Farmland under urbanization pressure: Conversion motivation among Norwegian landowners

Irreversible conversion of farmland to built-up land occurs globally. Despite farmlands' importance for food supply agricultural businesses, little research investigates what motivates landowners to convert their land. This paper aims to fill this gap. Based on a survey among owners of farmland in Norway, we found significant correlations between social structures and landowners' motivation for converting farmland, namely family understanding and willingness of other local landowners to convert their land. Values and interests were also significant; landowners emphasizing private interests and private property rights was most often motivated for conversion. Further, they often struggled to realize agricultural investments, and had limited agricultural income. Landowners located in highly productive agricultural areas, but facing urban growth, were significantly more motivated to convert farmland than others. They were also more often in contact with developers. This paper adds new empirical knowledge and develops theories to understand underlying farmland conversion causes among landowners, and provide insights for future policies.

Keywords: land use planning; farmland conversion; landowners; causes

Introduction

Climate change and unsustainable land use practices threaten our capacity to feed an increasing population and to meet global sustainability goals (FAO & ITPS, 2015). Farmland is essential for the world's food security and for food production, but agricultural landscapes also provide public goods, such as open landscapes, biodiversity, arenas for mental and physical recreation, and possibilities for learning about food production (Francis et al., 2012; Skog, Brattestå, & Thomassen, 2016; Zasada, 2011). The conversion of farmland to built-up land is considered an irreversible process (Amundson et al., 2015), threatening the land's ability to supply food and other vital ecosystem services (Tan, Beckmann, van den Berg, & Qu, 2009).

Cities have historically been built on our most productive farmland (Ferrara et al., 2014), and most remaining farmland is often located around these urban settlements (Skog & Steinnes, 2016). As continued urban sprawl threatens our future supply of food, the Food and Agriculture Organization of the United Nations (FAO & ITPS, 2015) has called for policies to promote farmland preservation and more sustainable land use practices.

Norway has dedicated policies to limit farmland conversion, thereby securing future supply of food. Only 3% of the total land area is farmland, and arable land per person is almost half of the average in OECD countries (0.16 hectares (ha) vs 0.30 ha per capita) (The World Bank, 2015). One-third of Norwegian farmland is of sufficient quality to grow grains and vegetables with the potential for human consumption, while the remaining two-thirds are grassland used for fodder production. The proportion of food supplied from national resources is less than 50% and slowly decreasing (Ministry of Agriculture and Food, 2016–2017).

Norwegian land use policies are mainly implemented by municipalities (Planning and Building Act of 2008), who are responsible for decision-making regarding farmland conversions. Regional and national government bodies can object if local decisions conflict with vital interests. Since 2004, an important policy target has been to halve the annual rate of conversion from 1200 ha to 600 ha of farmland per year (Ministry of Climate and Environment, 2004–2005). In 2016, the national target was met. Thus, Parliament established a new target: annual farmland conversion should total less than 400 ha by 2020 (Standing Committee on Business and Industry, 2015-2016).

Land use planning can restrict private property rights in the public interest (Campbell & Marshall, 2002). Local land use planning is the main tool for farmland preservation policies to (1) regulate the market and (2) control and direct where to

construct new buildings. Therefore, planning policies influence how much market and private landowners' interests affect land use practices. Private actors often have the right to initiate and negotiate for land use conversions, although planners and politicians facilitate action and make the final land use decisions for possible change (Heurkens & Hobma, 2014).

In most OECD countries, market forces, not public policies, cause urbanization trends (Kamal-Chaoui & Sanchez-Reaza, 2012). In the Netherlands and Germany, land use planning is decentralized, and strong private property rights hinder regulation of market interests for farmland conversion (Tan et al., 2009). Individual economic motivation also appear to drive land use decisions in the US and Canada (Francis et al., 2012). In Britain and Japan, however, it seems like the state more effectively limits farmland conversions to non-agricultural built-up purposes (Millward, 2006).

In Norway, the objective of the Land Act (1995) is to ensure that farmland is maintained for agricultural activities for the betterment of the society and the farmers. Despite this, the control of farmland conversions for development purpose is considered quite liberal. Land use decisions are mainly made by local politicians in the municipalities. The state can regulate local decisions, but current government policy limits state control (Strand & Næss, 2017). Private actors can prepare zoning plans, and market forces heavily influence land use outcomes (Falleth, Hanssen, & Saglie, 2010; Skog, 2018). Further, research shows that landowners experience significant pressure from developers (Bjørkhaug, Rønningen, & Vinge, 2019).

While land use planning policies restrict farmland conversion through regulation in Norway, agricultural policy potentially motivates continued farming. For instance, income from farming and optimism about the future might influence farmers' willingness to invest in future farming (Bjørkhaug, 2012). Thus, economic conditions

and agricultural policies are most likely highly relevant for farmland conversion motivation. Further, given structural trends in agriculture and a high and increasing share of rented land amongst remaining farmers, researchers recommend distinguishing in future studies between landowners who are active farmers and those who do not farm themselves, but rent out their land to other farmers (Forbord, Bjørkhaug, & Burton, 2014; Koontz, 2001; Primdahl & Kristensen, 2011).

It is considered important to include landowners when analyzing why land use changes occur (Nguyen, Nguyen, Lippe, & Grote, 2017; Primdahl & Kristensen, 2011; van Vliet, de Groot, Rietveld, & Verburg, 2015). However, there is limited research on how different driving forces influence their land use decisions (Koontz, 2001; Lokhorst, Staats, van Dijk et al., 2011; Slätmo, 2016; van Dijk et al., 2016). Further, drivers of land use changes have often been investigated at the meta-level, while factors explaining solely the conversion of farmland to urban land have been less emphasized. Moreover, van Vliet et al. (2015) request research covering a broader range of underlying causes, including demographic and sociocultural drivers that have been less explored.

This study aims to contribute to a better understanding of what influences landowners' motivation for converting their farmland for development purposes. Building on driving forces theory and institutional theory, a conceptual framework emerged with a broad focus on the influences from socioeconomic and biophysical conditions, and perceived norms and rules-in-use. Hence, the study also contributes to theory development and gives input to the framing of future policies.

Status of research

In this section, we examine literature on landowners' roles and their motivation when it comes to decision-making about land use change. We also review the status of research

and theories that can explain the underlying driving forces of farmland conversion.

Landowners´ land use motivation

There is a need to understand the social-ecological linkages between individual actors and land use changes (Bieling, Plieninger, & Schaich, 2013; Hersperger et al., 2010; Koontz, 2001; Plieninger et al., 2015). Research targeting land users and land owners is particularly called for (Koontz, 2001; Plieninger et al., 2015).

van Vliet et al. (2015) and Koontz (2001) emphasize the link between land use motivations with the different landowner characteristics. Primdahl and Kristensen (2011) found differences in land use management motivations based on how they considered their role as a landowner of farmland; (1) as a producer of food, (2) as a person solely viewing the farm as a place to live; or (3) as a citizen emphasizing the collective interests of the local society. These findings provide the basis for assuming that differences in motivation for converting farmland might be more significant for landowners who do not cultivate their own land anymore, but rent it out to other farmers. In Norway, such landowners own more than 40% of Norwegian farmland (Forbord, Bjørkhaug, & Burton, 2014).

Giddens (1991) defines motivation as the potential for action, stating that most daily actions are not directly motivated. Research shows that it is more difficult to explain actual behaviour than the intention to perform it (van Dijk et al., 2016). Despite the distinction between motivation and action, driving forces have most often been identified as underlying factors causing land use change, see for instance Plieninger et al. (2016) and van Vliet et al. (2015). When we look into the driving forces of land use change from the landowners' perspective, this picture becomes blurred; some changes are caused by decisions made at other levels (for instance, by the government in infrastructure projects), while others are initiated by landowners themselves. Bürgi,

Hersperger, and Schneeberger (2004) highlight the importance of distinguishing intentional from accidental drivers. Focusing on motivation rather than action is a strategy to uncover intentions, if a certain behaviour is dependent on the intention to perform it (Ajzen, 1991). Individual intentions make it possible to identify the underlying driving forces of land use change (Davies et al., 2004; Eiter & Potthoff, 2007).

Factors influencing land use change

Determining driving forces has been geographers' main approach to understanding land use changes (Hersperger et al., 2010). However, research covering a broader range of driving forces is limited (van Vliet et al., 2015). Further, several landscape changes, such as land abandonment and urban development, are often included simultaneously (Bürgi et al., 2017; Plieninger et al., 2016; Slätmo, 2014; van Vliet et al., 2015). There is a lack of research that explicitly focuses on farmland conversion and the comprehensive set of underlying intentions driving conversion.

Francis et al. (2012) question individuals' farmland conversion attitudes. The relationship between actors' attitudes and social structures has become important in land use planning research (see for instance Healey (1999)). Nevertheless, cultural drivers are not often mentioned in driving force analyses (Bürgi et al., 2004; Hersperger et al., 2010) and remain a vague concept (Bürgi et al., 2004). Institutional theory might contribute to a better understanding of the cultural dimension of driving force theory, namely the formal and informal rules-in-use that define the guiding principles of human motivations and behaviour (Vatn, 2015). Here, policies can be characterized as formal rules-in-use, while norms shared within social structures and individual attitudes correspond to informal rules-in-use. McGuire, Morton, Arbuckle, and Cast (2015) highlight influences such as family, other farmers, and local community on attitudes,

beliefs, and experiences. This is not covered in previous research on driving forces. For instance, van Vliet et al. (2015) mention sociocultural drivers without reference to specific social institutions and include attitude as a farmer characteristic without a link to sociocultural drivers. However, their inclusion of attitude, as well as other more general landowner attributes, provides insight for theory development.

When addressing attitudes, Dramstad and Fjellstad (2013) explicitly express the need to increase understanding of how people value landscape, and how these attitudes impact land use decisions. However, the process by which people attach values to a certain landscape is poorly understood as a driver of land use change (Plieninger et al., 2015). In this sense, landowners' attitudes towards agricultural landscapes and their provision of multifunctional ecosystem services appear to be important.

Both economic income from farming and non-economic factors are relevant for land use management decisions (Kvakkestad, Rørstad, & Vatn, 2015; Lokhorst et al., 2011; McGuire et al., 2015; Primdahl & Kristensen, 2011; van Dijk et al., 2016). Research focusing on farmland conversion emphasizes the alternative economic value of turning landscapes into built-up land as being decisive in decision-making (Antrop, 2004, 2005; Bateman et al., 2013).

Plieninger et al. (2015) describe natural factors such as climate conditions, soil characteristics, and topography as driving forces that might motivate certain land use behaviour. Koontz (2001) found that the size of owned farmland influenced landowners' motivation for certain land use activities. However, there is limited knowledge about how different motivations are shaped by a wider range of factors (McGuire et al., 2015). This is also the case with technological driving forces (van Vliet et al., 2015).

van Vliet et al. (2015) find demographic driving forces articulated less frequently and address them in a separate category. Others, like Plieninger et al. (2016), include them as elements in cultural drivers. Koontz (2001) and van Vliet et al. (2015) emphasize the need to include distance to urban settlements to understand landowners' decision-making motivation for land use practices. Given the high rate of farmland conversion in urban areas (Skog & Steinnes, 2016), urban proximity is an important explanation for agricultural to urban land use changes (see also Mazzocci, C., G. Sali & S. Corsi, 2013). Thus, location seems highly relevant for determining the potential for farmland conversions, and thereby influencing landowners' motivation.

Policies determine property rights (Blomley, 2005), defining how people can use and access land (Brown, 2007; Ostrom, 2003), and thereby landowners' right to sell for development purposes. Researchers find political drivers, what van Vliet et al. (2015) call institutional drivers, relevant for land use change (Plieninger et al., 2016). Agricultural policies influence the use of farmland (Slätmo, 2016) and land use motivation (van Dijk et al., 2016) by establishing criteria and levels for farming subsidies and by limiting the price of renting out farmland. In Norway, the price of farms and agricultural land is regulated. Hence, in the Norwegian context, policies limit the economic output from selling land to farming purposes. However, when politicians license farmland for other purposes, the market determines the prices. Thus, planning practices define farmers' ability to convert their land (Slätmo, 2014). Primdahl and Kristensen (2011) state that there is limited research investigating how and to what extent policies and planning influence landowners' motivation.

The literature reveals that previous research on farmland conversions has covered a wide range of explanations for farmland conversions. However, farmland owners' motivation for such conversions have been overlooked. This article builds on

203 previous research and addresses this gap. The following section presents how the
204 various factors outlined above structure our empirical analysis of landowners'
205 motivation to convert their farmland.

206 ***Conceptual framework***

207 This study analyses the various causes of farmland conversions to built-up land
208 (urbanization of agricultural land). We focus on landowner level as a key premise for
209 land use decision-making. We consider landowners' motivation to convert their land
210 from farmland for development purposes as the most valid expression of their
211 intentions. Further, the location of their farmland, specifically whether the farmland is
212 located in high pressure urbanising areas or low-pressure areas, is an area of focus.
213 Based on previous research (Primdahl and Kristensen, 2011, in particular) we also
214 distinguish between farmland owners who cultivate their own land and those who
215 mainly rent out their land to farmers.

216 Many land use change studies are not connected to overarching frameworks
217 (Bieling et al., 2013). Hersperger et al. (2010) call for theories to support causal
218 relationships and the development of conceptual models that link land change, driving
219 forces, and actors to progress in land change science. Based on driving forces theory
220 and institutional theory (McGinnis & Ostrom, 2014), we developed a conceptual
221 framework of landowners' motivation (Figure 1).

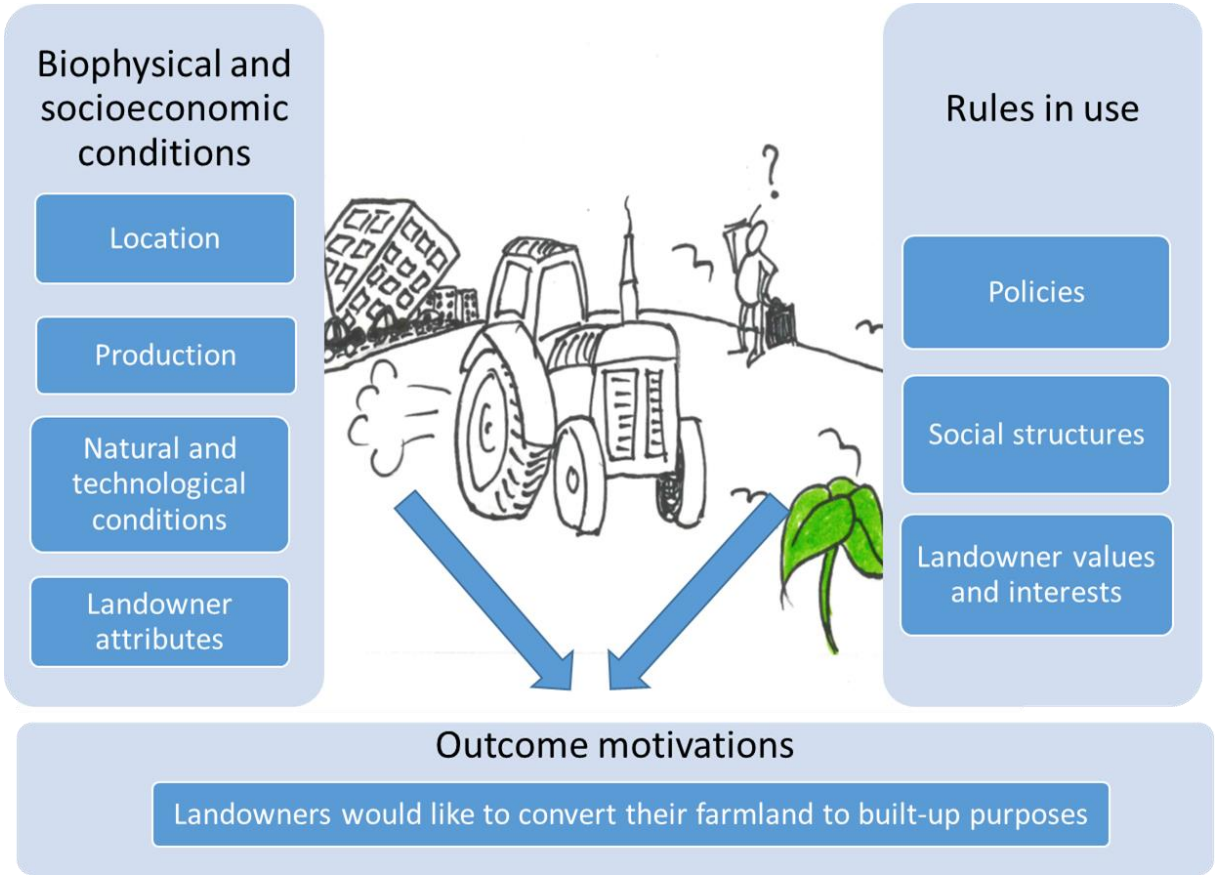


Figure 1: Conceptual framework of potential underlying factors influencing landowners' motivation for farmland conversion.

The framework conceptualizes several biophysical and socioeconomic conditions that might influence landowners' motivation:

- Location refers to spatial elements such as centrality and distance to urban settlements (see e.g. van Vliet et al. (2015)) and includes demographic specifiers, but not natural and technological conditions. Further, it indirectly refers to the real estate market, since urban properties are more expensive if licensed for conversion. We expect landowners located close to urban settlements more motivated to convert their land.
- 'Production' and 'Natural and technological conditions' refer to what Brandt, Primdahl, and Reenberg (1999) call 'drivers'. Production is directly related to income from farming practices or owning land. We expect landowners with low

income from farming or who have less productive land to be more motivated to convert their land.

- ‘Landowner attributes’ includes age, gender, and ownership status and corresponds partly to what van Vliet et al. (2015) call ‘farmer characteristics’. Further, we include their potential contact with developers and the existence of option agreements. Option agreements give developers the right, but not obligation, to purchase real estate in case farmland will be regulated to urban development. Landowners usually receive a certain amount of money to enter into this agreement, as well as any selling price. Most often, the public does not know about the agreements. We expect aging landowners who lease out most of their farmland to other landowners to be more motivated to sign option agreements and convert their land.

Political and cultural drivers are part of the institutional dimension, understood as rules-in-use that guide individual choices (Cole, 2014; Ostrom & Ahn, 2009).

- ‘Policy’ corresponds to what Vliet et al. (2015) and Plieninger et al. (2016) define as ‘institutional’, including agricultural and land use policy from both the local and national level. We expect landowners who are not satisfied with the current funding within the agricultural policy and who welcome liberal land use planning to be more motivated to convert their land.
- ‘Social structures’ include the different informal social institutions influencing land use motivation, like family and local society. This is not included in previous research. We expect landowners to be more motivated to convert their farmland when the local society or family members endorse it.

- ‘Landowner values and interests’ is an expression of how the respondents value certain qualities of their land. We expect landowners who mainly appreciate the private goods provided by farmland, i.e. income from farming, to be more motivated to convert their land.

Many of the different categories in the conceptual model affect each other. For instance, agricultural policy provides the basis for income from farming, and personal values and interests are institutionalized within the social structures people feel connected to. These relations are illustrated as two-sided arrows in Figure 1 above.

Methods

From exploratory pre-study to causal survey design

A survey design was selected to test correlations between different potential causes of farmland conversion motivation among and between landowners. Theory and previous research provided the basis for developing our conceptual framework. An exploratory pre-study was added to help formulate adequate measurements for the questionnaire. A semi-structured in-depth qualitative study was carried out for this purpose. Five farmers in two municipalities experiencing moderate to high rates of farmland conversions were interviewed, two who had suggested their land for residential development in current land use planning processes, while the three others wanted to continue cultivating their farmland. In addition, three representatives of regional farming associations in high-pressure areas were interviewed. Questions were open-ended to explore the institutional context for farmland conversion motivation, including personal, social, political, economic and other reasoning behind their motivation. Input from this exploratory study enabled formulation of more precise questions and measurements included in the survey.

The survey was then developed and structured by the categories in the conceptual framework. A pilot survey was sent to ten respondents, both farmers and researchers. Based on feedback, the survey was adjusted and prepared for the national survey. The survey was composed of a set of background questions about the owner and farm/farmland characteristics and blocks of statements with likert-scales measuring agreement/disagreement aiming for the assessment of motivation. Appendix 1 shows the total operationalization of the various questions (potential causes of farmland conversion motivation) structured according to the various dimensions described in the conceptual framework.

Selection of respondents

From 1959 to 2016, the number of active farms in Norway decreased from 198,000 to 40,000, although the amount of tilled land remained quite stable. Many of the smallest farms have closed production while medium and large farms are steadily growing (Bjørkhaug, 2012) and substantially increasing their effectiveness (Ministry of Agriculture and Food, 2016-2017). In 2017 the average farmland area per farm was 24,4 ha, an 18% increase since 2007 (Statistics Norway, 2018). These farmers lease an average of 40% of their cultivated land (Forbord, Bjørkhaug, & Burton, 2014). We distinguish between farming and non-farming landowners in this study.

A national registry administered by the Norwegian Agricultural Directorate was used to draw the sample of respondents. The registry contains all landowners of agricultural property over 0.5 ha in Norway. In 2016, there were 99,590 landowners in the total population, of which 35,922 applied for subsidies (active farmers). Five thousand respondents received the survey. Two strategic sampling methods were used to create four samples: to cover (1) active farmers and (2) landowners who mainly rent

out their land and (less active farm owners); and to ensure that (3) central municipalities important for the national food supply were represented in the sample as distinguished to (4) farm properties located outside these high pressure grain areas. A sample of 1250 farmland owners were randomly drawn from each of the 4 groups. To meet the first criterion, samples were randomly drawn from 'active farmers' and from 'less active owners'. Active farmers are farmers who had applied for agricultural subsidies in 2015 and 2016 and whose farming activity was located on their property. In the population, these account for 36%. Less active owners are landowners who had not applied for farm subsidies in 2015 or 2016.

To meet the second criterion, samples were randomly selected from municipalities in the regions most important for national food supply in Norway (prime farmland/grain areas). These are located in the south-western, south-eastern and northern parts of Norway (see the highlighted map, Figure 2) and are subject to high urban development pressure, and defined as high-pressure grain areas.

The selected municipalities in this group also had arable farmland that accounted for at least 15% of their total land. These municipalities account for 10% of all municipalities in Norway and are considered inside 'high pressure grain areas' in this study.

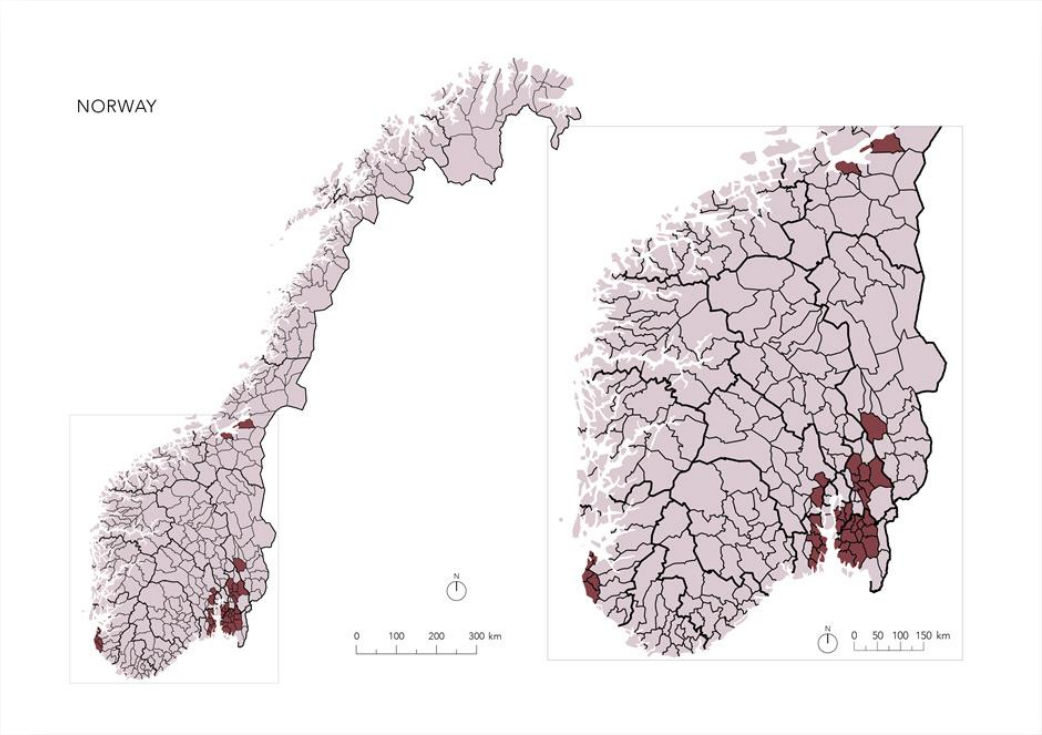


Figure 2: Respondents from municipalities in 'high pressure grain areas', marked in brown, accounted for half of the sample in the survey. Nikolina Søgnen prepared the figure.

Respondents received a welcome letter by mail, explaining the purpose and conditions of the survey and inviting them to open a link, provided in the letter, to the online survey. To motivate a high response rate, we also sent a text message with a direct link to the survey. Because of available email addresses in the national register, active farmers also received the survey by email.

Respondents represent 321 out of Norway's 426 municipalities, accounting for more than 90% of total agricultural land in Norway.

Methods for analysis

The response category 'I would like to convert my farmland' is coded and used as the dependent variable measuring variation in motivation to convert farmland. Given our coding of the dependent variable into the values 1=Am motivated to convert

341 farmland and Else=0, we have a binary dependent variable. Hence, a binary logistic
342 regression model was developed as the most robust tool to capture variation in the
343 dependent variable on explanatory variables operationalized from the conceptual
344 framework in the survey. To avoid problems with multicollinearity, explanatory
345 variables that correlated strongly were removed (i.e. those with a Pearson correlation
346 coefficient greater than 0.6).
347 Our binary logistic regression analysis combined forward selection and
348 backward elimination procedures. We first carried out a stepwise forward selection
349 method. Variables were introduced in groups corresponding to the theoretically defined
350 factors (see the conceptual framework in Figure 1) and hence reporting on variation in
351 explanatory variables on motivation to convert farmland for development purposes
352 within the factor. The complete forward analysis includes the involvement of 7 factors
353 (steps) and 47 variables (see Appendix 2 for results in each step from Model 1 to Model
354 7).
355 Our analysis proceeded with a backwards elimination process first excluding
356 variables that had proved insignificant for explaining variation in our dependent
357 variable in all preceding steps (Model 8 and Model 9 in Appendix 2). The first
358 backward model (Model 8) contained 15 explanatory variables. Five variables provided
359 insignificant contribution to the model and were removed. The final model, Model 9,
360 contains all significant variables ($P < 0.05$) explaining variation in positive motivation
361 to convert own farmland for development purposes.

Results

Response rates and descriptive statistics

Our total response rate was 30%. Table 1 shows the responses distributed between the different sample categories. The response rate was higher for one of the two sample categories: 40% of active farmers responded, compared to only 20% of the less active owners. The opportunity to send reminders to active farmers might have increased responses in that sample. Although responses differs between the different samples, our sampling method secures a better representation of landowners from the four categories we seek than if we employed a non-sampling methodology, e.g. drawing a random sample from all landowners.

Table 1: Gross and net samples and response rate of all respondents divided into strategic sample groups.

	Total population	Gross N	Responses	Response rate
Total	***99,590***	***5000***	***1433***	***30%***
Active farmers	35 922	2500	967	40%
Less active owners	62 668	2500	466	20%
Inside 'high pressure grain areas'	10 260	2500	694	29%
Outside 'high pressure grain areas'	89 330	2500	739	31%

1401 respondents replied to the question covering the dependent variable, namely landowners' motivation for converting farmland. Of these, 10.6% (152 respondents) answered that they were motivated to convert their farmland for development purposes. Since the topic of the survey was farmland preservation, it may have been that those most interested in the topic responded more often to the survey. As such, the share of landowners motivated to convert their land might be higher in the total population.

Appendix 1 shows the descriptive statistics of all explaining variables included in the survey corresponding to the various factors in the conceptual framework.

Explaining conversion motivation

Ten of our explanatory variables returned with a statistically significant result, when analysed together in the final model. The Hosmer and Lemeshow test suggests that the model has a good fit ($P > 0.05$). Table 2 reports the final model 9 results.

Table 2: Binary logistic regression analysis of significant variables explaining motivation for farmland conversion. Final model.

Explanatory variables significant in final test			**B**	**S.E**	**Exp (B)**	**Sig.**
Biophysical and socioeconomic conditions						
Location	Farm located in high pressure grain areas (1= inside and 0 = outside)		0.546	0.219	1.726	0.013
Production	Farm income share of household income (%)		-0.014	0.005	0.986	0.008
	There is a need for major investments in my agricultural business that I do not have the capacity to implement *		-0.261	0.082	0.77	0.002
Landowner attributes	In dialog with developers for conversion purposes (Yes= 1, else =0, else= 0)		0.817	0.248	2.263	0.001
Rule- in-use						
Policies	All in all, there is a need to strengthen farmland preservation policies *		0.451	0.083	1.570	0.000
Social structures	**Family**	My family understands and accepts if I want to sell farmland for development purposes *	-0.246	0.093	0.782	0.008
	Agricultural society	I have the impression that there are many landowners who want to sell farmland for development purposes in my municipality *	-0.359	0.086	0.699	0.000
Landowner values and interests	My farmland is a common good I have borrowed. and it should be managed for the benefit of future generations *		0.274	0.078	1.315	**0.000**
	I should have the right to decide future use of my farmland. even if I wish to sell it to developers *		-0.340	0.094	0.712	**0.000**
	The authorities should decide whether my farmland should be converted or not *		-0.234	0.082	0.791	**0.004**
Constant			0.669	0.698	1.951	0.338
Cox						0.185
Nagelkerke R Square						0.375
Hosmer and Lemeshow Test (step 1, Chi-square 6.295, df 8)						0.614
N						1333
Notes:	* Response categorization for explanatory variables coded by increasing agreement (1 = strongly agree - 6 = strongly disagree)					

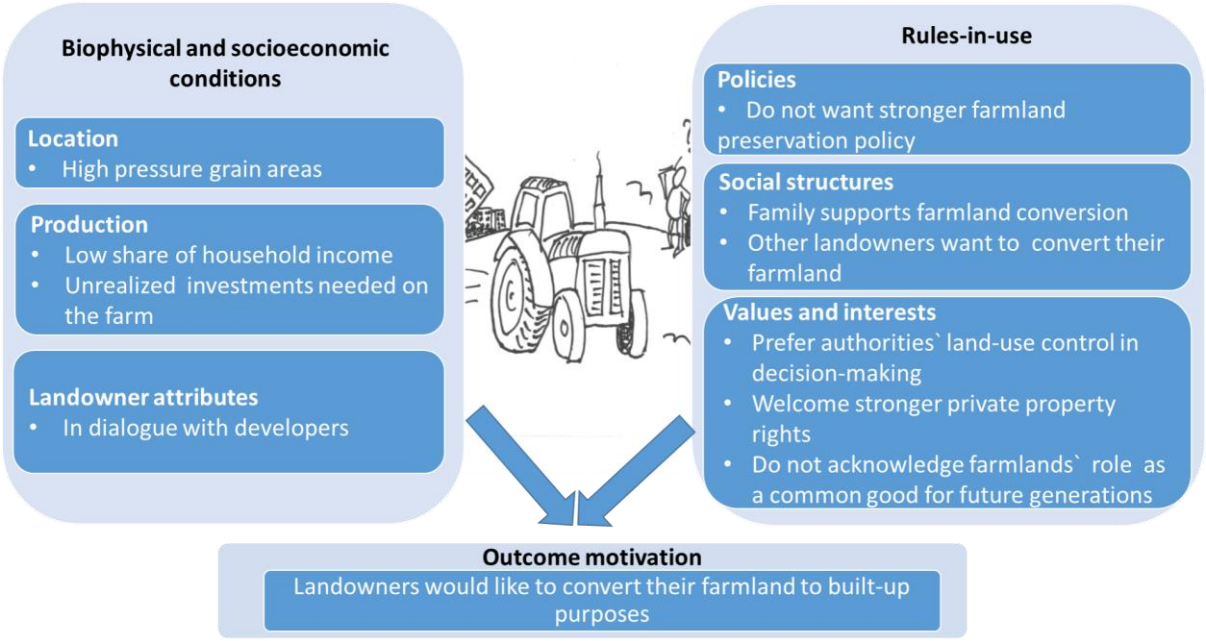
Four variables from the *Biophysical and socioeconomic* factors contributed significantly to explain motivation for farmland conversion in the final model. Landowners located in areas exposed to urban development pressure with a high share of prime farmland give a higher probability for being motivated to convert their farmland. Further, two variables connected to production opportunities provided significant explanation; lower household incomes and perceptions of insufficient economic means to invest or re-invest on their farm give a higher probability being

motivated to convert own farmland. Only one landowner attribute remained significant; landowners who have been in contact with developers.

Rules-in-use factors contribute with more explanatory power to our research question than the biophysical and social factors. Six variables correlate significantly with the motivation for converting one's own farmland.

From the policy factors, the claim 'All in all, there is a need to strengthen farmland preservation policies' correlates with the motivation to convert one's own farmland, meaning that not favoring stronger policies gives a higher probability for being motivated to convert one's farmland. From social structures, agreement with 'My family understands and accepts if I want to sell farmland for development purpose' gives a higher probability for being motivated to convert farmland. From agricultural society, the same applies for agreement with the claim 'I have the impression that there are many landowners who want to sell farmland for development purposes in my municipality'.

Two variables from the landowner values and interest factor also remained significant; 'I should have the right to decide future use of my farmland, even if I wish to sell it to developers' and 'The authorities should decide whether my farmland should be converted or not'. Disagreement with the claim 'My farmland is a common good I have borrowed, and it should be managed for the benefit of future generations' gives a higher probability for being motivated to convert own farmland. Figure 3 summarizes the findings from our analysis.



419

420 Figure 3: Significant variables explaining landowners' motivation for farmland
421 conversion.

422 **Discussion**

423 Given liberal and market-driven land use planning practices, landowners have a
424 key role in decision-making processes. Further, our focus on landowners' conversion
425 motivation, not the actual land use changes, determines what factors influence
426 landowners' preferences in a potential choice-situation. In this, our study is different
427 from most research studying the driving forces of land use changes. Our approach made
428 it possible to assess how landowners perceive the relative importance of a wide range of
429 potential factors (Hersperger & Bürgi, 2009; van Vliet et al., 2015). Further, we include
430 both rural and urban areas, which was found to be unexplored in the meta-study by van
431 Vliet et al. (2015).

432 Despite farmland preservation ambitions to secure national food supply, it
433 appears that conversions occur most often in highly productive urban areas (Skog &
434 Steinnes, 2016). This is also found relevant in other research (Martellozzo et al., 2014;
435 Salvati, 2013). This pattern supports the motivational findings in our study.

Respondents located in high-pressure grain areas are significantly more likely to be motivated to convert their land. In these areas, the pressure to build is high and the availability of alternative land for building purposes is limited. Further, alternative job opportunities are greater in urban areas. Given the emphasis of farmlands' contribution to food supply and provision of other ecosystem services, urban conversion motivation is worrying. Most of the remaining and most productive farmland is located here, around urban settlement in the most central municipalities (Skog & Steinnes, 2016).

Economy was the only *production* component relevant to understand conversion motivation. First, a low share of household income from the farm corresponds significantly to conversion motivation. The short-term financial gain from selling farmland for development purposes is high, and overrules the economic interest of staying in the agricultural business when the relative importance of farm income is weak. This corresponds to the *location* finding: in high-pressure grain areas, the market value of selling land for development purposes is higher. We also found conversion motivation higher when landowners have been in contact with developers. Hence, the alternative market value of their farmland has been introduced. Further, landowners experience this dialogue as a pressure from developers (Bjørkhaug, Rønningen, & Vinge, 2019). This corresponds to previous studies determining the importance of the alternative economic value of turning landscape into built-up land (Antrop, 2004, 2005; Bateman et al., 2013). It seems difficult to compete with the alternative market value of selling the land for development purposes. However, the relative importance of agricultural income to avoid conversion motivation seems essential; increasing the agricultural share of household income enhances it.

Another production-specific parameter also illustrates the importance of economy in the agricultural sector as a positive incentive for farmland preservation. The

landowners motivated to convert their farmland are the ones who find it most challenging to realize planned investments on the farm. This can be seen as a consequence of the ongoing structural trends in the agricultural sector, where increasing demand for higher productivity leads to a reduction of farmers (Forbord, Bjørkhaug, & Burton, 2014). Slätmo (2016) considers agricultural policy as a trigger for farmland preservation. In our study, agricultural policies define the economic incentives for farming. Almost two-thirds of the respondents consider the incentives within the agricultural policies not sufficient to prevent farmland conversions in this study.

Other natural/technological conditions, like quality and size of their farmland as such, were not significant in the final model. From the landowner perspective, other variables emerge as being more important. Previous research called for a better distinction between how landowners characterize their farming practice and their motivation (Koontz, 2001; Primdahl & Kristensen, 2011; van Vliet et al., 2015). The highest percentage of landowners motivated to convert their farmland is in the 'less active owner' category, but this group was not a significant explanation of farmland conversions in the final model. However, motivation for converting farmland and the different landowner characteristics should be further investigated. These factors are highly relevant for understanding various land use impacts of ongoing structural changes in the agricultural sector, like the decreasing number of active farmers and increasing farm sizes and land rentals.

Formal and informal rules-in-use, with reference to cultural and political drivers, were by far the least addressed elements in previous research (Bürgi et al., 2004; Hersperger et al., 2010). In our study, we find policies, social structures, as well as the corresponding individual values and interests very important for explaining conversion motivation.

Policies are formal rules defining how people can use and access land (Brown, 2007; Ostrom, 2003). We find landowners motivated to convert their land significantly disagree with the need for planning policies to limit conversions. It seems logical that those motivated to convert their land do not see the need for stronger land use regulations. Similar to many other countries (Sager, 2011), Norway has rather liberal land use policies, which are strongly influenced by the market (Falleth et al., 2010; Strand & Næss, 2017). The current planning regime promotes the power of developers and landowners, and thereby the influence of landowners motivated for farmland conversions (Skog, 2018). We also find that landowners motivated for conversion do support the idea that authorities shall decide on land use conversions. This might be a claim to maintain our formal land use planning decision-making processes in Norway, while also supporting the liberal practice of how politicians follow up on current farmland preservation policy.

van Vliet et al. (2015) contribute meaningfully to driving force theory by including landowner attitudes, here expressed as values and interests. For the small group of landowners motivated to convert their farmland, we found stronger individual rationality. This group is less appreciative of non-economic values, articulated here as farmland's role as a common good for future generations and elsewhere as social values or landowners' role as citizens (Primdahl & Kristensen, 2011). We found individual preferences to be stronger, with an emphasis on farmland decisions to be a private good and the right to make decisions of present and future land uses themselves. van Vliet et al. (2015) find that attitudes only explain how land is managed, and not the decisions to quit farming activities. Conversion of farmland to built-up land marks a definite end to the future farming of the land. In this, this study somewhat contradicts previous research.

The strong emphasis on their own private property rights expresses a seemingly inconsistency with their preference for authorities` land-use control. This can be interpreted as a confirmation of existing land-use control as rather liberal. It can also be understood as first expressing inherent own decisive rights against community control and the second a will to comply with a general statement within the society.

Influences from social structures within the society, like family and the agricultural sector, strengthen individual values and interests, and vice versa. Family understanding for farmland conversion motivation makes the decision easier, in addition to a perceived farmland conversion motivation within the agricultural society. This corresponds to findings by McGuire, Morton, Arbuckle, and Cast (2015). Social structures and personal values and interests seems vital for farmland conversion motivations, and future farmland preservation research could benefit from including this.

van Dijk et al. (2016) indicate that a financial focus on policy development has led to more benefit-optimizing motivations and behaviour. In Norway, a liberal land use planning regime is identified (Falleth, Hanssen, & Saglie, 2010). Further, national farmland preservation policies lack emphasis on farmland’s role in the provision of collective ecosystem services for the local society (Skog, 2018). Consequently, individual economic benefits override socioeconomic interests. This picture is illustrated in this study through the strong private property preferences; those motivated to convert their land emphasize the right to decide on their future land use. Further, they do not recognize the value of their farmland as a common good that should be managed for the benefit of future generations. Löhr (2010) and Skog et al. (2018) state that a better connection between public benefits and corresponding social costs could strengthen farmland preservation policies.

Through the identification of significant explanations, we have been able to show some of the variation in landowners' motivation to convert farmland, as well as factors that might influence on farmland conversions. Given limited previous research using this holistic approach, our results can be useful empirically and theoretically for future research. Further research might increase the understanding of how explanations themselves evolve, which might be helpful in future policy development and planning for farmland preservation.

Conclusion

In this study, we identified explanatory factors for landowners' motivation to convert their own farmland. Some elements covered in previous research were significant, such as the influence of urban development pressures. However, by including institutional theory in our methodology, we found formal and informal rules-in-use, such as policies, social structures and personal values, to be even more important in understanding their farmland conversion motivation. No prior research has included such a broad spectrum of factors explaining farmland conversion motivation among landowners. Our focus on a particular type of land use change (motivation for converting farmland to built-up land) and actors (different types of landowners) made this approach possible.

Land use change is governed by complex interactions between social and ecological systems and across multiple scales. This study is a first step towards understanding landowners' motivation for converting farmland. Subsequent research could deepen this new knowledge and holistic conceptual framework by including different actors and interactions linked to specific farmland conversion outcomes. Research is needed to better understand how local interactions occur in planning

processes, and how to create more resilient and sustainable outcomes to limit unsustainable farmland conversions.

Policies can also benefit from this understanding: for instance, by facilitating the multifunctional goods and ecosystem services delivered from agricultural land (Francis et al., 2012). Studies of local food systems illustrate how this potential can be developed (Migliore et al., 2014; Schifani et al., 2016; Skog et al., 2018). Planning policies could also take into account the specific challenges in urban areas where the most productive soil is located, and the outcomes provided by local agriculture and urban farming (Zasada, 2011). Further, agricultural policies seem important for providing the economic basis for farming. This can be a way forward to strengthen climate resilience and our contribution to future supply of food.

Acknowledgements

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Amundson, R., Berhe, A. A., Hopmans, J. W., Olson, C., Sztein, A. E., & Sparks, D. L. (2015). Soil and human security in the 21st century. *Science*, *348*(6235). doi:10.1126/science.1261071

Antrop, M. (2004). Landscape change and the urbanization process in Europe. *Landscape and Urban Planning*, *67*(1–4), 9-26. doi:http://dx.doi.org/10.1016/S0169-2046(03)00026-4

Antrop, M. (2005). Why landscapes of the past are important for the future. *Landscape and urban planning*, *70*(1), 21-34.

Bateman, I. J., Harwood, A. R., Mace, G. M., Watson, R. T., Abson, D. J., Andrews, B., . .Dugdale, S. (2013). Bringing ecosystem services into economic decision-making: Land use in the United Kingdom. *Science*, *341*(6141), 45-50.

587 Bieling, C., Plieninger, T., & Schaich, H. (2013). Patterns and causes of land change:
588 Empirical results and conceptual considerations derived from a case study in the
589 Swabian Alb, Germany. *Land Use Policy*, *35*, 192-203.
590 Bjørkhaug, H. (2012) Exploring the sociology of agriculture: Family farmers in
591 Norway—future or past food producers? In D. Ersaga (Ed.), *Sociological*
592 *Landscape: Theories, Realities and Trends* (pp. 283-303). Rijeka: InTeck.
593 Bjørkhaug, H., & Richards, C. A. (2008). Multifunctional agriculture in policy and
594 practice? A comparative analysis of Norway and Australia. *Journal of Rural*
595 *Studies*, *24*(1), 98-111. doi:http://dx.doi.org/10.1016/j.jrurstud.2007.06.003
596 Bjørkhaug, H., Rønningen, K., & Vinge, H. (2019). "Jordvern" as a situation of action:
597 The material and non-material forces shaping the protection of farmland in
598 Norway. In H. Bjørkhaug, P. McMichael, & B. Muirhead (Eds.), *Finance or*
599 *Food? The Role of Cultures, Values and Ethics in Land Use Negotiations.*
600 Toronto: University of Toronto Press.
601 Blomley, N. (2005). Remember property? *Progress in Human Geography*, *29*(2), 125-
602 127.
603 Bowler, I. R. (2014). 3 Structural change in agriculture. In M. Pacione (Ed.) *Progress in*
604 *Rural Geography (Routledge Revivals)* (pp 46-74). New York: Routledge.
605 Brandt, J., Primdahl, J., & Reenberg, A. (1999). Rural land-use and landscape
606 dynamics: Analysis of "driving forces" in space and time. *Man and the*
607 *Biosphere Series*, *24*, 81-102.
608 Brown, K. M. (2007). Understanding the materialities and moralities of property:
609 Reworking collective claims to land. *Transactions of the Institute of British*
610 *Geographers*, *32*(4), 507-522.
611 Bürgi, M., Bieling, C., von Hackwitz, K., Kizos, T., Lieskovský, J., Martín, M. G., . . .
612 & Printsmann, A. (2017). Processes and driving forces in changing cultural
613 landscapes across Europe. *Landscape Ecology*, 32(11), 2097-2112.
614 doi:10.1007/s10980-017-0513-z
615 Bürgi, M., Hersperger, A. M., & Schneeberger, N. (2004). Driving forces of landscape
616 change—current and new directions. *Landscape Ecology*, *19*(8), 857-868.
617 Campbell, H., & Marshall, R. (2002). Utilitarianism's bad breath? A re-evaluation of
618 the public interest justification for planning. *Planning Theory*, *1*(2), 163-187.
619 Cole, D. H. (2014). *Formal institutions and the IAD framework: Bringing the law back*
620 *in*. IU Ostrom Workshop, Maurer Law School, SPEA. Retrieved from

https://ostromworkshop.indiana.edu/~workshop/pdf/seriespapers/2015s_c/Cole_paper.pdf

Davies, B., Blackstock, K., Brown, K., & Shannon, P. (2004). *Challenges in Creating Local Agri-Environmental Cooperation Action Amongst Farmers and Other Stakeholders*. Aberdeen, UK: Macaulay Institute.

Dramstad, W. E., & Fjellstad, W. J. (2013). Twenty-five years into "our common future": Are we heading in the right direction? *Landscape Ecology*, *28*(6), 1039-1045. doi:10.1007/s10980-012-9740-5

Eiter, S., & Potthoff, K. (2007). Improving the factual knowledge of landscapes: Following up the European Landscape Convention with a comparative historical analysis of forces of landscape change in the Sjodalen and Stø lsheimen mountain areas, Norway. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, *61*(4), 145-156.

Falleth, E. I., Hanssen, G. S., & Saglie, I. L. (2010). Challenges to democracy in market-oriented urban planning in Norway. *European Planning Studies*, *18*(5), 737-753.

FAO, & ITPS. (2015). *Status of the world's soil resources (SWSR)*: *Main report.* Retrieved from http://www.fao.org/documents/card/en/c/c6814873-efc3-41db-b7d3-2081a10ede50/

Ferrara, A., Salvati, L., Sabbi, A., & Colantoni, A. (2014). Soil resources, land cover changes and rural areas: Towards a spatial mismatch? *Science of The Total Environment*, *478*, 116-122. doi:http://dx.doi.org/10.1016/j.scitotenv.2014.01.040

Forbord, M., Bjørkhaug, H., & Burton, R. J. F. (2014). Drivers of change in Norwegian agricultural land control and the emergence of rental farming. *Journal of Rural Studies*, *33*, 9-19. doi:http://dx.doi.org/10.1016/j.jrurstud.2013.10.009

Francis, C. A., Hansen, T. E., Fox, A. A., Hesje, P. J., Nelson, H. E., Lawseth, A. E., & English, A., (2012) Farmland conversion to non-agricultural uses in the US and Canada: Current impacts and concerns for the future. *International Journal of Agricultural Sustainability*, *10*(1), 8-24. doi:10.1080/14735903.2012.649588

Giddens, A. (1991). *Modernity and Self-Identity: Self and Society in the Late Modern Age*. Stanford, CA: Stanford University Press.

Healey, P. (1999). Institutionalist analysis, communicative planning, and shaping places. *Journal of Planning Education and Research*, *19*(2), 111-121.

Hellevik, O. (2009). Linear versus logistic regression when the dependent variable is a dichotomy. *Quality & Quantity*, *43*(1), 59-74.

Hersperger, A. M., & Bürgi, M. (2009). Going beyond landscape change description: Quantifying the importance of driving forces of landscape change in a Central Europe case study. *Land Use Policy*, *26*(3), 640-648.

Hersperger, A. M., Gennaio, M.-P., Verburg, P. H., & Bürgi, M. (2010). Linking land change with driving forces and actors: Four conceptual models. *Ecology and Society*, *15*(4), 1.

Heurkens, E., & Hobma, F. (2014). Private sector-led urban development projects: Comparative insights from planning practices in the Netherlands and the UK. *Planning Practice & Research*, *29*(4), 350-369. doi:10.1080/02697459.2014.932196

Kamal-Chaoui, L., & Sanchez-Reaza, J. (2012). *Urban trends and policies in OECD countries*. (Regional Development Working Papers No *2012*(1)). Paris: OECD publishing.

Koontz, T. M. (2001). Money talks? But to whom? Financial versus nonmonetary motivations in land use decisions. *Society & Natural Resources*, *14*(1), 51-65.

Kvakkestad, V., Rørstad, P. K., & Vatn, A. (2015). Norwegian farmers' perspectives on agriculture and agricultural payments: Between productivism and cultural landscapes. *Land Use Policy*, *42*, 83-92. doi:http://dx.doi.org/10.1016/j.landusepol.2014.07.009

Lokhorst, A. M., Staats, H., van Dijk, J., van Dijk, E., & de Snoo, G. (2011). What's in it for me? Motivational differences between farmers' subsidised and non-subsidised conservation practices. *Applied Psychology*, *60*(3), 337-353. doi:10.1111/j.1464-0597.2011.00438.x

Löhr, D. (2010). The driving forces of land conversion. Towards a financial framework for better land use policy. *Land Tenure Journal*, *2010*(1), 61-89.

Mann, S., Freyens, B., & Dinh, H. (2016). Crises and structural change in Australian agriculture. *Review of Social Economy*, 57(1), 61-87.

Martellozzo, F., Ramankutty, N., Hall, R. J., Price, D. T., Purdy, B., & Friedl, M. A. (2014). Urbanization and the loss of prime farmland: A case study in the Calgary–Edmonton corridor of Alberta. *Regional Environmental Change*, *15*(5), 881-893.

688 Mazzocci, C., Sali, G., & Corsi, S. (2013). Land use conversion in metropolitan areas
689 and the permanence of agriculture: Sensitivity Index of Agricultural Land
690 (SIAL), a tool for territorial analysis. *Land Use Policy*, *35*,155–162.
691 McGinnis, M. D., & Ostrom, E. (2014). Social-ecological system framework: Initial
692 changes and continuing challenges. *Ecology and Society*, *19*(2), 30.
693 McGuire, J. M., Morton, L. W., Arbuckle, J. G., & Cast, A. D. (2015). Farmer identities
694 and responses to the social–biophysical environment. *Journal of Rural Studies*,
695 *39*, 145-155.
696 Migliore, G., Schifani, G., Guccione, G. D., & Cembalo, L. (2014). Food community
697 networks as leverage for social embeddedness. *Journal of Agricultural and*
698 *Environmental Ethics*, *27*(4), 549-567. doi:10.1007/s10806-013-9476-5
699 Millward, H. (2006). Urban containment strategies: A case-study appraisal of plans and
700 policies in Japanese, British, and Canadian cities. *Land Use Policy*, *23*(4), 473-
701 485.
702 Ministry of Agriculture and Food. (2016). *Endring og utvikling: En fremtidsrettet*
703 *jordbruksproduksjon [Change and development: A future oriented agricultural*
704 *production]* (Report No. 11 to the Parliament). Oslo: Ministry of Agriculture
705 and Food. Retrived from https://www.regjeringen.no/no/dokumenter/meld.-st.-
706 11-20162017/id2523121/
707 Ministry of Climate and Environment. (2004-2005). *Regjeringens miljøvernpolitikk og*
708 *rikets miljøtilstand [The government's environmental policy and the state of the*
709 *environment in Norway]* (Report No. 21 to the Parliament). Oslo: Ministry of
710 Climate and Environment. Retrived from
711 https://www.regjeringen.no/no/dokumenter/stmeld-nr-21-2004-2005-/id406982/.
712 Nguyen, T. T., Nguyen, L. D., Lippe, R. S., & Grote, U. (2017). Determinants of
713 farmers' land use decision-making: Comparative evidence from Thailand and
714 Vietnam. *World Development*, *89*, 199-213.
715 doi:http://dx.doi.org/10.1016/j.worlddev.2016.08.010
716 Ostrom, E. (2003). How types of goods and property rights jointly affect collective
717 action. *Journal of Theoretical Politics*, *15*(3), 239-270.
718 Ostrom, E., & Ahn, T. K. (2009). The meaning of social capital and its link to collective
719 action. In D. Castiglione, J. W. van Deth, & G. Wolleb (Eds.), *Handbook of*
720 *Social Capital: The Troika of Sociology, Political Science and Economics* (pp
721 17-35). Northampton, MA: Edward Elgar.

Plieninger, T., Draux, H., Fagerholm, N., Bieling, C., Bürgi, M., Kizos, T., . . . Verburg, P. H. (2016). The driving forces of landscape change in Europe: A systematic review of the evidence. *Land Use Policy, 57*, 204-214.

Plieninger, T., Kizos, T., Bieling, C., Le Dû-Blayo, L., Budniok, M.-A., Bürgi, M., . . . Kolen, J. (2015). Exploring ecosystem-change and society through a landscape lens: recent progress in European landscape research. *Ecology and Society, 20*(2), 5.

Primdahl, J., & Kristensen, L. S. (2011). The farmer as a landscape manager: Management roles and change patterns in a Danish region. *Geografisk Tidsskrift-Danish Journal of Geography, 111*(2), 107-116.

Sager, T. (2011). Neo-liberal urban planning policies: A literature survey 1990–2010. *Progress in Planning, 76*(4), 147-199. doi:https://doi.org/10.1016/j.progress.2011.09.001

Salvati, L. (2013). Monitoring high-quality soil consumption driven by urban pressure in a growing city (Rome, Italy). *Cities, 31*, 349-356. doi:http://dx.doi.org/10.1016/j.cities.2012.11.001

Schifani, G., Migliore, G., Hashem, S., Romeo, P., & Cembalo, L. (2016). Identifying social entrepreneurial behaviour in farmers participation in alternative food network. *Rivista di Economia Agraria, 71*(1), 495-504.

Skog, K. L. (2018). How Do Policies and Actors' Attitudes, Interests and Interactions Influence Farmland Conversion Outcomes in Land-Use Planning?. Sustainability, 10(6), 1944.

Skog, K. L., Brattestå, A. C., & Thomassen, M. M. (2016). Jordbrukslandskap i urbaniseringsprosesser: et tomrom eller en ressurs for stedsutvikling? [Agricultural landscapes in urbanization processes: Empty spaces or resources for urban place making?]. *KART OG PLAN*, 76(4), 252-262.

Skog, K. L., Eriksen, S., Brekken, C., & Francis, C. (2018). Building Resilience in Social-Ecological Food Systems in Vermont. Sustainability, 10(12), 4813.

Skog, K. L., & Steinnes, M. (2016). How do centrality, population growth and urban sprawl impact farmland conversion in Norway? *Land Use Policy, 59*, 185-196. doi:http://dx.doi.org/10.1016/j.landusepol.2016.08.035

Slätmo, E. (2014). *Jordbruksmark i förändring. Drivkrafter bakom och förutsättningar för offentlig styrning i Sverige och Norge (Agricultural land use change in Sweden and Norway. An analysis of driving forces and the potential to influence*

change through policy) (Doctoral dissertation). Goteborg: Goteborg University. Retrieved from http://hdl.handle.net/2077/37012

Slätmo, E. (2016). Challenges in Agricultural Land Management. In L. Head, Saltzman, K., Setten, G. & Stenseke, M. (Eds.), *Nature, Temporality and Environmental Management: Scandinavian and Australian Perspectives on Peoples and Landscapes* (pp. 169-185). Abingdon, Oxon: Routledge.

Standing Committee on Business and Industry. (2015-2016). *Innst. 56S (2015-2016)*. Retrieved from https://stortinget.no/no/Saker-og-publikasjoner/Publikasjoner/Innstillinger/Stortinget/2015-2016/inns-201516-056/.

Statistics Norway. (2018). *Structure of agriculture—agricultural area per holding.* Retrieved from https://www.ssb.no/en/statbank/table/04500?rxid=7fcec21c-aa09-428e-b2c4-6f6c515b6a24

Strand, A., & Næss, P. (2017). Local self-determination, process-focus and subordination of environmental concerns. *Journal of Environmental Policy & Planning*, 19 (2), 156-167. doi:10.1080/1523908X.2016.1175927

Tan, R., Beckmann, V., van den Berg, L., & Qu, F. (2009). Governing farmland conversion: Comparing China with the Netherlands and Germany. *Land Use Policy*, *26*(4), 961-974.

The Land Act, Act No. 23 of 12 May 1995.

The Planning and Building Act, Act No. 27 of 8 May 2009.

The World Bank. (2015). *Arable land (hectares) per person*. Retrieved from https://data.worldbank.org/indicator/AG.LND.ARBL.HA.PC?end=2015&start=2015&view=map&year=2015

van Dijk, W. F., Lokhorst, A. M., Berendse, F., & de Snoo, G. R. (2016). Factors underlying farmers' intentions to perform unsubsidised agri-environmental measures. *Land Use Policy*, *59*, 207-216.

van Vliet, J., de Groot, H. L., Rietveld, P., & Verburg, P. H. (2015). Manifestations and underlying drivers of agricultural land use change in Europe. *Landscape and Urban Planning*, *133*, 24-36.

Vatn, A. (2015). *Environmental Governance: Institutions, Policies and Actions*. London, UK: Edward Elgar Publishing.

Zasada, I. (2011). Multifunctional peri-urban agriculture: A review of societal demands and the provision of goods and services by farming. *Land use policy*, *28*(4), 639-648.

Appendix1: Descriptive characteristics of the various variables from the survey.

	Explaining variables	Mean	St.dev.	N
1.	**Biophysical and socioeconomic conditions**			
1.1.	**Location**			
1	Distance to urban settlement (less than 1 km=1 (13.5%), else = 0 (86.5%))			1412
2	The building pressure in my municipality is a challenge to avoid farmland conversions*	3,363	1,10	1375
3	Farm located in high pressure grain areas (1= inside and 0 = outside)			
1.2.	**Production**			
	Production most relevant for farming (1= most important source of income, else = 0)**:			1437
4	Milk (1 = 12%)			
5	Chicken /egg (1 = 2.6%)			
6	Meat ((1 = 14.7%)			
7	Grain (1 = 16%)			
8	Vegetables / fruit (1 = 5.1%)			
9	Other farm related production (1 = 3.6%)			
10	Have sufficient amount of farmland (yes = 40.3%)			
11	Farm income share of household income (%)	26,25	26,64	1402
12	There is a need for major investments in my agricultural business that I do not have the capacity to implement *	3,23	1,55	1386
1.3.	**Natural and technological conditions**			
13	Size of land owned and cultivated by owner**	4,11	2,26	1437
14	Size of land rented out for farming	1,87	1,45	1437
15	Size of owned and abandoned land (1= 0 ha, to 8= 40 ha+)	1,27	0,85	1437
16	Size of rented land for farming purposes (1= 0 ha, to 8= 40 ha+)	2,35	2,12	1437
17	Most land used as grassland (dummy 1= yes (40.2%) Control variable Grain 41.4%			1437
18	Most land used as horticulture (dummy 1= yes 4.3%)			1437
19	Most land used as pasture (dummy 1= yes 4.3%)			1437
20	Most farmland not in use (dummy 1= yes 2.2%)			1437
21	Quality of land for farming purposes (1= good quality (62%)			1437
22	The proportion of rented land is not a challenge promoting farmland conversions in my municipality *	3,17	1,37	1382
1.4.	**Landowner attributes**			
23	Gender (Man = 1 80%))			1422
24	Agricultural education (Yes=1 37.7%)			1420
25	Live on the farm (Yes=1 85.6%)			1437
26	Farm on Allodial rights (Yes =1 68.5)			1427
27	In dialog with developers for conversion purposes (Yes= 1 14.5%))			1437
2.	**Rules-in-use**			
2.1.	**Policies**			
28	I do not think the amount of option agreements between developer and landowner is a challenge to prevent	3,36	1,10	1375
29	Agricultural policy as agreed on at the national level provides good conditions for farmland preservation *	3,98	1,27	1383
30	Land use planning in my municipality ensures that my farmland is protected from conversion to built-up land *	3,35	1,28	1378
31	The politicians in my municipality support an active policy to prevent farmland conversions *	3,40	1,31	1377
32	All in all, there is a need to strengthen farmland preservation policies *	2,01	1,22	1384
2.2.	**Social structures**			
2.2.1.	*Family*			
33	My family understands and accepts if I want to sell farmland for development purposes *	3,62	1,25	1391
34	I experience a pronounced or unspoken expectation from the family to sell farmland for development purposes *	4,79	1,22	1384
35	Future prospects (1= In twenty years, I cultivate the land myself or it is taken over within the family, 57.7%)			1410
36	It is hard to take decisions alone regarding farmland conversion *	4,01	1,46	1384
2.2.2.	*Local society*			
37	I am rarely acknowledged/ rarely meet respect as an owner of farmland in my local community *	3,90	1,41	1393
38	It is a taboo to talk about motivation for farmland conversion among inhabitants in my community *	3,63	1,16	1395
2.2.3.	*Agricultural society*			
39	The local agricultural society is optimistic regarding the future for continued farming *	2,98	1,19	1381
40	I have the impression that there are many landowners who want to sell farmland for development purposes in my municipality *	3,96	1,35	1388
2.2.	**Landowner values and interests**			
41	My main concern as a landowner of farmland is that food is produced at my property *	2,02	1,25	1392
42	My farmland should provide the community with multifunctional values, such as beautiful scenery or local	2,32	1,26	1388
43	My farmland shall primarily serve as a property for housing and/or cottage *	4,59	1,48	1391
44	My farmland must first and foremost generate income for the household and my inheritors *	2,56	1,28	1384
45	My farmland is a common good I have borrowed, and it should be managed for the benefit of future generations	2,11	1,26	1382
46	I should have the right to decide future use of my farmland, even if I wish to sell it to developers *	3,00	1,63	1392
47	The authorities should decide whether my farmland should be converted or not *	4,68	1,42	1390

NOTES: * 1 = strongly agree to 6 = strongly disagree, ** 1= 0 ha to 8= 40 ha+

Appendix1: Results from the binary logistic regression analysis testing of variables behind motivation for farmland conversion.

Biophysical and socioeconomic conditions			Model 1 (Forwards)				Model 2 (Forwards)				Model 3 (Forwards)				Model 4 (Forwards)				Model 5 (Forwards)				Model 6 (Forwards)				Model 7 (Forwards)			
			B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.
Location	1	Distance to urban settlement (less than 1 km= 1, else = 0)	0.623	0.226	1.865	**0.006**	0.576	0.239	1.778	**0.016**	0.629	0.244	1.875	**0.010**	0.411	0.262	1.508	0.117	0.310	0.277	1.364	0.262	0.156	0.296	1.169	0.598	0.012	0.322	1.012	0.970
	2	The building pressure in my municipality is a challenge to avoid farmland conversions	0.361	0.059	1.435	**0.000**	0.344	0.063	1.411	**0.000**	0.327	0.065	1.387	**0.000**	0.313	0.067	1.368	**0.000**	0.056	0.086	1.058	0.516	0.119	0.097	1.126	0.222	0.086	0.106	1.090	0.414
	3	Farm located in high pressure grain areas (1= inside and 0 = outside)	0.824	0.191	2.281	**0.000**	0.952	0.206	2.592	**0.000**	1.049	0.226	2.854	**0.000**	0.869	0.232	2.385	**0.000**	0.840	0.249	2.317	**0.001**	0.780	0.270	2.181	**0.004**	0.799	0.283	2.223	**0.005**
Production	4	Production most relevant for farming (1= most important source of income, else = 0) — Milk					-0.012	0.462	0.988	0.979	0.085	0.489	1.089	0.861	0.153	0.508	1.165	0.764	0.352	0.539	1.422	0.513	0.463	0.593	1.589	0.435	0.502	0.645	1.651	0.437
	5	Chicken /egg					-0.825	1.055	0.438	0.434	-0.72	1.058	0.487	0.497	-0.529	1.064	0.589	0.619	-0.295	1.071	0.745	0.783	0.250	1.107	1.284	0.821	0.343	1.130	1.409	0.762
	6	Meat					-0.327	0.346	0.721	0.346	-0.265	0.362	0.767	0.464	-0.432	0.379	0.649	0.255	-0.287	0.401	0.751	0.474	0.099	0.434	1.104	0.819	0.245	0.454	1.278	0.589
	7	Grain					-0.343	0.295	0.709	0.245	0.046	0.336	1.047	0.892	0.066	0.346	1.069	0.848	0.212	0.364	1.236	0.561	0.425	0.385	1.529	0.270	0.514	0.413	1.672	0.214
	8	Vegetables / fruit					-0.399	0.624	0.671	0.522	-0.581	0.663	0.559	0.381	-0.67	0.668	0.512	0.316	-0.791	0.690	0.454	0.252	-0.588	0.745	0.555	0.430	-1.950	1.165	0.142	0.094
	9	Other farm related production					-0.184	0.568	0.832	0.746	-0.192	0.58	0.825	0.741	-0.302	0.586	0.739	0.607	-0.497	0.624	0.608	0.426	-0.319	0.635	0.727	0.616	-0.390	0.677	0.677	0.564
	10	Have sufficient amount of farmland (yes = 1, else = 0)					0.055	0.209	1.057	0.792	0.151	0.224	1.164	0.498	0.177	0.229	1.194	0.439	0.138	0.243	1.148	0.570	0.041	0.263	1.042	0.876	-0.011	0.283	0.989	0.968
	11	Farm income share of household income (%)					-0.02	0.006	0.98	**0.001**	-0.013	0.007	0.987	**0.043**	-0.015	0.007	0.985	**0.026**	-0.012	0.007	0.988	0.101	-0.012	0.008	0.988	0.135	-0.008	0.009	0.992	0.357
	12	There is a need for major investments that I do not have the capacity to implement *					-0.319	0.074	0.727	**0.000**	-0.287	0.076	0.75	**0.000**	-0.295	0.079	0.744	**0.000**	-0.351	0.086	0.704	**0.000**	-0.297	0.091	0.743	**0.001**	-0.291	0.099	0.747	**0.003**
Natural and technological conditions	13	Size of land owned and cultivated by owner (ha)									-0.074	0.061	0.928	0.224	-0.054	0.066	0.948	0.416	-0.058	0.070	0.943	0.406	-0.084	0.076	0.920	0.269	-0.076	0.082	0.927	0.354
	14	Size of land rented out for farming (ha)									-0.008	0.069	0.992	0.909	-0.013	0.074	0.987	0.860	-0.050	0.080	0.951	0.532	-0.139	0.088	0.870	0.116	-0.138	0.096	0.871	0.151
	15	Size of owned and abandoned land (ha)									0.171	0.096	1.186	0.076	0.14	0.105	1.151	0.180	0.157	0.108	1.170	0.145	0.127	0.119	1.135	0.286	0.097	0.119	1.102	0.413
	16	Size of rented land for farming purposes (ha)									-0.099	0.069	0.906	0.151	-0.117	0.072	0.889	0.103	-0.114	0.077	0.893	0.138	-0.147	0.085	0.863	0.082	-0.180	0.090	0.835	**0.046**
	17	Most land used as grassland (dummy 1= yes) **									0.189	0.256	1.208	0.459	0.073	0.268	1.076	0.784	0.072	0.290	1.075	0.804	0.023	0.307	1.023	0.941	0.065	0.326	1.067	0.841
	18	Most land used as horticulture (dummy 1= yes) **									0.69	0.481	1.994	0.151	0.731	0.494	2.078	0.138	0.890	0.519	2.435	0.086	0.829	0.570	2.291	0.146	0.732	0.630	2.078	0.246
	19	Most land used as pasture (dummy 1= yes) **									0.333	0.329	1.396	0.311	0.179	0.344	1.196	0.604	0.192	0.364	1.212	0.599	-0.056	0.392	0.946	0.887	0.020	0.411	1.020	0.961
	20	Most farmland not in use (dummy 1= yes) **									-0.233	0.651	0.792	0.720	-0.798	0.683	0.45	0.243	-0.711	0.668	0.491	0.287	-0.744	0.705	0.475	0.292	-1.015	0.721	0.362	0.159
	21	Quality of land for farming purposes (1= good quality, else 0)									-0.204	0.207	0.815	0.324	-0.227	0.216	0.797	0.293	-0.056	0.232	0.945	0.809	0.042	0.252	1.042	0.869	0.091	0.265	1.095	0.732
	22	The proportion of rented land is not a challenge promoting farmland conversions in my municipality*									-0.024	0.08	0.977	0.769	-0.003	0.082	0.997	0.971	0.032	0.093	1.033	0.730	0.109	0.103	1.115	0.289	0.084	0.112	1.088	0.450
Landowner attributes	23	Gender (Man = 1, else= 0)													0.246	0.259	1.279	0.341	0.137	0.271	1.147	0.614	0.152	0.290	1.164	0.600	0.048	0.305	1.049	0.875
	24	Agricultural education (Yes=1, else= 0)													-0.211	0.219	0.81	0.335	-0.220	0.236	0.803	0.350	-0.265	0.253	0.767	0.295	-0.475	0.276	0.622	0.086
	25	Live on the farm (Yes=1, else= 0)													0.162	0.284	1.175	0.570	0.162	0.298	1.176	0.588	0.101	0.315	1.106	0.749	0.040	0.326	1.041	0.903
	26	Farm on Allodial rights (Yes =1, else= 0)													-0.356	0.218	0.701	0.103	-0.458	0.233	0.632	**0.049**	-0.280	0.254	0.755	0.270	-0.159	0.268	0.853	0.552
	27	In dialog with developers for conversion purposes (Yes= 1, else =0,)													1.462	0.226	4.313	**0.000**	1.116	0.247	3.053	**0.000**	0.831	0.270	2.295	**0.002**	0.662	0.299	1.938	**0.027**
		Constant	-3.958	0.297	0.019	**0.000**	-2.544	0.372	0.079	**0.000**	-2.558	0.599	0.077	**0.000**	-2.600	0.663	0.074	**0.000**												
		Cox				0.043				0.077				0.086				0.117												
		Adjusted Rsq				0.088				0.156				0.174				0.236												
		N				1361				1356				1351				1325												

Continuation of the model testing

Rules-In-Use			Model 1	Model 2	Model 3	Model 4	Model 5 (Forwards)				Model 6 (Forwards)				Model 7 (Forwards)			
							B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.
Policies	28	I do not think the amount of option agreements between developer and landowner is a challenge to prevent farmland conversions in my municipality *					-0.210	0.104	0.810	**0.044**	-0.187	0.112	0.830	0.096	-0.126	0.119	0.882	0.291
	29	Agricultural policy as agreed on at the national level provides good conditions for farmland preservation *					0.128	0.092	1.137	0.163	0.110	0.102	1.116	0.285	0.109	0.111	1.115	0.327
	30	Land use planning in my municipality ensures that my farmland is protected from conversion to built-up land *					0.054	0.111	1.055	0.630	0.038	0.120	1.039	0.749	0.043	0.130	1.044	0.741
	31	The politicians in my municipality support an active policy to prevent farmland conversions * - removed					-0.104	0.108	0.902	0.338	-0.194	0.117	0.823	0.095	-0.165	0.126	0.848	0.191
	32	All in all, there is a need to strengthen farmland preservation policies *					0.587	0.085	1.799	**0.000**	0.558	0.094	1.747	**0.000**	0.358	0.111	1.430	**0.001**
Social structures		**Family**																
	33	My family understands and accepts if I want to sell farmland for development purposes *									-0.387	0.102	0.679	**0.000**	-0.323	0.110	0.724	**0.003**
	34	I experience a pronounced or unspoken expectation from the family to sell farmland for development purposes *									-0.050	0.094	0.951	0.594	0.030	0.103	1.031	0.770
	35	Future prospects (1= In twenty years. I cultivate the land myself or it is taken over within the family. else = 0)									-0.165	0.266	0.848	0.536	0.064	0.284	1.066	0.821
	36	It is hard to take decisions alone regarding farmland conversion *									-0.121	0.078	0.886	0.121	-0.162	0.085	0.850	0.056
		Local society																
	37	I am rarely acknowledged/ rarely meet respect as an owner of farmland in my local community *									-0.070	0.087	0.933	0.425	-0.025	0.093	0.975	0.789
	38	It is a taboo to talk about motivation for farmland conversion among inhabitants in my community *									-0.086	0.101	0.917	0.394	-0.054	0.107	0.948	0.616
		Agricultural society																
	39	The local agricultural society is optimistic regarding the future for continued farming *									0.021	0.111	1.022	0.847	0.099	0.118	1.104	0.401
	40	I have the impression that there are many landowners who want to sell farmland for development purposes in my municipality *									-0.393	0.100	0.675	**0.000**	-0.374	0.108	0.688	**0.001**
Landowner values and interests	41	My main concern as a landowner of farmland is that food is produced at my property *													0.192	0.110	1.211	0.081
	42	My farmland should provide the community with multifunctional values, such as beautiful scenery or local agricultural experiences *													0.159	0.101	1.173	0.114
	43	My farmland shall primarily serve as a property for housing and/or cottage *													-0.028	0.093	0.972	0.765
	44	My farmland must first and foremost generate income for the household and my inheritors *													0.035	0.105	1.036	0.737
	45	My farmland is a common good I have borrowed, and it should be managed for the benefit of future generations *													0.222	0.097	1.248	**0.023**
	46	I should have the right to decide future use of my farmland, even if I wish to sell it to developers *													-0.285	0.111	0.752	**0.010**
	47	The authorities should decide whether my farmland should be converted or not *													-0.212	0.094	0.809	**0.024**
		Constant					-2.638	0.913	0.072	**0.004**	1.457	1.208	4.292	0.228	1.048	1.404	2.851	0.456
		Cox								0.159				0.196				0.221
		Adjusted Rsq								0.320				0.396				0.449
		N								1293				1265				1239
Notes :		Centrality and farm income removed due to multicorralation with other variables																
		* (1 = strongly agree - 6 = strongly disagree)																
		** dummy set. Grain = control variable																

797

798

Lav uavhengig gir høy motivasjon		Model 8 (Backwards)				Model 9 (Backwards)			
		B	S.E.	Exp(B)	Sig.	B	S.E.	Exp(B)	Sig.
Biophysical and socioeconomic conditions									
	Location								
3	Farm located in high pressure grain areas (1= inside and 0 = outside)	0.623	0.23	1.864	**0.007**	0.546	0.219	1.726	**0.013**
	Production								
11	Farm income share of household income (%)	-0.01	0.006	0.99	**0.045**	-0.014	0.005	0.986	**0.008**
12	There is a need for major investments that I do not have the capacity to implement *	-0.251	0.085	0.778	**0.003**	-0.261	0.082	0.77	**0.002**
	Natural and technological conditions								
16	Size of rented land for farming purposes (ha)	-0.135	0.074	0.874	0.068				
	Landowner attributes								
26	Farm on Allodial rights (Yes =1. else= 0)	-0.313	0.227	0.731	0.169				
27	In dialog with developers for conversion purposes (Yes= 1. else =0. else= 0)	0.863	0.253	2.370	**0.001**	0.817	0.248	2.263	**0.001**
Rules in use									
	Polices								
28	I do not think the amount of option agreements between developer and landowner is a challenge to prevent farmland conversions in	-0.067	0.105	0.935	0.522				
32	All in all. there is a need to strengthen farmland preservation policies *	0.409	0.093	1.506	**0.000**	0.451	0.083	1.570	**0.000**
	Social structures: Family								
33	My family understands and accepts if I want to sell farmland for development purposes *	-0.223	0.095	0.8	**0.020**	-0.246	0.093	0.782	**0.008**
	Social structures: Agricultural society								
40	I have the impression that there are many landowners who want to sell farmland for development purposes in my municipality *	-0.414	0.091	0.661	**0.000**	-0.359	0.086	0.699	**0.000**
	Landowner values and interests								
45	My farmland is a common good I have borrowed. and it should be managed for the benefit of future generations *	0.252	0.081	1.286	**0.002**	0.274	0.078	1.315	**0.000**
46	I should have the right to decide future use of my farmland. even if I wish to sell it to developers *	-0.303	0.097	0.739	**0.002**	-0.340	0.094	0.712	**0.000**
47	The authorities should decide whether my farmland should be converted or not *	-0.248	0.084	0.780	**0.003**	-0.234	0.082	0.791	**0.004**
	Constant	1.021	0.870	2.777	0.240	0.669	0.698	1.951	0.338
	Cox				0.192				0.185
	Adjusted Rsq				0.391				0.375
	N				1313				1333

Hosmer and Lemeshow Test	Step	Chi-square	df	Sig.
	1	6.295	8	0.614

Notes	
	Centrality and farm income removed due to multicorralation with other variables
	* (1 = strongly agree - 6 = strongly disagree)
	** dummy set. Grain = control variable

799

800

801