Exploring the Differences in Structural Change Between Organic and Conventional Agriculture in Norway

Authors: Ruth Sofie Hillesund, Lennart Kokemohr, Klaus Mittenzwei

Introduction and motivation

Agriculture provides food and a large variety of ecosystem services such as agrobiodiversity and cultural landscape. However, the recent debate also focuses on the environmental externalities of production, such as GHG emissions. Furthermore, agriculture is considered important to maintain decentralized settlements in Norway, so the government of Norway facilitates to maintain structures for agricultural across the country. Preventing farm structural change, i.e., keeping the number of active farms stable is motivated through various considerations, inter alia, rural development and geo-political considerations in the North of Norway (NOU, 2023: 17). In economics, structural change is a change in how the market usually operates or changes in employment or resources. In this context, we define farm structural change as the change in number of active farms or change in management types such as organic and conventional.

Accordingly, the four strategic goals for agricultural policy in Norway are: food security, maintaining agriculture across the country, increased value creation, and sustainable agriculture with lower emissions of greenhouse gases (Ministry of Agriculture and Food, 2016). These goals are supported by comprehensive policy intervention, mainly through extensive subsidies. Total support accounted for about 50 percent of gross farm receipts between 2020-2022. One governmental strategy to achieve sustainability goals is the extension of organic production and consumption due to perceived beneficial effects for the environment, health, taste, and animal welfare (Ministry of Agriculture and Food, 2009). However, the share of organic payments in budget support is below 1 percent (OECD 2023).

For the future of the food system, it is considered necessary to achieve sustainable agriculture while feeding a growing population. Organic farming is perceived as a way to mitigate greenhouse gas emissions because of management practices such as less or no use of chemicals, minimum tillage, returning crop residues to the soil, and the use of cover crops and rotations (FAO, u.d.). A report from the Rodale Institute (2022) finds that organic farming prevents the accumulation of toxins in waterways in contrast to conventional agriculture. In addition, it improves soil quality and vitality and keeps more carbon in the soil. Yet there is various evidence of whether organic farming does have an effect on the reduction of greenhouse gas emissions (Smith, Kirk, Jones, & Williams, 2019). Another limitation of organic farming is that it typically has a lower yield of production compared to conventional (Seufert, Ramankutty, & Foley, 2012).

Several studies analyze Norwegian organic farming. There is literature that explains the failure to increase the production and demand of organic food in Norway by studying organic farming only, potential reasons for that failure include consumer reluctance (Vittersø & Tangeland, 2015; Kvakkestad, et al., 2018), professional challenges of organic adoption (Flaten, O. et al., 2005a), risk perceptions (Flaten, O., et al., 2005b) and profitability and regulations (Flaten O. , Lien, Koesling, & Løes, 2010). While the contribution of organic farming to environmental goals, profitability, and adoption are researched, its influence on farm structural change compared to conventional farming is missing. Therefore, the motivation of this paper is to compare organic and conventional farms relating to the policy goals of maintaining agriculture across the country. We hypothesize that organic farming is relatively more "robust" to structural change. Based on previous studies, we identify that management practices, farm size, location, and neighborhood effects may be important drivers for this observation. In addition, there might be more long-term investments in organic farming or a higher willingness to put in effort for more environmental measures as part of a farm family lifestyle. In this paper, we explore the observed differences in structural change between organic and conventional agriculture in Norway. Our contribution is to investigate whether the management type is important to farm survival.

Literature:

In a review by Shennan et al. (2017) comparing organic and conventional farming, they conclude that organic and ecological farming is favorable across several environmental and socioeconomic factors. Although they do highlight the difficulties of comparing the production forms due to differences in the sizes of crops, farms, and management forms. From a rural development perspective, it has been argued that organic farming could provide economic benefits to the local economy through a closer connection to the local market for retailers and employment. Lobley, Butler, and Reed (2009) enhance these arguments with results from their study in England where they find that organic farms generate more employment also outside the family, which benefits more people living in rural areas. However, the data shows few differences between organic and conventional farms in terms of local connection to the economy.

On the farm-community level, Koesling, Flaten and Lien (2008) highlight several studies that show that organic farmers are more likely to be women and younger age. They also tend to be motivated by factors other than economic ones, such as environment, lifestyle choices, and animal welfare. Koesling et al. (2008) investigated these aspects further and found in a farmer survey about goals on the farm, that organic farmers were the only group that reported sustainable and environmental farming as their highest goal. Followed by “producing high-quality food” and “reliable and stable income”. Conventional farmers put more emphasis on economic goals compared to organic farmers.

Some recent literature investigates whether organic farms are less likely to exist than conventional farms. Marton and Storm (2021) look at the organic conversion of dairy farms in Norway between 2003 and 2015. They find that if farms are reverting to conventional or exiting, neighboring farms are also more likely to do so. Potential organic conversion or exit is more likely to happen if the neighbors do so. It is more important than the farmer's age, herd size, and agricultural land. In other words, neighbors affect each other. In Switzerland, Zorn and Zimmert (2022) studied structural change in the dairy sector, specifically farm exit and changing the type of farm. Results from their study show that more specialized dairy farms have higher exit probabilities. On the other hand, farm size in terms of employees, the number of dairy cows, and the connection to organic or animal welfare standards reduce the exit probabilities. This aligns with our hypothesis, that organic farming is more “robust” over time.

Most literature on structural change tries to understand different reasons why farms exit. Storm, Mittenzwei, and Heckelei (2015) explore neighbor relations between farms. They look at the effects direct payment to the neighboring farms have on farms to remain in business. Their results show that higher direct payments for neighbors decrease the probability of the farm surviving. Another finding is that the farm’s economic size is more important than the on-farm income.

Bragg and Dalton (2004) find four variables to be significant in the decision to exit dairy: age, off-farm income, farm economic performance, and farm specialization. An older farmer is more likely to exit, as well as a higher off-farm income, in other words, a higher opportunity cost to keep farming. Higher returns over variable costs reduce the probability of exit, which the authors argue is aligned with the theory that producers with lower costs per unit is more durable. In contrast to the Swiss study, they find that specialized dairy farms are less likely to exit, and diversification of on-farm income is associated with being more likely to leave dairy farming. Foltz (2004) looks at how dairy prices affect the decision to exit or not and finds a lower probability for farms to exit if they have a higher productivity, measured by the yield of the cows on the farm. Further, they argue that small farms, as in fewer cows, are not "doomed" to go out of business, but unproductive farms are. They also find that more outside farm labor opportunities are related to farm exits.

Theoretical Framework

To understand why some farmers choose to be organic, the literature highlights the economic theory of adoption (Koesling, Flaten, & Lien, 2008; Caswell, Fuglie, Ingram, Jans, & Kascak, 2001). It suggests that the adopter chooses based on the maximization of expected utility subject to prices, policies, personal characteristics, and natural resource assets. This framework indicates that farmers' decision-making processes encompass more than just monetary constraints. We build this further with the theory of sunk cost fallacy, where people tend to continue with a measure they have invested money, effort, or time into (Arkes & Blumer, 1985). This addresses the issue that people do not want their investment to be wasted, and one could say they have a higher willingness to stay. In other words, the farmer experiences a higher opportunity cost to quit, due to a higher overall investment. Classical economic theory assumes a person is rational and profit maximiser. Yet, Willock et al. (1999) argue that most decisions of the farmers are driven by attitudes and beliefs and the object of the farmer. They try to explain differences in the decision making of business- and environmental-orientated farmers. This could underline the theory that some are driven by more than profit, and then have a higher willingness to stay in farming motivated by other factors than maximizing farm income, such as having organic farming as a lifestyle.

If organic farmers have higher environmental goals and ambition, as some studies suggest (Koesling, M., Flaten, O. and Lien, G. (2008), it could imply that the opportunity cost to quit is higher for organic farms. Yet, conventional farms might face higher sunk costs due to substantial monetary investments and larger farm sizes, which could also imply higher opportunity costs to quit, at least in the short run. On the other hand, conventional farms might have lower transaction costs to sell the farm and the land because there are more farms with the same management type and fewer restrictions on how to farm. Which again could ease the cost of exiting for conventional farms.

Saint-Cyr, Storm, Heckelei and Piet (2019) argue that a farm will remain active if its willingness to pay for land is higher than that of their neighbor's. However, they go further in this argument, and highlight literature that explains how large neighboring farms can lead to both exit, through being 'eaten up' by competition and lower willingness to pay (WTP), but also that large farms can provide motivation to remain because of spillover effects of new technology from the large farms, since they have more resources to invest. Hence, the number of neighboring farms may have an ambiguous effect on a farm's survival rate.

Data and Methodology

Norwegian Freedom of Information Act (2009) ensures the publication of governmental aid payments to legal entities and private persons. This includes agricultural holdings, which are eligible for many subsidies, price premiums, and compensation payments. The respective payments, alongside with the agricultural land, kept animals, grown crops, and harvest for which farmers receive payments, are published annually in the national data catalog (Norway Digitalization Agency, 2023). The payments are degressive, meaning the first animal gets more subsidies than the last and the location of the farm could also enable some additional payments. Almost any grown crop and farm animal receives funding. There are specific payments for organic produce regarding acreage and animals (Norway Digitalization Agency, 2023). Together with the high share of governmental aid in farm income (about 50 percent according to OECD 2023), the database covers the active Norwegian farm population. This includes family-owned farms, but also juridical persons such as schools, counties, and prisons. Farms with a turnover under a certain threshold are not eligible for subsidies and, therefore, not included in the database. Eligible farms that, for various reasons, do not apply for subsidies are also not covered.

To identify farms over time we utilize the farm's property number, which remains consistent. Unlike the tax number, which is linked to the farmer and changes with a new successor or manager. The property number remains stable and represents the physical entity of the farm. When multiple tax numbers are registered on a single farm, we have combined their values. In this study, a farm is defined as a physical entity, and we do not consider structure changes within the farm.

During this period there have been some changes in the structure of counties and municipalities (which is a part of the property number). Some municipalities have merged, others split, and then some municipalities have been split again after an earlier merge. These changes resulted in new municipality codes and caused complications in the property number of the farms, since it builds on the municipality code. To overcome the problem with the identification key, we identified all farms using public property information and other sources to match farms year by year so that we could trace identical farms although the property number may have changed. Therefore, we are now able to identify the unique farms over the period, despite a change in the identification number.

Descriptive Statistics and Variables

Our focus is on determining whether farms that were active in 2013 remained active in 2022. In our dataset, we have 39 760 unique farms in 2013 and 36 072 in 2022. This is almost aligning with the numbers Statistics of Norway (SSB) reports, 43 726 in 2013 and 37 921 in 2022 (Statistics of Norway, u.d.). Organic farms account for about 5 percent of the total farms for all years. In our data, organic farms made up 5,46 percent of all farms in 2013, and 4,67 percent in 2022. SSB reports for 2022 that 5,2 percent of farms in Norway are organic (Statistics Norway, 2023). Over the 10-year period active years of a farm is 8,6 years on average. In Table 1, we see the year-to-year changes of the number of conventional and organic farms.

Table 1 - Year-to-year changes of the number farms

Year	Conventional farms	Organic farms	Share of organic farms
2013	37 591	2 169	5,46 %
2014	37 361	2 034	5,16 %
2015	36 932	1 915	4,93 %
2016	36 589	1 882	4,89 %
2017	36 704	1 719	4,47 %
2018	36 126	1 748	4,62 %
2019	35 516	1 725	4,63 %
2020	35 147	1 713	4,65 %
2021	34 793	1 675	4,59 %
2022	34 388	1 684	4,67 %

In table 2, we have calculated that 25 percent of conventional farms will not be active after 10 years, whereas for the organic farms there 19 percent not active after 10 years. This description aligns with our hypothesis. We will investigate this further by using a binary model, where we can check this relation while holding other constants unchanged.

Table 2 – Number of farms which are active and exit.

	Active	Exit	Total	Percentage of farms in 2013 not active in 2022
Conventional	28 121	9 470	37 591	25,2 %
Organic	1 757	412	2 169	19,0 %
Total	29 878	9 882	39 760	24,9%

All variables included in the analysis are presented in Table 3. We define the exit-variable as 0 if a farm is active in 2013 and in 2022, i.e. no change. If the exit-variable equals 1, farms are active in 2013, but not in 2022, in other words they have not "survived" during the given time period. Which is the observed survival of the farms. All explanatory variables are derived from the National Data Catalogue of 2013, as well as census data from Statistics Norway.

Table 3 - All variables included in the analysis.

Variable	Obs.	Mean	Std. dev.	Min	Max
Exit	39760	0,248541	0,432173	0	1
Organic	39760	0,054552	0,227107	0	1
Age groups					
1) 1999-89	39760	0,031011	0,17335	0	1
2) 1983-64	39760	0,400755	0,490058	0	1
3) 1963-44	39760	0,485513	0,499796	0	1
4) 1943-20	39760	0,046227	0,20998	0	1
5) Entities etc.	39760	0,036494	0,187518	0	1
Total area in daa (1/10ha)	39760	162,8641	412,5092	0	48 383
Herfindahl Index	39760	0,749857	0,374106	0	1
Contribution margin in NOK	39760	752668,3	2142302	0	199 000 000
Total direct payment in NOK	39760	123332,2	117050,5	0	2 218 216
DP-groups					
1) 0-29820NOK	39760	0,200201	0,400156	0	1
2) 29822-60821 NOK	39760	0,199799	0,399854	0	1
3) 60829-117760NOK	39760	0,2	0,400005	0	1
4) 117780-210453NOK	39760	0,2	0,400005	0	1
5) 210464-2218216NOK	39760	0,2	0,400005	0	1
Rurality index	39760	56,94415	17,38879	0,122785	100
Rurality-groups					
1) *1-41*	39760	0,208199	0,406025	0	1
2) *42-50*	39760	0,192656	0,39439	0	1
3) *51-62*	39760	0,201232	0,400926	0	1
4) *63-72*	39760	0,197988	0,398488	0	1
5) *73-100*	39760	0,199925	0,399948	0	1
Number of farms in the municipality	39760	200,4356	128,987	1	571

We are interested in the effect organic farming has on the probability of exiting. We include an organic variable whose value depends on whether a farm receives organic payment (1) or not (0). The variable is defined for 2013. Organic farming is most common among dairy farms, suckler cow farms and sheep farms. Furthermore, we do not observe many conversions between the management forms. For conventional farms 0,77 percent of the population have converted to organic farming, and for organic farms 1,75 percent reports to be conventional at the end of the period.

We include age as an explanatory variable aligned with the literature presented. For the observations of 2013, we have categorized the age variable into five groups. People born between 1999-84, 1983-64, 1963-44, 1943-20. All other farms, i.e., family farms with missing age information and non-family farms, are reported to be birth year 0. We categorize farms with the birth year 0 as entities. Most of the observations belong to the third and second age groups. When excluding farms in the entities group, the average birth year in 2013 is 1962, meaning the average farmer is 52 years old in 2013. The average age of organic farmers and conventional differ by one year, where organic farmers are on average younger.

From the data we have information about farm characteristics. We know how much subsidy the farms have received, total area, herd size, and quantity produced. For instance, the number of cows, both dairy and suckler, could imply information about the size of the farm and the intensity of the production. We include the total area of the farms as a measure of the size of the farm, and we expect it to be negatively related to exit – the greater the farm, the less likely it is to exit. The average area of a farm in our data is 16,3 hectares. In addition, we have included a proxy for the profit on the farm as the calculated contribution margin, which is expected price of the animal or acres multiplied by the quantity. We have also included the amount of subsidies that the farms receive as a proxy for the size of production. The average sum is 123 332 NOK, which is about 10 841 Euro (rate of 1£ to 11,38NOK). This also includes organic payment.

From the information about the farms and their production, we have followed the approach of Zorn and Zimmert (2022) to compute a variable for specialization within the farm by using the Herfindahl-Hirschman Index (Hirschman, 1964). The variable is calculated as the sum of the squared share of the contribution margin (sometimes gross margin) for the following production lines: cow's milk, beef, sheep, goat's milk, pig, egg, chicken (poultry), potato, cereal, vegetables, and others. The index takes values between 0 and 1, where 0 is diverse and 1 is fully specialized. In our data we observe that the average for all farms in 2013 is 0,75, which implies that most farms are rather specialized than diversified. Most farms only perform 1 or 2 types of production. The most common production types are sheep, cereal, and milk.

Further, we control for other structural effects that could contribute to the decision of exiting. We have included the government's index of rurality for 2023 (Ministry of Local Government and Regional Development, 2024). The Rurality index is on the municipality level and is supposed to show the degree of rurality. The variable ranges from 0 to 100, where 0 is the most rural. The index is composed of four different indicators: SSB’s centrality index (weighted 40 percent), population growth in the last 10 years (weighted 40 percent), growth in employment in the last ten years (weighted 10 percent), and the diversity of industries as the Herfindahl index of the private sector (weighted 10 percent). SSB’s centrality index is based on people’s access to workplaces and services in geographical units, not municipalities. This is then weighted according to the commuting distance. The data is then aggregated to the municipality level, using the population level in the geographical area as a weight (Statistics Norway, 2020). The average score of the Rurality Index is 57. The effect of the index on farm exit could go both ways; many farms are located in rural areas, and in general there is more movement from rural areas to urban areas. This could mean that there is a negative relationship – the more rural, the higher the exit rate because people move from the rural areas. However, in more central areas there could be a more attractive labor market which could mean the opportunity cost to exit is lower, hence a positive relationship.

Marton & Storm (2021) looked at how location and neighborhood affect the decision to convert or revert from organic and conventional farm management. To control for neighborhood effects, we have included a variable for the number of farms in the municipality. We hypothesize that it is easier to continue farming when there are other farmers close by due to the advantages of a community. Conversely, more farms could make it easier to exit due to competition for land and better market options to sell farm assets.

Because of changes in the municipality structure between 2013 and 2024, we have connected the variables for municipalities to the municipality structure in 2024. This means that for some municipalities, the structure in 2013 is not the same as for 2024. There are also changes over time in how the population is counted, because some municipalities have gained new areas and people. For instance, a municipality that existed in 2013, but not in 2024, has been given the variable value for its successor municipality in 2024. In 2024, Norway is structured in 15 counties and 357 municipalities, compared to 2013 when there were 19 counites and 428 municipalities (See map of Norway with counties in the appendix). Innlandet, Vestland and Trøndelag are the counties with most farms, yet Oslo has the highest percentage organic farms out of the total farms in the region. Figure 1 shows the number of organic and conventional farms by county. Figure 2, the percentage of organic farms of total farms by county:

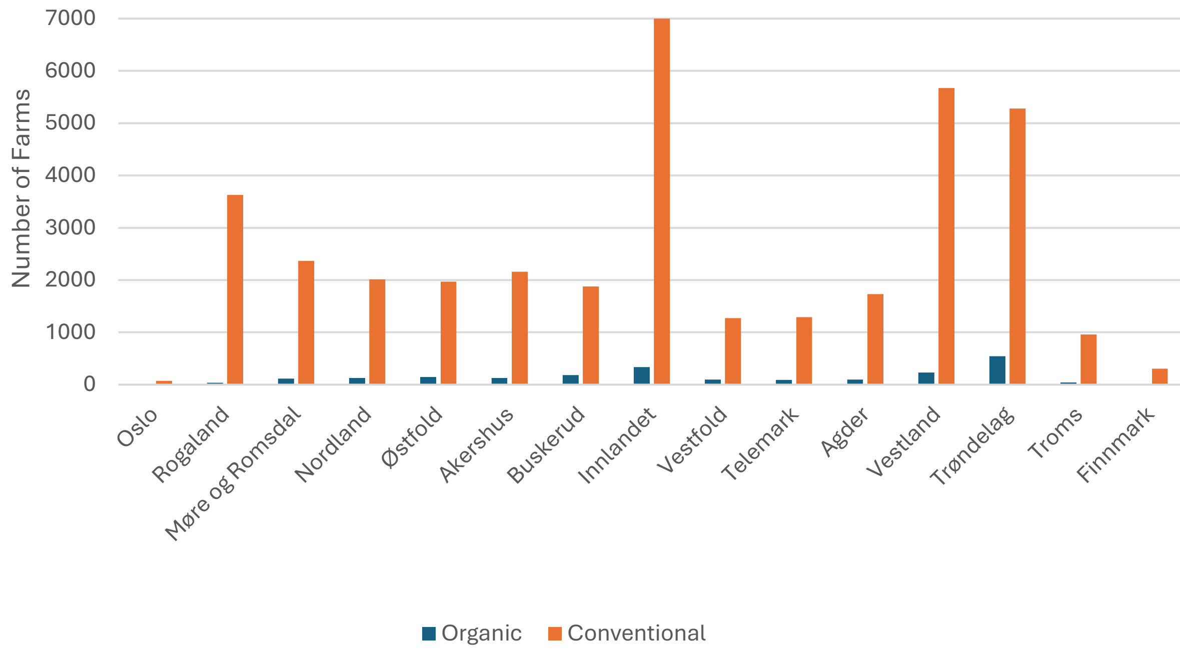

Figure 1

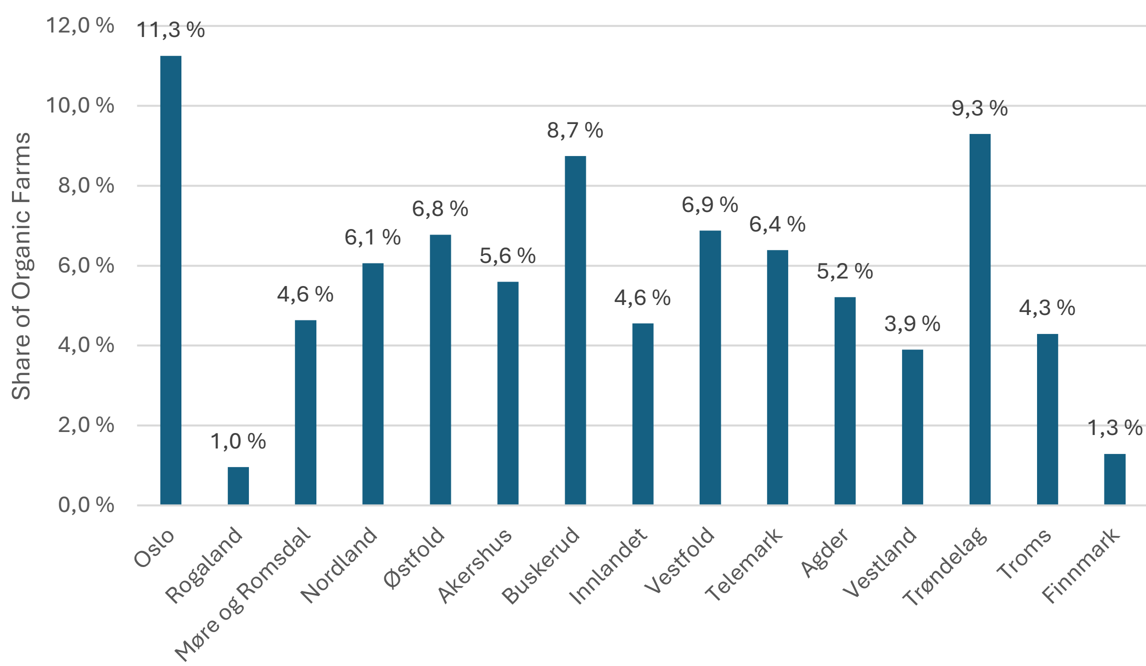

Figure 2

Moreover, Table 4 presents the pairwise correlation of the variables. As expected, there are correlations between total area, contribution margin, and direct payment. But there is not any substantial correlation between the dependent variable, exit, and the other variables.

Table 4 - Pairwise correlation matrix for variables in 2013

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Exit	1,0000								
(2) Organic	-0,0310*	1,0000							
(3) Birthyear	-0,1699*	0,0204*	1,0000						
(4) Total area in daa	-0,1002*	0,0122*	0,0448*	1,0000					
(5) Contribution margin	-0,1066*	-0,0155*	0,0337*	0,5991*	1,0000				
(6) Herfindahl Index	-0,1201*	-0,0312*	0,0009	0,0392*	0,0810*	1,0000			
(7) Total direct payment in NOK	-0,2458*	0,0881*	0,1404*	0,4349*	0,3807*	0,1682*	1,0000		
(8) Rurality index	-0,0148*	-0,0076	0,0046	0,1597*	0,1843*	0,0398*	-0,0626*	1,0000	
(9) Number of farms in the municipality	-0,0343*	-0,0043	0,0358*	0,0589*	0,0927*	0,0174*	-0,0174*	0,3467*	1,0000

** Significant at 0,05. Observations with birth year 0, i.e. entities are excluded.*

Method:

To analyze the probability of exiting, we use a two-period logit model consisting of all farms in 2013, following the method of Storm et al. (2015). It is a binary model to estimate the probability between the two outcomes, in our case, if a farm exits or not. The logit model is a non-linear model where the probability for the variables lies between 0 and 1 (Verbeek, 2004). In equation (1), we have a general function for some function of $G(.)$,

$$p(y_i = 1|x_i) = G(x'_i, \beta) \tag{1}$$

Here the probability of exiting, $y_i = 1$, depends on a vector of variables, x'_i, such characteristics of the farmer and the farm, as well as structural factors. Due to the constraint that the probability lies between 0 and 1, the logit model has a standard logistic distribution function given by equation (2),

$$p(y_i = 1|x_i) = F(z) = \frac{e^z}{1+e^z} \tag{2}$$

In the logit model, the coefficients are estimated by maximum likelihood estimation (MLE), which is consistent and normally distributed in large samples (Verbeek, 2004) (Stock & Watson, 2012).

MLE assumes that the distribution of an observed phenomenon is known, except for some unknown parameters that will be estimated by taking those values that give the observed values the highest probability (Verbeek, 2004).

The logit coefficient is preferable to be interpreted by computing predicted probabilities, odds ratio, or average marginal effects (Stock & Watson, 2012). We will calculate and present average marginal effects (AME). Marginal effects will be the partial derivative of the probability that $y_i = 1$, showed in equation (3)

$$\frac{\partial \Pr(y = 1|x)}{\partial x} = \frac{dF(z)}{dz}\frac{\partial z}{\partial x} = \frac{e^z}{(1+e^z)^2}\beta \quad (3)$$

Where $z = \alpha + x'\beta$. This shows the marginal effect on y_i of a small change in x_i. The average marginal effect calculates each individual observation's marginal effects and then takes the average of that.

We use a simple logit model, with all explanatory variables for 2013 and exit variable derived from 2022. This enables a long-term perspective to the analysis. This method also includes farms that use conversion as a survival strategy, as we do not cover conversion as a factor in survival.

Results

The results of the analysis are presented in Table 6. We observe that being an organic farm decreases the likelihood of exiting, with almost all variables being significant at p<0.01 level. To answer our research question of the effect of organic farming on exiting, we present five models so that we can observe the effect of organic farming more closely. All models in Table 5 are presented with the average marginal effect (AME). It is the average change in the probability of the dependent variable when the explanatory variable increases by one unit or goes from 0 to 1. Results with logit coefficients are included in Table A1 in the appendix.

Table 5 – Results from the analysis

VARIABLES	(1) AME	(2) AME	(3) AME	(4) AME	(5) AME
Organic	-0.0675***	-0.0592***	-0.0326***	-0.0318***	-0.0249**
	(0.0104)	(0.0103)	(0.00990)	(0.00991)	(0.00978)
Age (*1: Birth year 1999-89)*					
2: 1983-64		-0.0138	0.00195	0.00159	0.00676
		(0.0120)	(0.0116)	(0.0116)	(0.0111)
3: 1963-44		0.0700***	0.0693***	0.0682***	0.0671***
		(0.0120)	(0.0115)	(0.0116)	(0.0110)
4: 1943-20		0.288***	0.209***	0.207***	0.189***
		(0.0164)	(0.0155)	(0.0155)	(0.0155)
5: Entities etc.		-0.00122	0.0525***	0.0501***	0.0518***
		(0.0157)	(0.0167)	(0.0168)	(0.0161)
Area in daa			-8.65e-07	9.91e-08	-3.27e-06
			(6.17e-06)	(5.86e-06)	(5.58e-06)
HHI			-0.0408***	-0.0384***	-0.0250***
			(0.00536)	(0.00534)	(0.00540)
Contribution margin			-1.58e-08***	-1.22e-08***	-9.15e-09***
			(3.44e-09)	(3.22e-09)	(3.34e-09)
Total DP *(1: 0-29820NOK)*					
2: *29822-60821 NOK*			-0.125***	-0.128***	-0.101***
			(0.00754)	(0.00759)	(0.00781)
3: *60829-117760NOK*			-0.185***	-0.191***	-0.152***
			(0.00771)	(0.00777)	(0.00814)
4: *117780-210453NOK*			-0.242***	-0.249***	-0.196***
			(0.00775)	(0.00783)	(0.00908)
5: *210464-2218216NOK*			-0.303***	-0.311***	-0.246***
			(0.00778)	(0.00783)	(0.00955)
Rurality index (1: *1-41*)					
2: *42-50*				-0.0204***	-0.0198***
				(0.00661)	(0.00646)
3: *51-62*				-0.0117*	-0.0104
				(0.00685)	(0.00672)
4: *63-72*				-0.0283***	-0.0179**
				(0.00705)	(0.00699)
5: *73-100*				-0.0250***	-0.0181**
				(0.00702)	(0.00706)
Number of farms in the municipality				-7.23e-05***	-5.64e-05***
				(1.80e-05)	(1.77e-05)
Dummy for dairy					-0.00246
					(0.00602)
Dummy for sheep and goat					-0.0328***
					(0.0107)
Dummy for cereal					-0.00593
					(0.00596)
Observations	39 760	39 760	39 760	39 760	36 566

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

In model 1, if a farm is organic, the probability of the farm exiting decreases by 6,75 percentage points. In model 4, controlling for farmers and farm characteristics and structural factors, organic farming decreases the probability of exiting by 3,18 percentage points on average. Model 2 includes the age of the farmer, and the organic coefficients are still robust but have decreased to 5,92 percent. Age is a categorical variable, where the youngest group is the reference group. The second and the fifth age group does not report a significant effect. Age groups 3 and 4 are likelier to exit than the youngest group (group 1). The fifth group, which covers most entities, gets a significant effect when including more variables. The effect is positive, indicating they are more likely to exit. Yet, this is somewhat unexpected as non-family farms, such as schools, do not depend on successors and economic performance to the same degree as family farms.

In model 3, the probability of organic farming on exit reduces when additional farm-level characteristics are included. The total area of the farm shows no significant effect. HHI is included to control for farm specialization on the farm. It is a continuous variable ranging from 0 to 1. The result shows that more specialization on the farm decreases the probability of exit. We have also included contribution margin as a proxy for profit, this effect is negative, as expected, but the effect is small. The DP variable is a categorical variable, with the group receiving the lowest payments as the reference group. In the group with the highest DP, the exit probability decreases by 30 percent compared to the lowest group. More DP implies a higher production of animals and crops with higher subsidy rates.

In model 4, we also control for additional structural factors. Here, organic farming decreases the probability of exit by 3,18 percent. Being 70 years or older increases the probability of exiting compared to farm holders younger than 24 years with 20,7 percent. A higher rurality index, meaning more central and higher employment and population growth over time, decreases exit probability. Being in the group 4 and group 5 of rurality, the probability of exiting is 2,8 and 2,5 percent, respectively, lower than for the farm located in the most rural group. More farms in the municipality decrease the probability of exiting, but the effect is small.

In the fifth model, we included dummy variables for the three largest production types: sheep, dairy and cereal. When including dummy variables, the probability of exit for organic production decreases by 2,49 percent. It is only the variable for sheep and goats that yield significant values.

Discussion and conclusion

Our research examines whether organic farming decreases the probability of exit. In other words, could more sustainable farming practices contribute to agriculture across the country and more resilient farms? To investigate this, we utilized a logit model, analyzing data for nearly all farms in Norway in 2013 and tracking their status 10 years later in 2022. Organic farms are defined as those receiving organic payment in 2013. Our findings indicate that being an organic farm decreases the probability of exit by 3,18 percent compared to conventional farms, when controlling for farmer and farm characteristics as well as structural factors. Our results reveal significant effects of age on the likelihood of farm exit. Specifically, older farmers are more likely to exit compared to younger farmers, which aligns with the literature presented (Marton et al., 2021; Zorn et al., 2022; Bragg et al., 2004; Storm et al, 2015).

All farms in our data have received direct payments (DP) for their production, making DP a measure of farm size. When controlling for DP, we observe a considerable change in the coefficient for organic status, with the effect of organic farming becoming smaller. We also include the total area of the farm in our analysis, though this variable has no significant effect when all variables are included. The proxy for profit has the expected direction of the sign, with more profitable farm decreases the likelihood of exit. A potential concern is the correlation between DP and farm area, as some DP depend on the farm's area; however, the correlation is not substantial (see Table 5). This suggests that the economic size of the farm is a relevant factor when considering the likelihood of exit. DP can be seen as a reflection of the farm's economic size, and previous research by Storm, Mittenzwei, and Heckelei (2015) indicates that a farm's economic size is more important than on-farm income. This finding may explain the changes in the coefficient for organic farming when DP is included in our analysis. In addition, organic farms on average receive higher DP.

A limitation of our study is that DP and the proxy of profit is the only economic factor we have included. Nevertheless, farms in the group receiving the highest DP have a 31 percent lower probability of exit compared to those in the lowest DP group. However, it can be argued that DP reflects production size rather than economic size and does not necessarily indicate farm profitability. Our proxy for profitability does have limits because it is expected price multiplied by the quantity, but we have not considered the costs of production. Future research should include improved profitability measures to better understand its effect on exit, and also whether organic farms are more profitable due to the additional payments they receive. In Norway, organic farming is generally profitable, and income is comparable to conventional farming (NIBIO, 2016).

Zorn and Zimmert (2022) argue that organic dairy production allows for higher added value because of the low costs of transitioning to organic production, thus reducing exit probability. In Norway, organic dairy farmers do also receive a small additional payment for organic milk, also in the transition period, due to higher costs of production (Norwegian Agriculture Agency, 2022). For further analysis, it would be interesting to dissect the payment to better understand whether these additional payments are the primary drivers behind the decision to adopt organic farming. This could provide deeper insights into the motivations for maintaining organic farming practices.

In Norway, there is a political goal to support agriculture across the country, especially in small and rural areas. Therefore, we aimed to address structural changes in agriculture with respect to the change in the number of farms. Our results indicate that farms in more rural areas are more likely to exit. Being located in less rural places decreases the probability of exiting by about 2 percent. The differences are not too large between the groups. Also, the probability of exit is closest between the most rural places and group 3, which is the group with the average score on the Rurality index. The rurality index was included to capture structural factors such as centrality and labor market dynamics. These factors could imply a higher opportunity cost for exiting farming due to a more limited labor market. Our findings show that higher scores on the rurality index, indicating more central locations with higher employment growth over time, correlate with a decreased probability of exit. This contrasts somewhat with the findings of Foltz (2004), who observed that more outside farm labor opportunities are associated with increased farm exits.

One key issue that remains unaddressed in our analysis is the potential influence of unobserved characteristics of farmers, which could significantly impact their decision to exit farming and explain why organic farms are more robust. Koesling et al. (2008) found that conventional farmers put more emphasis on economic goals than organic farmers in a survey about goals on the farm. They find that organic farmers tend to be motivated by more than economic factors, such as environment, lifestyle choices, and animal welfare. These results could underline that there are personality traits that influence decisions. Personality traits, which are relatively fixed at the individual level, could ideally be accounted for using a panel data model. Panel data offers the advantage of observing farms over a longer period, thereby allowing us to control for unobserved time-invariant factors. However, we did not find sufficient justification to employ a panel logit model in our case. The use of a fixed effects model, while potentially controlling for these unobserved characteristics, introduces additional assumptions and complicates the interpretation due to changes in the exit variable over time. Additionally, we must acknowledge the potential problem of endogeneity in our study, which may further complicate our analysis and interpretation.

Other variables should be considered for further improvement of our analysis. Firstly, as mentioned, we lack economic variables such as farm income, debt, and profitability. These could all be crucial factors in determining why a farmer might choose to or be forced to exit. Moreover, we have not included production yield or efficiency measures, which could also influence the likelihood of exit. However, Marton and Storm (2021) find that the neighborhood effect is more important than herd size and agricultural land. Conversely, Bragg and Dalton (2004) find that higher returns over variable costs reduce the probability of exit, suggesting that a profitable farm would be less likely to exit. Similarly, Foltz (2004) argues that unproductive farms are more likely to go out of business, indicating that productivity, rather than farm size, is a critical factor.

Our results show a potential benefit in supporting organic farming, though the observed effect is relatively modest. This raises questions about the underlying factors contributing to the resilience of organic farms. Further research is also needed to understand the role of farmer characteristics in the success of organic farming. Additionally, the environmental impact of organic farming is still debated in the literature. Some studies highlight the environmental benefits, such as reduced pesticide use and improved soil health, while others point to challenges like lower yields and potential difficulties in maintaining large-scale food production. This debate is particularly relevant to Norway's policy goals, which include ensuring food security through sufficient domestic production. Balancing environmental sustainability and maintaining high levels of food production presents a significant policy challenge.

In conclusion, while organic farming has the potential to contribute to several of Norway's agricultural policy goals, policymakers should consider both the environmental benefits and the practical challenges associated with it. Further analysis should focus on measures that could support and align with multiple policy goals.

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Appendix

Table A1 – Results as logit coefficients

VARIABLES	Logit	Logit	Logit	Logit	Logit
Organic	-0.362***	-0.325***	-0.194***	-0.189***	-0.168**
	(0.0560)	(0.0565)	(0.0589)	(0.0590)	(0.0657)
Age (*1: Birth year 1999-89)*					
2: 1983-64		-0.0865	0.0130	0.0106	0.0533
		(0.0732)	(0.0773)	(0.0776)	(0.0885)
3: 1963-44		0.384***	0.419***	0.412***	0.468***
		(0.0722)	(0.0763)	(0.0767)	(0.0873)
4: 1943-20		1.324***	1.111***	1.102***	1.119***
		(0.0845)	(0.0891)	(0.0894)	(0.101)
5: Entities etc.		-0.00748	0.324***	0.310***	0.372***
		(0.0960)	(0.103)	(0.104)	(0.116)
Area in daa			-5.14e-06	5.90e-07	-2.19e-05
			(3.67e-05)	(3.49e-05)	(3.75e-05)
HHI			-0.243***	-0.229***	-0.168***
			(0.0320)	(0.0319)	(0.0364)
Contribution margin			-9.39e-08***	-7.27e-08***	-6.14e-08***
			(2.05e-08)	(1.92e-08)	(2.25e-08)
Total DP *(1: 0-29820NOK)*					
2: *29822-60821 NOK*			-0.566***	-0.578***	-0.505***
			(0.0342)	(0.0343)	(0.0385)
3: *60829-117760NOK*			-0.887***	-0.912***	-0.816***
			(0.0371)	(0.0373)	(0.0423)
4: *117780-210453NOK*			-1.249***	-1.284***	-1.134***
			(0.0411)	(0.0415)	(0.0518)
5: *210464-2218216NOK*			-1.762***	-1.817***	-1.615***
			(0.0505)	(0.0511)	(0.0676)
Rurality index (1: *1-41*)					
2: *42-50*				-0.120***	-0.132***
				(0.0387)	(0.0429)
3: *51-62*				-0.0681*	-0.0680
				(0.0397)	(0.0439)
4: *63-72*				-0.167***	-0.119**
				(0.0417)	(0.0463)
5: *73-100*				-0.147***	-0.120**
				(0.0414)	(0.0468)
Number of farms in the municipality				-0.000430***	-0.000379***
				(0.000107)	(0.000119)
Dummy for dairy					-0.0165
					(0.0405)

Dummy for sheep and goat					-0.233***
					(0.0810)
Dummy for cereal					-0.0400
					(0.0404)
Constant	-1.088***	-1.328***	-0.364***	-0.176**	-0.606***
	(0.0119)	(0.0704)	(0.0784)	(0.0831)	(0.0944)
Observations	39 760	39 760	39 760	39 760	36 566
Pseudo R2	0.00100	0.0212	0.0879	0.0892	0.0724
Log Likelihood	-22272	-21822	-20335	-20306	-17046

Figure A1 – Map of 2024 counties in Norway. Statistics Norway.