MODELING FARMERS PREFENCES FOR AGRIENVIRONMENTAL SCHEME DESIGN: SPANISH CASE STUDY

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ABSTRACT

Agri-environmental schemes (AES) have had a limited effect on European agriculture due to farmer's reluctance to participate in them. Information on the role that AES design can have on encouraging farmers to participate can be an important input into the design of such policies. This paper investigates farmers' preferences for different design options related to a specific AES in Spain using a mixed logit error component choice experiment approach allowing for preference heterogeneity and correlation amongst the non status quo alternatives. In particular, findings show farmers preference for greater flexibility in scheme implementation, presence of a fixed-rate payment per contract and additional advisory services. However, heterogeneity in the value of the AES attributes across regions and farmers is significant. The results show that there is room for improvement in current AES design that will lead to higher adoption rates however, farmer reluctance to AES sign-up is still substantial.

KEYWORDS: choice experiment, agri-environmental schemes, farmers

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INTRODUCTION

Agri-environmental schemes (AES) are the main policy instrument in the European Union designed to foster improvements in the relationship between agriculture and the environment (European Commission, 2005). A typical AES requires farmers to modify crops distribution or cultivation practices in exchange for a per-hectare payment. This payment is calculated using a supply side approach, considering the income forgone or the additional costs associated with the requirements. The substantial public expenditure required to fund these schemes (€6.8 billion in the EU's 2007-2013 budget) has motivated a wide range of research to be undertaken with the aim of both evaluating and improving their performance. The voluntary nature of AES means that farmers' decisions to participate, with participation distributed appropriately across target areas, is central to achieving policy objectives. Thus, many studies have investigated the factors influencing participation (for a review see Siebert *et al.*, 2006). However most studies are based on actual participation behaviour rather than contingent behaviour (Wynn *et al.*, 2001; Wossink and Wenum, 2003; Vanslembrouk *et al.*, 2002). A drawback of this approach is that it is made ex-post to the design of the AES, hence there would usually be insufficient observed variation across scheme design attributes to permit estimation of their impact.

In order to inform agri-environmental policy design an ex-ante evaluation of farmer up-take of different AES design features would be needed allowing to analyse the impact of different attributes and attribute levels to those already implemented on farmer sign-up decisions. In this setting, choice experiments (Louviere *et al.*, 2000) provides an interesting alternative to evaluate how farmers' react to changes in AES design. Moreover by including the premium as one of the attributes, the net saving of public expenditure for each new design can be estimated. Modelling farmers' choices permits us to estimate how they would trade-off different levels of these contract attributes against per hectare payments. Knowledge of such trade-offs can inform AES policy design.

In the last decade the choice experiment approach has increasingly been used to value the demand of quality changes in environmental attributes in the society as a whole (Carlsson and Kataria, 2008; Campbell, 2007 ; Scarpa *et al*., 2007; Hanley *et al*., 2006 and 2001; Garrod and Willis, 1999; Adamowicz *et al*.,1998), however the applications with farmers, either considering supply or demand issues is very limited (Ruto *et al*., 2008; Peterson *et al.*; 2007; Roessler *et al*., 2007; Birol *et al*., 2006; Scarpa *et al*., 2003a and 2003b). Moreover, to our knowledge this is the second application in which farmer willingness to supply environmental goods and services through AES are evaluated in the context of the Common Agricultural policy, the other being Ruto and Garrod, 2007.

CASE STUDY DESCRIPTION

This paper uses data collected from three hundred surveys to farmers in two regions in Spain (200 in Aragón and 100 in Andalusia). In the sample strategy there is a discretional overrepresentation of farmers who had participated in AES included in the 2000-2006 Rural Development Programmes (RDP). Although geographically distant, the two regions share common features in relation to agriculture mainly low yield rain fed cereal production in some cases associated with semi-extensive ovine regime. The choice of attributes and levels for the choice experiment was based on a combination of evidence from the literature and on information from a previous study investigating factors affecting famers' adoption of AES in the two case study areas.

In order to maintain the relevance of the field work to the ongoing agri environmental policy agenda, we developed a common measure which was present in both Aragón and Andalusia 2007-2013 RDP. The measure selected was "*introduction of nitrogen fixing crops in dry land areas*" (NFD) and can be considered a follow up of the Alternative Crop Measure (ACM) applied in the Aragón 2000-2006 RDP. In order to be able to value the implicit prices (marginal rate of substitution), a monetary attribute related to the payment level (PREMIUM) was included. The attributes and levels used to describe the NFD in the CE framework are described in Table 1.

Table 1. AES attributes and levels used in the CE design

Attribute	Description	Levels
SUR	Flexibility over the amount of land to be enrolled in the AES	**Free**
		50% eligible surface
GRAZING	Flexibility over grazing in the land under the AES	Free
		Limited from 01/08 to 30/09*
TTA	Existence of a compulsory and free of charge technical and training advisory service	Yes
		No
FIXED_PREM	Existence of a 1000 € one-time payment per contract independently of the area enrolled	Yes
		No
PREMIUM	Payment level per ha and year	60 € ha^{-1}
		80 € ha^{-1}
		100 € ha^{-1}
		120 € ha^{-1}

Levels in bold represent the AES currently available in Aragón and Andalusia RDP

* In Andalusia, the grazing limitation was all year around to take into account the specification on the RDP

Considering the number of attributes and levels a large number of AES profiles can be constructed (96 profiles) and even more combinations of them when presenting a two-option choice set design (96^2). To create a more reasonable number of options, the choice sets were created using Street and Burguess experimental design (Street *et al.,*2005; Street and Burgess, 2007), which is based on D-z optimatility criterion. In order to estimate main and two-way interaction effects a resolution five orthogonal design is needed. This is obtained from the full factorial using three generators (00111, 10102 and 11001) which results in 96 profiles. This experimental design ensures the identification of main and interaction effects with uncorrelated attributes and a D-efficiency of 91.32% (Street and Burgess, 2007). In order to make the number of choice tasks manageable for respondents, the 96 choice sets were blocked into 16 versions of six choice sets in each block. In each choice set farmers were asked to choose between two alternatives allowing for a no choice (or status quo) option which meant the farmer continues with his current farm management. In Table 2 a choice set example is presented.

The questionnaire was designed by the research team after a thorough review of previous research, agricultural structure in the area and discussion with the government agencies responsible for AES implementation. The survey gathered data regarding four main topics: a) farm basic data, b) Introduction to the attributes in the choice experiment c) Choice experiment and follow-up questions and d) basic farmer socio-economic data.

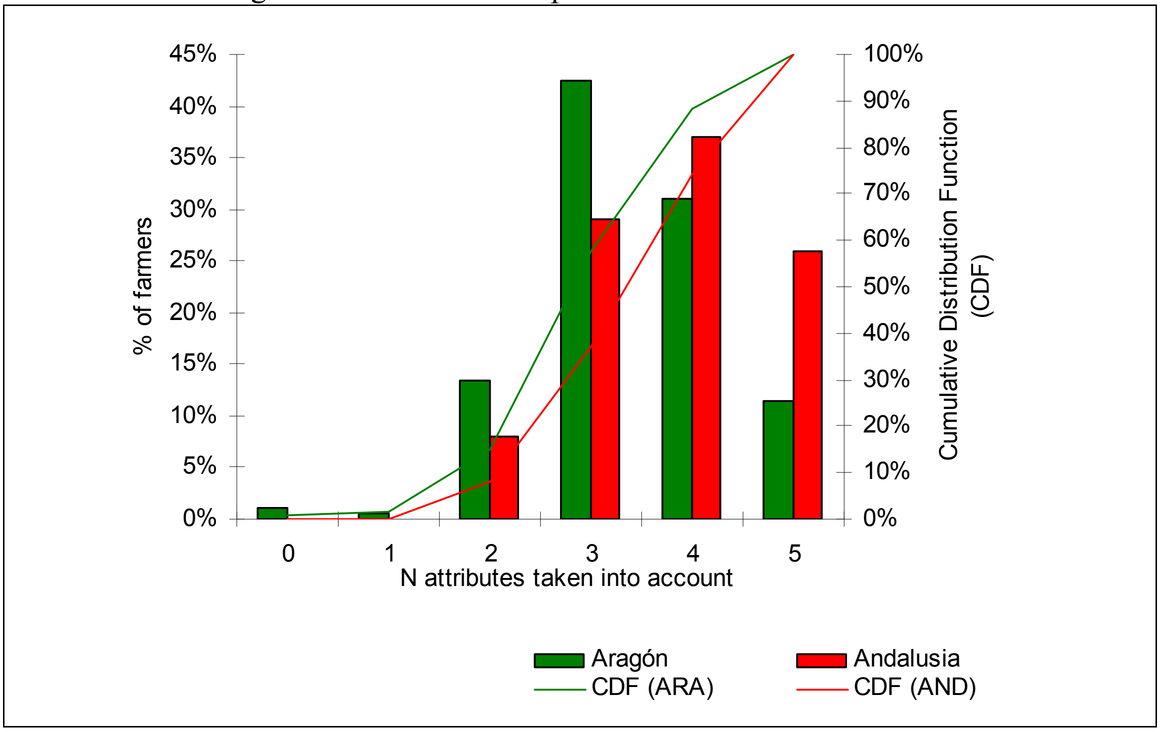
Table 2. Example of a choice set (Aragón sample)

	Alternative A	Alternative B	Alternative C
Surface	50 % eligible surface	Free to choose	**Neither Alt A nor Alt B. I will stay with my current farm management**
Grazing in the enrolled surface	Free	Forbidden between 01/08-30/09	
Technical Advisory Service compulsory and free of charge	No	Yes	
Fixed Payment of 1000 €	No	Yes	
Payment level (€ ha^{-1} $year^{-1}$)	60	80	

ECONOMETRIC SPECIFICATION

Choice experiments are based on Lancaster's theory of consumer choice which postulates that consumption decisions are determined by the utility or value that is derived from the attributes of the particular good being consumed (Lancaster, 1966). The econometric basis of the approach rests on the behavioural framework of random utility theory, which describes discrete choices in a utility maximising framework (McFadden, 1974; Ben-Akiva and Lerman, 1985). Statistical analyses of the responses obtained from CE can be used to derive the marginal values for attributes of a good or policy or an individual implicit price to gain an outcome with more desirable combination of characteristics. Thus the main aim of the econometric analysis is to estimate the economic value of the AES design attributes. Nevertheless, this estimation assumes continuity in preferences which implies unlimited substitutability between attributes within the choice sets (Campbell *et al*., 2008). However recent studies have shown that individuals might be ignoring one or more attributes in the choice experiment process and that respondent discontinuous preferences should be taken into account when modelling choices (Hensher *et al*., 2005; Rosenberger *et al*., 2003; DeShazo and Fermo, 2002; Sælensminde, 2001; Gelso and Peterson, 2005, Campbell *et al*., 2008). Therefore, the survey included a follow-up questions regarding the attributes that respondents considered when making the choices in order to identify discontinuous preferences (Hensher *et al.,* 2005). Attributes that farmers declared were ignored have not been taken into account in the estimation process by the inclusion of a dummy variable. Figure 1 represents the number of attributes considered by the farmers when making their choices. The attribute that was most considered was the premium (97% and 98% of the farmers in Aragón and Andalusia respectively) while the attribute that was least considered is the training advisory service (56% in Aragón and 33% in Andalusia).

Figure 1. Farmers distribution (percentage) according to the number of attributes taken into account during the discrete choice experiments



A secondary aim of the econometric analysis is to investigate whether farmers preference varies across and within the case study areas. In other words, a characterisation on preference heterogeneity between case studies (therefore targeting areas) and within each case study (targeting farmers). In order to achieve these goals, the set of observed discrete choices produced with the CE were employed to estimate a series of Random Utility models, a selection of which is presented in the paper.

The well-known multinomial logit analysis (MNL) of qualitative choices (McFadden, 1974) has been used to compare if the set of parameters is shared across the two sets of respondents: Aragón and Andalusia. It is hypothesised that farmers in different regions may have different preferences regarding the design of AES and if such differences occur they should be considered by the policy makers in order to ensure efficient targeting of AES. This is of special interest as the new RDP strategy 2007-2013 provides for the possibility of implementing different AES in each region[1]. Therefore to

[1] In the previous period 2000-06, there was a national main AES framework from which each autonomous region could only make minor changes.

test the preference stability across the two regions Multinomial Logit models (MNL) have been estimated to obtain estimates for each system and five likelihood ratio test (LR) are performed[2],

$$H0: \beta_{POOL} = \beta_{ARA} = \beta_{AND} \quad \text{versus} \quad H1: \beta_{POOL} \neq \beta_{ARA} \neq \beta_{AND} \qquad [1]$$

where $\beta_{POOL,}$ β_{ARA} and β_{AND} are respectively the vectors of estimates for the MNL parameters from the pooled models, the Aragón sample and the Andalusia sample. If the null hypothesis (*H0*) that the two regions share the same set of preferences is rejected, then spatial heterogeneity should be taken into account by specifying two different models, one for each region. As far as intra-region preference heterogeneity is concerned, the basic MNL model assumes homogenous preferences among farmers, however accounting for heterogeneity enhance the accuracy and reliability of the results. Two types of heterogeneity can be considered: observed heterogeneity (also called conditional heterogeneity) and unobserved heterogeneity. In order to account for the observed heterogeneity interactions of individual specific social and economic characteristics with the Alternative Specific Constant for the status quo option (ASC_{SQ}) will be performed. The second kind of heterogeneity, the unobserved heterogeneity is analyzed using a Mixed Logit model (ML). The ML model obviates the three limitations of standard logit by allowing for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors (Train, 2003). Among the different approaches existing to implement ML, in this study the use of the error component to induce correlation over utilities from different alternatives is used. The Error Component Mixed Logit (EC_ML) model is a special case of the ML in which a random error component is used in addition to other random parameters to induce correlation amongst the non-status-quo alternatives (assumed to be normally distributed). This approach allows to analyse the implications derived from including the status quo (SQ) option in the choice set. The SQ effect is described as "systematic inclination of respondents to display a different attitude towards SQ alternatives from those reserved to alternatives involving some change, over and beyond what can be captured by the variation of attributes' levels across alternatives" (Scarpa *et al*., 2005).

[2] The specification tests corresponds to: both samples sharing the same set of preferences, pooled preferences shared by Andalusia, pooled preferences shared by Aragón, Andalusia preferences shared by Aragón and vice versa.

The EC_ML specification accounts for a correlation effect in the non-status quo alternatives. Therefore the utility function can be defined as:

$$\begin{aligned} U_{ALTA} &= \beta'\chi + \eta_{NON-SQ} + \varepsilon \\ U_{ALTB} &= \beta'\chi + \eta_{NON-SQ} + \varepsilon \\ U_{SQ} &= ASC_{SQ} + \beta'\chi + \gamma S + \varepsilon \end{aligned} \qquad [2]$$

Where ASC_{SQ} is the non random alternative specific intercept, X is the vector of attributes for farmer n, $\eta_{non\text{-}SQ}$ is the error component to induce correlation amongst the non-status-quo alternatives which is assumed to be normally distributed $\eta_{non\text{-}SQ} \sim N(0,\sigma^2)$, the coefficient β' varies among the population with density $f(\beta|\theta)$, where θ is a vector of the true parameters of the taste distribution and γS captures systematic preference heterogeneity as a function of farmer socioeconomic and technical farm characteristics (interacting with the ASC_{SQ} intercept) . The random term ε are the Gumbel distributed errors that have been specified to be the same for all choices made by the same individual (panel structure), instead of being independent across choices. This is relevant as it breaks away from the assumption of independence in the error structure across choices by the same respondent (Scarpa *et al.*, 2005). In the case of specification of a panel data the probability integrand involves a product of logit formulas (Train, 2003). Thus, the choice probability of observing a sequence of choices *t (n)* from respondent *n* is defined as:

$$P(t(n)) = \int_{\beta}\int_{\eta}\prod_{t=1}^{n}\frac{\exp(\lambda(\beta'\chi_{ti}+\eta_{in}))}{\sum_{j\subset A_t}(\lambda(\beta'\chi_{ti}+\eta_{jn}))} f(\beta|\theta)d\beta.\varphi(0,\sigma^2)d\eta_{jn} \qquad [3]$$

Where, A_t = {ALTA, ALTB, SQ} is the choice set; λ is a scale parameter; $f(\beta|\theta)$ is the density of the attributes random parameters; and φ (.) is the normal density of the error component (η_j) which equals zero when j=status quo.

Equation [3] describes the open form in which the utility coefficients vary among individuals. The integral cannot be evaluated analytically and we have to rely on a simulation method for the probabilities. In this case we are simulating the log-likehood by using 1000 Halton Draws (Train, 1999). It is also necessary to make assumptions regarding the distribution of each of the random coefficients. We are assuming a normal distribution for all the attributes, except the payment level attribute that is assumed to be non-random. In the EC_ML specification model we have added the interactions with the socio demographic variables in order to account for observed heterogeneity.

RESULTS

The estimation of the standard MNL model is reported in Table 2. The utility function was estimated to be linear in the attributes as all the variables are dummy variables, except for the payment level attribute in which non-linearity was tested by effects coding the variable. The non-linearity was rejected using the Wald test ($\alpha < 0.01$).

The heterogeneity in the two case studies is estimated by the log-likelihood ratio tests based on regression with the pooled and the separate case studies samples (equation [1]). The null hypothesis that the regression parameters are equal for the different case studies is rejected. The values of the χ^2_6 are much larger in the five specification tests than the critical value of 11.07 for a conventional one tailed test with probability of type I error of 5%, thus there is heterogeneity in the demand in the two locations and two different estimations will be conducted for each case study to determine the economic value of the AES attributes.

Table 3. MNL estimates of AES attribute preferences in different samples

Attribute	**Pooled sample**			**Aragón Sample**			**Andalusia Sample**		
	Coeff.	*SE*	*p-val*	*Coeff.*	*SE*	*p-val*	*Coeff.*	*SE*	*p-val*
ASC_SQ	1.190	0.100	0.000	0.710	0.110	0.000	5.214	0.416	0.000
SUR	0.376	0.072	0.000	0.454	0.085	0.000	0.938	0.164	0.000
GRAZING	0.558	0.098	0.000	0.554	0.134	0.000	1.344	0.177	0.000
TTA	-0.795	0.114	0.000	-0.698	0.152	0.000	-0.779	0.202	0.000
FIXED_PREM	1.079	0.076	0.000	1.002	0.090	0.000	1.554	0.166	0.000
PREMIUM	0.006	0.001	0.000	0.008	0.001	0.000	0.029	0.004	0.000
Ln-likelihood	-1785.016			-1169.886			-457.936		
Pseudo-R^2	0.092			0.100			0.209		
N observations	1800			1200			600		

The ML_EC allows accounting for unobserved heterogeneity in preferences among respondents, we account as well for observed heterogeneity by interacting the socioeconomic and farm technical variables with the ASC_{SQ}. Results are presented in Table 3. All the attributes standard deviations are significant, except for the TTA in

Andalusia, and therefore the final model treats it as non random. The ASC_{SQ} is positive and significant, reflecting that farmers are reluctant to change their current farm management. This result is common in choice experiments (Birol *et al.,* 2006; Campbell *et al.,* 2008) indicating that respondents make decisions that are closer both to rational choice theory and the behaviour observed in reality (Huber and Pinnell, 1994; Dhar, 1997).

The significance of the standard deviation in the $\eta_{non\text{-}SQ}$ suggests that there is substantial positive correlation among non SQ alternatives[3] (0.76 and 0.81 for Aragón and Andalusia respectively). The estimated total variance for non SQ utilities is 5.313 and 6.911, much larger than the Gumbel error variance of $\pi^2/6$ (Louviere *et al*., 2000). As ML models allow for recovering individual-level parameters from the estimated model using the Bayes' theorem, the magnitude of the reverse sign in the AES attributes can be estimated. Sign reversal is a minor concern as it reaches a maximum of 10% (SUR attribute in Aragón) and even does not occur for some attributes (FIXED_PREM attribute in Aragón).

The socio-economic and technical variables were tested in the model after eliminating collinearity based on an assessment of variance inflation factors (VIF[4]) for each variable, however in the final model only the socio demographic and technical characteristics significant at the 95% level were retained. Prior participation in AES, ACM in Aragón and the participation in any AES in the eligible area in Andalusia[5], (PARTICIPANT) increases the utility derived from participation. This seems to support the idea that there is a learning process in AES implementation which somehow reduces the cost on sign-up. On the other hand farmers that believe that the farm will be abandoned in a future (FARM_ABAN) are more likely to choose the Status Quo, as the AES can be seen as an investment (learn the new crop management and buy new seeds) and as a limitation to future land transfers.

3 This is calculated as $\eta_{non\text{-}SQ}^2/(\eta_{non\text{-}SQ}^2 + \pi^2/6)$ (Train, 2003).
4 Variance Inflation Factors (VIF_j) for each variable is calculated as: $VIF_J = 1/1\text{-}R^2$, where R^2_j is the R^2 of the "artificial" ordinary least square regression with the jth independent variable as a "dependent" variable. A VIF value over 5 indicates that estimation with the characteristics concerns is affected by multicollinearity (Maddala, 2000).
5 ACM is not in place.

Table 3. ML_EC estimations for the two case studies

	Aragón sample			Andalusia sample		
	Coeff.	*SE*	*p-val*	*Coeff.*	*SE*	*p-val*
Mean values						
ASCSQ	5.019	0.459	0.000	13.586	1.823	0.000
SUR	1.448	0.215	0.000	2.771	0.548	0.000
GRAZING	1.498	0.369	0.000	4.066	0.626	0.000
TTA	-1.443	0.353	0.000	-0.988	0.399	0.013
FIXED_PREM	1.863	0.188	0.000	3.020	0.626	0.000
PREMIUM	0.049	0.004	0.000	0.076	0.011	0.000
Standard Deviations						
SUR	1.782	0.246	0.000	2.629	0.608	0.000
GRAZING	2.250	0.466	0.000	2.398	0.596	0.000
TTA	1.766	0.408	0.000		Non-random	
FIXED_PREM	1.135	0.237	0.000	3.383	0.663	0.000
$\eta_{non\text{-}SQ}$	2.305	0.275	0.000	2.629	0.608	0.000
Covariates (sociodemographic variables)						
PARTICIPANT	-5.934	0.618	0.000	-2.246	0.814	0.006
FARM_ABAN	3.014	0.976	0.019	2.685	1.336	0.045
Ln-likelihood		-927.204			-362.008	
Pseudo-R^2		0.293			0.441	
N observations		1200			600	

The distribution of the marginal implicit prices (Table 4) is obtained by using the Delta method[6] in which we are taking into account the conditional probabilities. Since all the attributes are normally distributed and the payment level is fixed, the implicit price is also normally distributed. Because the impact of each attribute is not predetermined, the marginal implicit prices can be either positive or negative. In our CE, the monetary attribute was described as an annual per hectare premium, hence positive values indicate the per hectare premium that farmers would be willing to trade-off or forgo in order to gain schemes with more desirable attributes or from a public policy perspective it is the amount of money that society should compensate farmers in return for accepting less desirable contractual obligations. Therefore the implicit price for the SUR attribute means that if the policy maker impose a 50% uptake of the eligible surface as a requisite in the AES specifications, farmers should be compensated 29.57 €/ha or that farmers are willing to trade-off this amount of money if they have flexibility on the amount of land to be enrolled in the AES. Conversely, negative values indicate the increase in the level of payments farmers would demand in return for accepting less desirable contractual

[6] The delta method estimate of the variance of a non-linear function of two (or more) random variables is given by taking a first order Taylor expansion around the mean value of the variables and calculating the variance for the expression.

obligations. For example, the implicit price figure for the TTA attribute[7] mean that farmers would demand a compensation of 29.57 €/ha if technical training is not offered in an AES contract.

Table 4: Implicit prices (€/ha) in the ML_EC model in the two case studies

Attribute	Aragón Sample			Andalusia Sample		
	Coeff.	*SE*	*p-val*	*Coeff.*	*SE*	*p-val*
SUR	29.576	4.391	0.000	34.406	5.831	0.000
GRAZING	30.588	7.528	0.000	50.499	8.701	0.000
TTA	-29.461	7.184	0.000	-12.983	4.888	0.001
FIXED_PREM	38.036	3.723	0.000	37.503	6.783	0.000
TOTAL		127.7 €/ha			135.4 €/ha	

The overall farmers' implicit price for the desired level of all attributes is similar in both case studies (127.7 €/ha in Aragón and 135.4 €/ha in Andalusia), this result is 28% higher than the current ACM premium in Aragón. However while in Aragón the individual attributes' implicit prices range from 29.5 €/ha and 38.0 €/ha respectively for the TTA and FIXED-PREM to be implemented, in Andalusia the attributes valuation range is greater. The least valued attribute is also TTA (13.0 €/ha), however the GRAZING management is the attribute with the highest marginal utility (50.5 €/ha). This could be explained by the fact that the grazing attribute value is more constraining in Andalusia; grazing allowed in opposition to not allowed, while in Aragón is just the grazing period that is limited.

CONCLUSIONS

The main objective of this study is to investigate the role that the design of AES can have on encouraging farmers to participate in this kind of schemes in Spain. This was achieved by using a choice experiment to investigate farmers' preferences for various important elements of AES design, using the case of an AES designed to increase nitrogen in soils by cultivating fodder crops. The results from the mixed logit error component models estimated show that, in general, farmers prefer greater flexibility over area of land to be enrolled on a scheme and over grazing rights on their land. They also have positive preference for a fixed payment and access to compulsory technical advisory service. The grazing management has the highest marginal utility in Andalusia (50.5 €/ha), while in Aragón is the existence of fixed payment (38.0 €/ha).

[7] The coding was: 0=TTA provided; 1=TTA not provided.

Among the socio economic variables that have an influence on the choices, farmers already in an AES are more willing to participate in the proposed AES alternatives, therefore there is potential improvement in the current scheme attributes. Whether or not a farmer expects to leave farming in the future also appeared to be important in decisions regarding the choice of the status quo over the AES alternatives. The results suggest that farmers who expect to leave farming in the future have lower utility for participating in the AES than those who expect to continue farming. This finding is related to the fact that the AES considered implies a significant change in farm management, as AES with low requirements and reflecting traditional farming practices have been preferred by farmers close to retiring (Potter and Lobley, 1992; Drake *et al.*, 1999). For these farmers, the fixed payment could be an incentive to these farmers to overcome the fixed initial costs (transaction costs and investment costs) associated with being in a scheme.

This paper contributes in two main ways to the literature. First it is one of the few CE incorporating simultaneously the error component approach to induce correlation among the non SQ alternatives and the random parameters approach in the attributes. (Campbell *et al.*, 2008 tested the addition of treating the attributes as random parameters in addition to the error component specification, but they did not increase the model fit). Secondly, although other CE have been undertaken with farmers (i.e. Peterson *et al.*; 2007; Roessler *et al.*, 2007), there is only one precedent focused on AES (Ruto *et al.,* 2007). The study undertaken by Ruto *et al.* is at a European scale, therefore involving a wide range of AES and the payment attribute was considered as a percentage change in the payment level, therefore we can not compare the implicit prices estimates, however one similarity can be found in the two studies related to the high marginal utility of flexibility of the grazing management in Andalusia and the fact that flexibility over what areas in the farm enter the AES and over not undertaken some of the requisites were the attributes with the highest marginal utility[8] in the European study.

As the attributes and levels considered have been designed to resemble actual AES in Spain, the reported findings can be used to improve AES in the regional RDP guidelines 2007-2013. The main recommendation is that as long as the main environmental

[8] The other attributes are contract length, and paper work.

objective is satisfied, the existence of farmers demand heterogeneity should be considered in the design of these schemes. In particular, reducing the grazing restriction in both areas could lead to significant increases in farmer up-take maintaining current premiums or reduce budgetary costs as farmers would be willing to sign-up for less compensation.

Future research could compare the marginal cost of providing technical advisory service and of providing the fixed payment with the farmer's implicit price for these services in order to see whether net benefits would be derived from this new institutional arrangements. Additionally, benefits and costs of restricting grazing in relation to the nitrogen cycle and as well as livestock over stocking problems[9] should be evaluated to see whether this requirement could be relaxed while maintaining desired environmental benefits. Future research could also compare the monetary compensation claimed by farmers to enrol more land in AES with the environmental gain derived from the potential increase in the amount of land in AES.

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