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On the structural development of arable land in Finland – How costly will it be for the climate?

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ABSTRACT

Finland is the most sparsely populated country in the European Union. Finland's northern location presents special challenges for the profitability of agriculture. At the same time Finland has a fragmented property structure which means that each farmer cultivates a number of separate fields that are scattered into small parcels located around the village. The situation came into being because of land reforms whose purpose was to handle socio-political issues and not to improve the feasibility of farms. It is obvious that this inefficient property structure increases the cultivation costs but what is often forgotten is that it also increases the harmful emissions to the climate.

The purpose of this article is to present the property structure of arable land and its development in Finland until 2020. The main objective is to estimate the monetary value for those climate impacts that the development causes. The study was set up to analyze land management tools and their capabilities to handle the future challenges. First, the study estimates how much petrol consumption increases because of the increased need for agricultural traffic due to the forecasted development of property structure. Secondly, the study estimates a monetary value for the increased emissions to the climate due to the changes in petrol consumption. To estimate the monetary value of the climate effect a substitute cost method is used.

It was estimated that by year 2020 the agricultural working hours will increase by almost three million hours per year from its current level because of the expected changes in property structure. By using the information about petrol consumption and emission rate of petrol, it was calculated that the total increase in CO_2-emissions will be more than 200 000 tkgCO_2 per year. By using the information about the level of increase in CO_2-emission and their shadow prices, it was calculated that the changes in property structure will cost 37 million euros until year 2020 and 544 million euros until year 2050. The sensitivity analysis showed that the results are strongly dependable on shadow prices of CO_2-emissions, property structure's development scenarios and the expected fuel efficiency of agricultural machinery. On the other hand it also showed that the impact will be remarkable especially in the long run if the changes in property structure cannot be prevented.

The study showed that there is a massive potential for land management activities. But since the current land management tools that are utilized in Finland are not efficient to handle the future problems the toolbox should be renewed. As the renewing work requires both legislative and organizational changes the progress will take time. This means that the harmful impacts that the development of property structure causes will be realized in the upcoming decades. The study concludes that the increase in CO_2-emissions doesn't concern only Finland but also other EU countries and that is why the matter should be investigated in other countries as well.

Introduction

Finland is the most sparsely populated country in the European Union (EU) and its climate and northern location present special challenges for the profitability and competitiveness of agriculture. At the same time Finland has a fragmented property structure which means that each farmer cultivates a number of separate fields that are scattered into small parcels located around the village and often far away from farm compound. The situation came into being in crofter liberation (during 1918–1940) and settlement activities (1945–1950) when the number of farms almost doubled. These land reforms, whose purpose was to handle socio-political issues (liberate crofters and settle evacuees) and not to improve the feasibility of farms, have had a detrimental effect on Finnish

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agricultural productivity since it is inefficient to cultivate scattered fields (MAF, 2007; Hiironen, 2012, pp. 43–45).

The agricultural structure is changing at a rapid rate along with technological development. Especially very specialized cattle and vegetable production will be in the hands of even fewer professionals and frequently concentrated geographically in areas with an already strong basis of production. This is an international trend that seems to be continuing. Increase of productivity and decrease of costs will also be courted with the help of benefits gained from specialization and large scale (Pyykkönen et al., 2010, pp. 6–13).

Despite the fact that the number of farms has dropped from 96 000 to 61 000 and the average farm size increased from 24 to 37 ha during Finland's EU membership, there has been no change in the profitability of Finnish farms (CSOF, 2012). 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 (see Hiironen, 2012, p. 114; Hiironen and Niukkanen, 2012, p. 11).

Climate change is estimated to impact the Finnish nature in various ways. In the current climate conditions we are already experiencing weather and climate variations and extreme events that we need to prepare for. The situation is the same all around the world. Combating climate change is a top priority for the EU. Europe is working hard to cut its greenhouse gas emissions substantially while encouraging other nations and regions to do likewise. At the same time, the EU is developing a strategy for adapting to the impacts of climate change that can no longer be prevented. Reining in climate change carries a cost, but doing nothing will be far more expensive in the long run (EC, 2012).

As agriculture is a significant contributor to climate change (agriculture's proportion of the EU's total greenhouse gas emissions is 9 percent) the Ministry of Agriculture and Forestry (MAF) of Finland has published an action plan to address the matter. The action plan defines 14 measures for agriculture that help the prevention of climate change. The first measure states that climate change must be taken into consideration when other agricultural policy objectives are defined. The action plan looks for synergies between different actors and sectors and identifies linkages between climate change and other policy objectives. The linkages between land consolidations and climate change are recognized in Finnish land consolidation strategy (LCS) (MAF, 2011, pp. 6–8, 47).

According to LCS public financing for the improvement work of property structure should be allocated so that the measures implemented produce the best possible impact. The focus in 2008–2013 should be on combining different perspectives in land consolidation, in which case the perspectives related to environment etc. can be more extensively taken into consideration. LCS states that land consolidation should broadly support social goals, such as rural viability and environmental protection, so that the activities would help to achieve the best possible overall impact to social welfare (MAF, 2007, pp. 14–15).

Traditional effects of inefficient property structure like increased production costs can be defined quite easily in monetary terms. But as the objectives of the improvement work have become more complex (see Vitikainen, 2004, pp. 28–29; MAF, 2007) so has the decision making process. This means that in addition to direct market based values other benefits and drawbacks, e.g. environmental effects, should be taken into consideration when actions to improve property structure are prioritized (Virtanen, 2006, pp. 7–8; Hiironen et al., 2010, pp. 11–12). One aspect that is not properly taken into consideration when the overall impacts of structural development of arable land are estimated is the emissions to climate.

This study presents Finland's current property structure and the development scenario until 2020. Presentation is focused on the size of the parcel and on the distance between the parcel and farm compound since these two properties are the main elements that define the quality of property structure of arable land (Hiironen, 2012, p. 114; see Klemola et al., 2002; Peltola et al., 2006; Najafi, 2000; Lerman, 2002; Bentley, 1987). From the perspective of property structure these two elements define how much time it will take to cultivate a certain land parcel. Therefore it also defines the petrol consumption and the emissions to the climate (see Hiironen and Niukkanen, 2012, pp. 8–11; Panschin and Vitikainen, 2010, pp. 2–3; NLS, 2006).

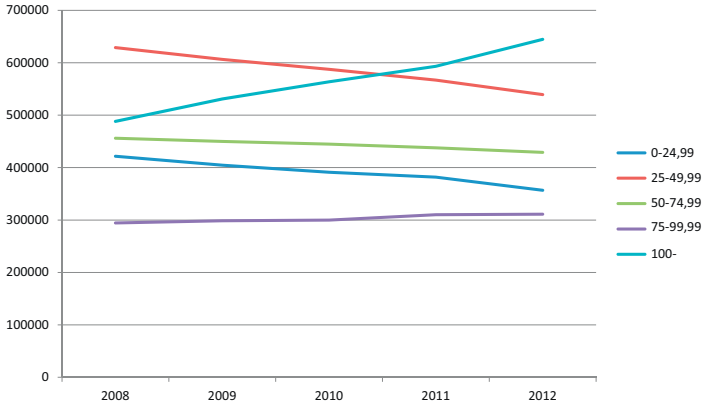

Fig. 1. Field area (ha) and its development (percent) in 2008–2012 categorized by farm size (ICMAF, 2013).

This study calculates the changes in petrol consumption as a function of property and farm structure until 2020. The objective of this study is to estimate the monetary value for the climate emissions that the change in petrol consumption causes. As a result the study presents a monetary value for the environmental cost that the development of property and farm structure has. The discussion section the study, in which the frame of reference is land management, analyses the consequences that the forecasted development and its effects will have to the work that is being done to improve the property structure of arable land.

Materials and methods

Study material is gathered from the Land Information System (LIS) and Finnish Land Parcel Identification System (LPIS) (NLS, 2012a, 2012b). Detailed information of size, distance to compound and line of production (cattle farm/vegetable farm/grain farm) was collected from each field parcel. The study material includes around one million observations and it covers all field parcels that were cultivated in Finland in the year 2011.

As the objective of this study is to estimate future development, forecasts for farm and property structure were also needed to define the cultivation times in 2020.

The number of farms has been decreasing for 50 years starting from the beginning of the 1960s. At that time there were over 300 000 farms, whereas in 2011 there were only 61 000. At the same time the average size of farms has increased because nearly all of arable land is still cultivated. By measuring the field area, the average size of farm was around 37 ha in 2011 (CSOF, 2012). It is estimated that the number of farms will drop to 45 000 and the average field area of farms will increase to 50 ha by 2020. From year 2007 the field area has increased only among farms whose size is over 75 ha, whereas the overall area of farms smaller than 75 ha has decreased (see Fig. 1) (Pyykkönen et al., 2010, pp. 4–5; ICMAF, 2013).

If the number of farms in different groups (production lines) is analyzed it is noticed that the decrease has been the strongest among cattle farms. The number of grain farms has not decreased