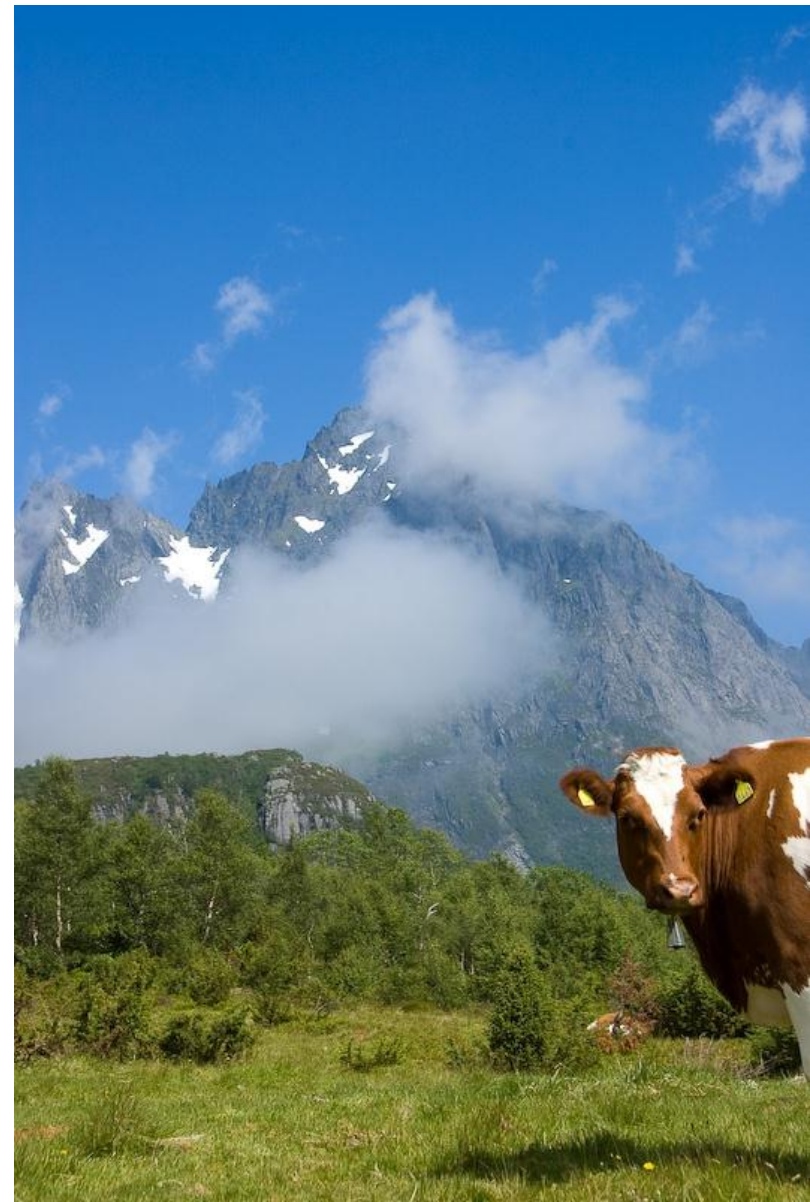


Designing sustainable systems for dairy farming - a modelling approach

Knut Anders Hovstad



Norwegian Institute for
Agricultural and
Environmental Research





Project:

“Designing sustainable livestock production systems delivering cultural landscapes with public goods and ecosystem services”



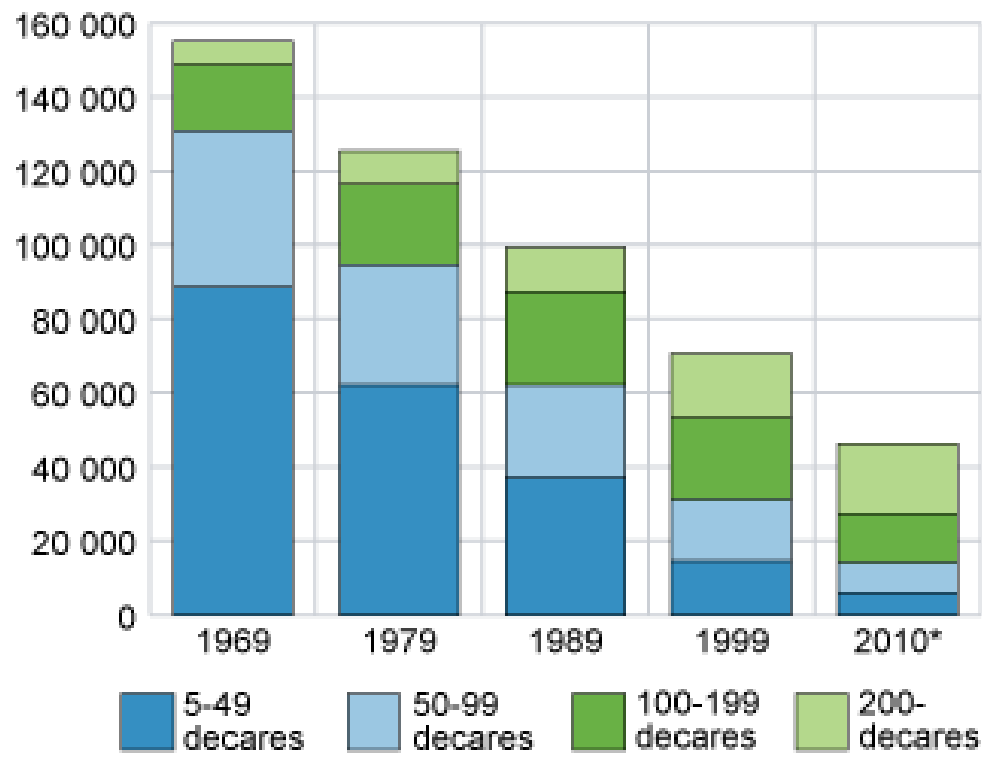
NILF
Norwegian Agricultural
Economics Research
Institute

**HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ**



Large structural changes

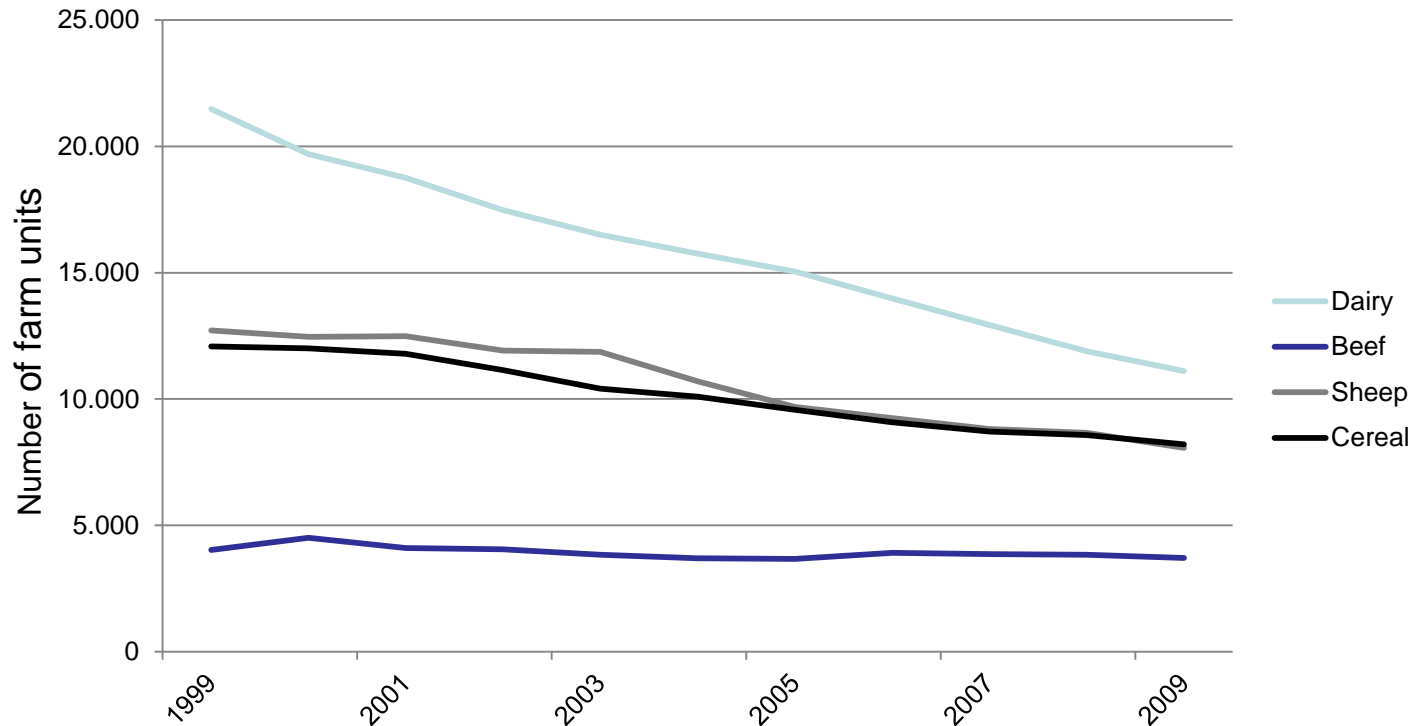
Holdings by size of agricultural area in use. 1969, 1979, 1989, 1999, 2010*



Large decline in number of dairy farms



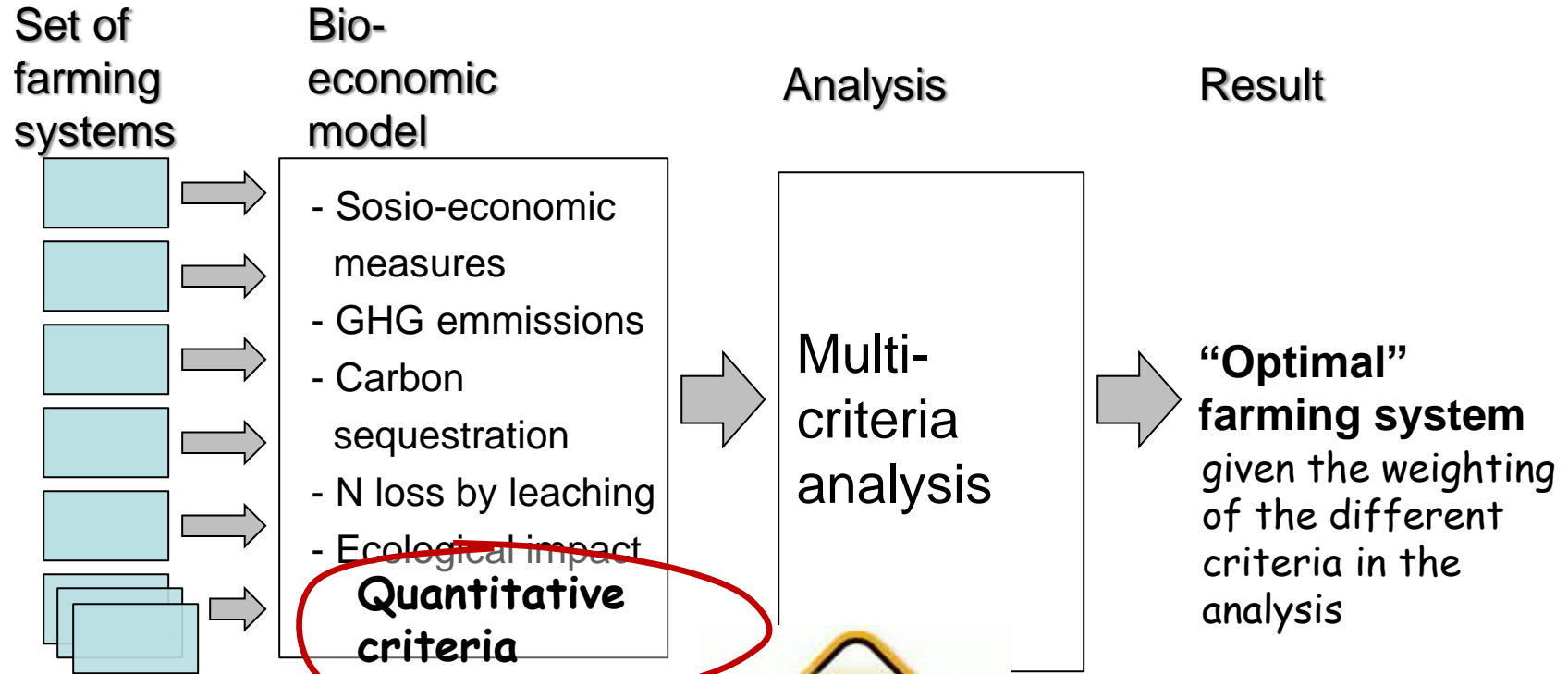
Farmers are not able to keep up with the increase in income in other industries



Our objectives:

- ✓ Main objective: «...to explore and evaluate the multifunctionality of different dairy farming systems»
 - both current and potential new farming systems
- ✓ Build a basic but extendible model which describes the relationship between economy, farm-level processes and environmental impact
- ✓ Describe farm-level processes in a way that can be scaled up to the landscape or regional level
- ✓ Combine ideas and methods from different disciplines

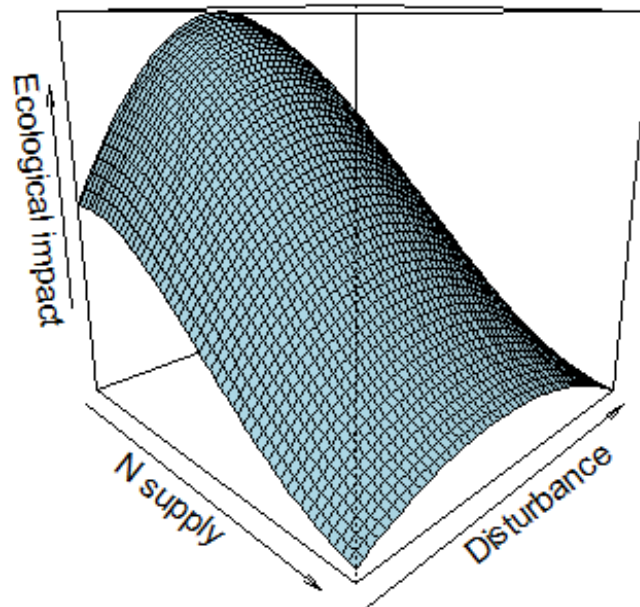
Our modelling approach:



Biodiversity effects

Ecological impact index - based on basic principles in ecology

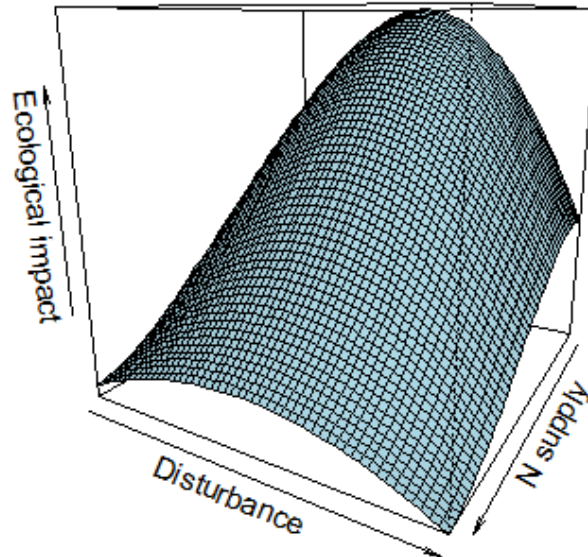
- i.* Intermediate disturbance hypothesis
- ii.* Diversity - N supply relationship with inverse s-shape



Biodiversity effects

Ecological impact index - based on basic principles in ecology

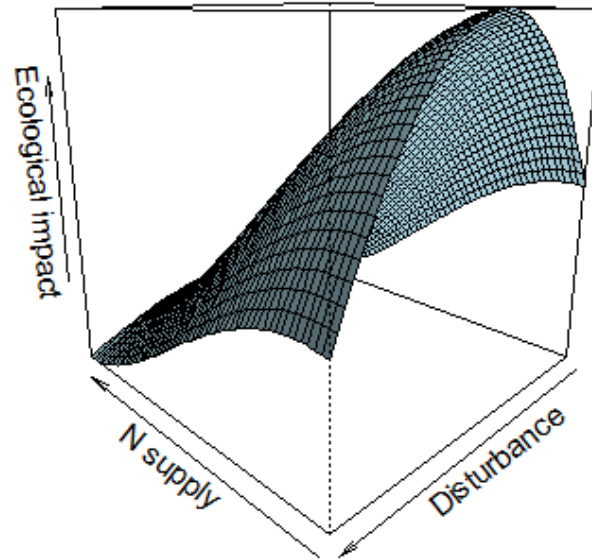
- i.* Intermediate disturbance hypothesis
- ii.* Diversity - N supply relationship with inverse s-shape



Biodiversity effects

Ecological impact index - based on basic principles in ecology

- i.* Intermediate disturbance hypothesis
- ii.* Diversity - N supply relationship with inverse s-shape



GHG emissions

- ✓ CH₄ and N₂O are estimated using an accounting approach which builds on IPCC standards but adapted to Norwegian conditions
- ✓ N excretion per animal is calculated based on production intensity
- ✓ CH₄ emissions are estimated from gross energy intake and a CH₄ conversion rate which depends on livestock category, milk yield and feeding plan
- ✓ For livestock, emissions also depend on housing of livestock, manure handling and grazing period
- ✓ For the plant soil system, emissions depend on grassland and crop type, use of fertilizer and other factors as time between ploughing and reseeding
- ✓ N loss by leaching and C sequestration is also estimated but this part need improvement

Examples

	Farming system		
	High yield	Moderate yield	Moderate yield +
Farm land, ha	27	27	33
Cultivated ley, ha	14	14	16
Pasture, ha	13	13	17
Milk quota, kg milk	150000	150000	150000
Dairy cows	19	24	24
Yield per cow, kg milk	7500	6000	6000

Examples

	Farming system		
	High yield	Moderate yield	Moderate yield +
Farm land, ha	27	27	33
Cultivated ley, ha	14	14	16
Pasture, ha	13	13	17
Milk quota, kg milk	150000	150000	150000
Dairy cows	19	24	24
Yield per cow, kg milk	7500	6000	6000
Forage requirement, FEm x 1000	164	184	184

Examples

	Farming system		
	High yield	Moderate yield	Moderate yield +
Farm land, ha	27	27	33
Cultivated ley, ha	14	14	16
Pasture, ha	13	13	17
Milk quota, kg milk	150000	150000	150000
Dairy cows	19	24	24
Yield per cow, kg milk	7500	6000	6000
Forage requirement, FEm x 1000	164	184	184

Bulls and heifers are reared with approximately similar feed plans in the three systems

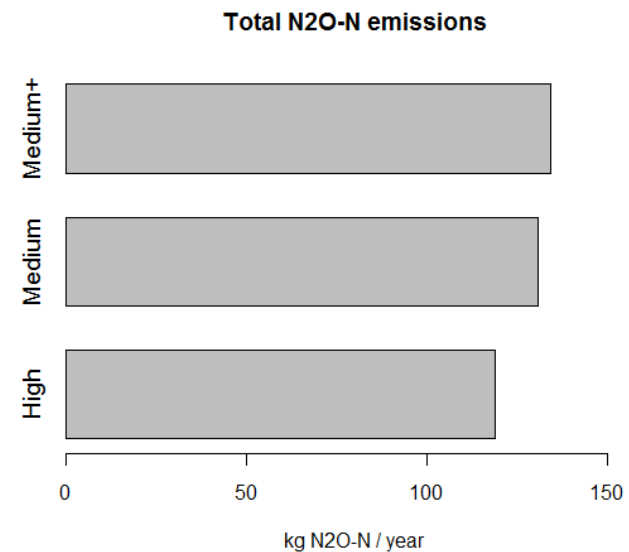
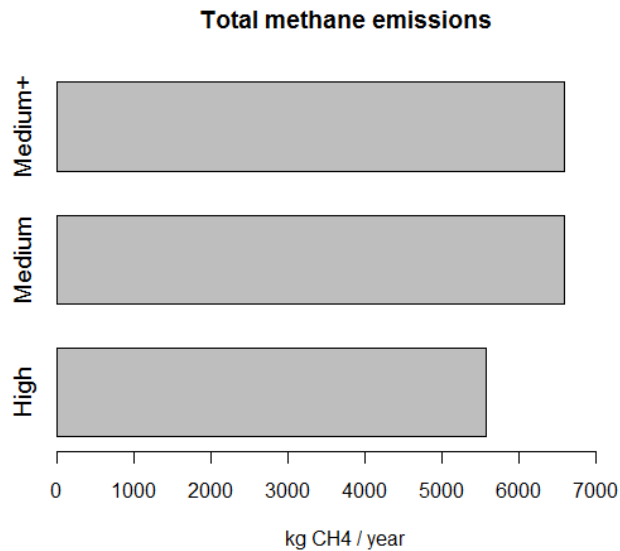
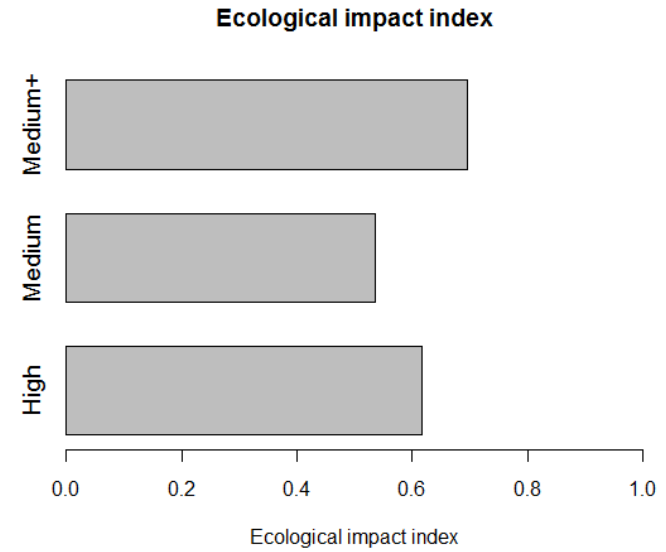
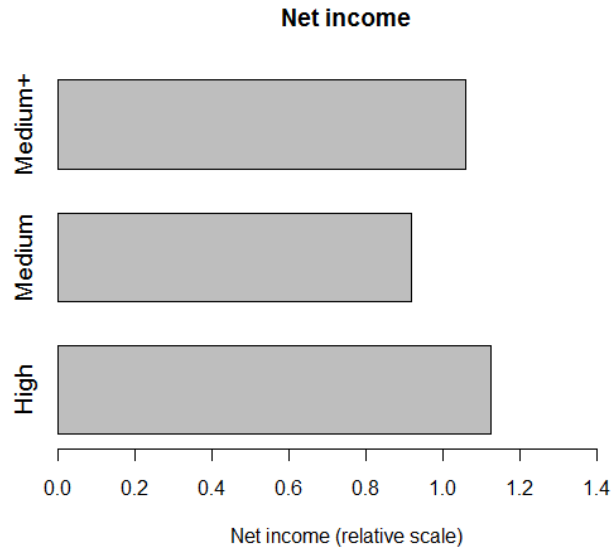
Examples

	Farming system		
	High yield	Moderate yield	Moderate yield +
Farm land, ha	27	27	33
Cultivated ley, ha	14	14	16
Pasture, ha	13	13	17
Milk quota, kg milk	150000	150000	150000
Dairy cows	19	24	24
Yield per cow, kg milk	7500	6000	6000
Forage requirement, FEm x 1000	164	184	184

Bulls and heifers are reared with approximately similar feed plans in the three systems

The use of fertilizer is the same on cultivated ley. Pastures get more fertilizer in the "Moderate yield" farming system in order to meet the need of a larger herd.

Examples - Preliminary results!



Thanks to colleagues **Gustav Fystro, Agnar Hegrenes**
and **Ann Norderhaug!**

Thanks for listening!

