NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

POTENTIAL ECONOMIC BENEFITS OF LAND REALLOCATION BETWEEN FARMS

Klaus Mittenzwei, NIBIO

with significant GIS-help from Eva Solbjørg Flo Heggem and Grete Stokstad

OECD workshop - Farm Level Analysis Network

Oslo, 4.-5. June 2018

OUTLINE

- Research problem
- Previous research
- Project
- Economic model
- Data
- Preliminary results
- Next steps

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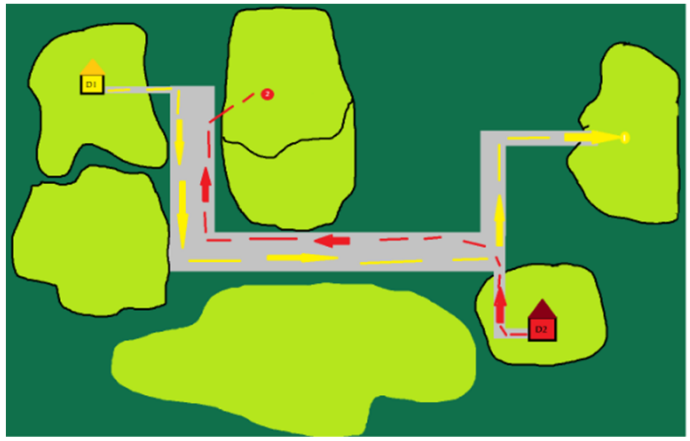
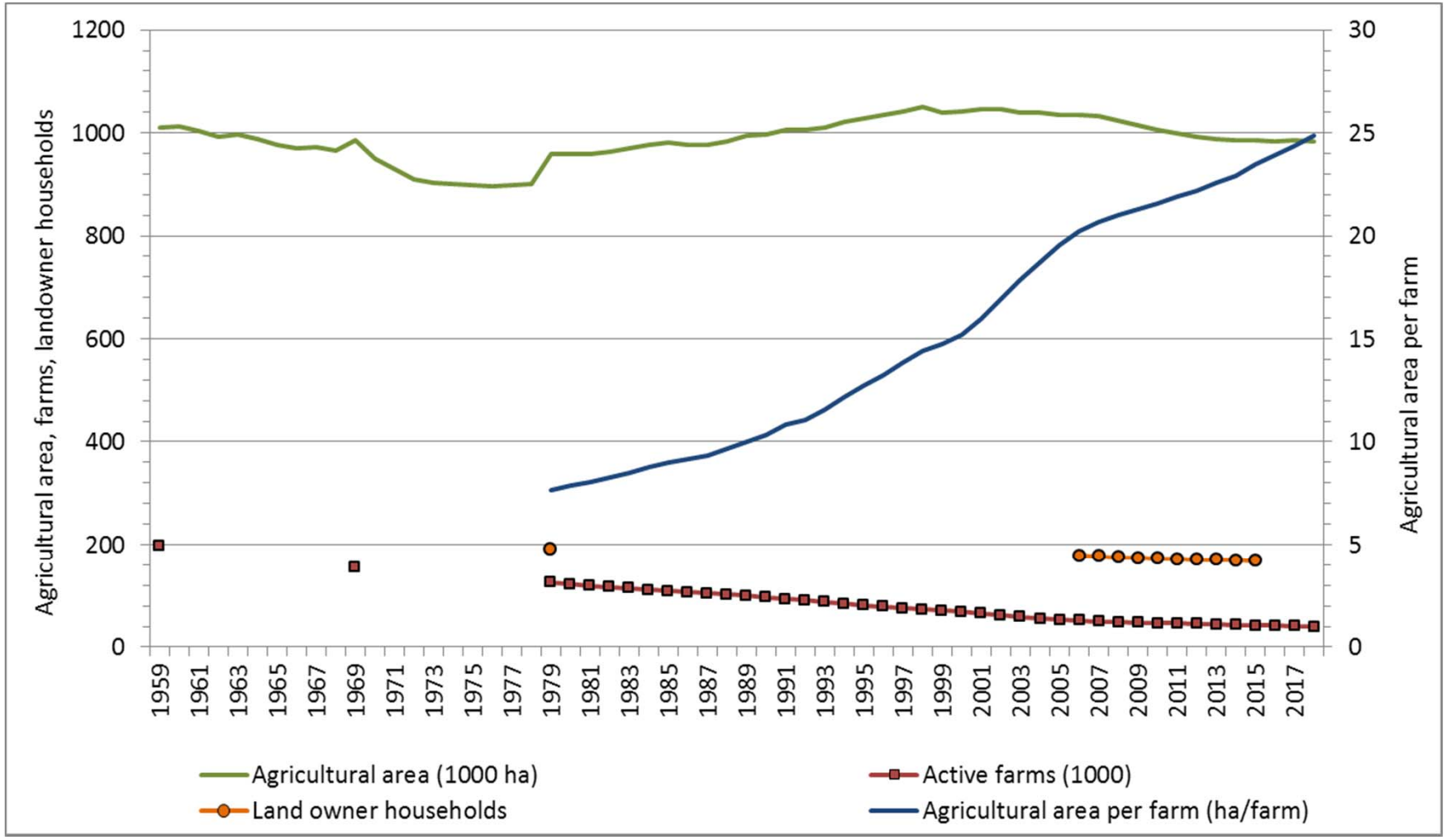
RESEARCH PROBLEM



Kårstad et al. (2015)

- # of land owner households persists
- Technological development favours larger farms
- Scattered and small fields
- => increasing transport for growing farms has become a political issue
- => can land reallocation help reduce transport costs (and reduce farms' carbon footprint)?

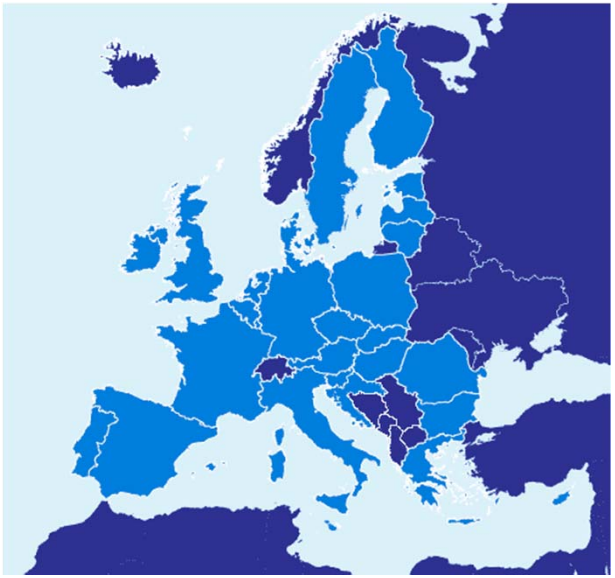
INCREASE OF FARM SIZE AND RENTED LAND

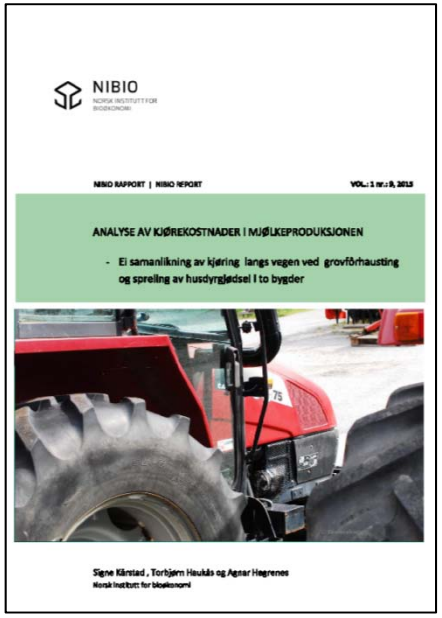


Source: Own compilation based on NIBIO and SSB

PREVIOUS RESEARCH

- Not much in the agricultural economics literature
- Farm density (2010):
  - EU-28: 2.9 farms per km^2
  - Norway: 0.1 farms per km^2
- Some initial work at NIBIO and extension services





NIBIO

NIBIO RAPPORT | NIBIO REPORT

ANALYSE AV KJØREKOSTNADER I MJØLKEPRODUKSJONEN

- Ei samanlikning av kjøring langs vegen ved grovfôrhausting og spreiing av husdyrgjødsel i to bygder

Signe Kårstad , Torbjørn Haukås og Agnar Hegrenes
Norsk institutt for biøkonomi

The project aims at testing methods and processes to facilitate voluntary land reallocation. Scattered and disjointed fields constitute an increasing problem that has grown over time in Norwegian agriculture.

- 2017-2020
- Work packages
  - WP 1: GIS analysis and map production (NIBIO)
  - WP 2: Economic modeling (NIBIO)
  - WP 3-4: Farmer-owner interaction & testing (Ruralis, Nordland Research Institute, NMBU)
- 8 case study regions at municipality level
- International cooperation: Luke, Agroscope
- Aim of WP2: Develop an applied tool to be used by municipality administrators to assess the costs and benefits of voluntary land reallocation

ECONOMIC MODEL

- GIS-referenced network elements in a defined geographic region:
  - Farms: Ag area, animal herds, equipment (?)
  - Fields: Size, owner, manager, crop cover(?), yield potential (?)
  - Road segments: Distance, max speed and elevation
- Objective: Minimize region's total transportation costs
- Constraints:
  - Type of transportation: Roughage production (?), manure spreading (?)
  - Reallocation criteria: ownership, field sharing, yield potential (?)
  - Farm effects: transport costs, agricultural area per farm, farm survival (?)
- Approach: Dantzig, G.B. 1963. Linear Programming and Extensions. RAND.
- Technical implementation: GAMS

CASE STUDY REGION: ØRSTA MUNICIPALITY

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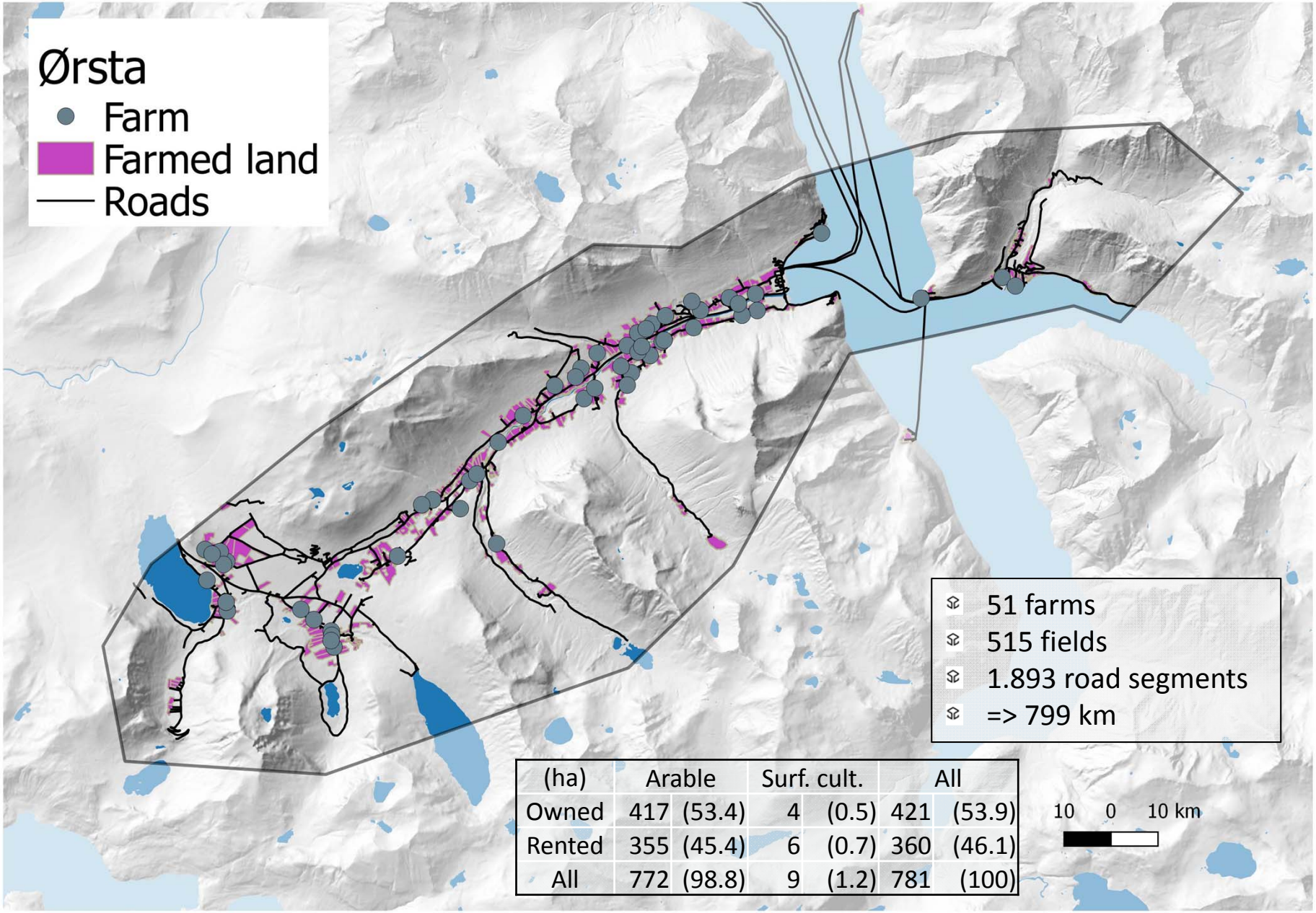
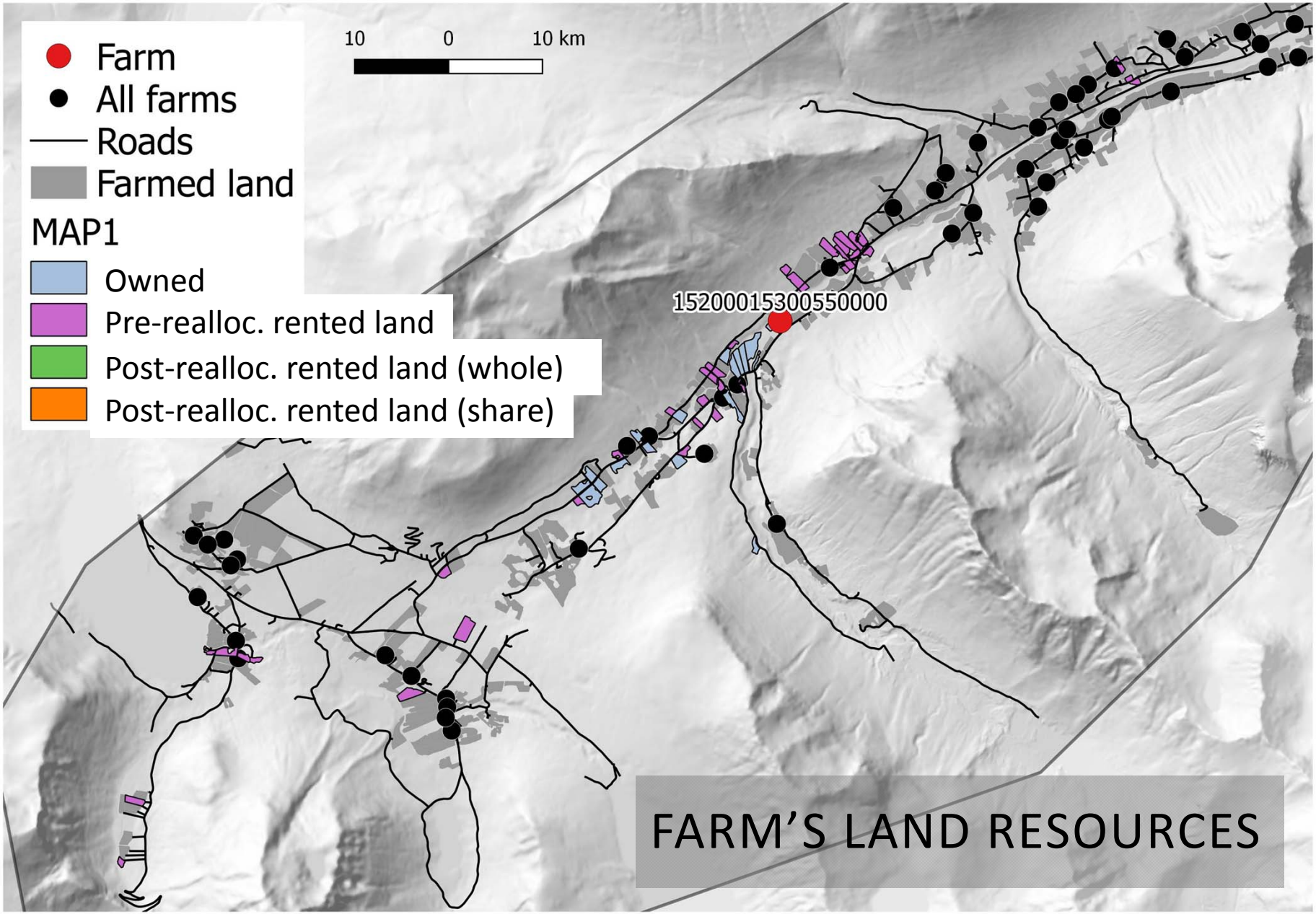
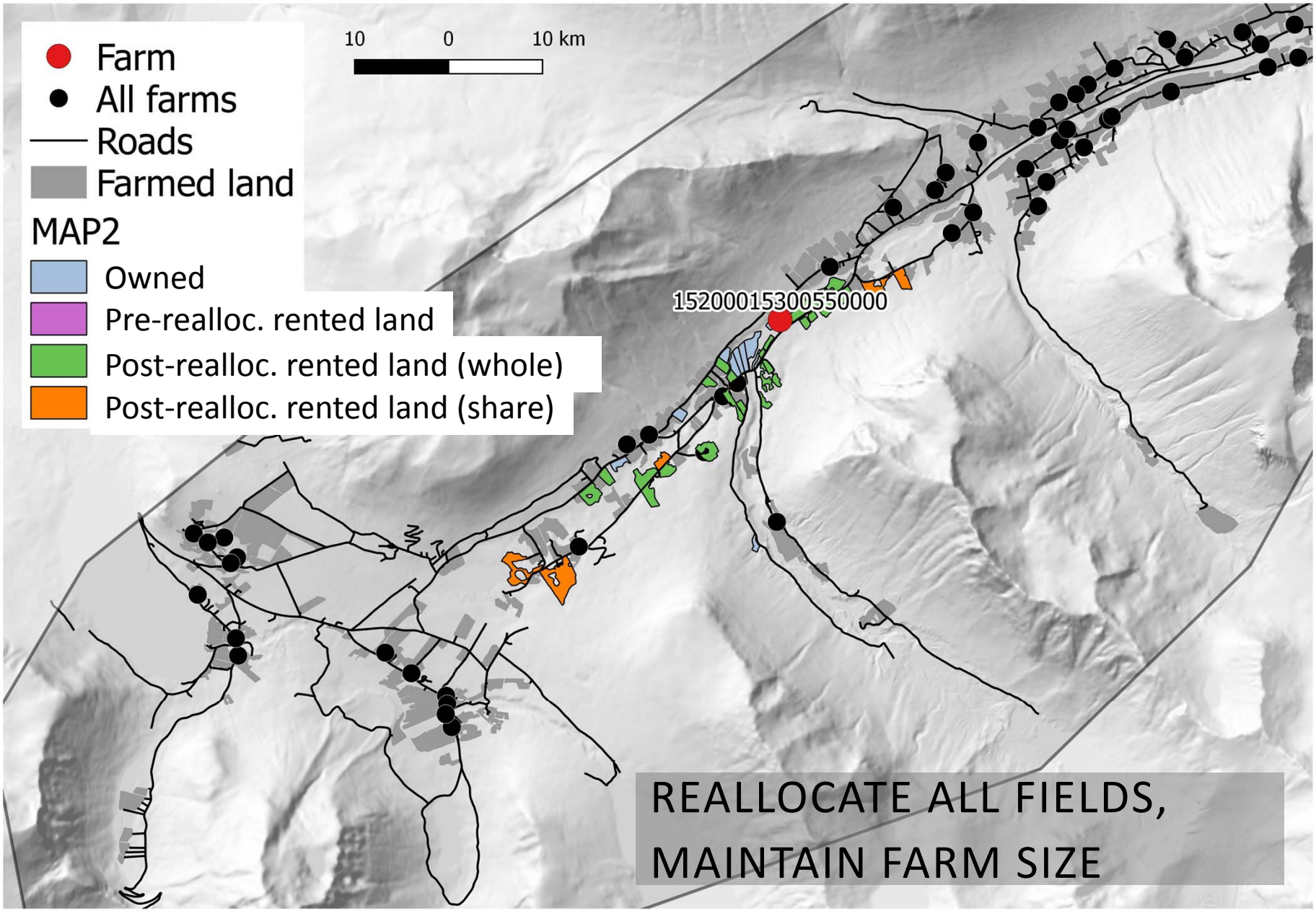
PRESENTED BY GOOGLE MAPS



(ha)	Arable		Surf. cult.		All	
Owned	417	(53.4)	4	(0.5)	421	(53.9)
Rented	355	(45.4)	6	(0.7)	360	(46.1)
All	772	(98.8)	9	(1.2)	781	(100)


Farm
All farms
Roads
Farmed land
MAP1
Owned
Pre-realloc. rented land
Post-realloc. rented land (whole)
Post-realloc. rented land (share)
10
0
10 km
15200015300550000
FARM'S LAND RESOURCES

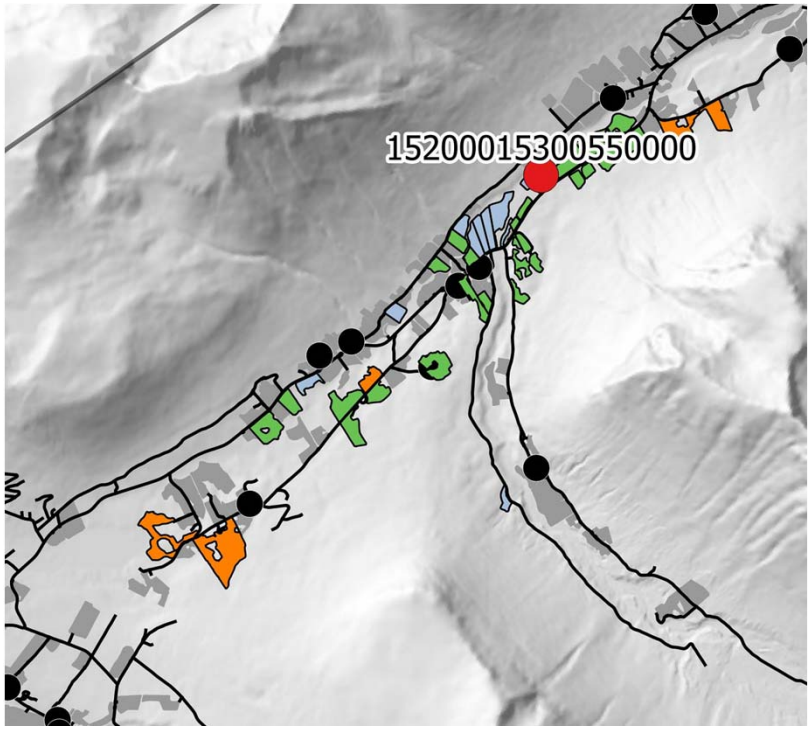

Farm
All farms
Roads
Farmed land
MAP2
Owned
Pre-realloc. rented land
Post-realloc. rented land (whole)
Post-realloc. rented land (share)
10 0 10 km
15200015300550000
REALLOCATE ALL FIELDS,
MAINTAIN FARM SIZE

PRELIMINARY RESULTS

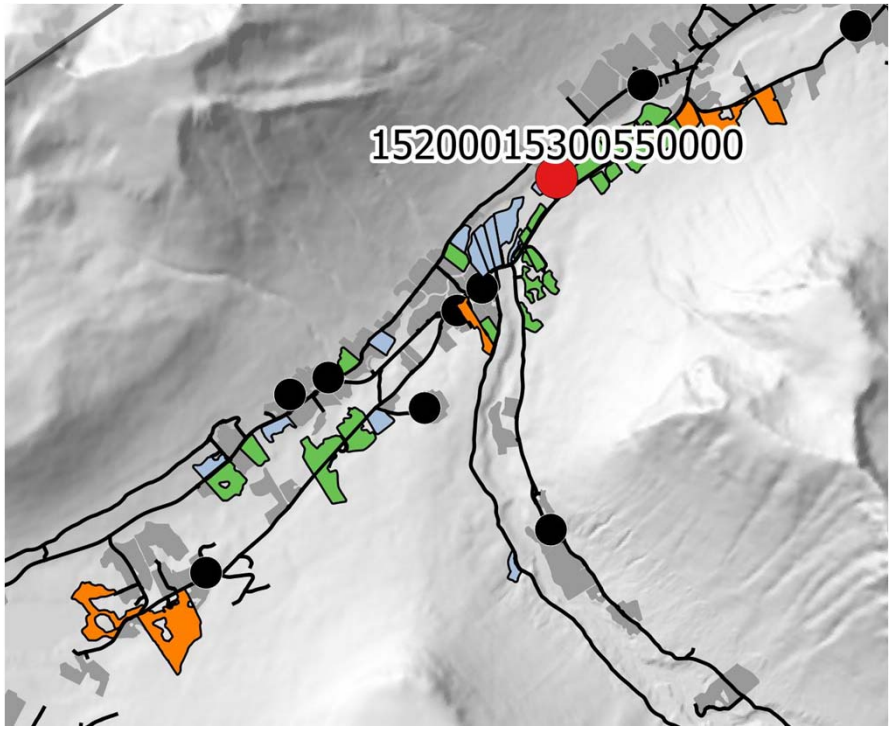
Constraints	Total distance farms – fields	Total distance savings	
	km	km	%
Prior to reallocation	799	0	
Farm size maintained for each farm	464	335	41.9

But: 23 of 51 farms get longer distances

REALLOCATE ALL FIELDS,
MAINTAIN FARM SIZE



REALLOCATE ALL FIELDS,
MAINTAIN FARM SIZE,
MAX CURRENT DISTANCE

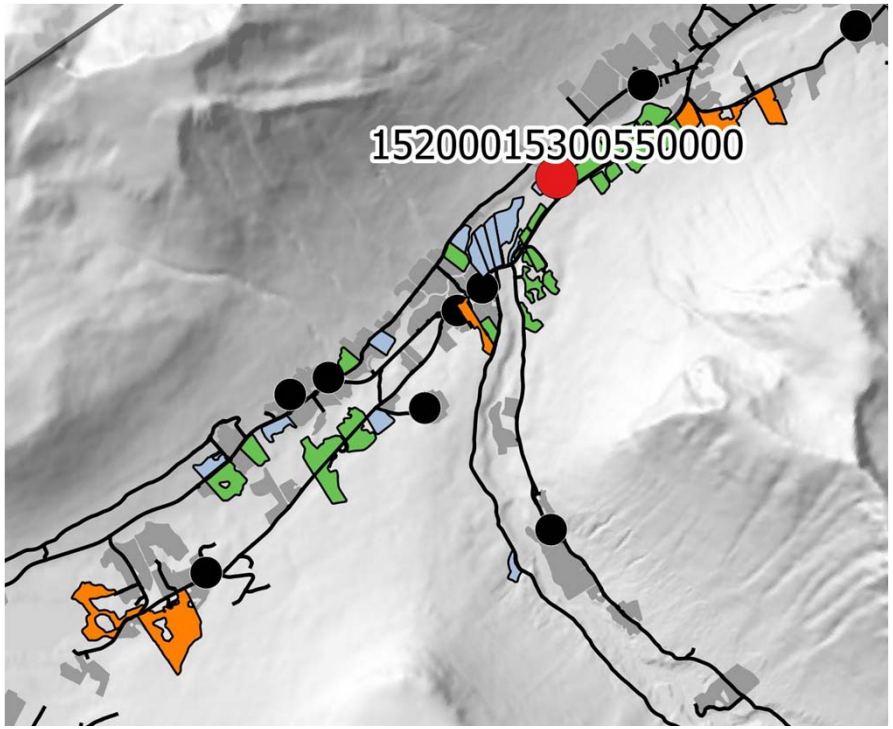


PRELIMINARY RESULTS

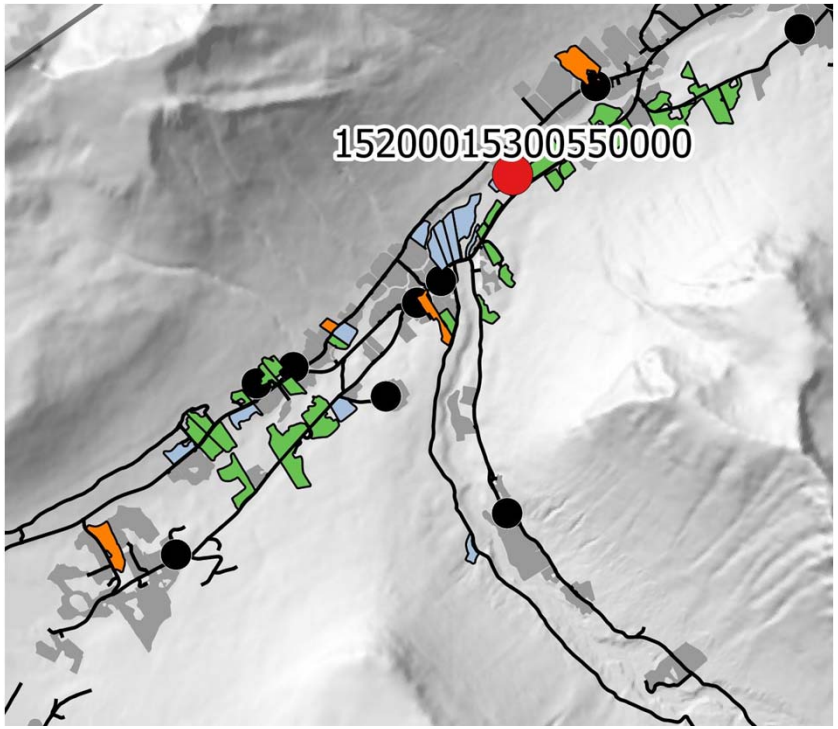
Constraints	Total distance farms – fields	Total distance savings	
	km	km	%
Prior to reallocation	799	0	
Farm size maintained for each farm	464	335	41.9
No increase in transport for each farm	485	313	39.2

But: farms reallocate owned land

REALLOCATE ALL FIELDS,
MAINTAIN FARM SIZE,
MAX CURRENT DISTANCE



REALLOCATE RENTED LAND,
MAINTAIN FARM SIZE,
MAX CURRENT DISTANCE



PRELIMINARY RESULTS

Constraints	Total distance farms – fields	Total distance savings	
	km	km	%
Prior to reallocation	799	0	
Farm size maintained for each farm	464	335	41.9
No increase in transport for each farm	485	313	39.2
Reallocate only rented land	544	255	32.0

But: farms split fields (as a result of LP) – is land sharing an option?

PRELIMINARY RESULTS: VERY ROUGH ESTIMATE OF ECONOMIC BENEFIT

Economic accounts for agriculture, 2018	mill nkr	% of total variable costs
Totale variable costs	21 412	100
Fuel costs	1 149	5
Maintenance of machinery & equipment	409	2
Maintenance of vehicles etc.	142	1
Max cost saving (42 %)	713	3

Harvesting gras and spreading manure (based on Kårstad et al. 2015)		
Distance, farm-field	km/farm	16
Fields	#/farm	9.72
Total distance per farm (4 tours per field)	km/farm	1 217
Labour costs (speed 30 km/h, return to labour 174 nkr/h)	nkr/farm	7 061
Labour costs (44 719 farms)	mill kr	315
Max cost saving (42 %)	mill kr	132

NEXT STEPS

- Estimate transportation equipment per farm
  - Use physical machinery from FADN entrant farms? (ca. 50 per year)
- Develop transport cost functions
- Calculate GHG-emission coefficients
- Consider land heterogeneity (yield, cover)
- Implement binary allocation constraint?

- Technically feasible to endogenize number of farms

- ***Ideas for and cooperation on scientific publication welcome!***