



Farm management and sustainability indicators: What and how to include in farm scale models?

LiveM 2016 Conference, 15-16 June 2016, Potsdam

Vera Eory¹ and Nick Hutchings²

¹Scotland's Rural College, ²Aarhus University

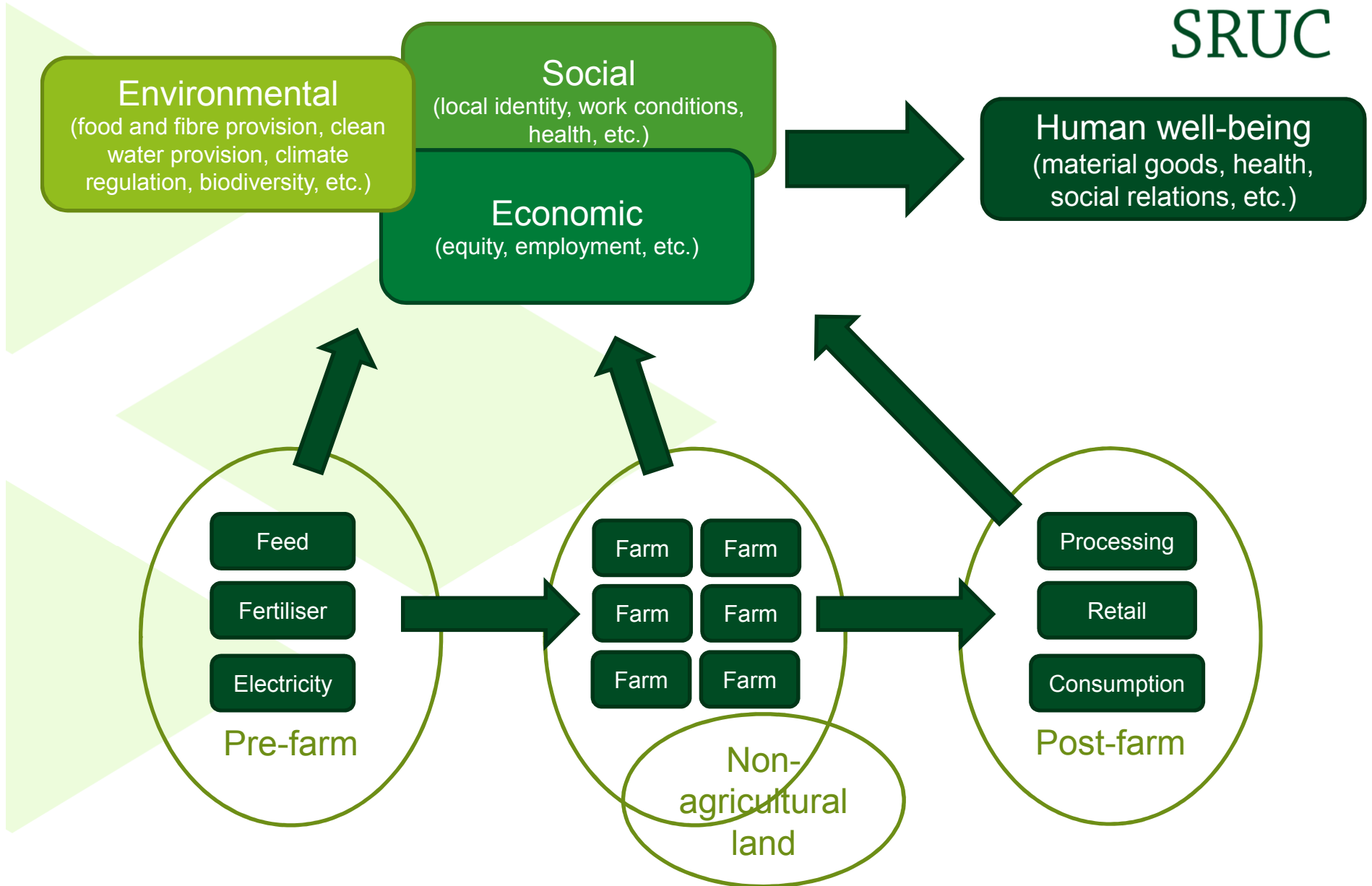
Leading the way in Agriculture and Rural Research, Education and Consulting

Key stuff



1. Considering positive and negative impacts of farm management
2. Footprinting of environmental AND economic AND social impacts

Agricultural sustainability



Costs & benefits of agriculture



Impact	UK	Germany
Water pollution	267	105
Air pollution (GHG, NH ₃)	1,287	1,301
Soil	111	+
Biodiversity and landscape	146	6
Human health	898	10
Total external costs [M EUR y⁻¹]	2,707	1,422
Total external costs (arable & grassland) [£ ha⁻¹]	240	82
Production value [EUR ha ⁻¹]	1,750	2,289
Gross value added [EUR ha ⁻¹]	531	635
Subsidies [EUR ha ⁻¹]	291	181
External costs + Subsidies / Production value	30%	12%
External costs + Subsidies / Gross value added	100%	41%

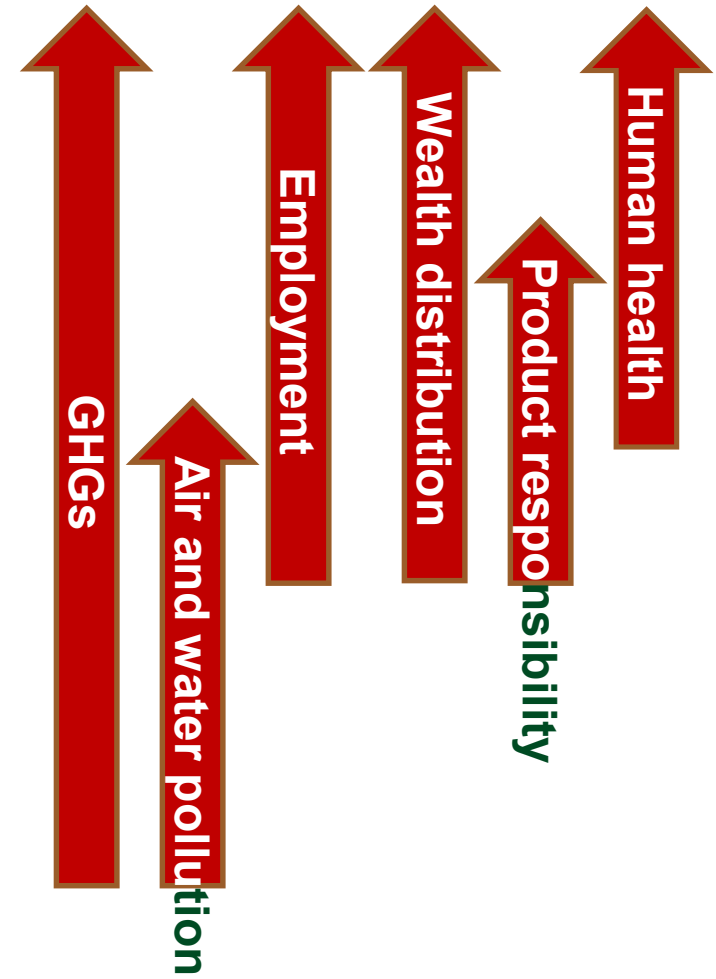
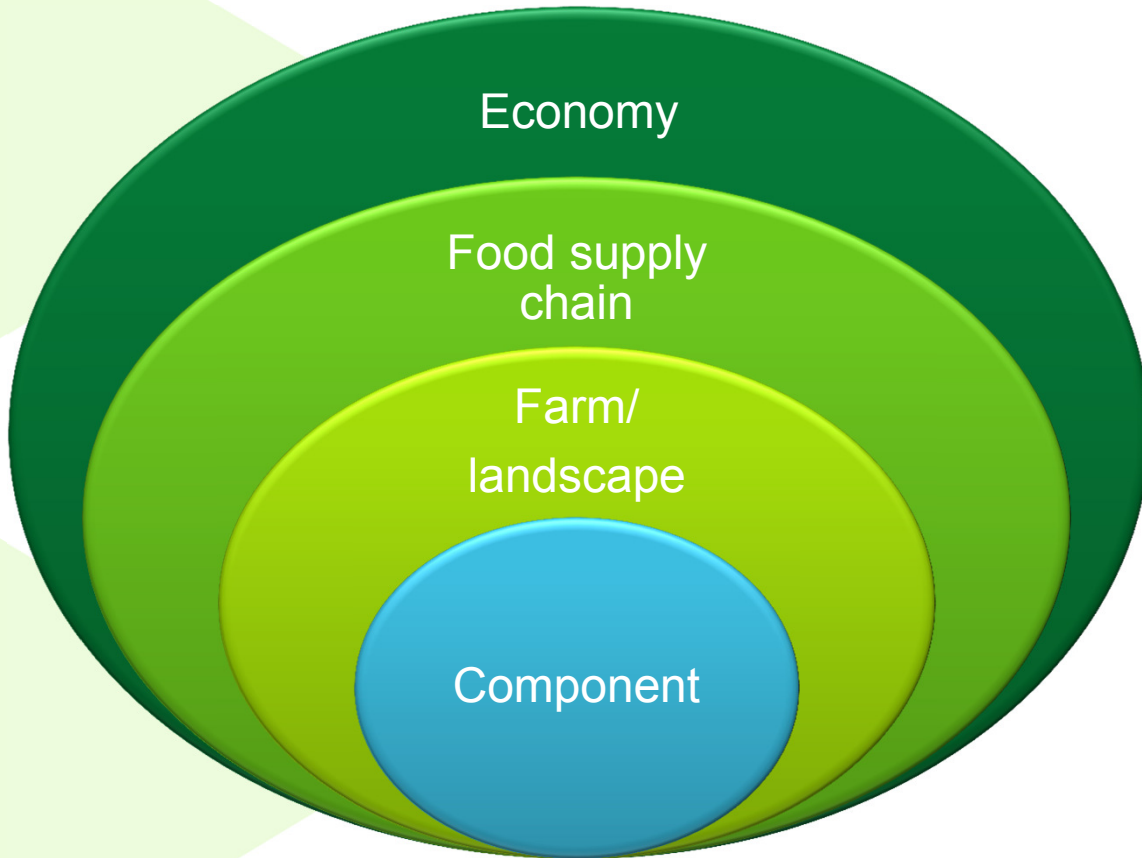
Based on Pretty *et al.* 2001, Eurostat

Agricultural sustainability



Environmental	Economic	Social
Water quality (N, P, ...)	Production	Working conditions
Air quality (N, PM, ...)	Income/wealth distribution	Human rights
GHGs	Employment	Communities, society
Soil quality	Consumption patterns	Product responsibility
Land use	Technology, infrastructure	Human health
Biodiversity	Production efficiency	Animal welfare
Pests and diseases	Competitiveness	...
Energy use	...	
Water use		
Toxicity (incl. antibiotics)		
...		

Scale and scope



What to consider



1. What are the significant negative & positive impacts?
2. Which impacts depend mostly on on-farm decisions?
3. What are people/policy most concerned about?

How to integrate



- Taking stock (~inventory approach) versus looking at changes (~impact assessment)
- Extent of impact (implicit in the model or coefficients)
- Assessment options
 - Physical characterisation without a common assessment framework (e.g. LCA, ecosystem service modelling)
 - Multi-criteria assessment – weights of impacts defined by stakeholders
 - Cost benefit analysis (CBA), ecosystem service valuation
 - impacts monetised

Environmental effects



Impact categories	Emissions/effects	Common metric
Global warming	GHGs	CO ₂ eq
Land use (& sea bottom)	Land occupation	Ecological damage
Energy use	Fossil fuels	Resource used versus left
Acidification	SO _x , NO _x , NH ₄ , etc	H ⁺ eq
Eutrophication	PO ₄ , NO _x , NH ₄ , NO ₃ ⁻	PO ₄ eq
Water use	Water extraction	Resource used versus left
Biodiversity	Biodiversity loss	Species richness and evenness
Terrestrial & aquatic toxicity	Chemicals with lethal concentration	LC ₅₀ eq
...		

Based on Curran 2006

- Many well developed techniques (e.g. LCA)
- Useful data sources

Economic effects



- Impact categories: income/wealth distribution, (rural) employment, consumption patterns, technology/infrastructure, competitiveness
- Farm metrics: labour, mechanisation, income/profit
- Data sources: economic equilibrium models, econometric approaches and input-output models (e.g. employment multipliers) as they capture cross-economy and international effects

Social effects



- Impact categories: working conditions, human rights, communities & society, product responsibility, human health, animal welfare
- Farm metrics: farm/contract labour, product quality, additional data on retailer/market
- Data sources: social impact assessment and Social LCA
 - Boundaries: company's influence vs product comparison
 - Often qualitative indicators (good/bad rating)
 - Data scarcity

Valuation



- Location is important
- In some cases threshold effect and strong marginal effect
- Limited number of studies for a comprehensive coverage in Europe – benefit transfer

Potential data sources

- GHG: C value (non-traded sector)
- Valuation of ecosystem services, e.g. UK National Ecosystem Assessment, European Nitrogen Assessment,
- Government environmental valuation publications (a UK database:

<http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=19514#Description>)

Conclusion



1. There is a need to consider both positive and negative impacts of farm management...
2. ... regarding environmental AND economic AND social impacts – economic and social footprinting?
3. Methodologies exist which can be adapted
4. Some data are available both on the economic and social effects



Thank you!

vera.eory@sruc.ac.uk

nick.hutchings@agro.au.dk

Leading the way in Agriculture and Rural Research, Education and Consulting