A mechanistic model to explore potential beef production of cattle breeds in contrasting climates

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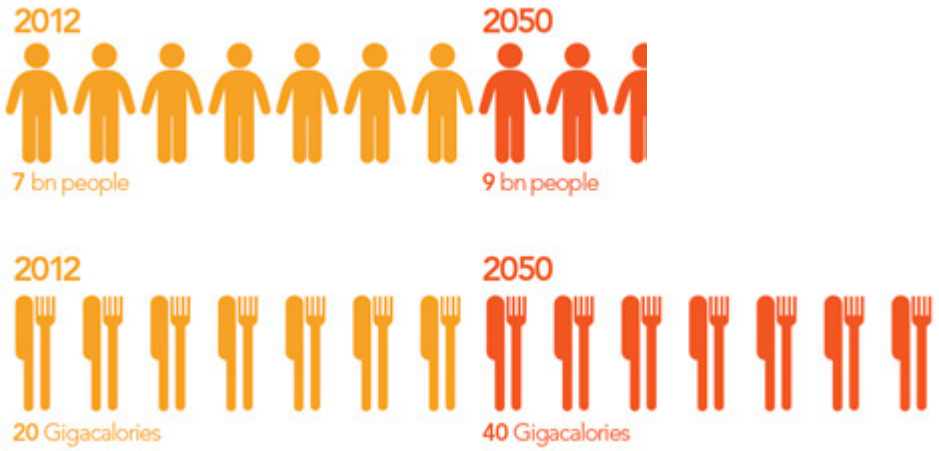
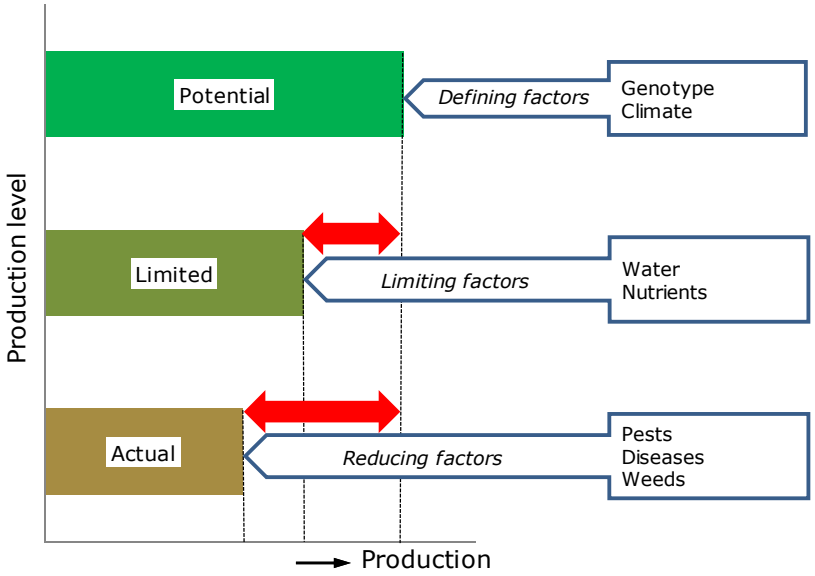
Introduction

- Increased demand for livestock products
- Sustainable intensification
- Production ecology



Introduction

Crops



Adapted from: Van Ittersum and Rabbinge (1997) and Van de Ven *et al*. (2003)

Research aims

Develop a method to quantify

- potential production
- feed limited production

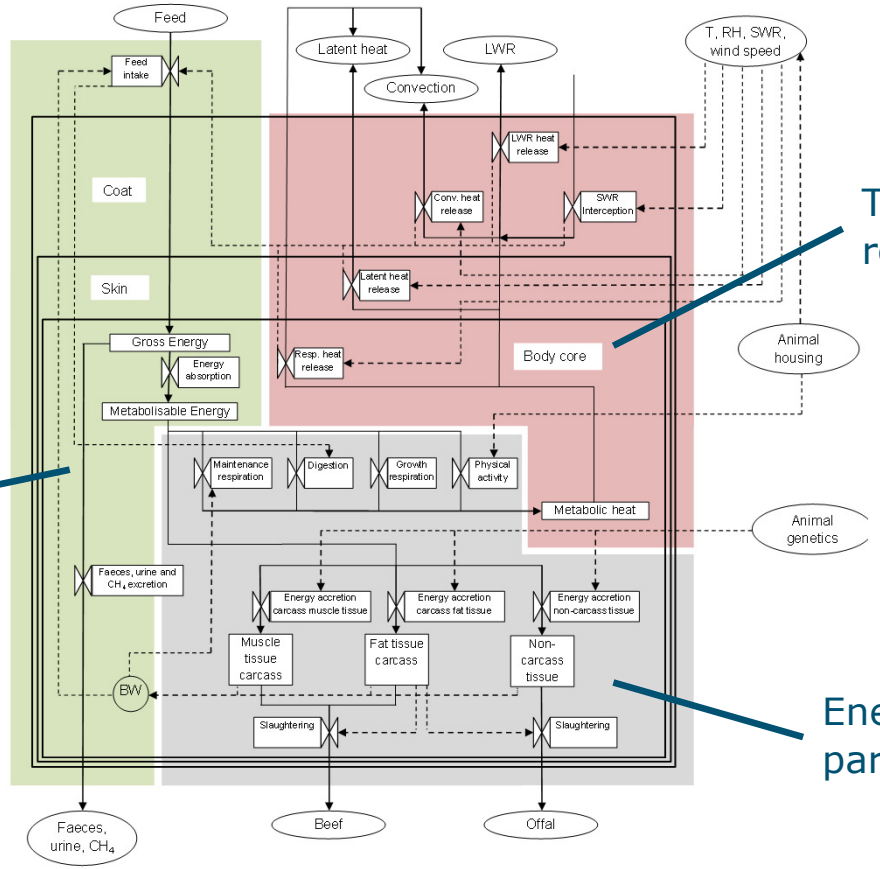
for Charolais and Boran beef cattle in the Netherlands, France, and Ethiopia

Charolais

Boran

Methods: livestock model

- Livestock growth model based on production ecology

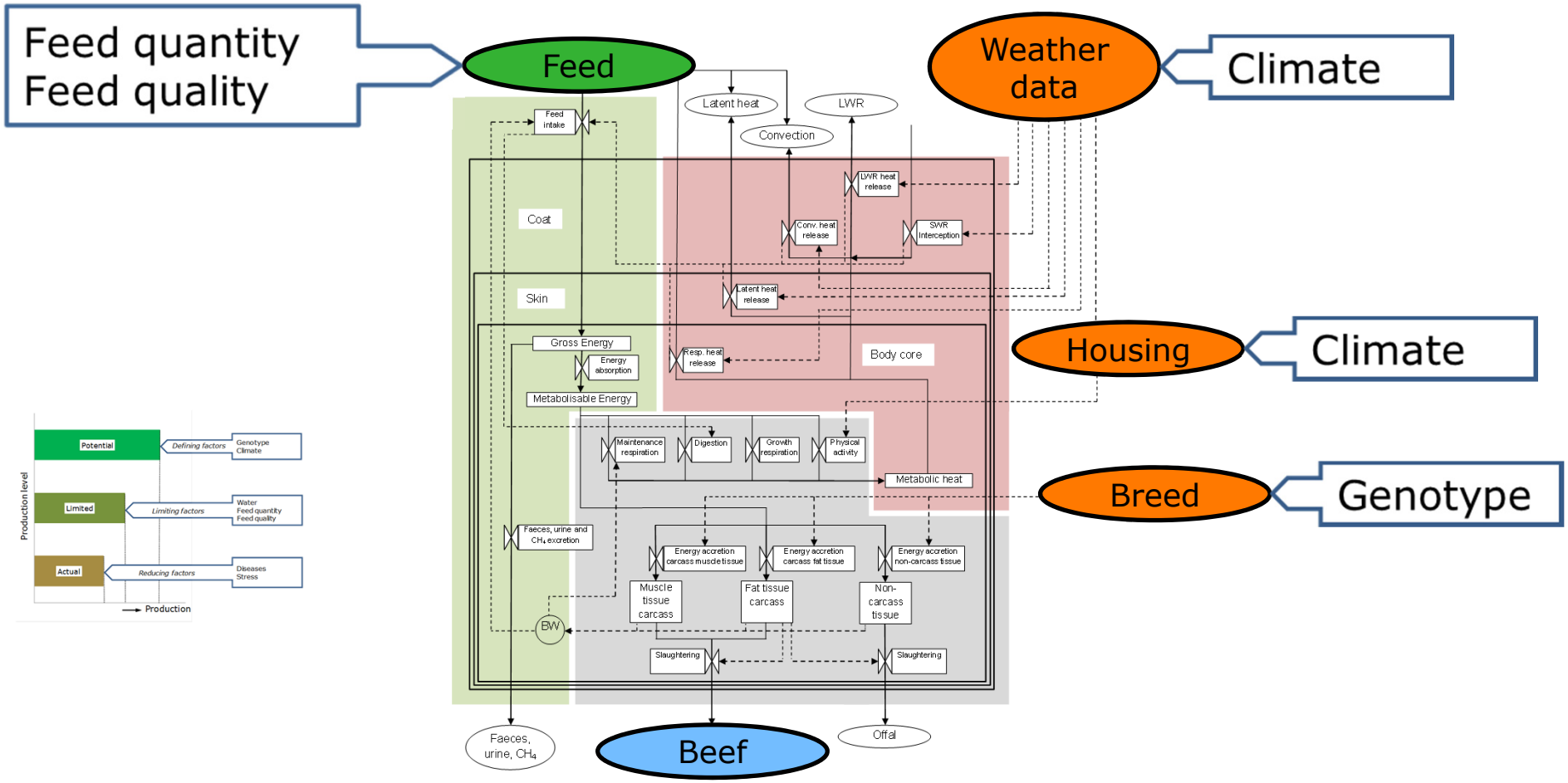


Thermo-regulation

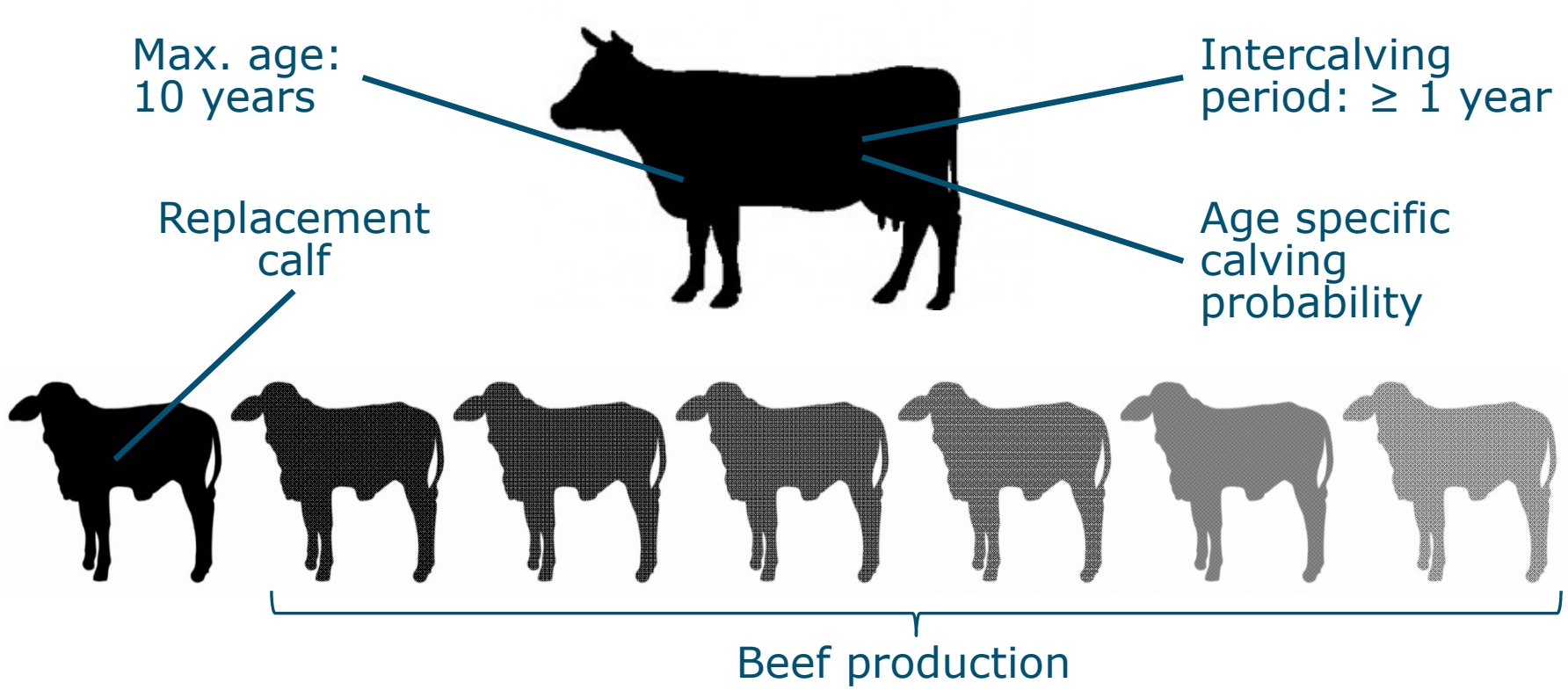
Feed intake and digestion

Energy partitioning

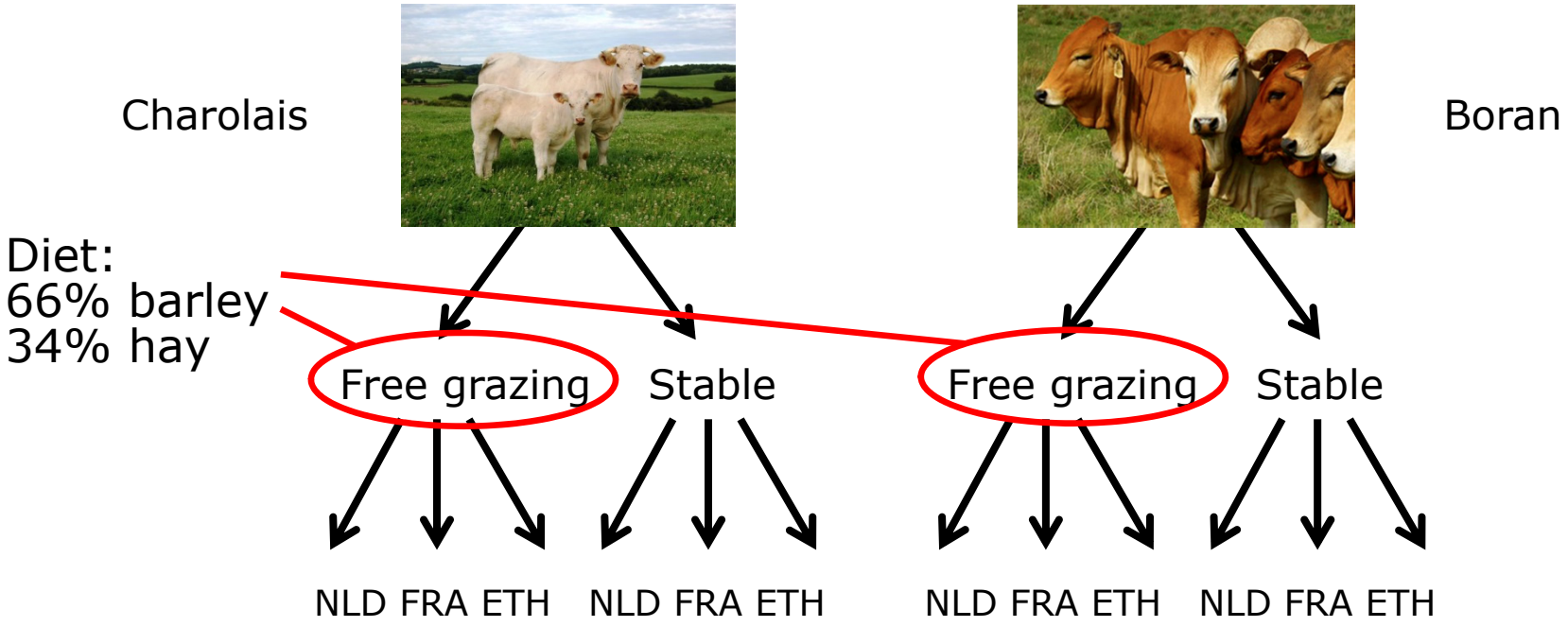
Methods: livestock model



Methods: herd dynamics



Model simulation: potential beef production



NLD = Netherlands; FRA = France; ETH= Ethiopia

Results: potential beef production

Breed	Housing	Country	Potential production level	
			Feed efficiency (g beef kg^{-1} DM feed)	Beef production (kg beef $animal^{-1}$ $year^{-1}$)
Charolais	Stable	Netherlands	53	
		France	53	
		Ethiopia	53	
	Free grazing	Netherlands	45	
		France	45	
		Ethiopia	35	
Boran	Stable	Netherlands		
		France		
		Ethiopia		
	Free grazing	Netherlands		
		France		
		Ethiopia		

Results: potential beef production

Breed	Housing	Country	Potential production level	
			Feed efficiency (g beef kg^{-1} DM feed)	Beef production (kg beef $animal^{-1}$ $year^{-1}$)
Charolais	Stable	Netherlands	53	
		France	53	
		Ethiopia	53	
	Free grazing	Netherlands	45	
		France	45	
		Ethiopia	35	
Boran	Stable	Netherlands	38	
		France	39	
		Ethiopia	47	
	Free grazing	Netherlands	35	
		France	36	
		Ethiopia	40	

Results: potential beef production

Breed	Housing	Country	Potential production level	
			Feed efficiency (g beef kg^{-1} DM feed)	Beef production (kg beef $animal^{-1}$ $year^{-1}$)
Charolais	Stable	Netherlands	53	
		France	53	
		Ethiopia	53	
	Free grazing	Netherlands	45	
		France	45	
		Ethiopia	35	
Boran	Stable	Netherlands	38	
		France	39	
		Ethiopia	47	
	Free grazing	Netherlands	35	
		France	36	
		Ethiopia	40	

Results: potential beef production

Breed	Housing	Country	Potential production level	
			Feed efficiency (g beef kg^{-1} DM feed)	Beef production (kg beef $animal^{-1}$ $year^{-1}$)
Charolais	Stable	Netherlands	53	120
		France	53	120
		Ethiopia	53	120
	Free grazing	Netherlands	45	116
		France	45	114
		Ethiopia	35	82
Boran	Stable	Netherlands	38	46
		France	39	47
		Ethiopia	47	56
	Free grazing	Netherlands	35	48
		France	36	49
		Ethiopia	40	56

Model simulation: feed limited production

Charolais

Boran

Diet:
66% grass (summer)
34% hay

Free grazing Stable Free grazing Stable

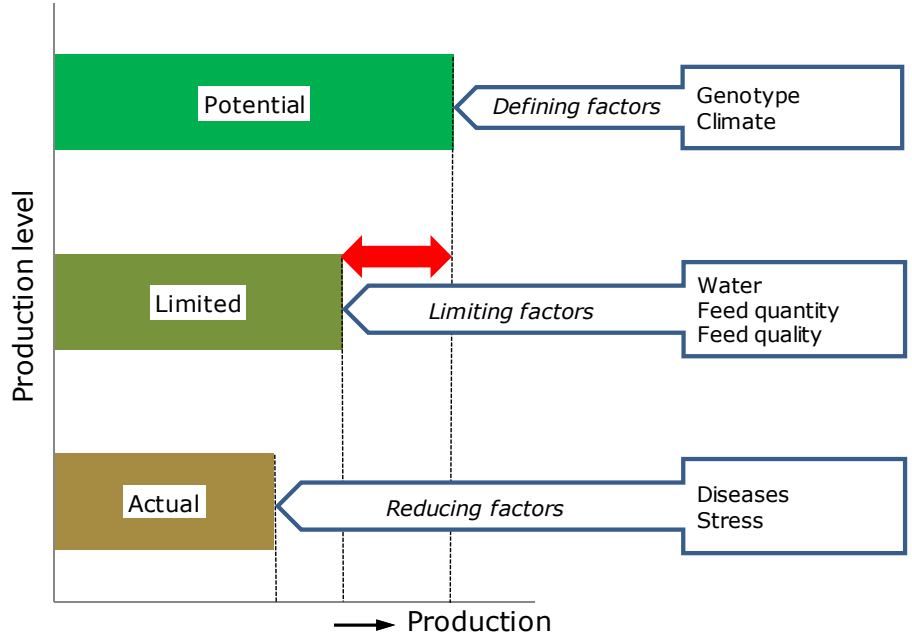
NLD FRA ETH NLD FRA ETH NLD FRA ETH NLD FRA ETH

NLD = Netherlands; FRA = France; ETH= Ethiopia

Results: Feed limited production

Breed	Housing	Country	Feed efficiency	
			Potential (g beef kg^{-1} DM feed)	Feed limited (g beef kg^{-1} DM feed)
Charolais	Stable	Netherlands	53	33
		France	53	33
		Ethiopia	53	33
	Free grazing	Netherlands	45	29
		France	45	28
		Ethiopia	35	18
Boran	Stable	Netherlands	38	23
		France	39	24
		Ethiopia	47	29
	Free grazing	Netherlands	35	22
		France	36	22
		Ethiopia	40	24

Results: yield gaps



Results: yield gap

Breed	Housing	Country	Feed efficiency		
			Potential (g beef kg^{-1} DM feed)	Feed limited (g beef kg^{-1} DM feed)	Yield gap (% potential)
Charolais	Stable	Netherlands	53	33	37%
		France	53	33	37%
		Ethiopia	53	33	37%
	Free grazing	Netherlands	45	29	36%
		France	45	28	37%
		Ethiopia	35	18	49%
Boran	Stable	Netherlands	38	23	40%
		France	39	24	38%
		Ethiopia	47	29	38%
	Free grazing	Netherlands	35	22	37%
		France	36	22	39%
		Ethiopia	40	24	39%

Discussion

- Application with more detailed data
- Model validation
- Extend concepts to chicken, pigs, and dairy cows
- Coupling crop and livestock production

Conclusions / key messages

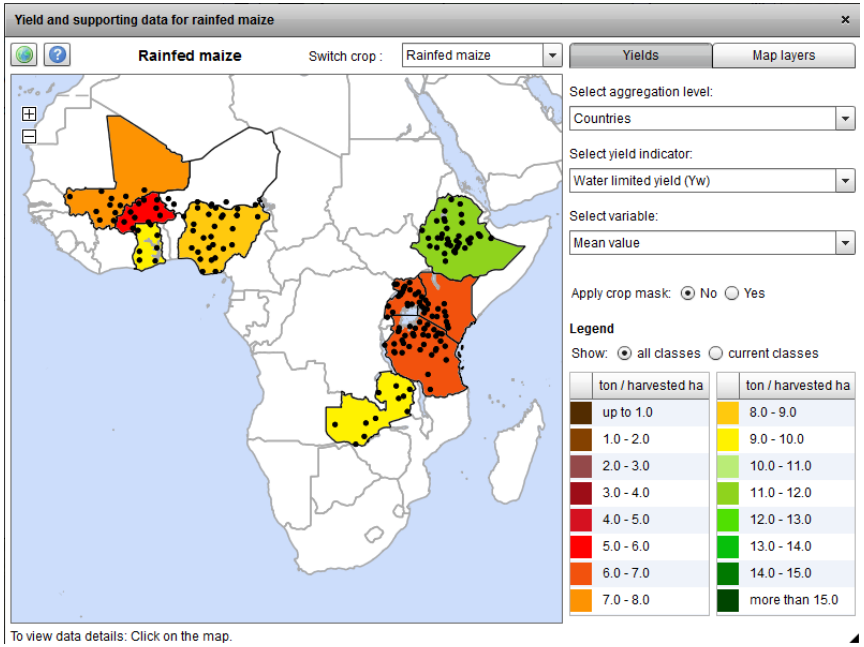
- First quantitative assessment of potential and feed limited beef production
- Approach enables development of new, generic models for yield gap analysis in livestock
- Simulation of farm management options to improve livestock production

Thank you!

More information:

www.yieldgap.org

Contact:
aart.vanderlinden@wur.nl



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References

Van de Ven, G.W.J., de Ridder, N., van Keulen, H., van Ittersum, M.K., 2003. Concepts in production ecology for analysis and design of animal and plant-animal production systems. Agric. Syst. 76, 507-525, http://dx.doi.org/10.1016/s0308-521x(02)00110-5.

Van Ittersum, M.K., Rabbinge, R., 1997. Concepts in production ecology for analysis and quantification of agricultural input-output combinations. Field Crop. Res. 52, 197-208, http://dx.doi.org/10.1016/s0378-4290(97)00037-3.

Photos

Slide 1: http://www.fao.org/ag/agp/AGPC/doc/Counprof/Australia/australia.htm

Slide 2: http://www.core77.com/blog/case_study/case_study_ento_the_art_of_eating_insects_21841.asp

Slide 6: http://en.wikipedia.org/wiki/Charolais_cattle

http://delareyboran.co.za/boran_cow_list.asp

Internet

Global Yield Gap Atlas
http://www.yieldgap.org/

Mapping for Sustainable Intensification project
https://www.youtube.com/watch?v=NLad4f2Rt9E
http://www.wageningenur.nl/en/About-Wageningen-UR/Strategic-plan/Mapping-for-Sustainable-Intensification.htm

PhD project Aart van der Linden 'Benchmarking Animal Production Systems'
https://www.wageningenur.nl/en/show/Benchmarking-animal-production-systems.htm