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PARIS-SACLAY

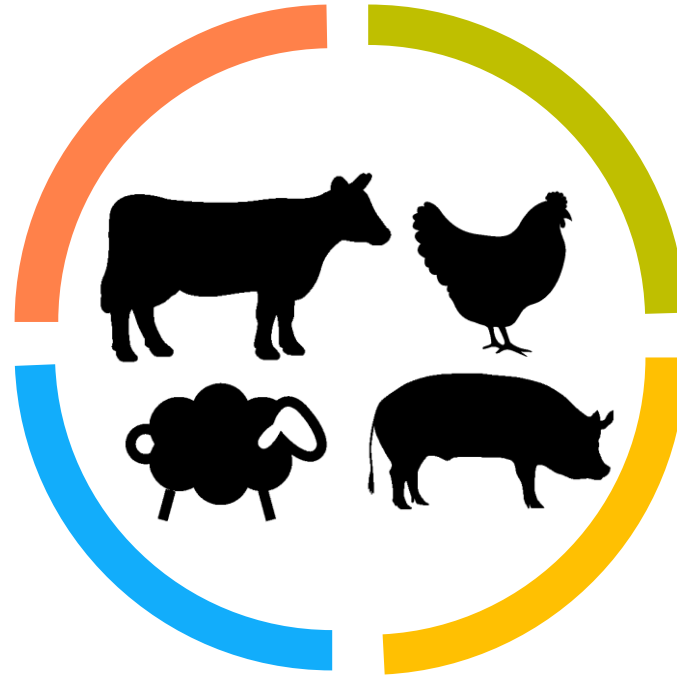
INRAE

Territorial-scale trade-offs of livestock performance: cattle diet composition perspective

Wang, R.¹, Accatino, F. ¹, Pinsard, C. ¹, Puillet, L. ², Lescoat, P. ¹

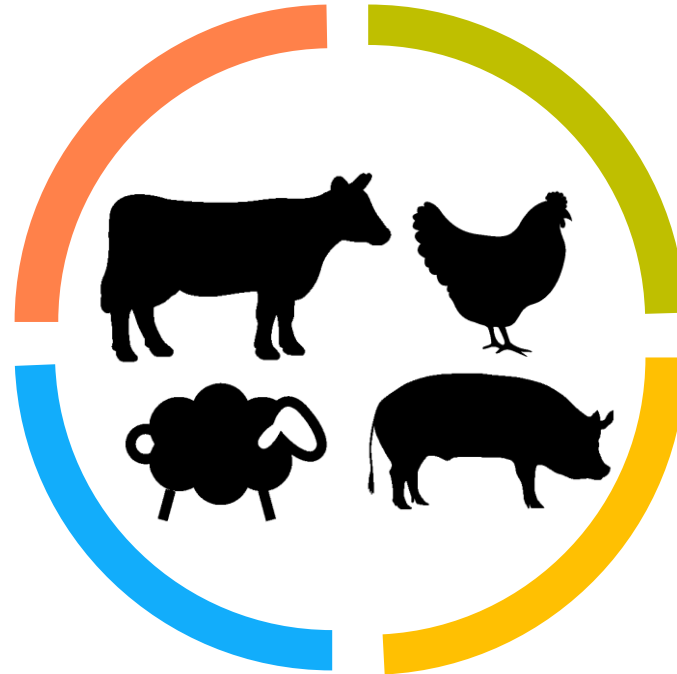
1. Paris-Saclay University, INRAE, UMR SADAPT
2. Paris-Saclay University, INRAE, UMR MoSAR

Introduction



Meat provider

Land user

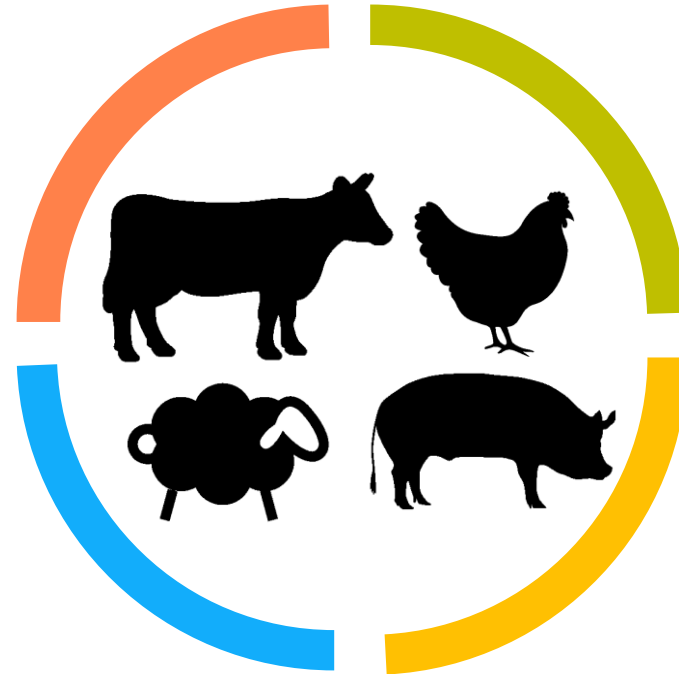
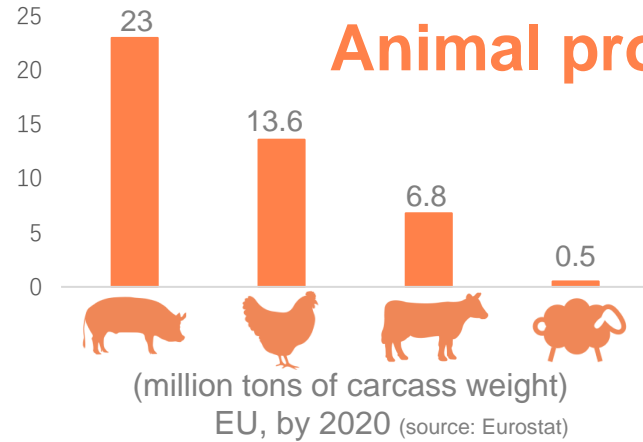


GHG contributor

Feed consumer

Meat provider

Land user

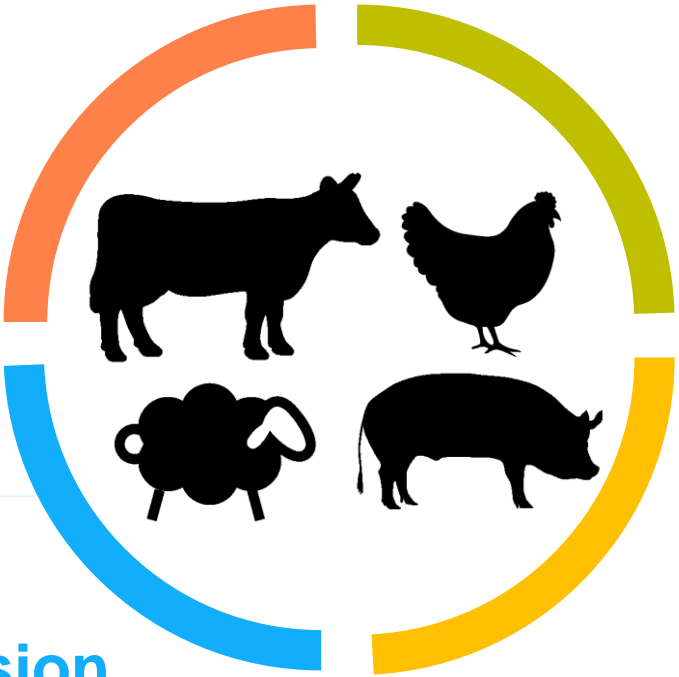
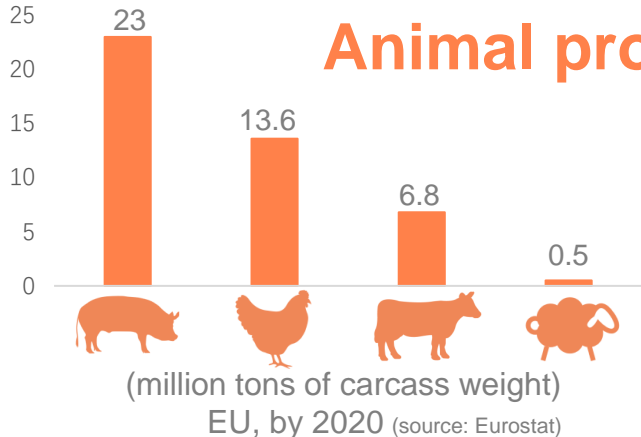


GHG contributor

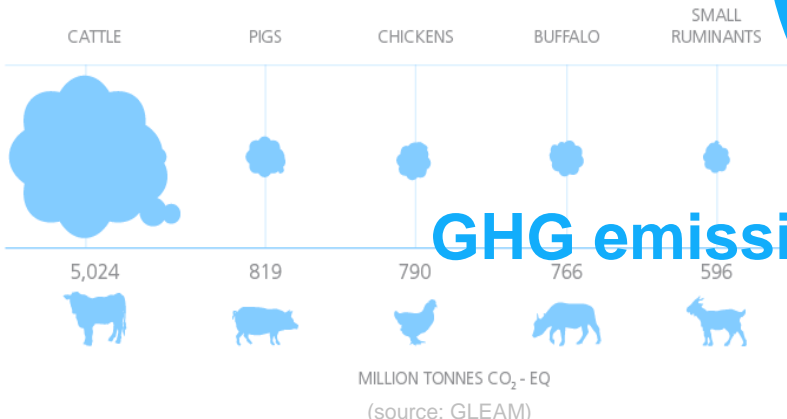
Feed consumer

Land user

Animal production



GHG emission

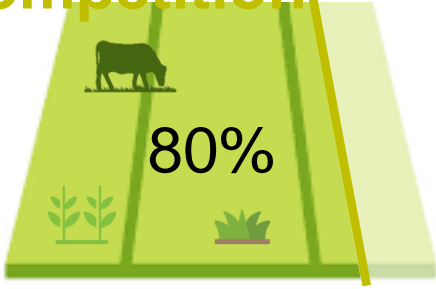


GHG contributor

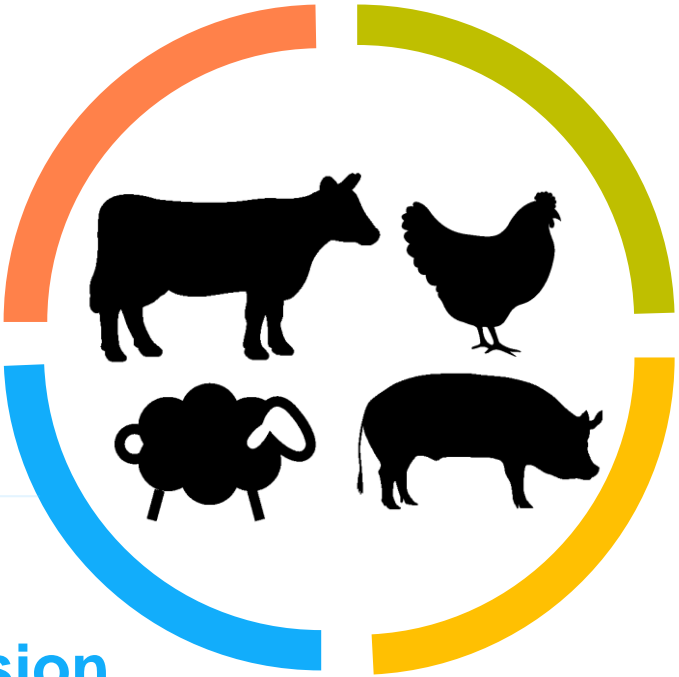
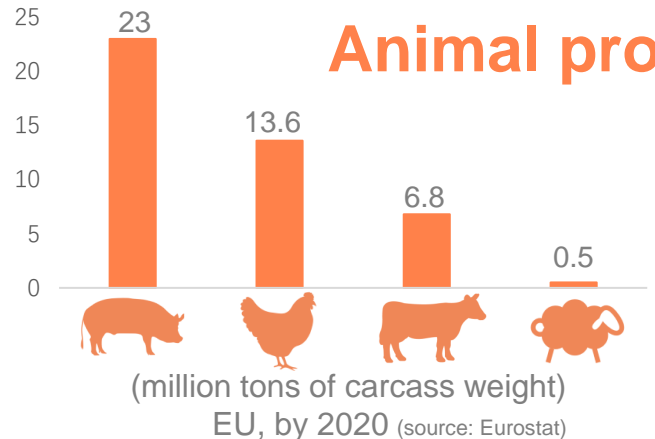
Feed consumer

Land user

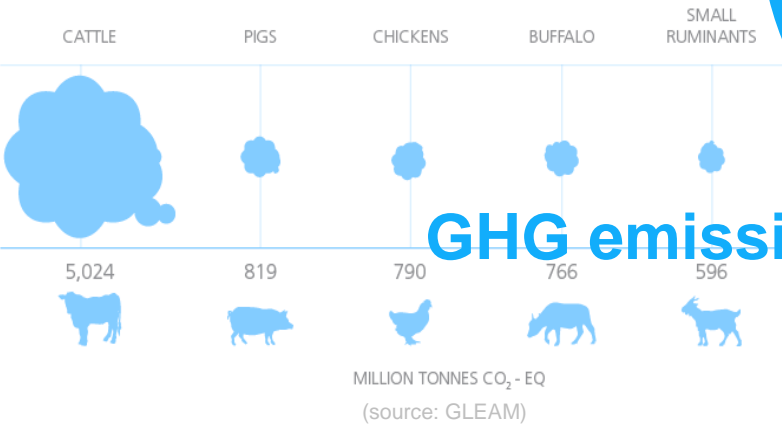
Feed-food competition



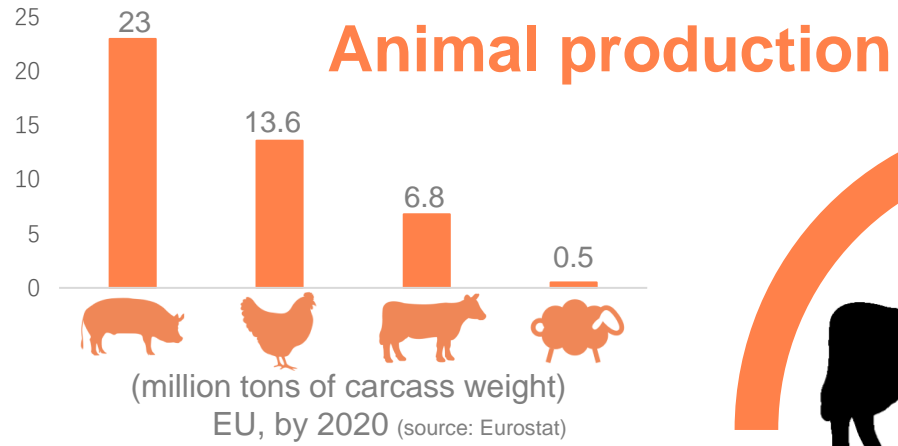
Animal production



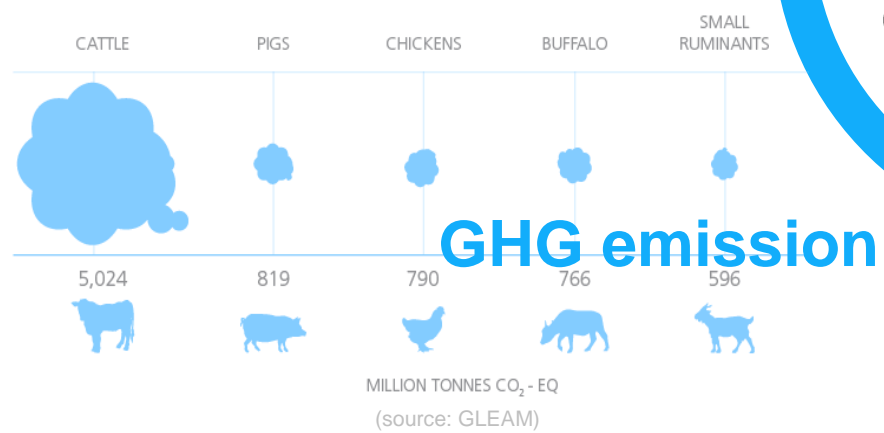
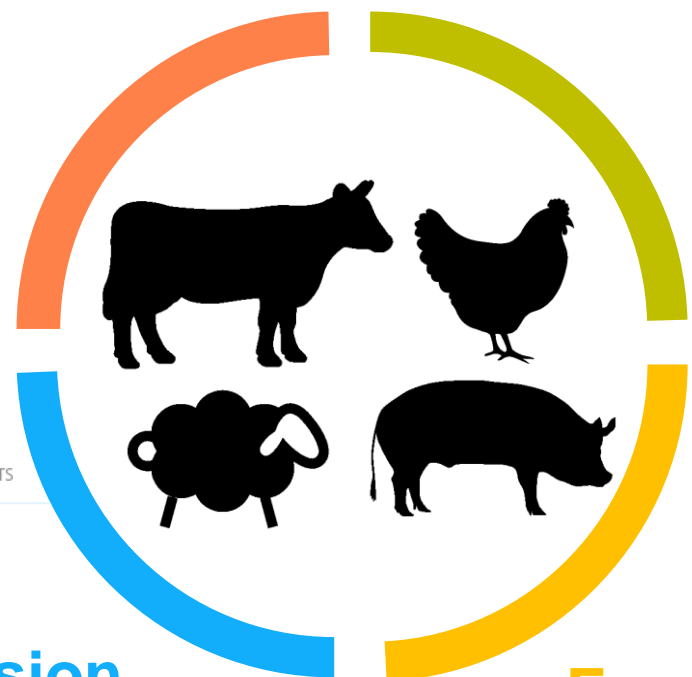
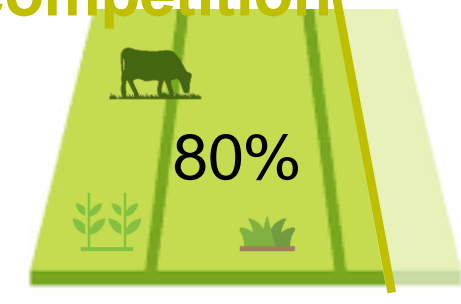
GHG emission



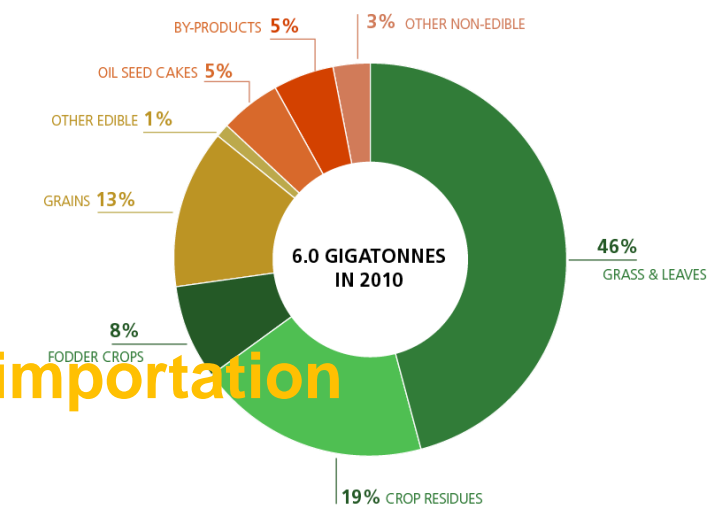
Feed consumer



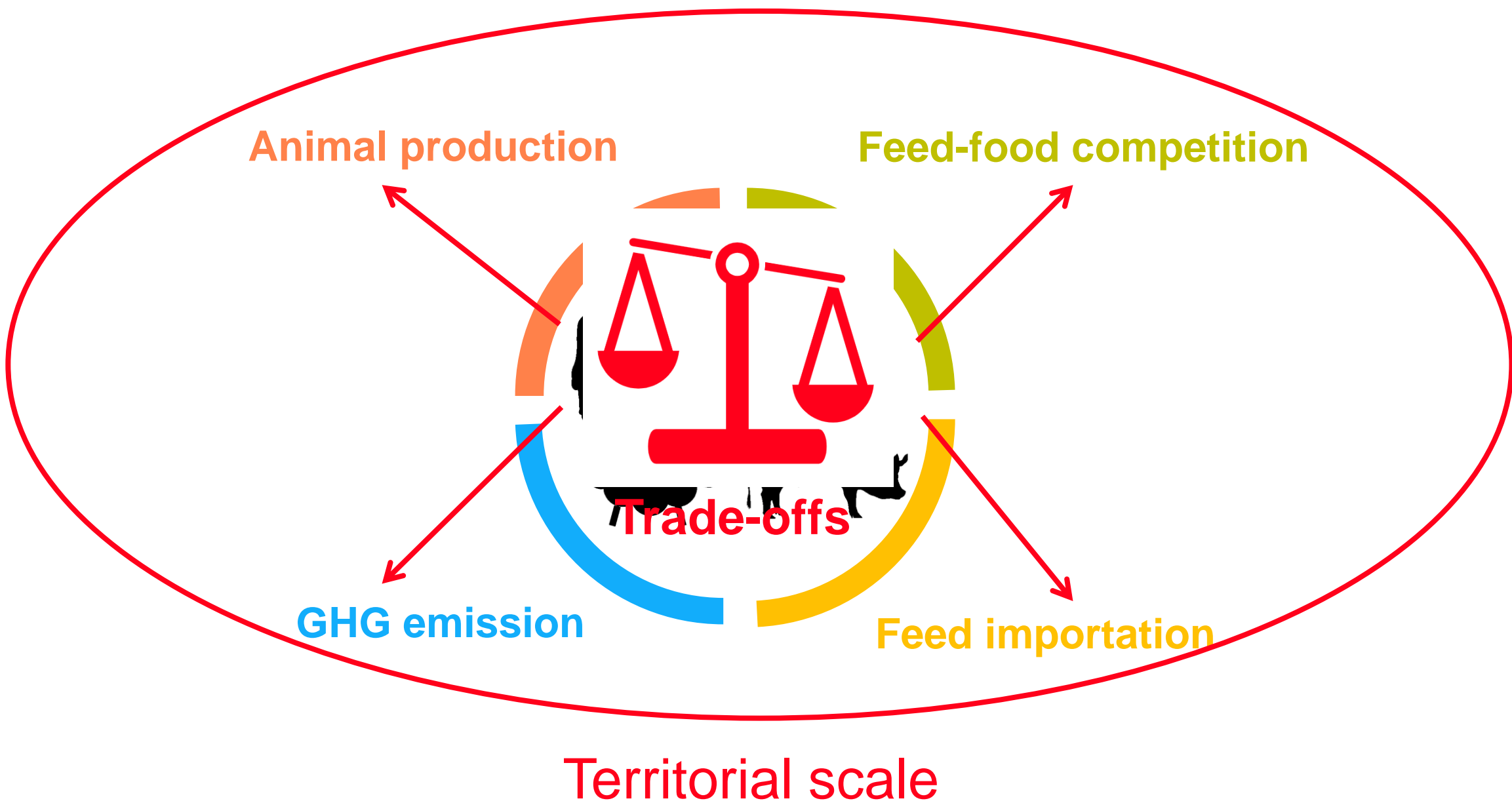
Feed-food competition

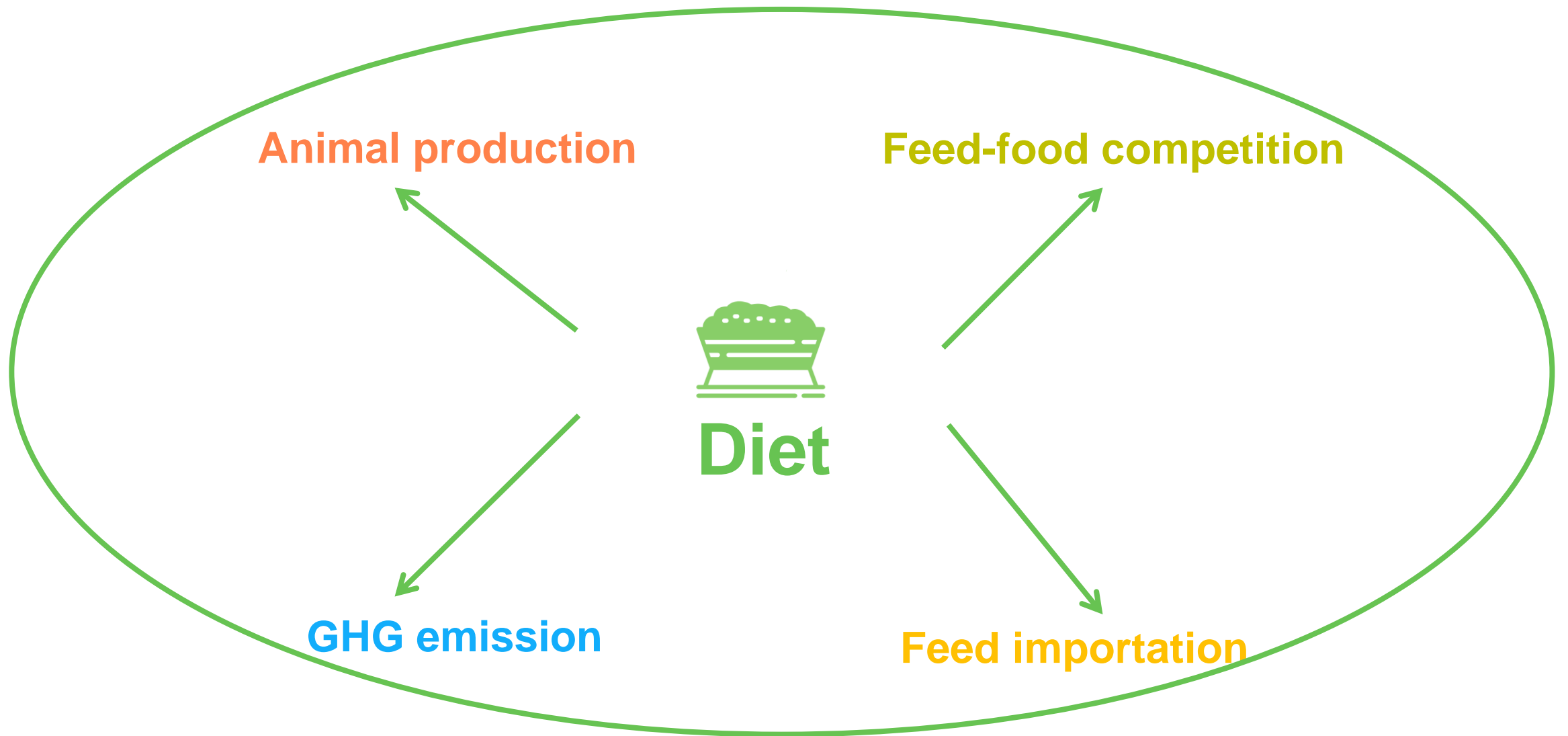


Feed importation



Feed consumer





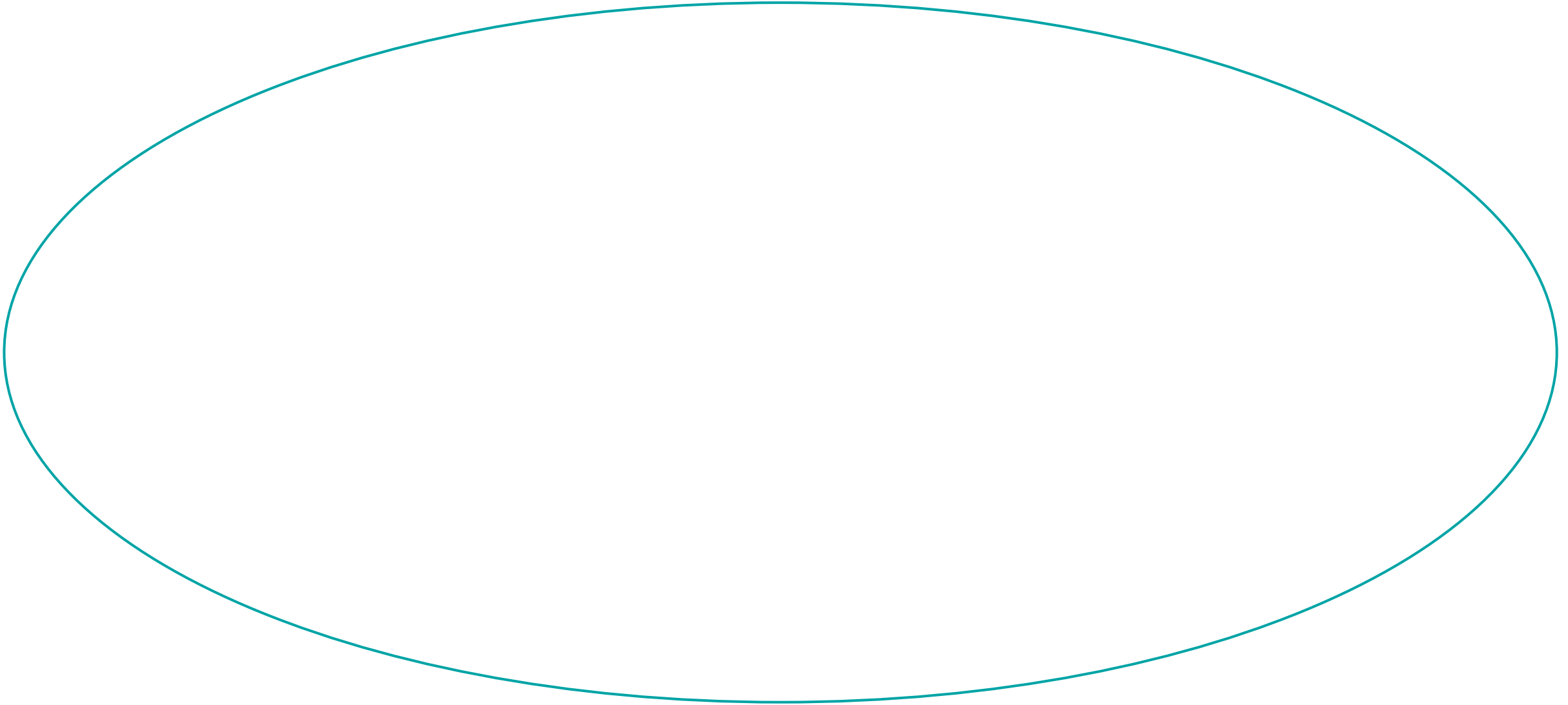
Diet as a lever to soften the trade-offs?

Modelling approach

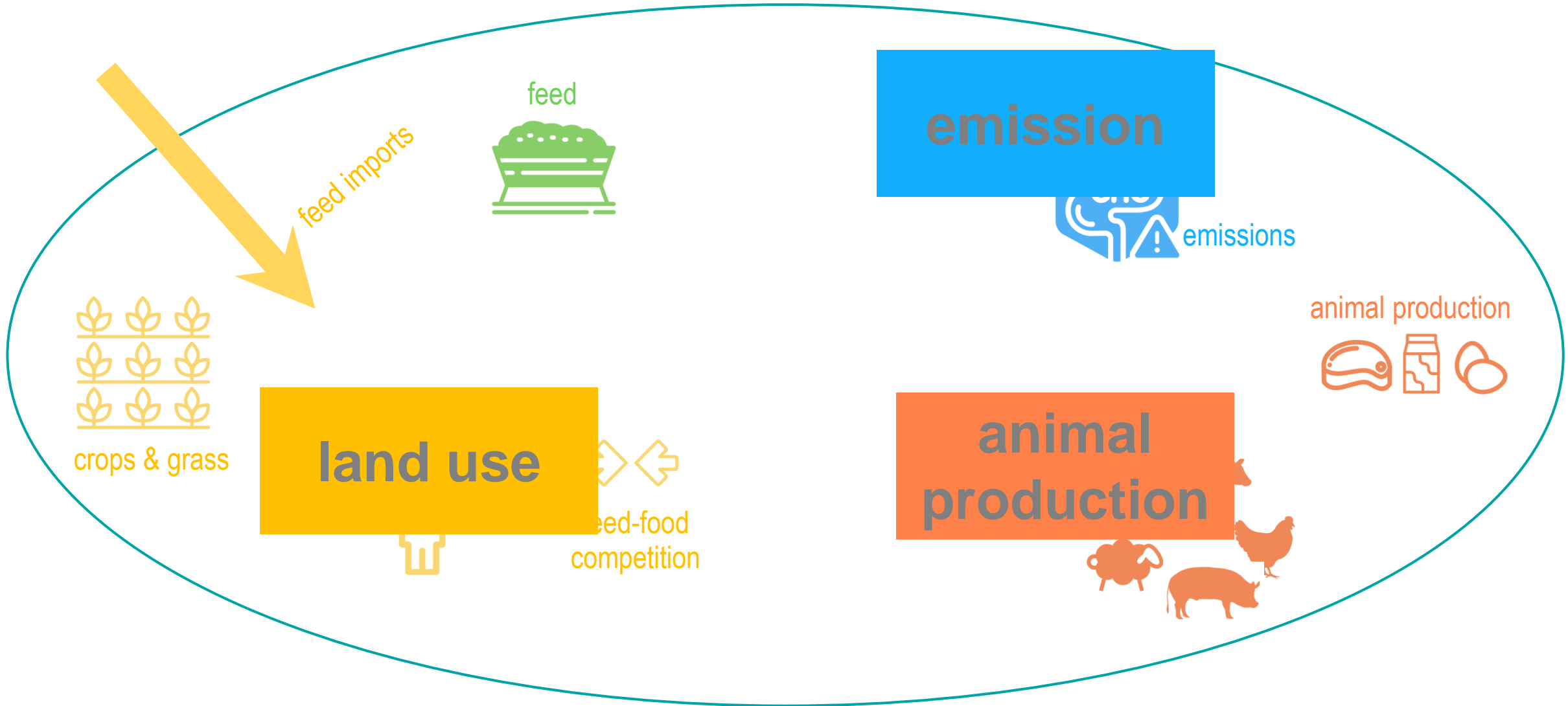
Modelling approach

scale: French SAR **region** (small agricultural region)

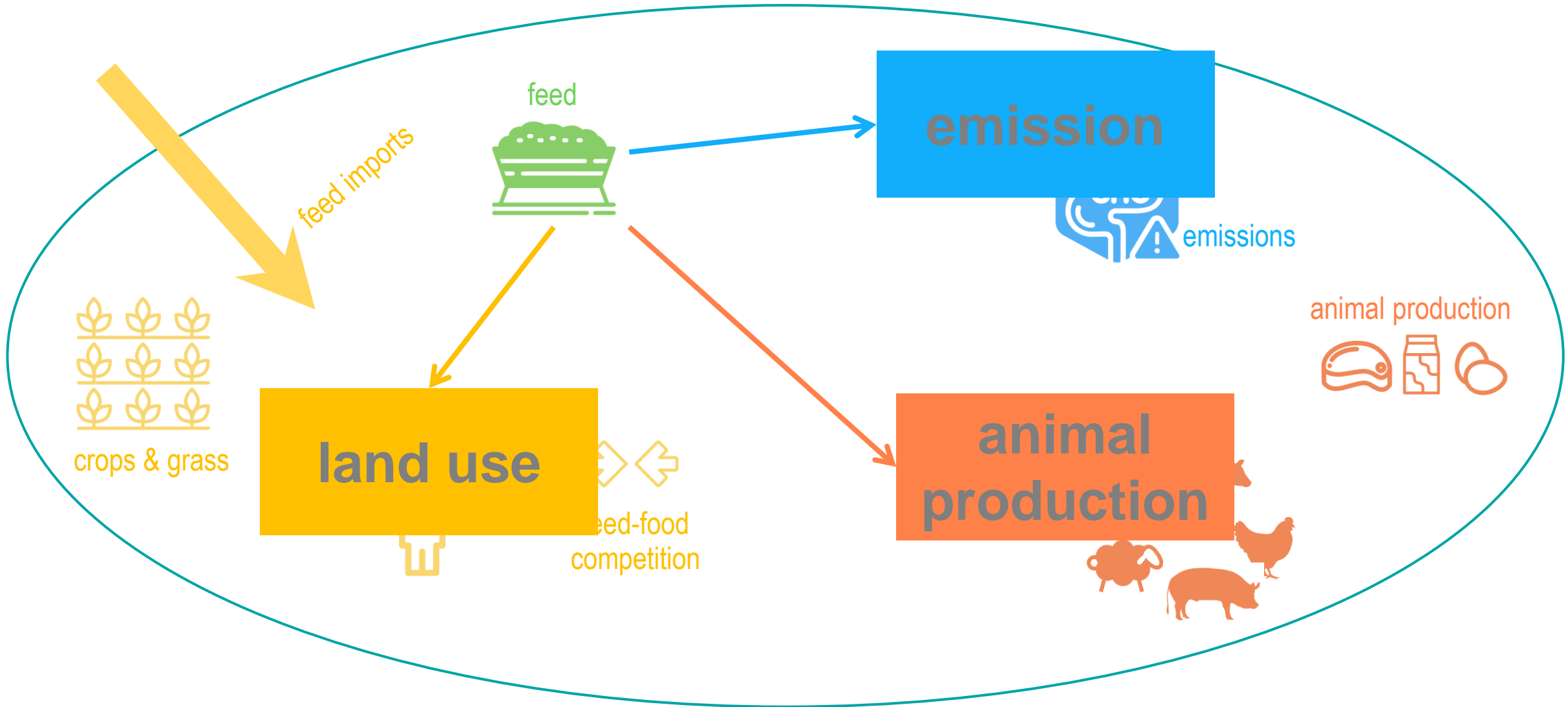
Modelling approach



Modelling approach



Modelling approach

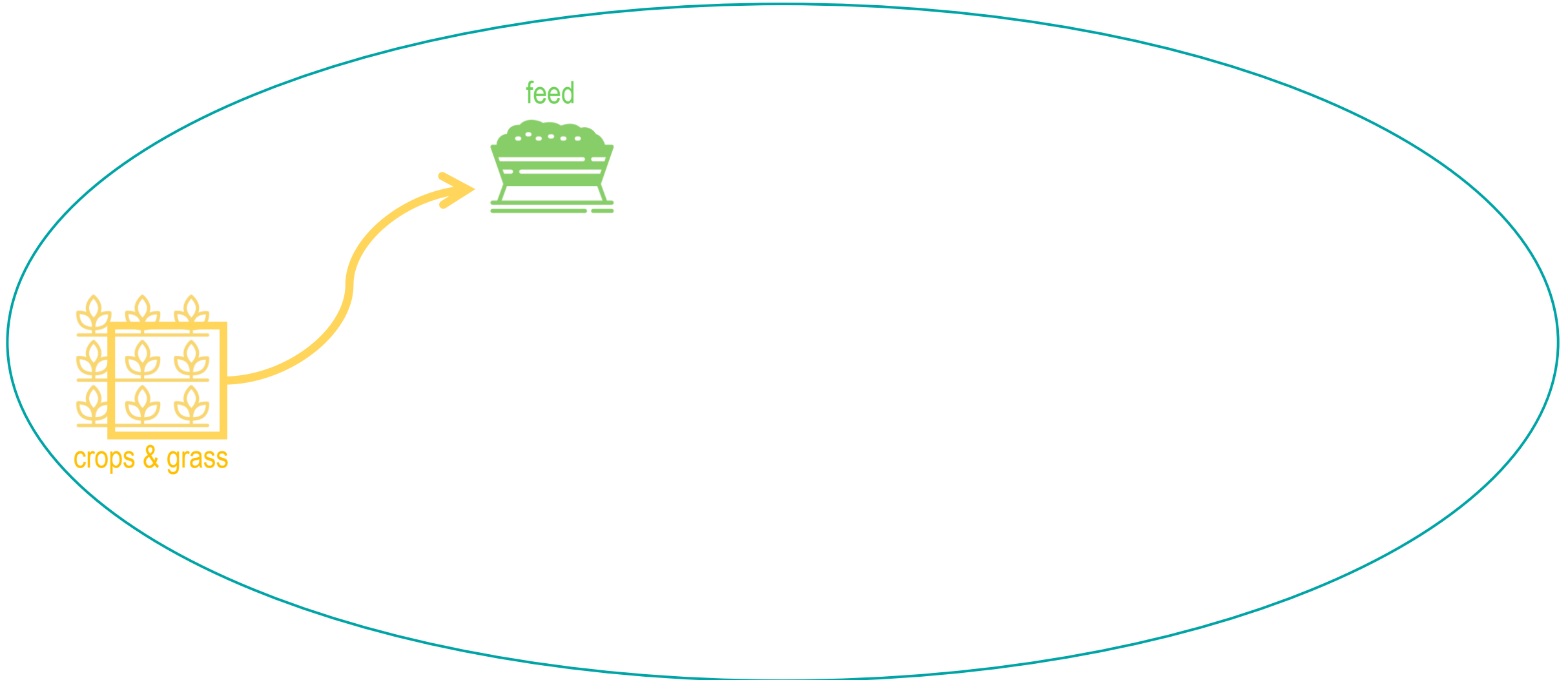


Schematic plan

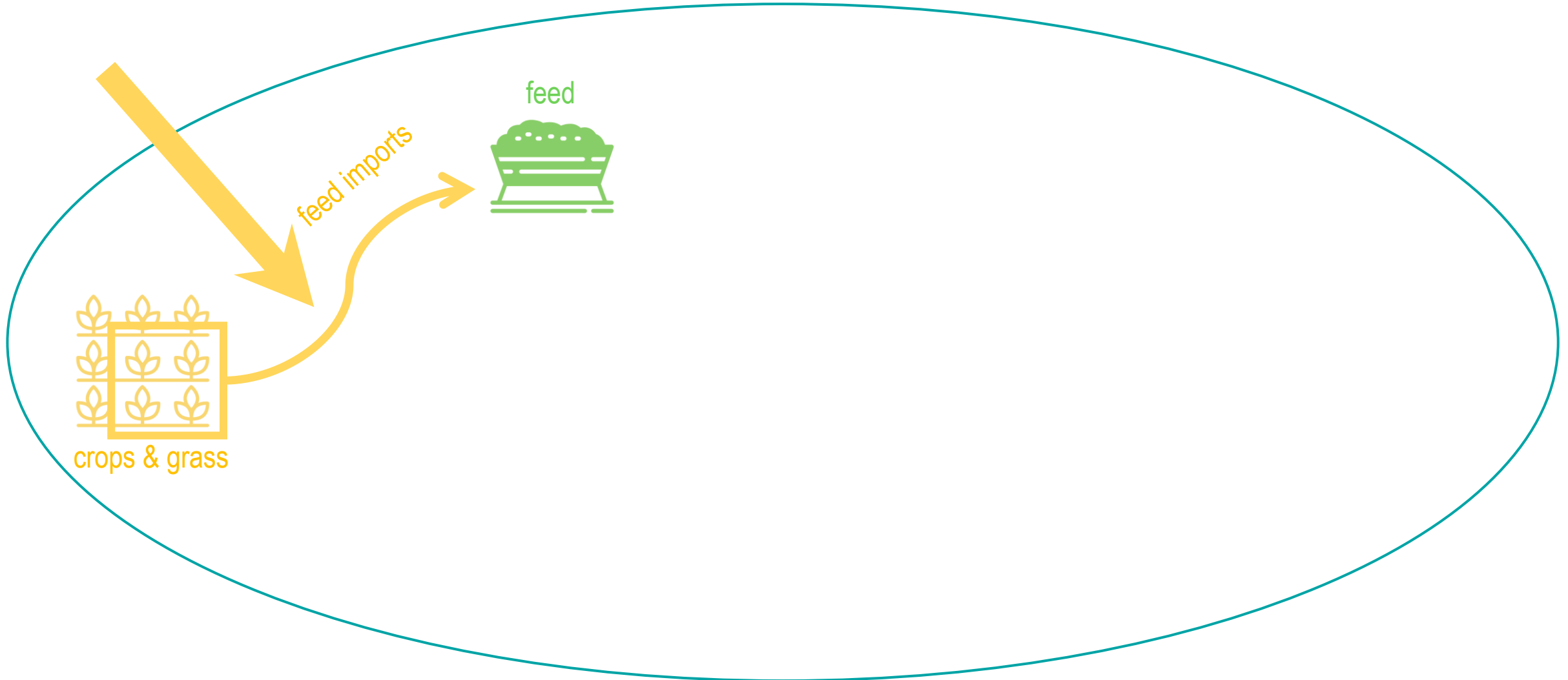
feed



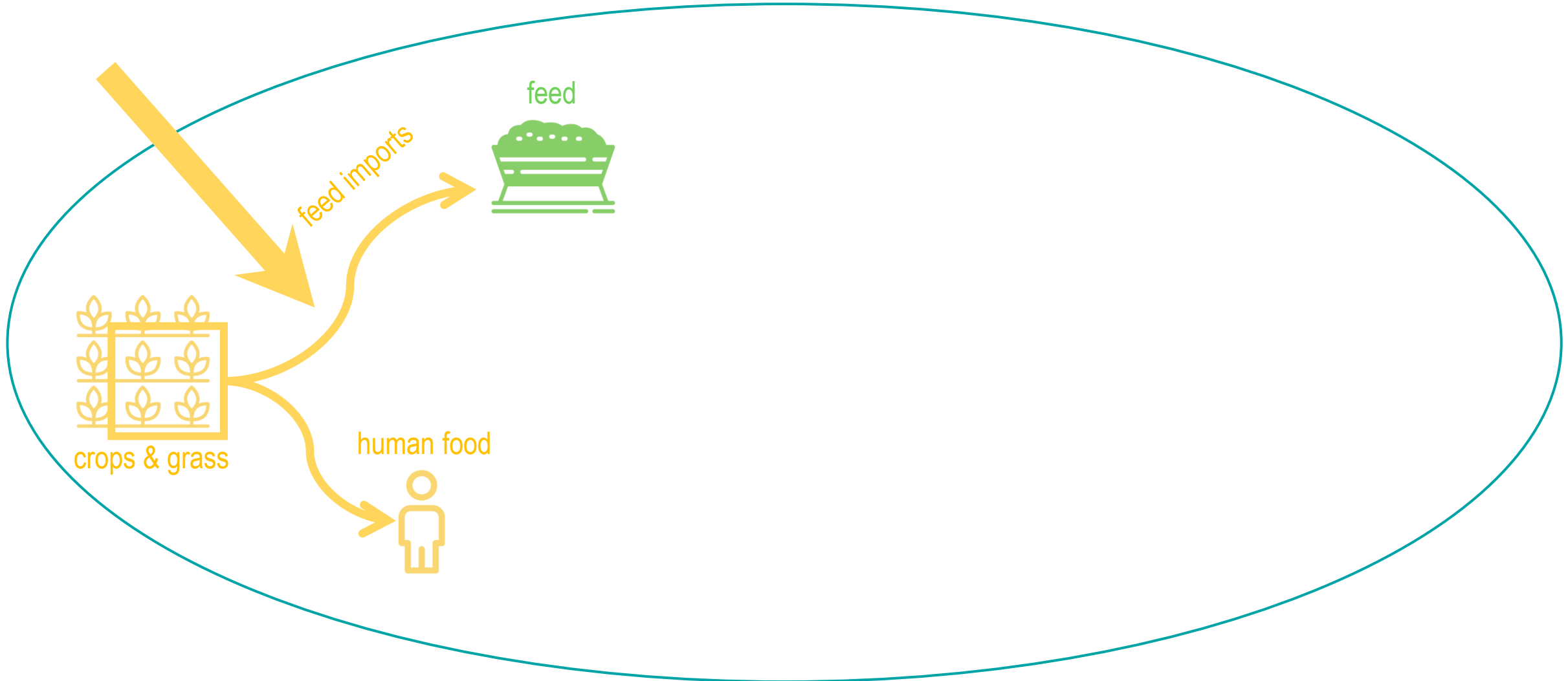
Schematic plan



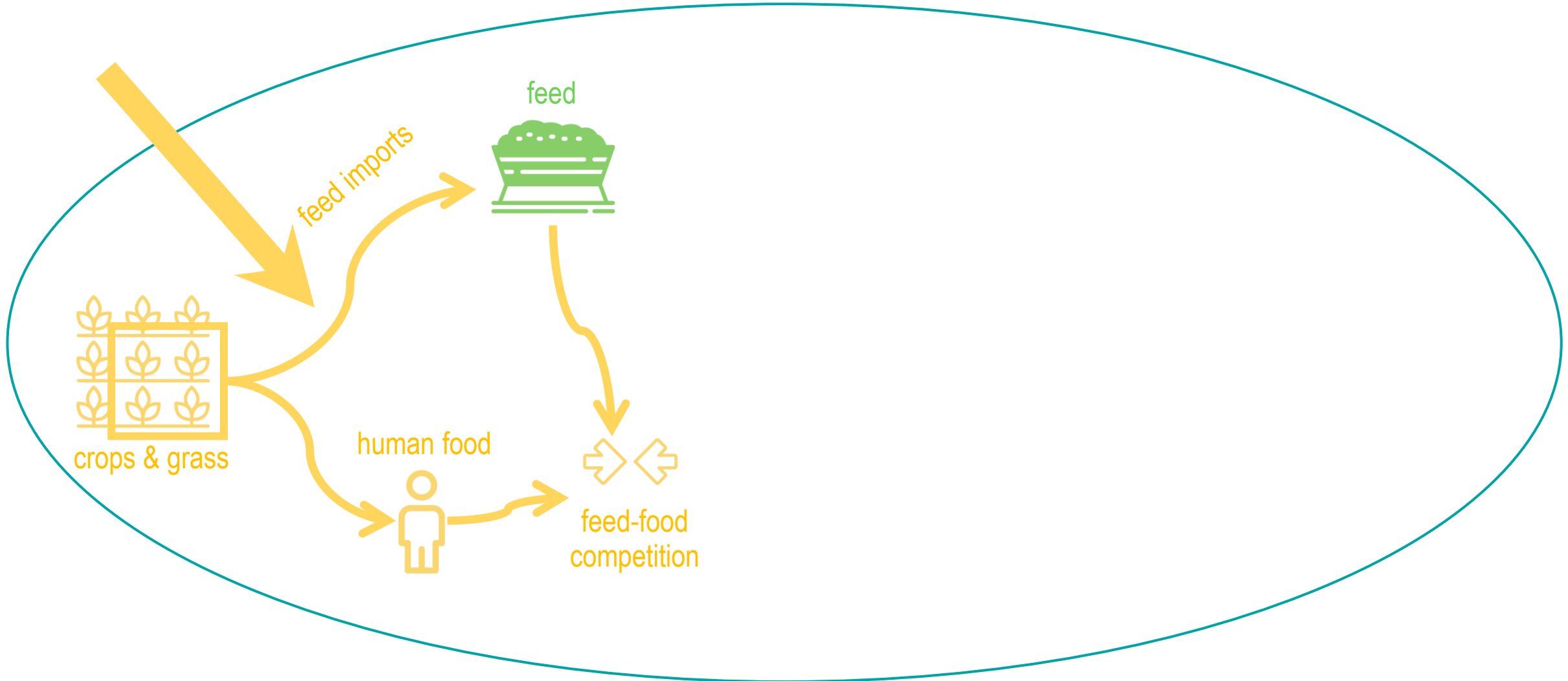
Schematic plan



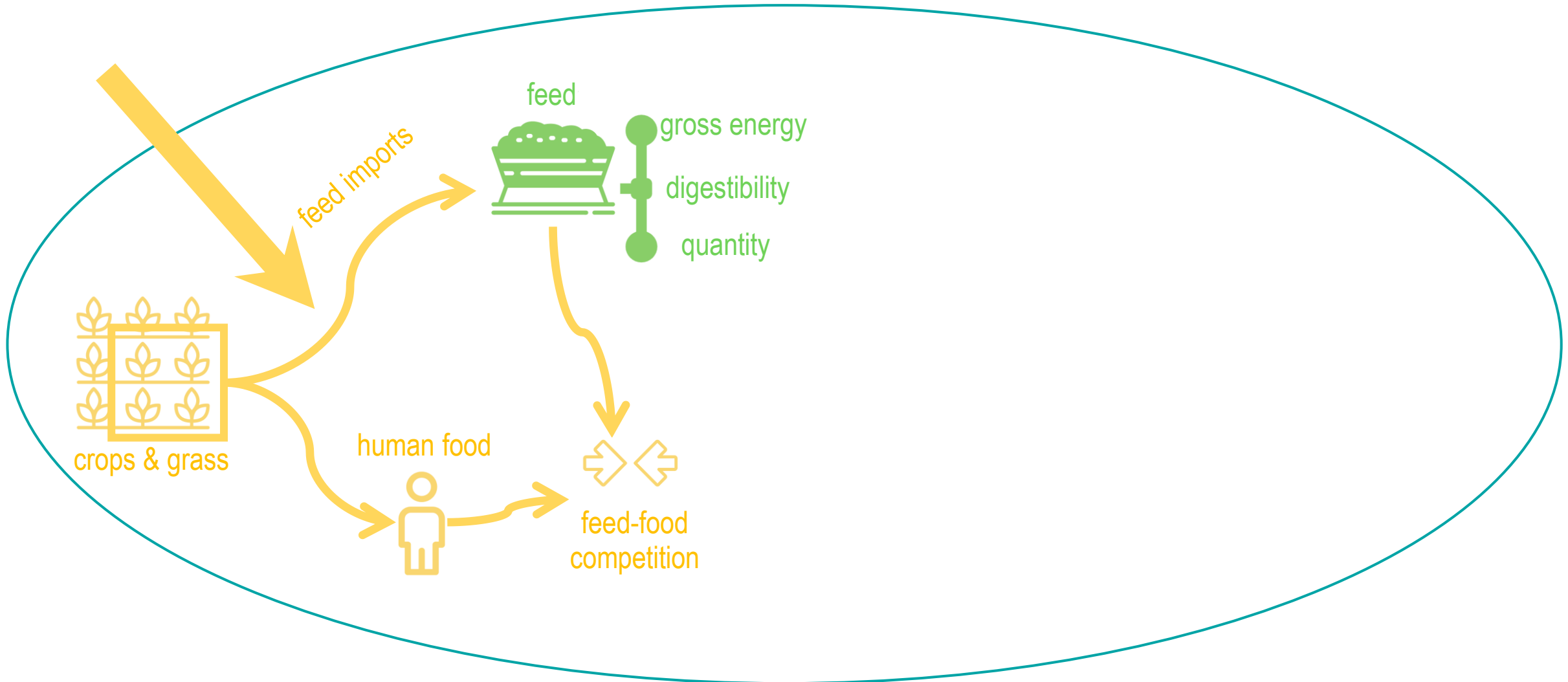
Schematic plan



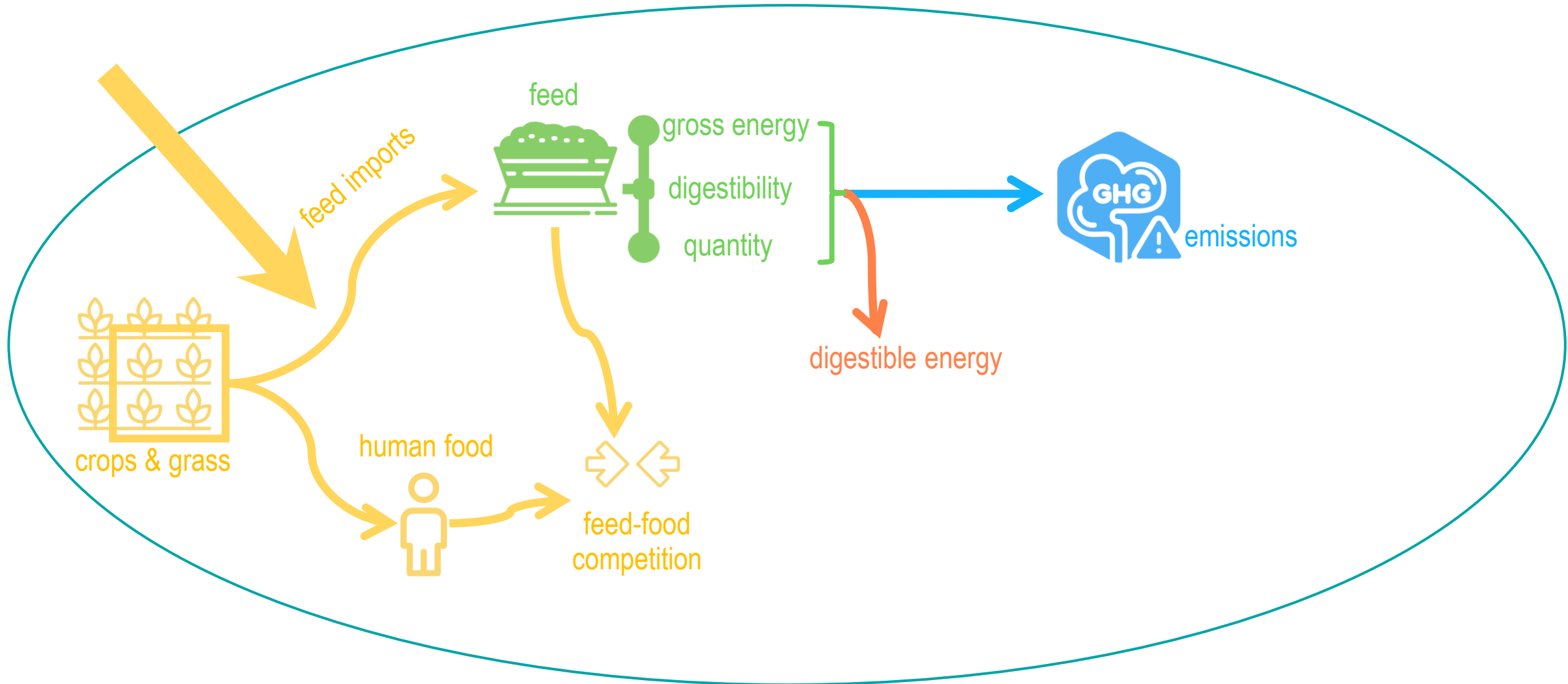
Schematic plan



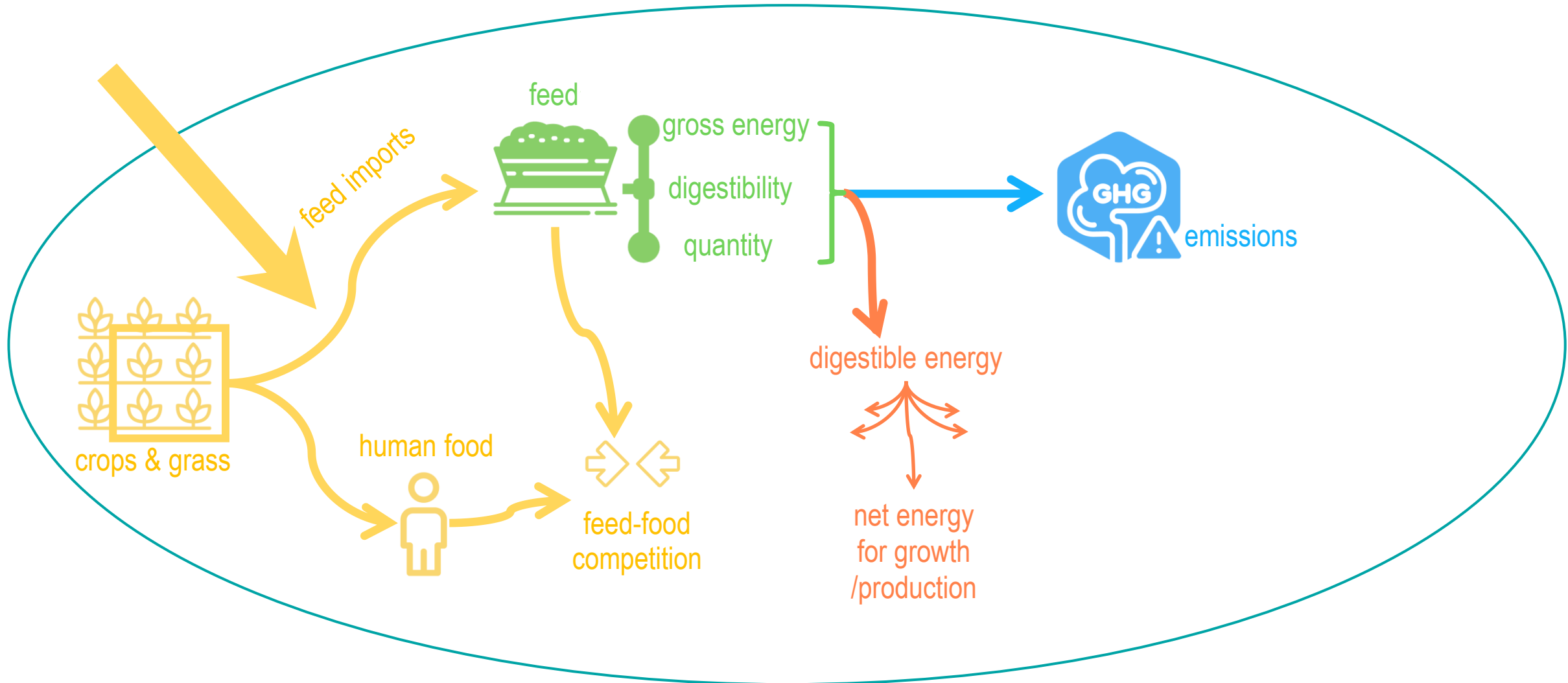
Schematic plan



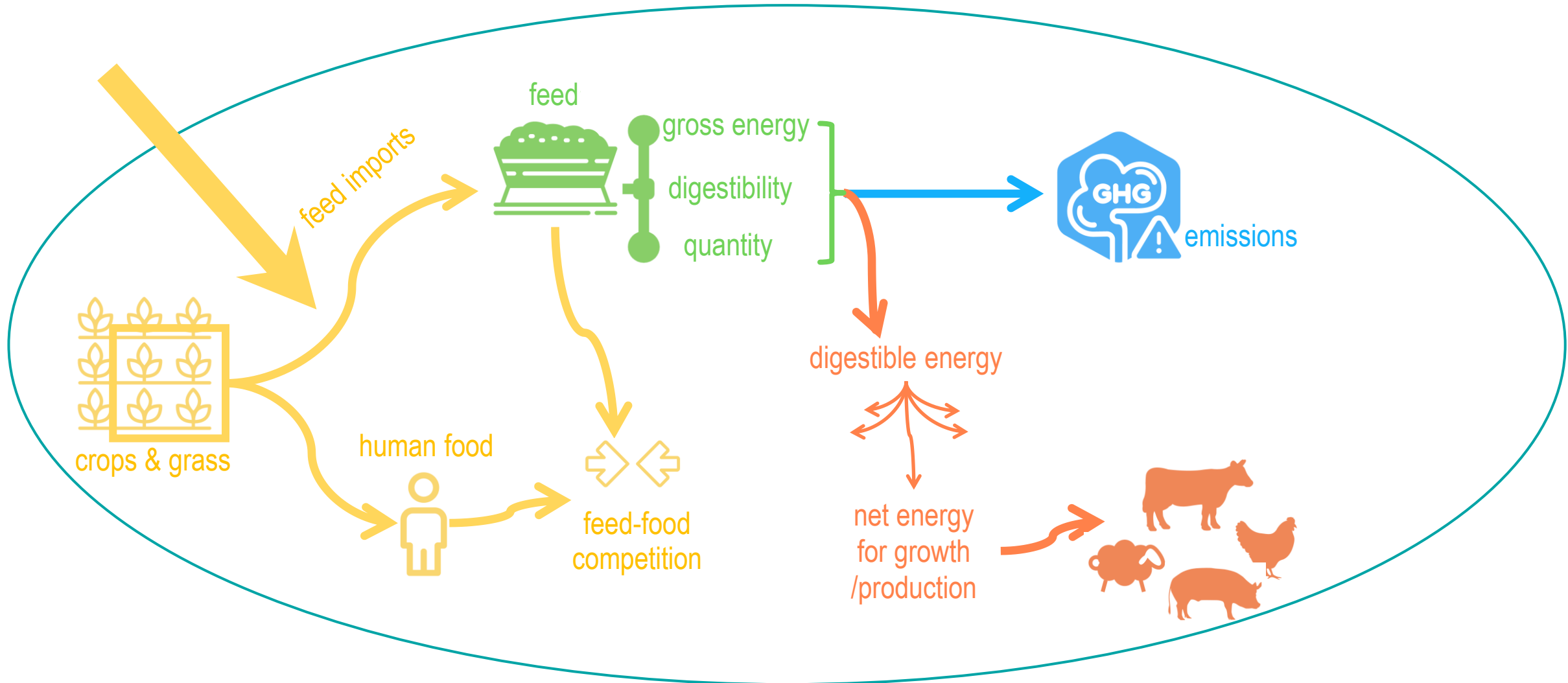
Schematic plan



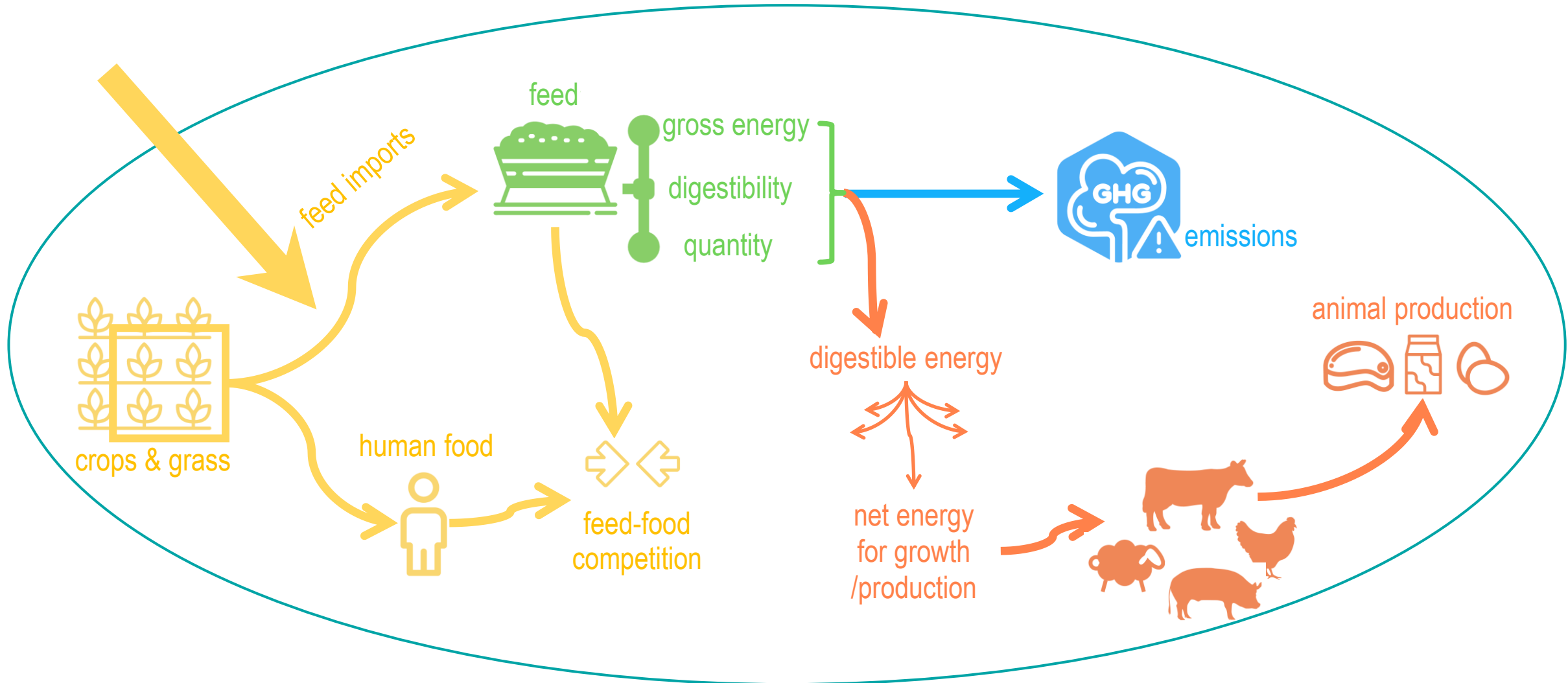
Schematic plan



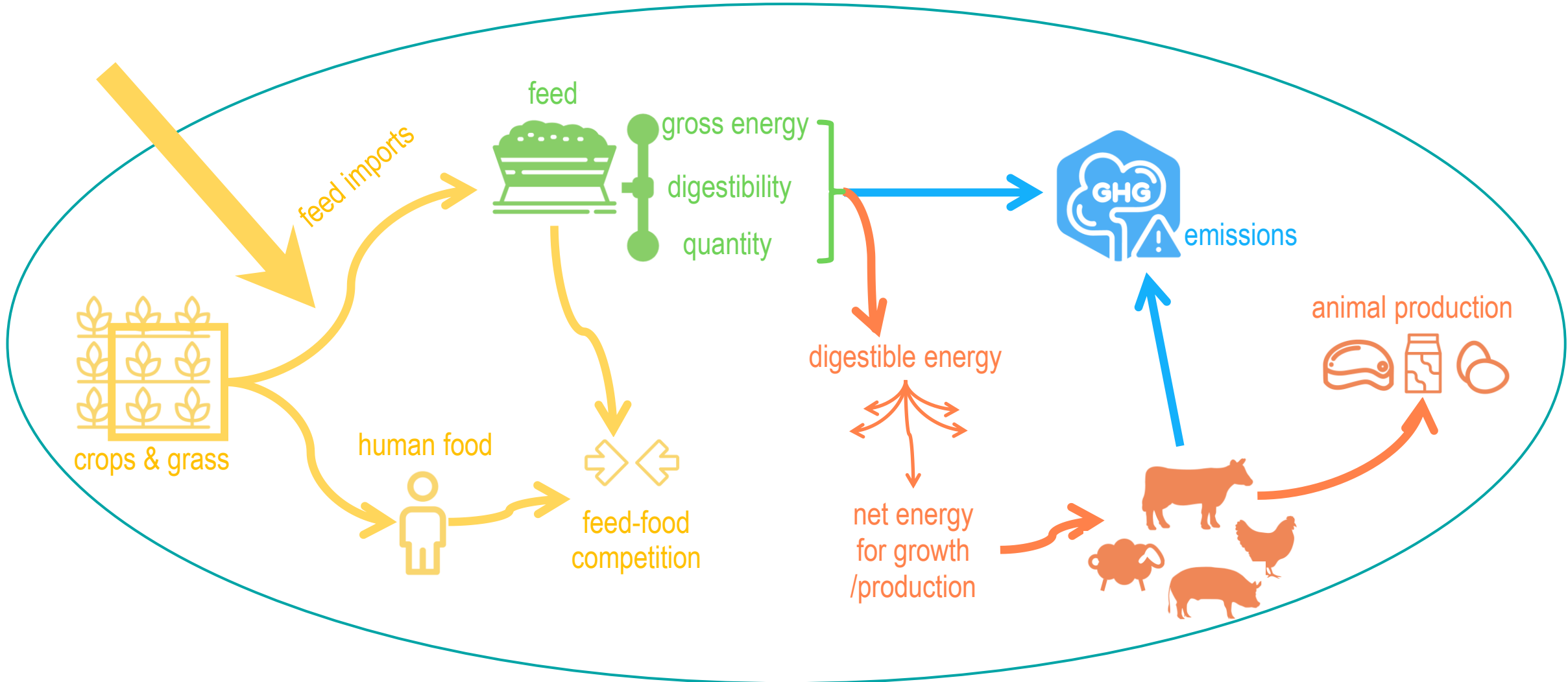
Schematic plan

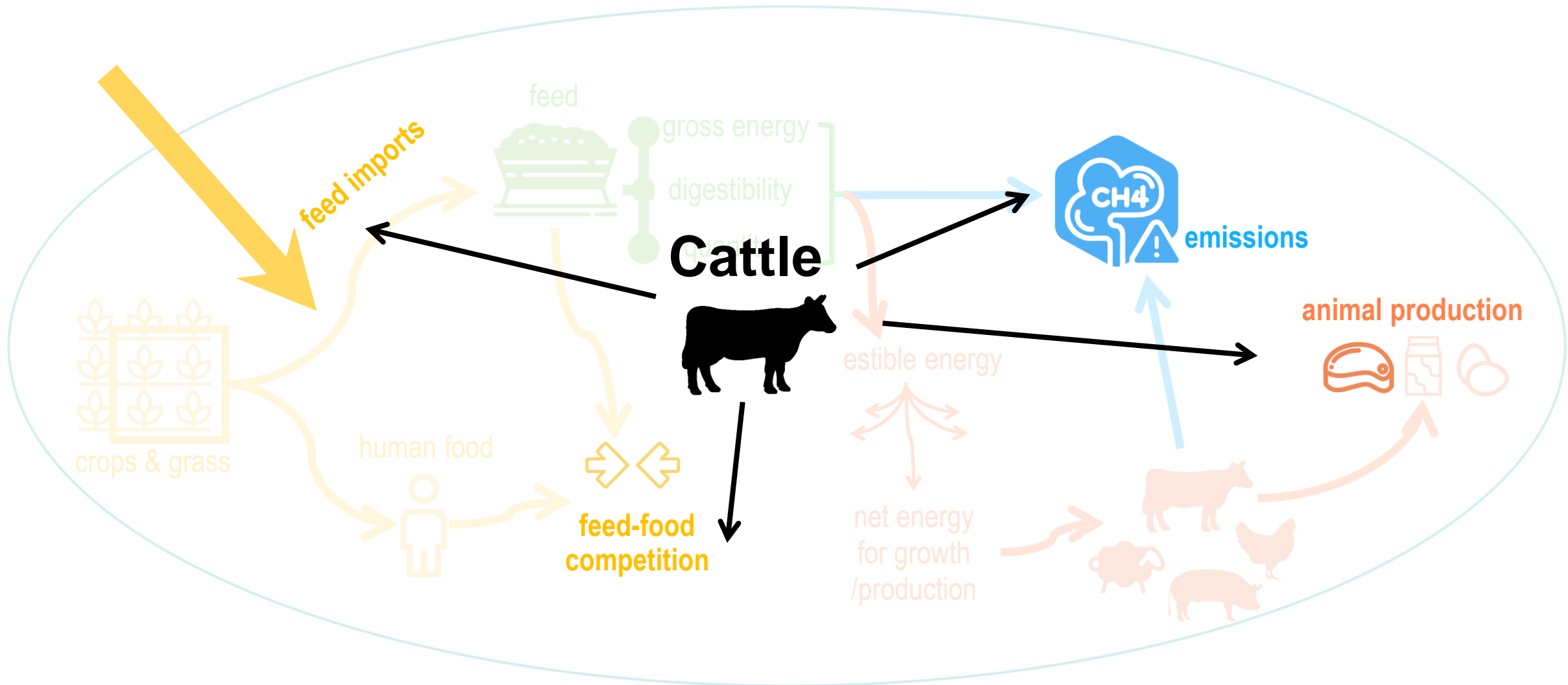


Schematic plan

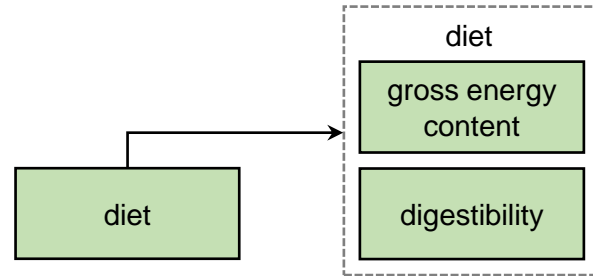
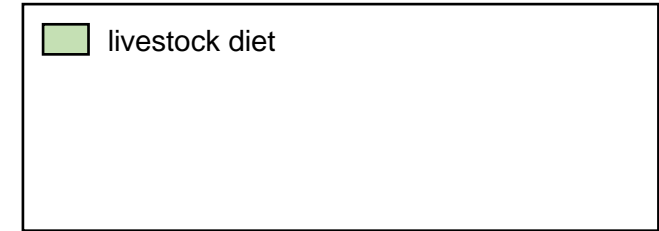


Schematic plan





Model description

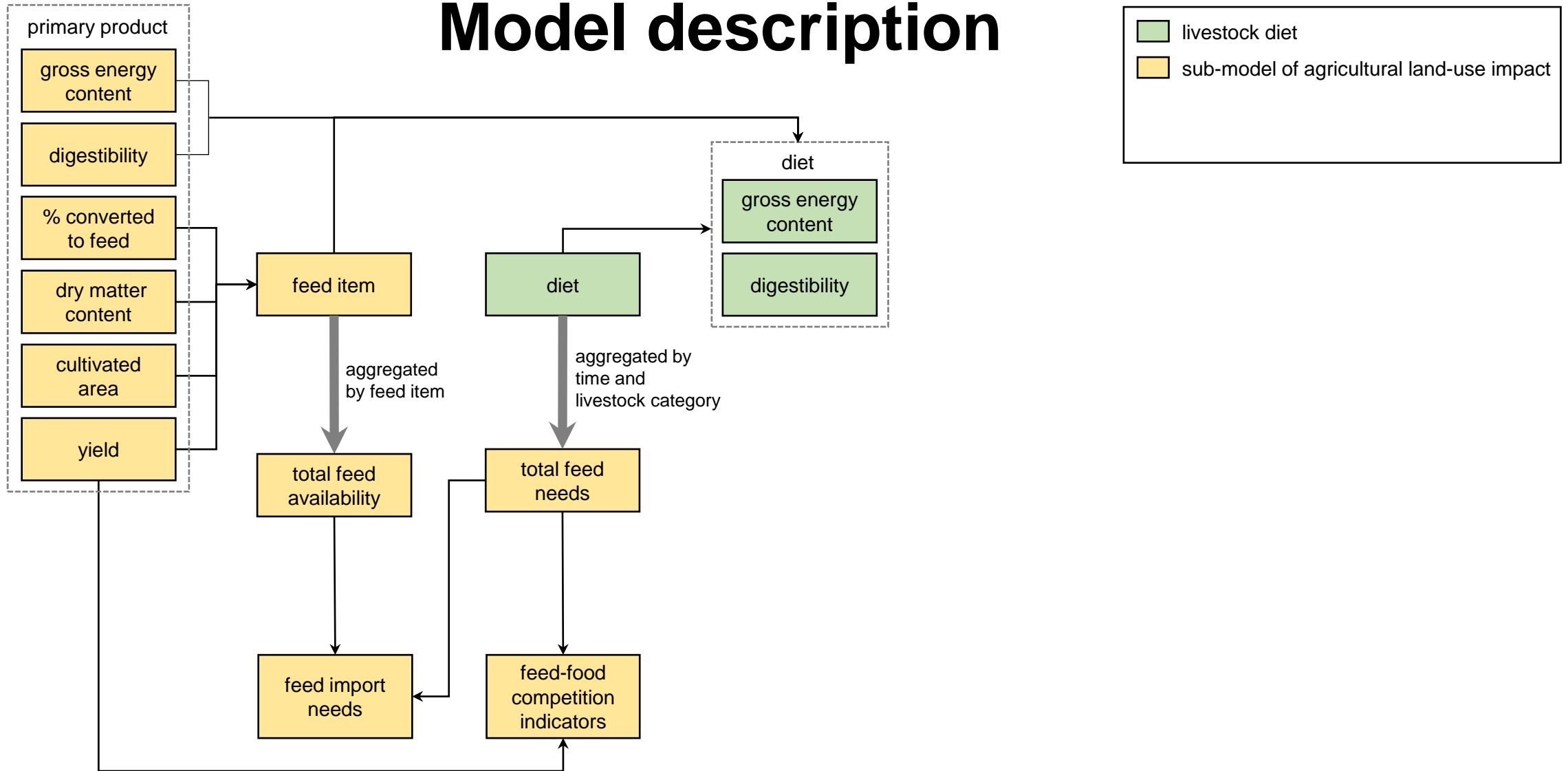


Feed type	Quantity (kg head ⁻¹ day ⁻¹)
cereals	
co-products	
oil-protein	
meals	
forage	
grass	

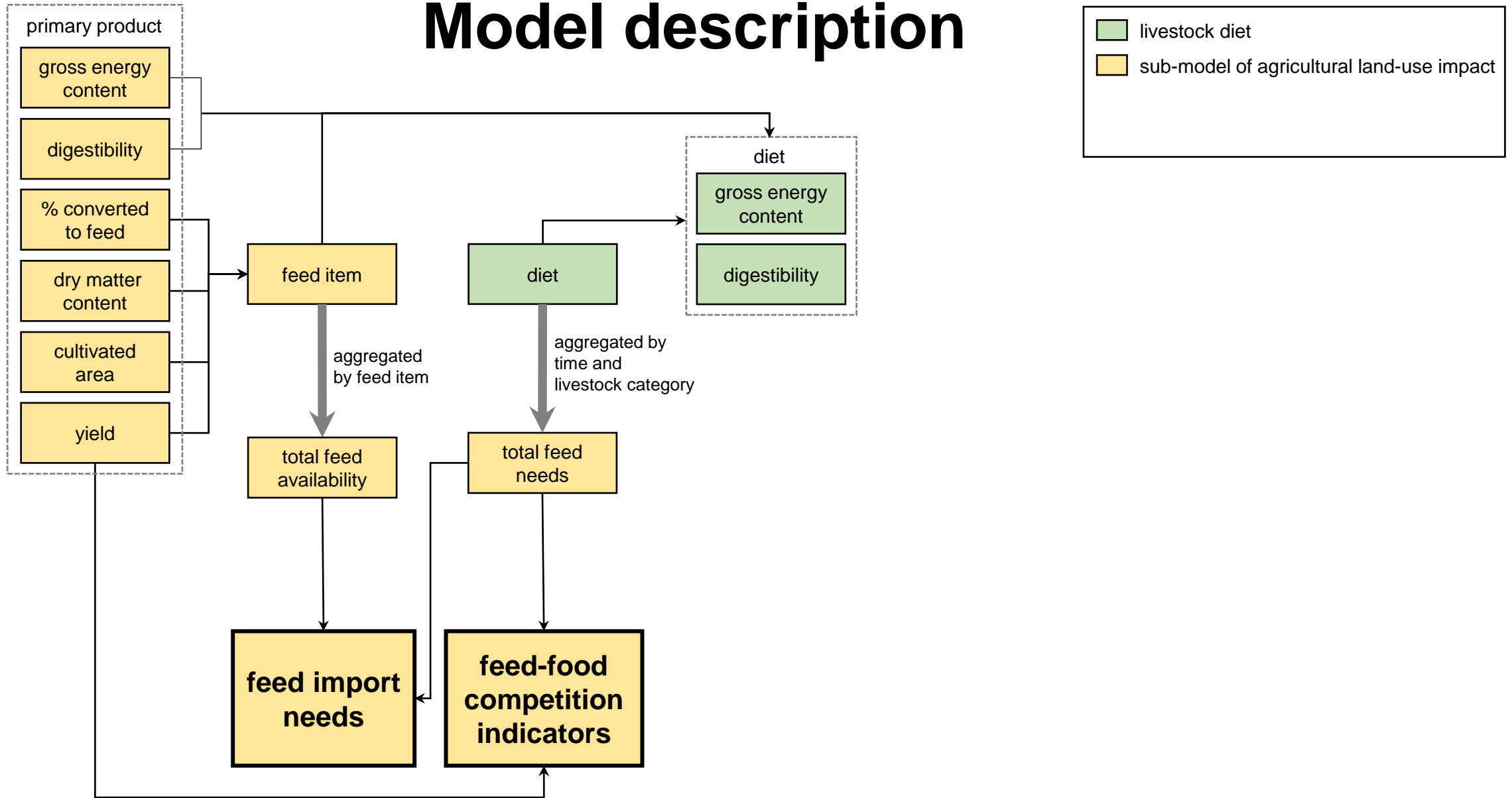
Feed Quantity

Feed Composition

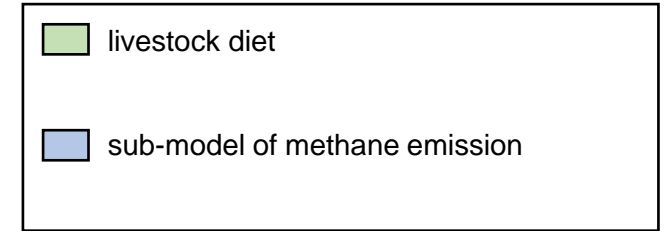
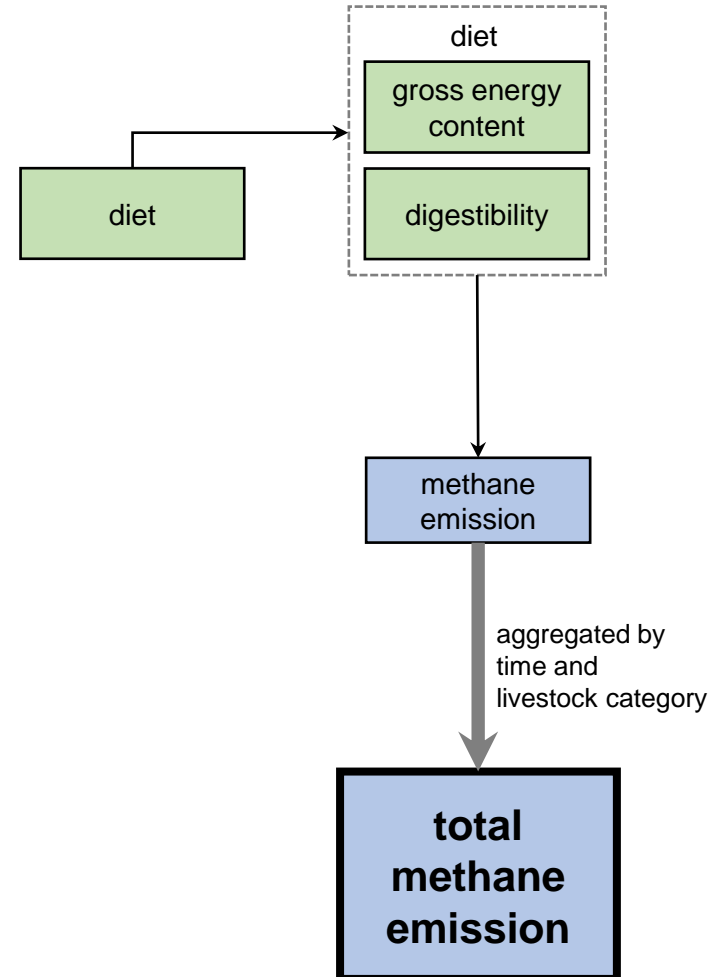
Model description



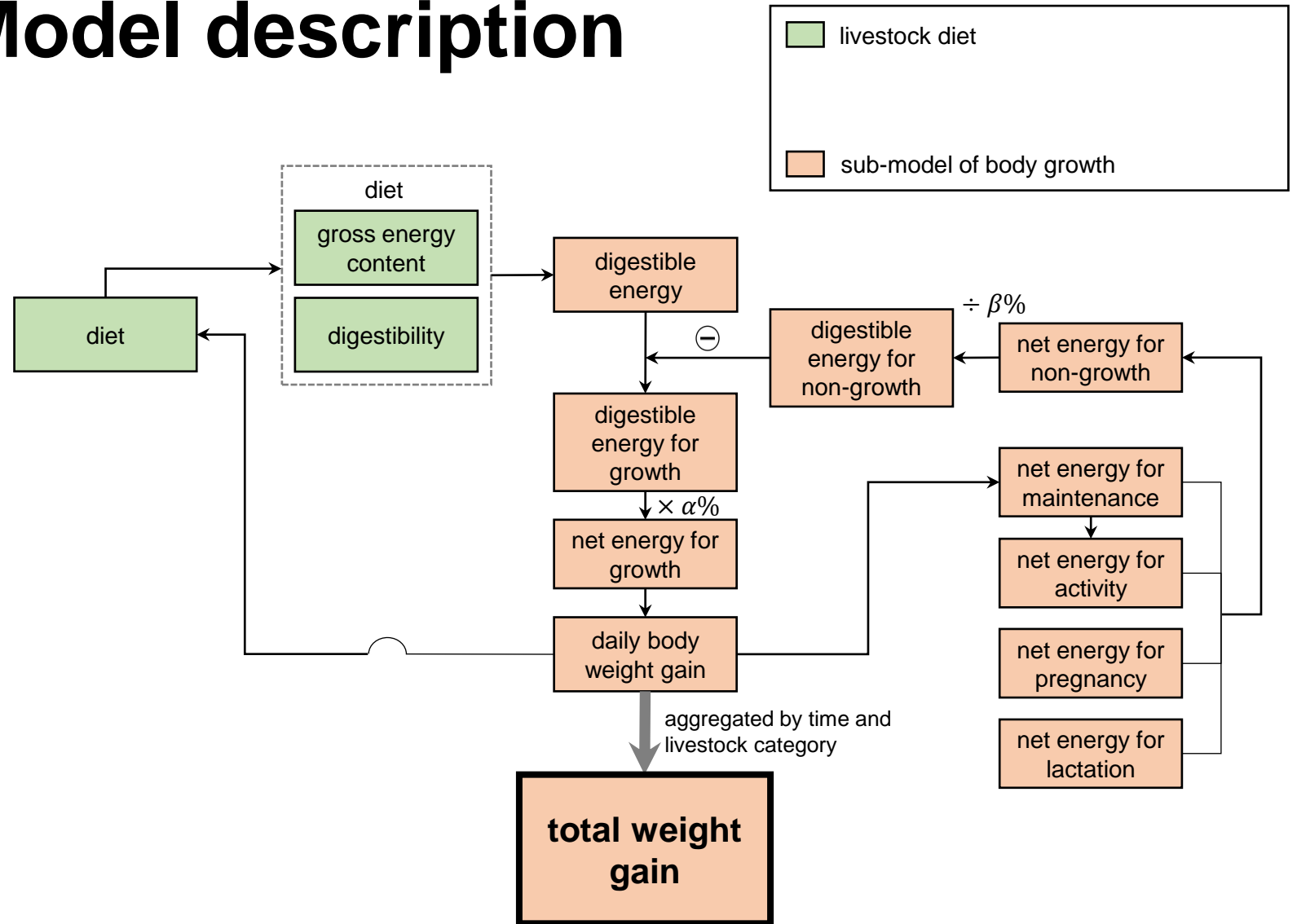
Model description



Model description

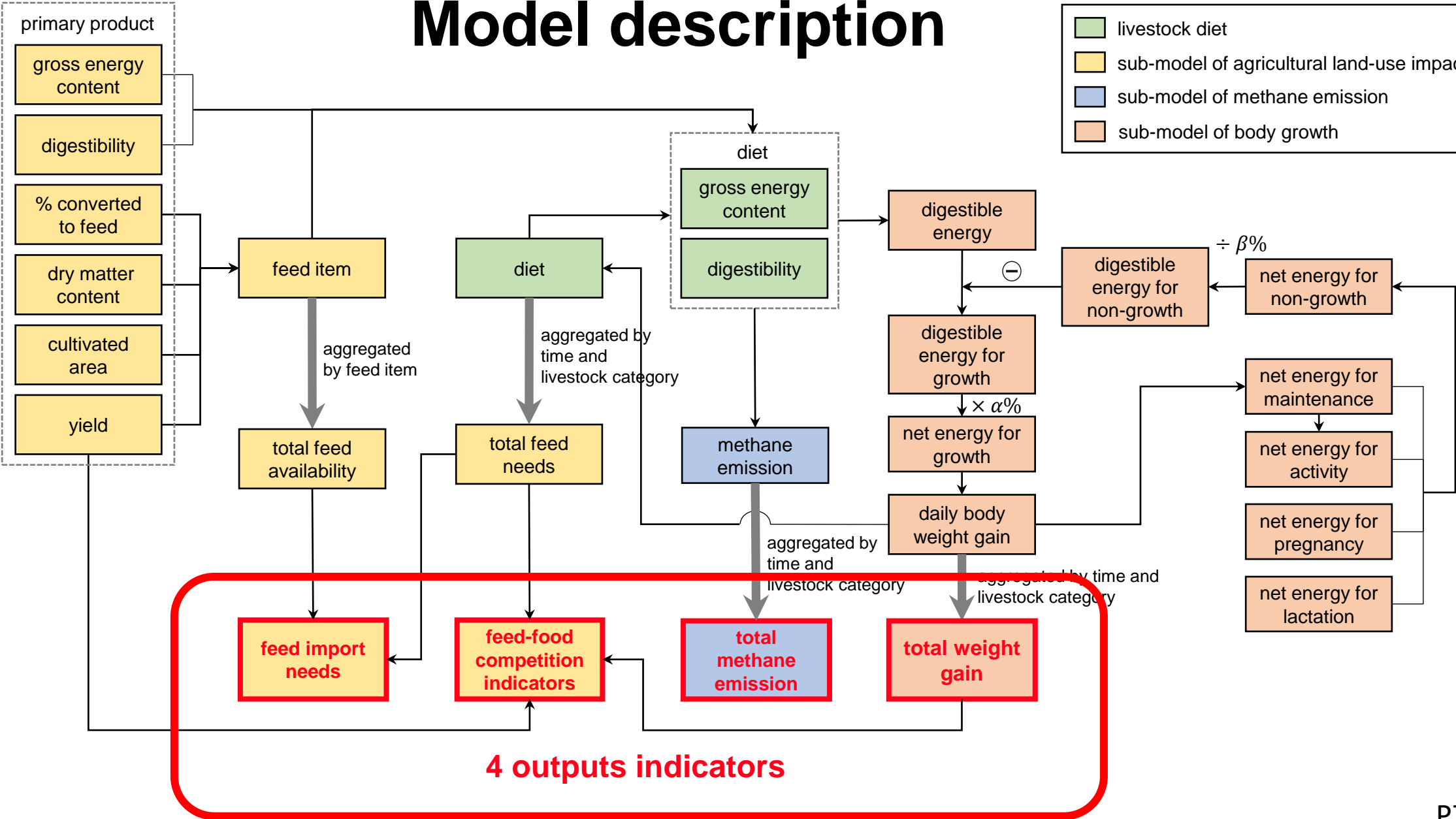


Model description



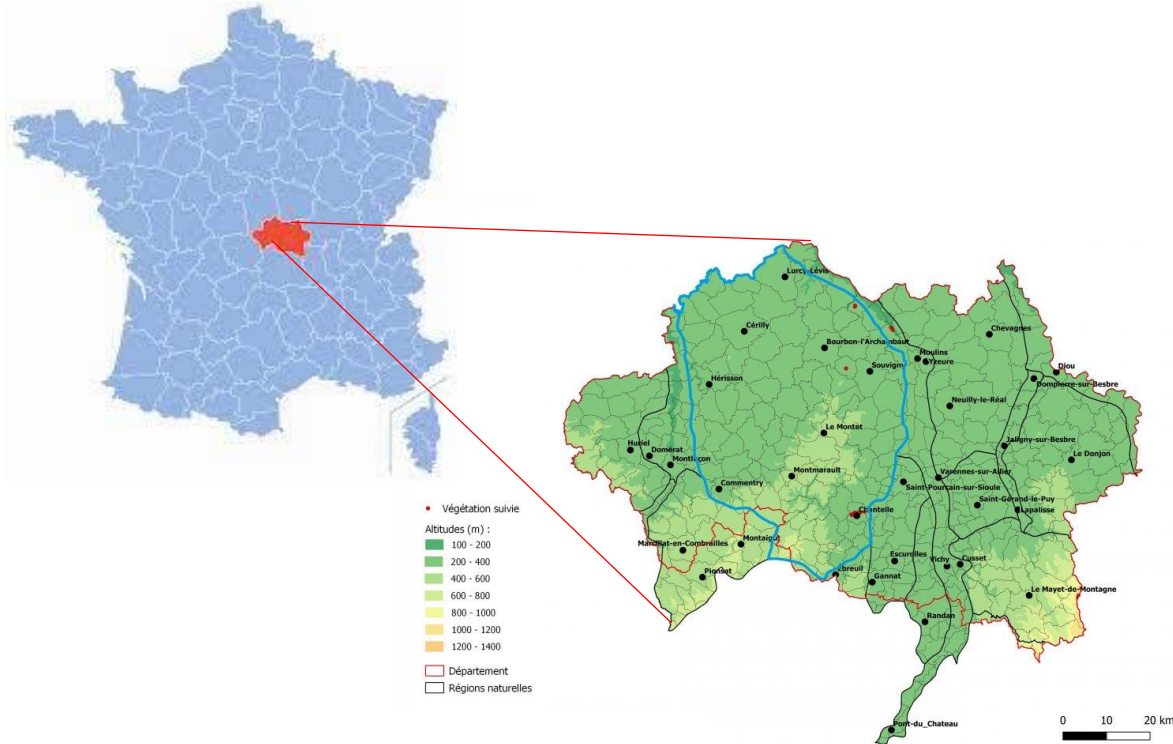
Model description

- livestock diet
- sub-model of agricultural land-use impact
- sub-model of methane emission
- sub-model of body growth



4 outputs indicators

Baseline in Bocage Bourbonnais, France



Beef production dominance

Extensive cattle rearing

Grassland-dominated landscape (85%)

grain-based diet VS. grass-based diet

grain-based diet VS. grass-based diet

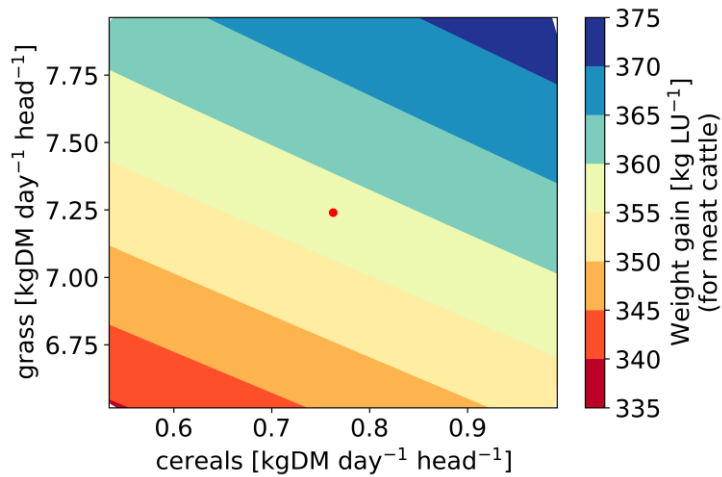
Cereals [kg day⁻¹ head⁻¹]: ± 30%

Grass [kg day⁻¹ head⁻¹]: ± 10%

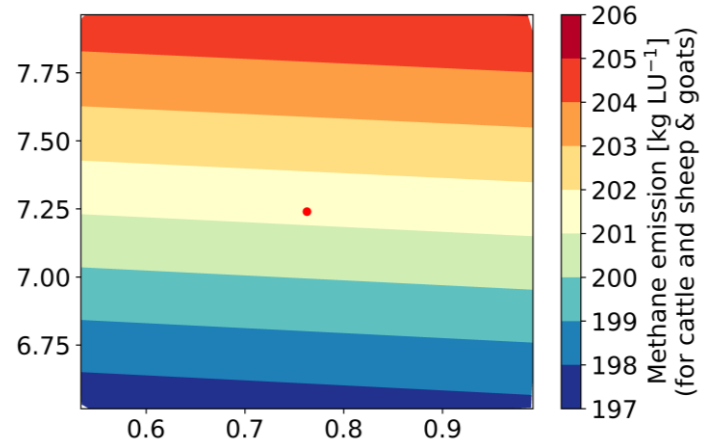
Random combinations for 1000 times

Results

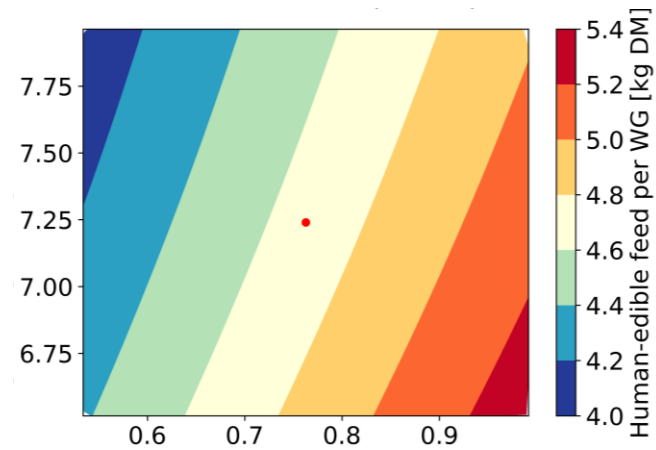
by changing the combination
cereals and grass in diet



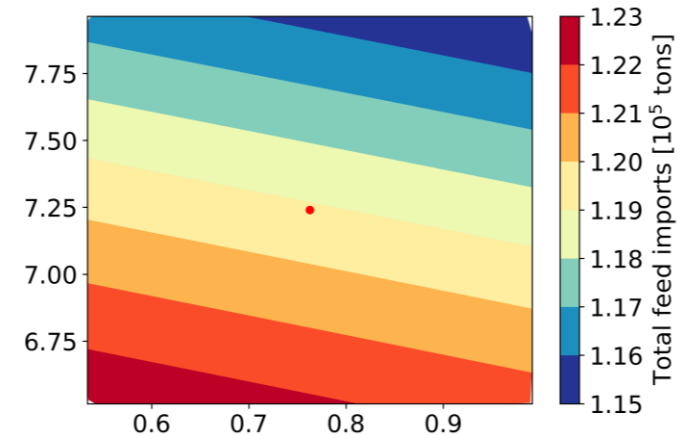
Weight gain



Methane emission



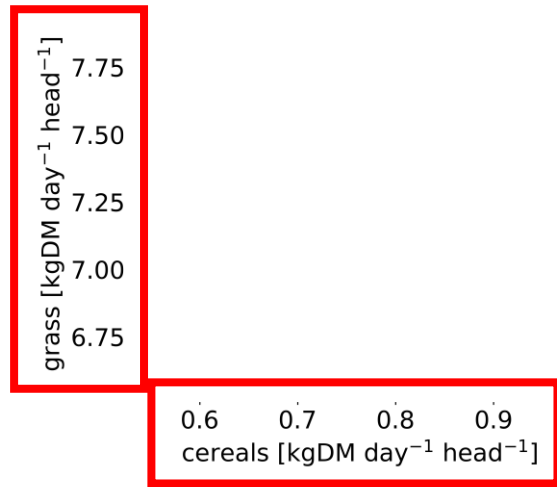
Feed-food competition indicator
(Human-edible feed per WG)



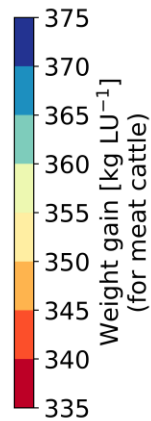
Feed importation

Results

by changing the combination
cereals and grass in diet

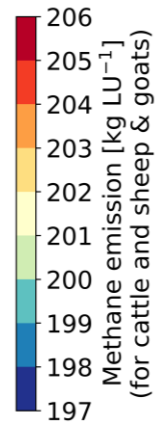


Weight gain

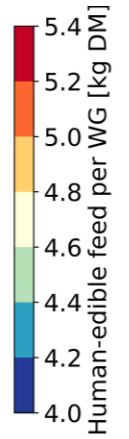


7.75
7.50
7.25
7.00
6.75
7.75
7.50
7.25
7.00
6.75
7.75
7.50
7.25
7.00
6.75

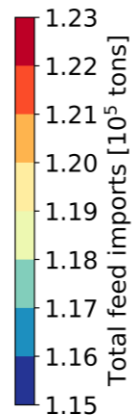
0.6 0.7 0.8 0.9



Methane emission



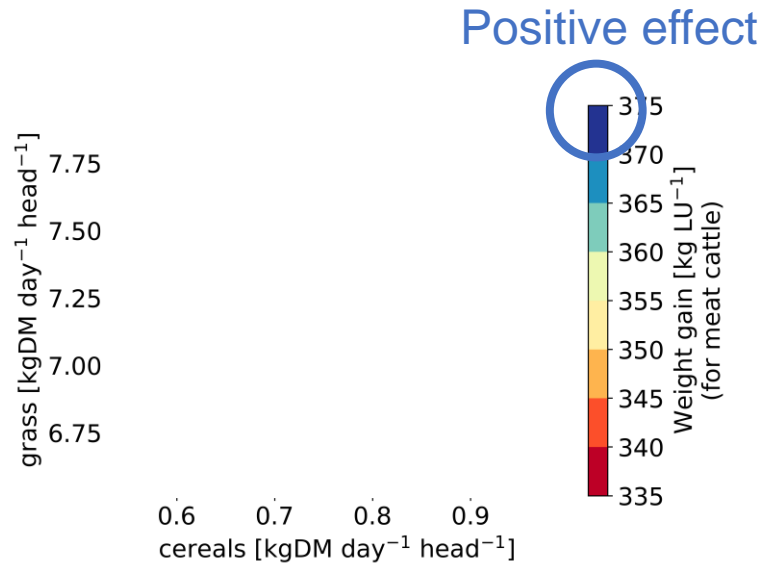
Feed-food competition indicator
(Human-edible feed per WG)



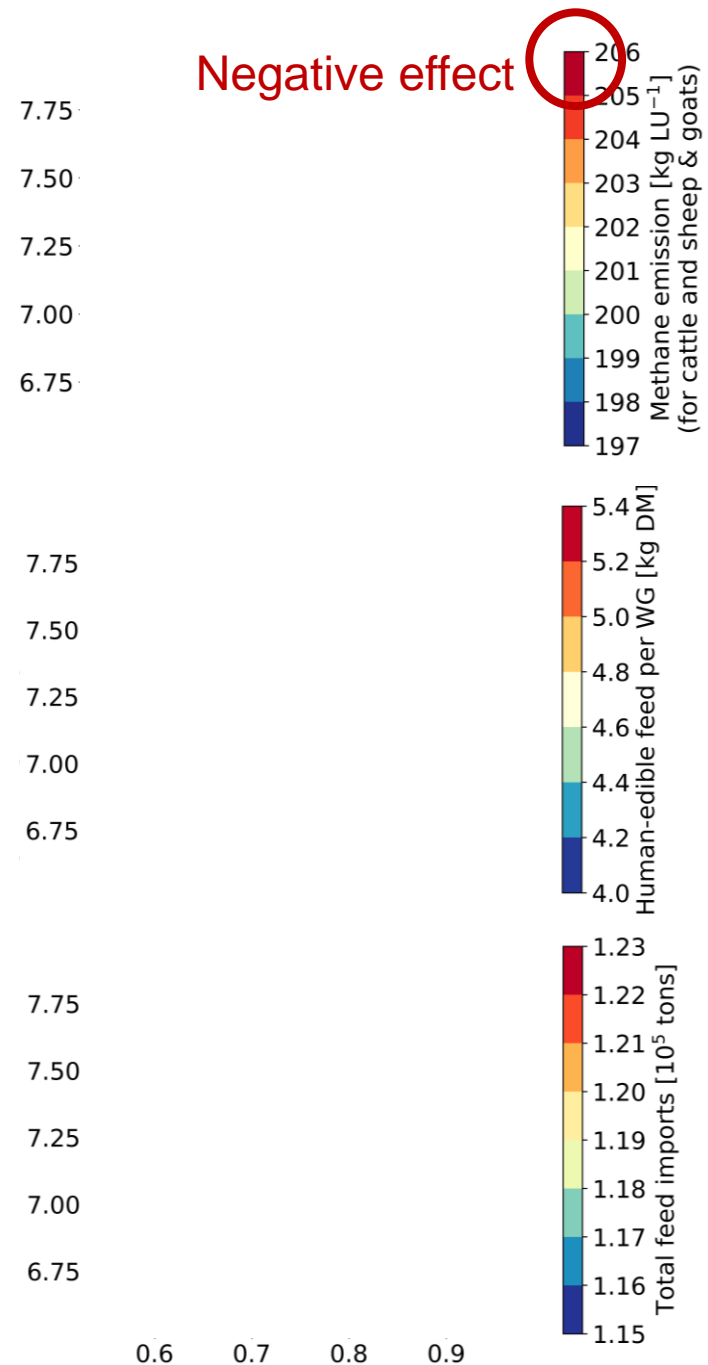
Feed importation

Results

by changing the combination
cereals and grass in diet



Weight gain

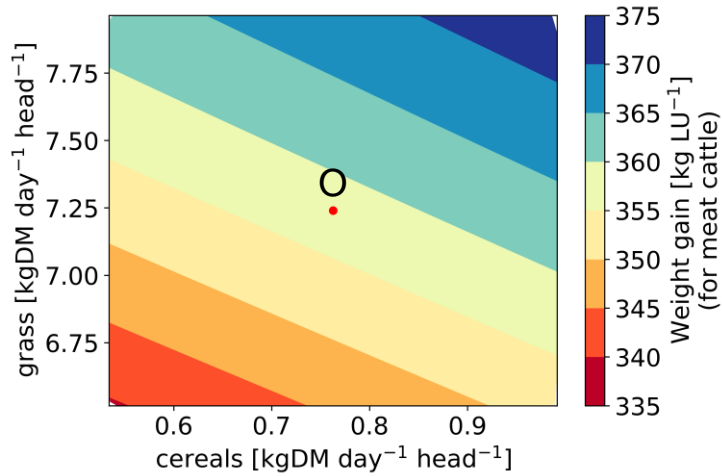


Methane emission

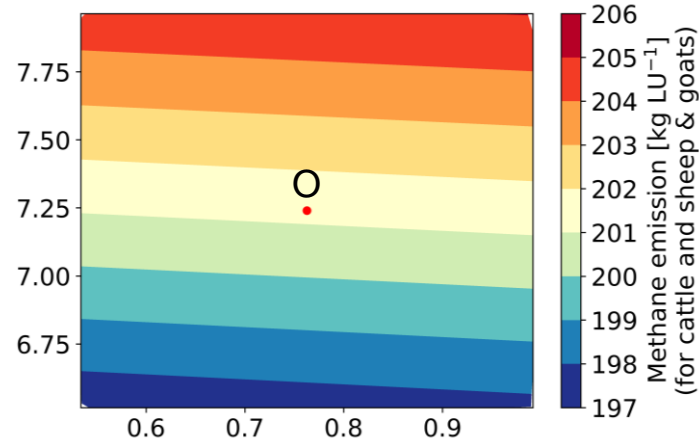
Feed-food competition indicator
(Human-edible feed per WG)

Feed importation

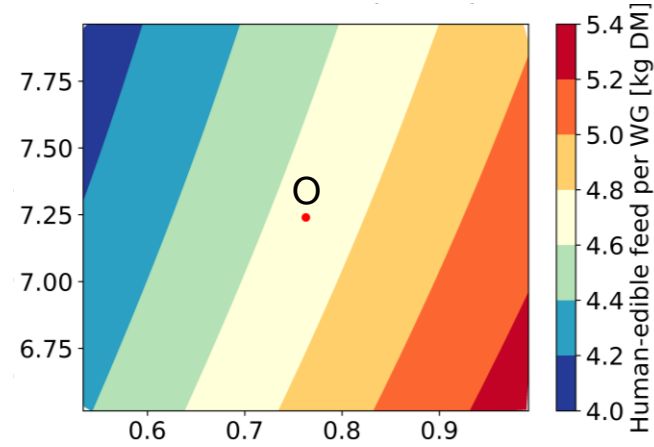
Baseline (point O)



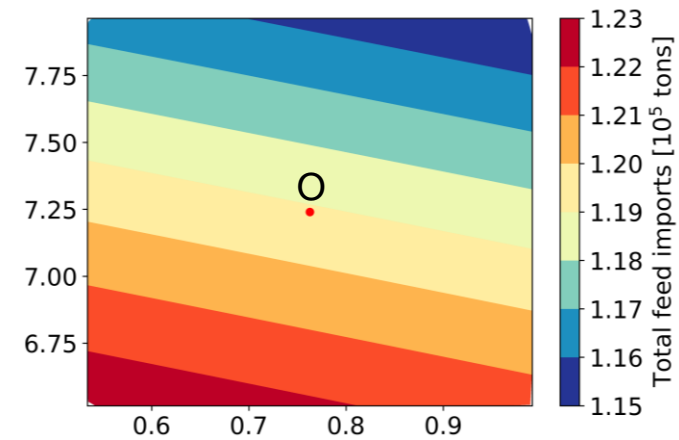
Weight gain



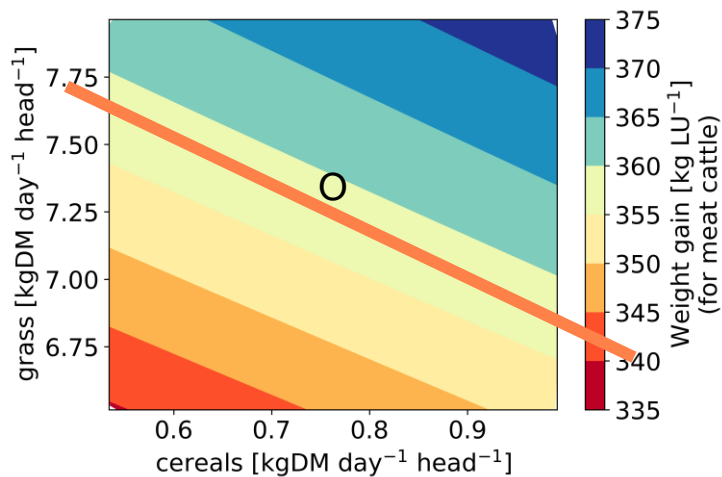
Methane emission



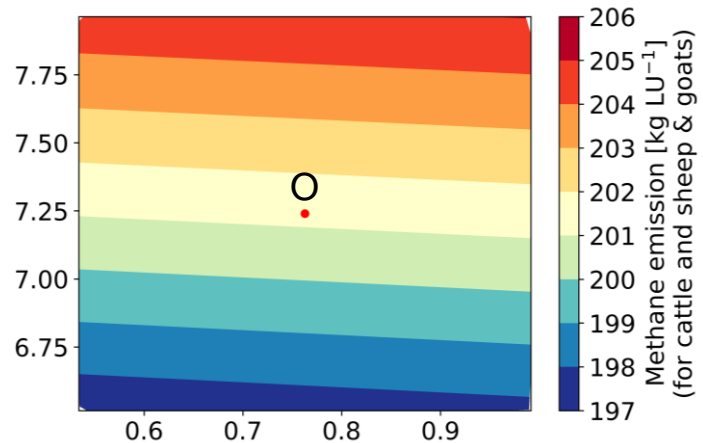
Feed-food competition indicator
(Human-edible feed per WG)



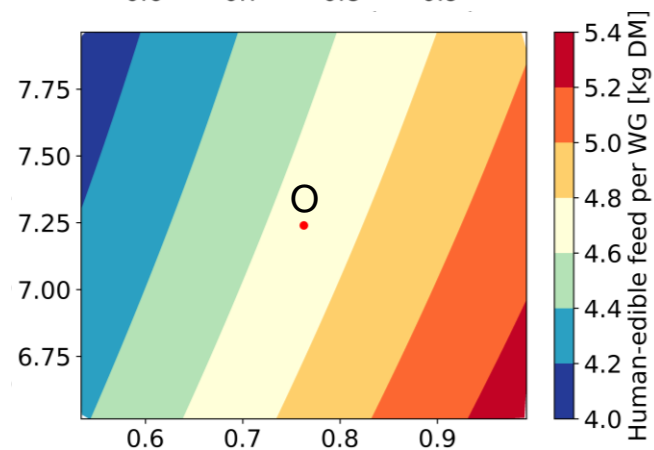
Feed importation



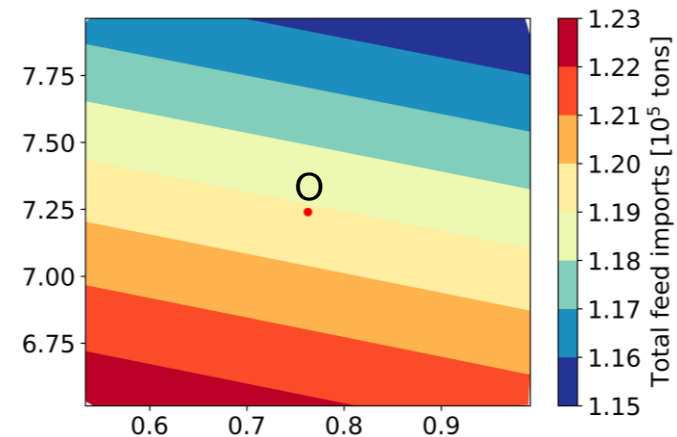
Weight gain



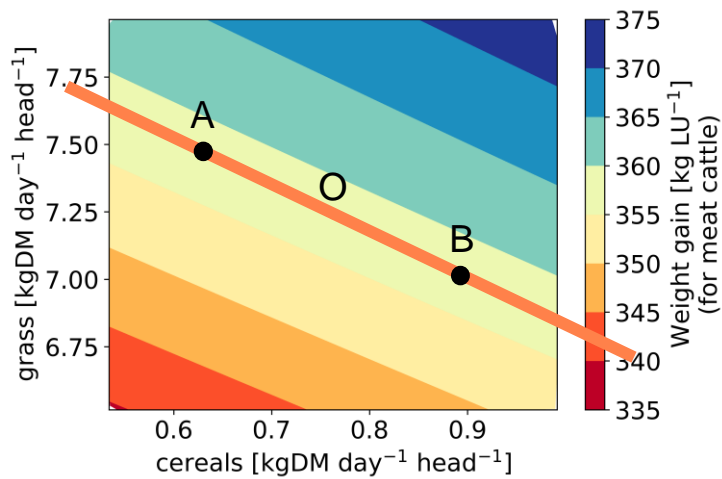
Methane emission



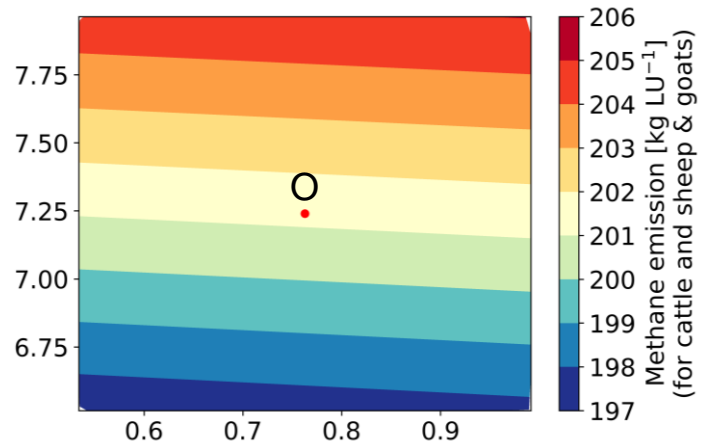
Feed-food competition indicator
(Human-edible feed per WG)



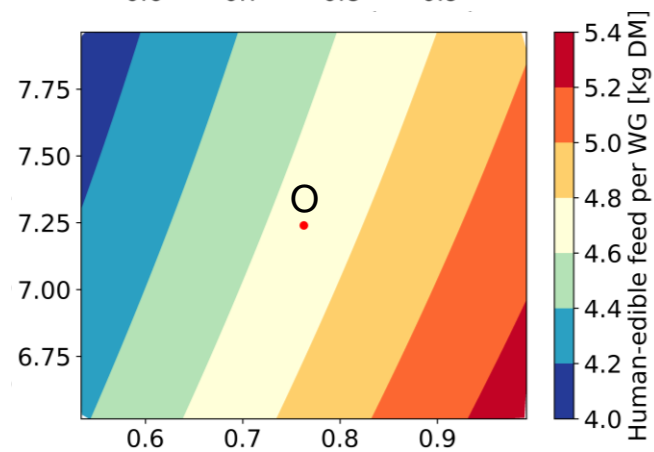
Feed importation



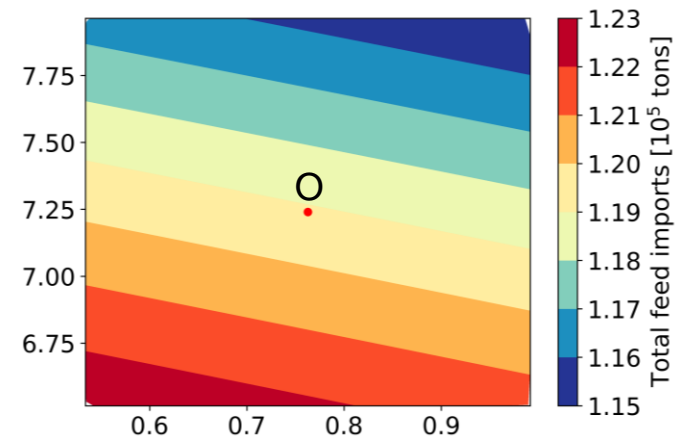
Weight gain



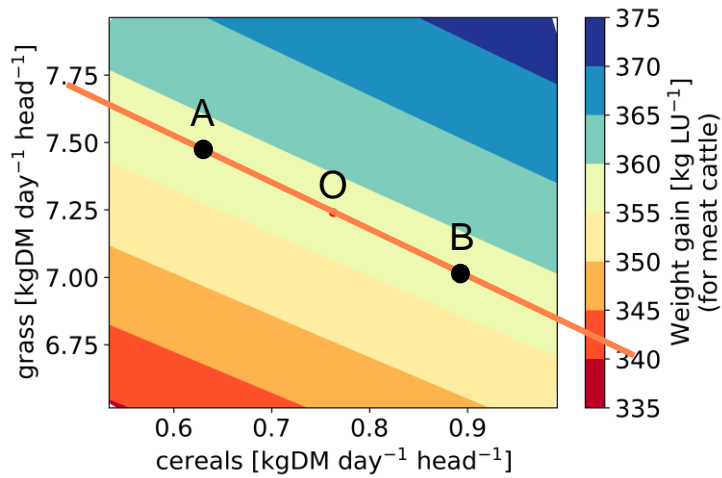
Methane emission



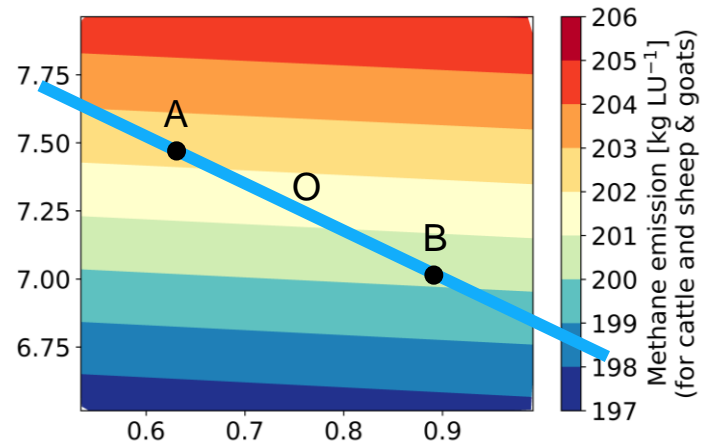
Feed-food competition indicator
(Human-edible feed per WG)



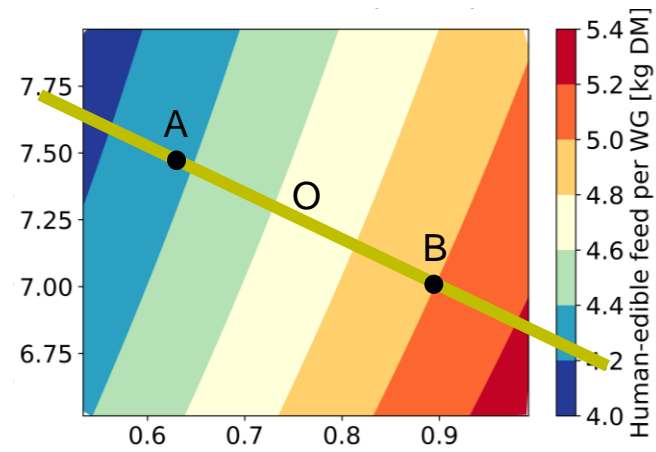
Feed importation



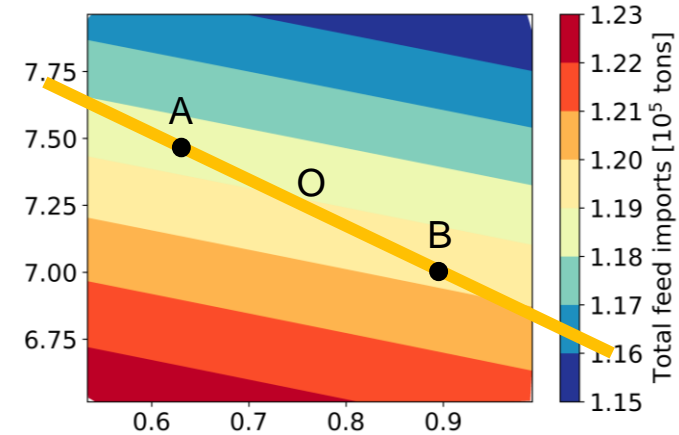
Weight gain



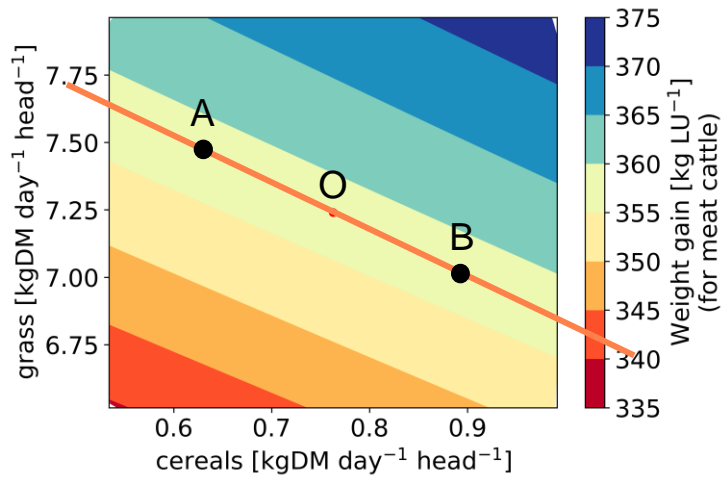
Methane emission



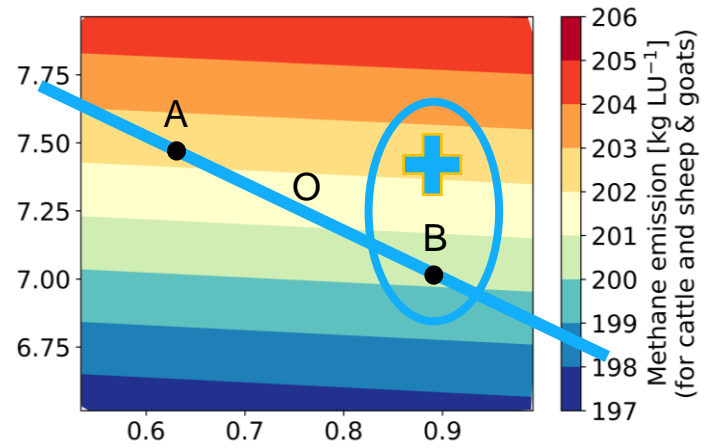
Feed-food competition indicator
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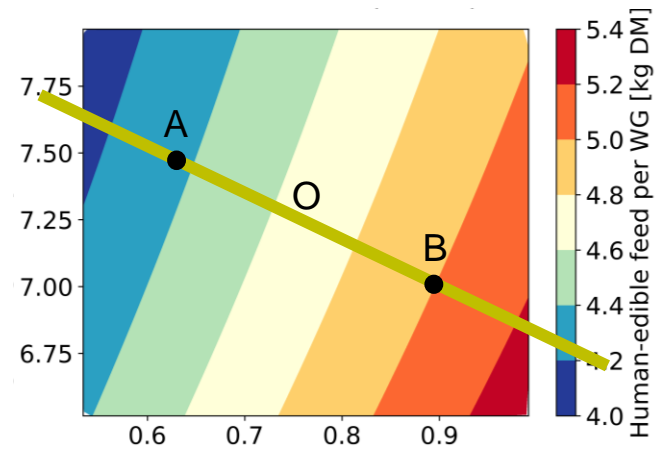
Feed importation



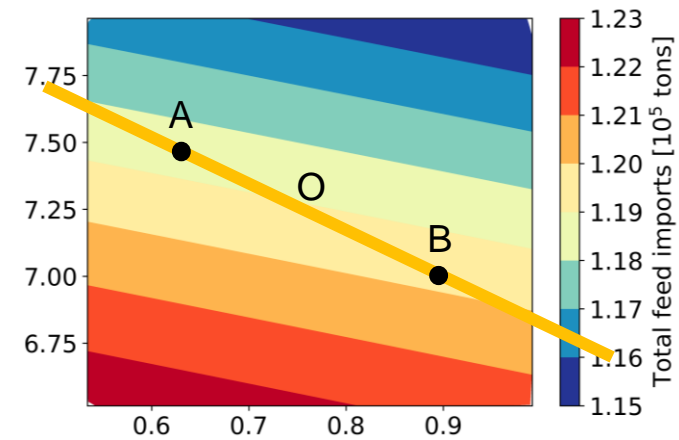
Weight gain



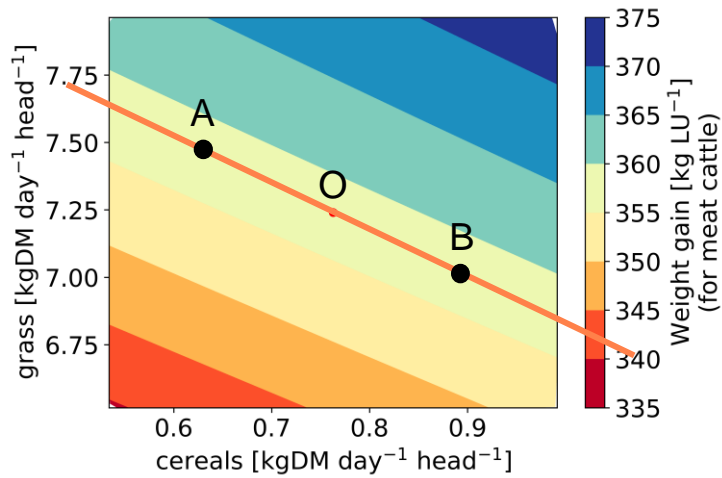
Methane emission



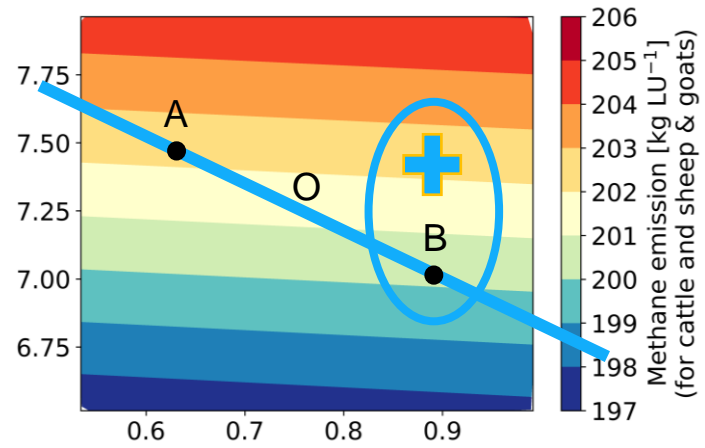
Feed-food competition indicator
(Human-edible feed per WG)



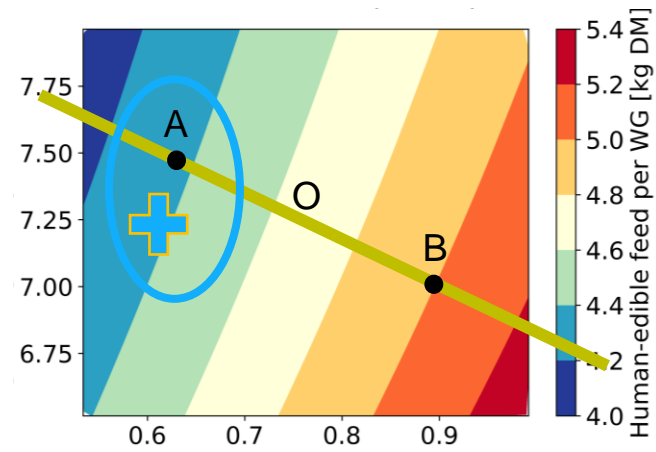
Feed importation



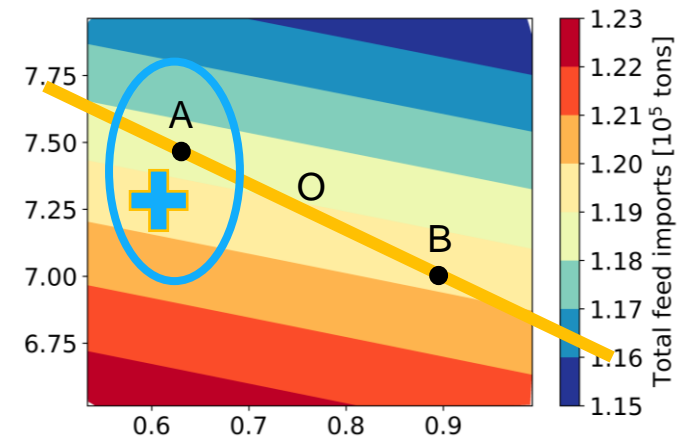
Weight gain



Methane emission



Feed-food competition indicator
(Human-edible feed per WG)



Feed importation

Simulated scenarios

Drought

Yield for all crops & grass -20%

Grazing time on pasture -20%

Grass intake in diet -20%

Concentrates intake increase to the **same daily energy intake as baseline**

Grazing improvement

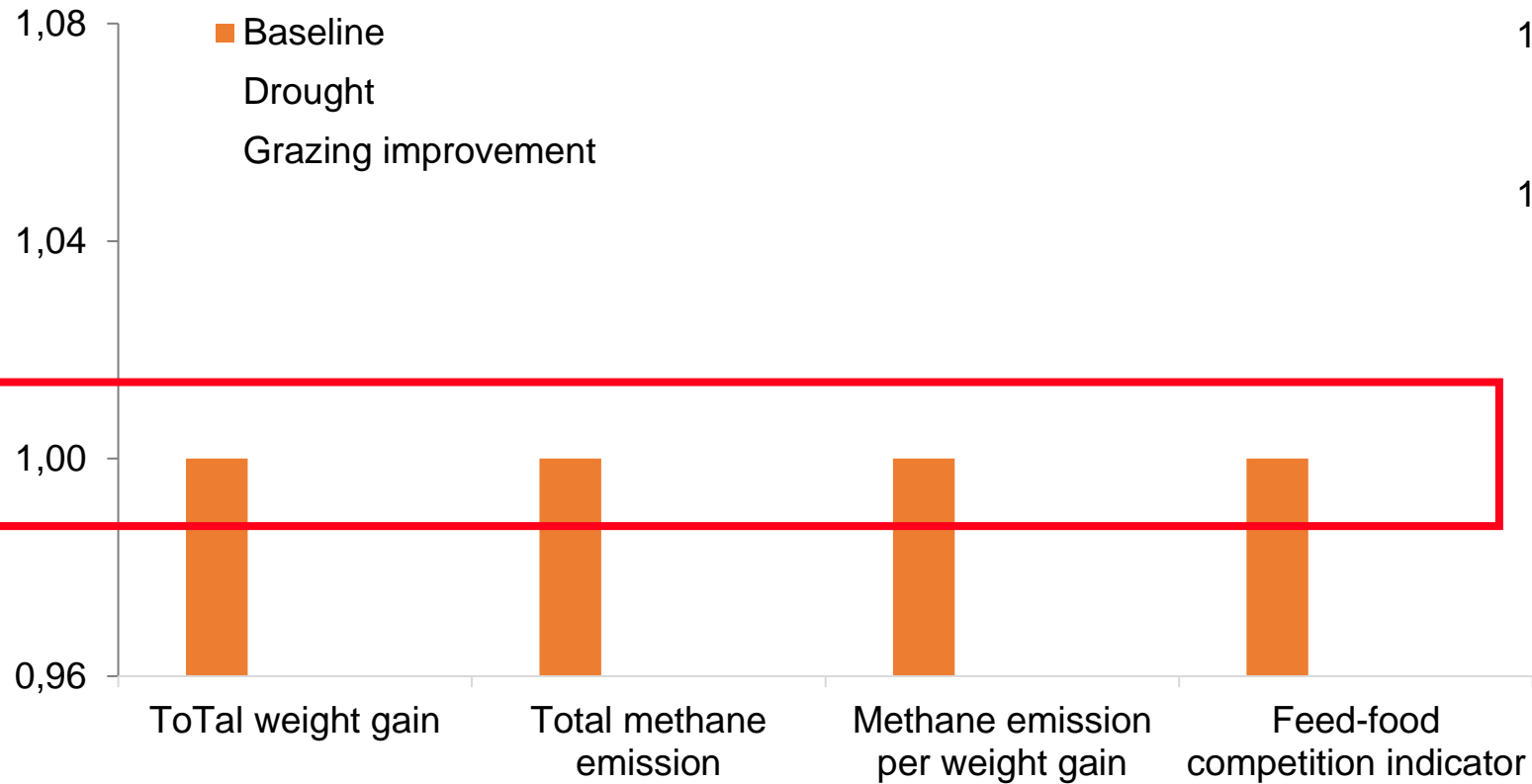
Average **gross energy** of grass +1%

Average **digestibility** of grass +1%

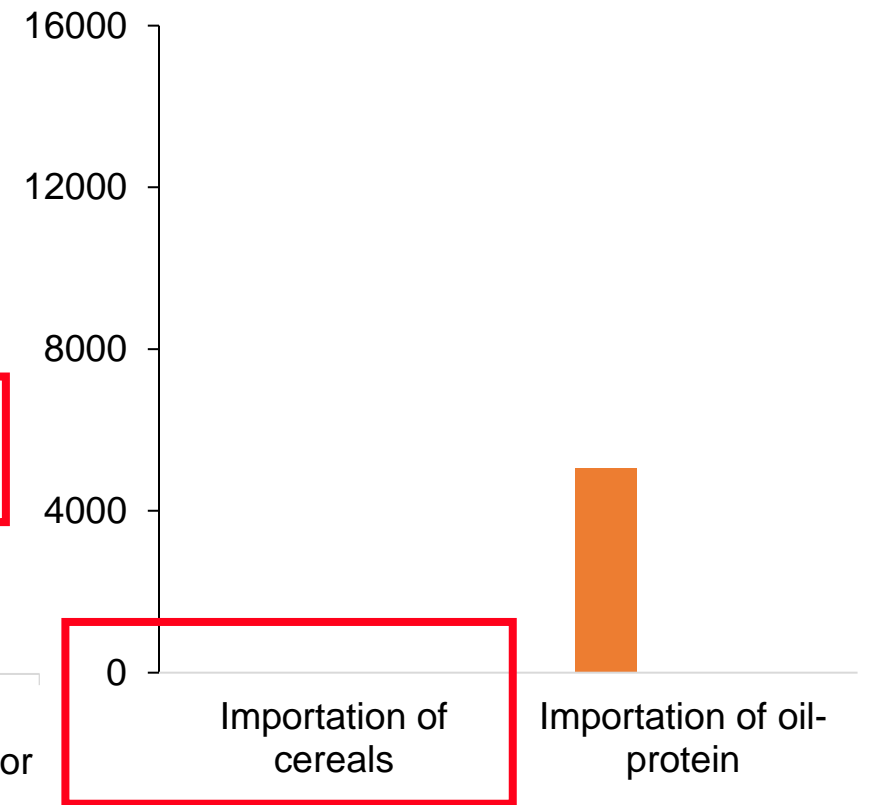
Decrease grass intake to the **same daily energy intake as baseline**

Results of scenarios

Variation compared to baseline

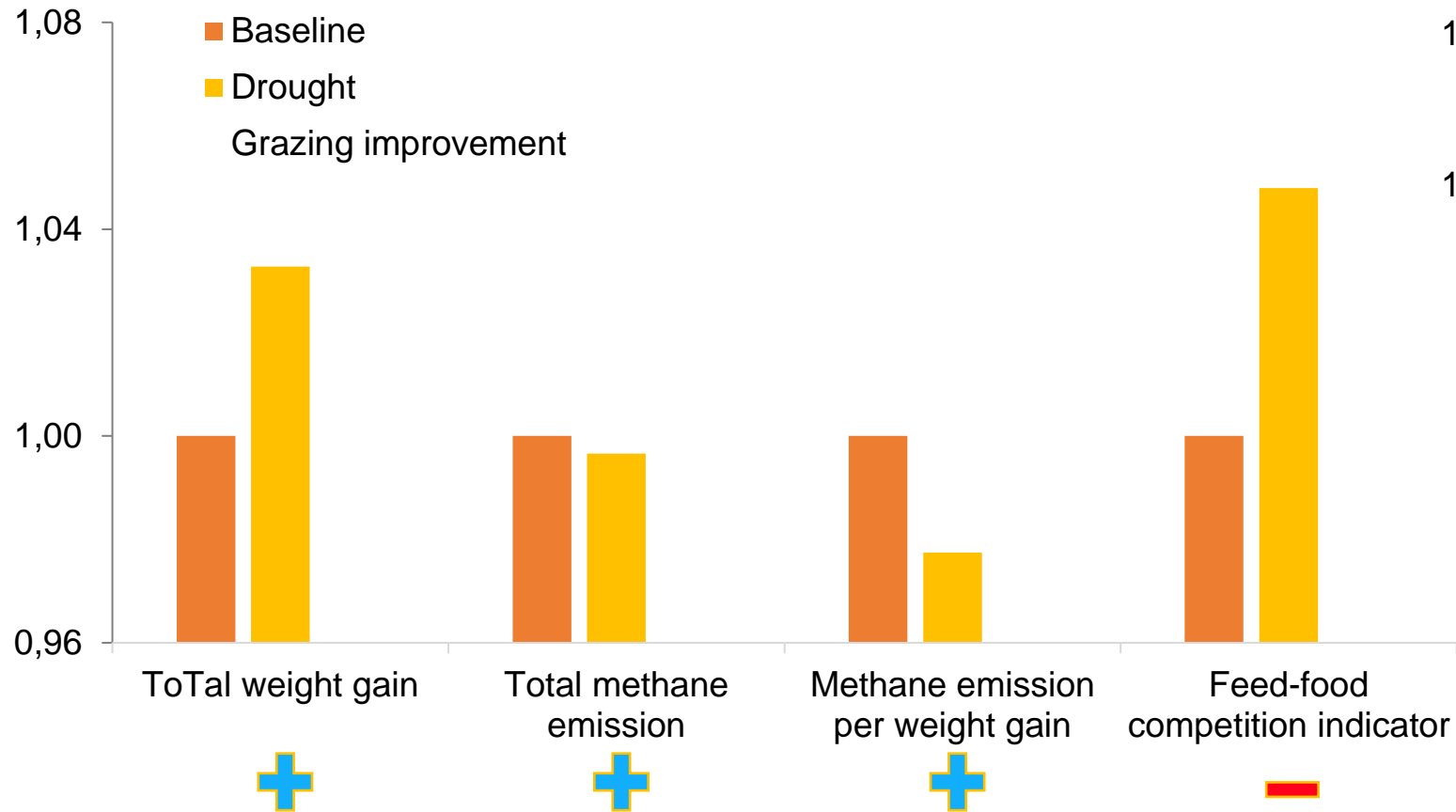


Importation (tons)

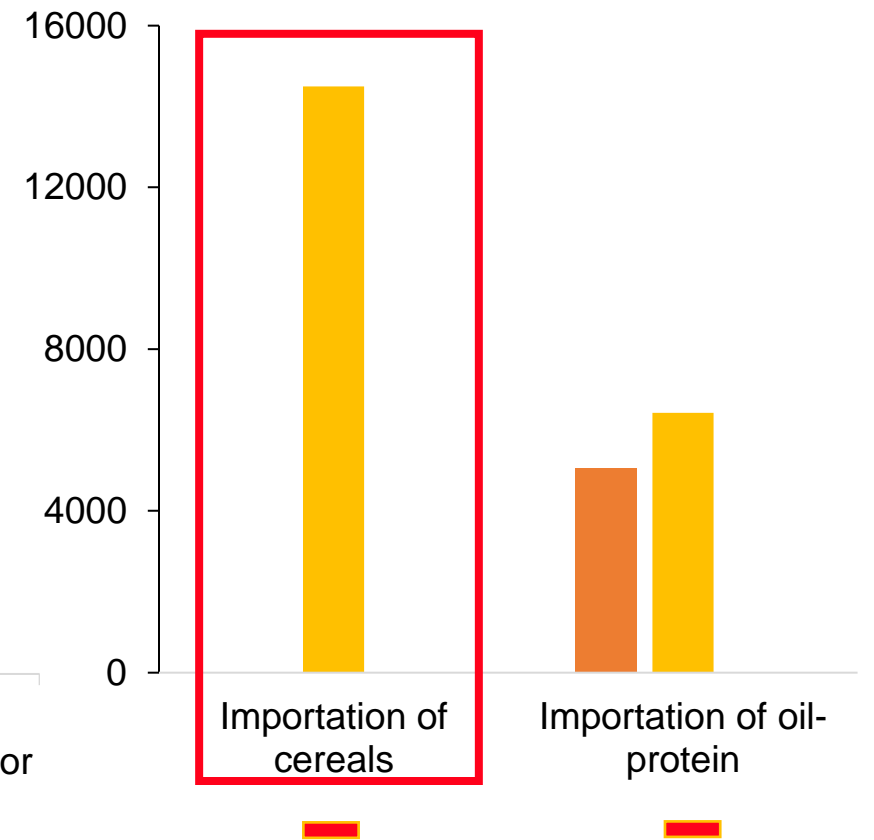


Results of scenarios

Variation compared to baseline

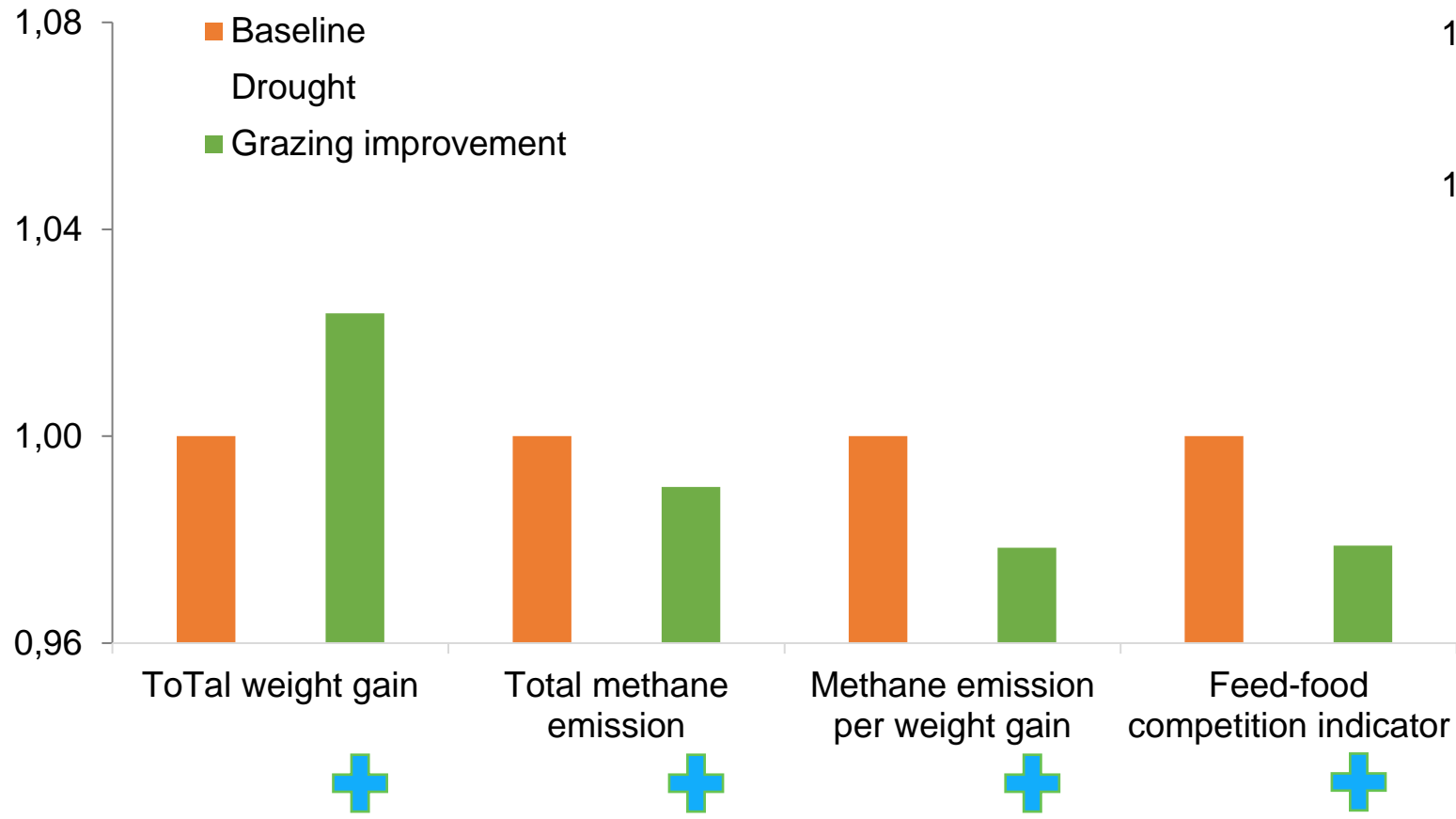


Importation (tons)

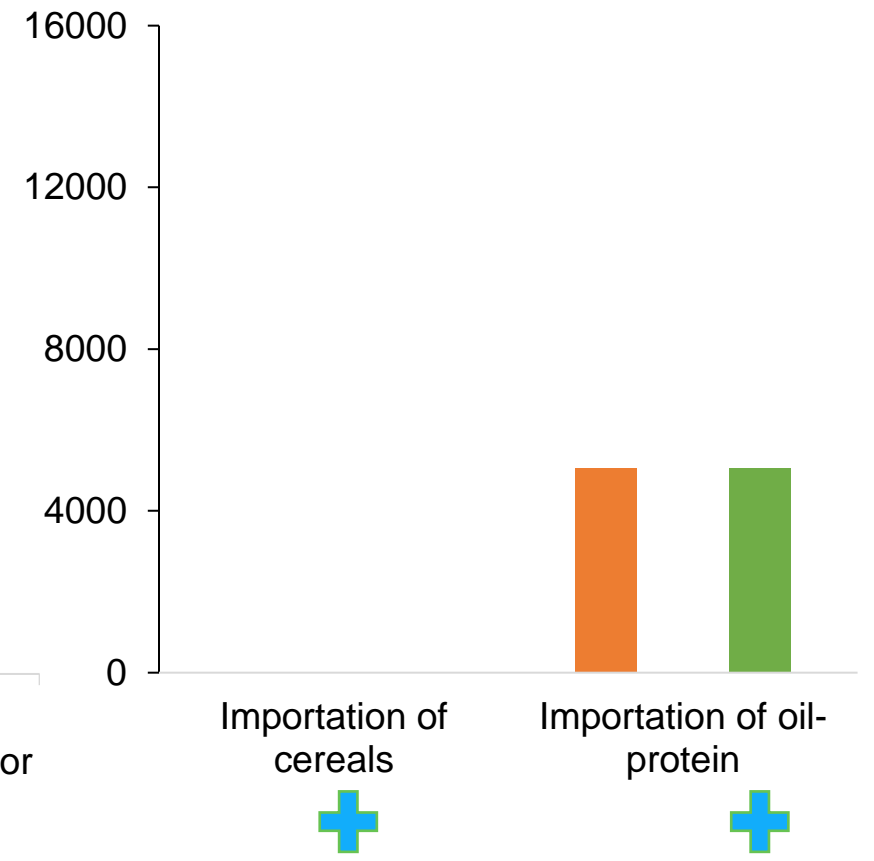


Results of scenarios

Variation compared to baseline

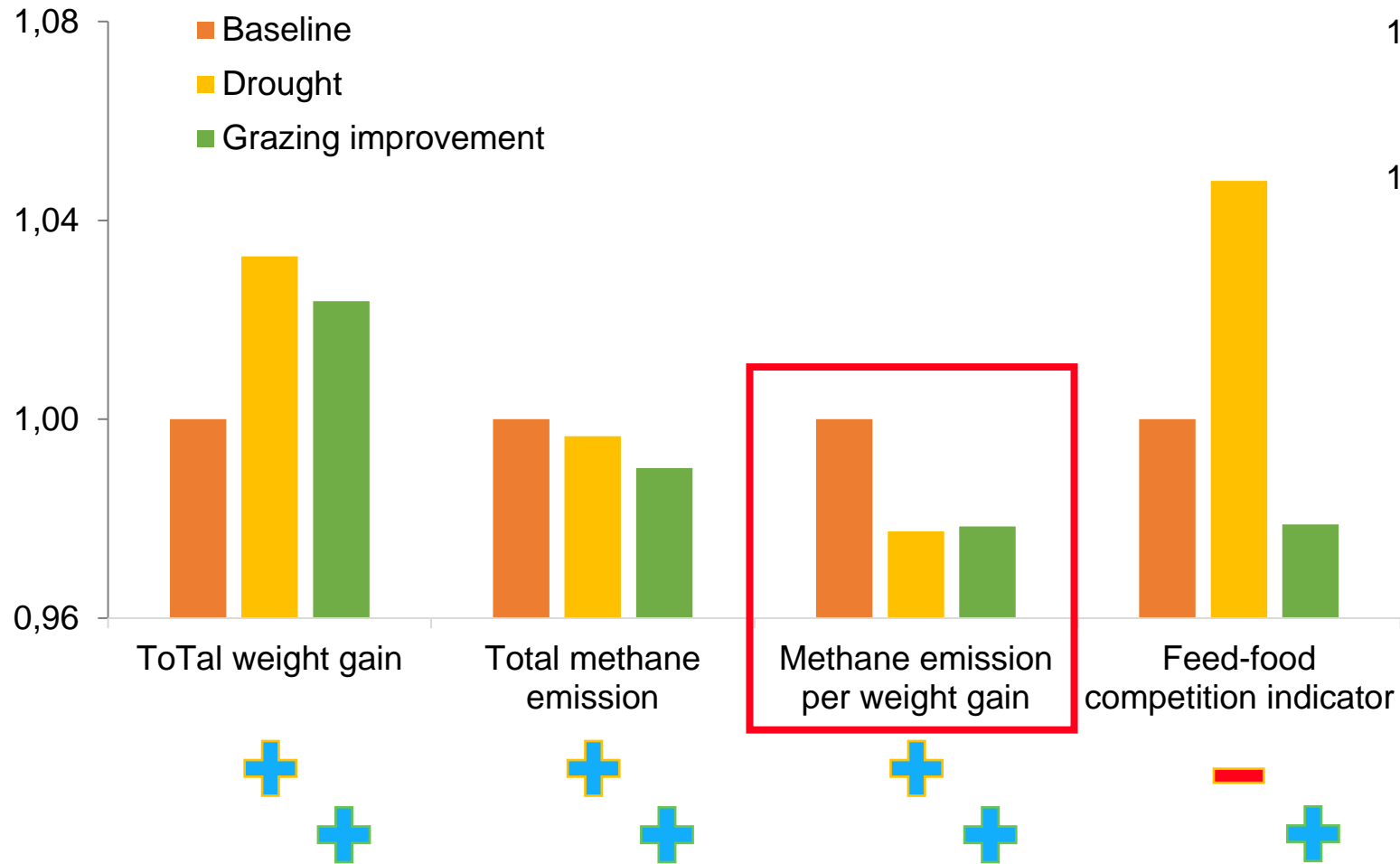


Importation (tons)

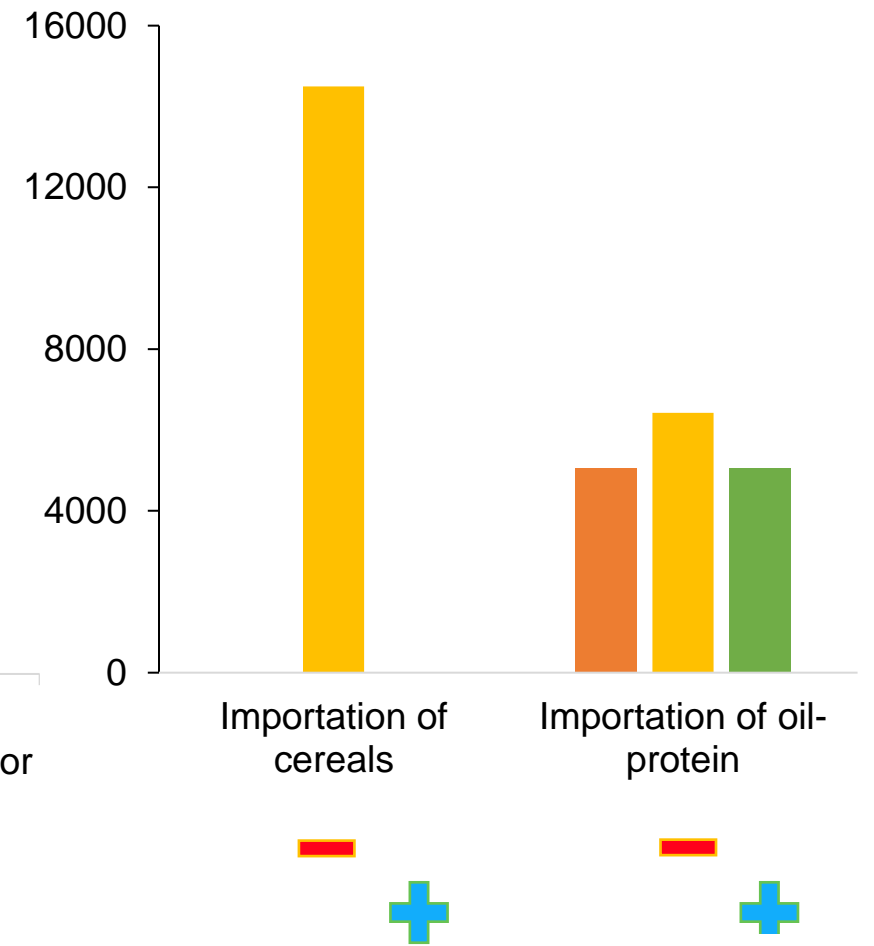


Results of scenarios

Variation compared to baseline



Importation (tons)



Conclusion

- Agricultural production (crop and grass), livestock utilization (feed and land) and animal performance (meat and methane) in a **territorial scale** are integrated in our model
- **Diet composition** is a lever to handle trade-offs **between animal performance and land use**
- **Cereals** addition provide a **possibility of win-win** on increasing animal meat production and reducing methane emission, but with a risk of **intensifying food-feed competition and import needs**.
- **Improving grazing quality** could be a win-win strategy for cattle management

Thank you for listening!



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