



Aalto University
School of Engineering

Structural development, land fragmentation, land consolidation and climate change in Finland

7th international LANDNET conference

7th October 2015, Session 9 – Infrastructure and climate change



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Who am I?



Currently Dr. Hiironen is working as a Research Fellow in the Department of Real Estate, Planning and Geoinformatics at Aalto University School of Engineering. Previously Dr. Hiironen has been responsible for planning land consolidation strategies as a member of core advisor team in the central administration of National Land Survey of Finland (NLS). In NLS Dr. Hiironen has also been responsible for the development of legal cadastral surveys in the field of valuation and land consolidation proceedings.

Dr. Hiironen has made his Doctoral Dissertation on "On the Impacts and Profitability of Farmland Consolidation". Dr. Hiironen has published several scientific articles related to land consolidation and its ecological effects e.g.:

- Hiironen, J., Niukkanen, K. (2014). On the structural development of arable land in Finland – How costly will it be for the climate? Land Use Policy. Volume 36, January 2014, pp. 192-198.
- Hiironen, J., Niukkanen, K. (2013). Possibilities to reduce nutrient loads to water system in land consolidations. Article in FIG Working Week 2013 (6.-10.5.2013), Abuja, Nigeria.
- Hiironen, J., Niukkanen, K. (2012). Land consolidation and its effect on climate. Article in FIG Working Week 2012 (6.-10.5.2012), Rome, Italy.



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Content of the presentation

Structural Development of Agriculture:

1. How does it effect on land fragmentation?
2. What is the relation of land fragmentation and climate emissions?
3. What is the role of land consolidation in climate change mitigation?

Structural Development of Agriculture



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The size of farms is increasing in order for agriculture to be able to provide a sufficient level of earning to farmers.

- The number of farms has declined from 100,000 to 50,000 between 1995-2015
 - The number of farms is currently at same level as in the 16th century
- Migration and urbanization
 - Farmers are moving from countryside to cities
- Development trend is similar around Europe

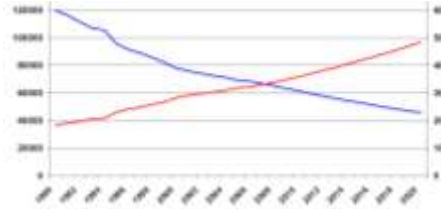


Figure 2: Number and average size of Finnish farms

Development of property structure

How to measure the goodness of property structure?

- **Most typical properties used to analyze property structure, from the perspective of land use, are (Blarel et al., 1992; Hung et al., 2007; Hiironen & Ettanen, 2013):**
 - *number of land holdings, average size (ha) of the land holdings, and average distance between farm compound and land holdings.*
- **There are also different kind of indexes that combine different property structure variables to a single index number.**
 - *the Simmons Index (Simmons, 1964), the Schmook index (1976), the Januszewski Index (Januszewski, 1968), the Igbozurike Index (Igbozurike, 1974), and the Simpson Index of Blarel et al. (1992)*

Number of land holdings

- In 2000 a typical farm had 10 parcels to cultivate when in 2012 the number was 16.
- Finnish farms have either gone out of business or acquired more arable land.
- The most concerning observation is that the structure has worsen the most among the largest farms – both in absolute and in relative terms.

Size of the farm, ha	2000	2012	Change, %
1-4	2.98	3.48	16.8
5-9	5.26	5.45	3.5
10-14	7.20	7.47	3.7
15-24	9.88	10.27	3.9
25-49	14.72	16.11	9.4
50-74	21.54	24.54	13.9
75-99	28.01	31.86	13.8
100-149	33.38	41.09	23.1
150-	49.35	61.94	25.5
All farms	10.23	15.81	54.50

Average size (ha) of the land holdings

- Average size has increased 7 % during 2000-2012.
- From the farmers point of view it can be observed that every farm cultivates smaller parcels than what they did in 2000.
- The most concerning observation is that the size has decreased the most among the largest farms – both in absolute and in relative terms.

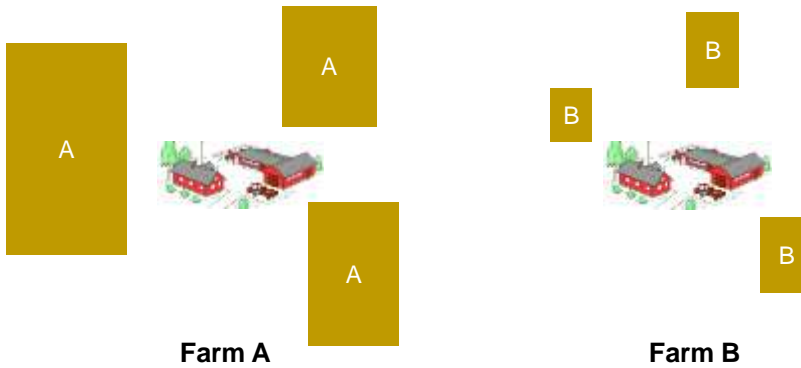
Size of the farm, ha	2000	2012	Change, %
1-4	1.00	1.01	0.9
5-9	1.41	1.37	-3.0
10-14	1.73	1.66	-3.5
15-24	1.99	1.92	-3.3
25-49	2.34	2.23	-5.6
50-74	2.79	2.48	-11.0
75-99	3.04	2.70	-11.2
100-149	3.51	2.91	-17.2
150-	4.18	3.48	-16.7
All parcels	2.24	2.39	6.9

Average distance

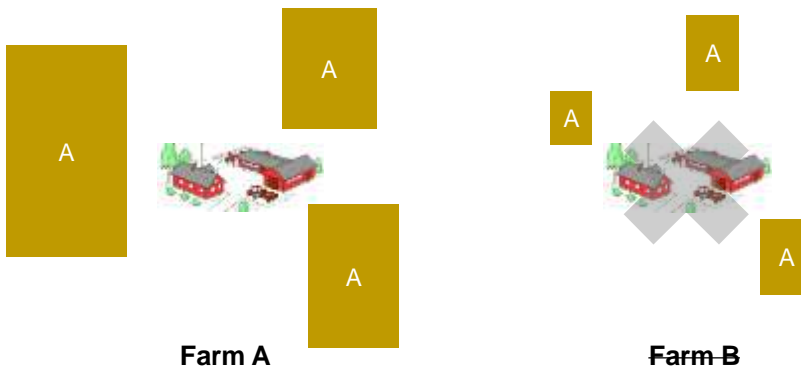
- Farmers way to work has doubled during 2000-2012
- The average distance has increased by 30 %. As the number of parcels has increased at the same time by 60 %, the total travelled distances have doubled.

Size of the farm, ha	2000	2012	Change, %
1-4	4.7	6.7	40.5
5-9	9.0	9.9	9.9
10-14	13.0	14.6	11.9
15-24	19.0	18.9	-0.5
25-49	35.5	38.8	9.3
50-74	71.3	75.7	6.2
75-99	98.2	115.8	17.9
100-149	150.0	170.8	14.2
150-	371.2	497.5	34.0
All farms	25.3	51.0	101.4

What is happening?



What is happening?



The Simmons Index ($0 < \text{index} < 1$)

- Property structure has worsen among all farms
- The worsening has been strongest among the biggest farms

Size of the farm, ha	2000	2012	Change, %
1-4	0.58	0.53	-8.6
5-9	0.37	0.37	-0.8
10-14	0.29	0.28	-3.4
15-24	0.22	0.21	-4.5
25-49	0.15	0.14	-6.7
50-74	0.11	0.10	-9.1
75-99	0.09	0.08	-11.1
100-149	0.08	0.06	-25.0
150-	0.07	0.05	-28.6
All farms	0.22	0.20	-11.0

What is the relation of land fragmentation and climate emissions?

Rapid structural development of agriculture continues

- **The number of farms will drop almost 30 % in the next 10 years.**
 - *This causes continually growing fragmentation of property structure as the farmers buy and rent farmland even further away from homestead.*
- **It is estimated that the average size will remain the same but the average distance will increase 80 % and the number of parcels will increase 30 % until 2020.**
 - *It is obvious that the inefficient property structure of arable land increases the production costs but what is often forgotten is that it also increases the harmful emissions to the climate.*

GHG-emission increase hand in hand with the growing distances

- **By using production cost calculations (see Hiironen & Niukkanen, 2014) and the information about farm and property structure development, it was calculated that the working hours will increase 2,898,644 h/year from its current level until 2020.**
- **By using the information about the petrol consumption and the emission rate of petrol, it was calculated that the total increase in CO₂ emissions is 202,076 tkgCO₂/year over the same period.**

The cost of GHG-emission increase

- By using the information about the level of increase in CO2 emissions and the shadow prices of CO2 emissions, it was calculated that the changes in farm and property structure will have an environmental cost of 37 million euros until 2020.
- If the timeframe is extended until 2050 the cost of CO2 emissions can be estimated to be 544 million euros (see Hiironen & Niukkanen, 2014).

What is the role of land consolidation in climate change mitigation?

Land consolidation is an effective tool for improving property structure

- According to Hiironen (2012) typical Finnish land consolidation reduces the number of parcels by 50 % and increases the average parcel size by 100 %.
- On average land consolidation halves the travelling times and reduces cultivation times by 25 %.
- Savings in, not only in the production costs, but also in climate emissions are obvious.

What is the role of land surveyors in climate change mitigation?

Surveyors have the possibility to mitigate the problems caused by this development.

- Surveyors can reveal that the structural development is scattering the property structure and therefore hindering the benefits gained from specialization and large scale.
- Surveyors can promote land consolidation, as it is not always accepted among farmers and politicians as a tool to improve the profitability of agriculture.

It is important to share positive experiences

- With the help of positive feedback and good results from ongoing land consolidation projects, surveyors could show the doubtful parties that land consolidation is not obsolete or something that belongs to the past.
- In my opinion land consolidation is a land management tool for the future.
 - With the help of land consolidation, agricultural rationalization actions could be concentrated on correcting the basic defects in the rural areas and not on handling the consequences caused by them, year after year.

Thank You.