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Italian winegrowers' acceptance of result-based agri-environmental schemes

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Abstract

As the debate around the cost-effectiveness of agri-environmental schemes (AES) is growing at the European level, researchers and policymakers are exploring the potential of result-based AES. Result-based AES initiate payments only if pre-defined environmental outcomes are achieved, thus increasing risks for farmers. Using a contingent valuation method, we investigated Italian winegrowers' acceptance and intensity of participation in a result-based AES targeted at pollinators' conservation in vineyards. We focused on the role of farmers' behavioural factors and risk attitudes in driving the acceptance. Results show that, among the 222 farmers who completed the survey, 71 per cent of participants are willing to participate in such a scheme. Non-participation is associated with a high perceived bureaucratic burden. Risk also plays a significant role, as the perceived risk of the scheme decreases the likelihood of enrolment, while risk-seeking farmers are more likely to participate. We found no evidence of risk affecting the intensity of participation. In contrast, while a treatment of a randomly assigned rare-species bonus did not affect the scheme's overall acceptance, it positively influenced intensity. Behavioural factors appear to be related to both acceptance and intensity. Considering this, we suggest strategies to encourage farmer participation in result-based AES.

Keywords: Risk attitudes, Behavioural economics, Viticulture, Italy, Contingent valuation, Stated preferences, Explorative research, Outcome-based schemes

JEL code: Q12, Q18, Q57

1. Introduction

In the last 40 years, European agricultural land has suffered from a decrease in biodiversity and ecosystem services, mainly due to agricultural management intensification. In response to this ecological challenge, the European Union's (EU) Common Agricultural Policy (CAP) introduced several policy instruments. Among these, agri-environmental schemes (AES) have become a tool to tackle biodiversity and climate crises related to agriculture. These schemes are voluntary programs in which participating European farmers are paid to adopt sustainable practices that are expected to deliver environmental benefits. Since their introduction with the MacSharry reform in 1992, the AES' reward mechanism has typically been action-oriented, meaning that the payments are provided contingent on the adoption of sustainable agricultural practices, established by national regulations, regardless of the environmental outcome achieved. Even though this system has proven to deliver many benefits over the last decades, two main issues still need to be considered: (1) many ecological examinations have found that the biodiversity objectives are rarely met, and (2) there is a lack of evidence of the cost-effectiveness of action-based measures (Kleijn and Sutherland 2003; MacDonald et al. 2019; Pinto-Correia et al. 2022). To overcome these limitations, European researchers and policymakers are considering shifting AES from an action- to a result-based approach, thus making payments conditional on the delivery of environmental outcomes, rather than on the adoption of specific agricultural practices. As in this novel framework farmers are only paid if environmental outcomes are achieved, thus avoiding payments for non-delivery, result-based payment schemes are expected to increase the overall cost-effectiveness (Burton and Schwarz 2013). Furthermore, these schemes may allow land managers to fully use their experience and knowledge and select the context-specific agronomical practices that best achieve environmental outcomes (Burton and Schwarz 2013; Sidemo-Holm, Smith, and Brady 2018; Wuepper and Huber 2022).

Result-based AES also face challenges. First, monitoring tools may be inadequate or too costly to accurately track environmental outcomes. Second, European farmers' are mostly risk-averse (Iyer et al. 2020), and this becomes critical in result-based contracts (Dessart, Barreiro-Hurlé, and van Bavel 2019). Unlike action-based schemes, a result-based reward system does not guarantee payments, as farmers are exposed to the risk of not achieving the prescribed environmental outcomes, also due to external factors unrelated to their farming practices (e.g. adverse weather conditions and bad techniques implemented by neighbours). Furthermore, farmers' participation in AES is influenced by diverse factors, including contract features, and farmers' socio-economic attitudes and behavioural factors. Behavioural factors, which include emotional, personal, and social processes, may even outweigh traditional economic and demographic considerations (Thompson et al. 2023), as the adoption of new schemes and technologies may be a multi-stage process (Weersink and Fulton 2020) in which farmers also care about non-pecuniary factors (Howley 2015). These factors, such as attitudes, environmental awareness, and risk perception, are crucial in redesigning effective agri-environmental measures (Barreiro-Hurlé et al. 2023; Schaub et al. 2023).

This study adopts Dessart, Barreiro-Hurlé, and van Bavel's (2019) classification of behavioural factors into dispositional, social, and cognitive facets, highlighting their impact on decision-making within AES contexts. Dispositional factors, including environmental concern, influence farmers' willingness to adopt sustainable practices due to intrinsic ecological values (Barreiro-Hurlé et al. 2023; Schaub et al. 2023). Social factors, like signalling motives, affect participation as farmers seeking social recognition are more inclined to engage in AES (Dessart, Barreiro-Hurlé, and van Bavel 2019). Cognitive factors, such as perceived financial risk, benefit, and control, also significantly shape farmers' decisions (Iyer et al. 2020; Rommel et al. 2023).

Although there is a literature on the effectiveness of result-based as compared to action-based AES in terms of improvement in environmental outcomes and cost-effectiveness (Kleijn and Sutherland 2003; Schwarz et al. 2008; Matzdorf and Lorenz 2010; Primdahl et al. 2010; Börner et al. 2017; Sidemo-Holm, Smith, and Brady 2018; Bartkowski et al. 2021; Chaplin, Mills, and Chiswell 2021), studies aimed at understanding farmers' perceptions of result-based payments are still scarce. Most of them employed stated preference techniques and found a generally positive attitude toward result-based contracts. For example, a discrete choice experiment conducted in Japan by Tanaka, Hanley, and Kuhfuss (2022) showed that farmers are willing to enrol in result-based schemes. However, they also found that the size of the payment was crucial for determining the intensity of participation. Similarly, results from a pilot scheme in a typical sub-Mediterranean High Nature Value farming system in Slovenia indicate that landowners prefer result-based schemes over the existing management-based schemes (Šumrada et al. 2022). Niskanen et al. (2021) and Schroeder et al. (2013), in studies conducted in Finland and England, respectively, highlighted how farmers' heterogeneity affects participation. Finally, Massfeller et al. (2022), in their contingent valuation (CV) survey, found behavioural factors have a significant role in farmers' willingness to enrol, whereas Block, Hermann, and Mußhoff (2024) find a low cost-effectiveness of result-based soil management programs.

The present study adopts a behavioural perspective and provides evidence from Italy. By employing a CV survey, we explore the factors influencing Italian winegrowers' acceptance and intensity of participation (measured in terms of the share of farmland willing to enrol) in a result-based AES. In particular, the aims of the paper are threefold: we (1) experimentally investigate whether a rare-species bonus payment (i.e. an additional payment to the baseline payment) increases the overall acceptance and intensity of enrolment; (2) estimate the impact of farm-level heterogeneity on the overall willingness to accept the scheme and on the intensity of participation; and (3) analyse how-risk attitudes and behavioural factors affect participation.

The choice of focusing on winegrowers' preferences has several reasons. First, biodiversity loss has been particularly evident in European viticulture, where the sustainable provision of environmental outcomes is threatened by agricultural practices at the local scale, such as intensive pesticide use and inter-row management (Chen et al. 2022; Zachmann et al. 2023). Second, one of the objectives for which result-based payment schemes are mostly appropriate is the maintenance of the floristic biodiversity of vineyards. However, result-based AES targeting biodiversity conservation in vineyards are currently scarce in Europe, with only one ongoing in Switzerland. Providing evidence from Italian winegrowers may thus contribute to increasing their presence throughout Europe and reducing the risk of wild species loss. Third, Italy is of great relevance as a case study for exploring the dynamics of AES adoption. The latest data about AES participation in Italy date to 2013, when 23 per cent of the country's utilized agricultural area was under AES. This percentage not only has presumably increased since then (the goal for 2020 was set to 27 per cent), but it was also in line with the European average (26 per cent) (Eurostat 2017). Thus, as AES seem to be particularly relevant to the Italian context, a better understanding of farmers' preferences may help policymakers to better align environmental objectives with farmers' motivations. Fourth, the literature on understanding decision-making in viticulture is scarce (Chen et al. 2022). Furthermore, the wine sector is one of the most representative and promising industries of the Italian economy, with the country ranking first in global wine production (Pomarici et al. 2021). As production is expected to grow in the coming years—probably resulting in land management intensification—increasing result-based schemes may help winegrowers to preserve biodiversity. Lastly, advantages to producers may also arise: Italian consumers are willing to pay a premium price for biodiversity conservation practices in vineyards (Mazzocchi, Ruggeri, and Corsi 2019).

The remainder of the paper is organized as follows. In Section 2, the methodology and data are presented. Section 3 shows the results of the econometric analysis. Section 4 is dedicated to the discussion and Section 5 to the conclusions of the study.

2. Methodology and data

2.1 Behavioural factors: Theoretical framework

In this study, we adopt the classification of behavioural factors by Dessart, Barreiro-Hurlé, and van Bavel (2019) into dispositional, social, and cognitive factors.

Dispositional factors are related to an individual's values, beliefs, and personality. In agriculture, these are expected to affect risk tolerance, farming objectives, and resistance to change. In the context of this study, environmental concern (i.e. farmers' awareness of ecological issues) is the only dispositional factor considered. While other dispositional factors presented in Dessart, Barreiro-Hurlé, and van Bavel (2019) can influence farmers' adoption of sustainable farming practices, they were not the primary focus of our study. We expected environmental concern to be particularly relevant for the scheme's objectives and to be a main driver for participation (Läpple and Van Rensburg 2011; Barreiro-Hurlé et al. 2023; Schaub et al. 2023). We did not explicitly consider risk tolerance as a dispositional factor, but we did include the risk dimension by measuring farmers' risk aversion on an 11-point scale from Dohmen et al. (2011).

Social factors (descriptive norms, injunctive norms, and signalling) are related to farmers' interactions with other individuals and to the need for social status. Individuals are found to be more willing to engage in prosocial behaviours (i.e. actions that benefit society as a whole) when such actions imply social recognition (Bénabou and Tirole 2006). As such, these factors are expected to influence farmers' decision-making processes and their adoption of sustainable farming practices. However, they can overlap: farmers are influenced by others' expectations (injunctive norms) and by what other farmers are doing (descriptive norms), which is related to how farmers want to be perceived (signalling). To ensure the survey was engaging and not tiring for participants, we focused only on signalling, still providing a clear overview of how social recognition influences farmers' behaviour (see Dannenberg et al. 2024 for a recent survey on how to conceptualize pro-environmental behavioural norms).

Lastly, cognitive factors are concerned with farmers' perceptions of the benefits and risks related to a specific AES as well as with their ability to achieve environmental outcomes without drastically changing management practices. For this study, the cognitive factors employed are perceived financial risk, perceived financial benefit, and perceived control. Financial risk refers to the financial risks that farmers associate with sustainable farming practices (Dessart, Barreiro-Hurlé, and van Bavel 2019). In contrast, the financial benefit refers to farmers' perceptions of the expected financial outcomes of the practice (e.g. subsidies, higher returns, and premium prices). Finally, perceived control refers to farmers' expectations in relation to their skills to achieve the targeted environmental outcomes (Defrancesco et al. 2008). We think these cognitive factors have great relevance to the decision-making process regarding the adoption of our result-based scheme. However, we did not take all factors from Dessart, Barreiro-Hurlé and van Bavel (2019) into consideration. Our choice of what to investigate was conditional on avoiding redundancy and complexity among different measurements. In this case, general knowledge about sustainable farming practices was excluded from our focus, as perceived control is already incorporating this factor. Similarly, the perceived environmental benefit of the scheme is related to farmers' environmental concern. Fig. 1 summarizes the conceptual framework of farmers' decision-making in this context.

2.2 The contingent valuation scenario

The CV method is a stated preference technique aimed at eliciting individual preferences to attribute monetary values to non-market goods and services (Haab et al. 2013). Participants are presented with a hypothetical scenario, and they are asked to answer questions, as if they were in a real market (Haab and McConnell 2002).

Our CV scenario consists of a result-based measure whose primary objective is biodiversity conservation (see Table 1). The secondary objective of the scheme is the promotion of pollinators' presence in wild species-rich vineyards. This fits well into the current context, as pollinators are vulnerable to agricultural intensification, and their preservation is crucial for overall biodiversity (Ollerton et al. 2011; Potts et al. 2016).

As outlined in the literature, the efficiency of result-based payment schemes targeted to support biodiversity is strictly linked to the choice of the most suitable biodiversity

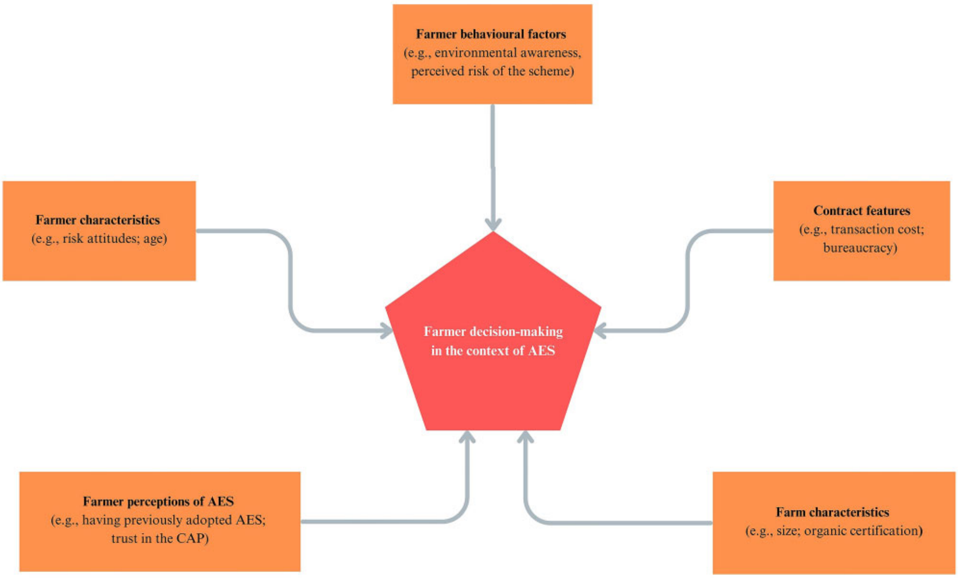

Figure 1. Conceptual framework of farmers' decision-making in the context of AES.

Table 1. Summary of the result-based AES.

Country	Primary objective	Secondary objective	Unidimensional indicators	Threshold for payment
Italy	Biodiversity conservation	Promotion of pollinators' presence in the vineyards	Five nectar-rich wild plant species	Four nectar-rich wild plant species

indicators (Burton and Schwarz 2013; Herzon et al. 2018; Elmiger et al. 2023). Unidimensional indicators were chosen for our scenario, as we expected these to be more immediate to be captured in a survey rather than composite indexes, and as they are also applied in practice (e.g. in Germany's rich grassland species scheme in Baden-Württemberg[1]). The indicators chosen are a list of five nectar-rich wild plant species that represent a source of food for pollinators, based on Bellucci, Piotto, and Silli (2021).

Since adapting to smaller regional and target habitat conditions is essential to preserve biodiversity (Elmiger et al. 2023), we presented each winegrower with a specific list composed of five plants according to the macro-area where the farm was located (North-West, North-East, Centre, and South). Three species were kept identical for all the areas, as, according to experts' opinions and preliminary farmers' interviews, they are commonly detectable in vineyards throughout the country: *Taraxacum officinale*, *Capsella bursa-pastoris*, and *Papaver rhoeas*. The other two species were macro-area specific, so each area had two species closely linked to that specific territory.

Inspired by the EuLLa AES 'Kennartenprogramme' in the German region of Rheinland-Pfalz[2] (Western/Southwestern Germany), the annual payment of our result-based AES is conditional on the occurrence of at least four key species out of the list of five we presented. Furthermore, following Elmiger et al. (2023), we introduced an additional bonus payment as an experimental treatment (randomly shown to half of the participants), in case a rare or endangered species, not belonging to that list, is found in the vineyard. This is expected to increase both acceptance and intensity of enrolment by farmers with high environmental awareness. As for the species necessary to receive the base payment, the rare and endangered species for the bonus payment were selected according to Bellucci, Piotto, and Silli (2021). Furthermore, they were also tailored to each specific macro-area. In this way, we ensured farmers were more likely to already have some familiarity with them, which helped enhance the scenario's credibility and contextualization. Readers can find a more comprehensive table (Table A.1) reporting the plants shown to participants in Annex A.

In the survey, interviewed winegrowers were also provided with additional information about the monitoring of the scheme results. In line with most of the already implemented result-based AES, as outlined by Elmiger et al. (2023), this must be carried out by the winegrowers themselves through visual assessment. Following existing and proposed result-based payment schemes in EU countries different from Italy, farmers must record the species observed and note them on a record sheet, ensuring their presence in at least every other row. However, it is not strictly necessary for all four species to be present altogether. This means, for example, that there could be two species in a specific inter-row and two others in a different one. Moreover, farmers were told that the presence may be randomly checked by assessors. This was aimed at enhancing the scenario's credibility. Based on similar studies (Massfeller et al. 2022), we also informed participants of regional agricultural advisors available to advise farmers on the management needed to integrate their agricultural operations as well as on how to autonomously recognize the plant species indicators. Especially during the first years of the scheme implementation, farmers must gain knowledge on how to recognize the species that contribute to the payment, and therefore the help of regional agricultural advisors is crucial.

2.3 Survey design

The structure of the survey was as follows. After a brief and broad explanation of the aims of the study through informed consent, participants were asked general questions regarding their farms (e.g.: 'Where is your farm located?'; 'Is your farm organic?'). A short introduction to AES's objectives was then displayed, followed by the presentation of the scenario concerning our result-based AES. We invited participants to picture a new AES targeted at pollinators' conservation in the vineyard being introduced in Italy. The payment and contract conditions were also explained (see the survey in the researchbox[3]). At this stage of the survey, a randomly selected half of the participants (treatment group) were presented with the possibility of receiving a rare-species bonus, while the other half was not (control group). The treatment group received the following additional information: 'Additionally to the base payment, you may receive a bonus payment for the presence of a particular rare species (provided you met the requirements for the base payment). The bonus is equivalent to 30 €/ha/year'. After that, both groups were asked, 'Would you be generally interested in adopting this result-based AES for all or part of your farm?' (*Yes/No*). Those who stated non-acceptance were asked to indicate the reasons for their choice among: 'It implies too much bureaucracy' (1); 'It is too risky for my yields' (2); 'It will require drastic agricultural adjustments' (3); 'I do not think this measure will be implemented' (4); 'I do not think it is an effective measure' (5); 'I do not trust CAP's funding system' (6); and 'Other' where they could state their reasons (7).

To test whether higher payment offers increase the intensity of participation (i.e. the share of farmland the farmer is willing to enrol in the scheme), those who stated acceptance were shown one of the three bid vectors displayed in Table 2 and were instructed as follows: 'Please, indicate the share of your land you would like to enrol for each payment indicated below'. Bids varying from 70 to 500 €/ha were chosen following experts' recommendations and real-life payment schemes. To investigate starting point bias, an anchoring effect that

Table 2. Bid vectors to estimate the intensity of participation.

Level 1	Level 2	Level 3
70 €/ha	110 €/ha	180 €/ha
110 €/ha	180 €/ha	250 €/ha
180 €/ha	250 €/ha	330 €/ha
250 €/ha	330 €/ha	410 €/ha
330 €/ha	410 €/ha	500 €/ha

can occur in stated preference studies (van Exel et al. 2006), participants were randomly assigned to one of the bid vector levels as shown in Table 2, with level 1 being the lowest and level 3 the highest. We expect higher payments to increase the share of land farmers would enrol, while higher levels of the bid (under the presence of anchoring) to decrease it (so that, for example, the indicated share for 180 €/ha would be lower if level 3 is displayed as compared to level 1). Except for the assigned treatments, no other randomization (such as assigning random orders to survey items) was applied in the survey.

Parts of our research are clearly deductive, such as estimating the impact of the bid vector and estimating the impact of the rare species bonus. Other parts, such as the impact of the cognitive, social, and dispositional behavioural factors, are more explorative (although they emerged from a discussion of the authors before data collection). We did not pre-register the study. Under strict rules (Barreiro-Hurlé 2021), one should consider any non-registered study to be explorative. For our study, in particular the parts that are not based on randomly assigned treatments should be considered explorative. We aimed for the largest possible sample from the target population of winegrowers, not conducing a priori power analysis. For the main treatment effects (bid vectors, rare species bonus), our design should have sufficient power to detect medium effect sizes (Cohen's d of 0.5) under the simplified assumption of a normally distributed outcome and a t-test. Informed consent was obtained from all participants.

Hypothetical bias is a shortcoming of the CV method (Hausman 2012; cf. chapter 2.6 in Mariel et al. 2021 for a survey). We employed several measures to address it. First, we introduced a 'cheap talk' script to prompt participants to consider their choices as if they were real (Cummings and Taylor 1999). Before showing the bid vector, the questionnaire stated: 'Please, answer sincerely and considering the current and real situation of your farm'. Second, the scenario was designed to reflect real-world situations: reducing the abstraction that may lead to hypothetical bias (List and Gallet 2001). To achieve this, we provided participants with a realistic context designed with the help of experts, as explained in Section 2.2. Third, before starting data collection, a pilot survey involving 12 farmers was conducted to ensure participants correctly understood the tasks and the scenario. This helped us to correct potential sources of bias arising from misunderstanding (Harrison and List 2004). Incentivized experiments are one way to address the intention–action gap, as they introduce financial consequences for pro-social or pro-environmental choices (e.g. Barreiro-Hurlé et al. 2023). However, such experiments often cannot introduce rich contexts, highlighting the need to combine complementary types of experiments (Lefebvre et al. 2021).

After the CV scenario, to test whether and how behavioural factors and risk attitudes relate to acceptance and adoption intensity, participants were asked to evaluate fourteen statements (see Table 3) concerning behavioural factors on a 5-point scale (1 = I strongly disagree; 2 = I disagree; 3 = I do neither agree nor disagree; 4 = I agree; and 5 = I strongly agree). The fourteen statements are based on those employed by Massfeller et al. (2022). After that, farmers had to indicate their level of willingness to take risks in general ('How willing are you to take risks, in general?') as well as for their farm ('How willing are you to

Table 3. Statements used in the survey and related behavioural factors.

Statement in survey	Behavioural factor	Cronbach's α
Cognitive factors		
Participating in this agri-environmental measure is risky from a financial perspective.	Financial risk	
It will be easy for me to achieve the results of this agri-environmental measure.	Perceived control	
Participating in this agri-environmental measure will …	Environmental benefit	0.65
… be effective in increasing the presence of pollinators.		
… help mitigate the effects of climate change.		
… result in a lower agricultural yield.	Financial benefit	0.48
… result in more bureaucracy.		
… result in a greater effort in terms of work and time.		
… result in higher returns.		
Dispositional factors		
The use of chemicals negatively impacts the presence of pollinators.	Environmental concern	0.69
The environmental issues associated with agricultural activities are exaggerated by the media.		
Organic viticulture is better for the environment than conventional.		
The use of chemicals in viticulture is essential for higher yields.		
Social factors		
I think it's important to show consumers your environmental commitments.	Signalling	0.47
I believe that showing consumers your environmental commitments is effective in increasing profits.		

make risky decisions regarding your farming business?') on an 11-point scale from Dohmen et al. (2011) ranging from 0 (extremely risk averse) to 10 (extremely risk seeking).

Following Massfeller et al. (2022), the fourteen statements concerning behavioural factors were aggregated into five new variables: perceived financial risk, perceived control, perceived financial benefit, environmental concern, and signalling (Table 3). To create the constructs, we reversed the values of the negatively worded statements; we grouped the statements (except for perceived financial risk and perceived control of the scheme, which are built upon one statement each), as shown in Table 3, by taking the mean of the values indicated by winegrowers for each of them. Then, the internal validity of the constructs composed of more than one statement was checked with Cronbach's alpha (α). All the constructs exhibited a fair degree of internal validity ($\alpha > 0.50$), except for financial benefit ($\alpha = 0.48$) and signalling ($\alpha = 0.47$).

Lastly, participants responded to general demographic questions (e.g. education level, gender, age, and agronomical knowledge).

The English version of the survey is provided in Annex A.

2.4 Sampling strategy and sample structure

The target population was Italian winegrowers, with differences in farm size, geographical distribution, and production method (organic or conventional). Data collection started at

Table 4. Descriptive statistics of variables.

Variable	Number of valid observations	Mean	SD
Farmers' characteristics			
Age 18–20	0	–	–
Age 21–29	21	0.1	–
Age 30–39	44	0.1	–
Age 40–49	60	0.3	–
Age 50–59	61	0.3	–
Age ≥60	35	0.1	–
Male	218	0.7	–
Viticulture as main source of income (1 if yes)	220	0.7	–
Prior AES adoption (1 if yes)	222	0.6	–
Agriculture knowledge (1 if yes)	220	0.6	–
Farms' characteristics			
Organic (1 if organic)	222	0.5	–
Size 0–5	44	0.1	–
Size 5–10	65	0.2	–
Size 10–20	53	0.2	–
Size 20–50	33	0.1	–
Size ≥50	27	0.1	–
Cognitive factors			
Financial risk	222	3.7	0.9
Perceived control	222	3.3	0.9
Environmental benefit	222	3.3	0.5
Financial benefit	222	2.6	0.5
Dispositional factors			
Environmental concern	222	3.4	0.8
Social factors			
Signalling	222	3.8	0.6
Risk attitude			
Risk	222	5.6	1.9

the end of February 2023 and was concluded at the end of March 2023. Three main channels were employed to reach the target: a mailing list of approximately 4,000 winegrowers, distributed throughout Italy and representative of all sizes (1); the FIVI's (Federazione Italiana Vignaioli Indipendenti) mailing list of about 1,500 winegrowers spanned across the country, with an average vineyard area of 10 hectares and about 51 per cent of the vineyards being cultivated under organic practices (2); and social networks (Instagram and Facebook) to reach personal contacts (3). We collected in total 386 answers, which represents a response rate of 9.65 per cent. After the data-cleaning process—which consisted of excluding those who did not finish the questionnaire and those who answered incorrectly—222 observations remained (approximately 5.55 per cent of the estimated total). Among these, 117 were randomly assigned to the rare species bonus treatment, while 105 were randomly assigned to the control group.

Participating farmers, despite being part of a convenience sample, may be considered reasonably indicative of the target population (see descriptive statistics in Table 4, and region, size, and organic/conventional distributions in Figs B.1–B.3 in Annex B). Similar to our sample, the percentage of women engaged in viticulture in Italy is 28 per cent (CRIBIS 2017). Moreover, the geographical distribution of our sample closely represents the regional distribution of wine production in Italy (Wine Observatory 2023) . Veneto, Tuscany, and Piedmont are not only the most represented regions in the sample but are also among the top winegrowing regions in Italy. At the same time, the regions that are underrepresented in our sample, such as Basilicata and Valle d'Aosta, marginally contribute to the overall wine production. Some differences emerge when looking at farmers' age; 29 per cent of winegrowers in our sample are under 40, while, at the national level, only 9 per cent of farmers fall into this category. Furthermore, when compared to the national average of 21 per cent organic vineyard area in Italy (SINAB 2023), the sample is skewed toward organic viticulture (49 per cent).

2.5 Empirical modelling

This study aims to estimate both the acceptance and intensity of enrolment in the result-based AES. However, we must consider that only the participants willing to adopt our result-based scheme revealed their intensity of participation. This means that data on the intensity are only available for a subset of the sample, specifically for those observations who stated acceptance, thus possibly leading to sample selection bias (Wooldridge 2010). Because of this potential bias, a two-step Heckman sample selection model was employed (Heckman 1979), as in other CV studies that had to deal with the same issue (Mäntymaa et al. 2018; Massfeller et al. 2022; Opdenbosch and Hansson 2023).

The first stage of the Heckman sample selection model (selection equation) is specified as:

$$S_i = \beta X'_i + \upsilon_i, \tag{1}$$

where S_i is the latent variable for the selection process of respondent i, X_i is a vector of observed variables affecting the selection, β is a vector of parameters, and υ_i is the error term. The observed outcome is a binary variable, D_i, denoting acceptance, so that:

$$D_i = \begin{cases} 1 & if\ S_i^* > 0 \\ 0 & otherwise \end{cases}.$$

Because of the binary nature of the dependent variable, the first stage is estimated through a Probit model.

The second stage (outcome equation) is defined as:

$$Y_i^* = \ \gamma Z'_i + \delta\lambda_i + \ \upsilon_i, \tag{2}$$

where Y_i^* is the latent variable for the outcome of interest, Z_i is a vector of observed variables influencing the outcome, γ is a vector of parameters, and υ_i is the error term. The term λ_i is the inverse Mills ratio (IMR), a correction parameter derived from the selection equation (1) and then added to equation (2) to account for selection bias. The IMR is calculated for the observations selected into the sample as:

$$\lambda_i = \frac{\phi(\beta X'_i)}{\Phi(\beta X'_i)},$$

where ϕ represents the standard normal probability density function and Φ is the cumulative distribution function. The outcome equation is estimated using ordinary least squares.

In our case, we called the first step the 'acceptance equation' (for the extensive margin). We use it to estimate the willingness to adopt the result-based scheme for biodiversity conservation based on the yes or no question concerning general interest in the scheme. We modelled the acceptance equation by a probit model as follows:

$$\Pr\left(D_i = 1\right) = \phi\left(\beta^{bonus} T_i^{bonus} + \beta^{part} N_i^{part} + \beta^{risk} R_i^{risk} + \beta^{beh} Z_i^{beh} + \beta^{dem} X_i^{dem} + \ u_i\right), \tag{3}$$

where D_i takes the value 1 if winegrower i indicates willingness to adopt the scheme, T_i is a dummy variable taking the value of 1 if the participant is in the treatment group and 0 otherwise, N_i is a dummy variable taking the value of 1 if the participant has been previously enrolled in an AES, R_i is a continuous variable representing risk propensity taking values from 0 to 10, Z_i is a vector of the behavioral factors, and X_i is a vector of demographic variables (i.e. age, gender, size of the farm, organic certification, having viticulture as the main source of income).

The second stage is referred to as the 'intensity of participation equation' (for the intensive margin), as it is aimed at estimating the area farmers are willing to enrol in the scheme, as long as they are willing to adopt it. The intensity of participation equation is the following ordinary least squares regression:

$$y_{iv} = \beta^{payment} P_{iv}^{payment} + \beta^{level2} \Gamma_{iv}^{level2} + \beta^{level3} \Gamma_{iv}^{level3} + \beta^{bonus} T_{iv}^{bonus} + \beta^{risk} R_i^{risk} + \beta^{beh} Z_i^{beh} + \beta^{dem} X_i^{dem} + \lambda_{iv} + u_{iv}, \quad (4)$$

where y_i is the percentage farmer i is willing to enrol in the result-based scheme for bid offered v, P_i is the bid, and Γ_i are the dummy variables for level 2 and level 3 of the bid vectors (Table 2); level 1 is the reference category.

The Heckman model should include at least one variable in the first stage that does not appear in the second stage (Mozzato et al. 2018). These variables, which allow for compliance with the exclusion restriction, influence the probability of an observation being in the sample but do not influence the ultimate dependent variable of interest in the second stage of the procedure. Previous experience with the AES should make the farmer more familiar with AES in general, and thus more likely to try a new set-up of the AES. However, previous participation with any AES is unlikely to affect the share of farmland the farmer is willing to enrol under a new AES as this depends primarily on the type of scheme. In order to check this assumption, we compute the correlation coefficient between the declared intensity of participation in the new AES and the dummy variable indicating previous adoption of AES in general. The correlation coefficient is very low (0.075). Moreover, we compute the correlation coefficient between the farmer's acceptance of the new AES and previous AES experience and found a value of 0.89, which supports that the exclusion criterion is satisfied in our data.

3. Results

3.1 Sample description

Among the whole sample of 222 respondents, 70.7 per cent are male; 66.2 per cent have agriculture knowledge, and, for 71.1 per cent of the respondents, viticulture is the main source of income. Most respondents fall in the age groups 40–49 (27.0 per cent) and 50–59 (27.4 per cent). There are no observations of people in the age group 18–20; hence, this group has been excluded from the analysis. Finally, 65.7 per cent were enrolled in an action-based AES at the time of the survey or were enrolled in the past. Regarding behavioural factors, most participants disagree (38.7 per cent) or strongly disagree (21.1 per cent) with the perceived financial risk statements; most of them (37.8 per cent) are uncertain ('I do neither agree nor disagree') about the perceived control statement. As the other factors were built upon several statements, we could not calculate the exact percentage of strong agreement or agreement. However, 73.4 per cent agree or strongly agree with the statements related to the perceived environmental benefit. Concerning dispositional factors, environmental concern statements were rated as 3 by most participants (41.9 per cent), indicating that the knowledge of respondents concerning environmental issues is uncertain. Finally, 53.6 per cent of respondents agree or strongly agree with the signalling statements.

3.2 First step of the Heckman model: Scheme acceptance

Table 5 shows the average marginal effects (AME) of the acceptance equation based on the results of the regression formulated in equation (3).

Table 5. AME of the acceptance equation (selection equation).

	AME	SE
Treatment (bonus for rare species)	−0.00	0.01
Prior AES adoption	0.05***	0.02
Size 0–5	0.01	0.03
Size 5–10	0.01	0.03
Size 10–20	−0.00	0.02
Size 20–50	−0.07	0.03
Organic	0.01	0.02
Viticulture as main source of income	0.01	0.02
Age 21–29	0.03	0.04
Age 30–39	−0.00	0.03
Age 40–49	−0.03	0.03
Age 50–59	−0.03	0.03
Male	−0.04**	0.02
Risk	0.02***	0.00
Signalling	0.03*	0.02
Perceived control	0.04***	0.01
Financial risk	−0.02*	0.01
Financial benefit	0.01	0.02
Environmental benefit	0.06***	0.01
Environmental concern	0.00	0.01

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

Out of 222 respondents, 70.7 per cent show a willingness to participate in the result-based scheme. Having previously adopted an AES shows a statistically significant increase in the likelihood of enrolment in the scheme by 5 per cent on average. Conversely, the rare-species bonus treatment is small and not statistically significant for the scheme acceptance, meaning that an additional payment of 30 €/ha is not sufficient to affect farmers' decision to uptake the result-based AES. While age does not affect the probability of participating in the scheme, being male decreases the probability by 4 per cent. Some of the behavioural factors play a role in driving the decision to enrol in the scheme. A significant relationship is found between risk-seeking behaviour (represented by the variable 'risk') and scheme acceptance, indicating that individuals who are more willing to take risks are more likely to participate in the scheme by 2 per cent. Accordingly, a higher perceived financial risk of the scheme is associated with a drop of 2 per cent in the probability of taking up the scheme, although this estimate is only significant at 10 per cent. Signalling and perceived control both show a positive influence on enrolment, increasing the probability of acceptance by 3 and 4 per cent on average, respectively. The behavioural factor showing the greatest positive impact on the likelihood of enrolment is the perceived environmental benefit of the scheme (6 percentage points on average, and statistically significant at 1 per cent).

3.3 Reasons for non-acceptance

The 65 farmers (29.7 per cent of the respondents) who stated non-acceptance were asked why. Fig. 2 displays the answers to the question. Most participants indicated bureaucracy (40.9 per cent) and perceived lack of efficacy of the scheme (14.5 per cent) as the main barriers. Although none indicated the financial risk associated with the scheme as a reason to not be willing to enrol, those who stated their reason under the 'Other' option (17.2 per cent) expressed concerns such as: 'It implies paying a consultant, and dedicating time to the measurement to maybe obtain a contribution, typically of modest amount'; or 'The effort required to achieve the results is not compensated by the awarded prize'; or 'I am not sure

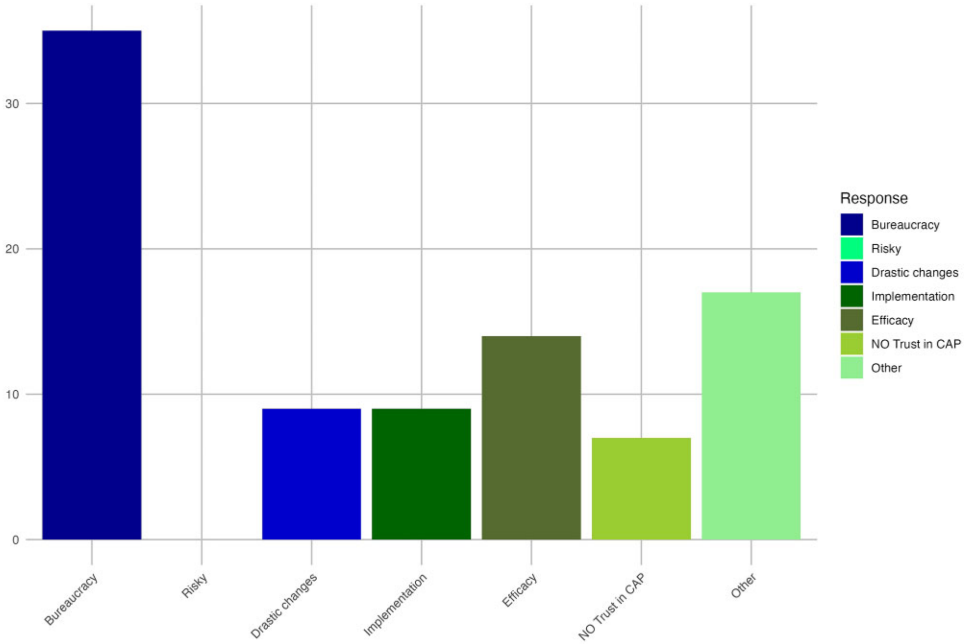

Figure 2. Reasons for non-acceptance.

whether I will get the payment'. Thus, we assume that another important factor negatively influencing the adoption of our scheme is financial risk.

3.4 Second step of the Heckman model: The intensity of participation

Table 6 displays the results of the second step of the Heckman model based on the results of the regression formulated in equation (4).

Our analysis shows a €1 increase in the payment level increases the share of farmland participants are willing to enrol (i.e. the intensity of participation) by 0.2 percentage points, at the 1 per cent statistical significance level. The estimates of the two categorical variables (payment level 2 and payment level 3) indicate the effect of the same payment amount in the case it belongs to either level 2 or level 3 compared to when it belongs to level 1. When the farmer faces a payment amount belonging to the bid vector represented by level 2, the share of farmland he or she would enrol is 8 per cent lower compared to the share he or she would enrol for the same payment amount belonging to the bid vector of level 1. Similarly, when the payments belong to level 3, the share of farmland decreases by 25 percentage points compared to the same payment belonging to the bid vector of level 1. The observed phenomenon demonstrates the presence of an anchoring effect.

Being part of the treated group is associated with an increase of 8 per cent in the intensity of participation. Adopting organic viticulture decreases the indicated percentage of land by 11 per cent. Concerning behavioural factors, risk attitude, perceived financial risk of the scheme, environmental concern, and signalling are not statistically significant. Finally, perceived control, environmental benefit, and financial benefit (which are all cognitive factors) are associated with a statistically significant increase in the land potentially enrolled of 6, 4, and 11 percentage points, respectively.

Figure 3 shows the farmers' supply curve for our result-based AES. This was built by relating the payment/ha offered by the scheme with the average percentage of land

Table 6. Results of the intensity of participation equation (outcome equation).

	Estimate	SE
Payment	0.20***	0.01
Payment level 2	−8.38**	3.46
Payment level 3	−25.10***	3.46
Treatment (bonus for rare species)	7.97***	2.75
Size 0–5	2.81	5.34
Size 5–10	2.22	4.95
Size 10–20	5.44	4.89
Size 20–50	6.86	5.51
Organic	−11.01***	3.13
Viticulture as main source of income	3.03	3.20
Age 21–29	4.08	5.29
Age 30–39	8.88*	4.56
Age 40–49	10.37**	4.13
Age 50–59	13.55***	4.40
Male	0.12	3.14
Risk	−1.34	0.90
Signalling	3.65	2.46
Perceived control	5.85***	1.79
Financial risk	−1.57	1.87
Environmental benefit	3.84*	2.35
Financial benefit	10.62***	3.08
Environmental concern	1.64	2.16
Constant	−71.34***	19.56
Mills ratio (λ)	−10.93	13.23
Adjusted R^2	0.33	

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

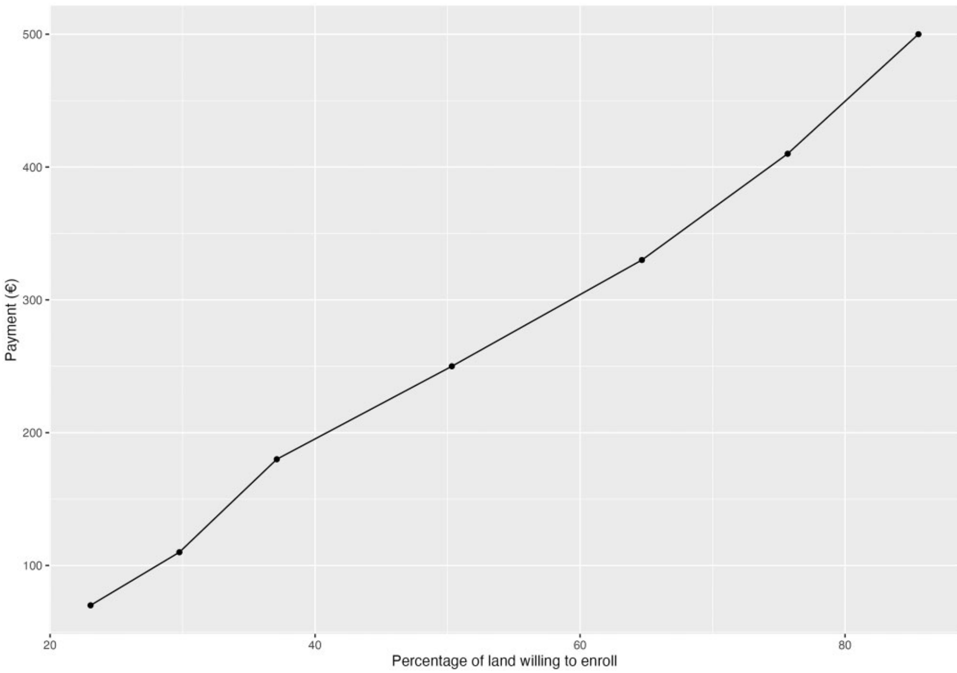

Figure 3. Farmers' supply curve for the AES.

self-indicated by participants. As expected, they are positively related, meaning that a higher payment results in a higher share of land enrolled.

In Annex C (Tables C.1 and C.2), we reported two additional models for both the selection equation and the intensity equation. Model 1 serves us as a benchmark. It includes the experimentally determined covariates, which are all exogenous through random assignment (i.e. the treatment bonus for rare species in the selection equation and the treatment bonus for rare species along with the payment and the payment levels 2 and 3 for the intensity equation). Prior adoption of AES, while not being an experimentally determined variable, remains in the selection equation to allow the estimation of the model. Model 2 includes the same variables as model 1 plus the socio-demographic variables of the farmer and the farm characteristics. Controlling demographics, farm characteristics, and behavioural factors result in no variations in the significance levels of most estimates in both equations.

4. Discussion

4.1 Scheme acceptance

Results show that 70.7 per cent of participants are willing to participate in our result-based AES. This rate is in line with the study conducted by Schroeder et al. (2013), who found that 72 per cent of participants would enrol in a result-based scheme. Similar results were observed by Massfeller et al. (2022): 60 per cent of the participants accepted their hypothetical result-based contract. Tanaka, Hanley, and Kuhfuss (2022) also found a general willingness to participate.

The present study has been the first to examine the impact of a rare-species bonus additional to the baseline payment, as an experimental treatment, on both the acceptance and intensity of participation within a result-based AES. The bonus was intended to incentivize winegrowers to a greater environmental commitment. However, our results suggest that this additional payment has not been a primary driving factor in the participants' decision-making process. There is a possible explanation for this. Schroeder et al. (2013) found that, in the context of result-based AES, farmers are willing to accept higher risks associated with rare species only if adequately rewarded. Burton and Schwarz (2013) also highlight the need of financial incentives to sufficiently compensate for additional risk or effort. In our case, the annual bonus of 30 €/ha for the rare species may not have been sufficient to compensate for the risks associated with the scheme, thus not influencing farmers' enrolment decision.

We found that participants who already had adopted an AES in the past (65.7 per cent of our sample), and thus are familiar with its functioning, are more likely to enrol. Schroeder et al. (2013), Šumrada et al. (2022), and Massfeller et al. (2022) also found the same relationship. However, given the high percentage of participants who had already enrolled in an AES in our sample, it is plausible that there has been a self-selection of farmers with previous experience. Hence, the real acceptance rate may be lower than our study suggests.

Farmers' self-valued risk attitude has also been found to play a role, as risk-seeking farmers are more likely to enrol. This is consistent with the finding of the negative relationship between the perceived financial risk of the scheme and its acceptance. Furthermore, these results are supported by the risk-related reasons non-adopters mentioned. These findings, apart from being consistent with each other, have also frequently emerged in the literature. Farmers expressed concerns about non-payments in case of the scheme objectives' failure also in the studies of Massfeller et al. (2022) and Chaplin, Mills, and Chiswell (2021). Moreover, the uncertainty of the reward system was also identified by Tanaka, Hanley, and Kuhfuss (2022), Russi et al. (2016), and Schroeder et al. (2013) as a barrier to participation in result-based contracts.

Other statistically significant behavioural factors influencing the decision to enrol are signalling, perceived control, and perceived environmental benefit. The positive impact of signalling aligns with the findings from Defrancesco et al. (2008) and Mzoughi (2014), who found that farmers who value their image to society are more likely to adopt sustainable farming practices. Likewise, the influence of perceived control is consistent with the literature. Canessa et al. (2023), in their investigation of how farm-level ecological conditions influence farmers' preferences for alternative payment schemes, found that the decision to enrol is strongly affected by farmers' perceived achievability of the outcome. Lastly, we found the greater the environmental benefit participants perceived from undertaking our scheme, the higher the likelihood of enrolment. This observation suggests that participants in our study are not only driven by financial incentives but also by the possible positive impact their actions can lead to. There is supporting evidence of this from the literature. Schulz et al. (2014) found that farmers who do not perceive the mandatory CAP's greening requirements as beneficial for the environment are more likely to opt out compared to those who recognize their advantages. On the other hand, this finding may point towards a limitation of our study. Participants perceiving high environmental benefits may also be located in areas or on farms with a high potential of achieving the targeted environmental outcomes or with different structural characteristics such as farm size. We cannot fully rule out that such confounds introduce bias in our results. If perceptions and structural farm characteristics or financial constraints were interrelated, our behavioural factors could pick up some of this heterogeneity in economic or environmental conditions. Ultimately, a better understanding of the diverse environmental and economic conditions of a farm, as well as a better understanding of the process of locating and leaving farms, is needed to distinguish such structural differences from the behavioural drivers of adopting AES.

Finally, we found the greatest barrier to accepting the scheme is the perceived bureaucratic burden. This not only aligns with results from papers examining the perception of result-based contracts (Massfeller et al. 2022; Tanaka, Hanley, and Kuhfuss 2022) but also with studies in the context of action-based schemes (Defrancesco et al. 2008; Pe'er et al. 2018; Chèze, David, and Martinet 2020). This suggests that the AES' administrative framework is commonly perceived as a burden, independent of whether the payment system is result-based or action-based.

4.2 Intensity of participation

In our investigation of the factors determining the intensity of participation, we found that the bonus for the rare species played a significant role. This implies that, once participants are willing to adopt the scheme, the provision of a possible bonus payment encourages them to enrol more land. Probably, farmers who are willing to participate in the scheme perceive having the rare species as a minor additional task, as they are already adhering to the scheme's guidelines. This is supported by Kelemen et al. (2023), who show that innovative contracts, such as result-based AES, can prompt farmers to adopt additional sustainable farming practices if properly designed and tailored to their needs. Furthermore, farmers may recognize that the presence of rare or endangered species in their vineyard improves land value and ecosystem services. This added value, depending on how it is perceived, may or may not enhance farmers' sense of contributing to a broader conservation effort, thus increasing or decreasing the percentage of land they would enrol.

The results confirmed the price–quantity relationship of standard economic theory: offering higher payment levels to farmers leads to increased intensity of participation. This is well supported in the literature. For example, Schaub et al. (2023), in their systematic literature review, found evidence that higher financial incentives enhance farmers' participation. In our study, also behavioural factors play a role in determining participation intensity. Particularly relevant are the effects of perceived environmental benefits and perceived financial risks. The positive and statistically significant estimate of financial benefits implies that farmers' perceptions of the economic gains from the scheme influence their intensity decision. At the same time, the positive effect of perceived environmental benefits, although only statistically significant at the 10 per cent level, reflects a more altruistic perspective. These relationships are evidenced also in Kelemen et al. (2023), who found that farmers are motivated both by economic gains and intrinsic motivations (e.g. when protecting biodiversity).

Our findings also show that following organic practices is associated with a decrease in participation intensity. One possible explanation for this is that organic winegrowers already have a great part of their land under strict environmental regulations, making the additional requirements of our scheme less feasible. This is in line with Bartkowski et al. (2023), who suggest that farmers who already meet high environmental standards might not want to engage in additional measures. However, we must discuss this result carefully, because there is a high chance of self-selection into our sample. More than 50 per cent of participants in our experiment follow organic agricultural practices, whereas the average national organic vineyard area in Italy is only 21 per cent. This skewness toward organic farmers indicates that average winegrowers in the population would be willing to enrol even higher shares of land.

Lastly, we tested the presence of an anchoring effect (or starting point bias). To check for the bias, we employed three different starting points (low, medium, and high) for the bid vectors that were randomly assigned to participants. Consistent with other studies (Ariely and Simonson 2003; Chien, Huang, and Shaw 2005), results indicate anchoring is present as the signs of the estimated coefficients for levels 2 and 3 are negative. When winegrowers are presented with the same amount of money, they tend to indicate a different share of land depending on which of the three levels of bid vectors they were assigned to. Participants visualizing level 1, with a lower starting bid, indicate a larger share for the same amount (e.g. 110 €/ha) than participants assigned to levels 2 and 3, whose anchors shift upwards. Although the payment offered is the same, participants perceive it differently due to higher reference points. To provide a more comprehensive understanding of the extent of the anchoring, we calculated the minimum payment required to prompt participants to enrol an average of 50 per cent of their land for each payment level. Under level 1, this minimum is 199.72 €/ha. The minimum under level 2 is 225.65 €/ha, while it is 345.10 €/ha under level 3. A more comprehensive table is provided in Annex D (Table D.1). The minimum payment to get an average of 50 per cent of land enrolled in the program is progressively higher, meaning that participants have been anchored to the initial bids. The estimated payment of 345.10 €/ha offers insights into the magnitude of the payment the government would need to provide to enhance farmers' participation.

4.3 Policy implications

Our findings have many implications for policy design. Firstly, the high acceptance rate (70.7 per cent) may induce policymakers to consider implementing result-based measures for Italian winegrowers. However, as the perceived bureaucratic burden is the greatest barrier to participation, we recommend policymakers to provide farmers with clear guidelines, and, possibly, digital platforms where they can easily submit applications and/or report results. Training sessions may also be useful to assist farmers in understanding the AES and to provide them with the necessary knowledge to achieve the desired environmental outcomes. Participating in these training sessions may also enhance farmers' perceived control of the measures, which was found to be a behavioural factor affecting both participation and intensity. Furthermore, as we found previous AES participation to increase the likelihood of enrolment, these trainings become even more important when they target farmers with no experience.

While our findings did not provide any evidence of the effects of risk on the intensity of participation, we found several confirmations of the high influence risk had on acceptance.

This emerged from the role of participants' perceived risk of the scheme and their risk attitudes on the likelihood of enrolment. More evidence supporting this is the risk-related reasons participants stated for non-acceptance. Consequently, as result-based schemes are perceived as risky—mainly because they offer no steady source of income compared to action-based schemes (Burton and Schwarz 2013)—our suggestion to policymakers is to find ways to reduce risk (e.g. through the establishment of hybrid payment schemes). Such schemes imply payments partly dependent on results and partly on taking prescribed actions. Recent evidence from the UK (Tyllianakis et al. 2023) and Germany (Canessa et al. 2023) shows that hybrid contracts are preferred among farmers. However, these payments may also result in worse environmental outcomes as well as in greater administrative burdens for both farmers and scheme assessors, as pointed out by Herzon et al. (2018). Another solution may be to establish a pure result-based system with a low initial threshold that gradually increases over the years. Farmers may be incentivized to enrol because of the lower financial risk and the greater chance to achieve environmental outcomes. Furthermore, this solution may allow farmers to familiarize themselves with result-based payments in a transition phase that allows them to adapt practices for meeting a higher threshold in later years. Taking risk perceptions into account is fundamental, as, in the context of result-based schemes, farmers are uncertain about their ability and knowledge to achieve the defined threshold due to factors beyond their control (e.g. weather events, ecological conditions, and neighbouring farmers' practices). This is why offering farmers flexible or hybrid contracts, or providing them with all the necessary technical assistance, makes them sometimes more willing to enrol (Schulze et al. 2024), although many challenges with hybrid contracts and result-based contracts remain (Gars et al. 2024).

Another conclusion drawn from our study is that behavioural factors affect both acceptance and intensity of enrolment. For example, signalling plays a significant role in farmers' participation. Policymakers might leverage this by introducing labels communicating the provision of environmental services and, thus, enhancing participating farmers' reputations (Schulze et al. 2024).

The key takeaway message from our study is that farmers' enrolment decision is influenced by both extrinsic values (e.g. financial incentives) and intrinsic motivations (e.g. environmental commitment and personal beliefs). While these relationships are frequently found in the agricultural economics literature, our research adds unique contributions to the field. First, this is one of the few studies examining farmers' perceptions of result-based AES. Second, it is the only one specifically targeting winegrowers. As previous studies have mainly focused on other types of contracts, our findings are particularly relevant given the innovative nature of result-based schemes. The need to better capture the dynamics of these instruments is also highlighted by Kelemen et al. (2023), who recognize policymakers' growing interest in result-based schemes. Intrinsic motivations are arguably more relevant in the context of result-based schemes than in action-based schemes, where taking specified actions is sufficient to be rewarded. Policymakers, acknowledging that the interplay of extrinsic and intrinsic motivations is relevant for result-based schemes, should not only ensure that the payment entirely compensates the costs and risks associated with the schemes, but also clearly communicate the environmental benefits of new result-based schemes.

Although AES have gained attention from policymakers as a cost-effective alternative to traditional AES for delivering environmental benefits, the recent protests across Europe, including Italy, have shed light on farmers' dissatisfaction with bureaucracy, fuel prices, and the focus of the EU Green Deal on environmental goals. Given that perceived bureaucratic burden was a major adoption barrier in our study, policymakers should carefully consider the design and implementation of new AES, ensuring a low additional administrative burden.

5 Concluding remarks

This study analysed Italian winegrowers' willingness to adopt a result-based AES, as well as the impact of different payments and factors related to the intensity of participation (measured in terms of the percentage of land farmers are willing to enrol). We sent an online CV survey to Italian winegrowers and collected 222 complete responses. The high adoption rate of the scheme (70.7 per cent) implies a general willingness to adopt result-based schemes among winegrowers, particularly when they have AES experience, or they recognize the environmental benefits of participation.

The positive impact of the perceived financial benefit, payment level, and the rare-species bonus suggests that financial incentives can significantly influence farmers' intensity of enrolment. However, our findings highlight the importance of considering also intrinsic motivations when designing result-based schemes. This, together with reducing the bureaucratic load and the risks of the payment system, may enhance participation. We also found the anchoring effect was present, and, taking this bias into account, governments should reward farmers with at least 345.10 €/ha to make them participate in the result-based AES with an average of 50 per cent of their land.

However, since this is the first study of this kind to be conducted in Italy, further similar research is needed to confirm and solidify our findings, also accounting for variations across agronomical contexts. Moreover, while here we presented only the 30 €/ha/year bonus, varying the bonus payments is a promising route for future research.

The study has some limitations. Although quite wide and representative of most criteria (size, regions), the sample is a convenience sample. Furthermore, it is over-representative of organic farms. In combination with the topic of the survey, this may have caused self-selection bias. Therefore, results from this study should be carefully interpreted and future research is needed to reach a more representative sample of the Italian winegrowers' population. Another limitation is the use of the CV method, which comes with the risk of hypothetical bias.

End Notes

1 For more information on the Germany's rich grassland species scheme in Baden-Württemberg, visit: https://www.rbpnetwork.eu/country-infos/germany/species-rich-grassland-artenreiches-dauergruenland-baden-wuerttemberg-47/

2 For more information on the Kennartenprogramme visit: https://www.rbpnetwork.eu/country-infos/germany/species-rich-grassland-artenreiches-gruenland-kennarten-rheinland-pfalz-35/

3 Data, code, and material are shared in the researchbox: https://researchbox.org/3300&PEER_REVIEW_passcode=YKZKXU.

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Supplementary material

Supplementary data are available at *Q Open* online.

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Conflict of interest

The authors declare no competing interests.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

Annex A

Table A1. Summary of the indicators according to geographical area.

North-West	North-East	Centre	South
Taraxacum officinale	Taraxacum officinale	Taraxacum officinale	Taraxacum officinale
Capsella bursa-pastoris	Capsella bursa-pastoris	Capsella bursa-pastoris	Capsella bursa-pastoris
Papaver rhoeas	Papaver rhoeas	Papaver rhoeas	Papaver rhoeas
Arabidopsis thaliana	Salvia pratensis	Lavandula stoechas	Trifolium repens L.
Geranium molle	Linaria vulgaris	Malva sylvestris	Cichorium intybus
Bonus species Papaver argemone	Bonus species Silene noctiflora	Bonus species Anthemis arvensis	Bonus species Agrostemma githago

Annex B

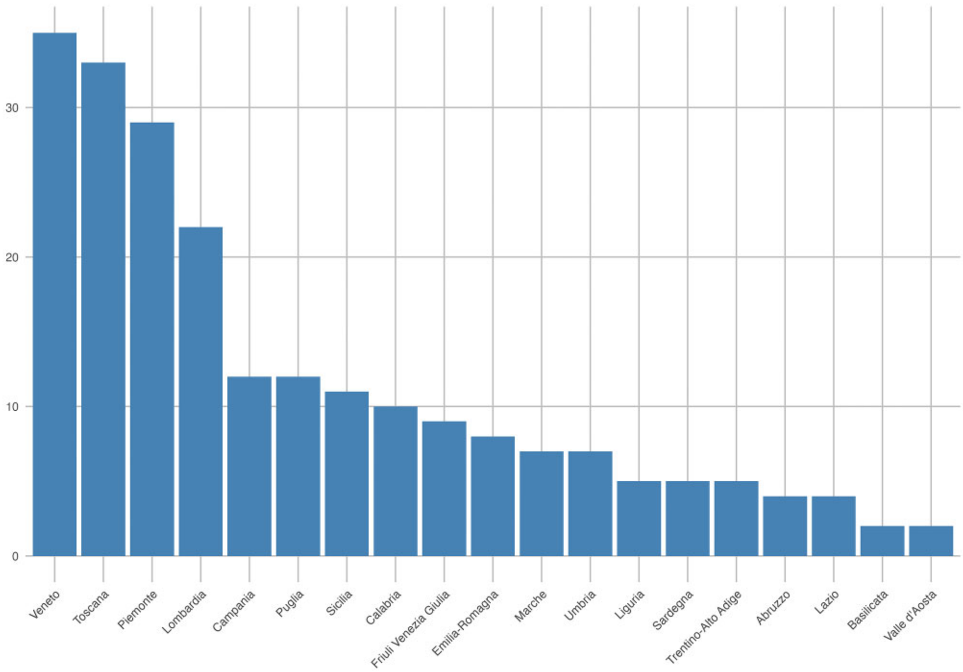

Figure B1. Geographical distribution of the sample.

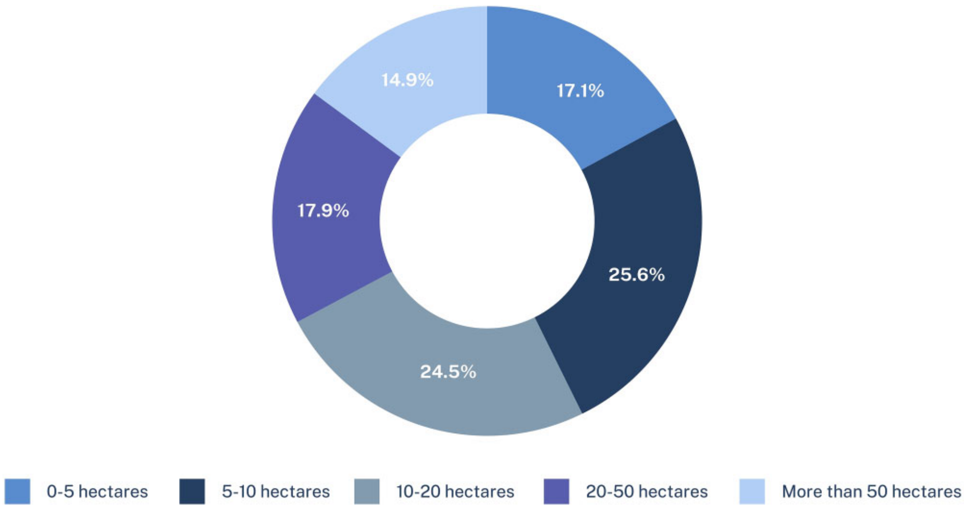

Figure B2. Size distribution of the farms of the sample.

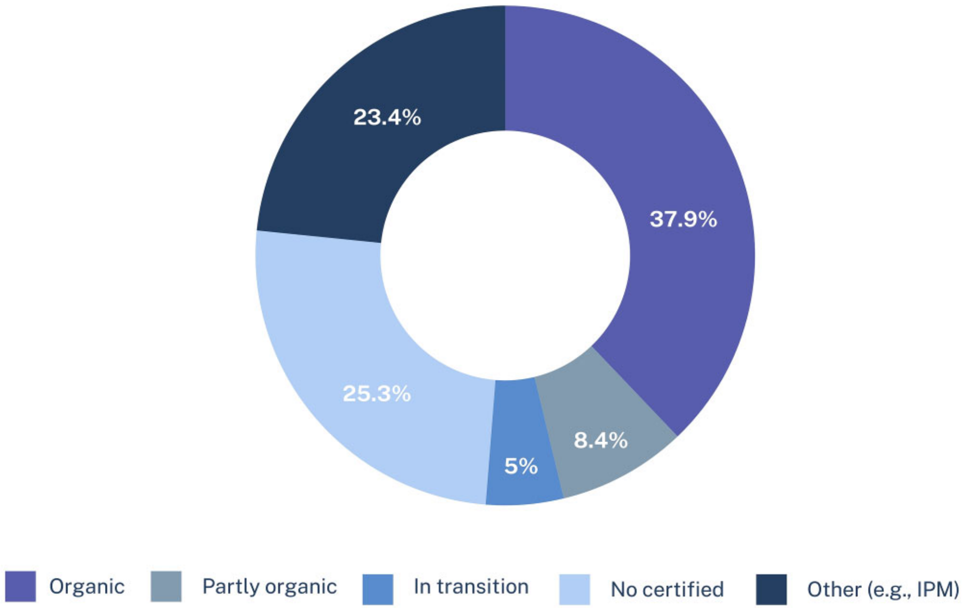

Figure B3. Type of agriculture distribution of the sample.

Annex C

Table C1. Models 1 and 2 of the Heckman model: selection equation.

	Model 1		Model 2	
	AME	SE	AME	SE
Treatment (bonus for rare species)	0.00	0.02	−0.01	0.02
Prior AES adoption	0.08***	0.02	0.07***	0.02
Size 0–5			0.04	0.03
Size 5–10			0.04	0.03
Size 10–20			0.00	0.03
Size 20–50			0.01	0.03
Organic			0.03*	0.02
Viticulture as main source of income			−0.00	0.02
Age 21–29			0.06*	0.04
Age 30–39			0.03	0.03
Age 40–49			0.02	0.03
Age 50–59			−0.00	0.03
Male			−0.06**	0.02
Risk			0.02***	0.00

$^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$.

Table C2. Models 1 and 2 of the Heckman model: outcome equation.

	Model 1		Model 2	
	Estimate	SE	Estimate	SE
Payment	0.20***	0.01	0.20***	0.01
Payment level 2	−5.52	3.46	−9.21**	3.60
Payment level 3	−22.26***	3.64	−23.77***	3.71
Treatment (bonus for rare species)	10.14***	2.94	10.98***	3.02
Size 0–5			6.82	5.61
Size 5–10			2.19	5.27
Size 10–20			8.17	5.35
Size 20–50			10.05*	6.00
Organic			−8.06***	3.02
Viticulture as main source of income			4.09	3.53
Age 21–29			6.35	5.91
Age 30–39			11.26**	5.06
Age 40–49			12.96***	4.63
Age 50–59			15.56***	4.86
Male			−3.06	3.20
Constant	11.29***	4.67	0.48	7.46
Mills ratio (λ)	−42.36**	19.05	−51.78***	8.43
Adjusted R^2	0.26		0.30	

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

Annex D

Table D1. Money required to get an average of 50 per cent of enrolment under the different bid vectors.

Level	Payment	Percentage (mean)	Minimum of money required
1	70 €/ha	23.05%	199.72 €/ha
1	110 €/ha	31.40%	199.72 €/ha
1	180 €/ha	45.18%	199.72 €/ha
1	250 €/ha	62.26%	199.72 €/ha
1	330 €/ha	75.79%	199.72 €/ha
2	110 €/ha	27.82%	225.65 €/ha
2	180 €/ha	36.95%	225.65 €/ha
2	250 €/ha	56.95%	225.65 €/ha
2	330 €/ha	73.69%	225.65 €/ha
2	410 €/ha	88.69%	225.65 €/ha
3	180 €/ha	29.58%	345.10 €/ha
3	250 €/ha	33.57%	345.10 €/ha
3	330 €/ha	46.51%	345.10 €/ha
3	410 €/ha	64.96%	345.10 €/ha
3	500 €/ha	85.53%	345.10 €/ha

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