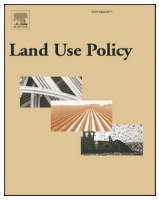
Land Use Policy 135 (2023) 106941

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol



Management of rented farmland in Norway: Factors impacting on tenants' decisions to make investments

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ARTICLE INFO

Keywords:
Agriculture
Food production
Decision-making
Policy implications
Sustainable agriculture

ABSTRACT

Renting agricultural land is a common practice in many countries. The possibility to rent land provides farmers with increased flexibility in terms of production volume. Land renting may have various effects on farmland management; however, results from studies analysing these are ambivalent. Farmland in the best possible state is a prerequisite for following up ambitions of feeding a growing population through a sustainable agriculture. Decisions regarding investments on farmland are key. The aim of this study is to increase the understanding of which factors are the most important ones for farmers' decisions about investments on land they rent. We carried out a questionnaire survey followed by a multiple linear regression considering 34 variables. Although variables included in our model come out as significant in explaining investments, a large part of the variation is left unexplained ($R^2 = 0.22$). Our interpretation of this result is that making investments is a complex decision. Non-economic factors impacting on farmers' investment decisions such as trust or norms may contribute to the unexplained variation, but may only have been captured partly by our variables. Moreover, decisions regarding investments may not only vary among farmers but also among investments made by an individual farmer. The complex nature of the decisions on how to treat rented land makes it challenging for policymakers to develop measures targeted at farmers renting land. However, the finding that farmers are driving longer distances to rented land than they find acceptable deserves political attention. One potential policy implication may be strengthened incentives for land re-allotment. Re-allotment may address increasing distances and potential consequences such as reduced productivity and increased land abandonment. However, the sustainability of a re-allotment process needs to be considered carefully in terms of economic viability, ecological soundness and social responsibility.

1. Introduction

In Europe, the share of agricultural land managed as rented land can be more than 70% on a national level (Eurostat, 2020, data from 2013). Renting of farmland is thus a widespread practice to get access to land for farm operation (Carolan, 2005; Sklenicka et al., 2015; Stokka et al., 2018; Wästfelt and Zhang, 2018). Potential reasons for renting land may be legal restrictions on farmland sale or a restricted amount of farmland available for sale (Forbord et al., 2014; Stokka et al., 2018). Moreover, renting land provides farmers with the possibility to invest in their farm without having to spend their means on buying land (Andersson, 2014; Strømsæther and Lundamo, 2015). To rent out farmland can be an option for landowners whose land parcels have become too small and scattered to be of interest for them to farm (Sklenicka et al., 2014). By renting out farmland landowners in Norway who are not farming themselves comply with their legal obligation to keep farmland in production (Forbord et al., 2014). In a European context, it is probable that the alternative for land renting had been abandonment and reforestation – especially in marginal areas (Filho et al., 2017).

Concerns about potential consequences of increased land renting have been raised in Norway as well as in other countries. Land renting may impact the spatial configuration of farms and their production

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https://doi.org/10.1016/j.landusepol.2023.106941
Received 2 February 2021; Received in revised form 12 September 2023; Accepted 16 October 2023
Available online 31 October 2023

(Wästfelt and Zhang, 2018). Land renting may also have an impact on the maintenance of farm elements providing amenity values and habitat, e.g. stone fences, grave mounds, or coastal heathlands (Stokka et al., 2018). A particular concern has been whether land renting may result in reduced management efforts to sustain or improve the land's production value. However, no final conclusions can be drawn. Studies from the Czech Republic, Finland, Norway and the US found indications of that tenants to a lesser degree than owners may engage in activities to protect soil including its production value, and in farming practices providing long-term benefits (Soule et al., 2000; Myyrä et al., 2005; Eldby, 2012; Sklenicka et al., 2015; Strømsæther and Lundamo, 2015; Walmsley and Sklenička, 2017). In contrast, studies from Austria, the US and Norway found no or only slight differences in soil quality and how tenants and owners manage farmland (Strømsæther and Lundamo, 2015; Stokka et al., 2018; Frisvold et al., 2020; Leonhardt et al., 2020).

Sustainability in general, and of agriculture specifically have been topics high on the international and Norwegian political agendas since the Brundtland report on sustainable development (World Commission on Environment and Development, 1987; Commission of the European Communities, 2001; Norges offentlige utredninger (NOU), 2005; European Environment Agency, 2019; Maggio et al., 2015; Muller and Bautze, 2017; St., 11AD; European Commission, 2020; Haugen and Svardal, 2020; report). A large number of alternative definitions of sustainable agriculture exist (Velten et al., 2015). While there are issues shared by the majority of the definitions, e.g. regarding 'ecological soundness', 'social responsibility' and 'economic viability', no agreement exists on what sustainable agriculture is and how it can be achieved (Velten et al., 2015). The question of how to ensure a sustainable agricultural production becomes even more challenging in a situation where food production needs to increase to feed a growing population (Pradhan et al., 2015).

One prerequisite for sustainable production, however, is agricultural land kept in its best possible state. Key stakeholders are the people making day to day management decisions regarding use and investments on the farmed land. To be able to promote a more sustainable agriculture it will be important to understand how they make their decisions. The importance of a globally increased proportion of agricultural land managed by someone other than the owner is rarely analysed; however see Carolan (2005) and Cox (2010; 2011). The aim of this study is to increase the understanding of how farmers make decisions regarding investments on rented land: Which are the most important factors impacting on farmers' decisions about investments on land they rent? We discuss our results in terms of which implications they have for developing target policies for promoting sustainable agriculture.

2. A short history of land renting and factors impacting the treatment of rented land

Historically, different principles of land renting existed in Norway. Between 1200 and 1300 and the end of the 1800s commonly farmers were tenants (*leilendinger* in Norwegian) renting whole farms (Sevatdal et al., 2017). The number of tenants declined towards the end of the period, and by the end of the 1700s more than half of the farmers owned their farms. The crofter system (*husmannsvesenet* in Norwegian) occurred from the mid-1600s until the 1880s and was phased out by the end of the 1920s (Sevatdal et al., 2017). Crofters commonly rented some land and a place to live from a tenant or a farm owner. The current principle of land renting became common in the 1950s (Sevatdal et al., 2017). As a result of a comprehensive modernization and rationalization process in agricultural production since the Second World War, the number of farms decreased while the size of the remaining farms increased (Almås, 2004; Daugstad, 2013). Farmers aiming to enlarge their farms rent parts or all land of abandoned farms. If not farming themselves, landowners can rent out their land with rental contracts of a minimum of 10 years, to comply with their already mentioned obligation to keep farmland in production (Forbord et al., 2014). However, c.44% of the farmers did not have a written contract for the land they rented in 2013 while c.25% did have agreements with and without written contracts (Statistics Norway, 2022). Contracts – written or oral – may also have shorter rental periods than 10 years (Stokka et al., 2018). Although farmers can use a standard contract as for example provided by the Norwegian Farmers' Association, no regulations exist about the issues written contracts should address.

The decision about how to manage rented farmland and where and when to make investments seems to be a complex one. Lacking land tenure security has been pointed out as an important reason for why farmers may lack motivation to carry out management efforts – at least in a long-term perspective (Soule et al., 2000; Carolan et al., 2004; Carolan, 2005; Sklenicka et al., 2015; Leonhardt et al., 2020). Desertification in southern New Zealand starting in the second half of the nineteenth century is an early example of the relationship between lacking tenure security and land degradation (Mather, 1982). However, a case study from Ethiopia showed that lacking tenure security did not result in land degradation but rather in an effort to invest in land conservation to increase tenure security (Moreda, 2018). For farmers who are strongly dependent on the produce from their rented land, the competition for land with other farmers may be a driver to treat rented land well (Stokka et al., 2018). A fear of losing rented land if not treated well, the relationship between tenant and landowner, social norms in terms of how farming should be done, and the physical distance to the rented land are other factors impacting on farmers' decisions on how to treat rented land and when and where to make investments (Stokka et al., 2018; Leonhardt et al., 2020). Grammatikopoulou et al. (2013) found that Finnish farmers favoured farming themselves on plots close by their farm and renting out plots located at a greater distance to their farm. Secured access to land, competition for land among farmers, access to knowledge, cultural norms about how farmland should look and not at least trust were among the important factors impacting on the application of sustainable agriculture methods of farmers in the US (Carolan, 2005). The relationship between owner and renter was also an important factor for Swiss and Swedish landowners' decisions regarding to whom they would rent their land (Häusler, 2010; Grubbström and Eriksson, 2018).

3. Methods

We carried out a questionnaire survey among farmers to get an insight into which factors have an impact on the management of rented farmland.

3.1. Study area

Taking into account that suitability of land for farming is highly variable in Norway (Stokstad and Puschmann, 2018), we choose the seven counties in Norway with the largest amount of farmland in use in 2016: Hedmark, Rogaland, Oppland, Nord-Trøndelag, Akershus og Oslo, Østfold and Sør-Trøndelag (i.e., 162 municipalities) (Statistisk sentralbyrå, 2017a) (Fig. 1). These counties cover areas most suitable for agricultural production regarding climate and soil conditions. More information about factors influencing agriculture and production systems in the study area can be found in Stokstad and Puschmann (2018), Daugstad (2013), Puschmann (2005) and Puschmann et al. (2004).

3.2. Data collection and analysis

3.2.1. Selection of farmers

In some municipalities a high demand for agricultural land exists, both for farming and for other purposes, e.g., urban development. Stokka et al. (2018) documented that farmers were very much aware of the competition for land and that competition for land may impact on how farmers use rented land. Thus, we stratified our sample into three groups based on the demand for agricultural land for farming and other

Fig. 1. The study area consisting of seven counties.

purposes:

- Group 1: Farmers from municipalities with high demand for agricultural land for farming purposes but little demand for land for other purposes (i.e., commonly municipalities with well-developed agriculture located far enough from larger urban areas to be less impacted by urban development).
- Group 2: Farmers from municipalities with strongly declining farming activities and therefore little demand for agricultural land for farming purposes, and also little demand for agricultural land for other purposes than farming (i.e., commonly municipalities far from urban areas which experience a decline in agricultural activities).
- Group 3: Farmers from municipalities with high demand for agricultural land for development purposes and for farming (i.e., commonly municipalities close to developing urban areas with high quality agricultural land).

3.2.2. Map data

We used map data of 'Norway's most exposed agricultural land' (*Norges mest utsatte jordbruksareal*) as an indicator of the demand of agricultural land for other purposes than agricultural production. This raster data consists of a 5 × 5 km grid upon which occurrence of agricultural land and population density have been used to calculate the potential for agricultural land to be converted to built-up land given as three classes (Krøgli et al., 2015). The grid data were overlaid with municipality borders in ArcGIS (version 10.5) to assess the potential for development in each municipality. For each municipality the area within a class was weighted by its class. The weighted area values were summed up and divided by the municipality's area. We selected the 50 municipalities with highest values and the 50 municipalities with lowest values. Thus, we included the upper and lower third of the municipalities in our sample. Municipalities with low values but with a large area of the municipality being covered by water were excluded.

As an indicator for farming activity (i.e., reflecting the demand for

farmland), we used the changes in percentage of farms per municipality between 2006 and 2016 (Statistisk sentralbyrå, 2017b). We are aware of that a decline in number of farms may not necessarily indicate a decline in farming activity. Rather, a decline in farm number may also reflect an increase in scale of production. However, competition for farmland will still decline when the number of competitors declines. We selected the 50 municipalities with an increase or least decline in number of farms and the 50 municipalities with the largest decline in farms.

3.2.3. Questionnaire survey

The questionnaire was thoroughly discussed, tested on a farmer, and revised prior to carrying out the survey (Supplementary material 1). Within each group of farmers 100 randomly chosen farmers were interviewed via telephone (101 in group 1). Farmers were asked about their farm and their productions, about their rented land and the investments they have made. By investment we mean any management of the land, including management that requires investments in terms of money and/or time. We considered, for example, draining with drain pipes costing money and time, and removing weeds which requires mainly time. Several farmers (57) were either unsure about the number of investments they had made or stated that they had made zero investments but still provided information about the different types of investments they had made. These respondents were omitted from the statistical analyses.

Spearman's rank correlation coefficient was calculated to investigate correlations between the number of investments made by each farmer and several continuous variables. Mann-Whitney U Test (Eq. 1) was used for binary variables with R as the sum of ranks

$$U = R - \frac{n(n+1)}{2} \quad (1)$$

Mann-Whitney U Test is a non-parametric test that enables a comparison of two sample means from the same population. The result signals whether the two sample means are equal or not. See Supplementary material 2 for an overview of all variables. For two correlations some respondents were omitted from the calculation of the Spearman's rank correlation coefficient. This regards correlations between the variables 'Number of investments' and 'Average duration of contracts' and between the variables 'Number of investments' and 'Average distance to the field where an investment was made' (N = 236 and N = 218). See Supplementary material 2 for reasons for why respondents have been omitted.

A multiple linear regression was carried out with 'Number of investments' as dependent variable. All other variables besides 'Longest acceptable driving distance' and 'Percentage of investment paid by the renter' were included as independent variables. The two latter were excluded since they were either considered to be without relevance for explaining the number of investments ('Longest acceptable driving distance') or constituted a subsample of the variable 'Number of investments' ('Percentage of investment paid by the renter'). To control for the different groups of farmers, dummy variables were added. Lacking data for the variables 'Average duration of contracts' and 'Average distance to the field where an investment was made' were predicted with the multiple imputation tool in SPSS (IMB SPSS Statistics, Version 25) based on all variables included in the multiple regression.

A first run of a multiple linear regression showed that error terms were non-normally distributed, and that the variance of errors reflected heteroscedasticity. Thus, a box-cox transformation (Eq. 2) with $\lambda = -0.18$ was used to transform the dependent variable (y).

$$z = -(y+1)^{-0.18} \quad (2)$$

To provide some interpretation of the regression coefficients, we have back transformed z for two examples for which we keep all but one independent variable constant.

The regression in SPSS was run with the backward selection option. See Supplementary material 3 for full model before variable selection. In the final model all independent variables with a significant contribution to the model were included. Moreover, since we wanted to control for the different farmer groups, Group 2 which was not part of the selected variables was added to the model.

3.3. Limitations of the study

Although respondents in our study were randomly chosen, the study investigates the factors impacting on management decisions of a selected group of farmers. Farmers not answering the phone or declining to participate in the questionnaire may have added bias to the data. Our findings may thus not be applicable to all Norwegian farmers. Moreover, using municipalities as spatial units with similar characteristics throughout is a simplification of the real-world situation. A potential consequence of this simplification is described in the discussion. While we acknowledge these limitations, we still believe that our sample captures a relevant and interesting sample of Norwegian farms, farmers, and geographies. Further, we are aware that we focus on only one type of investment, quantifiable physical actions. Thereby we may miss those explanatory variables that reflect "soft knowledge", for example, an investment in form of time spent to gain knowledge about qualities of a specific piece of land. To cover these kinds of investments was, however, outside the scope of this study.

4. Results

4.1. Descriptive statistics

We received responses from 244 farmers, all counties included (Fig. 1) (see *3.2.3 Questionnaire survey* for details about why responses were excluded). Farmers were on average 53 years old and had been working as a farmer between 0 and 52 years. About 90% of the farmers were male, 10% female. The amount of farmland in use varied from 0 to 300 ha, and the amount of rented land from 0.3 to 190 ha. Additional descriptive statistics are provided in Supplementary material 2.

4.2. Number and types of investments and driving distances

The number of investments carried out on the rented land differed among farmers. The range was from zero to 50 investments per farmer, while the average number was 4.5 investments. Farmers reported different types of investments, and both long- and short-term investments (Table 1). To some degree types of investments are linked to types of productions, i.e., some types of investments are more likely to be carried out for certain types of productions than others. For example, a larger share of farmers in Group 1 reported to have put up fences than in Group 2 and 3, while the share of farmers in Group 1 that had been digging ditches was smaller than in Group 2 and 3. Farmers in Group 1 had more livestock than farmers in Group 2 and 3, while the production of grass, hay and cereals was much smaller in Group 1 than in Group 2 and 3 (Table 2).

Most commonly the renter paid for the investment. On average 78.2% of investments were paid for by the renter (Supplementary material 2). For about half of the contracts (52.9%) an agreement about who should pay for investments was included. Driving distance to rented land was on average 5.8 km. Excluding one outlying observation of 110 km, provides an average of 5.3 km. Interestingly, the average number of kilometres a farmer replied to be willing to drive to a rented piece of land (one hectare), was below both values (4.5 km).

4.3. Factors impacting farmers' decisions about investments

The results show that although the independent variables statistically significantly predict the 'Number of investments' ($p < 0.01$), a large amount of variation remains unexplained ($R^2 = 0.22$). Moreover,

Table 1
Number and types of investments.

Farmer group*	Set up fences		Digging ditches		Added lime		Construction/ rehabilitation of buildings		Road construction/ rehabilitation		Other types of investments* *	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
1	44	53.0	38	45.8	48	57.8	6	7.2	18	21.7	10	12.0
2	27	32.5	46	55.4	62	74.7	4	4.8	26	31.3	17	20.5
3	27	34.6	44	56.4	56	71.8	7	9.0	25	32.1	20	25.6
Sum	98	40.2	128	52.5	166	68.0	17	7.0	69	28.3	47	19.3

* Farmer group 1 and 2 consist of 83 farmers and farmer group 3 of 78 farmers.
* * Other investments included, for example, removing thicket, trees, stones and weeds.

Table 2
Types of production.

Farmer group*	Milk		Cattle		Pigs		Sheep & Goats		Vegetables & Fruits		Cereals	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
1	27	32.5	32	38.6	4	4.8	30	36.1	2	2.4	7	8.4
2	27	32.5	30	36.1	0	0	8	9.6	4	4.8	15	18.1
3	12	23.1	18	23.1	2	2.6	11	14.1	3	3.8	39	50
Sum	68	27.0	80	32.8	6	2.5	49	20.1	9	3.7	61	25

Farmer group*	Forest		Grass & Hay		Other	
	Count	%	Count	%	Count	%
1	3	3.6	24	28.9	9	10.8
2	1	1.2	40	48.2	5	6.0
3	2	2.6	30	38.5	8	10.3
Sum	6	2.5	94	38.5	22	9.0

* Farmer group 1 and 2 consist of 83 farmers and farmer group 3 of 78 farmers.

the contribution of those variables that significantly contribute to an increase in the number of investments (i.e., 'Area rented', 'Number of contracts' and 'Percentage of contracts for which an agreement exist') is very small (Table 3). However, the results of the Spearman rank correlations show that these three variables also are among those strongest correlated with 'Number of investments' (Table 4).

Two variables in our model concern production types – 'Vegetables, etc.' (including vegetables, fruits, berries, potatoes, and flowers) and 'Other' (meaning other productions). The regression coefficients of these variables are negative. The Mann-Whitney U Test shows that mean ranks for those mentioning the production types 'Vegetables, etc.' or 'Other' are lower than for those not mentioning these types of productions. This means that fewer investments were carried out by those farmers that have the production type 'Vegetables, etc.' and those that have 'Other' types of production compared to those not having these production. However, for the production 'Vegetables, etc.' the difference is not statistically significant (Table 4). Finally, belonging to Farmer group 1 and Farmer group 2 reduces the number of investments compared to Farmer group 3. However, again coefficients are small, and for Farmer group 2 the value is not statistically significant.

Back transforming z with 'Area rented' and 'Percentage of contracts for which an agreement exists' set to average value, no production of 'Vegetables, etc.' and 'Other', and belonging to Farmer group 1, we expect a very small increase in number of investments when the number of contracts increases from three to four (0.02 investments). Back transforming z with 'Area rented', 'Percentage of contracts for which an agreement exists' and 'Number of contracts' set to average value, no production of 'Vegetables, etc.' and 'Other', we expect a larger increase in number of investments when farmers do not belong to Farmer group 1 (3.76 investments).

Table 3
Results of the multiple linear regression for number of investments as dependent variable (N = 244; R2 = 0.22%).

	B	Std. Error	p-value	VIF
Constant	-0.831	0.017	0.000	
Area rented	0.00	0.00	0.042	1.454
Number of contracts	0.011	0.004	0.004	1.417
Percentage of contracts for which an agreement exists	0.000	0.000	0.003	1.067
Type of production: Vegetables, etc.	-0.083	0.035	0.018	1.009
Type of production: Other	-0.047	0.023	0.044	1.021
Farmer group 1	-0.45	0.017	0.007	1.453
Farmer group 2	-0.23	0.016	0.159	1.408

5. Discussion

5.1. Significant variables

While some variables in our model have a significant effect on number of investments, the model leaves a large part of the variation unexplained. A probable reason for this result is the many factors having impact on the decision to make investments. Deciding on investments and the specifics regarding the type of investment, may not only vary among farmers but also among investments made by an individual farmer. Moreover, the decision to make an investment is not a purely economic decision. It has previously been documented that social norms, trust and personal relationships impact decisions about whom to rent out land to, the treatment of rented land, as well as farmland control in general (Carolan, 2005; Häusler, 2010; Forbord et al., 2014). We assume that these non-economic variables make more of a difference when the land is rented, compared to when the land is owned. Although we have included a question about whom farmers rent land from, other non-economic factors impacting on farmer's investment decisions have not been captured, such as trust or norms regarding what is considered appropriate treatment of rented land.

The results regarding variables contributing to an increase in investments in this study are in general explainable. An increase in rented land as well as an increase in number of contracts point to an increase in the amount of land that needs to be taken care of. More land means more investments required. Moreover, given the changing soil, water, and terrain conditions apparent even over short distances in Norwegian

Table 4
Spearman's rank correlation coefficient and results of the Mann-Whitney U Test.

Variable	N	Rho	p-value
Age	244	0.047	0.463
Years being a farmer	244	-0.03	0.646
Amount of farmland on the whole farm	244	0.104	0.104
Amount of farmland in use	244	0.073	0257
Area rented	244	**0.388**	**0.000**
Area rented as % of all farmland in use	244	**0.272**	**0.000**
Number of contracts	244	**0.296**	**0.000**
Average duration of contracts	236	-0.109	0.093
Percentage of contracts for which an agreement exists	244	**0.227**	**0.000**
Average distance to the field where an investment was made	218	**0.177**	**0.009**
Longest driving distance to rented land	244	**0.130**	**0.042**
Longest acceptable driving distance	244	0.076	0.239
Percentage of investments paid by the renter	244	**0.273**	**0.00**
Variable	N	U	p-value
Gender	244	2379.5	0.422
Bought more land, took more land into use or transformed other land into farmland	244	6738.5	0.223
Rented more land	244	4248.0	0.070
Type of production: Milk	244	5784.5	0.853
Type of production: Beef	244	6242.5	0.535
Type of production: Pigs	244	639.5	0.659
Type of production: Sheep, goats	244	4670.0	0.806
Type of production: Vegetables, etc.	244	692.5	0.076
Type of production: Cereals	244	4865.0	0.129
Type of production: Forest	244	636.5	0.646
Type of production: Gras, hay	244	6745.5	0.566
Type of production: Other	244	**1670.0**	**0.013**
Rented land from: Neighbours	244	4629.0	0.416
Rented land from: Family	244	4144.0	0.196
Rented land from: Others	244	5762.5	0.444
Type of contract: Oral	244	**4424.0**	**0.014**
Type of contract: Written	244	6695.0	0.222
Type of contract: Both	244	4209.00	0.253
Type of contracts: Oral with those mainly oral added	244	**4931.0**	**0.019**
Type of contracts: Written with those mainly written added	244	**5167.5**	**0.008**

agricultural landscapes, having more land implies an increasing diversity of investments needed. An agreement about who takes the responsibility of covering the costs of an investment, contributes to predictability and may make farmers renting land more willing to invest in rented land.

Differences may occur in number and type of investments required in different types of productions. These differences may explain why we, for example, see a decrease in the number of investments for farmers being involved in production of vegetables. Another explanation could be that only land where investments have already been made is interesting to rent for use in more specialised productions such as vegetables. The share of farmers in the whole sample and in the different farmer groups producing vegetables, fruits, berries, potatoes and flowers or involved in 'Types of production: Other' is small though, making it necessary to interpret the results with some caution (Table 2).

5.2. Farmer groups

The results show only slight relationships between Farmer group and number of investments (Table 3). These results are somewhat in contrast to previous research, which indicated that demand for agricultural land and competition of agriculture with other purposes of land use have an impact on farmer's decisions on how to treat rented land (Stokka et al., 2018).

Two different reasons may explain why differences among Farmer groups are not stronger. On the one hand, the demand for agricultural land, and competition with other land uses, may not only differ among municipalities but also within. On the other hand, variation between Farmer groups may already be reflected in the variables contributing significantly to the model. This can be interpreted based on how the average amount of rented land and the average number of contracts increase from Farmer group 1 to Farmer group 3. In addition, the findings of Stokka et al. (2018) did come from a region with a very intense agricultural land use. Also in other studies, this region was found to be somewhat different from other parts of the country regarding its agriculture (Forbord and Zahl-Thanem, 2019).

5.3. Non-significant variables

It seems surprising that 'Duration of contracts' did not turn out to be a significant variable. Several publications underline the importance of secured long-term access to the rented land for farmers' willingness to take care of this land (Mather, 1982; Soule et al., 2000; Carolan et al., 2004; Carolan, 2005; Sklenicka et al., 2015). However, as shown by Stokka et al. (2018) the number of years a contract lasts does not necessarily reflect the perceived access to land. Contracts may only seem valid for a short period of time when considering the number of years. However, farmers' may feel that their access to the land is secured for a longer time due to being part of a community that is regulated by certain norms. For example, contracts may be automatically renewed if no other agreement has been made and if the tenant takes good care of the land he/she will be allowed to continue renting it.

Moreover, despite a possible assumption that farmers neglect land at a larger distance from the farm, distance to the rented land did not negatively impact on farmers' decisions to invest on rented land. The correlation results even show a positive relationship (Table 4). This result coincides with what has been indicated by Stokka et al. (2018). Rather than neglecting the land, farmers adjust their use of the land. For example, they may chose low-maintenance crops (Leonhardt et al., 2020). Finally, despite the fact that we in communication with authorities involved in farmland management, have been presented with an observation that farmers rather than making investments rent more land, this relationship is not visible in the results. There may of course be farmers who follow this strategy; however, they are most likely not the majority, otherwise both an increase in the number of contracts and in the amount of rented land should have resulted in a decrease in the number of investments.

5.4. Implications for policy

As stated in our introduction, an important prerequisite for sustainable production is agricultural land in its best possible state. In the following we discuss potential implications of our results for management of rented land. The results confirm that decisions regarding investments on rented land are complex. Thus, developing targeted measures directed at farmland renters seems not to be the easiest and most promising approach. In addition, management decisions made by farmers renting land are already impacted by existing agricultural support schemes similar for owned and rented land. Sklenicka et al. (2015) found that owners applied soil conservation measures more frequently than tenants in the Czech Republic; however, they also documented that the differences between owners and tenants were minimized or even eliminated when conservation measures were supported by incentives. Adaptation of conservation practices providing long-term benefits increased for renters as well as for owners when lack of practices result in missing subsidies (Soule et al., 2000).

However, the results indicate that encouraging agreements between landowners and tenants about who will pay for investments on rented land is advisable. Anecdotal information does exist on how the lack of such agreements has led to conflicts over payments for investments already done, causing abrupt finalization of previously well-functioning renting agreements. According to a legal rule already from the beginning of the 20th century, Swedish landowners have to pay for the drain pipes while tenants are responsible for the work (Morell, 2014; Wästfelt,

2014).

The fact that farmers in average are driving longer distances to rented land than they find acceptable is an interesting result. One reason for the result may be that when we asked for acceptable driving distances we asked for a parcel of land of a certain size (1 ha; see Supplementary material 1). Although this figure is the average size of a parcel of farmland in Norway, some farmers may consider this to be rather small, and would thus be reluctant to driving a long distance to reach it. Farmers accept longer driving distances to rented land than to owned land as shown in a study of Austrian farmers (Leonhardt et al., 2020). However, the figures of acceptable and actual driving distances in this study are similar and may indicate that we are approaching a limit regarding distances farmers are willing to drive to rented land. From a sustainability perspective, driving long distances can be considered environmentally and economically unsustainable. Further, productivity may decline when farmland operations are carried out during non-optimal time periods or in non-optimal weather (Vik and Fløⱥ, 2017). We can assume that distant farmland is particularly vulnerable to this effect.

Although driving distances to rented land did not significantly impact farmers' decisions about investments in this study, and farmers seem to be able to deal with producing on plots located at larger distances, our finding can have important implications for agriculture production and future farmland management in Norway. In accordance with development in other European countries, Norwegian agriculture has been up-scaled to ensure farmers sufficient and acceptable income. This means that production has increased, been specialized, intensified and mechanized (Almås, 2004). Numbers of farms and active farmers continue to decline (Statistics Norway, 2020c; Statistics Norway, 2020a), while average farm and herd size has increased (Statistics Norway, 2020b; Statistics Norway, 2020d). Aside a few more intensively managed regions (Stokstad and Puschmann, 2018) farmland appears very fragmented in Norway (Forbord and Zahl-Thanem, 2019). Thus, farmers who need to rent land will meet the challenge that available plots are located at increasing distances to their farm. In such a situation, areas with limited accessibility, as for example on islands along the coast, may become unattractive to keep in use (Dramstad and Sang, 2010).

Agricultural policy needs to address the potential consequences of increasing distances to rented land and farmers' possible reluctance to drive (even) long(er) distance(s) to rented farmland. Reorganisation of landownership could be one approach (Forbord and Zahl-Thanem, 2019; Mittenzwei, 2020). Examples from several countries show that land re-allotment reduced transport time (Sky, 2009). However, the sustainability of a re-allotment process needs to be considered carefully.

Examples show that land re-allotment may be economically viable (Sky, 2009), in Norway probably due to the strict adherence to the Pareto-optimal principle; in practice that all participants are to gain (Sevatdal and Sky, 2003; Sky, 2009; Forbord and Zahl-Thanem, 2019). However, land re-allotment will most likely reduce the amount of land available on the rental market which again may reduce the flexibility land renting provides to farmers. In addition to the economic viability of land re-allotment, its 'ecological soundness' and 'social responsibility' need to be considered as well. Reorganising spatially land owned by one farmer may open up for enlarging fields. Enlarging fields is an important aspect that needs to be considered in terms of ecological soundness, since a large number of studies have demonstrated that removing natural field boundaries, such as hedgerows, grassy banks and ditches, reduces biodiversity (Benton et al., 2003; Berendse et al., 2004; Billeter et al., 2008). In terms of 'social responsibility', aspects such as complex bonds among farming families, and between farmers and the land that had been owned by their families for generations are important to consider (Mariola, 2005; Neumann et al., 2007; Sky, 2009; Laskemoen, 2011; Ahnström et al., 2013). Finally, complex field and landownership patterns are important witnesses of agricultural history (Skowronek et al., 2006). These witnesses may be lost as a consequence of land re-allotment.

6. Conclusions

A large proportion of the planet is used for some type of agricultural production. This makes those responsible for use and care of land important decision makers in the process of achieving sustainable agriculture. Although different options exist about what sustainable agriculture means, it is a topic high on the political agenda. Agricultural land kept in its best state is one prerequisite for sustainable production. To be able to influence farmers' decisions on how to manage land, policy makers need a sound understanding of which factors may contribute to farmers' decision-making processes. Numbers of active farmers have declined for several decades, and an increasing proportion of farmland is managed by tenants. Some studies show that management of rented farmland may be different from owned farmland, while others find no significant differences (see Introduction). We found that agreements on who pays for investments on rented land slightly increased the number of investments. Thus, politically encouraged agreements about the payment for investments may support the maintenance of rented land. The amount of area rented and the number of contracts also increased number of investments slightly which seems to imply that with an increasing amount of rented land and number of contracts (i.e., a larger amount of land needs to be taken care of) more investments are required. Thus, although neglect of rented land may occur, this seems not to be a general strategy.

The complex nature of the decisions on how to treat rented land, makes developing measures targeted at farmers renting land challenging. However, the potentially increasing distances between rented land and farmyard and the possibility of reduced productivity and increased land abandonment deserves attention. We have suggested land re-allotment as one potential political approach to address the increasing distances and its possible consequences. However, the sustainability of a re-allotment process needs to be considered carefully in terms of economic viability, ecological soundness and social responsibility.

This study aims to make a contribution to our understanding of farmers' decision about management of rented land, but as our results show a lot of variation remains unexplained. To increase the sample size and testing of specific hypotheses could be a way to reduce the unexplained variation. However, human decisions are complex and – as we have explained – difficult to fully address in terms of quantifiable variables. We thus recommend further research to also include qualitative approaches that allow to address investments that are not easily quantified.

CRediT authorship contribution statement

Dramstad Wenche E.: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Writing – review & editing. **Potthoff Kerstin:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The data that has been used is confidential.

Acknowledgements

We would like to thank Gregory Taff, Torfinn Torp and Hilde Vinje for their help with the statistical analyses and Ulrike Bayr for making the map. We would also like to thank three anonymous reviewers for comments that helped improving the manuscript. The work was co-financed by the Norwegian Research Council, project number 194051.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2023.106941.

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