How can cooperatives promote environmental practices? A choice experiment to identify contracting strategies in the wine sector

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Abstract

The wine sector faces a major challenge in reducing pesticide use. We explore the role of agricultural cooperative in encouraging the adoption of organic standards by their members through contracting. We conducted a discrete choice experiment with all the 70 winegrowers of a wine cooperative. Results show that winegrowers are highly responsive to market-based economic incentives such as a 30% premium and compensation options for yield loss. They have heterogeneous preferences regarding the inclusion of environmental requirements within the farming contracts. Winegrowers who declare that they enjoy testing risky solutions and feel ready to convert to organic farming are more willing to adopt a contract where organic farming is a requirement. We identify three distinct winegrower profiles. The *Reluctant to organic* group exhibits a positive attitude toward the possibility of adopting a new contract on only 50% of their land. In contrast, the *Reluctant to change* winegrowers view this option negatively. They also have a negative perception of the possibility of receiving advice from the cooperative on economic and labor organizations in addition to technical advice. Only the *Organic lovers* winegrowers, who represent 13% of the sample, hold a positive view on environmental requirements. While cooperatives' farming contracts can be a potential instrument to increase uptake of organic farming, additional tools and policies are needed, at least in the short-term, to scale up the uptake of organic farming.

Keywords: Contracting, agricultural cooperative, organic farming, choice experiment

JEL classification: L14, Q13, Q52

1. Introduction

In France in 2022, 2.88 million hectares of land were cultivated using organic farming practices, accounting for 10.7% of the country's Utilized Agricultural Area (UAA) and involving nearly 60,000 farmers (L'Agence BIO, 2023). Thanks to the support of public policies through subsidies and the development of dedicated supply chains, conversions to organic farming have increased in recent years. We observe a significant conversion trend since 2015, witnessing annual increases of more than 10% in the agricultural land dedicated to organic farming. However, the year 2022 seems to mark a turning point with a slowdown in the growth dynamics, featuring only a 2.7% increase in the area cultivated under organic farming. This growth rate falls short of the targets set by the European Green Deal at the European level and those announced by France. France sets a target of 18% of agricultural land under organic farming by 2027 in its National Strategic Plan in response to the Green Deal objective of cultivating 25% of agricultural land under organic farming by 2030 (European Commission, 2020; Ministère de l'agriculture et de la souveraineté alimentaire, 2022).

To achieve the ambitious organic conversion objectives set by the French government and European Commission, barriers to conversion need to be remove. Yet, many farmers still face barriers to converting into organic farming, as it requires meeting stringent requirements that entail adopting new environmental practices and redesigning the farming system. The farm structure, the socio-demographic characteristics of farmers and behavioral factors influence the adoption of organic farming (Latruffe and Nauges, 2014; Dessart *et al.*, 2019; Serebrennikov *et al.*, 2020; Sapbamrer and Thammachai, 2021). Dessart et al. (2019) distinguish three types of behavioral factors: (1) dispositional factors which relate to farmers' general tendency to behave in a certain way such as personality, risk tolerance and environmental concerns, (2) social factors which encompass norms and signaling motives, and (3) cognitive factors which involve aspects of learning and reasoning. They emphasize that the study of behavioral factors is crucial for tailoring policy design to promote and support the adoption of environmental practices. Serebrennikov *et al.* (2020) and Sapbamrer and Thammachai (2021) highlight the important effect of sources and information and extension agents in promoting the adoption of organic farming. In addition, Sapbamrer and Thammachai (2021) underline that governments subsidies and market environment affect the adoption of organic farming.

Indeed, organic products can be regarded as vertically differentiated products in the market. Some consumers are thus willing to pay a premium to get these products giving market opportunities to farmers to increase their revenue. As agricultural cooperative hold 40% of the total agri-food market shares (La coopération agricole, 2022), they are key stakeholders in the agri-food supply chain and they can thus play a role in encouraging the adoption of organic farming. Their governance organization favors a close relationship with farmers. They can participate both upstream by supplying inputs and downstream by managing the farm production sales. Supply chains stockholders have incentives to invest in product differentiation. Cooperative organizations enable farmers to secure their markets by expanding their market shares in existing markets or creating new market opportunities (Ambec and Lanoie, 2008; Candemir *et al.*, 2021; Duvaleix *et al.*, 2020). Agricultural cooperatives can influence farms' production choices through the contracts they offer to their members. They may enforce specific practices adoption and the purchase of specific inputs through production contracts, or encourage quality standards adoption using marketing contracts (Goodhue, 2011; Hao *et al.*, 2018; Swinnen and Kuijpers, 2019; Duvaleix *et al.*, 2020). Several empirical studies highlighted cooperatives' positive effect in incentivizing farmers to adopt environmentally friendly practices (Candemir *et al.*, 2021). While it can be challenging for agricultural cooperatives to influence dispositional factors (such as openness to new experiences, risk seeking, environmental concerns, and farming objectives) – as they are not directly tied to a specific decision and tend to be relatively stable over time – they can exert greater influence on social and cognitive factors. Social norms play a significant role within social factors, and they can be categorized into two types. Descriptive norms come into play when practices are shaped by the observed behaviors of others, while injunctive norms are at work when practices are influenced by what individuals believe others anticipate from them (Dessart *et al.*, 2019). Agricultural cooperatives can influence descriptive norms by favoring relationships among their members, allowing them to observe each other's farming practices. When the adoption rate of organic farming is high enough, agricultural cooperatives can promote it among conventional farmers, who then may be willing to adopt organic farming to do as the majority. Agricultural cooperatives also have an important role to play in terms of injunctive norms because the expectations of the cooperative's advisors can positively influence the adoption of organic farming. Regarding cognitive factors, previous studies highlight that adoption of specific sustainable practices is higher when farmers have sufficient knowledge and skills related to these practices, and when they believe that these practices can increase their benefits with limited risks (Dessart *et al.*, 2019). Cooperatives also provide technical advice and training (Naziri *et al.*, 2014; Wossen *et al.*, 2017; Duvaleix *et al.*, 2020; Yu and Huang, 2020). They could also get more involved in economic advice to de-bias monetary cost and benefits perception. The present bias can be significant, it implies that immediate benefits and costs carry more weight in decisions compared to equivalent benefits and costs in the future (Doyle, 2013). To mitigate the risk perception of organic farming, cooperatives can also implement mutual funds to offset potential yield losses.

To examine more in depth the potential role of agricultural cooperatives in encouraging farmers to adopt organic farming practices, we first analyze farmers' preferences for different contracts in a wine cooperative. We chose the wine sector as the focus of our case study due to its important reliance on pesticides. The sector faces a major challenge in aligning with societal expectations by reducing or eliminating pesticide usage, as is the case in organic farming. Second, we intend to categorize winegrowers profiles based on their willingness to adopt organic farming. The decision to conduct an experiment was motivated by the scarcity of statistical data on contracts between farmers and cooperatives, as they are considered confidential (Magrini *et al.*, 2023). We thus conducted a discrete choice experiment (DCE) with all the 70 winegrowers of a wine cooperative who looks for encouraging its members to adopt organic farming. Given that farming contracts encompass various distinguishable attributes, employing the DCE methodology to assess the impact of these attributes on the likelihood of adopting an alternative contract is well-founded. We examine several contract attributes whose objective is to encourage winegrowers to adopt organic farming: (1) the option to get a cooperative advisor to assess the impact of practice changes on the economic performance of the vineyard and the farm labor organization, (2) the opportunity of contracting for only 50% of the vineyard area, (3 and 4) the pricing formula, encompassing the potential to receive a 30% premium on the base price and the access to a compensation mechanism to cope with yield loss.

Our article stands out from the DCE literature by focusing on farming contracts between cooperatives and farmers. To our knowledge, few DCEs focus on farming contracts with environmental requirement attributes. Most studies have investigated farmers' preferences regarding agri-environmental policies, particularly the design of agri-environmental schemes (see Mamine and Minviel (2020) for a meta-analysis). DCEs by exploring farmers preferences can contribute to improving the design of these schemes to make them more efficient (Latacz-Lohmann and Breustedt, 2019). Moreover, the DCEs conducted on farming contracts are mainly carried out in developing countries, where challenges differ from those in developed countries (Abebe *et al.*, 2013; Van den Broeck *et al.*, 2017; Fischer and Wollni, 2018; Ola and Menapace, 2020; Widadie *et al.*, 2021). The limited number of DCEs carried out on farming contracts in developed countries do not focus on environmental requirement attributes (Sauthoff *et al.*, 2015; Vassalos *et al.*, 2016) with the exception of Weituschat *et al.* (2023). Weituschat *et al.* (2023) show that farming contract is a potential strategy to encourage the adoption of environmental practices among specific wheat producers in Italy. The environmental practices studied include integrating legume or oil crop in the rotation, cultivating flower strips, and prohibiting the use of glyphosate. Given the complementary role farming contract proposed by cooperatives can play alongside public policies to incentivize the adoption of organic farming, our aim is to contribute to this literature gap through a case study.

The rest of the article is organized as follows. In section 2, we provide an overview of the context and challenges within which our study was conducted. We describe the experimental design of the DCE and present the econometric modelling approach. Section 3 is dedicated to introducing our winegrower sample, providing insights into their characteristics, their relation with the cooperative and their perception of organic farming. Moving on to Section 4, we present the DCE results, delving into the preferences of winegrowers concerning the various attributes of the contracts being examined. We conclude in section 5.

2. Methods

In this paper, we analyze the preferences of winegrowers for different contracts offered by their agricultural cooperative. Beside the choice experiment, the survey elicited information about the socio-demographic characteristics of the winegrowers and their farm.

2.1. The case study

In the wine sector, the cooperative network is well developed. According to "la Coopération Agricole"[1], by 2022 there will be 570 cooperative wineries in France and 58% of winegrowers will belong to a cooperative winery. About half of the wine produced in France comes from cooperative wineries. The weight of cooperatives in the sector is therefore considerable and the cooperative can have a significant impact on improving agricultural practices.

The experiment was carried out with members of a wine cooperative in a region, *Lot-et-Garonne,* in the south west of France. In this area, the wine cooperative gathers 95% of the total production. The remaining production is done by some farmers that use direct selling. All the wines produced by the cooperative are covered by the *Buzet* Protected Designation of Origin (PDO) and thus winegrowers must fulfil the set of rules defined in the French *Arrêté du 22 août 2019*[2]*.* In our study, we only consider farms that are commercial units and thus wine activity is part of their income revenue, we call these farms *active* farms. We conducted our survey with all these active members of the wine cooperative excluding those who produce under organic certification. Winemaking is done by the wine cooperative. This is a distinct profession requiring extensive knowledge and significant material investment. The wine cooperative by pooling grape production is able to finance this processing stage.

Reducing the use of pesticides, fungicides and herbicides is a major challenge for agriculture and specifically for the wine sector, which is a major pesticide user. There exist major social issues associated with the use of synthetic chemical inputs, which affect the health of all people within a wine

[1] The "Coopération Agricole - Vignerons Coopérateurs de France" represents the cooperative wine cellars and unions of cooperative wine cellars grouped within departmental federations. https://www.lacooperationagricole.coop/filieres/vignerons/mieux-connaitre-les-vignerons-cooperateurs

[2] https://info.agriculture.gouv.fr/gedei/site/bo-agri/document_administratif-157abec9-d546-4a2b-8b7c-779b3a6fa8e8/telechargement consulted on September 21st, 2023

area (farmers, consumers and local residents). To meet society's expectations, the studied wine cooperative has initiated an environmental transition by encouraging changes in its members' practices.

The *Vignerons de Buzet* cooperatives aim at differentiating on the market more broadly the *Buzet* PDO with environmental standards. Since 2004, the wine cooperative develops the use of environmental standards for their members, first with the French environmental standard *Agriconfiance* then with the French High Environmental Value (*HEV)* standard[3]. Now, the wine cooperative achieves that all its members meet the *HEV* standard. The cooperative's declared aim is to achieve the total elimination of all synthetic chemical inputs and the preservation of living soils within the PDO area. In order to encourage members to move towards organic standard, it is worth identifying the drivers that can be used in contracting between the winegrowers and the cooperative. To this end, a DCE was carried out, offering different sets of contract to identify what matters for winegrowers to improve their environmental practices.

2.2. Experimental design

In a choice experiment, participants have to reveal their preferences by choosing from a set of alternatives (Adamowicz *et al.*, 1998; Street and Burgess, 2007). The alternatives are defined in terms of attributes that characterize the contract. Each contract attribute consists of several levels, so that the contract can be defined as a whole.

The choice experiment was conducted with the 70 active non-organic winegrowers, members of the cooperative. During the choice experiment, each winegrower were confronted with the choice among the three alternatives contracts for 6 choice situations (corresponding to 6 tasks). One of the three alternatives represents the status quo and was therefore identically repeated in each choice situation. It has been highlighted in the literature that when the status quo is ill-designed, it can influence the DCE results. It thus is recommended to avoid specifying an imprecise status quo that does not take into account individuals' subjective perceptions or the initial situation they are facing (Barton and Bergland, 2010; Domínguez-Torreiro and Soliño, 2011; Ahtiainen *et al.*, 2015). In the DCE presented to the winegrowers, the status quo corresponds to the current contract that farmers have with the cooperative. All farmers have the same status quo since the cooperative currently offers one single

[3] Both the Agriconfiance and HEV standards are based on requirements specifications aimed at reducing the use of chemical pesticides and nitrogen fertilizers, optimizing irrigation management, and promoting biodiversity. The HEV standard is more stringent than the Agriconfiance standard.

contract, and furthermore, the winegrowers do not have a short-term option that allow them not to enter into a contract with the cooperative.

The characterization of the contracts was carried out in collaboration with the cooperative's management and technical advisors. The aim was to offer contract options with characteristics (attributes) that were consistent with the characteristics of the contracts already offered by the cooperative and that could be adjusted to levels that would encourage the adoption of less polluting practices. These discussions enabled us to formulate hypotheses about the potential drivers to be used in contracting. Thus, each attribute defined in the choice experiment can be used to provide answers about the potential drivers that can be used. The choice experiment and the questionnaire were carried out face-to-face. The interview was conducted by an experimenter who was not employed by the cooperative, and the participants were told that the collected data would be anonymized and that the cooperative would not have access to the individual collected data.

We defined five attributes, which means that these five attributes characterized each contract offered to the winegrowers. Table 1 summarizes the contract attributes and their attribute levels.

Table 1: Description of contract attributes and attribute levels used in the choice set design

Contract attributes	Attribute levels	Variable names
Access to individual support	Technical (SQ)	support_tech
	Techno-economic	support_tech-eco
	Techno-economic and labor organization	support_tech-eco-orga
Vineyard area contracted	100% (SQ)	area_100%
	50%	area_50%
Environmental requirement	HEV (SQ)	requirement_MQS
	Organic farming	requirement_organic
	Organic farming and conservation agriculture	Requirement_organic-CA
Payment	Base rate (SQ)	payment_base
	Base rate + 30%	payment_base+30%
Compensation for yield reduction	Annual yield target (SQ)	compensation_annual-target
	Externalize	compensation_externalize
	Cooperative Fund	compensation_coop-fund
	Guaranteed income per hectare	compensation_guaranty-ha
	Multi-year yield target	compensation_multi-year-target

SQ : Status Quo

The first attribute, *access to individual support*, aims to determine the extent to which the type of support offered by the cooperative is a determining factor when a winegrower chooses a contract. It therefore makes it possible to consider the type of support that should be favored in order to enable a change in agricultural practices. This attribute is subdivided into three levels: technical support (aimed at guiding the winegrower in his choices of production techniques), technical-economic support (enabling the cooperative the winegrower to evaluate with the cooperative advisor his choices regarding the economic performance of his vineyard) and, finally, technical-economic and labor organization support (offering a level of support that includes technical, economic and labor organizational aspects).

The second attribute, *vineyard area contracted*, is used to determine whether the contract area has an impact on the choice of contract. This attribute defines the area covered by the contract and can take two levels: 100% and 50%. As described by Mamine and Minviel (2020), numerous studies have shown a significant impact of the area dedicated to agri-environmental schemes, and we want to test whether this result holds for cooperative contracts.

The third attribute, *environmental requirement*, describes the level of requirements required on the hectares under the contract. Three levels are offered: HEV (status quo), organic farming and organic farming combined with conservation farming. Conservation agriculture is based on the following three principles: i) minimum soil disturbance (establishment of crops without mechanical tillage and with minimum tillage since the harvest of the previous crop) ii) permanent soil cover iii) intercropping (crop rotation is not possible for perennial crops). It should be noted that the combination of conservation agriculture and organic farming is challenging for farmers, as organic farming aims to avoid the use of synthetic inputs, whereas conservation agriculture aims to limit tillage. However, the joint development of these two types of practices is increasingly seen as an objective (Fleury *et al.*, 2014; Peigné *et al.*, 2015; Boeraeve *et al.*, 2022).

The fourth attribute, called *payment*, includes two pricing options: a basic price and an increase in the basic price by a rate of 30%. This price attribute was defined to reflect the common cooperative pricing formula. Members are usually offered a basic price that is fully earned when the target yield is reached (if the performance target is not met, the full amount of the payment is not transferred). The 30% premium represents the premium currently granted to members when producing under organic certification.

Finally, the last attribute, *compensation for yield reduction*, aims to characterize the potential compensation for yield loss. This attribute is categorized into five levels. At the time of the experiment, the wine cooperative linked the receipt of the full basic price to a minimum annual yield. The status quo situation is therefore defined by this level, called the *annual yield target* which do not secure any yield loss. In the status quo, winegrowers do not get a compensation when the target yield is not reached. The other four attribute levels are: a performance pluri-annual target (the performance target required by the cooperative is determined over a three-year period), externalized compensation (by underwriting an insurance contract), a compensation cooperative fund (the cooperative sets a pooling fund to cover the economic yield loss) and finally, a guaranteed income per hectare (a fixed income per hectare whatever the achieved yield).

With 5 attributes associated with 2 to 5 levels, the full factorial design is too large (360 combinations) to implement. Therefore, choice sets are the result of D-efficient design using modified Fedorov algorithm (Carlsson and Martinsson, 2003) with priors defined from a pilot experiment. Each choice set is composed of the status quo and two alternative scenarios, as shown in the example presented appendix (Figure A1, translated from French)

2.3. Survey

Many studies have examined the determinants of adoption of sustainable agricultural practices (for a review of this literature, see Dessart *et al.* (2019); Mamine and Minviel (2020); Sapbamrer and Thammachai (2021); Serebrennikov *et al.* (2020)). Individual farmer characteristics appear to have systematically a significant impact on the choice of production practices. For this reason, after the choice experiment, the participants answered a questionnaire that allowed us to elite information about individual characteristics of each winegrower and his farm. The questionnaire itself is divided into three parts.

The first part focuses on the characteristics of the farm and the winegrower. It allows us to characterize each farm according to its surface area, the number of production units, the sales and marketing channels, the type of standards currently implemented on the vineyard, as well as the usual socio-demographic characteristics of the farmer.

In the second part of the questionnaire, we elicit information about training and diagnosis for winegrowers. The aim is to assess the perception of the training activities carried out and to identify the winegrowers' expectations in terms of training format and tools.

Finally, the third part of the questionnaire aims to identify the determinants of changes in agricultural practices. We look for characterizing the winegrowers' positioning in relation to their own practices (what tools are used to improve agricultural practices, what are the objectives linked to grapes production, what is the positioning associated with decisions on farming practices, etc.) and those of other farmers.

2.4. Econometric modelling

When analyzing choice data, the aim is to understand the impact of the contract attributes of the different alternatives offered to the agents' level of utility. We use a random parameters logit model, also called mixed logit (MXL), which extend the standard conditional logit model (McFadden, 1973). To do so, we use discrete choice models that allow us to estimate to what extent each contract attribute contributes the utility level for each choice set and each attribute level combination in each choice set.

Thus, we estimate a logit model with random parameters taking into account preference heterogeneity and panel data structure. The utility U for a winegrower i choosing the contract alternative a in a choice situation t is given by U_{iat} :

$$U_{iat} = \beta_i X_{iat} + \alpha W_{iat} + \delta(X_{iat}.Z_i) + \varepsilon_{iat} \qquad (1)$$

β_i are random coefficients that vary over individuals in the population and X_{iat} is a vector of alternative specific variables that define the environmental requirement of the alternative. We consider random coefficients for the variables characterizing environmental requirements, thus assuming that preferences for environmental quality are heterogeneous across participants (we consider Gaussian-distributed coefficients). It follows that the vector X_{iat} contains three dichotomous variables: three level of environmental requirements (HEV being the reference attribute level (*ref.*), Organic farming and Organic and conservation agriculture) for each of the three alternative contracts. α is a vector of fixed coefficients and W_{iat}, a vector of alternative-specific variables. The vector W_{iat} contains the variables corresponding of the levels of the other attributes for each alternative. The effects of individual characteristics are identified by the interaction between the individual characteristics and the environmental requirement $X_{iat}.Z_i$. ε_{iat} is a random term that follows a type I extreme value distribution.

The probability that individual i choose alternative a ($a = \{1,2,3\}$) in the choice situation t ($t = \{1, \dots, 6\}$), conditional on the random parameter β_i is:

$$P_{iat}(\beta) = \frac{\exp(\beta_i X_{iat} + \alpha W_{iat} + \delta(X_{iat}.Z_i))}{\sum_{a=1}^{3} \exp(\beta_i X_{iat} + \alpha W_{iat} + \delta(X_{iat}.Z_i))} \qquad (2)$$

The Log-likelihood function is approximated by using 500 pseudo Monte Carlo draws, and the convergence to a global maximum of the likelihood function is ensured using a simplified version of the algorithm proposed by Bierlaire *et al.* (2010)[4].

We estimate four different specifications. The first specification, model (1), integrates only alternative specific variables. The characterization of individuals according to their risk preference was included in the model (2). The third specification estimates whether the feeling of being well prepared for the transition to organic farming has an impact on the choice of contract. Finally, the fourth model

[4] The estimations were carried out with R using the Appolo package (Hess and Palma, 2019).

integrates all the individual variables included in models 2 and 3. Results are commented in section 4 and presented in Table 5.

Afterwards, we analyze whether there is a segmentation of winegrowers according to their responses to the choice experiment. To do this, we conducted a latent class analysis on model 1 (without interaction terms). In a Latent Class model, heterogeneity is accommodated by making use of separate classes with different values for the vector β' in each class. We tested latent class models with two, three and four classes. The four-class model could not be estimated because the number of parameters to be estimated was too high compared to the number of observations in our sample. Based on the log-likelihood, McFadden's pseudo-R2, and the Akaike Information Criterion (AIC), the three-class model is preferred. The results are shown in Table 6. Non-parametric tests (Wilcoxon rank sum test for continuous variables and Fisher's exact test for discrete variables) were used to discuss differences in individual characteristics of winegrowers between each class.

3. Empirical data

3.1. Characteristics of winegrowers

We interviewed the 70 farm managers who are members of *Les Vignerons de Buzet* cooperative. The characteristics of both the winegrowers and their farms are presented in Table 2. The average age of the interviewed winegrowers is 51 years old, with over half of them having pursued higher education. It is worth noting that the farm structures are diverse. Nearly two-thirds of the farms in our sample are not specialized in grape production and have another production. In most cases, those farms have field crops (50%) or vegetables/fruits production (13%). We also observe diversity in farm size and the use of seasonal labor. Moreover, the primary goals of the winegrowers are diverse. The two most mentioned objectives are “increasing income” and “balancing work and family life”. “Farming while improving environment” was cited as the main objective for only 10% of the winegrowers.

Table 2: Descriptive statistics on farm and farmers characteristics

Variables	Mean	Standard deviation
Farm characteristics		
Legal form – individual (%)	34.3	
Utilized agricultural area (ha)	70.6	83.7
Family labor (labor unit)	1.7	0.8
Permanent employee labor (labor unit)	0.3	0.6
Temporary labor (hours)	1507.0	1891.0
Environmental subsidies (e.g. AES) (%)	51.4	
Farm not transmitted or outside the family within 5 years (%)	10.0	
Production in addition to grape production		
Another type of production (%)	62.9	
Crops (%)	50.0	
Vegetable and/or fruits production (%)	12.9	
Cattle (%)	5.7	
Poultry and/or Hogs (%)	4.3	
Forestry (%)	4.3	
Winegrowers characteristics		
Age	51.1	12.7
Higher education (%)	57.1	
Main objective		
Increasing income (%)	31.4	
Balancing work and family life (%)	24.3	
Being healthy	21.4	
Farming while improving environment (%)	10.0	

3.2. Relationship between winegrowers and the cooperative

In the survey, few questions focus on the relationship between the winegrowers and their wine cooperative. We explore information exchange between the cooperative and its members about agricultural practices and training (Table 3). The survey results highlight strong ties between the winegrowers and the cooperative *Les Vignerons de Buzet*. Almost all winegrowers (94%) state that they exchange information about their agricultural practices with the cooperative several times a year, and nearly half of them (42%) report exchanging information several times a month. These exchanges regarding practices between the cooperative and the winegrowers also encompass the environmental and social benefits of these practices. Beyond information exchange, there is also a normative dimension in the relation between the cooperative and winegrowers as 96% of winegrowers state that the cooperative assess their agricultural practices regarding environmental and social benefits.

With regard to training, winegrowers are generally satisfied with both the frequency and quality of the training they receive by the cooperative. This satisfaction is reflected in the fact that 60% of the winegrowers implement what they have learned in their vineyards.

Due to frequent interactions between the winegrowers and the cooperative through advisory services and training, the cooperative holds a privileged position for information transfer, especially regarding new agricultural practices. According to 90% of the surveyed winegrowers, the cooperative strategy is an important driver of their practices adoption.

Table 3: Descriptive statistics on the relationship between winegrowers and the cooperative

Variables	% of respondents
Cooperative and information sharing	
Cooperative advices about my practices several times a year	94.3
Cooperative advices about my practices several times a month	42.9
Environmental and social advantage of agricultural practices – discussion with the cooperative [a]	87.1
Environmental and social advantage of agricultural practices – evaluation by the cooperative [a]	95.7
Cooperative and Training	
Sufficient training opportunities [a]	94.3
Use of practices leaned during training [a]	60.0
Interesting issues [a]	78.6
Cooperative and practices change	
Cooperative strategy is an important driver of practices adoption [a]	90.0

[a] *Responses to the questions were given on a Likert scale (Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree). Responses were coded as dummy variables taking the value 1 if winegrowers responded "slightly agree, agree, or strongly agree" and 0 otherwise.*

3.3. The adoption of new practices by winegrowers and their perception of organic farming

We interviewed the winegrowers about their perception of organic farming. We also questioned them about their willingness to adopt new practices and the motivating factors. The results presented in Table 4 highlight that 73% of the winegrowers do not feel ready to adopt organic farming on their vineyards. However, for most of them, they cite that this is not due to a lack of access to advice and support (81%), neither a lack of skills and knowledge (64%).

Our survey reveals that one of the main obstacles to converting into organic farming is the technical aspect. Three-quarters of the winegrowers state that organic farming practices are challenging to implement, and efficient alternatives to synthetic chemical products are difficult to find. This result aligns with the more broad questions related to the adoption of new agricultural practices as winegrowers declare that technology (63%) and skilled labor availability (47%) are important drivers of the adoption of new practices. The second identified obstacle is the economic effect of organic farming: 74% of the winegrowers state that adopting this standard would negatively affect their profits. Farmers often view organic practices as riskier as compared to conventional methods due to an increased vulnerability in yield fluctuations resulting from restrictions on chemical pesticides and fertilizers usage (Gardebroek *et al.*, 2010; Knapp and van der Heijden, 2018). Risk perception for a majority of winegrowers is another additional barrier to adopting organic farming. While 70% of them declare liking to experiment with new practices, nearly 60% state that they do not enjoy testing risky solutions. The fourth identified barrier to convert to organic farming is the impact of this type of agriculture on the physical and mental workload, as well as the distribution of peak labor periods throughout the year. The latest identified barriers are social and normative factors. While 77% of the winegrowers declare that the well-established nature of an agricultural practice significantly influences its adoption, 63% of them admit to know few organic farmers. Additionally, nearly half of the winegrowers indicate that their neighboring farmers are concerned about the expansion of organic farming surfaces.

These results align with prior literature on factors influencing the adoption of organic farming (Dessart *et al.*, 2019). They reveal diverse perspectives among farmers regarding the adoption of new practices and highlight a heterogeneous perception of organic farming within our sample.

Table 4: Descriptive statistics on the adoption of new practices by winegrowers and their perception of organic farming

Variables	% of respondents
Important personal drivers of agricultural practices adoption	
Be proud of his work [b]	98.6
Respect future generations [b]	92.9
Well-established practice [b]	77.1
Innovative practice [b]	61.4
Important drivers of practices adoption	
Cooperative strategy [b]	90.0
Farm succession project [b]	25.7
Change in public regulation [b]	78.6
Technology availability [b]	62.9
Skilled labor availability [b]	47.1
Financial difficulties [b]	47.1
Change in input price [b]	37.1
Change in output price [b]	65.7
New sales opportunities [b]	58.6
Willingness to adopt new practices	
Like to experiment new practices [a]	70.0
Do not like to change usual practices [a]	58.6
Like to test risky solutions [a]	41.4
Like to think for a long time before taking action [a]	80.0
Tendency to postpone investment decisions [a]	32.9
Organic farming perception	
No consensus on organic farming as good [a]	60.0
Few organic farmers known [a]	62.9
Neighborhood fear about neighboring plot organic conversion [a]	48.6
Efficient alternative to synthetic chemical product hard to find [c]	75.7
Organic practices hard to apply [a]	77.1
Converting to organic farming	
Being ready [a]	27.1
Access to advice and support [a]	81.4
Lack of skills and knowledge [a]	35.7
Expected impact of organic conversion	
Decreased profit [d]	74.3
Decreased production [d]	95.7
Increased workload [e]	98.6
Increased seasonal labor [e]	94.3
Increased labor physical strain [e]	82.9
Increased mental workload [e]	92.9
Decreased quality of family life [d]	67.1

[a] *Responses to the questions were given on a Likert scale (Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree). Responses were coded as dummy variables taking the value 1 if winegrowers responded "slightly agree, agree, or strongly agree" and 0 otherwise.*

[b] *Responses to the questions were given on a Likert scale (Not at all important, Slightly important, Important, Very important). Responses were coded as dummy variables taking the value 1 if winegrowers responded "important or very important" and 0 otherwise.*

[c] *Responses to the questions were given on a Likert scale (Very difficult, Difficult, I don't know, Easy, Very easy). Responses were coded as dummy variables taking the value 1 if winegrowers responded "very difficult or difficult" and 0 otherwise.*

[d] *Responses to the questions were given on a Likert scale (High decrease, Slight decrease, No change, Slight increase, High increase). Responses were coded as dummy variables taking the value 1 if winegrowers responded "high decrease or slight decrease" and 0 otherwise.*

[e] *Responses to the questions were given on a Likert scale (High decrease, Slight decrease, No change, Slight increase, High increase). Responses were coded as dummy variables taking the value 1 if winegrowers responded "slight increase or high increase" and 0 otherwise.*

4. Results

4.1. Winegrowers preferences for farming contract attributes

In order to support winegrowers in adopting organic farming, the cooperative aims to introduce new contracts that align with the expectations and preferences of winegrowers. The results of the four MXL models are presented in Table 5. All four models treat *environmental requirement* attribute levels as random parameters. In Model 2, we introduce an interaction between the levels of *environmental requirements* and a dummy variable (*like_risky_solutions*), which takes the value 1 when winegrowers indicate a preference for testing risky solutions[5]. In Model 3, the interaction occurs with the dummy variable (*organic_ready*), which takes the value 1 when winegrowers declare that they are ready to convert to organic farming[6]. Model 4 includes both interactions.

For all four models, the *payment* attribute coefficient is statistically significant and has the expected sign. Offering a 30% price premium on the base rate increases the probability of winegrowers subscribing to the contract with the cooperative. Moreover, when adding a compensation for yield reduction through a cooperative pooling fund or guaranteeing income per hectare increases the probability of contract adoption. It is not surprising that the attribute level guaranteeing income per hectare is significant and positive, as this contract attribute provides a high level of security for the winegrowers. Winegrowers show a preference for contracts that include compensation for potential yield loss through a cooperative fund. It reflects their trust in their cooperative. However, as the agricultural cooperative is specialized, this pooling fund does not guarantee any production loss management when all members adopt organic production system. The solidarity among members is then not sufficient. The wine cooperative should then find external funds to offer this compensation scheme. Despite the concerns expressed about the impact of adopting organic farming on economic

[5] The exact question asked to the winegrowers was: "To what extent does the statement 'I like to try solutions that are risky' describe your approach to managing your vineyard?" The possible responses were provided on a 6-level Likert scale (Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree). The response was recoded into a dummy variable, taking the value 1 for winegrowers who responded Somewhat agree, Agree, or Completely agree, and 0 for those who chose otherwise.

[6] The exact question asked to the winegrowers was: "Do you feel ready to convert your vineyard to organic farming within the next five years?" The possible responses were provided on a 6-level Likert scale (Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree). The response was recoded into a dummy variable, taking the value 1 for winegrowers who responded Somewhat agree, Agree, or Completely agree, and 0 for those who chose otherwise.

and labor organization aspects (see section 2.3.3), the levels of the *access to individual support* attribute are not significant and positive in our results. This suggests that winegrowers may not want the wine cooperative to interfere in their decisions regarding their farm management and that the cooperative's role is primarily intended to support vineyards in technical matters. Coefficients associated with the two levels of the attribute *environmental requirement* are both negative and significant. It suggests that requiring the implementation of organic practices negatively affects the probability of winegrowers adopting a contract different from their current one. We also observe it when the contract requires the joint adoption of organic farming practices and conservation agriculture. The standard deviations of the parameters are significant, indicating that there is unobserved preference heterogeneity among winegrowers regarding the attribute *environmental requirement.* We further explore this heterogeneity in models 2, 3 and 4 by introducing interaction terms. Results show that winegrowers who declare that they enjoy testing risky solutions and feel ready to convert to organic farming are more prone to accept a contract with environmental requirements. These results are aligned with earlier studies that have pointed out the relatively lower risk aversion of organic farmers compared to their conventional counterparts (Serra *et al.*, 2008; Gardebroek *et al.*, 2010; Läpple and Kelley, 2015).

While providing individualized contracts for each winegrower is not realistic, the cooperative may offer a range of contract options to allow them to better align with their own and individual preferences. We implement a latent class model which identifies segments of individuals with homogenous preferences. This approach helps to identify the winegrowers that are more likely to adopt contracts with environmental requirements and determine the optimal contractual conditions for such an adoption.

Table 5: Mixed logit models estimations

	(1)	(2)	(3)	(4)
Attributes and constant				
support_tech	*Ref.*	*Ref.*	*Ref.*	*Ref.*
support_tech-eco	-0.45*	-0.43	-0.42	-0.41
	(0.27)	(0.27)	(0.27)	(0.27)
support_tech-eco-orga	-0.53	-0.53	-0.53	-0.52
	(0.37)	(0.37)	(0.37)	(0.37)
area_100%	*Ref.*	*Ref.*	*Ref.*	*Ref.*
area_50%	-0.31	-0.29	-0.28	-0.27
	(0.24)	(0.24)	(0.24)	(0.24)
requirement_MQS	*Ref.*	*Ref.*	*Ref.*	*Ref.*
requirement_organic	-3.56***	-4.50***	-4.30***	-4.76***
	(0.65)	(0.93)	(0.74)	(0.84)
Requirement_organic-CA	-4.77***	-5.55***	-5.78***	-6.14***
	(1.14)	(1.24)	(1.15)	(1.32)
payment_base	*Ref.*	*Ref.*	*Ref.*	*Ref.*
payment_base+30%	0.62**	0.66***	0.68***	0.69***
	(0.27)	(0.26)	(0.26)	(0.27)
compensation_annual-target	*Ref.*	*Ref.*	*Ref.*	*Ref.*
compensation_externalize	0.21	0.15	0.13	0.11
	(0.36)	(0.37)	(0.37)	(0.36)
compensation_coop-fund	0.97***	0.91***	0.89***	0.86***
	(0.33)	(0.34)	(0.34)	(0.34)
compensation_guaranty-ha	0.70**	0.68**	0.66*	0.64**
	(0.34)	(0.34)	(0.34)	(0.33)
compensation_multi-year-target	0.13	0.10	0.08	0.07
	(0.37)	(0.38)	(0.38)	(0.37)
Interactions				
requirement_MQS * like_risky_solutions		*Ref.*		*Ref.*
requirement_organic * like_risky_solutions		2.22** (1.00)		1.74* (0.93)
requirement_organic-CA * like_risky_solutions		2.16** (1.09)		1.63 (1.13)
requirement_MQS * organic_ready			*Ref.*	*Ref.*
requirement_organic * organic_ready			2.29***	1.92**
			(0.89)	(0.93)
requirement_organic-CA * organic_ready			3.75*** (1.21)	3.37*** (1.16)
Std. dev. of the parameters				
requirement_MQS	*Ref.*	*Ref.*	*Ref.*	*Ref.*
requirement_organic	-3.25***	-2.81***	-3.00***	-2.61***
	(0.74)	(0.52)	(0.62)	(0.49)
Requirement_organic-CA	-4.59***	-4.30***	-3.81***	-3.44***
	(1.31)	(1.16)	(0.87)	(0.72)
Log-likelihood	-301.96	-297.88	-294.70	-292.19
McFadden's pseudo-R^2	0.25	0.26	0.27	0.27
AIC	627.91	623.76	617.40	616.39
BIC	676.4	680.32	673.97	681.03
Number of observations	420	420	420	420
Estimated parameter	12	14	14	16

, **, * indicate significance at the 10%, 5% and 1% levels, respectively.*

4.2. Identifying winegrowers likely to adopt contracts with environmental requirements

Results of the Latent Class model are presented in Table 4.6. We pinpoint a class that we refer to as *Organic lovers*. The likelihood of choosing a contract rises as the contract requires the implementation of organic practices, either exclusively or combined with conservation agriculture. For this group of winegrowers, the two components of the pricing formula also enhance the probability of contract adoption: the inclusion of a 30% premium tied to the base payment and the compensation for potential yield loss. Only the coefficient related to compensation by an external organization such as an insurance company does not significantly affect the probability of contract adoption. We identify a second group, labelled as *Reluctant to organic*. Both levels of the *environmental requirement* attribute negatively affect the probability of adopting a contract different from the current one. However, these winegrowers perceive as beneficial the alternative of contracting for only 50% of their vineyard surfaces. Within this group, the probability of adopting a new kind of contract is also increased by modifying the pricing formula; they value the 30% premium on the base price and the possibility of compensating potential yield losses with a guaranteed income per hectare. The last group that we identified differs from the previous one in that, apart from being reluctant to contracts with environmental requirements, they also display reluctance towards the option of contracting for only 50% of their vineyards and receiving individualized economic and organizational support from the cooperative. We refer to this class of winegrowers as *Reluctant to change*. Similar to the winegrowers in the other two groups, the 30% premium on the base price increases the likelihood of adopting a new type of contract. They are also receptive to the possibility of using a cooperative pooling fund to mitigate potential yield losses. The preferences of the winegrowers in this last class support the hypothesis we presented in the previous section while examining the mixed logit model: although these winegrowers have confidence in the cooperative, they do not wish for the cooperative to intrude into their economic and organizational farm management.

The groups *Reluctant to change* gather most of the winegrowers of the cooperative, accounting for 61% of the members. In contrast, *Reluctant to organic* and *Organic lovers groups* comprise 13% and 26% of the cooperative's members, respectively. Resistance to change is link to the status quo bias which is described as people preferring to keep their current practices due to the perception that any modification represents a loss (Samuelson and Zeckhauser, 1988; Dessart *et al.*, 2019). The large number of winegrowers falling into this category is consistent with the results from literature on DCE conducted on agri-environmental policies, which show that a significant share of farmers tend to reject change systematically (Barreiro-Hurle *et al.*, 2018).

We investigate the winegrowers' characteristics that are associated with a higher likelihood of adopting contracts that require organic farming in Table 7. We find that farmers belonging to the group *Reluctant to organic* are, on average, more educated. At first, this result may seem surprising. However, we took a closer examination on the type of higher education that winegrowers pursued. It revealed that those farmers predominantly had agricultural studies and they are 47. It is noteworthy that a majority of those winegrowers completed their agricultural studies during a period when conventional practices were predominantly taught. This might explain the reason why farmers that are reluctant to organic farming are on average more educated.

Our findings emphasize differences between winegrowers in the Organic Lovers group and those in the other two groups. A majority of *Organic lovers* (67%) express readiness to convert their vineyards to organic farming, and less than half of them (44%) anticipate a decrease in their profits as a consequence. Nevertheless, similar to winegrowers in the other groups, *Organic lovers* also believe that this transition would have an impact on their production, workload, and labor organization. Considering that adopting organic farming might result in greater labor demands and a shift in its annual allocation is in line with previous finding (Midler *et al.*, 2019). The *Organic lovers* also stand out in terms of their willingness to adopt new practices. The majority of them declare that they enjoy experimenting new practices (100%), testing risky solutions (78%), and are ready to modify usual practices (78%). Furthermore, unlike the other two groups, none of them admits having a habit of delaying investments, and a larger proportion of them claim to make decisions promptly. These characteristics may reflect a lower perception of risk among winegrowers belonging to the Organic lovers group. Previous studies have highlighted that organic farmers tend to be less risk-averse than conventional farmers (Serra *et al.*, 2008; Gardebroek *et al.*, 2010; Läpple and Kelley, 2015) and have a lower perception of risk (Flaten *et al.*, 2005). On the contrary, risk perception and aversion to risk can hinder the adoption of environmental practices (Trujillo-Barrera *et al.*, 2016; Chèze *et al.*, 2020; Lefebvre *et al.*, 2020). Additionally, it is worth noting that their market environment highly influences the practices of the *Organic lovers'* winegrowers. They unanimously state that changes in the output price of and new sales opportunities are significant drivers when deciding to change agricultural practices.

The main difference between the *Reluctant to Organic* group and the *Reluctant to change* group lies in the question related to the burden of modifying usual practices. We find that a larger share of winegrowers in the *Organic reluctant* group declares that they do not like changing usual practices. This is a major barrier to the adoption of organic farming for farmers belonging to this group.

The reluctance to change their practices may be attributed to their past experiences with financial constraints and difficulties in hiring skilled labor. In fact, 78% of the winegrowers belonging to the "Reluctant to Organic" group had to change their agricultural practices due to a lack of qualified labor. This may make them more hesitant to adopt organic farming, which is known to require an increased level of skilled labor. Additionally, 67% of the *Reluctant to Organic* winegrowers had to change their practices in the past due to financial difficulties. It is worth noting the dichotomous positioning of the winegrowers who faced financial challenges. Those we classify as *Reluctant to Organic* do not foresee adopting organic farming as they fear it might lead to a decrease in profit. Conversely, the *Organic Lovers* seem to rely on the financial benefits of organic production, driven by the price premium, to address their financial difficulties.

Despite the cooperative's planned changes in contract attributes to support the adoption of organic farming, these incentives alone may not be sufficient to convince 87% of cooperative members to adopt contracts with more environmental requirements. These findings hold true in the short term; over time, the reluctant winegrowers might adjust their contract attribute preferences. If they witness positive outcomes among their peers who have opted for organic farming, they could reassess their risk perception. Furthermore, the decisions to adopt organic farming could be influenced by other farmers' actions, known as the descriptive norm effect (Dessart *et al.*, 2019). This appears even more plausible as 77% of the winegrowers in our sample state that the widespread adoption of a practice significantly affects the adoption of new practices. Upon reaching a certain adoption threshold of organic farming within the cooperative, it could encourage others to follow.

In our sample, 15 winegrowers consistently chose the *status quo* contract. The literature refers to them as protesters. The literature extensively discusses the challenges of identifying genuine protesters from individuals with a high willingness to accept, and managing protesters in data analysis, as this can influence willingness to accept measures (Villanueva *et al.*, 2017; Mariel *et al.*, 2021). To date, the question remains open. In our analysis, identifying protestors is less critical as we do not intend to measure willingness to accept. Moreover, we do not exclude protestors from our analysis because, as members of the cooperative, they provide valuable insights into winegrowers' preferences regarding contracts. To validate our findings, we conduct a robustness check presented in the appendix (Tables A1 and A2), where we estimate the models without protesters. Our conclusions remain robust even after excluding protesters.

Table 6: Latent class model estimations

	Reluctant to change		Reluctant to organic		Organic lovers	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Attributes and constant						
support_tech	*Ref.*		*Ref.*		*Ref.*	
support_tech-eco	-1.18***	0.48	0.73	0.77	0.41	0.38
support_tech-eco-orga	-1.35**	0.62	1.36	1.31	-2.01	1.62
area_100%	*Ref.*		*Ref.*		*Ref.*	
area_50%	-1.33***	0.45	1.03**	0.47	0.51	0.35
requirement_MQS	*Ref.*		*Ref.*		*Ref.*	
requirement_organic	-3.98***	0.71	-4.42***	0.80	4.34***	1.20
Requirement_organic-CA	-4.53***	0.71	-4.73***	1.23	5.76***	1.10
payment_base	*Ref.*		*Ref.*		*Ref.*	
payment_base+30%	0.77**	0.40	1.34**	0.64	3.78**	1.60
compensation_annual-target	*Ref.*		*Ref.*		*Ref.*	
compensation_externalize	-0.06	0.81	1.00	0.87	0.48	0.54
compensation_coop-fund	1.68***	0.62	0.52	0.66	2.01***	0.57
compensation_guaranty-ha	0.91	0.57	2.76***	1.00	1.92***	0.53
compensation_multi-year-target	0.64	0.73	1.47	0.92	1.36***	0.46
Share (%)	61.43		25.71		12.86	
Log-likelihood	-253.83					
McFadden's pseudo-R^2	0.33					
AIC	571.65					
BIC	700.94					
Number of observations	420					

, **, * indicate significance at the 10%, 5% and 1% levels, respectively.*

Table 7: Latent class model characteristics

Variables	% of respondents		
	Reluctant to change	**Reluctant to organic**	**Organic lovers**
Winegrowers' sociodemographic characteristics			
Age (years)			
< 40	14.0	33.3	22.2
[40 ; 60]	62.8	55.6	44.4
> 60	23.3	11.1	33.3
Education	$^{\beta}$	$^{\beta}$	
Primary education	2.3	11.1	0.0
Short-cycle secondary education	55.8	16.7	44.4
Long-cycle secondary education – agricultural	14.0	0.0	22.2
Long-cycle secondary education – non-agricultural	2.3	5.6	0.0
Higher education – agricultural	16.3	55.6	33.3
Higher education – non-agricultural	9.3	11.1	0.0
Farms characteristics			
Utilized agricultural area			
< 20	20.9	11.1	11.1
[20 ; 50]	37.2	22.2	44.4
]50 ; 100]	25.6	33.3	22.2
> 100	16.3	33.3	22.2
Another type of production in addition to viticulture	62.8	72.2	44.4
Important personal drivers of practices adoption			
Pride of work [b]	97.7	100.0	100.0
Respects future generations [b]	95.3	83.3	100.0
Well-established practice [b]	83.7	66.7	66.7
Innovative practice [b]	60.5	50.0	88.9
Important drivers of practices adoption			
Cooperative strategy [b]	86.0	94.4	100.0
Farm succession project [b]	20.9	38.9	22.2
Regulation change [b]	79.1	72.2	88.9
Technology availability [b]	60.5	61.1	77.8
Skilled labour availability [b]	34.9^{β}	77.8^{β}	44.4
Financial difficulties [b]	34.9^{β}	66.7^{β}	66.7
Input price change [b]	34.9	33.3	55.6
Product price change [b]	$53.5^{\alpha\beta}$	77.8^{β}	100.0^{α}
New sales opportunities [b]	46.5^{α}	66.7^{γ}	$100.0^{\alpha\gamma}$
Willingness to adopt new practices			
Like to experiment new practices [a]	62.8^{α}	72.2	100.0^{α}
Do not like to change usual practices [a]	53.5^{β}	$88.9^{\beta\gamma}$	22.2^{γ}
Like to test risky solutions [a]	34.9^{α}	38.9^{γ}	$77.8^{\alpha\gamma}$
Like to think for a long time before taking action [a]	88.4^{α}	72.2	55.6^{α}
Tendency to postpone investment decisions [a]	41.9^{α}	27.8	0.0^{α}
Organic farming perception			
No consensus on organic farming as good [a]	41.9	33.3	44.4
Few organic farmers known [a]	62.8	66.7	55.6
Neighbourhood fear neighbouring plot organic conversion [a]	46.5	44.4	66.7
Efficient alternative to synthetic product hard to find [c]	67.4	88.9	88.9

Organic practices hard to apply [a]	79.1	77.8	66.7
Converting to organic farming			
Being ready [a]	18.6$^{\alpha}$	27.8$^{\gamma}$	66.7$^{\alpha\gamma}$
Access to advice and support [a]	79.1	83.3	88.9
Lack of skills and knowledge [a]	41.9	33.3	11.1
Expected impact of organic conversion			
Decreased profit [d]	81.4$^{\alpha}$	72.2	44.4$^{\alpha}$
Decreased production [d]	95.3	94.4	100.0
Increased workload [e]	97.7	100.0	100.0
Increased seasonal work [e]	93.0	94.4	100.0
Increased work physical strain [e]	86.0	77.8	77.8
Increased mental workload [e]	93.0	94.4	88.9
Decreased quality of family life [d]	65.1	77.8	55.6

α, β, γ indicate significance between groups on the performed Wilcoxon rank sum test and Fisher's exact test; α indicates significant differences between groups Reluctant to change and Organic lovers; β indicates significant differences between groups Reluctant to change and Reluctant to organic; γ indicates significant differences between groups Reluctant to organic and Organic lovers

[a] *Responses to the questions were given on a Likert scale (Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree). Responses were coded as dummy variables taking the value 1 if winegrowers responded "slightly agree, agree, or strongly agree" and 0 otherwise.*

[b] *Responses to the questions were given on a Likert scale (Not at all important, Slightly important, Important, Very important). Responses were coded as dummy variables taking the value 1 if winegrowers responded "important or very important" and 0 otherwise.*

[c] *Responses to the questions were given on a Likert scale (Very difficult, Difficult, I don't know, Easy, Very easy). Responses were coded as dummy variables taking the value 1 if winegrowers responded "very difficult or difficult" and 0 otherwise.*

[d] *Responses to the questions were given on a Likert scale (High decrease, Slight decrease, No change, Slight increase, High increase). Responses were coded as dummy variables taking the value 1 if winegrowers responded "high decrease or slight decrease" and 0 otherwise.*

[e] *Responses to the questions were given on a Likert scale (High decrease, Slight decrease, No change, Slight increase, High increase). Responses were coded as dummy variables taking the value 1 if winegrowers responded "slight increase or high increase" and 0 otherwise.*

5. Conclusion

In this paper, we examine the role that a cooperative can play through contracting to increase the adoption of organic farming among winegrowers. The role of the cooperative is particularly important, as it is the only stakeholder making wine within the PDO and therefore the unique purchaser of grape in the territory. By actively encouraging winegrowers to adopt environmental practices, it can ensure spatial continuity in practices adoption, addressing a common criticism often directed at agri-environmental policies (Westerink *et al.*, 2015; Westerink *et al.*, 2017). The cooperative's commitment to engaging all its members in the organic farming is driven by its aspiration to differentiate more broadly the collective brand of the *Buzet* PDO by incorporating environmental requirements.

Our study reveals that winegrowers are more inclined to adopt contracts where the base price is complemented by a 30% premium and where compensation for yield loss is included. The preferred forms of compensation are income guarantee per hectare and the cooperative fund. Winegrowers have heterogeneous preferences regarding the inclusion of environmental requirements, such as organic and conservation farming, within the farming contracts. Winegrowers who declare that they enjoy testing risky solutions and feel ready to convert to organic farming are more willing to adopt a contract where organic farming is a requirement.

A latent class model allowed us to identify three groups of winegrowers with homogeneous preferences. The majority of winegrowers of the cooperative, 61%, are reluctant to change and merely 13% of the winegrowers would consider shifting to organic farming in their vineyards. *Organic lovers* winegrowers stand out from the other two groups regarding their perception of organic farming and willingness to adopt new practices. Most of them feel ready to convert their vineyards to organic farming and do not anticipate a decrease in their profits as a consequence. The majority of them declare that they enjoy experimenting new practices, testing risky solutions, are open to modifying usual practices, make decisions promptly and do not delay investments.

Overall, this study suggests that while cooperatives' farming contracts can be a potential instrument to increase uptake of organic farming, they will need to be complemented, at least in the short-term, with other tools and more public policies in order to scale the uptake of organic farming to a larger share of winegrowers. However, despite the declared ambitious political ambition in the Grean Deal to reach 25% of agricultural land under organic farming by 2030, the 2023-2027 Common Agricultural Policy (CAP) program eliminates support for maintenance of organic farming. It will be partially compensated by a 36% increase of the budget allocated to conversion subsidies but given the allocated resources, the French Court of Auditors doubts the achievement of the stated objective (Cour des comptes, 2022).

Over the long term, we identify two potential drivers that could promote the adoption of organic farming among winegrowers. The first factor relates to winegrowers potentially modifying their contract preferences if they witness positive outcomes experienced by their fellow winegrowers who have already adopted organic farming. Moreover, if the adoption of organic farming reaches a critical mass within the cooperative, the influence of social norms could encourage reluctantt winegrowers to adopt organic farming. The second long-term driver relies on market incentives. In the context of the wine sector, the organic segment is expanding, sales of organic wines increased by 2.2% from 2021 to 2022, despite a 0.4% decline in overall organic product consumption (Agence Bio, 2023). The adoption of organic agriculture could become a market access requirement in the future. This mechanism is strengthened by the fact that PDO is a collective brand, necessitating the commitment of all its members to ensure its persistence in the market.

The adoption of environmental practices is of significant concern for cooperatives situated on a PDO territory. If not through the adoption of the organic farming standard by its members, it could be achieved by incorporating environmental practices into the PDO specification. The proposal for regulation on EU geographical indication states that "producers of geographical indications should be encouraged to adhere to sustainability standards that are more stringent than the mandatory ones, encompassing environmental, social and economic objectives." If the regulation is approved by the European Parliament in October 2023, "specific requirements should be set out in the product specification or in a separate initiative"[7].

Our findings are particularly valuable for the partner cooperative to designing new contracts. Additionally, they contribute to a broader understanding of the winegrowers' preferences concerning attributes that can influence their decisions regarding contract adoption. However, the external validity of the results might be limited due to the studied sample. Our findings should not be generalized to varying production, cultural or winegrower-cooperative relationship scenarios. Unlike policy-oriented studies that frequently aim for nationwide application, our study was designed to address a specific contractual issue within a specific sector.

Five different attributes compose the choice set of the DCE. Although winegrowers are very familiar with the attributes of the contract, it is likely that not all winegrowers consider the attributes with the same level of importance. For instance, we can imagine that attributes like *Requirements imposed for the contracted area* and *Payment* carry more weight in the winegrowers' decision-making process than the type of *Individual support* offered to them. Some winegrowers may even consider only certain attributes when making their choices, which is referred to as Non-Attendance Attribute (ANA). As ignoring ANA impact model fits (Campbell *et al.*, 2008; Carlsson *et al.*, 2010), it would be valuable, as a robustness check in a future version of this paper, to identify possible ANA behavior by estimating analytical models.

[7] Amendments adopted by the European Parliament on 1 June 2023 on the proposal for a regulation of the European Parliament and of the Council on European Union geographical indications for wine, spirit drinks and agricultural products, and quality schemes for agricultural products, amending Regulations (EU) No 1308/2013, (EU) 2017/1001 and (EU) 2019/787 and repealing Regulation (EU) No 1151/2012 (COM(2022)0134 – C9-0130/2022–2022/0089(COD)) https://www.europarl.europa.eu/doceo/document/TA-9-2023-0210_EN.pdf

Appendix

Figure A1 : Choice Set

Attributes	Contract A	Contract B	Contract C
Access to individual support	Techno-economic and labor organization	Technical	Technical
Farm area contracted	100%	50%	100%
Environmental requirement	Organic farming and conservation agriculture	Organic farming	HEV
Payment	€ + 30% Base rate + 30%	Base rate	Base rate
Compensation for yield reduction	Externalized	Multi-year yield target	Annual yield target

Table A1: Mixed logit models estimations without potential protesters

	(1)	(2)	(3)	(4)
Attributes and constant				
support_tech	*Ref.*	*Ref.*	*Ref.*	*Ref.*
support_tech-eco	-0.35	-0.32	-0.31	-0.31
	(0.29)	(0.29)	(0.28)	(0.29)
support_tech-eco-orga	-0.37	-0.36	-0.34	-0.34
	(0.47)	(0.47)	(0.46)	(0.47)
area_100%	*Ref.*	*Ref.*	*Ref.*	*Ref.*
area_50%	0.00	0.02	0.02	0.01
	(0.25)	(0.25)	(0.25)	(0.24)
requirement_MQS	*Ref.*	*Ref.*	*Ref.*	*Ref.*
requirement_organic	-3.39***	-4.37***	-4.02***	-4.55***
	(0.65)	(0.91)	(0.73)	(0.89)
Requirement_organic-CA	-4.23***	-5.59***	-5.37***	-5.94***
	(1.15)	(1.66)	(1.10)	(1.38)
payment_base	*Ref.*	*Ref.*	*Ref.*	*Ref.*
payment_base+30%	0.77**	0.82***	0.82***	0.81***
	(0.32)	(0.32)	(0.31)	(0.31)
compensation_annual-target	*Ref.*	*Ref.*	*Ref.*	*Ref.*
compensation_externalize	0.33	0.26	0.27	0.27
	(0.39)	(0.39)	(0.38)	(0.39)
compensation_coop-fund	1.36***	1.31***	1.27***	1.29***
	(0.38)	(0.39)	(0.37)	(0.39)
compensation_guaranty-ha	1.20***	1.19***	1.18***	1.18***
	(0.38)	(0.37)	(0.37)	(0.36)
compensation_multi-year-target	0.51	0.47	0.46	0.47
	(0.39)	(0.39)	(0.39)	(0.39)
Interactions				
requirement_MQS * like_risky_solutions		*Ref.*		*Ref.*
requirement_organic * like_risky_solutions		2.45** (1.06)		2.16* (1.19)
requirement_organic-CA * like_risky_solutions		3.49** (1.67)		2.03 (1.33)
requirement_MQS * organic_ready			*Ref.*	*Ref.*
requirement_organic * organic_ready			2.35***	1.63
			(1.13)	(0.93)
requirement_organic-CA * organic_ready			4.36*** (1.37)	4.17*** (1.45)
Std. dev. of the parameters				
requirement_MQS	*Ref.*	*Ref.*	*Ref.*	*Ref.*
requirement_organic	-2.75***	2.61***	-2.61***	2.39***
	(0.59)	(0.56)	(0.58)	(0.72)
Requirement_organic-CA	-4.21***	-4.01***	-3.47***	-3.34***
	(1.07)	(1.27)	(1.12)	(0.98)
Log-likelihood	-245.78	-240.07	-237.16	-233.95
McFadden's pseudo-R^2	0.28	0.29	0.30	0.30
AIC	515.55	508.14	502.31	499.91
BIC	561.14	561.33	555.50	560.69
Number of observations	330	330	330	330
Estimated parameter	12	14	14	16

, **, * indicate significance at the 10%, 5% and 1% levels, respectively.*

Table A2: Latent class model estimations without potential protesters

	Reluctant to change		Reluctant to organic		Organic lovers	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Attributes and constant						
support_tech	*Ref.*		*Ref.*		*Ref.*	
support_tech-eco	-1.04**	0.58	1.01***	0.59	0.41	0.38
support_tech-eco-orga	-1.74**	0.85	1.69	1.26	-2.01	1.62
area_100%	*Ref.*		*Ref.*		*Ref.*	
area_50%	-0.63***	0.50	1.02**	0.51	0.51	0.34
requirement_MQS	*Ref.*		*Ref.*		*Ref.*	
requirement_organic	-4.11***	0.58	-4.38***	0.95	4.34***	1.20
Requirement_organic-CA	-5.07***	0.87	-4.88***	1.36	5.76***	1.10
payment_base	*Ref.*		*Ref.*		*Ref.*	
payment_base+30%	1.29***	0.51	1.20**	0.65	3.79**	1.60
compensation_annual-target	*Ref.*		*Ref.*		*Ref.*	
compensation_externalize	-0.26	0.89	1.20	0.80	0.48	0.54
compensation_coop-fund	2.19***	0.81	0.50	0.84	2.00***	0.57
compensation_guaranty-ha	1.27*	0.71	2.95***	1.06	1.92***	0.53
compensation_multi-year-target	1.13	0.73	1.70	1.14	1.35***	0.46
Share (%)	57.53		26.37		12.86	
Log-likelihood	-211.40					
McFadden's pseudo-R^2	0.33					
AIC	486.80					
BIC	608.38					
Number of observations	330					

, **, * indicate significance at the 10%, 5% and 1% levels, respectively.*

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