Predictors for interest to change from conventional to organic horticultural production

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This study addressed factors influencing farmers' decisions to switch from conventional to organic farming with special focus on outdoor horticulture production. A total of 343 horticulture producers responded to a survey conducted in 2014. The results indicate 12.1% of the farmers with conventional horticulture production were interested in converting to organic. Small farm size, horticulture being only a minor part of the enterprise, intermediate estimated yields, greater intent to grow new crops, hiring labor, having other income sources in addition to agriculture and participating in training courses emerged as significant predictors for the intention to switch to organic production in multivariable regression modeling. These results suggest potential to increase organic production could be found particularly among smaller part-time enterprises actively seeking new crops and knowledge.

Key words: organic farming, horticulture, agriculture, production

Introduction

The Finnish government has set goals to increase the agricultural land area in organic production to 20% by 2020, to diversify the supply of domestic organic food products and to improve the availability of organic food in commercial and institutional kitchens (Ministry of Agriculture and Forestry 2014). In 2015, organic agricultural land area was 224615 ha; 9.9% of the total agricultural land (Evira 2016). While the organic area has grown, it is still far from the goal. The share of organic area was particularly low in vegetable production (3%, or 255 ha). The organic area was also low in berries (10%, 557 ha) and fruit/apples (8%, 53 ha) (Luke Statistics 2016). The range of domestic organic horticultural crops is narrow; primarily carrots, peas, onions, currants, strawberries and apples.

Horticulture represents only about one percent of the total agricultural land area in Finland (Luke Statistics 2018). However, the economic value of horticulture production is about 25 percent of the total in plant production (Luke Economydoctor 2018). In 2017, 2984 enterprises had open field horticulture production. The production covered 19341 field hectares in total; 6,48 ha/enterprise on average. The share of organic horticulture was 1428 ha; 7 percent of the total open field horticulture area. The average organic horticulture area was 2.90 ha/enterprise. The main open field crops were peas, carrots, onions and strawberries (Luke statistics 2018).

Koivisto et al. (2016) identified reasons for low production levels for organic carrots and onions. The reasons included severe storage loss problems for onions, lack of effective weed control in carrots, low degree of on-farm processing and small farm size. This leads to a situation where supply does not meet the demand of the catering and retail sectors. A small number of farms represents a large share of the production (Iivonen et al. 2014). In 2012, 52 farms produced organic carrots while the two largest farms had nearly half of the production area. Organic onion production was also on a small scale, most farms having less than half hectare and none more than five hectares in onion production. Ten largest farms had 65% of the total organic onion production area (Iivonen et al. 2014).

Farmers' motivations to adopt conservation agriculture or organic farming have been addressed in several studies. Pietola and Lansink (2001) found that lower prices for conventional crops, higher subsidies for organic crops, large arable area, low sales and low yields were motivators while having specialized livestock or crop production were disincentives for change. Schmidtner et al. (2015) found that disadvantaged climatic region and favorable social and political environment encourage decisions to convert to organic. Läpple (2010) found that risk-averse farmers are less likely to convert whereas farmers with environmental concerns are more likely to convert. Increasing profitability of conventional farming slows the adoption of organic farming.

Knowler and Bradshaw (2007) found that awareness of environmental threats had a positive impact and high productivity soil a negative impact on the adoption of conservation agriculture. Karali et al. (2014) reported that economic factors are important, but farmers also consider political, social, household, individual and environmental factors. Koesling et al. (2008) found that organic farmers have more environmentally friendly attitudes,

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larger farm size, more education and closer proximity to urban areas. Knowler and Bradshaw (2007) concluded that while options for changes may be limited overall, local situations are important when considering changing to organic production.

Farmers with friendly attitudes or concerns about the environment are more prone to adopt organic practices (Cranfield et al. 2010, Kallas et al. 2010, Theocharopoulos et al. 2012, Koutsoukos and Iakovidou 2013). Kallas et al. (2010) also identified other contributing factors including small farm size, younger age, shorter career, risk taker attitude, willingness to generate employment, farming in less favored area, and having another economic activity besides farming. Older farmers with specialized large farms were not interested in adopting organic practices (Kallas et al. 2010). Those with diversified production are more likely to adopt organic practices (Kallas et al. 2010, Anderson et al. 2005). Burton et al. (1999) reported that organic farmers tend to be younger, female, and they have smaller enterprise size. Cranfield et al. (2010) noted that in addition to environmental issues, worker health and safety concerns are also predominant.

Empirical and normative models have been used for comparing conventional and organic production. Normative models, applied, e.g. by Carmona-Torres et al. (2016), Schuler et al. (2013), and Flaten and Lien (2009), compare alternative policy options and may involve simulation to predict the effects of new policy instruments and technology. Empirical models are commonly applied to showing the effects of actual incentives and agricultural policies, and this approach is better suited for analyzing survey data in our current study. Empirical econometric models are statistical representations of farm-level systems (Acs et al. 2005). Schmidtner et al. (2015) used spatial econometrics to determine essential factors to convert from conventional to organic farming in Germany. Lewis et al. (2011) used econometrics to examine the adoption of organic dairy farming in Wisconsin, and Läpple (2010) used econometrics to study adoption of organic farming in Ireland. Pietola and Lansink (2001) used econometric models to analyse factors associated with the choice between standard and organic farming technology in Finland.

The aim of our study was to identify factors that influence the interest to change from conventional to organic horticultural production in Finland. These factors may help policy makers to design educational, research and support efforts to reach national goals concerning organic production. Results can be also utilized by other countries aiming to increase their organic horticulture production area.

Materials and methods

Data

Empirical data were collected with a survey done by TNS Gallup Finland for the Finnish Ministry of Agriculture and Forestry. TNS Gallup received responses from 4835 farms (response rate 37%) in March – April 2014. The study sample was drawn from the register of the Agency for Rural Affairs (Mavi). Farmers were able to answer the questions either online (89% responded online) or by phone. The main purpose of the survey was to produce information for governmental authorities about the plans and outlook of Finnish farms. The survey has been repeated every second year. It consists of questions concerning production sector, production methods, cultivated plants, field areas, use of hired labor and services, marketing channels, other business activities in addition to agriculture, use and need for education and consultation, profitability of agriculture, forestry and other business activities, environmental activities, animal husbandry, other current activities and intentions for the future. Further, farm continuation, succession, development, investments and hiring, as well as coping with workload, limitations and characteristics of the farmer’s entrepreneurship were covered. A subset of the TNS Gallup survey data selected for this report contained 343 farms currently practicing conventional horticultural production. In this study, horticulture production covers outdoor vegetable and berry production. Questionnaire data were augmented by linking existing 2004–2013 register data from horticultural statistics collected by the Natural Resources Institute Finland (Luke). These data included production information about crops, field areas and yields.

Variables

The response variable “Interest” was coded as 1 for those farms that indicated an interest in converting to organic production of either vegetables or berries and as 0 for the farms indicating no interest to change. Potential predictors were selected based on findings of earlier studies, special characteristics of Finnish horticulture production and opportunities to find new predictors included in the dataset (Table 1). Similar to variables in earlier studies “Other income” described activities outside of the farm, “Number of species” described diversification of production and “Coping” indicated the farmers ability to manage workload demands. Three variables (“Development”, “New plants” and “Courses”) were formulated as indicators of tendencies to seek new production methods and knowledge. “New plants” indicated the farmer’s willingness to try new crops (e.g. broad bean, buckwheat). “Courses” measured the farmer’s activity to seek education and advisory services. “Development” indicated the number of measures taken in the areas of quality improvement, systematic crop rotation, monitoring markets, knowledge of yield and production costs, precision fertilizing and crop protection and investing in land productivity (drainage, liming, etc.).

“Environmental measures” summarised environmental protection measures including exceeding the minimum requirements for environmental support, organic production agreement, other specific environmental support agreements, conducting nutrient balance calculations, treatment of manure to improve its nutrition value, replacement of fossil fuels with renewable energy sources (incl. woodchips, geothermal heat), green electricity agreement, utilization of heat or gases created in animal production, farm energy program (energy conservation) and non-production enhancements for the environment, incl. establishing wetlands or traditional rural biotopes.

Literature includes conflicting views on the association of farm size and adoption of organic production. Koesling et al. (2008) and Pietola and Lansink (2001) reported that farmers with large agricultural land area are more likely to convert to organic production. Kallas et al. (2010) and Burton et al. (1999) found the opposite. There are also conflicting views on the effect of the proportion of horticultural crops out of total field area. We included “Size” and “Proportion of horticulture” in our analysis to see further evidence on these predictors.

Horticulture is a labor intensive production sector; especially when using organic methods (Luke Economydoctor 2018). Farmers have found recruiting and training of workers is challenging (Mattila et al. 2007). “Hired labor” variable measured if farmers-employers are more ready to change to organic production. Variable “Profit” was the farmer’s own estimate of the farm’s profitability. Variables “Return” and “Change in return” were used to assess the current and past economic output of the farm. Low yields and returns (Pietola and Lansink 2001) and location in less favored areas increase the probability to adopt organic production (Kallas et al. 2010, Schmidtner et al. 2015). “Change in return” was used for revealing past trend in farm sales. Decreasing trend may drive change to organic production.

Variable “Return” was calculated as mean estimated return (€ ha^{-1}) for horticultural production during 2008–2013 as follows:

$$\frac{1}{6}\sum_{y=2008}^{2013}\frac{\sum_{s\in S_y} v_{y,s} r_{s,y}}{\sum_{s\in S_y} a_{y,s}}$$

where S_y denotes the set of species for which production volumes of year y on the farm were available, $v_{y,s}$ is the production volume (kg) and $a_{y,s}$ the production area (ha) of species s in year y, and $r_{y,s}$ is the average price (€ kg^{-1}) of species s in year y. For farms with ‘missing years’, the above average was computed only over those years, for which some production volumes were available. Yearly average prices collected by Kasvistieto (2016) were used for each species, with the exception of arctic bramble, cranberry and lingonberry for which prices of wild berries were applied (MMM 2007, MMM 2008, MMM 2009, MMM 2010, Mavi 2012, Mavi 2013, Mavi 2015) and chokeberry for which only an expert assessment was available.

“Change in return” was estimated as mean annual change in return (€ ha^{-1} yr^{-1}) over the years 2004–2013. In order to obtain the most reliable assessment of change (maximum number of years), annual returns were computed slightly differently from those for the “Return” variable above:

$$z_y = \frac{\sum_{s\in S_y} v_{y,s} r_{s,y}}{a_y}$$

where a_y is the whole area of horticultural production, including also those species for which production volumes were not available. This enabled inclusion of years 2004–2007 for which species-specific production areas of berries were not available. The “Change in return” was then estimated by the slope of the farm-specific linear regression model fitted to the pairs of year y and return z_y.

Table 1. Variables and descriptive statistics

	Description	TRUE	FALSE	missing
Interest	TRUE if the farmer indicated an interest in converting to organic production of either vegetables or berries	45	298	0
Other income	TRUE if the farmer regularly worked outside of the farm full time or part time or had other business activities in addition to basic agriculture	211	123	9
Hired labor	TRUE if the farm used hired labor in 2013	198	141	4

	Description	min	median	mean	max	missing
Age	Age of the farmer in years on December 31, 2013.	24	50	49.1	77	11
Development	Adoption of practices to develop crop farming. Sum of responses to seven different actions[1] on a 5-point Likert scale: 0=not at all…4=very much	0	19	17.5	28	0
Environmental measures	Number of environmental actions already undertaken on the farm out of ten specifically defined options[2]	0	1	1.2	7	5
New plants	Willingness to grow new crops (e.g. broad bean, buckwheat), Likert scale: 1=not at all,…5=very much.	1	2	2.0	5	0
Number of species	Number of horticulture species grown on the farm each year during 2008–2013	1	2	2.6	27	26
Size	Area of agricultural production (ha) in 2013	2	22	36.2	341	0
Proportion of horticulture	Standard output (SO) of horticulture production in relation to SO of total production of the farm; average over all available years from 2010 to 2014	0	0.8	0.7	1	25
Courses	The number of topics on which the farmer had received education or consultation during recent years	0	2	3.6	18	11
Coping	How well the farm personnel are coping with the workload? Six point Likert scale: 1=very good...6=very poor	1	2	2.6	6	10
Profit	Farmer’s own assessment of the profitability of the farming activity in 2013. Six point Likert scale: 1=very good...6=very poor	1	3	3.5	6	10
Return	Mean estimated return (€ ha^{-1}) for horticultural production during 2008–2013	254	9426	11171	45185	26
Change in return	Estimated mean annual change in return (€ ha^{-1} yr^{-1}) over the years 2004–2013	-10570	312	586	14255	30

[1] The individual actions were: improving quality of agricultural product, systematic crop rotation, increasing follow-up of market situation, knowledge of yield and production costs, fertilizing based precisely on the needs of plants, crop protection precisely based on the needs of plants, investing in fundamental improvements of the fields (draining, liming, etc.).

[2] Ten specifically defined options as follows: exceeding the minimum measures required for environmental support, organic production agreement, other specific environmental support agreements, conducting nutrient balance calculations, treatment of manure to improve its nutrition value, replacement of fossil fuels with renewable energy sources (incl. woodchips, geothermal heat), green electricity agreement, utilization of heat or gases created in animal production, farm energy program (energy conservation) and non-production enhancements for the environment, inl. establishing wetlands or traditional rural biotopes.

Data analysis

We used a farm level empirical approach. Predictive models of the interest in converting to organic production were derived using logistic regression, which is a standard tool for statistical analysis of binary response variables (McCullagh and Nelder 1989).The logistic model assigns probability of interest, p, to each value combination of the predictor variables x_i. Because the main aim was to identify significant predictors, a simplifying assumption of no interactions between the predictors was made. Then the model form is

$$\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = \eta = \alpha + \beta_1(x_1) + \beta_2(x_2) + \cdots + \beta_m(x_m),$$

where m is the number of predictors included in the model, $\beta_i(x_i) = \beta_i x_i$, if x_i is a continuous predictor, and , if

x_i is a categorical predictor with classes coded as 0, 1, … , k_i. The model is identifiable, for example, with constraints $\beta_{i0} = 0$ for all categorical predictors x_i. Thus the model parameters estimated from the data are the intercept α, one slope parameter β_i per each continuous predictor, and k_i parameters per each categorical predictor with k_i + 1 classes.

We aimed at a parsimonious model with as few parameters as possible by (i) treating predictors as continuous (linear) whenever reasonable, (ii) categorizing continuous predictors into two or three classes, when linearity was not a feasible assumption, (iii) combining classes of categorical predictors with large k_i, and (iv) implementing a variable selection procedure resulting in a well-performing set of statistically significant predictors. Steps (i)–(iii) were based on preliminary univariate logistic models and classification trees, where each potential predictor in turn was considered in isolation, without including any other predictors in the model.

Approximate monotonicity of non-parametric univariate logistic regressions (Hastie and Tibshirani 1990, Hastie 2016) and relative uniformity of the observed values were used as criteria for treating continuous variables as linear predictors. Ordinal variables with more than 10 classes ("Courses", "Development", "Number of species") were also treated as continuous in the interest of parsimony (step i). Categorization of continuous variables (ii) and re-classification of categorical variables (iii) was primarily based on the results of univariate classification trees (Breiman et al. 1984, Ripley 2016), and on the amount of overlap of the 95% confidence intervals (CI) of p between neighboring classes in the univariate logistic models. The CI of p was approximated by the inverse logit transformation of $\hat{\eta} \pm 1.96 \times s.e.(\hat{\eta})$.

In step iv, backward elimination (iv) was implemented starting from the full model including all potential (partly re-classified) predictors. In each step of the first phase, removal of each of the remaining predictors was tested and the one leading to greatest drop in AIC was implemented, until the current model had smaller AIC than any reduced model. Remaining non-significant predictors were subsequently eliminated starting from the least significant until all remaining predictors were significant. Finally, addition of each of the previously dropped predictor to the reduced model was attempted, and accepted, if all predictors remained significant.

The final model obtained as a result of the variable selection procedure contains the set of variables that led to best predictions of the interest in converting to organic production. Since many predictors are associated with each other, influential variables may well be excluded from the final model. Therefore we also report the univariate logistic models, which assess the explanatory power of each variable alone.

All model fits were based on weighted maximum likelihood. The weights, provided as a part of the TNS Gallup survey data, were designed to correct the distribution of the received responses to represent active farms in Finland with respect to region (ELY Center), main type of production and arable land area. The analyses were performed using the glm function in the R environment (R Core Team 2017).

Results

Among the 343 current conventional horticultural producers included in the TNS Gallup survey data, 12.1% (95% CI 9.6% to 15.2%) were interested in converting to organic production.

The final predictive model obtained as a result of classification tree analysis followed by stepwise variable selection had seven statistically significant predictors (Table S1). The selected predictors were all either originally binary or aggregated to two or three classes during the preliminary analysis described in detail in the Supplement.

According to the final model, the interest in organic production was twice as large among farmers who had "Other income" sources in addition to agriculture compared to those who didn't (Table 2). Similar difference was found between farms with "Hired labor" and those without. In terms of the effort into growing new crops ("New plants"), the most distinct difference was found between those farmers with level of engagement between 3 and 5 in Likert scale and those with a smaller level. The group of 31 farmers, who had not participated in education or consultation ("Courses") during recent years, were particularly uninterested in organic production.

In terms of the area of agricultural production ("Size"), the clearest division found in the classification tree analysis was at 20 ha, slightly below the median size. The estimated probability interest in organic production in farms above that size was only 22% of that in the smaller farms. Farmers with the greatest interest in organic production were those 26 with the “Proportion of horticulture” below 0.18. One further group of particularly interested farmers was found as those with an intermediate “Return” of horticultural production between 10000 and 13000 € ha^{-1}.

Table 2. Rate ratios (“relative risks”) of the probability of interest in organic production according to the final model resulting from stepwise selection

Variable	Category	Rate Ratio	95 % confidence interval Lower	Upper
Courses	0 (Ref.)	1	1	1
	1 -	5.72	1.79	8.66
Other income	No (Ref.)	1	1	1
	Yes	1.99	1.02	3.68
Hired labor	No (Ref.)	1	1	1
	Yes	1.94	1.06	3.34
New plants	1 - 2 (Ref.)	1	1	1
	3 - 5	3.00	1.82	4.48
Return	- 10,000 (Ref.)	1	1	1
	10,000 - 13,000	3.49	1.92	5.40
	13,000 -	0.42	0.12	1.06
Size	- 20 (Ref.)	1	1	1
	20 -	0.22	0.08	0.53
Proportion of horticulture	- 0.18 (Ref.)	1	1	1
	0.18 -	0.07	0.02	0.29

When analyzing each predictor separately, we found that six of the seven individually significant predictors were also included in the final model (Table 3). The exclusion of variable “Environmental measures”, aggregated in the preliminary analysis to two classes ‘none’, ‘one or more’, indicates that it is highly associated with the other predictors included in the final model.

Table 3. Statistical significance of each predictor in logistic models including only one predictor

Predictor	Significance
Other income	0.028
Hired labor	0.099
Age	0.061
Development	0.081
Environmental measures	0.004
New plants	0.000
Number of species	0.407
Size	0.006
Proportion of horticulture	0.015
Courses	0.012
Coping	0.095
Profit	0.434
Return	0.000
Change in return	0.198

Discussion

This study identified predictors for horticulture farmers’ interest to change from conventional to organic production in Finland. Such information could guide policy efforts aiming to increase organic production to cover 20% of agriculture land area by 2020 (Ministry of Agriculture and Forestry 2014). The results indicate 12.1% of conventional horticulture farmers were interested in converting to organic production. Small farm size, horticulture being a minor part of the enterprise, intermediate estimated yields, greater emphasis on growing new crops, hired labor, other income sources in addition to agriculture and participation in courses were significant predictors of the intention to switch to organic production in multivariable regression modeling.

Earlier studies suggest that adoption of organic farming methods is more likely among younger horticulture producers (Burton et al. 1999, Kallas et al. 2010). Our analysis found no significant differences between age groups for the interest to change to organic production.

Other income outside of farming increased the interest to change to organic production, which is in accordance with results of Kallas et al. (2010). Organic horticulture production faces production and market risks, and seeking other income outside farming is one risk management strategy.

Kallas et al. (2010) and Anderson et al. (2005) reported that diversified production is more common among farms that are likely to adopt organic production. Our analysis found no statistical difference using the variable “Number of species”. Descriptive statistics show that most potential organic farms grow only few crop species, but the number of cultivated horticulture species varied from one to twenty seven.

Cranfield et al. (2010) found that worker health and safety concerns and environmental issues are more important motivators for converting than economic motives. Karali et al. (2014) also reported on the importance of health effects in farmers’ decision process, physical strain in particular. According to Karali et al. (2014) farmers in good health are more willing to adopt more physically demanding but less intensive farming methods, like organic farming. In our data, farmers’ self-reported coping with workload had no significant connection with their interest in changing to organic production. Evidence of the effects of organic farming on occupational health of farmers and farm workers is limited. Cross et al. (2008) compared migrant farm workers’ self-reported health in conventional and organic horticultural systems using four different methods. One of these methods, short depression and happiness scale, indicated that workers on organic farms were happier and had better health. Mzoughi (2014) reported that organic farmers express higher levels of life satisfaction compared to conventional farmers. Costa el al. (2014) found some evidence that production method may have an effect on the health status of agriculture workers. Given the limited evidence, the association of health and safety and production methods should be addressed in further studies.

Tendencies to improve farm practices were measured with three variables: “Development”, “New plants” and “Courses”. Two out of them (“New plants” and “Courses”) were significant predictors in the final multivariable model. Seeking knowledge through courses and advisory services and keeping an open mind to try new plants are associated with readiness to consider organic production as well. The third activity variable “Development” did not predict the adoption of organic farming.

Environmental issues are common motivators for adoption of organic farming methods (Knowler and Bradshaw 2007, Cranfield et al. 2010, Kallas et al. 2010, Läpple 2010). Our results confirm this as the variable “Environmental measures” was a significant predictor. However, it was not selected into the final model because it was highly associated with the other predictors.

Like in earlier studies among horticulture producers (Burton et al. 1999, Kallas et al. 2010), small farm size predicted the interest to convert to organic production. Moreover, low share of horticulture production (out of total land area), and intermediate estimated returns were also linked to higher interest. These farms may offer some potential to increase organic horticulture. Horticulture farms with large areas and high returns using current production practices are not interested in switching over to organic production, as also reported by others (Pietola and Lansink 2001). These findings offer only limited help to policy makers. The 20% goal for organic horticulture by 2020 is difficult to reach with farm groups identified to have interest in adopting organic production. On average farmers with interest to change had 3.9 ha in conventional horticulture production and those who were not interested had 6,7 ha. The other potential source to increase organic horticulture is existing organic farms. Our study excluded those farms, and further studies should explore their potential to expand their organic production.

Small farms have difficulties to find marketing channels for their products. However, farmers have found that organic production is a strength in local markets (Rikkonen et al. 2017), and it may be one reason why small horticulture farms are interested in converting to organic. Supporting these efforts by developing online trading centers for direct marketing from farmers to consumers, catering and other local processors could help create better chances for small organic producers. Demands for new strategies also creates challenges for research and extension services (Ondersteijn et al. 2003). In addition to advising on production, they should help new organic farmers with business models, product processing and marketing to improve profitability. Subsidies typically represent a small share of the total revenue of a horticulture farm; earnings come mostly from markets.

The clear majority of Finnish horticulture farms are privately owned family farms. Horticulture production is labor intensive, and the proportion of horticulture is often a minor part of the farm production, overall. Increasing horticulture production and changing to organic methods could create the need to hire labor. Hiring the first employee is both laborious and also an economic risk. Changing to organic production could be easier for farmers who already have hired labor. According to our final model, having hired labor was linked to the interest to adopt organic farming methods. Concrete support in recruiting, training new workers (who are usually foreign), education about employer duties and measures to manage work productivity could remove or lower barriers for hiring.

Our study has some limitations. Because we used secondary data in the analysis, we were limited to those variables included in the original questionnaire and administrative databases. More specific questions concerning education, work ability and stressors could be of interest in future studies. Species specific production volumes were not available for all species in years 2004–2007. Therefore the “Return” variable was computed from 2008–2013 production data, and “Change in return” could not be computed in an optimal way. Several predictor variables had a considerable number of missing values (up to 30 for the “Change in return”). Therefore the full model is based on a smaller number of farms than most of the univariate models.

Conclusions

Results of this study suggest that the current potential to increase organic horticulture area in Finland is limited. Potential comes from small part-time farms, which mainly cultivate others than horticulture crops, and are actively seeking new crops and knowledge. These farmers actively participate in courses and /or use consultation services. That means they can be reached by advisory organizations to inform and promote possibilities to expand organic horticulture area. Further expansion may also come from existing organic farms that expand their organic production area.

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Supplemental

Logistic regression models predicting the interest in converting to organic production were fitted after pre-processing the original explanatory variables with the aim of reducing the number of estimated parameters to a reasonable level in comparison to the number of observations. Parsimonius models with a small number of parameters are obtained with predictors that are either continuous and linear or categorical with a small number of classes.

Among the variables that were either originally continuous or treated as such because of the large number of ordinal classes, *Age* and *Development* had a relatively even distribution and monotonous relationship to the interest in converting (Fig. S1). These two variables were thus entered into models as continuous linear predictors. Furthermore, the two binary predictors, *Hired labor* and *Other income* (Fig. S2), naturally needed no pre-processing, either.

The remaining continuous variables had either a remarkably uneven distribution, or non-monotonous relationship with interest, or both (Fig. S3eg, S4ag, S5ad), and were therefore aggregated into categorical predictors.

Univariate classification tree resulted in a single split for four potential predictors (Fig. S3). They were aggregated to two classes according to that split. Those four predictors, for which no splits were found in the classification tree analysis, were aggregated into two classes with a natural interpretation (Fig. S4; labels explaining the "natural interpretation" in the right-hand column). Of the three or more splits obtained for two continuous predictors (Fig. S5), one or two most promising ones were subjectively chosen on the basis of the differences between the classes in the whole tree (Fig. S5be).

Table S1. Analysis-of-variance table for the final model resulting from stepwise selection with type-II likelihood-ratio (LR) tests of significance of each predictor given that all others are included

	LR Chisq	Df	Pr(>Chisq)
Courses	8.555	1	0.003
Other income	4.032	1	0.045
Labor	4.531	1	0.033
New plants	15.713	1	0.000
Yield, € $ha^{-1}yr^{-1}$	22.490	2	0.000
Size, ha	13.320	1	0.000
Proportion of horticulture	14.546	1	0.000

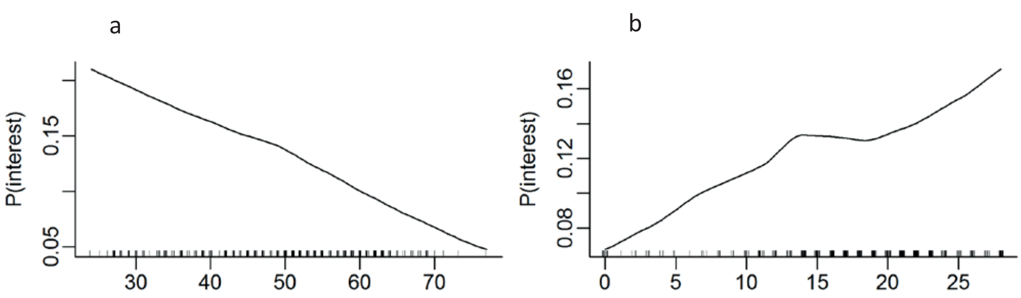

Fig. S1. Univariate non-parametric logistic regression model for the probability of interest in organic production with a) age of farmer (*Age*) and b) effort in developing the crop farming (*Development*) as explanatory variable. The tick-marks above the x-axis show the distribution of the explanatory variable.

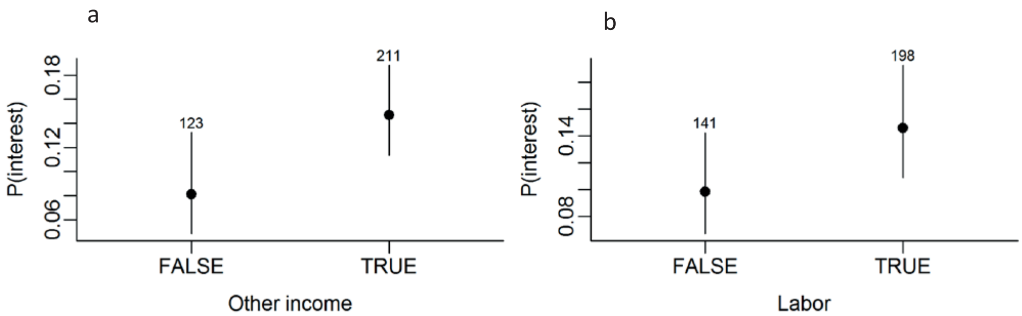

Fig. S2. Probability of interest in organic production with 95% confidence interval for farmers with and without other sources of income (a) and for those using or not using hired labor, and the number of farmers in each class

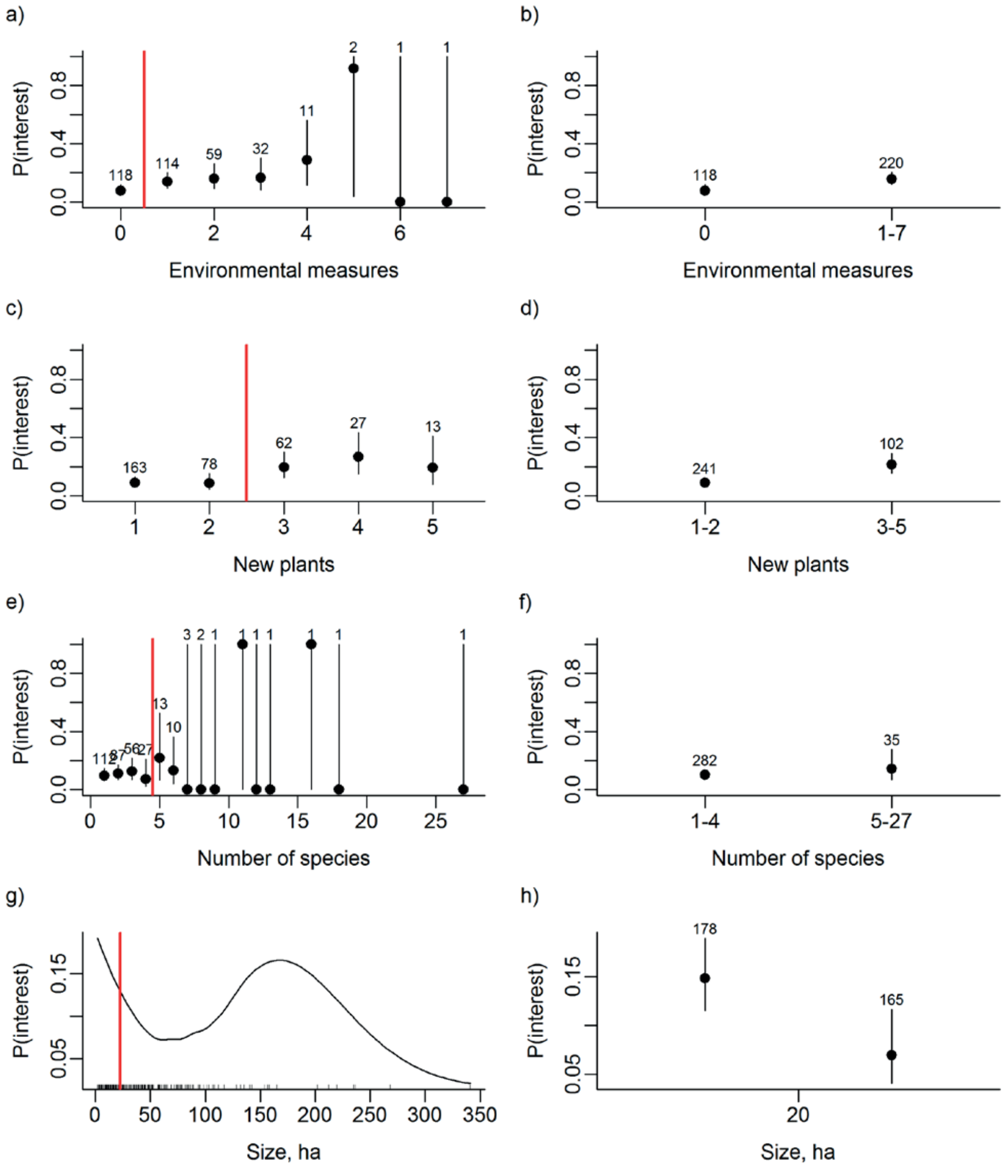

Fig. S3. Probability of interest in organic production as a function of those explanatory variables, which were aggregated directly according to the classification tree. The left hand panel shows the models using the original variables and the right hand panel those using the aggregated variables.

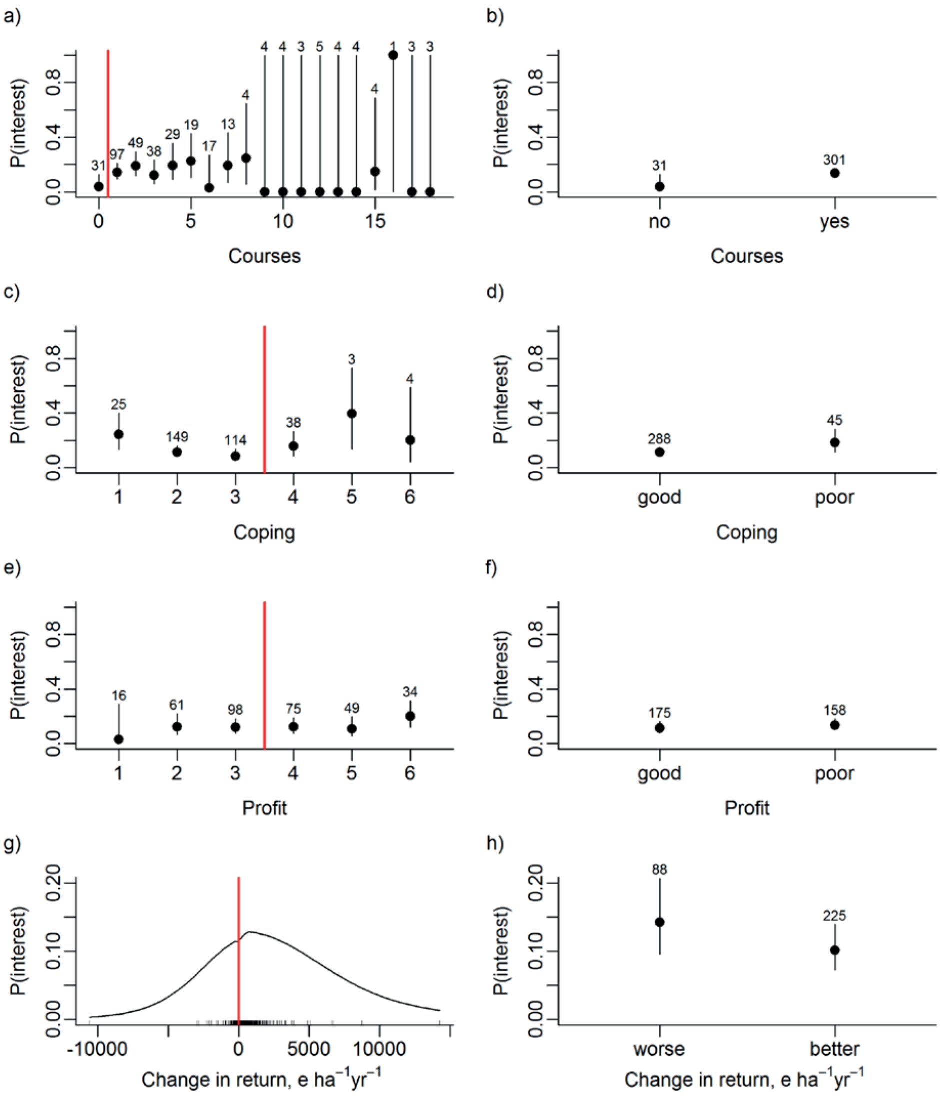

Fig. S4. Probability of interest in organic production as a function of those explanatory variables, which had to be aggregated subjectively.

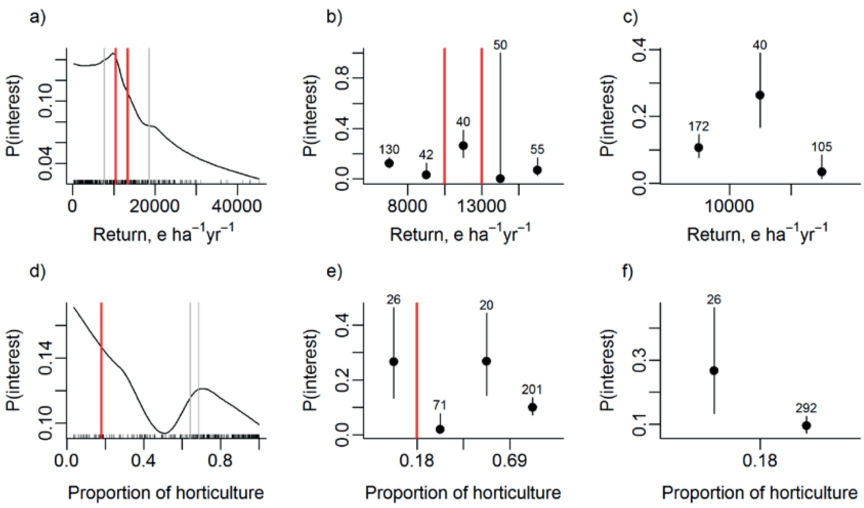

Fig. S5. Probability of interest in organic production as a function of those explanatory variables, which were aggregated using splits (red lines in left and middle panel) chosen subjectively from those suggested by the classification tree (all lines in left panel).