Collective incentives : what design for agri-environmental contracts ?

Laure Kuhfuss, Raphaële Préget, Sophie Thoyer

Preliminary version

Collective incentives : what design for agri-environmental contracts ?

Abstract

The evaluations of the French rural development program point out the low participation of farmers in the national Agri-Environmental Schemes (AES) granting compensation payments to farmers committing to reduce their use of pesticides. Using a choice modeling approach, our objective is to test whether the introduction of a collective dimension in agri-environmental contracts can enhance farmers' initial participation in AES and so initiate a group dynamics favoring a change of practices towards less intensive use of pesticides on a territory. Our collective dimension relies on a monetary 'bonus' paid per hectare engaged to each farmer who has signed a contract, provided that 50% of the area of interest is enrolled at the end of the contract. The objective of the paper is to measure empirically with a choice experiment the preference of farmers for this type of conditional bonus. We conduct an evaluation on hypothetical contracts for low-herbicide practices in the Languedoc-Roussillon region, located in the South East of France, where nearly two thirds of agricultural area is dedicated to vineyards. We show with a sample of 317 wine-growers that introducing a conditional bonus can be a way to improve participation and land enrollment for a lower budgetary outlay.

Keywords: payment for environmental services, choice experiment, collective incentive, agri-environmental schemes

1 Introduction

Agri-environmental measures were introduced in the Common Agricultural Policy (CAP) in 1992 to reduce the negative impact of agriculture on the environment. They are individual contracts signed with farmers who agree to implement environmentally enhanced management practices in return for an annual payment. This payment is calculated so as to compensate average compliance costs and foregone farming revenue. Over the 2007-2013 financial period, total payments made by the European Union for agri-environmental schemes (AES)[1] amounted to 22.7 billion euros, and were supplemented by Member states for an equivalent amount.

Two main shortcomings of these agri-environmental schemes are regularly pointed out by evaluation reports and research to explain the disappointing environmental outcomes of AES: the

[1] Financial plan of EARDF axis 2 measure 214 (agri-environment)

insufficient participation of farmers and low levels of enrolled area in agri-environmental measures which demand a greater environmental effort; and the lack of geographical targeting leading to the dispersion of contracts over large areas (Hanley et al, 1999; Yang et al, 2005; ECA, 2011). Agri-environmental schemes are regularly revised and adjusted in order to improve their cost-efficiency. In France, the national rural development program for the 2007-2013 period has imposed a better targeting on vulnerable area and has designed contracts proposing at least two different levels of environmental practices –an entry-level and a more demanding contract – matched by different levels of financial compensation – in order to better take account of the heterogeneity of farmers' preferences and constraints (Kuhfuss et al, 2013). Despite these adjustments, the rate of adoption of more environmentally-friendly practices remain slow and does not yield satisfactory environmental improvements.

There is a growing theoretical and empirical economic literature on the reasons why farmers choose to enroll or not into an agri-environmental contract. It shows that farmers' willingness to accept (WTA) requirements for entry into an agri-environmental measure are heterogeneous (Vanslembrouck et al, 2002; Peerlings and Polman, 2009; Christensen et al, 2011; Ma et al, 2012). In a simplified analysis, it is assumed that the farmer makes his decision based on the trade-off between the utility of contract payment and the disutility of the environmental effort he has to provide. WTA depend therefore on the level of restrictions imposed by the agri-environmental contract on farming practices, on the socio-economic characteristics of the farmer, but it also depends on specific attributes of the contract such as the contract duration, the flexibility of technical constraints, and the transaction costs associated with administration and control (Falconer and Saunders, 2002; Ducos et al, 2009; Ruto and Garrod, 2009). Based on these findings, recommendations were made to improve the design of contracts design and adjust them better to farmers' preferences and constraints.

One under-explored area of contract innovation is the collective dimension of contracts. Encouraging a group of farmers to enroll jointly in an agri-environmental scheme can be justified by the fact that many environmental services provided by improved farming practices have a local public good dimension and benefit to all farmers (and possible non farmers) located in the same area (Mac Farlane, 1998). Moreover the effectiveness of AES is often jeopardized by threshold effects, when the environmental state does not improve significantly as long as the global environmental effort (in terms of improved practices) has not reached a minimum level of intensity or has not been applied on a sufficient area in the zone of interest (Dupraz et al, 2009). Another justification for collective contracts is that they provide incentives for a group of farmers to enroll, therefore initiating a dynamic of change and a more rapid diffusion of new practices through learning and imitation (Bikhchandani et al, 1998).

There are examples of innovative contracts promoting the collective management of land via voluntary associations of farmers: they enable to limit the usual transaction costs associated with contract negotiation and enforcement but require that the group of farmers, as documented by Francks (2011) in his analysis of the Dutch environmental cooperatives experience, shares the same values and objectives. In this paper, we analyze another way to promote the collective dimension: it relies on a financial 'bonus' paid to each farmer who has signed a contract (on top of the contract payment), provided that the proportion of land collectively subscribed in the AES for the zone of interest reaches a predefined threshold**.** The interest of such conditional bonus is to signal that a greater participation rate in the AES will benefit to all contractors through an additional payment. It can therefore provide an incentive to farmers to promote the AES and to encourage their fellow farmers to sign in as well.

The principle of such type of payment has already been proposed to address the specific issue of spatial coordination of enrolled plots of land. When fragmented land needs to be reunited under a coherent habitat protection policy for example, the "agglomeration bonus" pays an extra bonus for every plot a landowner enrolls that borders another enrolled. The efficiency properties of a contract proposing an agglomeration bonus have been assessed through lab experiments, in particular to check how landowners coordinate on a Nash equilibrium (Parkhurst et al, 2002; Banerjee et al, 2009). The state of Oregon in the US has implemented a simplified version of the mechanism described in Parkhurst et al (2002) to increase the enrolment of vulnerable areas in its Conservation Reserve Enhancement Program (USDA 1998): an extra bonus was paid to participating landowners along a stream if at least 50% of the stream bank within a 5-mile stream segment was also enrolled in the program.

The objective of the paper is to measure empirically the preference of farmers for a similar type of conditional bonus, paid only if 50% of the area of interest is enrolled, and to assess under what conditions this new contract design could lead to a greater participation and larger land enrollment without increasing budgetary costs. We use a choice modeling approach because it enables us to measure the marginal willingness to accept of farmers for different contract attributes, including the collective bonus, and the substitution and complementary of the bonus with other contract characteristics.

Our evaluation is conducted in the Languedoc-Roussillon region, located in the South East of France, where nearly two thirds of agricultural area is dedicated to vineyards. The widespread use of chemical herbicides to control weeds has contributed to the contamination of groundwater and streams. French authorities have identified 38 watersheds in Languedoc-Roussillon which may represent a sanitary risk for drinking water and for which policy solutions must be found to reduce agricultural diffuse pollution. The main policy option is to induce farmers to switch to more environmentally-friendly weed control techniques such as mechanical weeding or controlled grass cover. France is thus re-examining the design of its AES in order to enroll larger vineyard areas in low-herbicide practices.

We show with a sample of 317 respondents that introducing a conditional bonus improves the probability to sign an agri-environmental contract and, for equivalent environmental effort intensity, it reduces the individual WTA by an amount which is 6 times greater than the amount of the expected bonus. The conditional bonus can thus be a way to improve enrollment for a lower budgetary outlay.

The structure of the paper is as follows: section 2 presents the collective dimension of contracts in the literature and previous experience with collective agro-environmental schemes are discussed. Section 3 describes the experimental design, survey and resulting data. Section 4 contains the results and discussions

2 Collective dimension of contracts

The introduction of a collective bonus in a contract, conditional on a minimal participation threshold, is expected to boost the rate of enrollment, by offering an additional incentive to contractors. An expected positive indirect effect is also that would-be contractors should be more confident that others will join as well and that the overall participation rate will be high (Francks, 2011). These are several reasons why a higher participation rate is important, both for the enrolled farmer (the supply side of environmental benefits) and for the policy-maker (the demand side).

The first reason lies in the public good dimension of the benefits: in the case of water contamination by herbicides, each farmer’s efforts to reduce pollution contribute to water quality improvement which is a public good shared by all consumers in the same catchment area. It can even be considered a public good with threshold: the pesticide concentration cannot exceed a maximum value set by health authorities, otherwise abstracted water must undergo costly treatments which are paid for by water users through higher water prices. Therefore total efforts to reduce pesticide use must be sufficient to ensure that the threshold is not exceeded. If it is not the case, all efforts made are wasted (Ferraro, 2003).

The second reason is linked to the cost of herbicide use abatement. Indeed, the individual costs borne by farmers to reduce their pollution can also depend on the global participation rate in the AES. Are there cost synergies in herbicide use abatement? The agriculture literature on this point is unclear. On the one hand, if many farmers in the catchment reduce their use of herbicide, we can expect that weeds will prosper and the cost of weed control will increase accordingly. On the other hand, if a group of neighboring farmers chooses to adopt similar no-herbicide technologies to control weeds, it is likely that they will share experience, will benefit from mutual learning, and could choose to buy costly equipment together. This could clearly contribute to reduce unit costs of abatement (Waterfield and Zilberman, 2012).

The third reason relates to farmers' behavior. Literature in social psychology and behavioral economics shows that our utility level does not depend exclusively on our absolute level of consumption or wealth but also on how we compare ourselves relatively to others and how we perceive our position or rank in the social group to which we belong (Bernheim 1994; Sustein and Thaler 2008). Decisions and choices can thus be guided by the willingness to obtain the same advantages as others, or more generally to behave like others. In particular, it has been demonstrated that individuals value the fact to conform to the social norm. Social norms are usually sustained by feelings attached to the reputation and self-esteem generated by conforming to the common rule or behavior, or the shame and guilt of not observing it. Therefore, individual behavior can be influenced by the behavior of other members in the community and, conversely, a change in aggregate behavior can induce a change in individual's behavior (Dietz 2002; Pretty, 2003).

A farmer can value the fact that his agricultural practices are similar to his neighbors' techniques. For example, Chen et al (2009) have studied the effect of different factors on people's intentions of re-enrolling in a specific payment for environmental services scheme in China. They find empirically with a choice modeling approach that, in addition to conservation payments and program duration, the main driver of re-enrollment is the information that the neighborhood is also intending to re-enroll. In other words, an already high level of participation can positively influence the choice of other farmers to participate. Chen et al suggest that this result is explained by unconscious imitation, inter-personal comparison and group's informal norms. Thus, the aggregate impacts of social norms at the neighborhood level on the cost of agri-environmental schemes can be substantial. This is the hypothesis tested with our choice experiment described in the next section.

3 The choice experiment method

3.1 The econometric model

Farmers' decision to participate in an AES can be explained by the characteristics (attributes) of the agri-environmental contracts available and by farms' and farmers' characteristics (Beharry-Borg *et al.* 2012, Ruto and Garrod 2009, Espinosa-Goded *et al.* 2010, Broch and Vedel 2011).

Farmers' decision to choose a contract is guided by the relative utility he can gain by choosing one contract (identified by its attributes) compared to the alternative contracts available and the *status quo* (no participation in the AES). Following the random utility theory, we assume that the utility of farmer n when choosing alternative i (U_{in}, unobserved) consists of an observable deterministic element V_{in} and a random part ε_{in}. That is : $U_{in} = V_{in} + \varepsilon_{in}$.

The explainable component V_{in} depends on the K attributes of the contract, represented by the vector X_i, and on the A characteristics of farmer n (vector Z_n). In a linear specification, it writes as:

$$V(X_i, Z_n) = \sum_{k=1}^{K} \beta_{ik} x_{ik} + \sum_{a=1}^{A} \alpha_{an} z_{an} \ .$$

The probability P_{in} that farmer n chooses alternative i rather than any other alternative j in the choice set C is:

$$P_{in} = P\left[V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \forall j \in C, j \neq i\right]$$
$$P_{in} = P\left[\varepsilon_{jn} < V_{in} - V_{jn} + \varepsilon_{in}, \forall j \in C, j \neq i\right]$$

With the assumption that the unobservable error terms ε_{in} are independently and identically distributed (IID) among the alternatives and across the population and follow a type 1 extreme value distribution, then we have the following expression of the Conditional Logit model:

$$P_{in} = \frac{\exp(\beta' X_i)}{\sum_{j \in C} exp(\beta' X_j)}$$ with β the individual preference vector of taste parameters.

Since farmer's characteristics are invariant through choices, they do not appear in the choice probability.

3.2 Data collection

The data were collected through a choice experiment survey in which farmers were invited to select their best option between two different contracts and a 'choose neither' alternative (Figure 1). If they chose one of the two contracts proposed, they were then asked how much land (in ha) they would be prepared to enrol in the selected contract.

The attributes of the contract and their levels (Table 1) were chosen with the technical help of the four local farm union-run bodies called Chambres Départementales d'Agriculture (CDA). The questionnaire was discussed with two focus groups made of winegrowers and experts and was partially redesigned. A pilot survey was conducted with 31 face to face interviews with winegrowers.

A full factorial design (all possible combinations of attribute levels) would have represented 20 592 choice cards. Thus an efficient design was selected (by an initial estimation of parameters from the responses obtained in the pilot survey) and composed of 3 blocks of 6 choice cards. An example of choice card is presented in Figure 1.

Table 1 Attributes and attribute levels chosen for the choice experiment

Attribute	Description	Levels
Herbicides used on the farm during the contract	Global reduction of herbicide use on the enrolled area (in proportion of present use)	Quantitative variable : -30% ; -60% ; -100%
Localized use of herbicides	Supplementary localized use of herbicides beyond the committed reduction	Dummy variable : Allowed (reference) ; Forbidden
Collective and final conditional bonus	150€/ha after five years, provided that, at the end of the 5 years, 50% of the area of interest is engaged in a process of herbicide use reduction	Dummy variable : Final bonus (150€/ha equivalent to 30 €/ha/year) ; No bonus (ref.)
Administrative and technical assistance	Free administrative and technical assistance included in the contract and provided by a local technician	Dummy variable : Yes ; No (ref.)
Individual annual payment per enrolled hectare	Payment received each year by the winegrower per enrolled hectare	Quantitative variable : 90€/ha ; 170€/ha ; 250€/ha ; 330€/ha ; 410€/ha ; 500€/ha

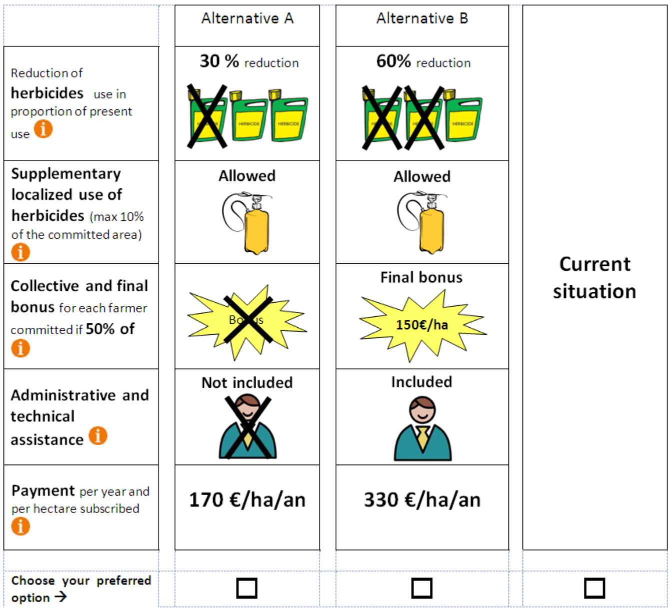

Figure 1: an example of choice card

The data were collected using an online, e-mail distributed survey sent to 3100 winegrowers in Languedoc-Roussillon with the help of the four CDA. 317 farmers answered the survey (response rate of 10.2%), each making 6 choices between 2 alternative contracts and a 'choose neither option'.

They also answered questions on their present herbicide use practices and on their socio-economic characteristics. Follow-up questions included a specific question on the attainability of the threshold. It was phrased as follows: do you believe that the 50% threshold of AES-enrolled land in your area can be reached? It was used in our analysis as a proxy of farmers' beliefs that the bonus will be paid.

4 Results

4.1 Our sample

Table 2 synthetizes some socio-demographic variables. There are a few missing data because respondents were not obliged to answer these questions.

Table 2 : Descriptive statistics of the sample (317 observations)

	Nb	% of sample
Gender		
Male	262	82.6 %
Female	51	16.1 %
Age		
18 to 34	42	13.2 %
35 to 44	67	21.1 %
45 to 54	112	35.3 %
55 to 64	82	25.9 %
> 65	14	4.4 %
Education		
Primary	8	2.5 %
Secondary (short)	75	23.7 %
Secondary (long)	92	29.0 %
Higher education	140	44.2 %
Status		
Full-time farmer	237	74.8 %
Part-time farmer	48	15.1 %
Employee	15	4.7 %

	Nb	% of sample
Main or exclusive activity : vineyard	290	91.5 %
Other activity on the farm	97	30.6 %
Off farm income available	190	59.9%
Winemaking		
Individual winery only	47	14.8 %
Cooperative winery only	242	76.34 %
Both	25	7.9 %
Presently engaged in an AES	38	12.0 %

Farm	**Nb**	**Mean**	**S.E.**	**Min**	**Max**
Total area (ha)	314	34.79	48.77	1	650
Vineyard area (ha)	316	24.72	21.29	1	155
Workforce (equivalent full time worker)	300	2.32	2.61	0	25
% of vineyard which cannot be mechanised	306	37.25	32.16	0	100

S.E. : Standard Error

71 (22%) of the 317 respondents always prefer not to subscribe a contract, *i.e.* they choose the opt-out option in the 6 choice situations. The systematic choice of the status quo may hide protest responses, even if choice experiment methods are expected to be less prone to this bias than contingent valuation methods (Hanley et al., 2001). In order to identify potential protest respondents, we used a debriefing question. Each time a respondent selected the 'choose neither' option, he was given the opportunity to explain his decision. He could explain his rejection of the two proposed alternatives by ticking one of the following options:

- *The financial compensations are too low (1)*
- *The required level of herbicide reduction is too constraining for my farm (2*

- *I do not want to be constrained on my farming practices, regardless of the compensation awarded (3)*
- *Other :* ______________________

Among the 71 farmers who always preferred not to sign a contract, 27 systematically chose the third explanation. We identify these 27 wine growers as protest respondents since they reject the contract whatever the associated financial compensation. In addition, when analysing the follow-up questions included in the survey, we noted that those respondents were significantly less convinced by the impact that such agri-environmental contract can have on water quality improvement and on the conversion of farmers to more environmentally-friendly practices (Wilcoxon Mann-Whitney tests). Therefore, as it is commonly done in the literature, we removed those 27 protest respondents from the sample (Adamowicz et al., 1998; Bario and Loureiro 2010). Following results are obtained with a reduced sample of 290 respondents.

4.2 The contract's choice: Conditional Logit model

The Conditional Logit model gives a first estimation of the effects of contracts' attributes on farmers' choice (β_k) (Table 3). Our first model (CL1) only contains the attributes of the contract as a factor of choice.

In a second model (CL2), we investigate how the interactions of the contracts' attributes can influence farmers' choices. Indeed, we expect that if free assistance is included in the contract, farmers will be encouraged to consider a more intensive reduction of herbicides. Similarly, the inclusion of this attribute, that also includes the presence of a local technician in charge of the agri-environmental scheme in the area of interest, should increase the preference for contracts with collective bonus, since they can expect that the threshold conditioning the bonus will be reached with a higher probability thanks to the work of the local technician. This model also includes the interaction effects of individual characteristics with some of the contracts' attributes. We expect that farmers' present use of herbicides can influence the level of the reduction they can reach. The last interaction included is the interaction between the bonus and the confidence that respondents declare to have in the possibility that the threshold can be reached. Indeed, the particularity of the collective bonus is that it is paid only if 50% of the zone of interest is enrolled in the AES. *Threshold Conf.* is coded as a dummy variable. Farmers believing that the threshold cannot be reached (*Threshold Conf.* = 0) should be indifferent to the presence of the bonus attribute in the proposed contract. On the contrary, farmers believing that this threshold can be reached (*Threshold Conf.* = 1) should be positively influenced in their choice by the presence of the bonus.

Finally, in our last model (CL3), we also introduced the individual characteristics of the respondents and their farm in interaction with the Alternative Specific Constant (ASC): some of farmers' characteristics can influence farmers' willingness to adopt an AES, rather than staying at their *status quo*. These individual characteristics need to be introduced in interaction with the ASC as they are invariant through the choices of a respondent.

Table 3 Conditional Logit model estimations

	Conditional Logit CL1		Conditional Logit CL2		Conditional Logit CL3	
	N = 290		N = 264		N = 264	
Depend. Var. : Choice	β	P value	B	P value	β	P value
ASC	0.285*	0.072	0.525***	0.009	3.331***	< 0.001
Herbicides reduction	-0.025***	< 0.001	-0.022***	< 0.001	-0.028***	< 0.001
Herbicides : localized use	-0.523***	< 0.001	-0.523***	< 0.001	-0.552***	< 0.001
Bonus	0.444***	< 0.001	-0.294*	0.089	0.414***	< 0.001
Free assistance	0.174**	0.043	0.123	0.640	0.174*	0.058
Payment	0.003***	< 0.001	0.003***	< 0.001	0.003***	< 0.001
Herbicides * IFT[2]	-	-	-0.007***	< 0.001	-	-
Herbicides * Assistance	-	-	0.005	0.124	-	-
Bonus * Assistance	-	-	-0.445**	0.044	-	-
Bonus * Threshold Conf.	-	-	1.196***	< 0.001	-	-
Age * ASC			-	-	-0.178***	0.001
Education * ASC			-	-	-0.076	0.272
Risk sensitivity * ASC			-	-	-0.272***	0.002
Total vineyard area * ASC			-	-	-0.007**	0.026
Mechanization * ASC			-	-	-0.015***	< 0.001
IFT * ASC			-	-	-0.262***	0.003
Individual winery * ASC			-	-	0.004**	0.030
Number of observations	*5220*		*4572*		*4752*	
LR chi2(5)	*382.33*		*428.21*		*472.46*	
Prob > chi2	*0.000*		*0.000*		*0.000*	
Pseudo R2	*0.100*		*0.128*		*0.136*	
Log likelihood	*-1720.42*		*-1460.18*		*-1503.97*	

*significant at a 90% confidence level, ** significant at a 95% confidence level, *** significant at a 99% confidence level

The results of the first model (CL1) are significant and match our hypothesis: winegrowers as a whole are reluctant to reduce their use of herbicides and to be forbidden localized chemical weed control. Introducing a bonus or free technical and administrative assistance in the contract has a

[2] IFT : Treatment Frequency Indicator, is an estimate of present use of herbicides by farmers. Farmers with a high level of IFT have an important use of herbicides.

positive influence on their probability to participate in the AES. The positive value of the ASC shows that farmers prefer to choose one of the contracts proposed rather than their *status quo* (significant at a 90% confidence level). Finally, as expected, the payment influences positively the probability of choosing the contract.

The introduction of interaction effects in the CL2 does somewhat change the analysis of the effect of the bonus on farmers' preferences. When farmers believe that the threshold cannot be reached, the presence of the bonus in the contract turns to have a negative impact on farmers' choice (significant at a 90% confidence level). But if they do believe that the threshold can be reached, then the presence of the bonus has a much higher positive impact on farmers' preferences.

Unlike what was expected, the presence of a free technical and administrative assistance reduces the impact of the bonus on farmers' choices, which becomes even more negative. This attribute of contract (free assistance), has no influence on farmers' willingness to consider a more intensive reduction of herbicides. Instead, the biggest users of herbicides are those who are the most reluctant to commit to a large reduction of herbicides use.

The third CL model links farm and farmer's characteristics to his propensity to choose one of the contracts rather than staying at his *status quo*. The older, risk sensitive winegrowers with higher levels of herbicides use, are less likely to move away from *status quo*. Similarly, this is also true for farmers with bigger farms or holding farms where the mechanic alternatives to chemicals are more difficult to implement. Winegrowers with an individual winery seem to be more likely to adopt one of the proposed contracts.

At this point, our first main results concerning the influence of collective incentives on farmers' preferences is that the introduction of this bonus does have a significant and positive influence on farmers' decision to choose an AE contract, but only if farmers believe that the threshold can be reached (which is the case for 69% of the winegrowers in our sample). The willingness to accept[3] a contract with a final conditional bonus is 174€ less per ha and per year than the same contract without bonus, which is much higher than the conditional monetary value of the bonus (30 €/ha/year). Thus, the introduction of a bonus in the AES could not only increase participation, but also reduce by 144€ per hectare committed the cost of the AES if the threshold is reached. We now estimate the impact of this bonus, as well as the impact of the other attributes on the area that farmers are willing to enrol in the AES.

---

[3] The willingness to accept of farmers for each attribute (by comparison with the reference level, see table 1) can be estimated with the Conditional Logit estimators by dividng the value of the parameter estimated for the attribute by the value of the parameter for the payment attribute.

4.3 The area committed: Tobit model

For each choice set, when the respondent chose one of the 2 contracts proposed, he had then to indicate how much of his farmland (in ha) he would be willing to enroll in the chosen contract. This additional information allows us to estimate a model explaining the proportion of farmland enrolled for each farm and each type of contracts.

The proportion of his vineyard, $0 \leq y_{in} \leq 1$, that a farmer *n* is willing to commit in a chosen contract *i*, does depend on the characteristics of the contract, X_i, and on farm and farmer's characteristics, Z_n.

$$y_{in} = \sum_{k=1}^{K} \chi_{ik} x_{ik} + \sum_{a=1}^{A} \delta_{an} z_{an}$$

If an alternative *i* is not chosen by the farmer, then no observation of the area committed is made, and y_{in} is censored at zero and at one. Therefore we use a Tobit estimation of y_{in}.

As the area data were only collected for the contracts that were chosen on a choice card, we have a missing data for the other contract proposed in the same choice set. Indeed, we don't know what the respondent would have done, had the selected contract not been presented. However, if the *status quo* option was chosen, then the 2 contracts of the choice card are maintained in the sample, and the area variable for these two contracts is set at zero. The status quo option itself is not maintained in the sample as our objective is to understand the factors affecting farmers' decision of the area committed in a contract. Our sub-sample for the Tobit estimations contains 2407 observations.

On average, farmers declare that they would enroll 79% of their farmland in the chosen contract (therefore here the zeros are excluded), with a minimum of 4.5%. More than half of the strictly positive observations correspond to the commitment of the whole vineyard in the chosen contract (54%). 60% of the 2407 observations are zeros and correspond to the situations where the *status quo* was chosen (Figure 1).

Three different Tobit models are implemented with different categories of explanatory variables: contract attributes, interaction of contract attributes, and individual characteristics. The results are presented in Table 4.

Table 4 Tobit model estimations

	Tobit T1		Tobit T2		Tobit T3	
Depend. Var. : % of total vineyard area (*y*)	β	P value	β	P value	β	P value
Constant	0.228	0.164	0.501**	0.011	2.967***	< 0.001
Herbicides reduction	-0.023***	< 0.001	-0.017***	< 0.001	-0.023***	< 0.001
Herbicides : localized use	-0.548***	< 0.001	-0.532***	< 0.001	-0.540***	< 0.001
Bonus	0.414***	< 0.001	-0.662***	< 0.001	0.378***	< 0.001
Free assistance	0.158	0.121	0.153	0.592	0.111	0.268
Payment	0.002***	< 0.001	0.002***	< 0.001	0.002***	< 0.001
Herbicides * IFT	-	-	-0.007***	< 0.001	-	-
Herbicides * Assistance	-	-	0.003	0.378	-	-
Bonus * Assistance	-	-	-0.319*	0.091	-	-
Bonus * Threshold Conf.	-	-	1.571	< 0.001	-	-
Age	-	-	-	-	-0.155***	< 0.001
Education	-	-	-	-	-0.051	0.328
Risk sensitivity	-	-	-	-	-0.204**	0.002
Total vineyard area	-	-	-	-	-0.010***	< 0.001
Mechanization	-	-	-	-	-0.012***	< 0.001
IFT	-	-	-	-	-0.367***	< 0.001
Individual winery	-	-	-	-	0.003**	0.021
left-censored observations at $y \leq 0$	1436		1196		1282	
uncensored observations	443		405		419	
right-censored observations at $y \geq 1$	528		499		502	
LR chi2(5)	*275.44*		*439.11*		*433.48*	
Prob > chi2	*0.000*		*0.000*		*0.000*	
Pseudo R2	*0.0600*		*0.1066*		*0.1015*	
Log likelihood	*- 2158.56*		*-1836.91*		*-1918.55*	

*significant at a 90% confidence level, ** significant at a 95% confidence level, *** significant at a 99% confidence level

The Tobit estimations confirm the Conditional Logit model's results but provide additional information on farmers' choice in terms of enrolled land. The model T1 shows that the bonus increases by 41 points of percentage the proportion of their vineyards that farmers would enroll in the contract in comparison with the proportion they would enroll in a similar contract with no bonus. For a 30% reduction of herbicide use, paid at 450€/ha/year, farmers would, on average, enroll 21% of their vineyard in the no- bonus contract condition (without free assistance, localized use of herbicides allowed). For the same contract, but including the bonus option, they are willing to enroll 62% of their vineyard.

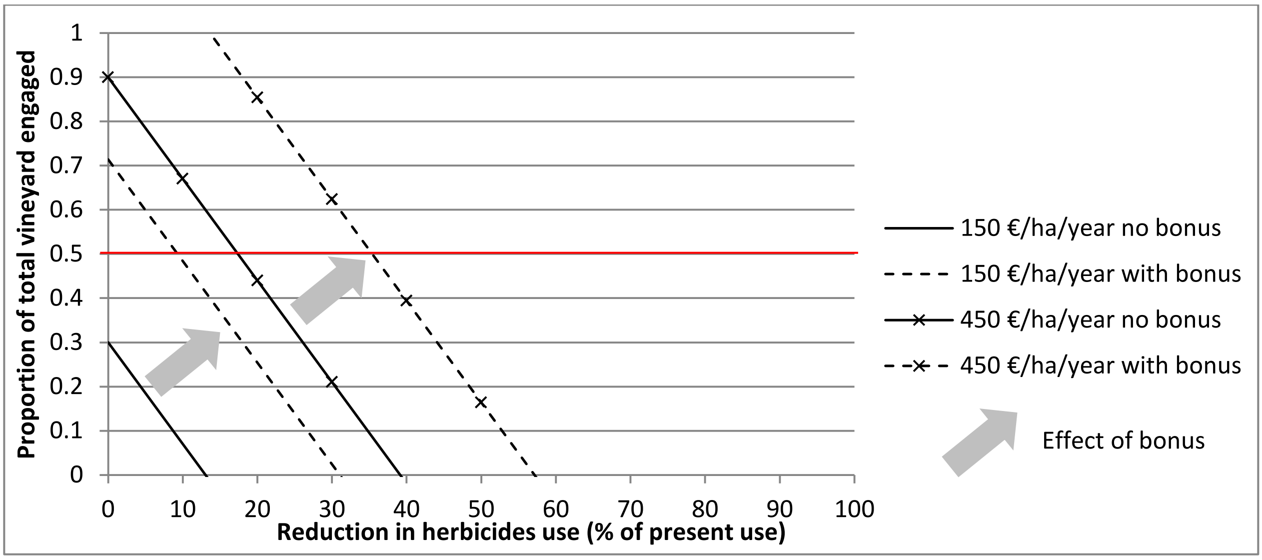

Figure 2: trade-off between 'deep and narrow' and 'wide and shallow' measures

Figure 2 shows iso-payment lines drawn from the Tobit estimations, for contracts including no assistance and in which localized use of herbicides is allowed. For a same payment, farmers prefer to enroll a smaller proportion of their vineyard in a higher reduction rate, or a bigger proportion of their vineyard in a lower reduction rate. Then, the 50% of local vineyards threshold can only be reached if the levels of reduction included in the AES are low, or if the budget of the scheme is important. For example, with the present payments proposed in existing agri-environmental measures in Languedoc-Roussillon for a total suppression of herbicides on the committed areas (184€/ha/an), the maximum reduction rate is around 15% of their present use if no bonus and no assistance is proposed. Of course, as these results are based on a regression on all famers of our sample, they hide some very heterogeneous situations between farmers of the region.

Models T2 and T3 estimations strengthen those of the CL2 and CL3 models: the variables that have a significant influence on contract choice do also have a positive influence on the proportion of their vineyard farmers are willing to commit.

5 Conclusion

One of the policy questions addressed in the wake of the forthcoming CAP reform is to find ways of promoting a wider and more effective participation of farmers to agro-environmental schemes without increasing budgetary expenditures. Results obtained in our choice experiment show that the introduction of a collective dimension in agri-environmental contracts could effectively enhance scheme's efficiency in three ways. First, it would enhance farmers' initial participation in agri-environmental schemes. Indeed, our bonus attribute is highly significant to explain the enrollment of respondents into an agri-environmental contract. In addition, the negative willingness to accept (-174€/ha/year) for this bonus means that the payment for a contract could be lowered by this amount if a bonus is included. Therefore, even if a bonus has to be paid to each farmer who has signed a contract (because the threshold has been reached), the cost of the scheme per hectare is reduced. Finally, we have demonstrated that the collective bonus encourages farmers to enroll a larger share of their vineyard in the scheme.

Beyond the impact of the bonus on participation rate, our study contributes to the analysis of farmers' behaviour towards collective dimensions of herbicides reduction contracts for local water quality. Respondents value the inclusion of the collective bonus option in the contract (174€/ha/year) more than its conditional payment (30€/ha/year). This is consistent with the hypothesis that farmers are more willing to provide environmental efforts when their neighbors also do so. One interpretation is that farmers want to make sure that their efforts do have a significant impact on water quality, impact that cannot be reached unless most famers also participate. Another interpretation is their willingness to choose the practice which is used by most of their neighbors. This collective bonus appears as a tool that could encourage the emergence of a new social norm influencing the winegrowers' behavior towards pro-environmental practices. Our interpretation of this result will be completed with the analysis of the answers to the open-ended questions of the survey. It is also encouraging to note that although we thought that the threshold of 50% of the area was quite challenging, a majority of respondents (69%) believed that this threshold can be reached. To conclude, we think that the CAP reform might be a true opportunity to implement new contract designs which would include some collective dimensions.

References

Adamowicz W, Boxall P, Williams M, Louviere J (1998) Stated Preference Approach for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. 80:64–75.

Banerjee, S., & Shortle, J. S. (2009). The Agglomeration Vickrey Auction for the promotion of spatially contiguous habitat management: Theoretical foundations and numerical illustrations. In: Proceedings of the annual meeting of the agricultural and applied economics association, Agricultural and Applied Economics Association, Milwaukee

Barrio M, Loureiro M (2010) The Impact of Protest Responses in Choice Experiments. FEEM working paper n°133.2010, Sustainable Development Series, 35p.

Beharry-Borg N., Smart J., Termansen M., Hubacek K. (2012) Evaluating farmers' likely participation in a payment program for water quality protection in the UK uplands. Regional Environmental Change: 1-15.

Bernheim B. (1994), A theory of conformity, Journal of Political Economy, 102 (5) p. 841-77

Bikhchandani S., Hirshleifer D., Welch I. (1998) Learning from the behavior of others: conformity, fads and informational cascades. Journal of Economic Perspectives 12: 151-70

Broch S., Vedel S. (2011) Using Choice Experiments to Investigate the Policy Relevance of Heterogeneity in Farmer Agri-Environmental Contract Preferences. Environmental and Resource Economics: 1-21.

Chen X., Lupi F., He G., Liu J. (2009) Linking social norms to efficient conservation investment in payments for ecosystem services, Proceedings of the National Academy of Sciences of the United States of America, 106(28): 11812-11817.

Christensen T., Pedersen A. B., Nielsen H.O., Mørkbak M.R., Hasler B. and Denver S. (2011) Determinants of farmers' willingness to participate in subsidy schemes for pesticide-free buffer zones-A choice experiment study. Ecological Economics 70(8): 1558-1564.

Dietz, R. D. (2002). The estimation of neighborhood effects in the social sciences: An interdisciplinary approach. Social Science Research, 31(4), 539–575.

Ducos G., Dupraz P. and Bonnieux F. (2009) Agri-environment contract adoption under fixed and variable compliance costs, Journal of Environmental Planning and Management 52, 669-687.

Dupraz P., Latiuche K. and Turpin N. (2009) Threshold effect and coordination of agri-environmental efforts, Journal of Environmental Planning and Management, 52(5), pp 613-630

ECA European Court of Auditors (2011) Is agri-environment support well designed and managed?, Special report No7, 88 pages

Espinosa-Goded M., Barreiro-Hurlé J., Ruto E. (2010) What Do Farmers Want From Agri-Environmental Scheme Design? A Choice Experiment Approach. Journal of Agricultural Economics 61(2): 259-273.

Falconer K. and Saunders C. (2002) Transaction costs for SSSIs and policy design, Land Use Policy 19, 157-166.

Ferraro P.J. (2003) Conservation contracting in heterogeneous landscapes: an application to watershed protection with threshold constraints, American and Resource Economics Review, 32(1): 53:62

Franks (2011) The collective provision of environmental goods: a discussion of contractual issues. Journal of Environmental Planning and Management, 54 (5) (2011), pp. 637–660

Hanley N, Mourato S, Wright RE (2001) Choice Modelling Approaches: A Superior Alternative For Environmental Valuation? Journal of Economic Surveys 15:435–462.

Hanley N, Whitby M., Simpson I. (1999) Assessing the success of agri-environmental policy in the UK, Land Use Policy, 16, pp 67-80

Kuhfuss L, Jacquet F, Preget R, Thoyer S (2013) Le dispostif des MAEt pour l'enjeu eau: une fausse bonne idée?, Revue d'Etudes en Agriculture et Environnement, 93(4), forthcoming

Ma, S., Swinton, S. M., Lupi, F., & Jolejole-Foreman, C. (2012). Farmers' Willingness to Participate in Payment-for-Environmental-Services Programmes. Journal of Agricultural Economics, 63(3), 604–626.

MacFarlane F., 1998, Implementing agri-environmental policy: a landscape ecology perspective, Journal of Environmental Planning and Management, 41 (5) pp 575-596

Parkhurst G., Shogren J., Bastian C., Kivi P., Donner J. and Smith R., 2002, Agglomeration bonus: an incentive mechanism to reunite fragmented habitat for biodiversity conservation, Ecological Economics, 41, pp 305-328

Peerlings J. and Polman N. (2009) Farm choice between agri-environmental contracts in the European Union, Journal of Environmental Planning and Management 52, 593-612.

Ruto E., Garrod G. (2009) Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. Journal of Environmental Planning and Management 52(5): 631-647.

Sustein C. and Thaler R. (2008) Nudge: improving decisions about health, wealth and happiness, New Haven and London Yale University Press

USDA US Department of Agriculture (1998) Conservation Reserve Program—Oregon State Enhancement Program. Farm Service Agency, Washington, DC: Government Printing Office.

Vanslembrouck I., Van Huylenbroeck G. and Verbeke W. (2002) Determinants of the Willingness of Belgian Farmers to Participate in Agri-environmental Measures, Journal of Agricultural Economics 53, 489-511.

Waterfield G and Zilberman D. (2012), Pest Management in Food Systems: An Economic Perspective, Annual Review of Environment and Resources 37: 223-245

Yang W, Khanna M, Farnsworth R (2005) Effectiveness of conservation programs in Illinois and gains from targeting, American Journal of Agricultural Economics, 87 (5), pp 1248-1255