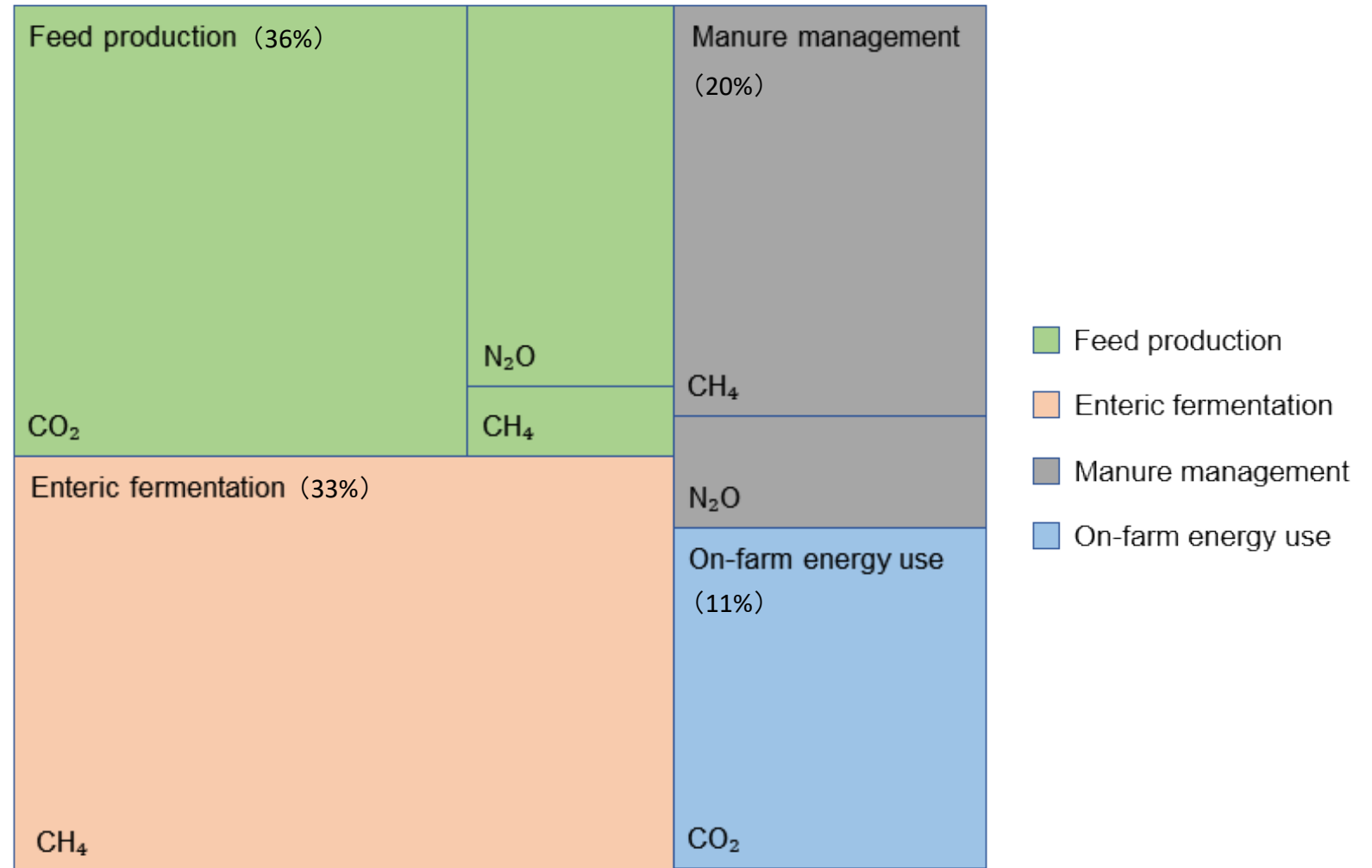


Life cycle assessment of the dairy farm



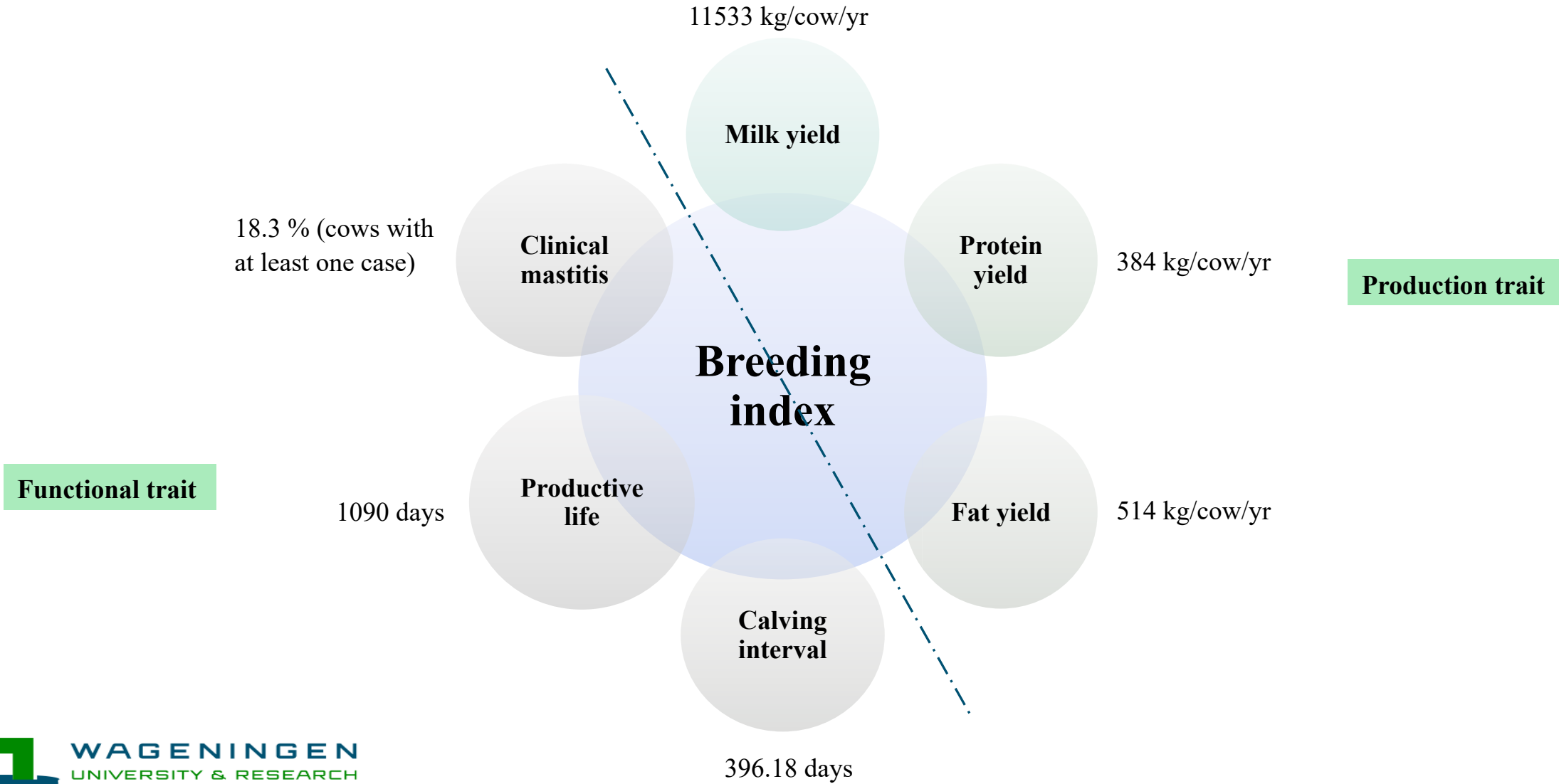
GHG emissions intensity from dairy production chain

1138 kg CO₂-eq per ton of FPCM

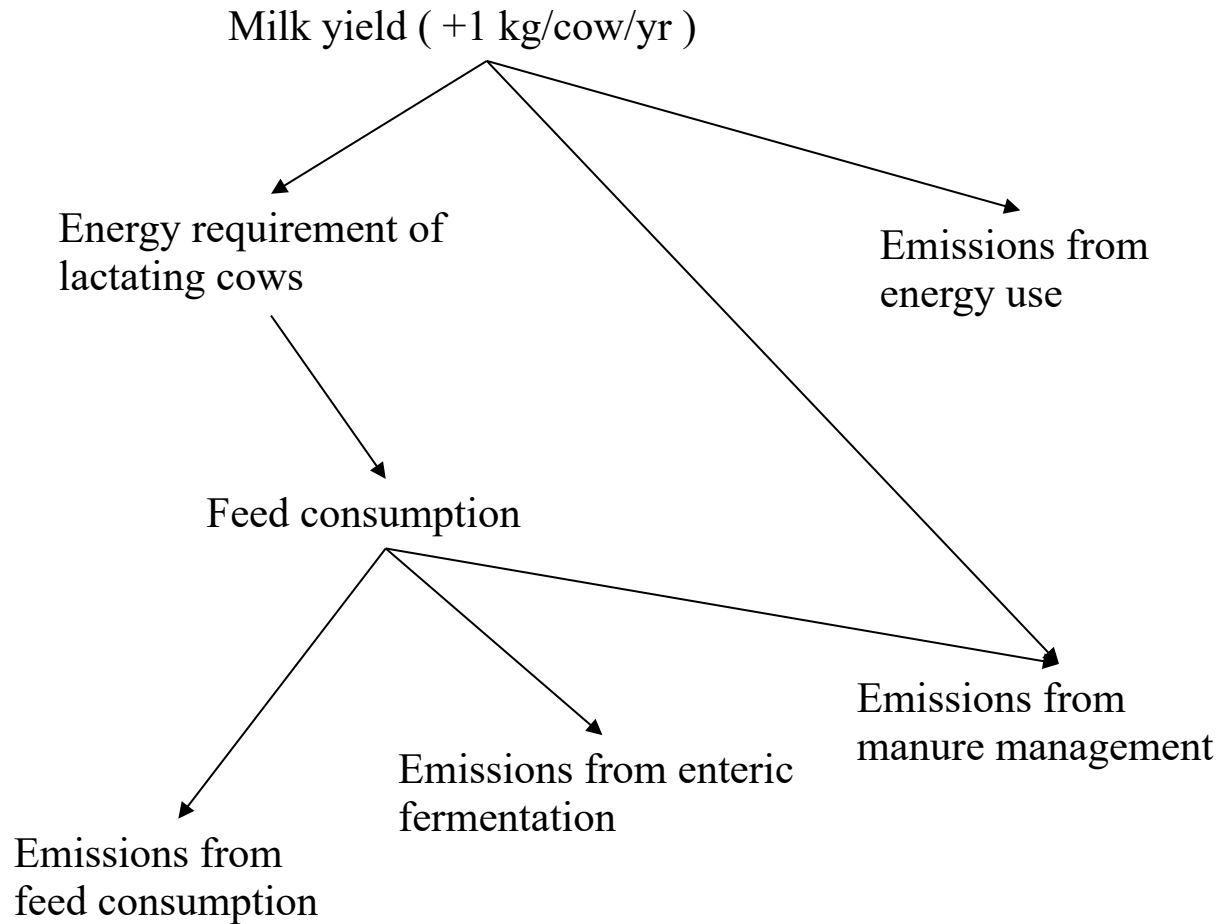


GHG intensity values of genetic traits

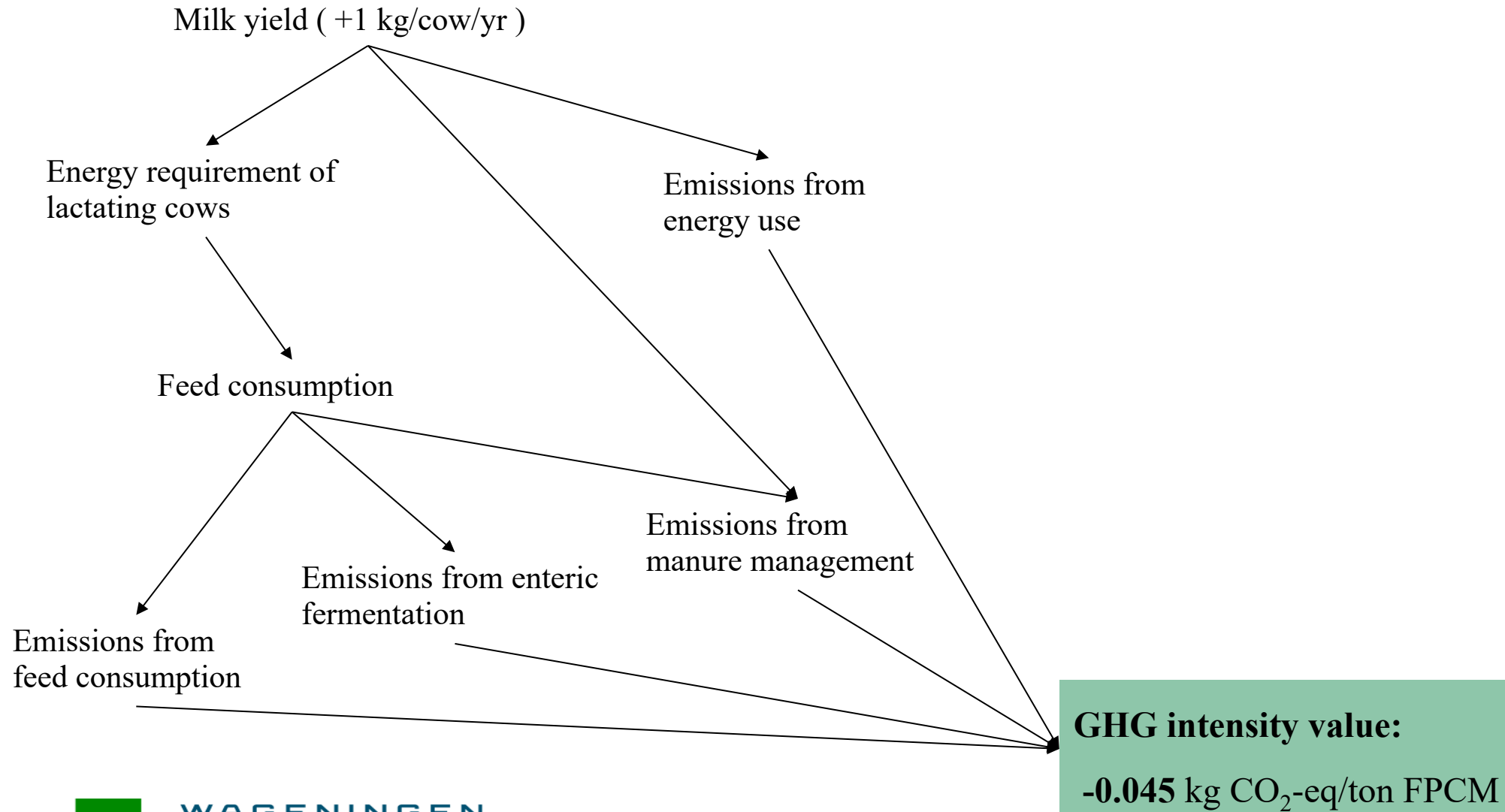
i.e., marginal change of GHG emission per ton of FPCM from a 1-unit change in the trait



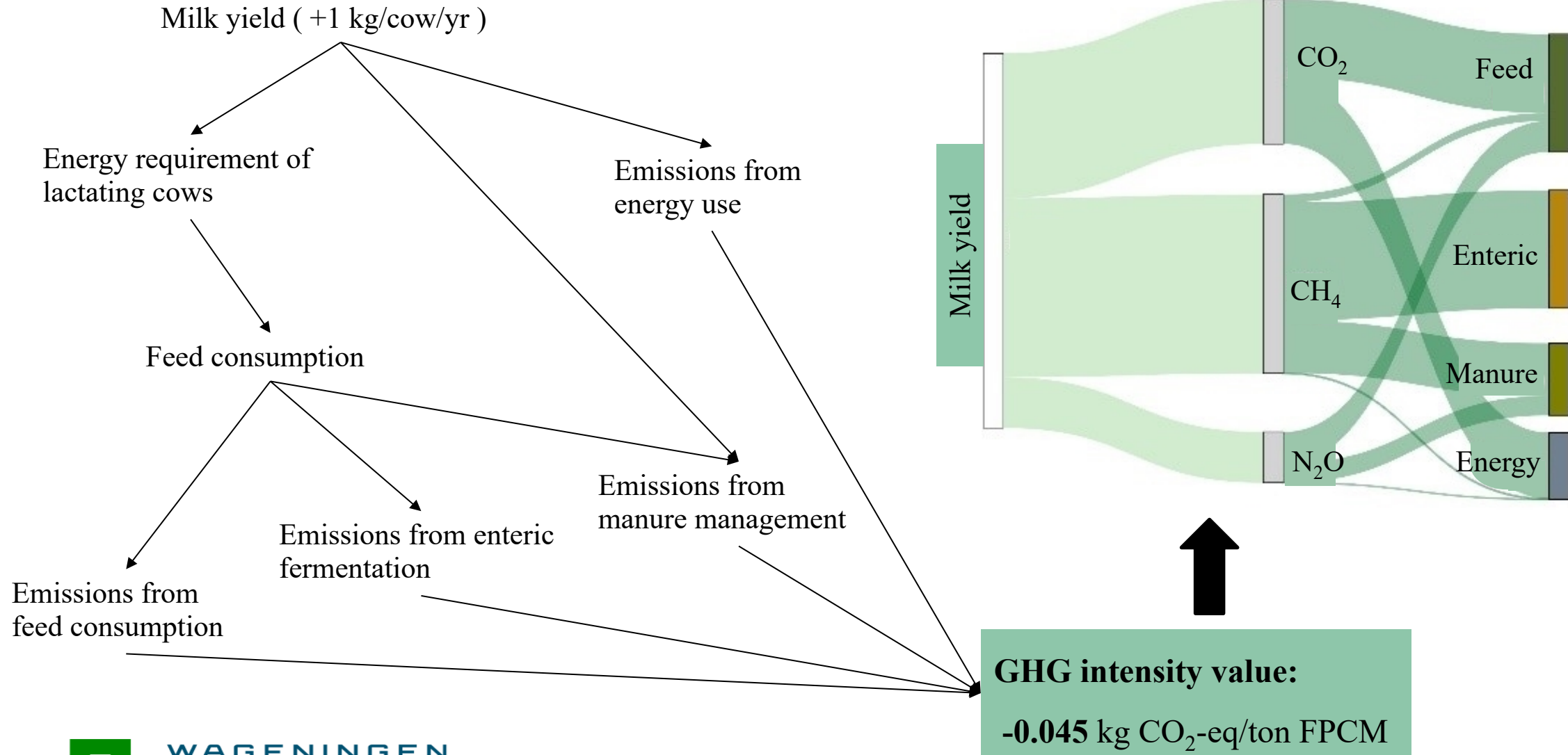
GHG intensity values of milk yield (example)



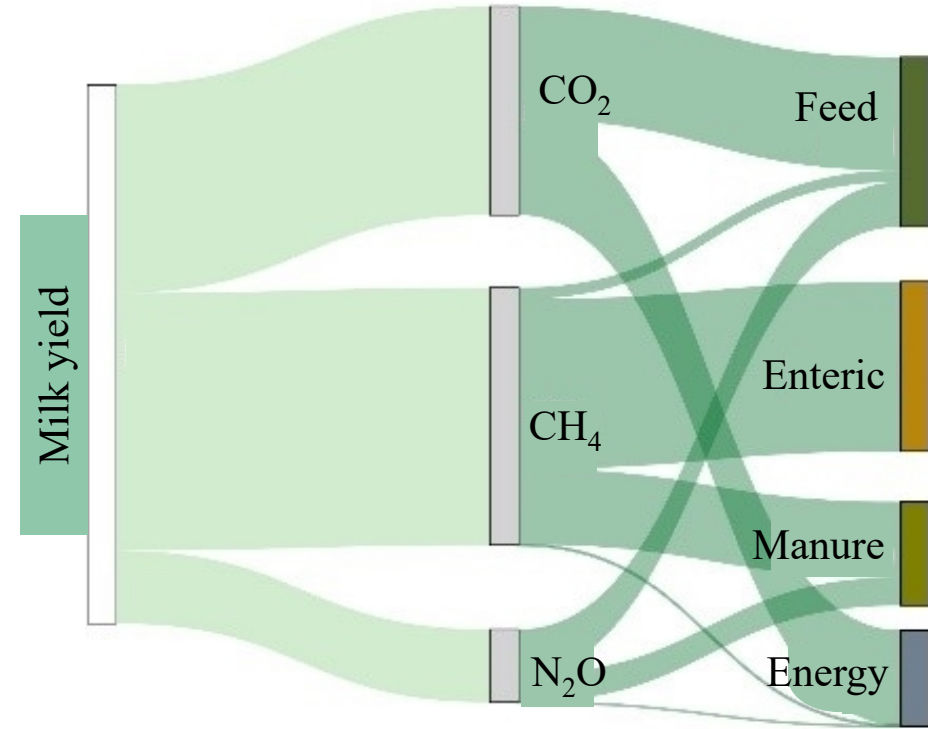
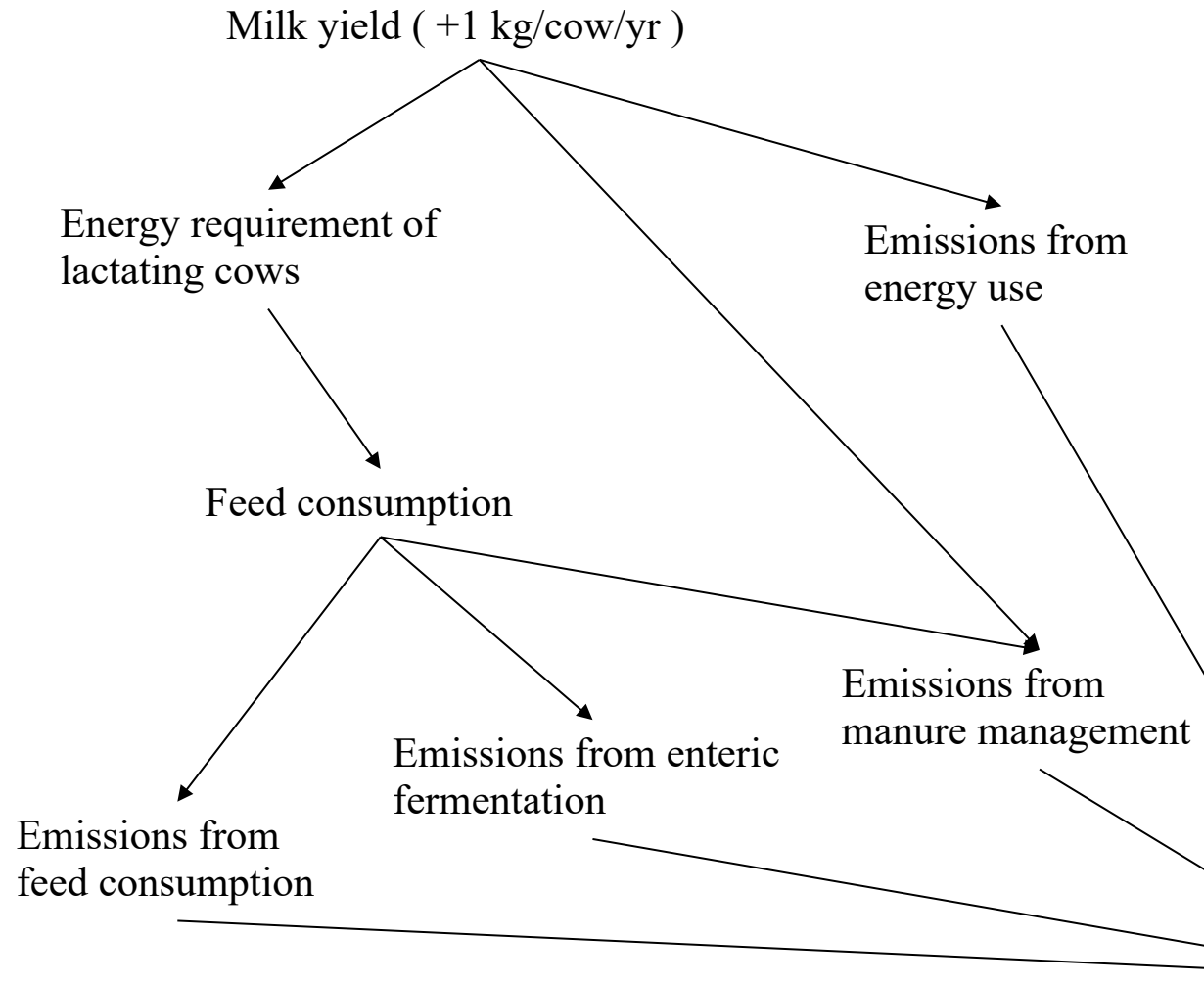
GHG intensity values of milk yield (example)



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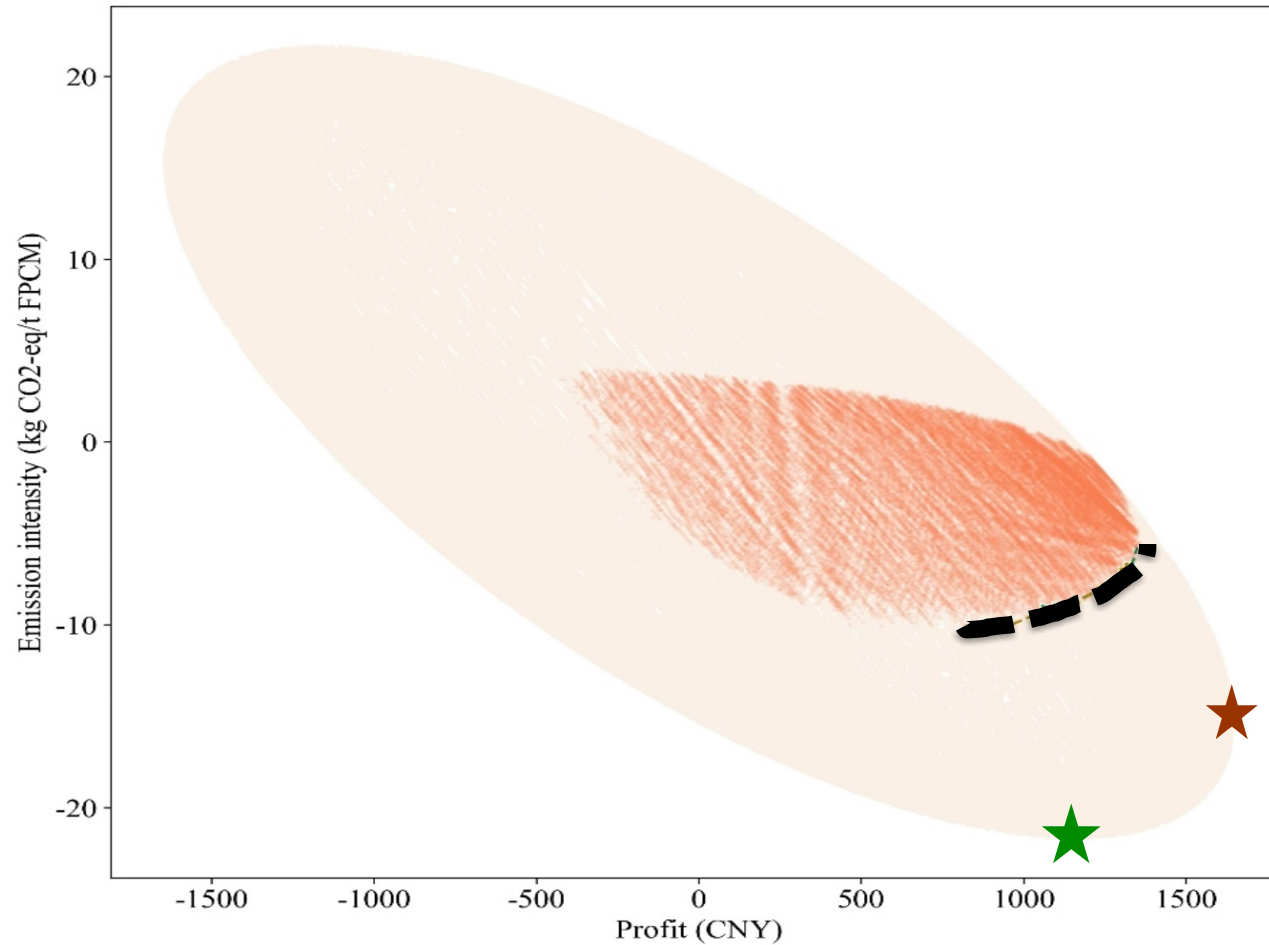
GHG intensity value:

-0.045 kg CO₂-eq/ton FPCM

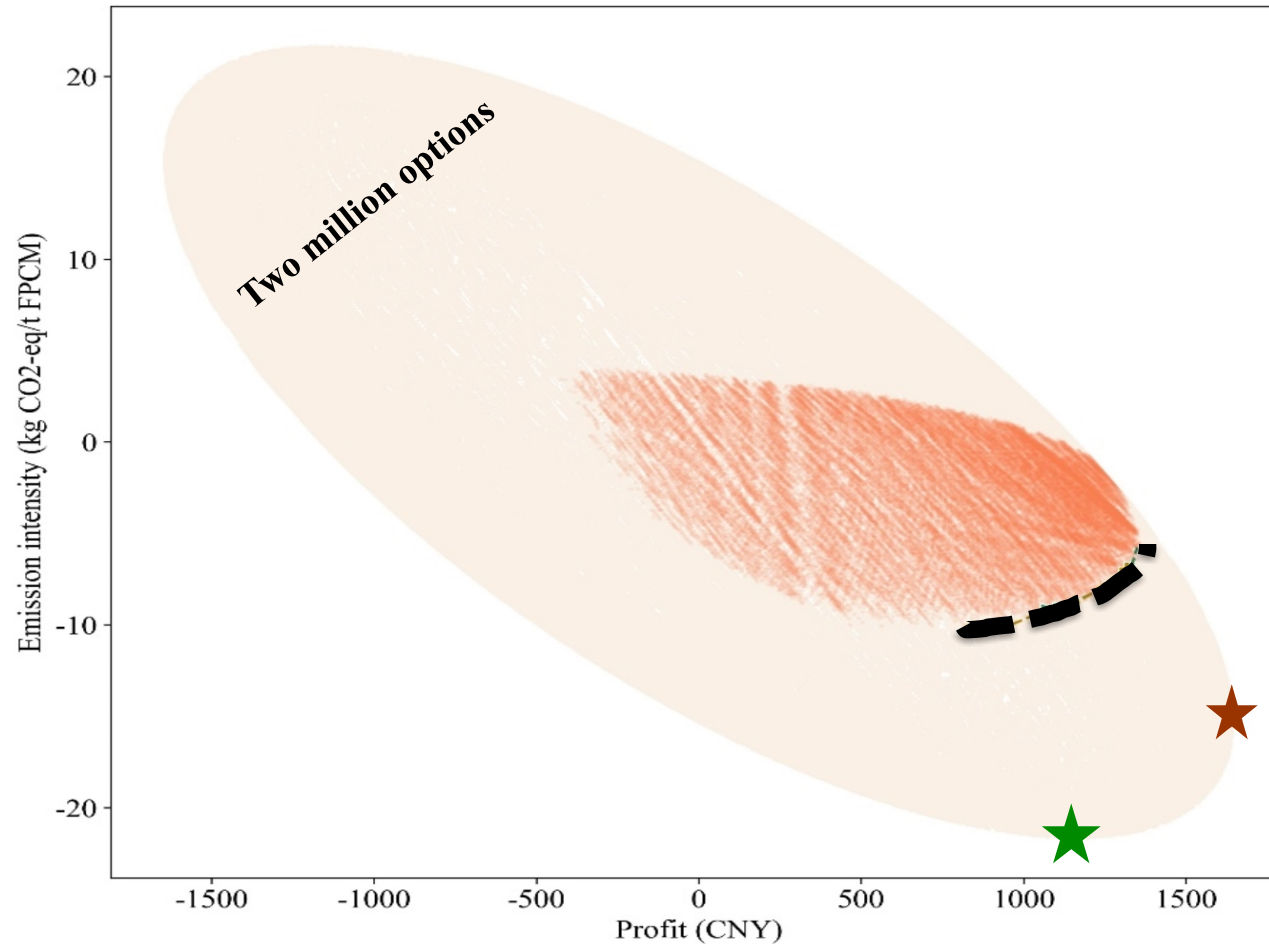
Economic value:

2.39 CNY per cow

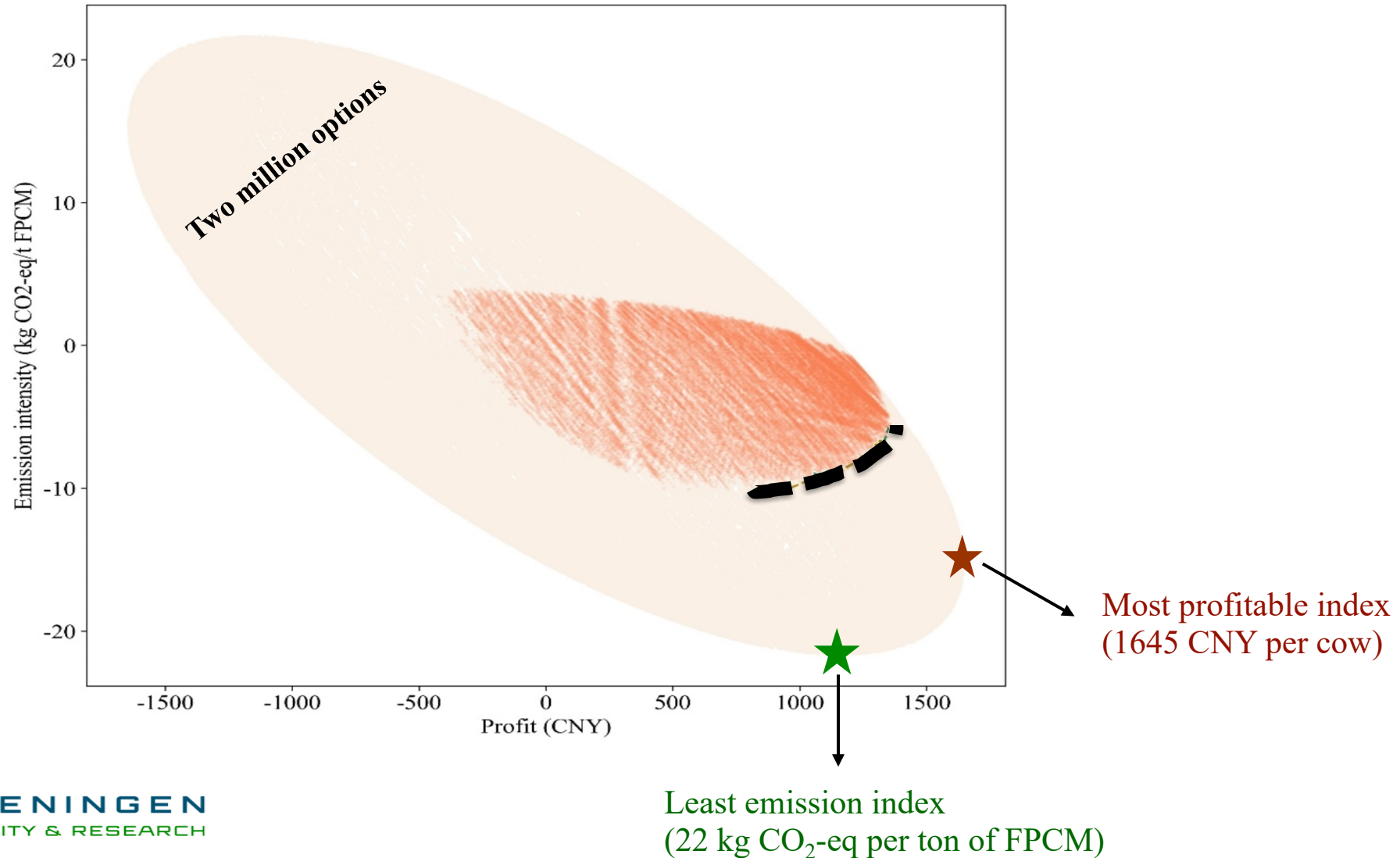
Economic and environmental consequences of different breeding indices



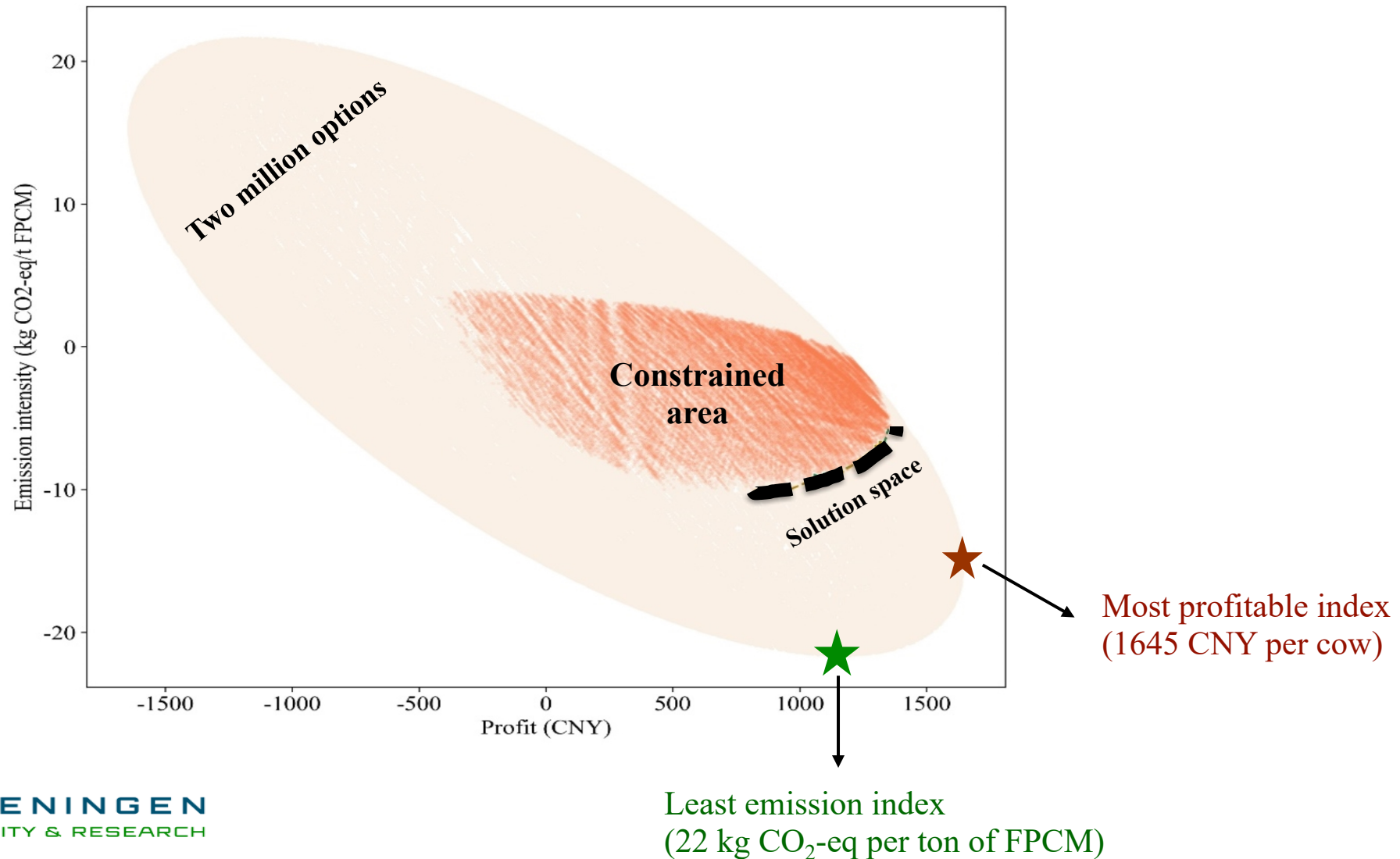
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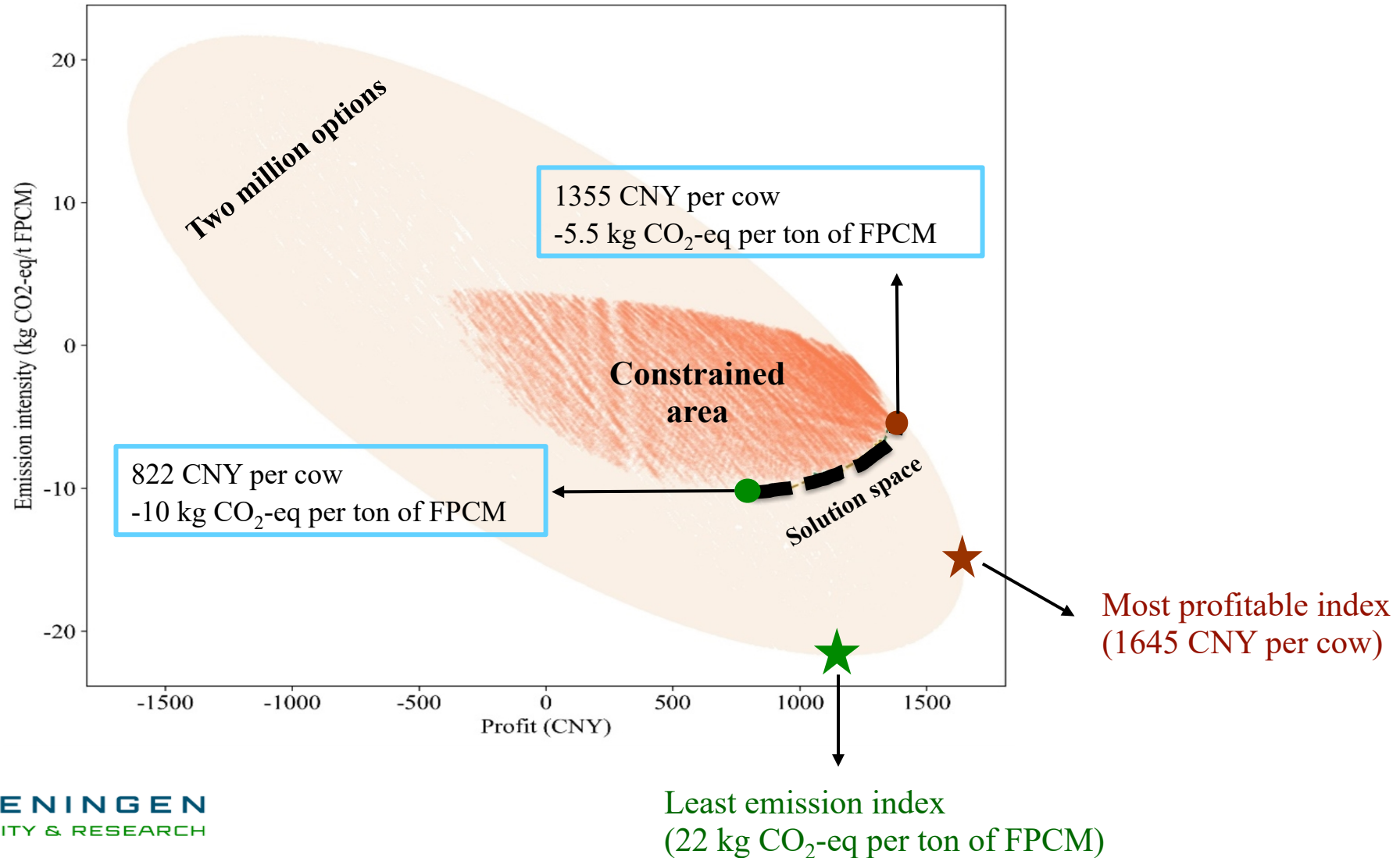
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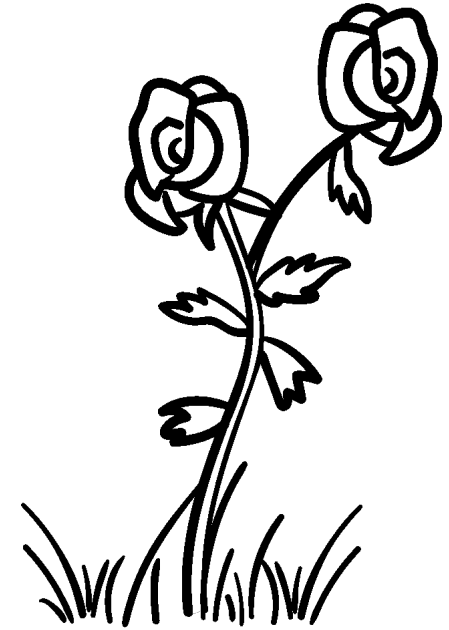


Summary

- **Methodologically**, the study provides novel insights into how to determine the GHG intensity values for different genetic traits (looking beyond enteric CH₄ emissions) and incorporate them into breeding indices
- **In practice**, the optional indices provide options for Chinese dairy farms to balance GHG intensity and economic benefits to different extents.
- The concept could be potentially applied to **other contexts** (e.g., regions, farming systems) as well as **different environmental indicators** (e.g., nutrient use, food-feed competition).

Thanks for your attention

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