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Research article

Factors fostering and hindering farmers' intention to adopt organic agriculture in the Pesaro-Urbino province (Italy)

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Abstract: Current global problems such as the loss of soil fertility and biodiversity and the growth of the world's population for which health and food sovereignty must be guaranteed, make it clear that it will be essential to spread innovations to increase not only productivity but also the quality of production in order to meet these challenges. However, this will not be enough if profound changes are not made in all systems and more sustainable food systems are not built. Organic agriculture is widely considered a more sustainable production system. However, despite the growing attention of consumers towards organic products and the increase in the area devoted to organic farming in recent years, its growth is not homogeneous among and within countries. Therefore, in this work, we investigate the main drivers and barriers to adopting organic farming, first analysing the literature and then administering a questionnaire to a sample of 202 conventional farmers in the Pesaro-Urbino province (Italy). The survey data show that the adoption of organic farming is fostered by the farmer's attitude towards this production method's social and environmental sustainability. The main hindering factors are the farmer's personal characteristics, such as old age, lower education level, perception of bureaucracy, and the farm's inadequacy of technical structures.

Keywords: organic agriculture; farm conversion; farmers' attitudes; Italy; ordered logit regression

1. Introduction

Organic agriculture is considered the most sustainable alternative to industrial agriculture due to

the many positive externalities associated with implementing innovative production processes [1]. This particular production farming system [2] includes, for example: restoration and protection of biodiversity [3–6]; maintenance of soil fertility [7–9] and higher water holding capacity [10]; reduction of greenhouse gas emissions [11–13]; human health protection [1,14]. The positive effects of organic farming on the environment, especially concerning the level of agroecosystem services provided by functional biodiversity [15], are amplified by a greater territorial concentration of production activities, which makes particularly significant actions aimed at the dissemination of this production model in a given area [16,17].

On the other hand, the quality of organic food is particularly appreciated by postmodern consumers, who are demonstrating growing attention to the healthy dimension of food [18,19], whose demand has steadily increased in recent years, especially (but not only) in the most developed countries, rising from 15.1 billion in 2000 to 96.7 in 2018, with annual growth rates that show no sign of slowing down [20].

The success of this type of agriculture also depends on the support received at a regulatory and political level. In Europe, for example, since the 1990s, organic farming has been supported by the Common Agricultural Policy [21] and, subsequently, by the Rural Development Regulations approved over the years. More recently, in the framework of the European Green Deal, the Farm to Fork strategy [22], among the various actions to achieve the goal of a resilient and sustainable food system in an environmental, social and economic sense, sets the goal of at least 25% of the agricultural area of the EU invested in organic farming to be reached by 2030. This recognition of the potential of these models [23] is important, but it requires the identification of factors that can facilitate the transition from industrial to organic farming.

Several studies [24–28] highlight that the adoption of this innovation is conditioned by multiple, sometimes interconnected, elements, including the personal characteristics of the farmer and his family (the psycho-behavioural, psychosocial factors and ethical reasons), the level of skills of the entrepreneur and the supportive factors (for example, training, information acquisition or membership of association) essential for reorganising productive and commercial activities, and the farming factors and perception of the economic and political/regulatory environment.

Our study will contribute to this strand of the literature, assessing the impact of decisive factors on organic farmers' intentions to convert to organic farming in the Marche region and, more specifically, in the province of Pesaro-Urbino.

The Marche region represents an interesting case because it is a 'zipper region', with a central position between Northern and Southern Italy, both in geographical terms and in terms of general economic and social conditions [29]. At the same time, it is one of the Italian regions with the greatest share of agricultural surface destined for organic farming (22.2%, in 2019). The Pesaro-Urbino province, where about 25% of farms with certified organic crops and livestock of the regional total are located (https://siar.regione.marche.it/web/public/ConsultazioneAlboBio.aspx), is characterised by the presence of pioneer farms and some supply chain in organic production. This territory is therefore configured as an area particularly suitable for the creation of programs aimed at strengthening organic agriculture, such as organic districts [30] or Area Agri-environmental Agreements[1] [31].

[1] These Agreements, financed by PSR of Marche region, have the purpose of aggregating and coordinating a set of public and private subjects of a particular territory, in order to face a specific environmental problem, for example water protection, through the undertaking of specific commitments especially by organic farmers.

To support this process, we aim to investigate the factors that may encourage (or discourage) farmers' choice of the organic farming system. The study was developed through a participatory approach, organising focus groups with experts, policymakers, and local stakeholders, to collect data and discuss the results obtained.

Through a farmers' survey and the econometric analysis of survey data, we analysed the relationships between the farmer's choice to adopt or not to adopt organic farming and a set of personal, professional and contextual factors.

The paper is structured as follows. Section 1 presents the main conceptual arguments proposed in the literature to explain the conversion process to organic farming. Section 2 illustrates the quantitative investigation adopted, particularly the choice and definition of the statistical analysis model and data collection. The results of the estimation procedures are reported and discussed in Section 3, whereas Section 4 presents some implications of the analysis carried out for stakeholders and policy makers and, at the same time, provides some directions for further research.

2. Conversion to organic farming: Drivers and obstacles

Since the early 1990s, the organic sector has steadily grown worldwide, both in surface area and the number of producers, from 11 million hectares certified as organic in 1999 to 71.5 million hectares in 2018, and reached almost 2.8 million producers [20,32]. Europe, in particular, is one of the continents with the largest share of agricultural land devoted to organic (8.5%, in 2019, with a growth rate of 38% over the last 10 years) [33]. The positive supply trend is certainly driven by the growth in demand and exports, especially to developed countries [34], where there is a strong increase in organic food consumers [35]. In fact, in recent years, the increasing attention towards the issue of environmental protection and food safety [26,36] has led to greater demands for organic foods, which are considered healthier, tastier, and obtained through more sustainable production processes than conventional foods [18,37,38].

In addition to excellent market prospects, several other factors may influence the choice of agricultural entrepreneurs to convert to the organic method, as highlighted by a vast body of literature.

In general, in the initial phase of the development of this sector, entrepreneurs were driven by ethical motivations rather than economic reasons [32]: organic farming, in fact, was considered a valid alternative to intensive production systems, able to ensure the preservation of the quality of natural resources and the ecosystem [26].

Over the years, several studies have reported the importance of other variables in the choice of production method, starting from personal characteristics. These include, for example, gender, age, and educational qualifications. In some articles, the farmers most likely to convert to organic would be mainly women [39], younger age individuals [28,40–42] and with a medium-high education level [25,26,35,43]; in other studies, however, older and more experienced farmers have been found to have a more favourable attitude towards this production system [44–47].

Organic certification adoption can be driven by farmers' values and lifestyle, especially in terms of environmental attention or awareness about the impact of production activities on natural resources [32,39,48–52] and human health [14,25–27].

In addition to social motivations, farm characteristics are also relevant for switching to this production method [25], although different studies show quite differentiated results. In fact, some

analyses emphasise that large companies are less likely to convert, as they usually use more intensive production methods than small to medium-sized companies [53–55]. Other research shows, however, that large firms are more likely to make this shift because they have greater financial resources and have the ability to overcome one of the biggest barriers to business transformation, namely access to technical assistance, contracting, and production planning services [46,56,57].

Shifting to more sustainable models would involve radical changes [27], which are not particularly smooth for individuals, such as farmers, who are risk averse [35,51,57–59].

Among the most important motivations to convert to organic farming, economic ones should certainly be considered, especially the provision of public incentives to adopt this production model [25,26,32,39,51,56]. In the European Union, for example, the development in the 1990s was supported by the definition of the regulatory framework on organic farming (starting with Regulation (EC) 2092/1991) and the introduction of incentives for low environmental impact techniques, initially with Regulation (EC) 2078/1992 and, later, with the introduction of agri-environmental payments [60].

Subsequently, with the reform of the Common Agricultural Policy 2014–2020, new rules for agricultural entrepreneurs were defined, such as the maintenance of ecological focus areas and sustainability as fundamental requirements to meet consumer expectations and create a competitive advantage [51].

Moreover, after switching from conventional to organic farming, farmers report higher productivity and earnings, given the higher price level [26,28,32,61].

The problems that hinder this process must also be considered, together with the motivations that may favour a farmer's conversion to organic. These include problems related to the availability of inputs, the difficulties of switching from conventional to organic, including those related to the bureaucratic aspects and the management of the certification system [32,35,46,49], and the lack of competent technical support [62].

An additional constraint on conversion to organic is uncertainty about the market and commercial outlets [25,32,35,46]. However, the greatest concern appears to be related to the fear of achieving lower production yields [25,35,39,48,51] and the presence of a higher workload than that required by industrial agriculture, resulting in higher production costs [25,26,35,46]. Moreover, another aspect that can hinder the conversion to organic farming is the absence of local origin labels, which is also related to ethnocentrism [63].

In addition to the obstacles related to higher production costs, problems related to the insufficiency of public measures to support this production system are also highlighted, in terms of contributions, advertising and food education to consumers [52,64], but especially the need for greater support for the acquisition of new knowledge and technologies [25].

3. Material and methods

This study's main variable of interest is the respondent's "Intention to adopt organic agriculture" on the farm. This variable is measured using a single-item scale, which results in an ordinal variable with three levels: N—I have no intention, U—I am uncertain, Y—I will adopt organic agriculture.

The frequency of responses will allow us to evaluate the share of conventional farmers interested or considering the possibility of starting the conversion process to become organic farmers.

Through the literature analysis, the framework of the multiple factors that can facilitate or

hinder the transition from conventional to organic agriculture has been defined. These factors are essentially related to drivers, obstacles, farm characteristics, and personal characteristics of the farmers.

The different types of drivers can be broken down into economic, socio-cultural, and environmental, while the obstacles can be divided into economic-organisational, and socio-cultural.

In addition to these, we consider the characteristics of the company and the level of satisfaction with the farm management results obtained. Finally, the personal characteristics of the farmer, such as gender, age, educational qualification, role on the farm, time spent on the farm, the municipality in which the farm is located.

In order to confirm or reject the relevance of these factors in orienting the behavior of entrepreneurs in the territory under consideration, we carried out a multivariate regression analysis. Given the nature of the dependent variable, the ordered logit regression approach was adopted [65]. This approach allows modeling the probability of an ordinal set of outcomes Pr(Z_i) based on the values of the predictors X, as in the equation (1).

$$\Pr(Z_i) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]} \tag{1}$$

This analysis makes it possible to relate, with a normal distribution of errors, the polychotomous ordinal dependent variable, which in the specific case is represented by the possible choices of the entrepreneur with respect to conversion to organic farming (No, Undecided, Yes) to the various independent variables: i) drivers (Driv); ii) obstacles (Obst); iii) farm characteristics (AgriB); iv) personal characteristics (Prof).

$$\Pr(Intention = No|Driv, Obst, AgriB, Prof) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]}$$

$$\Pr(Intention = Undecided|Driv, Obst, AgriB, Prof) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]}$$

$$\Pr(Intention = Yes|Driv, Obst, AgriB, Prof) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]} \tag{2}$$

Where:

$$X'\beta = \Sigma_{j=1}{}^{k} Driv\beta_j + \Sigma_{p=1}{}^{q} Obst\beta_p + \Sigma_{i=1}{}^{n} AgriB\beta_i + \Sigma_{m=1}{}^{d} Prof\beta_m$$

Data collection is carried out through the administration of a questionnaire. This questionnaire has been defined based on the examined literature and of a series of comparisons with different privileged witnesses, among which professors of the Department of agri-food sciences and technologies of the Alma Mater Studiorum University of Bologna and the Department of Economics, Society, Politics of the University of Urbino Carlo Bo, agricultural entrepreneurs, business consultants and managers of some producers' organisations.

The questionnaire is divided into four sections, aimed at collecting a wide range of qualitative and quantitative information about drivers, obstacles, farm characteristics and personal characteristics of the entrepreneur interviewed. The key question was the propensity to undertake or not to undertake the process of farm conversion to organic agriculture. The drives we identified are

the most often cited as key aspects for conversion in the literature [25–27,32,39]. Variables such as the company's small size, the lack of professionalism within the company for bureaucratic management, the higher costs linked to the certification process are the most commonly found obstacles to conversion [25,32,35]. Other aspects emerging from the literature have been included in the questionnaire, such as age and education since younger farmers with higher education levels are more inclined to convert [25,28,35].

Initially, the questionnaire was tested with a pre-test on 50 companies, above all, to verify the comprehensibility of the questions.

The variables obtained from the questionnaire are reported in Table 1.

Table 1. Independent variables (drivers, obstacles, farm characteristics and respondent profile).

	Drivers
DRIV_01	Organic crops allow for a higher income
DRIV_02	Organic allows you to receive more public incentives
DRIV_03	Organic is a tool to differentiate productions from competitors
DRIV_04	Organic farming reflects my philosophy of life
DRIV_05	Applying organic farming requires resourcefulness
DRIV_06	Organic is a production method highly respectful of the environment and animals
DRIV_07	Organic farming provides consumers with safer, healthier foods
DRIV_08	The application of the organic method protects my health and that of other agricultural operators
DRIV_09	Organic farming allows for better products
DRIV_10	My area is suitable for organic farming
DRIV_11	My family members are in favour of adopting organic farming
DRIV_12	The presence of an organic certification mark valid throughout Europe offers high guarantees
DRIV_13	The demand for organic products is continuously growing
DRIV_14	Organic products can be more easily placed on the market than conventional ones
DRIV_15	In the organic sector, there are opportunities arising from the creation of forms of integration (cooperatives, consortia, supply chains)
	Obstacles
OBST_01	Organic production costs are too high
OBST_02	The training required for organic is excessive
OBST_03	The organic sector needs to be sustained with more public funding
OBST_04	Costs (also of transport) of organic fertilisers are too expensive
OBST_05	Finding organic raw materials (such as seeds) is very difficult
OBST_06	My financial resources are not sufficient to undertake organic farming
OBST_07	The administrative requirements needed to undertake organic farming are difficult to manage
OBST_08	The technical-agronomic application of organic regulations is difficult
OBST_09	Controls for organic certification are too strict
OBST_10	I do not have the technical facilities and farm size to undertake organic farming
OBST_11	It is possible to efficiently adopt the organic regime only if neighbouring farmers also adhere to it
OBST_12	In the organic sector, it is difficult to create partnerships with other producers

Continued on the next page

	Obstacles
OBST_13	Selling prices of organic products are excessively high
OBST_14	The organic system does not allow a sufficiently wide range of products to be offered
OBST_15	The commercial channels able to enhance the value of organic products are too limited
OBST_16	In the organic sector, the lack of a national brand is strongly perceived
OBST_17	In the organic sector, the lack of a regional brand is strongly perceived
OBST_18	My fellow farmers make negative comments about organic farming
OBST_19	Organic conditions will worsen in the future
	Farm characteristics
AGRIB_01	Farm size (ha divided in classes: ">100"; "50-99,99"; "20-49,99"; "10-19,99"; "5-9,99"; "2-4,99"; "1-1,99"; "<1")
	Respondent profile
PROF_01	Gender (Man or Woman)
PROF_02	Age (Years)
PROF_07	Educational Qualification (UD = University Degree; HSD = High School Diploma; SS = Secondary School; ES = Elementary School)

Source: Survey questionnaire.

For the drivers and obstacles variables, a 5-point Likert scale was used, in which the response was coded with 1 = Totally Disagree, 2 = Partially Disagree, 3 = Neither, 4 = Partially Agree, and 5 = Totally Agree.

Before reaching the definition and estimation of the final model, monovariate analysis was performed to describe the individual variables considered. In order to understand the influence of these variables on the dependent, for purely exploratory purposes, a bivariate analysis was carried out among all the variables belonging to the four categories considered and the outcome variable Intention. After that, for the variables belonging to the Drivers and Obstacles categories, an *Explanatory Factor Analysis* was carried out in order to aggregate the variables that express a common concept. A correlation analysis with the Kendall method was carried out for personal characteristics variables. This aggregation will be conducted, within the identified categories, with arithmetic mean in cases with a reduced number of variables, and with the *Principal Components Analysis* (PCA) technique, in those with a high number of variables.

The R software [66] and the packages 'polycor' [67], 'MASS' [68], 'readxl' [69], 'psych' [70] and 'catspec' [71] were used to process and analyse the data.

Data collection was carried out through interviews with farmers who run conventional farms and are active in the territory of the Province of Pesaro-Urbino, selected through a non-probabilistic sampling procedure. Convenience sampling was carried out by inviting farmers belonging to the main producer organisations active in the territory (Confederazione Italiana Agricoltori and Coldiretti) to face-to-face interviews at their headquarters or on their farms, or participants in public events (seminars, conferences) held in various municipalities of the province. In order to reduce the unreliability of inference concerning quantitative information, especially regarding the response on the intention to convert to organic farming, entrepreneurs were informed that the interviews were carried out as part of a research project of the Department of Economics, Society, Politics of the University of Urbino, without specifying the objective.

The administration took place during the period October 2018–January 2019. A total of 202

entrepreneurs were interviewed, representing 2.4% of the reference population [72], whose company location falls in 40 municipalities out of 54 in the Province of Pesaro-Urbino. In the assumption of a random sample, this sample size would imply a power of 7.1% considering a binomial variable at a 33% expected proportion and a confidence level (α) of 0.05.

4. Results and discussion

4.1. The propensity of entrepreneurs to convert to organic farming

The survey data allowed us to analyse the four categories of variables that explain the farmer's decision.

The descriptive statistics of the single independent variables were highlighted with the monovariate analysis. The results are reported in Supplementary Tables 1–4.

The data collected are in line with the demographic characteristics of the European and Italian agricultural production structure [33,73], especially concerning the low presence of young entrepreneurs (10%), with a median age of our sample equal to 54 years (i.e. under 40 years of age, according to the indications of ISTAT and the Agricultural Accounting Information Network).

In terms of educational level, 40% of respondents have a university degree (82 respondents), 8% have a high school diploma (17 respondents), 9% have a middle school diploma (18 respondents), and the remaining 42% have a primary school diploma (85 respondents). The majority of farmers, about 77%, work full-time in agriculture. In addition, in 54% of cases, it was found that at least one other member of the household works on the same farm. In other words, there is a clear prevalence of family management. Finally, most farmers are men (90%), and women represent only 10% of the sample.

"Intention" is an ordinal dependent variable, measuring the propensity to adopt the organic production system, with three levels (NO, UNDECIDED, and YES). Figure 1 shows the number of responses in the sample.

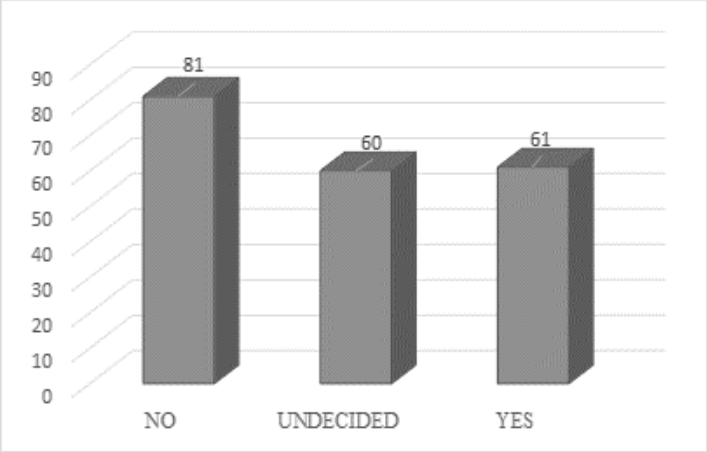

Figure 1. Intention to convert to organic agriculture.

An ordered logistic regression model (Ordered Logit) was estimated to identify the factors that most influence the propensity to convert to organic farming. In equation (3), reformulating (2), the predictors (i.e., the independent variables) are fifteen different motivations and nineteen issues that

may or may not have driven farmers to convert, one farm characteristic (farm size), and three personal respondent's characteristics (gender, age, and education level).

$$Pr\left(Intention = No \middle| Driv_j, Obst_p, AgriB_i, Prof_m\right) = \frac{exp\left(X'\beta\right)}{[1+exp\left(X'\beta\right)]}$$

$$Pr\left(Intention = Undecided \middle| Driv_j, Obst_p, AgriB_i, Prof_m\right) = \frac{exp\left(X'\beta\right)}{[1+exp\left(X'\beta\right)]}$$

$$Pr\left(Intention = Yes \middle| Driv_j, Obst_p, AgriB_i, Prof_m\right) = \frac{exp\left(X'\beta\right)}{[1+exp\left(X'\beta\right)]} \quad (3)$$

Where:

$$X'\beta = \beta_0 + \Sigma_{j=1}{}^{15}\beta_j Driv_j + \Sigma_{p=1}{}^{19}\beta_p Obst_p + \beta_{i=1} AgriB_i + \Sigma_{m=1}{}^{3}\beta_m Prof_m$$

Factor analysis, specifically PCA, which allows the extraction of a small number of independent, interpretable factors from a high-dimensional observed dataset with complex structure [74], was used to summarise the variables from the drivers and obstacles reported in Table 2.

Table 2. Synthesis variables.

Synthesis variables	Original variables
Social and environmental sustainability—SocEnvSust	Farmer's philosophy of life (DRIV_04)-Respect for the environment and animal welfare (DRIV_06)-Food safety (DRIV_07)-Health protection (DRIV_08)-Quality of organic products (DRIV_09)-Family members are favourable (DRIV_11)
Technical and bureaucratic requirements—TecBurReq	Bureaucratic compliance (OBST_07)-Technical implementation of legislation (OBST_08)
Inadequate corporate assets—InadCorpAs	Financial resources of the farmer (OBST_06)-Available technical facilities (OBST_10)-Controls for organic certification are too strict (OBST_09)
Local Visibility—LocVis	Absence of national label (OBST_16)-Absence of regional label (OBST_17)
Personal Characteristics—PersChar	Age (PROF_02)-Education qualification (PROF_07)

Source: Analysis of the survey data.

Drivers reflecting a positive attitude towards organic farming were aggregated into a single factor (*SocEnvSust*-Social and environmental sustainability), which had a factor loading greater than 0.6 (see Figure 2). These drivers were related to the farmer's philosophy of life (DRIV_04), the resourcefulness of farmers (DRIV_05), the respect for the environment and animal welfare (DRIV_06), food safety (DRIV_07), health protection (DRIV_08), higher quality of organic products (DRIV_09) and the favour of family members towards this production method (DRIV_11).

Regarding the obstacles, the variables with a factor loading greater than 0.6 (see Figure 3) were aggregated into three summarising factors by averaging them: the perceived difficulties in the management of bureaucratic requirements (OBST_07) and the technical-agronomic application of

the organic regulations necessary to undertake organic farming (OBST_08) were aggregated in the factor *TecBurReq*-Technical and bureaucratic requirements; the second factor *InadCorpAs*-Inadequate corporate assets aggregates the variables on the perceived lack of financial availability possessed by the farmer (OBST_06), absence of technical facilities and adequate company size (OBST_10) and difficulty of complying with the controls for organic certification considered too strict (OBST_09); finally, the lack of a national organic brand (OBST_17) and a regional organic brand (OBST_16), were aggregated in the factor *LocVis*-Local Visibility.

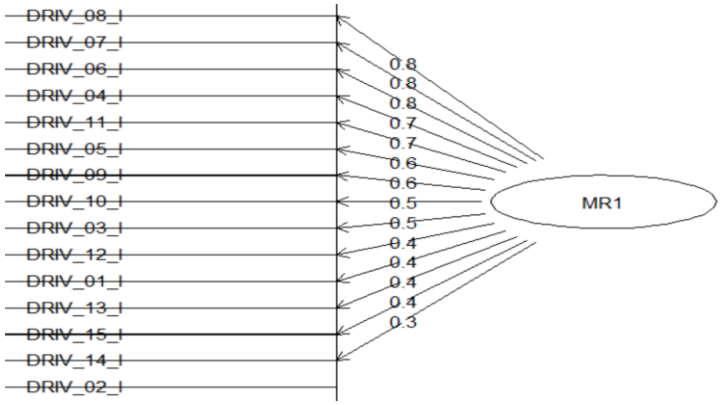

Figure 2. Factor analysis for drivers.

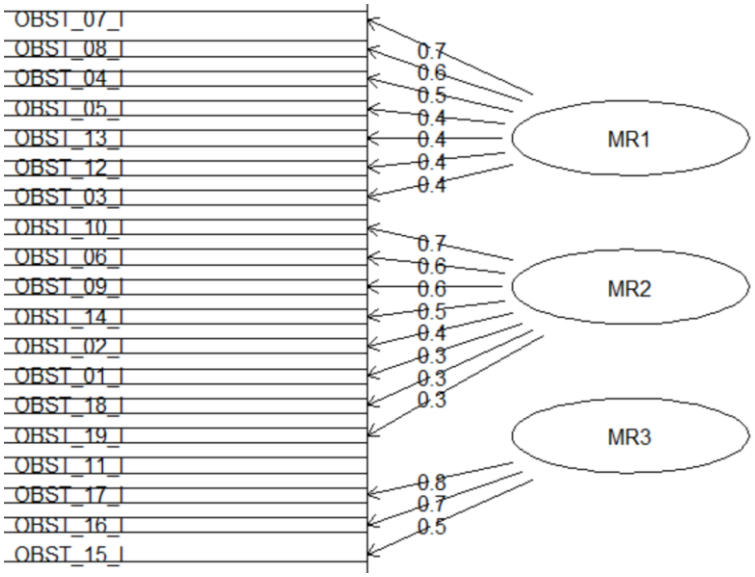

Figure 3. Factor analysis for obstacles.

Regarding the characteristics of the respondent's profile, a "*Kendall correlation*"[2] analysis was carried out between the identified variables to understand the correlation level, and the results are shown in Table 3.

[2] Values with a correlation greater than 20% are considered statistically significant, although those just above this value will be weakly correlated while those above 40-50% will be more so.

Table 3. Correlation between personal characteristics variables.

	PROF_01_l	Age	PROF_07_l
PROF_01_l	1.00	0.11	0.00
Age	0.11	1.00	−0.29
PROF_07_l	0.00	−0.29	1.00

Source: Analysis of the survey data, Kendall's correlation coefficients.

Among the variables of the respondent's personal characteristics, it can be seen that those relating to age (Age) and the educational qualification of farmers (PROF_07) are negatively correlated with a coefficient of −29%. Those belonging to the youngest age groups are, on average, also the most educated and, for this reason, the two variables have been merged, with mean, into a single synthesis variable *PersChar*-Personal Characteristics.

In the final multivariate *order logit* regression model, the new summary variables, *SocEnvSust*, *TecBurReq*, *LocVis*, *InadCorpAs*, *PersChar*, have been included.

The variable company size was not included as the bivariate analysis with Intention did not show it to be statistically significant.

$$\Pr(Intention = No|SocEnvSust, TecBurReq, LocVis, InadCorpAs, PersChar) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]}$$

$$\Pr(Intention = Undecided|SocEnvSust, TecBurReq, LocVis, InadCorpAs, PersChar) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]}$$

$$\Pr(Intention = Yes|SocEnvSust, TecBurReq, LocVis, InadCorpAs, PersChar) = \frac{\exp(X'\beta)}{[1+\exp(X'\beta)]} \quad (4)$$

Where:

$$X'\beta = \beta_0 + \beta_1 SocEnvSust + \beta_2 TecBurReq + \beta_3 LocVis + \beta_4 InadCorpAs + \beta_5 PersChar$$

To assess the significance of the synthesis variables in the final regression model, we used the *Residual Deviance*, the *Akaike Information Criterion* (AIC) and the *t-value*[3] and the signs of the coefficients of the value, allow us to interpret the effect, positive or negative, that each has on the probability of adopting the organic model.

4.2. Discussion of the results

In the estimated model, two variables (*SocEnvSust* and *LocVis*) assume a positive coefficient sign, showing an effect in favour of conversion to organic farming (Table 4).

Social and environmental sustainability is the variable that most influences the likelihood of adopting organic farming. In particular, the greater the farmer's degree of attention to the social and environmental benefits achievable through organic farming, the greater the likelihood that he or she will be inclined to undertake the conversion process to organic farming.

This result, which appears consistent with those reported in other studies [25–27,32,39], is essentially attributable to ethical and environmental motivation, considered to be the most significant

[3] Statistically significant variable when the t-value, in absolute value, is greater than or equal to 1.96 with 95% probability.

driver in orienting the choices of the first generation of organic farmers. In the province of Pesaro-Urbino, in particular, the high significance of this variable can also be explained by the widespread knowledge of the successful experiences of many organic agri-food companies that, for several decades, have successfully combined environmental sustainability with the achievement of high levels of competitiveness at a national and international level [75]. The variable that seems to have a lower level of influence is inherent to local visibility.

Table 4. Multivariate regression results.

	Value	Std. Error	t-value
SocEnvSust	0.73537	0.1625	4.5264
PersChar	−0.35665	0.1400	−2.5471
TecBurReq	−0.18323	0.1444	−1.2688
LocVis	0.02692	0.1399	0.1924
InadCorpAs	−0.18547	0.1433	−1.2942

Source: Analysis of the survey data.

Vice versa, the other three variables (Personal characteristics, Technical and bureaucratic requirements and Inadequate farm assets) have a negative coefficient, highlighting the farmer's tendency to maintain, with greater probability, the conventional production system. In particular, when the variable 'Personal characteristics' (which is highly influential) takes on a higher value, i.e. when the farmer's age increases or when the level of education decreases, the probability that the individual adopts organic farming tends to decrease. For example, when considering two farmers with perfectly equal holdings, the older or less educated farmer is less likely to convert to organic farming than a younger, more educated farmer.

These results are in line with the evidence from the literature review, which points to a higher propensity to convert to organic farming among younger and highly educated farmers [25,28,35]. According to [25,32,35], these aspects, such as the small size of the company, the lack of professionalism within the company for bureaucratic management, the higher costs related also to the certification process are the most marked obstacles to conversion.

5. Conclusions

To satisfy the growing demand for organic food, a substantial increase in the area devoted to this farming system is necessary [76]. Internationally, the value of organic retail sales has grown from 15 billion euros in 2000 to 106 billion euros in 2019, and, in the same period, Europe has gone from 7 billion euros to 45 billion euros, of which 4 billion in Italy [20]. Apparently, the possibility of obtaining more remunerative and less volatile prices, in the face of production costs that are not necessarily higher and of yields that are not always lower than those of industrial agriculture [77–79], are not enough to incentivise conversion to organic farming [16].

This work analysed the motivations and possible obstacles for the conversion process in a specific territory, providing information that could help policymakers identify appropriate support measures [80]. The effectiveness of policy measures is closely related to the knowledge of the factors that influence the propensity of agricultural entrepreneurs to convert to organic farming. Our

study confirms that propensity is strongly related to the individual's characteristics and needs.

Although in areas like the Province of Pesaro-Urbino, organic farming penetration is already quite high compared to other areas and the objectives of Farm to Fork [22], this penetration is not sufficient to reach the territorial scale needed to fully deploy the positive environmental effects of organic farming [2,17]. For companies operating in the local food supply chains, it would be necessary to promote economically sustainable production, distribution, and consumption projects, also favouring consumers' involvement [81,82].

More structured technical assistance could remove some of the identified obstacles in the case we examined. For instance, providing knowledge to young entrepreneurs and technical-organisational support to farmers worried about the bureaucratic burden through innovation transfer agencies or supporting integration and cooperation to improve the farms' quality management systems. These measures would facilitate the transition towards more sustainable production models [35,49] in environmental, social and economic terms, offering development opportunities to small and medium-sized enterprises and the most marginal rural areas.

An open question is whether these conclusions are valid in a context in which the penetration of organic farming is lower or inexistent. It may be reasonable to assume that farmers' attitudes about organic farming may be affected by the information they receive from their peers. Therefore, if the community does not include organic farmers or they are very few, a lack of trust in the information about the potential benefits of this farming system is to be expected. Subjective norms and the surrounding environment is positively correlated with the probability of converting to organic farming for less developed countries in Europe where this production model is still in its early stages [83]. This issue represents a limitation of this research, implying the need to analyse the predictors of organic farming adoption in a low penetration context.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

Conceptualisation E.V., M.C. and S.R.; Literature review F.G., M.C. and S.R.; Qualitative Analysis and Data collection F.G. and S.R.; Methodology M.C. and S.R.; Software M.C. and S.R.; Validation E.V., M.C., F.G. and S.R.; Wrote the paper E.V., M.C. and S.R. All authors contributed to the manuscript revision, read, and approved the submitted and final version.

Supplementary

Supplementary Table 1. Descriptive analysis of independent variables: drivers.

Variable label	Description	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
DRIV_01	Organic crops allow to obtain a higher income	27	40	24	83	28
DRIV_02	Organic allows you to receive more public incentives	3	6	10	56	127
DRIV_03[4]	Organic is a tool to differentiate productions from competitors	9	17	20	76	79
DRIV_04	Organic farming reflects my philosophy of life	17	19	53	43	70
DRIV_05	Applying organic farming requires resourcefulness	16	15	44	56	71
DRIV_06	Organic is a production method highly respectful of the environment and animals	4	13	8	46	131
DRIV_07	Organic farming provides consumers with safer, healthier foods	7	18	6	60	111
DRIV_08	The application of the organic method protects my health and that of other agricultural operators	5	14	6	45	132
DRIV_09	Organic farming allows to make better products	16	23	32	72	59
DRIV_10	My area is suitable for organic farming	16	20	25	51	90
DRIV_11	My family members are in favour of adopting organic farming	22	18	42	51	69
DRIV_12	The presence of an organic certification mark valid throughout Europe offers high guarantees	16	29	43	55	59
DRIV_13	The demand of organic products is steadily growing	4	5	12	60	121

Continued on the next page

[4] One omitted variable.

Variable label	Description	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
DRIV_14	Organic products can be more easily placed on the market than conventional ones	9	25	28	72	68
DRIV_15	In the organic sector, there are opportunities arising from the creation of forms of integration (cooperatives, consortia, supply chains)	6	11	61	68	56

Supplementary Table 2. Descriptive analysis of independent variables: obstacles.

Variable label	Description	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
OBST_01	Organic production costs are too high	26	43	22	64	47
OBST_02	The training required for organic is excessive	24	40	56	45	37
OBST_03	Organic sector needs to be sustained with more public funding	18	21	15	57	91
OBST_04	Costs (also of transport) of organic fertilizers are too expensive	16	17	53	49	67
OBST_05	Finding organic raw materials (such as seeds) is very difficult	24	28	43	63	44
OBST_06	My financial resources are not sufficient to undertake organic farming	63	35	45	32	27
OBST_07	The administrative requirements needed to undertake organic farming are difficult to manage	12	11	19	49	111
OBST_08	The technical-agronomic application of organic regulations is difficult	16	8	44	78	56
OBST_09	Controls for organic certification are too strict	50	41	47	45	19
OBST_10	I do not have the technical facilities and farm size to undertake organic farming	84	20	42	26	30
OBST_11	It is possible to efficiently adopt the organic regime only if neighbouring farmers also adhere to it	45	18	43	47	49
OBST_12	In the organic sector, it is difficult to create partnerships with other producers	34	24	68	35	41
OBST_13	Selling prices of organic products are excessively expensive	63	37	41	37	24

Continued on the next page

Variable label	Description	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
OBST_14	The organic system does not allow a sufficiently wide range of products to be offered	49	34	47	38	34
OBST_15	The commercial channels able to enhance the value of organic products are too limited	19	37	31	54	61
OBST_16	In the organic sector, the lack of a national brand is strongly perceived	12	11	69	36	74
OBST_17	In the organic sector, the lack of a regional brand is strongly perceived	12	13	76	50	51
OBST_18	My fellow farmers make negative comments about organic farming	35	35	63	43	26
OBST_19	Organic conditions will worsen in the future	72	49	46	23	12

Table 3. Descriptive analysis of independent variables: respondent profile.

Variable label	Description	Basic statistics			
PROF_01	Gender (n.)	Male = 180		Female = 22	
PROF_02	Age (years)	Min = 20	Median = 54	SD = 1.705099	
		Max = 82	Mean = 52.67		
PROF_07	Education level[5]	UD = 82	HSD = 17	SS = 18	ES = 85

Table 4. Descriptive analysis of independent variables: farm characteristics.

Variable label	Description	Basic statistics		
AGRIB_01	Farm size[6] (hectares)	Min = 1	Median = 6	SD = 1.705099
		Max = 8	Mean = 5.562	

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[5] UD = University Degree; HSD = High School Diploma; SS = Secondary School; SE = Elementary School.

[6] One omitted variable.

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