DOES INTENSITY OF CHANGE MATTER? FACTORS AFFECTING ADOPTION IN TWO AGRI-ENVIRONMENTAL SCHEMES

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ABSTRACT

Agri-environmental schemes are the main policy instrument currently available in the EU to promote environmentally friendly farming practices. Nevertheless, the adoption rate of these measures is still limited. This paper develops a theoretical framework to explain farmer sign-up decision and tests whether factors affecting this decision differ depending on the level of requirement of each measure. The model is tested with two different AES in Spain implying a low and a high farm management change. Technical factors are found to be most relevant when significant farm practice changes are at stake while the role of farmer characteristics is significant when minor changes are required. In both cases, social capital and farmer attitudes still explain part of the sign-up decision. In order to increase adoption rates, different promotion activities should be undertaken according to different measures, increasing technical suitability when major changes are at stake and enhancing social capital and better targeting to relevant farmers for measures with lower requirements.

Key-words: Agri-environmental schemes, adoption models, measure intensity, Spain

I. Introduction

Agri-environmental schemes (AES) are the main policy instrument currently available in the European Union to foster improvements in the relationship between agriculture and the environment. Over 35 million hectares were under some kind of AES in EU-15 in 2003 with an overall 3.7 billion € in public funds being allocated annually to this policy and an overall expenditure of 14 billion € of EAGGF funds during the 2000-2006 period (DG AGRI, 2006). The degree of AES implementation varies widely among Member States both regarding the scope of measures designed and the proportion of UAA involved (Van Huylenbroeck and Whitby, 1999). While Austria, Finland and Luxembourg have more than two thirds of the UAA involved in agri-environmental measures; in Belgium, Denmark, Greece, the Netherlands and Spain the coverage is just a mere 5% of their total UAA (Glebe and Salhofer, 2007).

Following Hanley *et al.* (1999) success or failure of agri-environmental policy should be evaluated combining both ecological and economic efficiency. Due to the uncertainty surrounding joint-production relationships as well as ecological indicator selection and the high costs associated with their quantification, adoption rate has been the most widely used measure of success. Even though this measure overestimates programme achievements, as some of the outputs could have been obtained even in the absence of such policy (Smith and Weinberg, 2004), we consider that while further scientific and technological base is achieved, and taking for granted that policy design is efficient in so far requirements assure outputs, adoption rates are valid indicators.

Therefore, further understanding of AES sign-up decisions by farmers is a key issue in order to increase agri-environmental policy effectiveness. This paper deepens in the theoretical model of farmer behaviour in the presence of AES by considering the effect of different factors depending on the intensity of the requirements for implementing a particular AES. Identifying the relevant factors influencing the adoption decision provides useful information for scheme design and implementation measures that increases sign-up probability. The rest of the paper is structured as follows: section II presents a review of current knowledge regarding farmer AES adoption and develops a theoretical model adapted to test the research hypothesis. Section III includes a description of the AES selected for corroborating the theoretical hypothesis as well as the fieldwork undertaken and the estimated econometric model. Next, model estimation results are presented and section V provides a summary of the main findings and the policy recommendations derived thereof.

II. Explaining the adoption of AES

Factors affecting farmers' individual decision to sign-up in AES can be grouped in four main categories (Vanslembrouck *et al*., 2002). Programme (type of measure, compensation paid, application costs, etc.) and market (food and environment demand) characteristics constitute the so-called extrinsic factors while farm (size, crop portfolio, etc.) and individual farmer (age, education, etc.) characteristics are intrinsic factors. As a distinctive component of intrinsic factors, special attention has been given to the effect of social capital, a concept which cannot be captured by a single definition (Coleman, 1988), however recurrently references to social capital involve social structures or networks which enhance certain actions, such as the adoption of technology or practice, trade, etc.

Previous research has tested the effect of many of these variables on farmer participation in AES. Related to programme characteristics only participation in another AES can be tested as the rest of the attributes are homogenous for each set of farmers. The most significant factor affecting participation seems to be prior participation in similar schemes (Potter and Lobley, 1992; Morris and Potter, 1995; Wilson, 1997; Drake *et al*., 1999; Wilson and Hart, 2001) indicating that once a farmer has shifted its technology towards environmental goods provision, this condition tends to prevail in the long term as long as the scheme is maintained. Other programme characteristics that has been previously analysed empirically are payment levels (Delvaux *et al.*, 1999; Van Huylenbroeck and Whitby, 1999; Vanslembrouck *et al*., 2002; Cooper, 2003; Wossink and Van Wenum, 2003) and contract duration (Wilson, 1997), while monitoring and targeting have been studied theoretically (Moxey *et al.*, 1999; Fraser, 2002 and 2004), with special focus on risk aversion. Market characteristics, although described in many cases (i.e. Gómez-Limón and Atance, 2004) have not been considered in sign-up decisions as prices of inputs and outputs are considered homogenous for each AES modelled.

As far as farmer individual characteristics are concerned, there is a wide consensus regarding increased participation of younger farmers (Morris and Potter, 1995, Bonnieux *et al*., 1998, Wilson and Hart, 2000; Mathijs, 2003; Vanslembrouck *et al*., 2002; Paniagua, 2001; Jongeneel *et al*., 2008). Nevertheless, when the AES is focused on extensification, older farmers are more prone to sign-up (Potter and Lobley, 1992; Drake *et al*., 1999) as this type of AES require less labour and does not request new investments either in capital and/or knowledge, which are the main reasons for deterring older farmers from participating. In this sense, in the evaluation of an extensification programme in Spain, Paniagua (2001) concludes that part-time farmers also tend to participate more often in programmes that require less involvement. The same conclusion has been obtained by Mathijs (2003) related to the willingness to adopt a countryside stewardship scheme in Belgium. In a research made by Jongeneel *et al*. (2008) on the adoption of different multifunctional activities by farmers in the Netherlands, having an outside job has a negative effect on participation in labour-intensive activities due to the fact that these leave less time available to participate in off-farm activities. However, an opposite and significant effect was found for participation in less labour-intensive measures.

Regarding farmer's education, Delvaux *et al*. (1999) and Dupraz *et al.* (2000) confirm that a better understanding of the AES requirements or a higher environmental concern positively affect participation, while formal education is positively related to participation in studies undertaken by, Delvaux *et al.* (1999), Drake *et al.* (1999), Dupraz *et al.* (2000) and Wilson and Hart (2000). On the other hand, a minority of studies (Bonnieux *et al.*, 1998; Jongeneel *et al.*, 2008) reach the opposite conclusion although the former alerts of co linearity between education and farm size that may have distort the coefficients and the latter is justified by the fact that higher education levels imply higher opportunity costs of labour in other sectors. Related to education, we can also consider farmer's attitudes towards the environment. Attitudes have been measured using several approaches (Morris and Potter, 1995; Bonnieux *et al.*, 1998; Drake *et al.*, 1999) but independently of the approach chosen, there is consensus regarding the positive relationship between participation and farmer's positive attitude towards the environment. Attitudes towards risk can also have an impact on farmer participation, mainly due to income security assured by environmental payments (Fraser, 2004). Nevertheless, Slangen (1997) and Sumpsi *et al.* (1998) claim that uncertainty regarding the future of AES and the impact of practices in future production ability may hamper participation. Risk aversion has also been highlighted as a factor interacting with monitoring and penalty programme characteristics (Ozanne *et al.*, 2001). An additional attitude that shows divergent effects on participation is that of innovativeness; although Willock *et al.* (1999) detect that pioneer farmers are participating more often in AES in Scotland, Wossink and Van Wenum (2003), do not find significant relationships between these two concepts by Dutch arable farmers in biodiversity conservation programmes, indicating that farmers associate participating in the existing conservation programmes with a traditional, non-innovative way of farming. Therefore, this influx is contingent on the degree of change the measure introduces into the farm management.

Finally, farm characteristics also affect farmer participation in AES. The most important factors considered in previous studies include farm size, property regime and farmer's succession. The latter factors provide divergent evidence regarding the influence on farmers' uptake. As an example, size seems to affect positively participation in extensification programs (Morris and Potter, 1995; Wilson, 1997; Paniagua, 2001), however in some specific programmes such as biodiversity conservation schemes seems to be negatively related with size (Siebert *et al.*, 2006) and other authors find size not significant when analysing farmer participation in AES (Bonnieux *et al.*, 1998; Wynn *et al.*, 2001; Wossink and Van Wenum, 2003). A final component affecting participation and resulting from the interaction of the former four is "social capital" which results from the relationships between farmers, managing authorities, extension agencies and other farmers. These relationships foster information, dissemination and programme promotion that in turn results in higher enrolment. This hypothesis has been confirmed by the empirical research undertaken by Mathijs (2003) or Jongeneel *et al*. (2008) in different settings and for different AES.

To sum up, and quoting the review of 160 AES studies undertaken by Siebert *et al.* (2006) "*farmers' decisions are the results of complex social and cultural interactions as well as of wider economic and programme design features*" (pp.328). Our study will identify how far these prior findings apply for to marginal dry-land areas and programmes varying in requirement intensity.

The conceptual model and the variables influencing their uptake described previously derive into a micro-economic modelling framework. Following Dupraz *et al*. (2003) such a model can be based on the assumption that farmers' derived their utility mainly from three components, the economic benefit

(m), the provision of agri-environmental goods (v) and farmers' individual characteristics (Z^U). Within those factors, a sub-component is defined to reflect farmers' social capital characteristics (Z^{SC}).

Farmers' main objective is to maximize his utility (equation [1]), subject to two restrictions (equations [2] and [3]). The first restriction limits economic benefit as a result of the profit derived by agricultural production (a) and the AES participation (b), minus the transaction costs (c) derived from the implementation of the AES. Agricultural profit (π^R) depends on the input and output market prices (p) and on the area signed-up under AES (v)[1] and the farm technical features (Z^π). AES participation is reflected as the AES premium (ρ) and the signed-up surface. Transaction Cost (TC)[2] is a function of Social Capital (Z^{SC}), as well as of farmer individual characteristics (Z^U)[3] and the contract characteristics (Z^C). All the variables belonging to this last category are homogenous for each AES and therefore cannot be tested. In addition, TC can also be influenced by technical specifications (Z^π). The second restriction (equation [3]) shows that the level of agri-environmental production receiving a compensation payment should be greater than a minimum level defined by the CAP[4].

$$\underset{m,v}{Max}\, U(m, v, Z^U, Z^{SC}) \text{ s.t.} \qquad [1]$$

$$m \leq \overbrace{\pi^R(p, v, Z^\pi)}^{a} + \overbrace{\rho v}^{b} - \overbrace{TC(Z^U, Z^\pi, Z^C, Z^{SC})}^{c} \qquad [2]$$

$$v > 0 \qquad [3]$$

The main contribution of this paper is to contrast the above stated hypothesis in two AES differentiated by the level of asset specificity. The basic assumption is that factors affecting participation will vary across AES. In AES with low asset specificity and no effect on the food and animal production, sign-up decision is hypothesized to be mainly driven by the effect associated with farmers' utility function derived from farmers' individual factors. On the other hand, for AES implying a more intensive change in the farm management, due for example to a change in the crop pattern, sign-up decision is hypothesised to be affected mainly by technical factors affecting the function derived from the profit forgone. For both measures, social capital should influence AES uptake due to a reduction on the transaction costs.

Some studies have identified relationships between practices required by AES and farmers' intrinsic factors. Vanslembrouck *et al.* (2002) modelled hypothetical participation in two AES differentiated by the farmers' effort to comply with the measure as well as the utility derived from applying the AES. Results showed a significant difference of factors influencing participation derived from the divergent nature of the measures. Differences related to farmers' characteristics were detected by Jongeneel *et al*. (2008) evaluating farmers' participation in different multifunctional activities in agriculture. De Francesco *et al*. (2007) analyse farmer participation in three types of measures, one of them defined as low input, however no clear distinction between measures was concluded. Finally, Ducos and Dupraz

[1] The model assumes that the land profitability enrolled and not enrolled in the AES differs.

[2] Hobbs (2004) defines TC as: search costs arising ex ante to the transaction, negotiation costs arising during the transaction and monitoring and enforcement costs occurring ex-post transactions.

[3] It should be mentioned that this effect is difficult, if not impossible, to distinguish in an econometric sense, from the effect these variables have on the farmers utility parameter.

[4] Under current CAP regulation, these restrictions are defined by cross-compliance requirements which are compulsory for all farmers receiving the Single Farm Payment.

(2007) focused their research on the effect of TC for different AES signs-up. Results showed that factors related to proxies associated with a lack of trust and uncertainty had a significant negative effect on the probability of farmers choosing more demanding practices.

III. Case study

III.1. Selected agri-environmental schemes

Two AES with different levels of requirements have been selected to test the theoretical framework sketched above; the *environmental fallow* (EFM) and the *alternative crops in special protected areas* (ACM) measures. EFM can be seen as a clear example of a low requirement measure while ACM represents a more intensive measure with regards to farm management changes. Table 1 reflects both measure's main characteristics.

Table 1. Selected AES main characteristics.

	Eligibility
EFM	• Farm located in an area with fallow index >10 • Minimum uptake surface 1 ha.
ACM	• Farm with non-irrigated COP declared surface for 99-00 campaign • 25% of enrolled plots limiting forest area • Farm located in municipalities compromising Natura 2000 Sites
	Requirements
EFM	• Implementing a farm management plan • Keeping stubble on the field until next sowing • Use of phytosanitary products during the no-cultivation period restricted • Livestock load restricted to 80% of GAP (1 LSU ha^{-1}) • Chop and leave straw on the field on at least 50% of fallow surface • Livestock grazing on stubble areas limited to 3 months
ACM	• Implementing a farm management plan • Cultivate Alfalfa maintaining the vegetable part of the plant green in summer • Harvesting and/or grazing forbidden from 31/VIII to 15/IX • For farm-holds with livestock: belonging to veterinary control group • Conventional and in favour of slope ploughing forbidden • Maximum of 10% cereal allowed in pulse crops fields
	Compensation
EFM	• 60.13 €.ha^{-1}
ACM	• 102.00 €. ha^{-1}
	Environmental benefit
EFM	• Enhance steppe bird population (increase feed and winter habitat; reduce mortality)
ACM	• Reduce fire risk and increase nitrogen soil content

Source: BOE (2002); BOA (2005) and own elaboration.

The EFM implies little, if any, additional requirements to traditional dry-land cereal management in marginal areas as the compulsory fallow index already imposes leaving 50% of total area uncultivated, hence there is no additional production loss. The only additional requirement is chopping and leaving the straw on the field, but this task can be easily outsourced and the payment nearly doubles estimated costs for this task. Thus, the EFM can be characterised as a low requirement and low asset-specificity measure. On the other hand, the ACM can be considered a high asset-specificity measure due to the change in the crop pattern that requires additional know-how and important opportunity costs due to the loss of cereal surface for cereal oriented farms, however once the crop change has been undertaken it can be classified as a low effort demanding measure.

III.2.Sample selection and questionnaire

Fieldwork has been undertaken in two regions were the AES were in place in 2006 and 2007 respectively. The EFM survey was administrated to cereal farmers in three counties in Andalusia (Southern Spain) while ACM was undertaken in three counties in Aragón (Northern Spain). In both cases, farmers interviewed had to be eligible for the AES under consideration and sample size was allocated discretionally to over-represent enrolled farmers. Actual uptake rate for EFM and ACM was 15.9% and 2.8% of total eligible farm holds respectively while for both samples 40% of surveys were addressed to enrolled farmers (see Table 2).

Table 2. Sample size distribution figures

	Signed up		**Non signed up**		**Total**	
	Population	*Sample*	*Population*	*Sample*	*Population*	*Sample*
EFM	388	120	2,445	180	2,833	300
ACM	107	62	3,838	94	3,945	156
TOTAL	**495**	**182**	**6,283**	**274**	**6,778**	**456**

Source: Own calculations based on 1999 agricultural census and AES monitoring reports.

For EFM, a total of 300 farmers have been interviewed, this sample size represents 33% of total programme signups in the study area. Fieldwork was conducted during June-August 2006. The questionnaire was designed by the research team after a thorough review of previous research, agricultural structure in the area and interviews with the AES managing authority. An initial version was field tested with 5 farmers for comprehension before generating the final version. Farmers were randomly selected from the population in each strata (enrolled / non-enrolled farmers by municipality) and interviewed in their homes by two agronomists trained by the research team; average interview time was 45 minutes. The ACM questionnaire was a redesigned and an improved version of the EFM taking into account the differences between both AES. The survey was conducted during the period April-June 2007 by a market research company that employed interviewers with agronomic background and trained *in situ* by the research team. Due to the smaller number of farmers enrolled in the ACM, sample size was reduced to 156. All farmers enrolled and accessible[5] were selected for interviewing, while non-enrolled farmers were randomly selected from the different municipalities according to the overall percentage of farmers.

[5] Differences between total sign-ups and sample size are due to same farm-hold applying for more than one contract (2 cases), contact data not facilitated by the managing authority (36 cases) or farmer not willing to participate in the survey (7 cases).

The questionnaire used gathered data regarding three main topics: a) farm basic data with special interest in cattle management, b) attitudes, opinion, knowledge and enrolment in AES and c) basic farmer socio-economic data[6].

III.3. Econometric model

To test the hypothesis put forward in section II, a discrete choice model is fitted to explain farmers' adoption decision. The outcome of the discrete model is the reflection on an underlying regression that models the benefit from contracting the first hectare, the latent variable in the probit model. This variable is derived from the marginal profit which is contingent on AES premium, change in profit due AES requirements, marginal rate of substitution between utility derived from environmental goods and economic benefits; and marginal transaction costs (see equation [4]).

$$b = \rho + \pi_v^R + \frac{U_v}{U_m} - TC_v \qquad [4]$$

Where b is the latent variable reflecting the marginal profit of adoption, ρ the AES premium, π_v^R the forgone agricultural profit due to AES adoption, TC_v the transaction costs associated with AES adoption and U_m and U_v the partial derivates of farmer's utility with respect to income and environmental services provision respectively. Equations [5] and [6] show the discrete choice modelling framework.

$$b_i = \alpha + \beta x_i + u_i \qquad [5]$$

$$Y_i = \begin{cases} 0 & if \quad b_i \geq 0 \\ 1 & if \quad b_i \leq 0 \end{cases} \qquad [6]$$

Where y_i is a binary variable reflecting whether the farmer has enrolled in the AES or not, x_i are the independent variables reflecting the farm and farmers' characteristics, and β are the estimated model coefficients (including a constant, α). The parameters β / σ are estimated by the maximum likelihood estimator as OLS (Ordinary Least Square) estimates are biased due to heterodasticity and non-normality distribution of residuals (Cramer, 1991). The observed variable (Y_i), takes the value 1 when the latent variable is positive and 0 when is negative. The probability of contracting is defined as $P(b \geq 0) = \Phi(x'\beta / \sigma)$ with Φ being the cumulative function of the normal distribution and σ its standard deviation. The variables affecting the enrolment decision and their signs will be used to test the theoretical framework presented in section II.

IV. Results

Variables included in the adoption models grouped by concept they measure and with expected signs for both AES considered are described in Table 3. The questionnaire included many more variables

[6] Both questionnaires are available upon request to the authors.

that could measure these concepts but this table only reports those that show the best statistical fit for the data.

Table 3. Variables included in the estimated models

Concept	Variable	Definition	Expected sign	
			EFM	**ACM**
$\mathbf{Z}^{\pi}$	LSU-PER-HA	Livestock units per hectare	-	+
	LSU	Presence of cattle in the farm-hold (1 if yes)	-	+
	NON-IRR-CEREAL	Crop distribution includes no-irrigated cereal (1 if yes)	**?**	-
	IRR-CEREAL	Crop distribution includes irrigated cereal (1 if yes)	**?**	-
	INSURANCE	Farm has contracted agricultural insurance (1 if yes)	**?**	**?**
	IRR-ALFALFA	Farm irrigated pulse crop surface (has.)	**?**	+
	NON-I-ALFALFA-00	Farm already had pulse crops before AES (1 if yes)	**o**	+
	HARVESTER	Farm owns harvester (1 if yes)	**?**	-
	MARKET	Farmer plans to sell/rent the farm when retiring (1 if yes)	**?**	-
$\mathbf{Z}^{SC}$	FARMER-UNION	Farmer is a member of farmers union (1 if yes)	+	+
	ADD-INF-SOUR	Farmer uses more than one source for technical advice (1 if yes)	+	+
	INF-AES-FINEN	Farmer obtains information related to AES from financial entities (1 if yes)	+	+
	INF-TECH-UNION	Farmer obtains technical advice from farmer unions (1 if yes)	+	+
$\mathbf{Z}^{U}$	AGE	Farmer's age (years)	**?**	**?**
	EDUCATION	Farmer formal educational level (4-point scale)	+	+
	INCOME	Farm income per capita (€ /year)	**?**	**?**
	FUT_IRRIG	Prob. of new irrigation plans being undertaken (1 if declared probability > average probability)	-	-
	INNOVATION	Farmer attitude towards policies implying changes in farm management (4-point increasing scale towards pioneers)	+	+
	POS-ENV-IMPACT	Environmental impact of dry-land cereal management in farm (4-point increasing scale towards positive impact)	+	+
$\mathbf{Z}^{c}$	OTHER-AES	Farmer participates in other AES (1 if yes)	+	+

+: positive sign expected; -: negative sign expected; o: question not included in the questionnaire; ?:no a priory sign expected

Table 4 presents the final models estimated for both AES. For the estimates presented only farmers declaring that they knew the existence of the AES have been considered due to data issues[7]. Technical variables play a minor role for the EFM adoption as expected. The only significant variable is related to the interaction between cereal and livestock production, moreover this variable could be partly endogenous, as farmers might have reduced their livestock density in order to comply with the AES requirements prior to signing up. On the other hand, up to eight technical variables explain the adoption choice in the ACM. These variables can be grouped to reflect three main vectors affecting the sign up decision: a) cereal specialisation, b) pulse crop management know-how and c) land market value. The first vector is represented by four variables (IRR-CER; NON-IRR-CER; HARVESTER and INSURANCE) that characterize farms with a strong focus on cereal production and consequently lower marginal costs associated with this crop. These farms would face higher forgone profits in the AES signed up area (π_v^R) and higher transaction costs due to the opportunity cost of the investment associated with the harvester[8], thus they should be less willing to participate as shown by the results.

[7] A basic premise is that in order to take a decision regarding adopting an AES farmers need to be aware of the measure. However, 16.6% of the total sample for EFM (50 cases) and 33.3% for ACM (52 cases) declared not knowing the existence of the studied AES and have been discarded from the reported models.

[8] Harvesters are not used for pulse crops.

Agricultural insurance in the area is mainly focused on cereal production and in this case is considered as a proxy of farm dependence on cereal income, with farmers being more prone to insure cereal production as their dependency on this crop increases.

Table 4. AES adoption models results

		EFM			ACM		
Concept	**Variable**	β	***S.d.***	***P-value***	β	***S.d.***	***P-value***
	α	-3.474	0.833	0.0000	0.368	1.145	0.7480
$\mathbf{Z}^{\pi}$	LSU-PER-HA	-0.558	0.363	0.0937			
	LSU				1.021	0.385	0.0079
	NON-IRR-CEREAL				-1.034	0.565	0.0672
	IRR-CEREAL				-1.254	0.475	0.0083
	INSURANCE				-1.788	0.876	0.0413
	IRR-ALFALFA				0.057	0.028	0.0393
	NON-I-ALFALFA-00				0.966	0.406	0.0172
	HARVESTER				-2.078	1.221	0.0961
	MARKET				-1.079	0.464	0.0200
$\mathbf{Z}^{SC}$	FARMER-UNION	0.705	0.189	0.0002			
	ADD-INF-SOURCE	0.872	0.372	0.0190			
	INF-AES-FINEN	0.421	0.187	0.0245	1.770	0.763	0.0204
	INF-TECH-UNION				1.123	0.508	0.0269
$\mathbf{Z}^{U}$	AGE	0.032	0.010	0.0019			
	EDUCATION	0.263	0.127	0.0381			
	INCOME	-0.650	0.281	0.0207			
	FUT_IRRIG	0.365	0.205	0.0748	-0.190	0.081	0.0186
	INNOVATION	0.215	0.096	0.0246			
	POS-ENV-IMPACT				0.589	0.237	0.0129
$\mathbf{Z}^{c}$	OTHER-AES				0.623	0.391	0.1111
	Number of observations = 250 -2log likelihood null = 344.635 -2log likelihood model = 287.916 χ^2= 56.719 p-value= 0.000 Mc_Fadden R^2 = 0.1646 % of correct predictions = 70.4 % (64.0% applicants/ 75.7 % non-applicants)				Number of observations = 104 -2log likelihood null = 140.304 -2log likelihood model = 66.424 χ^2= 73.878 p-value= 0.000 Mc_Fadden R^2 = 0.5266 % of correct predictions = 85.6 % (90.3% applicants/ 78.6 % non-applicants)		

The second vector is represented by three variables (IRR-ALFALFA; NON-IR-ALFALFA00 and LSU). The first two variables would decrease TC associated with the measure due to farmer already possessing management knowledge for the required crop. The last variable would decrease forgone profit as the farmer would use the new crop as pasture for the farm-hold livestock (mainly sheep). The final vector (MARKET) is associated with an increase forgone profit due to lower land value when retiring. If land has long-term commitments its price and sell/rent probability will be lower as uses are restricted.

As expected, social capital variables are significant for both measures. Social capital variables used in the models refer to its structural form that reflects connectedness between stakeholders involved in the implementation of the AES (Woodhouse, 2006). Increased social activity, measured by belonging to farmers' unions (FARMER-UNION) or information-gathering activities (use of social networks), reduce transaction costs associated with uncertainty regarding AES implications and/or farm management. A significant effect is associated with the role of financial entities in promoting AES adoption (INF-AES-FINEN), a characteristic which has not been reflected in any other study of AES sign-up and which might not be related to environmental benefits but by the amount of subsidies that are channelled through these entities.

Socio-demographics characteristics play a role on the EFM measure (AGE; EDUCATION; INCOME). As previously detected for low-requirement measures (Potter and Lobley, 1992; Drake *et al*., 1999), older farmers show a higher probability of participating due to easiness in implementing the requirements. In this particular case, EFM could be described as "traditional farm management" and therefore, older farmers were already following these requirements. Increasing levels of education have been detected as one of the drivers of EAS adoption due to a better understanding of measure requirements and implications', this seems to be the case for the EFM. The negative impact of income would be related to low, if any, forgone profits associated with measure implementation and the assurance of a steady income independent of climatic and market risks. As expected, farmer socio-demographics play no role for the more demanding measure, where technical variables limit their effect. Farmers' attitudes affect the sign-up decision for both measures and thus can be considered independent of the measure intensity of change. Expecting future transformation (FUT-IRR) into irrigation is expected to have a negative effect on adoption due to an increase opportunity costs. Unexpected negative influence is found for the EFM where traditional fallow is not compulsory when irrigation is available; however, as no investment is needed to undertake this measure, there are no sunk costs associated with breaking the contract if transformation into irrigation is undertaken. The positive sign for ACM does reflect the potential drawback when converting the land to irrigation due to the change in crop pattern. Higher environmental awareness (POS-ENV-MAN) is considered to be related to a higher utility derived from the implementation of the AES and therefore its positive sign reflects an increase of farmer's utility when signing-up for ACM.

V. Summary and policy implications

The main finding reported in this paper is the diminishing role of farm technical characteristics as AES become less asset specific. ACM sign-up decision is strongly influenced by farm technical features (Z^{π}), while farmer individual variables (Z^{U}) play a more important role explaining participation in a low-asset specificity measure (EFM). This corroborates the validity of the theoretical framework presented to evaluate agri-environmental policy. Nevertheless, two groups of variables play a role for both types of measures: social capital and farmers' attitudes. Both groups are interlinked as attitudes can be changed though enhanced social capital (Pretty and Smith, 2004). Additionally, social capital could play a role in increasing the AES awareness and thus expanding the base of potential adopters.

Policy recommendations for AES design stem directly from the above-reported findings. If AES is to be geared towards very specific measures, then participatory design with farmers and/or their representatives should be a must. Measures should be technically feasible for existing farms as, if not, although environmental benefits can be achieved according to the design specifications, farmers' uptake will be very limited. If less demanding AES are promoted, then targeting those farmers more willing to participate should be the area in which additional efforts would provide higher yields. Although recommendations can vary from case to case, our data seem to support promoting extensification as a pre-abandonment and income support option for older farmers with lower incomes.

For both cases increasing the social networks in rural areas is a win-win scenario. Apart from the knowledge effect mentioned above, increased SC promotes AES adoption either by reducing transaction costs or by directly influencing on farmers' utility functions. Nevertheless, social capital quality should also be taken into account. The impact of financial entities in sign-up does not assure enhanced environmental awareness by farmers and reinforces the risk of the end of contract dilemma (Whitby, 2000), when environmental benefits might be at risk when other production options are available (i.e. higher food and fibre prices and thus higher forgone profits). Further research should be geared towards increasing the understanding of interactions between the different components identified in order to optimise the promotion policy mix that assures an increase in adoption rates.

VI. References

Boletín Oficial de Aragón, (BOA). (2005). Orden de 27 de Septiembre de 2005, del Departamento de Medio Ambiente, por la que se establecen los requisitos y ámbito de aplicación de parte de las ayudas agroambientales gestionadas por el Departamento de Medio Ambiente para el año 2006. *Boletín Oficial de Aragón* n. 125 (21/10/2005).

Boletín Oficial del Estado, (BOE). (2002). Real Decreto 708/2002, de 19 de Julio, por el que se establecen medidas complementarias al Programa de Desarrollo Rural para las Medidas de Acompañamiento de la Política Agraria Común. *Boletín Oficial del Estado* n. 175 (23/07/2002).

Bonnieux, F., Rainelly, P. and Vermersch, D. (1998). Estimating the supply of environmental benefits by agriculture: a French case study. *Environmental and Resource Economics* 11: 135-153.

Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology* 94 (Supplement): S95–S120.

Consejería de Medio Ambiente, (CMA). (2005). Manual de buenas prácticas agrícolas para la conservación de las aves esteparias en Andalucía. SEO-Birdlife. Ed. Junta de Andalucía.

Cooper, J. (2003). A joint framework for analysis of agri-environmental payment programmes. *American Journal of Agricultural Economics* 85(4): 976-987.

Cramer, J.S. (1991). *The Logit Model for Economist*. London, UK: Edward Arnold Publishers.

Defrancesco, E., Gatto, P., Runge, F. and Trestini, S. (2007). Factors affecting farmers' participation in agri-environmental measures: A northern Italian perspective. *Journal of Agricultural Economics* 57(3): 393-414.

Delvaux, L., Henry de Frahan, B., Dupraz, P. and Vermersch, D. (1999). Adoption d´une MAE et consentement á recevoir des agriculteurs en région wallone. *Economie rurale* 249: 71-81.

Directorate General for Agriculture and Rural Development, (DG AGRI). (2006). Rural Development in the European Union: Statistical and Economic Information - Report 2006. European Commission: Brussels. [ec.europa.eu/agriculture/agrista/rurdev2006/index_en.htm] Accessed on 13/12/2007.

Drake, L., Bergström, P. and Svedsäter, H. (1999). Farmers' attitude and uptake. In: Van Huylenbroeck, G. and Whitby (eds), *Countryside Stewardship: farmers, policy and markets*. Amsterdam: Pergamon, 89-110.

Ducos, G. and Dupraz, P. (2007). The asset specificity issue in the private provision of environmental services: Evidence from agri-environmental contracts. Working paper 07-02. Institute National de la Recherche Agronomique (INRA). Rennes: INRA.

Dupraz, P., Vermersch, D., Henry de Frahan, B. and Delvaux, L. (2003). The environmental supply of farm households. A flexible willingness to accept. *Environmental and Resource Economics* 25: 171-189.

Dupraz, P., Henry de Frahan B., Vermersch, D.B. and Delvaux, L. (2000). Production de biens publics par des ménages: une application á l'offre environnementale des agriculteurs, *Revue d'Economie politique* 110(2): 267-291.

Fraser, R. (2004). On the use of targeting to reduce moral hazard in agri-environmental schemes. *Journal of Agricultural Economics* 55 (3): 525-540.

Fraser, R. (2002). Moral hazard and risk management in agri-environmental policy. *Journal of Agricultural Economics* 53(3): 457-487.

Glebe, T. and Salhofer, K. (2007). EU agri-environmental programs and the "Restaurant table effect". *Agricultural Economics* 37(2-3): 211-218.

Gómez-Limón, J.A and Atance, I. (2004). Identification of public objectives related to agricultural sector support. *Journal of Policy Modelling* 26: 1045-1071.

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

Hobbs, J. (2004). Markets in metamorphosis: The rise and fall of policy institutions. In G. Van Huylenbroeck, W. Verbeke and L. Lauwers (eds), *Role of Institutions in Rural Policies and Agricultural Markets*. Amsterdam: Elsevier, 199-212.

Instituto Nacional de Estadística (INE) (2004). *Censo de población y vivienda 2001 (resultados detallados)*. Madrid. [www.ine.es] Accessed on 15-01-2007.

Jongeneel, R., Polman, N. and Slangen, L. (2008). Why are Dutch farmers going multifunctional?. *Land Use Policy* 25(1): 81-94.

Mathijs, E. (2003). Social capital and farmers´ willingness to adopt countryside stewardship schemes. *Outlook on agriculture* 32(1): 13-16.

Morris, C. and Potter, C. (1995). Recruiting the new conservationists: Farmers' adoption of agri-environmental schemes in the UK. *Journal of Rural Studies* 11(1): 51-63.

Moxey, A., White, B. and Ozanne, A. (1999). Efficient contract design for agri-environmental policy. *Journal of Agricultural Economics* 50(2): 187-202.

Ozanne, A., Hogan, T. and Colman, D. (2001). Moral hazard, risk aversion and compliance monitoring in agri-environmental policy. *European Review of Agricultural Economics* 28(3): 329-347.

Paniagua, A. (2001). Agri-environmental policy in Spain. The agenda of socio-political developments at the national, regional and local levels. *Journal of Rural Studies* 17: 81-97.

Potter, M. and Lobley, M. (1992). Ageing and succession on family farms. *Sociologia Ruralis* 32(2): 317-334.

Pretty, J. and Smith, D. (2004). Social capital in biodiversity conservation and management *Conservation Biology* 18(3): 631-638.

Siebert, R., Toogood, M. and Knierim, A. (2006). Factors affecting European farmers participation in biodiversity policies. *Sociologia Ruralis* 46(4): 318-340.

Smith, K. and Weinberg, M. (2004). Measuring the success of conservation programs. *Amber Waves* 2(4): 14-21.

Slangen, L. (1997). How to organise nature protection by farmers. *European Review of Agricultural Economics* 24: 508-529.

Sumpsi, J., Iglesias, E. and Garrido, A. (1998). An integrated approach to agricultural and environmental policies: a case study of the Spanish cereal sector. In: Dabbert *et al*. (eds.), *The Economics of Landscape and Wildlife Conservation*. Wallinford: CAB International.

Van Huylenbroeck, G. and Whitby, M. (1999). Conclusions and policy recommendations. In: Van Huylenbroeck, G. and Whitby (eds.), *Countryside Stewardship: farmers, policy and markets*. Amsterdam: Pergamon, 177-188.

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(3): 489-511.

Whitby, M. (2000). Challenges and options for the UK agri-environment: Presidential address. *Journal of Agricultural Economics* 51 (3): 317-332.

Willock, J., Deary., I.J., Edwards-Jones, G., Gibson, G.J., McGregor, M.J., Sutherland, A., Dent, B., Morgan, O. and Grieve, R. (1999). The role of attitudes in farmer decision-making: business and environmentally orientated behaviour in Scotland. *Journal of Agricultural Economics* 50: 286-303.

Wilson, G. and Hart, K. (2000). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environment Planning A* 32: 2161-2185.

Wilson, G. (1997). Factors influencing farmer participation in the environmentally sensitive area scheme. *Journal of Environmental Management* 50: 67-93.

Woodhouse, A. (2006). Social capital and economic development in regional Australia: A case study. *Journal of Rural Studies* 22: 83-94.

Wossink, G. and Van Wenum, J. (2003). Biodiversity conservation by farmers: analysis of actual and contingent participation. *European Review of Agricultural Economics* 4: 461-485.

Wynn, G., Crabtree, B. and Potts, J. (2001). Modelling farmer entry into de environmentally sensitive area schemes in Scotland. *Journal of Agricultural Economics* 51(1): 65-82.