Payments for environmental services with provision thresholds: farmers' preferences for a conditional bonus

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Abstract

The effectiveness of payment schemes for delivering agri-environmental public goods with provision thresholds (biodiversity, water quality) depends on reaching enough farmland enrolment at the landscape scale. Supporting the development of collaborative approaches with a financial bonus conditioned to a collective element on top of an individual basic payment is a promising way to favour participation and continuity of environmental commitments in an area. However, little is known on farmers' attitudes towards such mixed-payment mechanisms. Using a choice experiment, we measure farmers' preferences towards an individual bonus for sponsoring peers, which can be combined with a collective bonus for improving the ecological quality of rivers in northwestern France. Applying a mixed logit model, we find that respondents have a positive willingness to accept contracts with a sponsor bonus, but a negative willingness to accept a sponsor bonus combined with a bonus for reaching a collective environmental objective. We characterize respondents' heterogeneity with a latent class model and identify 3 different attitudes towards the bonus options: (i) negative preferences for both, particularly for the combined bonus, (ii) indifference, (iii) positive preferences for both, even higher for the combined bonus.

Keywords Water quality, choice experiment, collective action, payment for environmental services, conditional bonus.

JEL code C25, Q15, Q18, Q25, Q28, Q53.

1. Introduction

Payment for environmental services (PES) are initiatives supporting farmers voluntary interventions contributing to the preservation of ecological functions (Duval et al., 2016; Wunder, 2005). They emerged in the early 1990s, in response to the growing awareness of the value and shortage of agri-environment-climate public goods (AECPGs). In the European Union (EU), the most widely implemented PES are the agri-environmental schemes (AES) of the common agricultural policy. Over the past decades, the low environmental additionality, participation rates and cost-effectiveness of AES have been highlighted in the literature, in particular because of underfunded and poorly designed measures (Cullen et al., 2018; Dupraz and Pech, 2007; Espinosa-Goded et al., 2013; Zavalloni et al., 2019). Dedicated PES involving other contractual arrangements and financial contributors are also implemented on a smaller scale. Examples include schemes funded by water bottlers such as the Vittel Company, or by municipalities such as the water authorities of Munich and New York city (Déprés et al., 2008; Grolleau and McCann, 2012).

Designing efficient incentive mechanisms for AECPG provision is a challenge that often involves trade-offs between environmental ambition and large acceptance by farmers. Conditionality rules must define an effort that reaches the environmental objective(s), but remain attractive enough to ensure significant participation. When the objective is to improve water quality or biodiversity, high participation and spatial continuity of environmental commitments at the landscape scale are necessary to observe environmental improvements (Dupraz et al., 2009). Developing instruments favouring collaboration among land managers, coordination of actions and high uptake within a same area are promising ways to increase the environmental effectiveness of farmers' actions, as well as the cost-effectiveness of incentive schemes. In addition to supporting to meet ecological thresholds, collective approaches provide other advantages, such as fewer transaction costs for the buyers of environmental services, and building of social capital for farmers (Kuhfuss et al., 2016; Lefebvre et al., 2015; Pretty, 2003).

Collective approaches can take different forms of contractual arrangements and therefore payment conditionality (Kuhfuss et al., 2019). Some involve a collective payment. In this case, the contracting party receiving the payment is a group of farmers, which distributes the amount to participants according to rules defined by the collective. The Netherlands provide a large amount of examples of successful collective AES, in which participants are local groups of farmers organised in environmental cooperatives (Franks, 2011). Cases from other EU countries are scarce. One can cite the collective AES for preserving the European Hamster (Cricetus cricetus) habitats in France (Eichhorn et al., 2020). Other approaches are based on individual contracting, but condition the distribution of the payment to the achievement of a collective objective (minimum participation or land enrolment at the landscape scale, reaching an environmental goal…) or collective action (coordination of management practices, agglomeration of the plots enrolled…). These conditionality rules can apply to all or part of the payment. In the latter case, the collective component of the contract takes the form of a conditional "reward" or "bonus". An example of mixed-payment scheme is the Swiss network bonus (agglomeration bonus) (Krämer and Wätzold, 2018).

The literature suggests farmers are reluctant when collective requirements are conditioning the full payment, but favourable to a reward conditioned to collective action on top of an individual basic payment. Villanueva et al. (2017) showed that individual contracting tends to be preferred to collective contracting of at least five farms from a same municipality, especially among older farmers with little experience of participating in cooperatives. Interestingly, Ben-Othmen and

Ostapchuk (2019) found an opposite result, with positive preferences for collective contracting of at least three farms from the same municipality. However, the two studies differed in the way collective participation was defined. In the study of Ben-Othmen and Ostapchuk (2019), it was made clear that farmers could form a group with whom they trust the most, and that only free-riding farmers would be sanctioned in case of noncompliance with management requirements, not the whole group. It therefore suggests that a key factor of collective AES acceptance is well-defined group governance and monitoring, what is often emphasized by researchers studying successful Dutch case studies of environmental cooperatives (Barghusen et al., 2021; Franks, 2011; Uetake, 2014). Le Coent et al. (2017) looked at farmers preferences for biodiversity offsets with the full payment conditioned to a minimum of 20% of participation of farmers from the area. They found that farmers anticipate transaction costs for reaching the participation threshold and prefer contracts without. Another study measuring preferences for an AES requiring the coordination of the location of tree planting with neighbouring farms also concluded that farmers were reluctant to the collective approach due to transaction costs and beliefs that other farmers would not be willing to cooperate (Villamayor-Tomas et al., 2019). However, they identified a peer effect, with the finding that farmers were more likely to choose an agri-environmental measure recommended by other farmers. When it comes to collective bonus options, a study by Kuhfuss et al. (2016) reveals positive preferences for a conditional bonus if at least 50% of the eligible area is enrolled in the scheme after five years.

Apart from this last study by Kuhfuss et al. (2016) among vine growers, there is still little evidence on farmers' attitudes towards mixed-payment mechanisms promoting collective approaches. Further analyses would confirm or nuance the acceptability of these nudges in other contexts, and provide recommendation for designing successful schemes. This present study aims at providing new elements on the acceptability among farmers of a collective component in PES, designed to meet high participation rates and environmental efforts. We develop a choice experiment (CE) to measure preferences for a contract targeting the improvement of rivers ecological quality in northwestern France. CE are particularly relevant to elicit preferences for specific contract characteristics that do not yet exist (Louviere et al., 2000). Two types of bonuses were tested to explore new elements on the design of payment mechanisms: an individual bonus for sponsoring a peer, and a sponsor bonus combined with a collective result bonus distributed equally to all participants.

The paper is organised as follow. In section 2 are presented the choice modelling and experimental design. The survey data are described in section 3. Section 4 presents and discusses the results. Section 5 provides some concluding remarks and policy recommendations.

2. Method

2.1. Discrete choice experiment approach

A CE is a survey-based method to elicit stated preferences of individuals. Respondents are successively asked to choose their preferred option among a small number of hypothetical alternatives, which differ according to several attributes. CE techniques are based on Lancaster's theory that consumption decisions are determined by the utility derived from the attributes of the good being consumed (Lancaster, 1966) and the random utility theory decomposing utility into a deterministic part and a random part (McFadden, 1974). They are particularly useful to estimate ex-ante the marginal utility of different characteristics of policy design. The application of CE methods already provided a lot of useful policy recommendations for agri-environmental contracts design, for instance regarding farmers preferences for contract length (Bougherara and Ducos, 2006; Christensen et al., 2011; Latacz-Lohmann and Breustedt, 2019; Ruto and Garrod, 2009), payment sequences (Bougherara et al., 2021) and conditional bonuses (Kuhfuss et al., 2016; Vaissière et al., 2018).

2.2. Model specification

Under the random utility theory, the utility U_{njt} that individual n obtains from choosing alternative j out of J alternatives in the choice set t out of a series of T choice sets, is made of an observed component V_{njt} (deterministic part) and a stochastic error term ε_{njt} (random part) (1).

$$U_{njt} = V_{njt} + \varepsilon_{njt} \tag{1}$$

We assume individual n chooses alternative j if and only if that alternative maximises his utility amongst all alternatives in choice set t. The probability that farmer n chooses alternative j is:

$$P_{njt} = Prob\left(V_{njt} + \varepsilon_{njt} > V_{nit} + \varepsilon_{nit}\right) = Prob\left(\varepsilon_{njt} - \varepsilon_{nit} > V_{nit} - V_{njt} \right) \forall i \neq j \tag{2}$$

The error term is assumed to follow the Gumbel Type-1 extreme-value distribution (McFadden, 1974), such that a logit model can be applied to estimate the parameters. Under the conditional logit (CL) model, the β coefficients representing respondents' preferences for the attribute levels X_{njt} are assumed homogeneous (3).

$$P_{njt} = Prob\left(\varepsilon_{njt} - \varepsilon_{nit} > \beta(X_{nit} - X_{njt})\right) \forall i \neq j \tag{3}$$

The Hausman test allows to check the independence of irrelevant alternatives (IIA) and validate the CL model specification (Hausman and McFadden, 1984). To relax the IIA assumption and account for taste heterogeneity across farmers or across groups of farmers, the mixed logit (ML) (4) or latent class (LC) (5) models are applied (Greene and Hensher, 2003).

$$P_{njt} = Prob\left(\varepsilon_{njt} - \varepsilon_{nit} > \beta_n(X_{nit} - X_{njt})\right) \forall i \neq j \tag{4}$$

$$P_{njt|q} = Prob\left(\varepsilon_{njt} - \varepsilon_{nit} > \beta_q(X_{nit} - X_{njt})|class\ q\right) \forall i \neq j \tag{5}$$

An estimate of the average willingness to accept (WTA) for each attribute X are obtained from the coefficient of the corresponding attribute β_X and the contract payment coefficient $\beta_{payment}$ (6) (Mariel et al., 2021).

$$WTA_X = \frac{-\beta_X}{\beta_{payment}} \tag{6}$$

WTA_X is the average annual payment per hectare a farmer requires to accept a contract for which the level of attribute X is higher by one unit.

2.3. Experimental design

A choice experiment was conducted to measure farmers' preferences for a 5-year contract targeting the improvement of the ecological quality of rivers in 3 regions of northwestern France (Brittany, Normandy and Pays de la Loire), for which participants would enroll all their farmland. Contract were characterized by management requirements defining the environmental services to be delivered by farmers to contribute to the improvement of water quality, a per-hectare payment distributed to farmers individually on an annual basis if they comply with management requirements, and a bonus option (Table 1).

Table 1: Attributes and attribute levels in the CE.

Attribute	Description	Levels
Soil cover	Average agricultural soil coverage throughout the year at the farm level	85% 90% 95%
Hedgerows	Average density of anti-erosion multi-species multilayer hedgerows at the farm level	20m/ha 60m/ha 100m/ha
Basic payment	Per-hectare individual annual payment	150€/ha 300€/ha 450€/ha 600€/ha
Bonus	Whether the contract includes the option of receiving a bonus conditioned to a collective action	**None** **Individual sponsor bonus:** 450€ each time the farmer convinces a peer into entering the scheme **Individual sponsor bonus + collective result bonus:** 450€ each time the farmer convinces a peer into entering the scheme + 50€/ha distributed to all participants if the river's ecological status reaches a higher step of the water quality scale

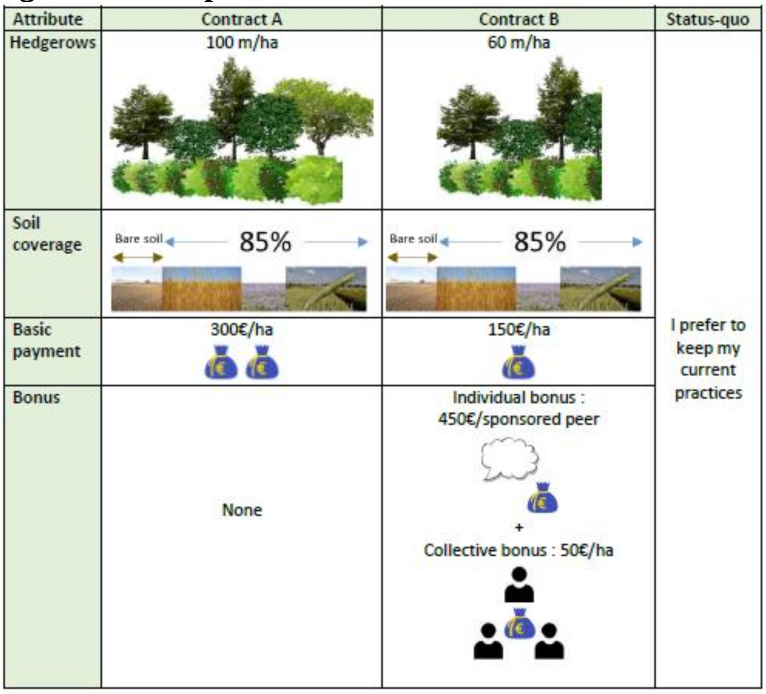
The choice of management and per-hectare payment attributes and levels was based on evidence from a previous study undertaken in a similar environmental context in Brittany (Gruau et al., 2021). Evidence shows that hedge networks in agricultural landscapes such as bocage, act as buffer zones and erosion barriers preventing runoffs in water catchments, in synergy with many other ecological side-benefits (Burel and Baudry, 1995; Caubel-Forget et al., 2001; Merot, 1999). Avoiding long periods of bare soil, in particular in winter, also contributes to limiting soil erosion and runoffs (Souchère et al., 2003).

The higher levels of per-hectare payment are higher than typical AES schemes, to include the possibility that all or part of the payment could be financed by other types of stakeholders (water catchment agency, private companies, municipalities…). The degradation of rivers ecological quality does not only contribute to the deterioration of biodiversity, but also induces higher costs of water depollution for securing drinking water quality. Protecting water resources is therefore of interest for many stakeholders (water catchment bodies, local citizens, local companies, municipalities…). Their role as PES scheme financers would allow to better capture society willingness to pay and farmers WTA, beyond foregone profits. WTA includes uncertainty and factors that are not necessarily technical barriers, such as transaction costs or social capital (Espinosa-Goded et al., 2013).

The bonus option levels were defined together with stakeholders involved in the development of experimental PES in the study area. A sponsor bonus, suggested by farmers involved in an experimental PES in Brittany, is introduced and takes the form of an individual reward for convincing a peer farmer from the water catchment area to enter the PES scheme. A farmer would receive a one-time 450€ per new peer sponsored. Each farmer can be sponsored only once. For the parties financing the PES scheme, the sponsor bonus offers the opportunity to increase participation at the water catchment scale while benefiting from the peer effect (communication on the scheme, knowledge spillover…). For the farmers, sponsoring peers induces new transaction costs (social commitments, time consuming). Therefore, a second level of bonus option introduces an additional reward of 50€/ha, distributed to all participants if a collective result is obtained. The environmental result considered is a higher step of the water quality scale for the river's ecological status. This option is introduced to encourage collaborative effort to reach a common objective and increase even further the environmental effectiveness of the scheme. The underlying hypothesis is that the consideration of sponsored peers' environmental outcome externality would lower farmers' individual adoption cost for the sponsor bonus.

Choice sets including two contract alternatives and the status-quo (option to opt-out and choose none of the contracts) were designed by combining the different attribute levels (see Figure 1 for an example of choice card). A d-efficient design of 36 choice sets to be divided into 4 blocks of 9 choice cards was constructed.

Figure 1: Example of choice set of the CE.



For the econometric analyses, management attributes (*COVER*, *HEDGEROWS)* and the basic payment attribute (*PAYMENT*) are coded as continuous variables and the bonus levels ($BONUS_{sponsor}$, $BONUS_{sponsor/collective\ result}$) as dummy variables. All the attribute levels are set at 0 for the status-quo alternative. We also define an alternative specific constant controlling for the status-quo alternative (ASC_{sq}).

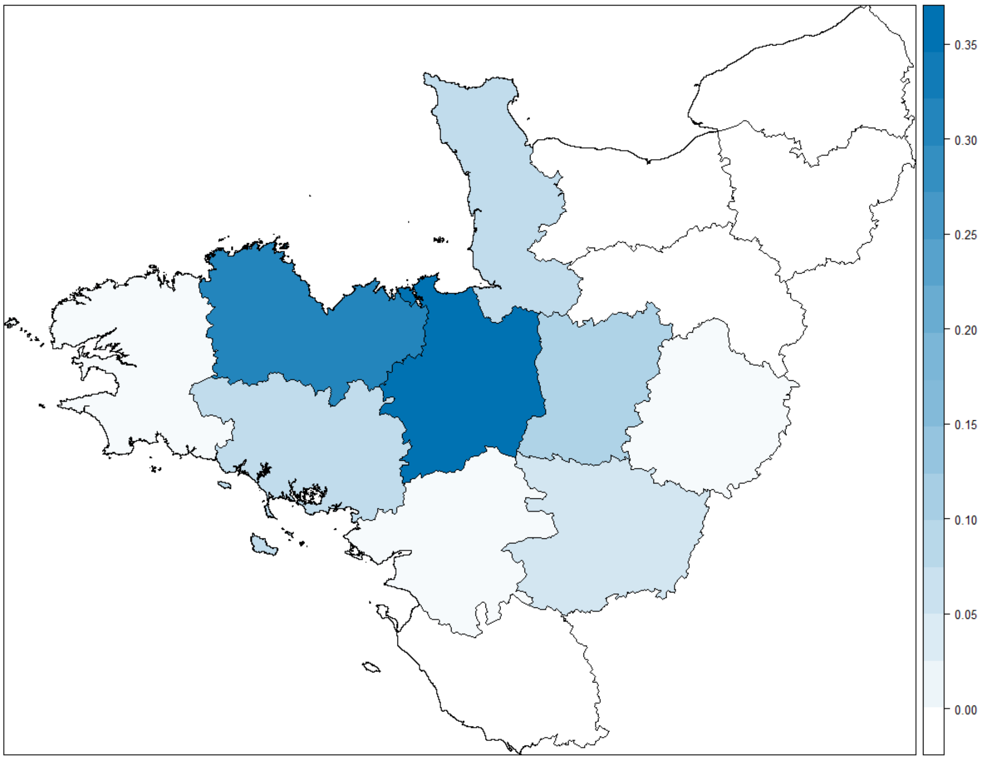
2.4. Survey structure

The CE was included as a section of a pan-EU survey on the acceptability of agri-environmental-climate contract solutions, conducted in spring 2021 among farmers located in Brittany, Normandy and Pays de La Loire. Voluntary farmers were contacted to organise a face-to-face interview after being recommended by intermediaries (farmers union, organisations of milk producers, farmers associations…). The first section of the survey includes general information on farmer and farm characteristics, and the second section on the impact of contract characteristics on the willingness to adopt contractual solutions. In particular, farmers were asked to state from a scale from 1 to 5 how much would the possibility to collectively agree on environmental targets and measures at landscape-level together with other land managers ($ATTITUDE_{collective\ agreement}$), and to receive a common payment to be distributed among participants ($ATTITUDE_{collective\ payment}$), increase or decrease their willingness to enroll? In this third section dedicated to the CE, respondents were introduced to the context, objective and rules of the game of the CE, and to the contract parameters (those fixed and those varying from one alternative to another). Preliminary questions were included to help the respondents estimating their current levels of management requirements (individual status-quo). The current soil cover duration was calculated from the stated hectares of permanent grasslands, arable crops, permanent crops and total utilised agricultural area (UAA), as well as the average number of days with bare soil on arable lands and proportion of grass cover on the permanent crops surfaces. The current hedgerows density was calculated from the total UAA and total meters of multispecies multilayer hedgerows currently present on the farmland. Farmers were then asked 9 times to choose the preferred option among 2 contract alternatives and the status-quo.

3. Data

130 farmers' responses were collected. 97 farmers are located in Brittany (74.6% of the sample), 23 in Pays de la Loire (17.7% of the sample), and 10 in Normandy (7.7% of the sample) (Figure 2).

Figure 2: Distribution of the sampled farms in the surveyed regions (%)



Descriptive statistics of the sample are provided in Table 2. A comparison of the sample characteristics with the 2010 agricultural census data for the study area (Brittany, Pays de la Loire, Normandy) shows that the sample is representative of farmers' age and UAA, but over represents male farmers with higher education, organic, dairy and mixed cattle farms (SSP, 2010). This bias is explained by the non-random sampling procedure respecting the data protection policy, with a preliminary selection of volunteers by intermediaries. The initial levels of anti-erosion multispecies multilayer hedgerows density and soil cover duration estimated for the sample are also particularly high for the surveyed area, with many farms already fulfilling the highest levels of the hypothetical contracts requirements. Farmers stated few days of bare soil for their arable land (25 days on average). Moreover, the farms of our sample stated having on average 88 m/ha of multispecies multilayer hedgerows, while all types of hedgerows considered (including monospecies or monolayer), the observed average density is 49 m/ha in Normandy, 48 m/ha in Brittany, and 55 m/ha in Pays de la Loire (Mission Bocage, 2011; Simon et al., 2019, 2018).

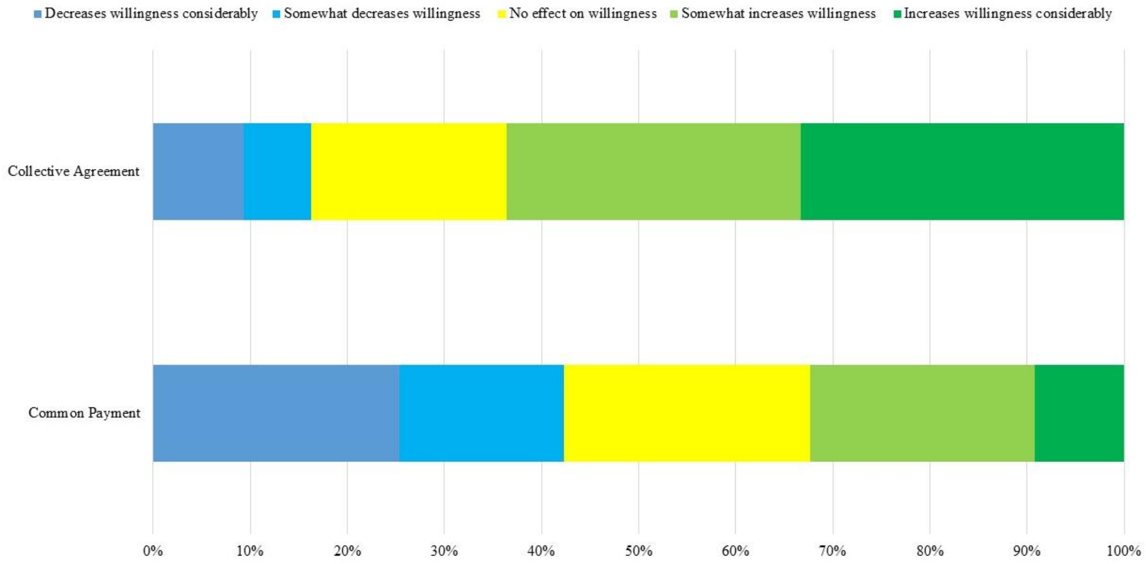
Table 2: Descriptive statistics of the sample

Variable	Sample mean	Standard deviation
Farms' characteristics		
UAA (ha)	100.3	64.3
Share of rented area (%)	72.1	28.5
Share of permanent grasslands (%)	35.7 (4 n.a)	31.6
Share of arable land (%)	62.3 (4 n.a)	31.9
Share of land under permanent crops (%)	2.0 (4 n.a)	10.2
Specialised in dairy (%)	50.8	50.2
Specialised in crops (%)	14.6	35.5
Specialised in granivores (%)	8.5	27.9
Organic farming (%)	39.2	49.0
Enrolled surfaces in AES in 2020 (%)	40.8	49.3
Number of full time workers	2.1	1.2
Farmers' characteristics		
Female (%)	13.1	33.8
Older than 50 years old (%)	44.6	49.9
Plan to stop managing farm activities in 5 years or less (%)	20.0	40.2
Higher education (%)	63.1	48.4
Current levels of management requirements		
Soil cover (%)	94.9 (4 n.a)	7.1
Hedgerows (m/ha)	87.8 (10 n.a)	73.7

n.a: not answered.

Regarding farmers perception of collective elements in PES, more than 50% of the sample stated the possibility to collectively agree on environmental targets and measures at landscape-level with other land managers would increase their willingness to enroll in a contract, while only a bit more than 30% stated receiving a common payment to be distributed among participants would (Figure 3).

Figure 3: Stated effect of collective components in contract design on willingness to adopt



4. Results and discussion

As a baseline, we estimate a CL model with attribute levels and ASC_{sq} as explanatory variables. The CL specification with effects coding for management attributes was compared with continuous coding (Bech and Gyrd-Hansen, 2005). Models did not significantly vary, and it was decided to keep the continuous coding. The Hausman-McFadden test reveals the IIA assumption is violated and preference heterogeneities across respondents, suggesting the need to rely on ML or LC models to analyse the data.

To disentangle preference heterogeneities, we apply a ML model with all attributes and status-quo coefficients as random parameters, expect for the basic payment coefficient we keep fixed (Table 3). The first ML specification (1), without individual specific variables, shows that the density of hedgerows and the level of the individual payment significantly affects respondents' choice, with the expected signs (negative effect for the level of hedgerows requirements and positive effect of the level of payment). The requirement of soil cover is however not significant. Farmers exhibit positive preferences for the bonus attribute, but only the sponsor bonus by itself is significant. The status-quo was chosen in 16% of the choice situations but results suggest farmers had no significant preferences for this option. The significance of standard deviation coefficients shows strong preference heterogeneities for both management attributes and the bonus option offering both the possibility of a sponsor bonus and a collective result bonus.

Table 3: Mixed Logit estimations (normal distribution of random parameters)

	(1)	**(2)**
	Estimate	Estimate
PAYMENT	**0.006*****	**0.006*****
	(0.000)	(0.000)
COVER	0.017	**-0.189***
	(0.016)	(0.074)
HEDGEROWS	**-0.013****	**-0.034*****
	(0.004)	(0.007)
$BONUS_{sponsor}$	**0.343***	**0.395***
	(0.157)	(0.161)
$BONUS_{sponsor/collective\ result}$	0.317	**-0.976***
	(0.184)	(0.412)
ASC_{sq}	-0.121	1.970
	(1.470)	(1.536)
$COVER*COVER_{current}$	-	**0.253*****
		(0.076)
*COVER*ORGANIC*	-	**-0.032*****
		(0.008)
*COVER*SHORT-TERM*	-	0.010
		(0.010)
$HEDGEROWS*HEDGEROWS_{current}$	-	**0.000****
		(0.000)
*HEDGEROWS*ORGANIC*	-	**0.040*****
		(0.009)
*HEDGEROWS*SHORT-TERM*	-	**-0.037****
		(0.011)
$BONUS_{sponsor/collective\ result}*ATTITUDE_{collective\ payment}$	-	**0.441*****
		(0.128)
SD.COVER	**0.051*****	**0.041*****
	(0.005)	(0.005)
SD.HEDGEROWS	**0.048*****	**0.040*****
	(0.005)	(0.004)
$SD.BONUS_{sponsor}$	0.281	0.123
	(0.279)	(0.284)
$SD.\ BONUS_{sponsor/collective\ result}$	**1.114*****	**1.142*****
	(0.196)	(0.210)
$SD.ASC_{sq}$	0.444	0.455
	(0.259)	(0.606)
Log likelihood	-819.93	-737.18
Pseudo-R^2	0.317	0.386
AIC	1661.858	1510.352
BIC	1717.57	1600.077
Observations	1170	1080
Number of farms	130	120

Significance levels: *** p-value <0.001, ** p-value <0.01, * p-value<0.05.
Standard errors in parentheses.

In a second ML specification (2), we investigate preference heterogeneities for management requirements and the combined bonuses option by adding interaction terms with individual specific variables collected in the survey. The covariates included were farms' current management attribute levels ($COVER_{current}$ and $HEDGEROWS_{current}$), and organic status (*ORGANIC*), plan to stop managing farm activities in 5 years or less (*SHORT-TERM*), and attitude towards collective payments as contract design characteristic ($ATTITUDE_{collective\ payment}$). Results suggest that, when controlling for the perceived current density of eligible hedgerows and duration of soil cover, coefficients for both the management attributes become significantly negative. In addition, interaction terms show that the higher the initial management requirement levels, the higher the preferences for higher levels of the corresponding attributes. Maintaining high density of hedgerows and a long period of soil cover is costly and farmers might see an opportunity to be compensated for it with a PES scheme. In particular, many farmers of the sample are located in a nitrate vulnerable zone and must already comply with strict rules of soil coverage during winter. Controlling for organic status shows that organic farmers prefer lower levels of cover duration, which can be explained by their higher need to use tillage for weed control. However, they tend to prefer higher density of anti-erosion hedgerows. We can assume they also value the multiple ecosystem services delivered by hedgerows that support organic practices (habitats for natural predators of pests, reducing exposure to pesticide spray drift from neighbouring farms…). Moreover, respondents who plan to stop farming activities in 5 years or less have stronger negative preferences for hedgerows, which require long-term engagement of maintenance. Finally, farmers who scored high in terms of impact of a common payment on the willingness to join a contract exhibit positive preferences for the combined sponsor and collective result bonuses, while on average, sample preferences are negative for this bonus level. It suggests that some farmers are "pro-collective" while others are opposed to collective payments.

Farmers' average marginal WTA and 95% confidence intervals for the attributes for both ML specifications are reported in Table 4. Ceteris paribus, a farmer accepts a contract with on average 67€ (specification (2)) less of individual payment per hectare if there is a sponsor bonus of 450€/peer. For a farm of 100ha (average farm size of the sample), it represents a decrease of 6,700€ of basic payment per year. A farmer would need to convince at least 15 new farmers each year to receive the same amount of sponsor bonuses, what confirms the result by Kuhfuss et al (2016) that introducing a bonus option can improve the cost-effectiveness of a scheme. However, the WTA a contract increases on average by 165€/ha if a collective result bonus of 50€/ha is also included in the scheme, in addition to the sponsor bonus.

Table 4: Average marginal willingness to accept PES contract design characteristics (delta method)

ML specification	(1)			(2)		
Attributes	WTA (€/ha/year)	Confidence interval		WTA (€/ha/year)	Confidence interval	
		2.5%	97.5%		2.5%	97.5%
COVER	-2.7	-8.1	2.6	**32.1***	7.7	56.4
HEDGEROWS	**2.2****	0.8	3.7	**5.8*****	3.4	8.1
$BONUS_{sponsor}$	**-56.9***	-108.2	-5.6	**-66.9***	-120.9	-12.9
$BONUS_{sponsor/collective\ result}$	-52.4	-111.9	7.0	**165.3***	28.2	302.4
ASC_{sq}	20.1	-457.3	497.4	-333.6	-842.3	175.2

We further characterise preference heterogeneities by estimating a LC model (Table 5). The first class (25.6% of respondents) describes preferences for low hedgerows density requirements and non-significant effects of bonuses. Farmers stopping their activity within 5 years are more likely to be in this "hedgerows averse" class. The second class (11.8% of respondents) depicts farms preferring the status-quo or contracts with high management requirements and no bonuses. Organic farmers are more likely to be in this "pro-environment individualists" class. The third class (62.6% of respondents) describes farmers with positive preferences for both types of bonuses, who also require higher levels of per-hectare payment. The level of financial incentives seems to drive their choice, more than technical constraints. This "pro-incentive" class more receptive to bonuses includes younger (not short-term-oriented) and conventional farmers. Kuhfuss et al. (2016) also found that younger farmers are more likely to prefer bonuses while asking for higher compensation levels. Since our sample over-represents organic farmers (39% instead of 10% locally), it would suggest that the combined bonuses can be cost-effective insofar as the overall payment is high enough to reach an environmentally effective participation level.

Table 5: Latent Class estimation

	Class 1	**Class 2**	**Class 3**
	Estimate	Estimate	Estimate
PAYMENT	0.002	**0.003*****	**0.007*****
	(0.001)	**(**0.001)	(0.001)
COVER	**0.105****	-0.027	0.025
	(0.035)	(0.032)	(0.016)
HEDGEROWS	**0.022*****	**-0.059*****	0.004
	(0.005)	(0.006)	(0.002)
$BONUS_{sponsor}$	**-0.681***	0.461	**0.701*****
	(0.324)	(0.298)	(0.180)
$BONUS_{sponsor/collective\ result}$	**-1.117****	0.122	**0.795*****
	(0.355)	(0.353)	(0.167)
ASC_{sq}	**11.882*****	-4.579	1.575
	(3.197)	(2.900)	(1.589)
Log likelihood		-825.03	
Pseudo-R^2		0.313	
AIC		1698.06	
BIC		1819.615	
Observations		1170	
Number of farms		130	
Probability of class	0.118	0.256	0.626

Significance levels: *** p-value <0.001, ** p-value <0.01, * p-value<0.05.
Standard errors in parentheses.

5. Concluding remarks

The effectiveness of payment schemes for delivering AECPGs with provision thresholds (biodiversity, water quality) depends on reaching enough farmland enrolment at the landscape scale. The objective of the present study was to elicit farmers' preferences for a mixed-payment mechanism made of a bonus on top of a basic payment incentivizing farmers to adopt a collaborative behavior favoring the delivery of public goods with landscape thresholds effects.

Findings suggest that overall, farmers prefer contracts with a bonus for sponsoring a peer to no bonus, but prefer contracts with no bonus to a combined sponsor/collective bonus for environmental achievement. Designing bonuses distributed according to an individual effort for attracting more farmers could be a promising way to increase participation, while collective bonuses distributed equally to all might be counterproductive. We characterized respondents' heterogeneity with a latent class model and identify 3 groups of farmers with a different attitude towards the bonus options: (i) "pro-environment individualists" with negative preferences for both, (ii) "hedgerows averse" farmers who seem indifferent to both, and (iii) "pro-incentive" farmers with positive preferences for both. The later class of farms, most likely to be receptive to the introduction of bonuses for collective actions in environmental contracts, tend to include younger and more conventional farmers. This is a particularly interesting result in the prospect of developing those incentive mechanisms in the future.

A limit to the generalization of our findings is that due to our sampling procedure, our data are slightly biased. Asking and controlling for individual status-quo levels allowed us to control part of the bias regarding the already high levels of management requirements implemented by respondents. In addition, there is an over-representation of organic farms (39% of the respondents while the actual share is closer to 10%). Since organic farms are more likely to have a “pro-environment individualist” preference pattern, our results likely overestimate the negative attitude towards the combined sponsor/collective result bonuses, which, according to the two other behaviour patterns identified, might actually be cost-effective as long as the total amount of financial incentive is attractive enough to effectively boost participation.

Further work is needed to see if conditional bonuses are successful in improving public good provision in practice. An agri-environment-climate measure to protect the European Hamster in France recently introduced an individual bonus payment when a burrow is detected on a plot. This case study might provide useful empirical evidence.

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