Possibilities to reduce nutrient loads to water system in land consolidations

Dr. Juhana Hiironen, National Land Survey of Finland
Ms. Kirsikka Niukkanen, Aalto University, Finland

FIG Working Week 2013 Abuja Nigeria
Wednesday, 8 May 2013
TS03A - Land Administration and Sustainable Development

NATIONAL LAND SURVEY OF FINLAND

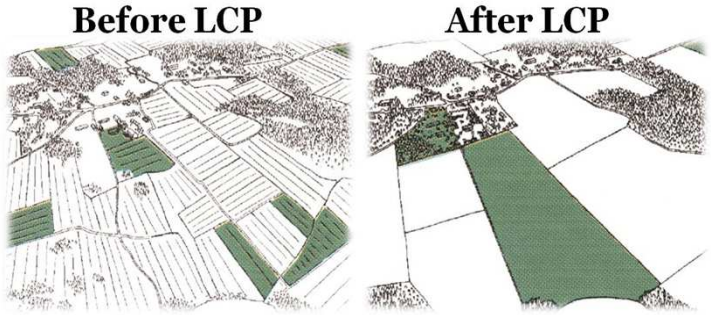
Possibilities to reduce nutrient loads to water system in land consolidations

- Finnish land consolidation strategy (LCS) states that the focus in 2008-2013 on land consolidations shall be on farmland consolidations.
  - *In these land consolidations the main purpose is to increase the profitability of Finnish farm industry.*
- Land consolidations are not made purely for environmental purposes in Finland.
  - *However LCS states that environmental aspects must be taken into consideration when land consolidation projects (LCP) are implemented.*

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

- Idea of Finnish land consolidation project (LCP). Small and scattered land parcels are re-arranged into bigger units that locate near farm compounds



NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

- Climate chance and eutrophication of the Baltic Sea are the most visible environmental problems in Finland.
  - *Actions which purpose is to address these problems form the basis for the environmental protection in Finnish land consolidations.*
- Toolbox for water protection measures includes eq. wetlands, allocation of grasslands and buffer zones.
  - *These actions are difficult to implement since the effectiveness of the measures is not clear. This causes a lack of official support since it is not evident that these actions are cost-effective. Also the farmers support is difficult to achieve since the actions often reduce field area and the profitability of farms.*

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

- This study focused on one "water protection tool": allocation of grasslands
  - *There is a hypothesis that it is beneficial to re-arrange fields in accordance with their loading values in order to minimize nutrient loads to water system.*
  - *Nutrient runoff in grassland is 60-75 % smaller than in other field types (grain, potato etc).*
  - *In practice this means that fields where only grass is cultivated should be re-arranged to the slopes near water areas from which the nutrient runoffs are the highest (50 % from the nutrient loads runoff from fields in which the slope is higher than 3 %).*
- But as there are no valuation methods in practice to valuate either the reduced nutrient loads or its monetary effect it is unknown whether or not these actions are cost-effective and therefore should be made.

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Practical example:

- Fields that locate next to water area and have more than 3 % slope are re-arranged for farmers that have animals (and who therefore need grasslands)
- Fields are not necessarily re-arranged to the closest farmers (which is the basic idea normally).

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Background > **Objectives & Methods** > Results > Conclusions

- This case study analyses how much phosphorus and nitrogen loads would have reduced if grasslands had been re-arranged according to their environmental (and not economical) impacts.
- The study estimates the monetary value of the reduced phosphorus and nitrogen loads.
- As a result the study presents the effectiveness of water protection activities concerning allocation of grasslands.
- As a conclusion the study considerers if reducing nutrient loads should be one of the objectives that land consolidations have.

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Background > **Objectives & Methods** > Results > Conclusions

The change in nutrient loads is calculated first..

- By using VIHMA nutrient loads in project area were calculated before land consolidation (Volume A).
- Nutrient loads after land consolidation were calculated by assuming that grasslands had been re-arranged to the risk areas (fields where the slope is 3 % or more) (Volume B).
  - *VIHMA is a model for the management of runoff waters from arable land. Model is made for the estimation of nutrient loading from arable land and their variations due to tillage practices and crop covers in a function of field characteristics (e.g. slope, area).*

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

The monetary value for the change is defined secondly..

- The study estimates the monetary value of the reduced emissions due to the changes in phosphorus and nitrogen loads (Volume A – Volume B).
- To estimate the monetary value of the environmental effect, substitute cost method is used.
- In this case, when the benefit is non-marketed, it is easier to measure the costs of producing the same benefits than the benefits themselves.
  - *Hypothetical example: If a building cost for a water treatment plant that reduces 100.000 kg of phosporus load is 1.000.000 euros, then the substitute cost for phosporus is 10 €/kg.*

Possibilities to reduce nutrient loads to water system in land consolidations

Background > **Objectives & Methods** > Results > Conclusions

And finally the cost of the environmental task is defined..

- The actual allocation of grasslands does not cost anything extra. However, as it is done from environmental and not from economical perspectives, the actions reduce agricultural benefits that could have been obtained otherwise.
- In this study the reduction of other benefits was assumed to be the cost of the "allocation of grasslands".
  - *First the total benefit of the project (Benefit A) was calculated by using real information without the assumptions ("..by assuming that the grasslands had been re-arranged to the risk areas.").*
  - *Then the total benefit of the project (Benefit B) was calculated by assuming that the production costs would not have been decreased for those farms whose fields are re-arranged in order to minimize nutrient loads and not to minimize production costs.*

Possibilities to reduce nutrient loads to water system in land consolidations

Background > Objectives & Methods > **Results** > Conclusions

The change in nutrient loads:

- By using VIHMA and the data collected from the project it can be calculated that nutrient loads before the project are 0,98 Pkg/ha/year and 20,00 Nkg/ha/year.
- If grasslands had been re-arranged to risk areas phosphorus loads would have reduced 2,4 % and nitrogen loads increased 0,1 % (nitrogen loads are not reducing because it isn't dependable on the slope of the field).
- This means that in this project phosphorus loads would have decreased 22,55 kgP/year and nitrogen loads increased 19,18 kgN/year.

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Background > Objectives & Methods > **Results** > Conclusions

The monetary value of the change:

- The average cost of reducing nutrient loads is 18 €/kgN and 348 €/kgP.
  - *The substitute costs are not selected to equal the cheapest cost because a variety of actions, which have different price tags, are done in Finnish agriculture in order to minimize nutrient loads.*
  - *Water protection requires different kind of activities depending on the local situation – the most cost-effective way is not always possible or enough to reduce nutrient loads.*
- By using the information about the level of reduction of P and N and the cost of P and N loads, it can be calculated that the monetary value of water protection activities in the case project (Järilä LCP) is 7.502 €/year.
- Total value of the effect is 115 327 € (30 years, 5 %).

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Background > Objectives & Methods > **Results** > Conclusions

The cost of the environmental task:

- First the reduction of total production costs was calculated by using real information without the assumptions made in this study (Benefit A).
- Then the reduction of total production costs was calculated by assuming that grassflands had been re-arranged in slopes near water areas (Benefit B).
- The difference between these two values was considered to be cost of "allocation of grasslands" (cost = Benefit A – Benefit B).
- The cost with the presented method was in this case 21.060 €.
- The monetary effect in the assumed situation was 94 000 euros (positive).

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

Background > Objectives & Methods > Results > **Conclusions**

- Allocation of grasslands is a cost-effective water protection tool, at least in this case.
- As the topography of the landscape differs between different project areas, similar results might not occur in all projects.
- The assumption of the marginal cost is something to debate on, especially whether to use the lowest or the average costs.
- It might also be very difficult to convince the farmers to participate in a project that might have harmful effect on their profitability.
  - *Most probably compensations, land or money, would have to be paid for the process to go smoothly.*
  - *Delays are also likely to occur since there are no standard practices to handle environmental issues in Finnish land consolidation.*

NATIONAL LAND SURVEY OF FINLAND

Possibilities to reduce nutrient loads to water system in land consolidations

- Based on the results of this study it can be stated that water protection activities should be taken into consideration when the objectives of land consolidation are defined and the re-allocation plan drawn.
- It must be reminded that the Finnish toolbox for water protection might not be exportable as such to other countries because situations vary significantly between different sites.
- It can be stated that the most exportable environmental tool that is utilized in Finnish land consolidations concerns climate change.
- The objectives of climate change is easy to combine with the objectives of land consolidation since farmers are eager to reduce their petrol consumption (and therefore emissions to climate)

Thank you for your attention!

Contact information:

Chief Expert Juhana Hiironen (Dr.Tech)
National Land Survey of Finland
Email: juhana.hiironen(at)nls.fi
Web site: http://www.maanmittauslaitos.fi/en

Doctoral Student Kirsikka Niukkanen (M.Sc)
Aalto University, School of Engineering
Department of Real Estate, Planning and Geoinformatics
Email: kirsikka.niukkanen(at)aalto.fi
Web site: http://maa.tkk.fi/en/