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Restricting the eligible maintenance practices of permanent grassland – a realistic way towards more active farming?

A.-H. Viira[1,*], J. Ariva[1], K. Kall[1], L. Oper[1], E. Jürgenson[2], S. Maasikamäe[2] and R. Põldaru[1]

[1]Estonian University of Life Sciences, Institute of Economics and Social Sciences, Kreutzwaldi 1 A, EE51006 Tartu, Estonia
[2]Estonian University of Life Sciences, Institute of Forestry and Rural Engineering, Kreutzwaldi 5, EE51006 Tartu, Estonia
[*]Correspondence: ants.viira@emu.ee

Abstract. As a result of agricultural, land and ownership reforms coupled with liberal agricultural policy during the transition, agricultural land use in Estonia became more fragmented. A significant portion of agricultural land users are now considered passive farmers who maintain their agricultural land (often permanent grasslands) in good agricultural and environmental conditions and are therefore eligible for single area and greening payment. The maintenance of permanent grassland is one of the objectives of the EU Common Agricultural Policy (CAP), which contributes to the overall climate and biodiversity objectives of the EU. Until 2014, in Estonia, the minimum eligible activity for the maintenance of permanent grassland was to cut the grass and leave it on the ground. In 2015 and 2016, the area on which the cut grass could be left on the ground was restricted in order to increase incentives for more active agricultural land use. This paper analyses the likely effects of such restriction on the use and maintenance of permanent grasslands. The results of the study show that in the case of restrictions on the eligible practices of permanent grassland maintenance, passive land users as well as crop and mixed crop-livestock farms are likely to reduce the area of permanent grasslands (*shrinking farms*). At the same time, grazing livestock farms (*expanding farms*) would be willing to expand their permanent grassland area. More than 70% of the permanent grasslands of *shrinking farms* are located within 1 km and more than 90% within 2 km of *expanding farms*. However, in some regions it is likely that the maintenance of permanent grasslands is stopped as a result of the restrictions. It is argued that if permanent grasslands are to be maintained, it is necessary to introduce supports for grazing livestock farms, targeted supports for passive land users for their maintenance or more comprehensive land use policy that takes the climate change mitigation requirements into account.

Key words: permanent grasslands, passive farming, greening, Common Agricultural Policy, direct payments.

INTRODUCTION

Changes in agricultural policy and land use

Following the restoration of independence in 1991, ownership and land reforms were undertaken in Estonia (Alanen, 1999; Swinnen, 1999) that resulted in the

fragmentation of agricultural land (Rudbeck Jepsen et al., 2015; Jürgenson, 2016; Arslan et al., 2019). The restructuring of agriculture resulted in the polarisation of commercially oriented farms, as well as small lifestyle or environmental stewardship oriented farms.

The shift from the planned economy of the Soviet Union to liberal agricultural policy (Unwin, 1997) caused a shock in Estonian agriculture. Due to a marked decline in producer support estimate (OECD, 1996), the utilised agricultural area (UAA) in Estonia declined by 49% from 1,374,000 ha in 1992 to 698,200 ha in 2002 (FAOSTAT, 2018).

With its accession to the European Union (EU) in 2004, Estonia implemented the EU Common Agricultural Policy (CAP). This resulted in higher prices for agricultural commodities, higher direct payments, agri-environmental payments and investment subsidies. One of the new policy instruments was the decoupled single area payment (SAP), which required beneficiaries to maintain their agricultural land in good agricultural and environmental conditions (GAEC).

The introduction of the SAP resulted in a new type of agricultural land use – permanent grassland temporarily not used for production purposes. In Estonia, this land use type mainly characterises those agricultural land users who became land owners as a result of restitution but are not producing agricultural products for market (any more), along with those who have bought agricultural land as a real estate investment.

Since 2015, the maintenance of permanent grasslands became one of the mandates related to the SAP and greening payment (Regulation (EU) No 1307/2013; Commission Delegated Regulation (EU) No 639/2014). It contributes to several of the CAP goals (and also climate policy): 1) the avoidance of abandonment of agricultural land; 2) the avoidance of ploughing of permanent grasslands for the cultivation of annual crops, and; 3) resultant contribution to carbon sequestration. If one considers these as primary goals of the SAP and greening payment, the question of whether permanent grasslands are maintained in GAEC by active or passive farmers[1] becomes a false problem, as suggested by Pupo D'Andrea & Romeo Lironcurti (2017).

While the effects of agri-environmental payments on the extensification of agricultural production in less favoured areas are considered positive (e.g. by Jones et al., 2016), views on the effects of SAP on the subsidised passive use of agricultural land are opposing. Passive farming is seen as an obstacle to structural change in remote areas (Brady et al., 2015; 2017), as the largest share of it takes place in regions with low soil fertility and is characteristic of relatively small, unprofitable farms (Trubins, 2013). Passive land use prevents the grazing livestock farms in these regions from expanding and increasing their production efficiency, resulting in them becoming marginalised and ultimately passive land holders themselves (Swinnen et al., 2013; Brady et al., 2015). It has been shown that passive farming reduces the ability of the SAP and basic payment scheme of the CAP to support the incomes of tenant farmers (Di Corato & Brady, 2019). On the other hand, subsidies for land maintained in GAEC are necessary for maintaining the agricultural land of high nature and cultural value, but of low fertility and in remote

[1] Regulation (EU) No 1307/2013 states that no direct payments shall be granted to natural or legal persons (passive farmers), whose agricultural areas are mainly areas naturally kept in a state suitable for grazing or cultivation and who do not carry out on those areas the minimum activity defined by Member States. According to Brady et al. (2017), passive farming occurs when landowners maintain their agricultural area to collect payments without producing commodities.

regions, from abandonment (Renwick et al., 2013; Abolina & Luzadis, 2015; Barnes et al., 2016; Lasanta et al., 2017).

Maintenance of permanent grasslands

The CAP has favoured a recovery of Estonian agricultural land use and production. From 2004–2019, the UAA in Estonia increased by 25% from 792,409 ha to 987,614 ha (Statistics Estonia, 2019). By 2015, the area of permanent grassland temporarily not used for production purposes increased to 125,053 ha and accounted for 13% of the UAA. This was the highest proportion of such land among the EU member states (Eurostat, 2018). The increase in the area of permanent grassland temporarily not used for production purposes by 103,099 ha (by 5.7 times) during the period of 2004–2015 comprised 51% of the total increase in the UAA (Statistics Estonia, 2019).

In Estonia, the appearance of this phenomena since 2004 and its persistence has fuelled discussion and disputes over the stimulating effects of the CAP, namely the SAP and greening payment, on passive ways of agricultural land use, as well as its effects on the price of agricultural land and the position of agricultural producers (active farmers) on the land market.

The cheapest practice for permanent grassland maintenance is to cut the grass biomass once a year and leave the residues on the ground. In Estonia, this practice was mainly used by arable farmers and passive land users (Viira et al., 2016). From 2004–2014, the land owners who carried out this practice for the maintenance of permanent grasslands in GAEC were eligible for the SAP (Regulation 11 of Agricultural minister, 30.07.2012). In order to provide incentives for utilising (more active) agricultural practices (such as grass or hay harvesting, or grazing) for permanent grassland maintenance, in 2015 and 2016 restrictions were set on using biomass cutting as a permanent grassland maintenance practice that is eligible for the SAP and greening payment (Regulation 32 of Agricultural minister, 25.04.2015; 25.04.2016). In 2017, the restrictions were eased (Regulation 32 of Agricultural minister, 28.04.2017) and the eligibility of the grass biomass cutting practice was restored.

Such restrictions on the eligibility of certain practices may have several outcomes. According to Van Herck & Vranken (2013), the increase of land rents has a negative effect on land mobility and, therefore, indirectly a negative effect on farm restructuring, because new farmers face a higher initial investment cost and existing farmers face a higher cost of expansion. Since the restrictions increase the cost of the maintenance of permanent grassland for those farmers who do not have grazing animals, they may reduce the rental or selling price of permanent grasslands and stimulate the transfer of permanent grassland from passive to active farmers. However, it also may result in the abandonment of permanent grassland, which is contrary to the aims of the CAP. The land use decline in Estonia in the 1990s demonstrates that the abandonment of less fertile agricultural land is not a theoretical option (Prishchepov et al., 2013; Terres et al., 2015). The possible behavioural responses of active farmers and passive land owners were analysed by Ariva et al. (2017) based on a survey of farmers in 2016 (Viira et al., 2016), and by Viira & Ariva (2019) based on the data of agricultural registers.

If the goal of the restricting certain management practice is to achieve a transfer of permanent grassland from passive to active farmers, the precondition for this is that the land parcels that passive farmers would want to sell or rent are located within a

reasonable distance of active farmers. Therefore, the objective of this paper is to determine to what extent the permanent grassland parcels of active farmers who could potentially be interested in expanding their permanent grassland area, and passive farmers who could potentially give up (sell or rent) some of the permanent grassland, are in a reasonable distance of each other. If these two groups are not located near each other, the actual change in active and passive land use as a result of the restriction on eligible permanent grassland maintenance practices would be limited.

In order to achieve the objective, the paper seeks answers to three research questions: 1) what kinds of farms are likely to reduce or expand their permanent grassland area; 2) what proportion of the permanent grassland parcels of those farms that are likely to reduce their permanent grassland area are located in proximity to those farms that are likely to expand their permanent grasslands; 3) what could be the results of restricting the eligible practices of permanent grasslands on permanent grassland maintenance at regional level? The next chapter of the paper gives an overview about the data and methods that were used to fulfil the objective and answer the research questions. After that, the results are presented and discussed. Final chapter of the paper summarises the main conclusions.

MATERIALS AND METHODS

Data

Information about the actual land use of the beneficiaries of the SAP and greening payment, as well as the number of their agricultural animals, was obtained from the Estonian Agricultural Registers and Information Board (ARIB). In 2015, there were 17,322 beneficiaries of the SAP and greening payment.

At the end of 2016, a survey was conducted among the beneficiaries of the SAP and greening payment. A sample of 6,811 beneficiaries was drawn from the total number of beneficiaries of the SAP and greening payment. In total there were 1,858 respondents (response rate 27.3%). The respondents were asked about their likely intentions (expansion, no changes, or reduction) regarding their permanent grassland use if the practice of cutting the grass and leaving biomass on the ground would become ineligible for the SAP and greening payment in the future (Viira et al., 2016).

Since the land use changes are related to changes in the structure of farm types and size (Stokstad & Krøgli, 2015; Pilgaard Kristensen et al., 2016; Van der Sluis et al., 2016), a farm type was assigned for each beneficiary of the SAP and greening payment, using the FADN typology (Commission Regulation (EC) No 1242/2008; Commission Regulation (EC) No 867/2009; Agricultural Research Centre, 2016). The SAP and greening payment beneficiaries who did not have field crops, permanent crops, fallow or agricultural animals were considered to belong to an additional farm type called *passive land user*, which is not present in the FADN typology.

Classification of expanding and shrinking farms

Probit regression was used to estimate how farm type, farm size, share of permanent grassland in total land use, and livestock density affect the likelihood that farms will increase, decrease or not change their permanent grassland area. For the regression analysis, the survey data, information on the land use of the SAP and greening payment beneficiaries, the number of their agricultural animals and information about their farm

type were combined. Those SAP and greening payment beneficiaries who did not respond or provided an ambiguous response about their likely intentions regarding their permanent grassland use (expansion, no changes, reduction) if cutting the grass and leaving biomass on the ground would become restricted in the future were excluded from the regression analysis. After merging the data from various sources, information on 629 beneficiaries of the SAP and greening payment remained valid for the regression analysis.

Table 1. The descriptive statistics of variables for probit regression models (N = 629)

Variable	Definition	Scale/ measurement	Average	St.Dev	Source
Dependent variables					
Land_dec	Land use will decrease	Yes = 1; No = 0	0.66	0.47	Survey
Land_inc	Land use will increase	Yes = 1; No = 0	0.14	0.35	Survey
Land_stable	Land use will not change	Yes = 1; No = 0	0.20	0.40	Survey
Explanatory variables					
Field_crops	Farm is specialised in field crops	Yes = 1; No = 0	0.27	0.44	ARIB/FADN
Horticulture	Farm is specialised in horticulture	Yes = 1; No = 0	0.00	0.06	ARIB/FADN
Perm_crops	Farm is specialised in permanent crops	Yes = 1; No = 0	0.02	0.14	ARIB/FADN
Gr_livestock	Farm is specialised in grazing livestock	Yes = 1; No = 0	0.40	0.49	ARIB/FADN
Granivores	Farm is specialised in granivores	Yes = 1; No = 0	0.00	0.04	ARIB/FADN
Mixed_crops	Farm is specialised in mixed cropping	Yes = 1; No = 0	0.01	0.11	ARIB/FADN
Mixed_livestock	Farm is specialised in mixed livestock holdings	Yes = 1; No = 0	0.00	0.06	ARIB/FADN
Crops_livestock	Farm is specialised in mixed crops-livestock	Yes = 1; No = 0	0.10	0.29	ARIB/FADN
Passive	Beneficiary is passive land user	Yes = 1; No = 0	0.20	0.40	ARIB/FADN
Area	Agricultural area	Ha	84.5	234.4	ARIB/FADN
Grassland_share	Share of permanent grassland in agricultural area	Share	0.63	0.39	ARIB
LU	Livestock units	LU	24.1	128.0	ARIB
LU_density	Livestock density	LU/ha	0.21	0.47	ARIB
Private_person	Beneficiary is private person	Yes = 1; No = 0	0.39	0.49	ARIB

Source: authors' calculations.

Table 1 provides descriptive statistics of the dataset used for estimating the parameters for 42 one-variable models and five models with interactions of explanatory variables using the probit regression, as shown by equation (1).

$$\Pr(Y = 1|X) = \Phi(X^T\beta) \quad (1)$$

In general, the probit model employed in this study estimates the probability (*Pr*) of the respondents' intentions regarding their land use in the future. The respondents'

intentions to increase, decrease or not change their permanent grassland area were considered as three different binary dependent variables *Y* which were obtained from the survey conducted in 2016. The vector of *T* explanatory variables *X* was assumed to influence the future land use change *Y*. The *ß* denotes the respective parameters to be estimated. For estimation of the model parameters, the R programme (version 3.5.1) was used.

The results of the regression analyses were used as an input for the logical classification, which divided the beneficiaries of SAP and greening payment into three groups: 1) farms that would likely reduce their permanent grasslands use; 2) farms that would likely expand their permanent grasslands; 3) farms that probably would not change their land use.

Based on this classification, all 17,322 beneficiaries of the SAP and greening payment in 2015 were assigned with a variable showing whether their use of permanent grasslands is likely to decrease, increase or not change in the future. The composition of all three groups according to the farm and land user types is given in Annex I. In the further analysis, farms that are likely to increase their permanent grassland area are referred to as *expanding farms*, and the farms and passive land users that intended to decrease their area of permanent grasslands are further referred as *shrinking farms*.

In order to analyse the proximity of the permanent grassland parcels of *expanding* and *shrinking* farms, the ARIB data on all the eligible parcels for SAP and greening payments was used. In 2015, there were 170,516 eligible land parcels for the SAP and greening payment.

Spatial analysis

The ArcGIS software was used for analysis of the spatial relations between the permanent grassland parcels of *expanding* and *shrinking farms*. For the purpose of spatial analysis, the data about the investigated farms and land users and the map of ARIB field parcels (hereafter parcels) were merged into one dataset. Two methodical approaches were used for the assessment of the distances between the permanent grassland parcels of *shrinking* and *expanding farms.*

At first, the buffer zones of 1 km, 2 km, 3 km and 4 km were generated around the parcels of *shrinking farms* and the corresponding number (1–4) was assigned to those zones. The maximum radius of zones was set to 4 km. See left panel of Fig. 1 as an example.

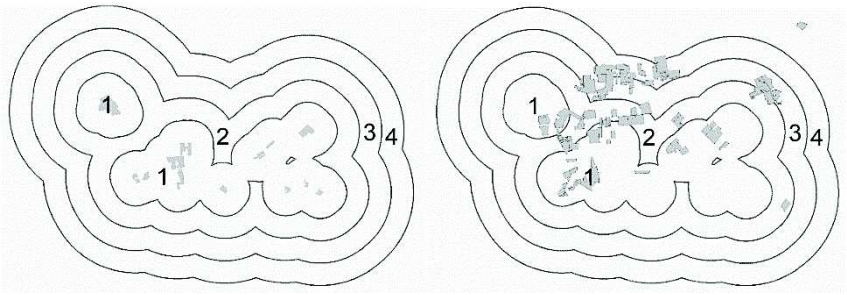

Figure 1. Buffer zones around permanent grassland parcels (left panel) of *shrinking farms* and location of permanent grassland parcels of *expanding farms* in those buffer zones (right panel).

Then, the overlay procedure of the buffer zone layer and the layer of the parcels of *expanding farms* was performed in ArcGIS. See the right panel of Fig. 1. The result of this overlay procedure is that all parcels of the layer of *expanding farms* received the appropriate zone number. This zone number shows the distance interval from the parcels of *shrinking farms* to the nearest parcels of *expanding farms*. For example, zone number 1 means that this distance is between zero and one kilometre, number 2 means that this distance is between one and two kilometres, and so on. The total number of *expanding farms'* permanent grassland parcels and the total area of those parcels in the buffer zones is the measure that characterises the potential to use the permanent grassland parcels of *shrinking farms*.

The second methodical approach was the calculation of distances from the permanent grassland parcels of *expanding farms* to the nearest permanent grassland parcel of *shrinking farms*. ArcGIS was also used for that purpose.

Finally, the heat maps were composed for illustration of the spatial distribution of the permanent grassland parcels of *shrinking farms* and location of the permanent grassland parcels of *expanding farms*.

RESULTS AND DISCUSSION

Likely changes in the use of permanent grasslands

It appears that 66% of the respondents of the survey indicated a willingness to decrease their land use due to restrictions in the eligible permanent grassland maintenance practices in the future, while 14% of the respondents said they would increase their land use and 20% said their land use would not change. The average agricultural area of the respondents was 84.5 ha. 27% of the respondents were specialist field crops farms, 40% were specialist grazing livestock farms and 20% were passive land users. The average share of permanent grassland was 63.2% which is markedly higher than the total Estonian average. On average, the respondents had 24.1 LU with an average livestock density of 0.21 LU ha^{-1}. 39% of the respondents were private persons who were not registered as private limited companies or sole proprietorships.

Table 2 summarises the results of the probit estimations of 42 one-variable models and 5 models with integrations of explanatory variables. Specialist field crops, mixed crop-livestock farms and passive land users were found to be more likely to decrease their permanent grassland use if the restrictions on cutting the grass and leaving the residues on the ground come into force. This could be explained by these farm types having no use for the grass biomass. Therefore, if leaving the cut biomass on the ground is restricted, these farm types have fewer incentives to maintain their permanent grasslands in the GAEC. On the contrary, grazing livestock farms were found more likely to maintain or increase their permanent grassland use. Farms with more LU and higher livestock density had a higher probability of increasing their permanent grassland use. As suggested also by Swinnen et al. (2013) and Brady et al. (2015), in the case of grazing livestock farms, additional permanent grassland parcels could potentially help in farm expansion or in the reduction of risks related to forage quantity. In addition, agricultural area (farm size) positively affected the likelihood that the farmer will expand permanent grassland use and it reduced the probability of a decrease in permanent grassland use. This is in line with previous results from Estonia that indicate that larger farms are more likely to expand their size (Viira et al., 2013). Farms and land users with

the higher share of permanent grassland in their agricultural area were found more likely to reduce their permanent grassland area. Beneficiaries of the SAP and greening payment who were private persons and not registered as business enterprises were more likely to decrease and less likely to increase their permanent grassland area. This suggests that if the eligible practices of maintaining permanent grasslands in the GAEC are restricted, passive land users are more likely to decrease their use of permanent grasslands, which is in accordance with the aim of the restrictions. This, in turn, could create opportunities for these grazing livestock farmers who are interested in farm expansion to expand their permanent grassland area.

Table 2. The summary of the probit regression results

Explanatory variables	*Dependent variables*					
	Permanent grassland use will increase		Permanent grassland use will not change		Permanent grassland use will decrease	
	Intercept	*β*	Intercept	*β*	Intercept	*β*
Field_crops	-0.983***	-0.362*	-0.790***	-0.252’	0.312***	0.400**
Horticulture	-1.065***	-3.755	-0.850***	-3.970	0.409***	4.410
Perm_crops	-1.061***	-0.322	-0.850***	-0.118	0.407***	0.267
Gr_livestock	-1.546***	0.921***	-1.178***	0.692***	0.914***	-1.114***
Granivores	-1.066***	-3.754	-0.851***	-3.968	0.410***	4.201
Mixed_crops	-1.066***	-0.085	-0.843***	-4.368	0.404***	0.746
Mixed_livestock	-1.065***	-3.755	-0.850***	-3.970	0.409***	4.410
Crops_livestock	-1.016***	-0.826**	-0.845***	-0.069	0.375***	0.421*
Passive	-0.954***	-0.891***	-0.735***	-0.846***	0.250***	1.094***
Area	-1.129***	0.001**	-0.872***	0.000	0.468***	-0.001**
Grassland_share	-0.963***	-0.168	-0.748***	-0.167	0.267**	0.231’
LU	-1.089***	0.001’	-0.858***	0.000	0.430***	-0.001
LU_density	-1.214***	0.590***	-0.908***	0.234’	0.548***	-0.640***
Private_person	-0.888***	-0.780***	-0.697***	-0.448***	0.141*	0.779***
Gr_livestock LU_density*	-1.288***	0.673***	-	-	-	-
*Gr_livestock*Area*	-1.108***	0.001*	-	-	-	-
*Gr_livestock*LU*	-1.104***	0.001*	-	-	-	-
Gr_livestock grassland_share*	-1.397***	0.888***				
Crops_livestock Grassland_share*	-	-	-	-	0.380***	0.616*

’significant at 0.1 level; *significant at 0.05 level; **significant at 0.01 level; ***significant at 0.001 level
-model was not estimated.

Since specialist grazing farms were found likely to expand their permanent grassland area, in this farm type the parameters of additional models with interactions between explanatory variables were estimated. The results indicated that specialist grazing farms with higher livestock density, a larger agricultural area, a larger number of LU, and a higher share of permanent grasslands in their land use were more likely to expand their permanent grassland area.

The parameters of models with interactions of explanatory variables were additionally estimated in the case of mixed crop-livestock farms. In this farm type, the share of permanent grasslands in total agricultural land had a positive effect on the probability of a reduction in permanent grassland area.

Based on the results of the regression analyses, the following logical classification was used to divide the beneficiaries of SAP and greening payment into three groups:

1) Area of permanent grasslands was considered likely to decline in the case of:
   - all specialised field crops farms;
   - those mixed crop-livestock farms in which the share of permanent grasslands exceeded the median (73.2%) for this farm type;
   - all passive land users.
2) Area of permanent grassland was considered likely to increase in the case of those specialised grazing livestock farms in which:
   - livestock density exceeded the median (0.417 LU/ha) for this farm type, or;
   - the share of permanent grasslands exceeded the median (89.5%) for this farm type, or;
   - the agricultural area exceeded the median (24 ha) for this farm type, or;
   - the total number of LU exceeded the median (4.8 LU) for this farm type.
3) Area of permanent grassland was considered likely to remain unchanged in all farms that did not belong to groups 1 or 2.

Proximity of permanent grassland parcels of *expanding* and *shrinking farms*

For a farm, one of the preconditions for expanding its agricultural land use is the availability of land that is for sale or for rent within reasonable proximity to its current boundaries. Fig. 1 demonstrates the situation where the permanent grassland parcels of several *expanding farms* are situated within a distance of 1–4 kilometres from the permanent grassland parcels of *shrinking farms*. In this case, it is apparent that the permanent grassland parcels of *expanding farms* are located around and between the permanent grassland parcels of potentially *shrinking farms*, as if in the pieces of a puzzle. These *expanding farms* would primarily be interested in buying or renting the permanent grassland parcels of neighbouring *shrinking farms*.

Table 3 shows that the number of *shrinking farms* exceeded the number of *expanding farms* by 2.7 times. However, the area of permanent grassland used by the *shrinking farms* comprised 53% of the area of the permanent grassland of *expanding farms*. The average *shrinking farm* was characterised by the smaller average number of parcels (3.23), the smaller average size of a permanent grassland parcel (3.35 ha) and the smaller average area of permanent grassland parcels (10.83 ha) compared to the respective values of the average *expanding farm* (10.58, 5.23 ha and 55.31 ha). This is consistent with the results from previous research (Viira et al., 2013), which determined that smaller farms have a higher probability of giving up agricultural production, while larger farms are more likely to expand their land use and production volume. However, it also suggests that the permanent grassland parcels of *shrinking farms* had less desirable characteristics (smaller size) compared to the parcels of *expanding farms*. Therefore, it is likely that *expanding farms* might not be interested in all the permanent grassland parcels of *shrinking farms*.

Table 3. A general description of the investigated farms and their permanent grassland parcels

Groups of farms	Number of investigated farms	Total number of parcels	Total area of parcels, ha	Average number of parcels per farm	Average area of parcels per farm, ha	Average parcel size, ha
Shrinking farms	7,998	25,829	86,579	3.23	10.83	3.35
Expanding farms	2,953	31,230	163,327	10.58	55.31	5.23
Total	10,951	57,059	249,906	5.21	22.82	4.38

Source: authors' calculations.

The number and area of the permanent grassland parcels of *shrinking farms* that were located in the buffer zones around the permanent grassland parcels of *expanding farms* was measured. 72% of the permanent grassland area of the *shrinking farms* were located within a 1 km buffer zone (Table 4), i.e. for 72% of the permanent grassland area of *shrinking farms,* there were potential *expanding farms* within a distance of less than 1 km. Respective figures for a 2 km buffer zone is 91%, 97% for a 3 km buffer zone and 99% for a 4 km buffer zone. Only 1% of the permanent grassland area of *shrinking farms* was located more than 4 km from the permanent grassland parcels of *expanding farms*. This suggests that the majority of the permanent grassland parcels of *shrinking farms* are located in sufficiently close proximity to *expanding farms*. Therefore, the main question mark over the active use of these permanent grassland parcels is not their location with respect to active farmers but rather the willingness of the passive land owners to sell or rent this land, as well as the financial capacity of active farmers to buy or lease this land.

Table 4. The amount and area of permanent grassland parcels of *shrinking farms* in the zones surrounding the permanent grassland parcels of *expanding farms*

The radius of buffer zones surrounding parcels of *expanding farms*, km	The number of parcels of *shrinking* farms in the zones	The total area of the parcels in the zones, ha	The proportion of parcels in the zones, %	
			by the number of parcels	by the area of parcels
1	18,327	62,690	70.9	72.4
2	5,163	16,472	20.0	19.0
3	1,569	4,746	6.1	5.5
4	525	1,651	2.0	1.9
Not in buffer zones	245	1,020	1.0	1.2
Total	25,829	86,579	100.0	100.0

Source: authors' calculations.

The measurement of the distance from the permanent grassland parcels of *expanding farms* to the nearest permanent grassland parcel of *shrinking farms* (Table 5) also confirmed that the bulk of the permanent grassland parcels of *expanding farms* (83% by the area) was located less than 1 km from the parcels of *shrinking farms*. 96% of the number and area of permanent grassland parcels of *expanding farms* were within a distance of 2 km from the locations of *shrinking farms*. Therefore, if any of the *shrinking farms* decide to sell or rent their permanent grassland, there is a high probability they will find an interested *expanding farm* within a radius of 1–2 kilometres.

Table 5. The distribution of the permanent grassland parcels of *expanding farms* to the nearest permanent grassland parcel of *shrinking farms* by distances

The distance from the parcels of *expanding farms* to the nearest parcel of *shrinking farms*, km	The number of parcels of *expanding farms* in the group	The total area of the parcels, ha	The proportion of parcels in the group, %	
			by the number of parcels	by the area of parcels
Less than 1.0	25,716	135,826	82.4	83.1
1.1 to 2.0	4,111	20,232	13.2	12.4
2.1 to 3.0	951	4,847	3.0	3.0
3.1 to 4.0	253	965	0.8	0.6
More than 4.0	199	1,457	0.6	0.9
Total	31,230	163,327	100.0	100.0

Source: authors' calculations.

The results in Tables 4 and 5 suggest that if the practices of maintenance of permanent grasslands are restricted in a way that *shrinking farms* are willing to sell or let their permanent grassland parcels to *expanding farms*, it is likely that the share of permanent grassland that would not be maintained in the GAEC would be modest[2].

Regional effects

Heat maps (Figs 2–5) illustrate the spatial distribution of the permanent grassland parcels of *shrinking farms* and *expanding farms*. The darker the colour on the map the higher the concentration of the phenomenon or objects in the space. It should be noted that the colour differences on the map show the relative differences in concentration. Thus, each map must be interpreted independently, as a comparison of colours on the different maps would lead to incorrect conclusions.

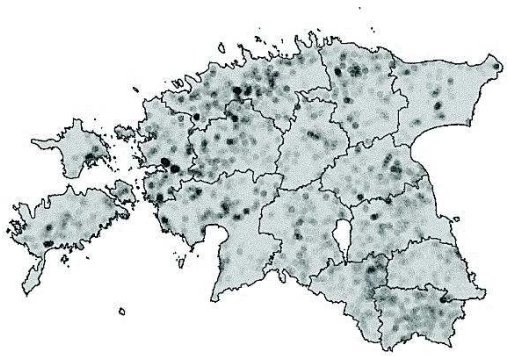

Figure 2. Concentration of permanent grassland parcels of *shrinking farms*.

The heat map on Fig. 2 shows the concentration of the permanent grassland of all *shrinking farms* across the whole of Estonia. Relatively higher concentration areas (darker colour) can be observed in the northern part of the country, around the region of the capital (Tallinn, in the north), in the coastal regions of the West-Estonian lowlands and in the southeastern part of Estonia with its hilly topography. This suggests that restrictions on the maintenance practices of permanent grassland that are eligible for SAP and greening payment would more severely affect passive land users, crop and mixed crop-livestock farms around the region of the capital, in coastal lowlands and in hilly regions that are less favourable for agricultural production due to their natural conditions. The last finding is concurrent with Brady et al. (2017) in that the passive management of

[2] However, this presumes well-functioning land and financial markets to facilitate the transactions. The functioning of land and financial markets, and land owners' willingness to sell or rent their land, falls outside of the scope of this paper due to the lack of such information.

agricultural land derives from low productivity. A higher concentration of passive farming around the region of the capital could be explained by a more active labour market and better options for higher remuneration outside of the agricultural sector.

Fig. 3 shows the concentration of permanent grassland parcels of *shrinking farms* locating at a distance of more than 1 km from the nearest *expanding farms*. This indicates the relatively higher risk that the permanent grasslands will not be maintained in the GAEC if the eligible maintenance practices are restricted. It appears that the risk is higher around the two largest cities – the capital Tallinn (in the north), and Tartu (in the southeast). This is dueto the lack of *expanding farms* that would potentially be interested in buying or renting permanent grassland parcels in these regions (Fig. 4).

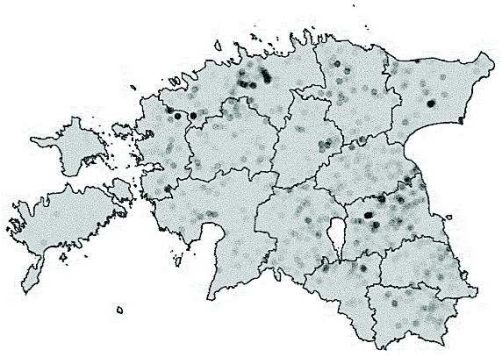

Figure 3. Concentration of permanent grassland parcels of *shrinking farms* located more than 1 km from permanent grassland parcels of *expanding farms.*

The permanent grasslands of *expanding farms* are concentrated on the islands and coastline of Western Estonia, Central Estonia and Southern Estonia (Fig. 4). This coincides with the regional concentration of cattle, sheep and goat farms (Kaasik et al., 2012) as well as the regional concentration of permanent grasslands in Estonia. It is likely that in these regions the restrictions on the eligible maintenance practices of permanent grasslands will not cause a decline in the area of permanent grasslands that are not maintained in the GAEC.

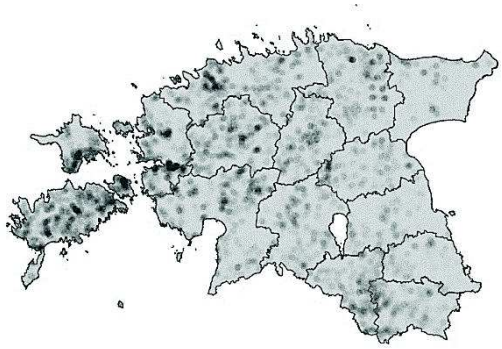

Figure 4. Concentration of permanent grassland parcels of *expanding farms.*

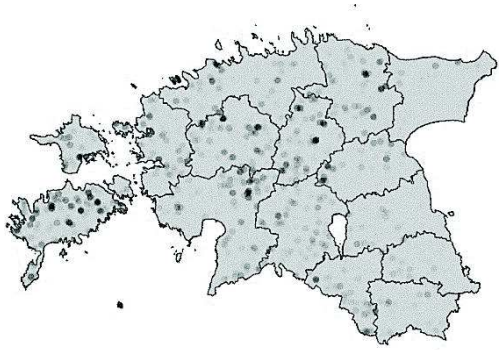

Figure 5. Concentration of permanent grassland parcels of *expanding farms* located more than 1 km from permanent grassland parcels of *shrinking farms.*

Fig. 5 presents the concentration of permanent grassland parcels of *expanding farms* located at a distance of more than 1 km from the nearest permanent grassland parcel of *shrinking farms*. It appears that in central Estonia and on the island of Saaremaa

there is some concentration of *expanding farms* that do not have permanent grasslands parcels of *shrinking farms* in the vicinity of less than 1 km. Central Estonia is the main region for intensive and larger scale dairy farms (Kaasik et al., 2012), which is why there are not many passive land users, crop and mixed crop-livestock farms that would maintain their permanent grasslands in the GAEC using the restricted grass biomass cutting practice. On Saaremaa, the concentration of *expanding farms* is higher than that of *shrinking farms*. Therefore, it is likely that the potential demand for permanent grassland parcels associated with the restriction on eligible permanent grasslands maintenance practices exceeds the potential supply.

Policy implications

The previous results show that the policy change in the form of the restriction of eligible practices in permanent grassland maintenance could only be partly successful in promoting more active use of permanent grasslands. It is likely, as a result, that the maintenance activities of permanent grasslands would be stopped in some parts of the country. Brady et al. (2017) conclude that elimination of the SPS would result in less land in production, specifically low-productive land, because production, rather than passive farming, is the least-cost alternative to meet the maintenance obligation for substantial areas of land. Therefore, if the maintenance of permanent grasslands via active farming practices, i.e. grazing or forage production (Mõtte et al., 2019), is the desired policy objective, then extensive grazing should be supported with respective subsidies or otherwise promoted. However, dairy and beef production comprise a significant effect on agriculture related greenhouse emissions (GHG) (Lesschen et al., 2011, Lenerts et al., 2019). Therefore, expanding grazing livestock systems is a questionable policy goal in the context of the urgent need to reduce GHG emissions in the EU.

This suggests that a subsidised passive farming type of maintenance is necessary for some low-productivity permanent grasslands if these permanent grasslands are to be maintained in the GAEC according to the aims of the CAP. This is in line with the conclusion of van der Zanden et al. (2017) that a discussion on agricultural land abandonment should consider the spatial diversity and help to develop context-dependent, nuanced management strategies. Furthermore, the maintenance of permanent grasslands should be considered within a wider context of land use and bioeconomy policies. In some cases, afforestation could be a viable alternative for permanent grassland maintenance, in other cases the collected biomass could be used for bioenergy purposes (Nurmet et al., 2019). However, in each case, the local context (soil quality, landscape, biodiversity, farm structure) should be considered before making any decision.

CONCLUSIONS

The results of the study show that more than 70% of the permanent grassland parcels of shrinking farms are located less than 1 km away from the permanent grassland parcels of expanding farms. Therefore, the distance from the active *expanding farms* is not the main obstacle to permanent grassland maintenance. The main reasons are most likely related to the willingness of passive land users to sell or rent their permanent grasslands to active farmers and the financial capacity of active farmers to buy or lease

the respective land. If the eligible maintenance practices of permanent grasslands are restricted, then passive land users, crop and mixed crop-livestock farms are more likely to reduce their use of permanent grasslands, while grazing livestock farms are likely to increase their use of permanent grasslands. Also, there are some regions (around two largest cities – the region of the capital Tallinn (in the north), and Tartu (in the southeast)) where there are not enough *expanding farms* close to *shrinking farms*, which suggests that in such regions permanent grassland maintenance might stop as a result of the restriction of eligible maintenance practices. Therefore, a policy change on the form of restriction of eligible practices could only be partly successful in promoting the more active use of permanent grasslands.

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Annex I

Descriptive statistics of farms and passive land users that are likely to decrease, increase or not change their use of permanent grasslands

Characteristic	Permanent grassland use will decrease	Permanent grassland use will increase	Permanent grassland use will not change
Agricultural area, ha	39.6	115.3	60.6
Share of specialist field crops farms	31.8%	0.0%	0.0%
Share of specialist horticulture farms	0.0%	0.0%	0.8%
Share of specialist permanent crops farms	0.0%	0.0%	5.3%
Share of specialist grazing livestock farms	0.0%	100.0%	38.8%
Share of specialist granivores farms	0.0%	0.0%	3.3%
Share of mixed cropping farms	0.0%	0.0%	2.7%
Share of mixed livestock farms	0.0%	0.0%	0.9%
Share of mixed crops – livestock farms	16.2%	0.0%	47.0%
Share of non-classified holdings	0.0%	0.0%	1.2%
Share of passive land users	52.0%	0.0%	0.0%
Share of permanent grassland in agricultural area	71.5%	73.9%	27.3%
Livestock Units, LU	0.283	57.486	30.904
Livestock density, LU ha^{-1}	0.006	0.669	0.246
Share of private persons	64.2%	29.8%	60.5%