AGRI-ENVIRONMENTAL MEASURES ADOPTION: NEW EVIDENCE FROM LOMBARDY REGION

Bertoni D., Cavicchioli D., Pretolani R. and Olper A.

University of Milano
Department of Agricultural and Food Economics (DEPAAA)

Contact: danilo.bertoni@unimi.it

European Association of Agricultural Economists

Università degli Studi della Tuscia

Istituto nazionale di Economia Agraria

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Abstract[1]

As a consequence of the ‘greening’ process of the Common Agricultural Policy (CAP) the demand for evaluation of actual agri-environmental measures (AEMs) calls for a deeper analysis of this policy instrument implementation. The idea behind this paper is that farmers’ willingness to participate is a necessary but not a sufficient condition in explaining the AEMs local uptake. Specifically, we test whether AEMs adoption depends both on farms and farmers’ characteristics, and on the local political and institutional framework, as well. Discriminating between genuine farmer incentive and attitude towards AEMs from the role played by the local institutional environment, appears a crucial step toward a better understanding of agri-environmental schemes. Empirical evidence conducted on the ‘universe’ of AEMs eligible farms located in Lombardy region gives substantial support to this hypothesis.

Keywords: Agro - Environmental measures, Lombardy region, CAP

JEL Code: Q10, Q18

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Introduction

As a consequence of the 'greening' process of the Common Agricultural Policy (CAP) the demand for evaluation of actual agri-environmental measures (AEMs) calls for a deeper analysis of this policy instrument implementation. Indeed, the patterns of farmers' participation strongly affect the policy's objective attainments.

Many studies have investigated the determinants of farmers' participation in rural development schemes, starting from the assumption that such a participation is mainly the outcome of a farmer utility maximization process (e.g. Vanslembrouck et al. 2002; Defrancesco et al. 2007; Barreiro-Hurlé et al 2008). The relevant literature considers also factors like social commitment and the environmental attitude of farmers as drivers in the participation (e.g. Damianos and Giannakopoulos, 2002; Wossink and Wenum 2003). However, with the few exceptions of Vandermeulen et al (2006) and Hackl et al. (2007), factors related to the policy decision-making environment have been normally neglected, despite the central role played by regional and local political bodies in the design and implementation of AEMs.

The idea behind this paper is that farmers' willingness to participate is a necessary but not a sufficient condition in explaining the AEMs local uptake. In this paper we test whether AEMs adoption depends both on farms and farmers' characteristics, and on the political institutional framework, as well. Indeed the relevant decisions about AEMs design and implementation, could be affected by the transaction costs of the bargaining process among farmers, other interest groups and regional and sub-regional governments. Thus, discriminating between genuine farmer incentive and attitude towards AEMs from the role played by the local political-institutional environment, appears a crucial step toward a better understanding of agri-environmental schemes (Bertoni and Olper, 2008).

To deal with this kind of issues we exploit a sample of *all* eligible farmers in the Lombardy Region agri-environmental program, taking advantage of the Regional Agricultural Information System (SIARL) database. Such database includes all the farms that received payments on the I and II pillar of the CAP. For each farm the database collects information related to several, technical, structural and farmer characteristics, as well as the affiliation to farmers organization. We have integrated these information with official data on social, demographic, territorial and political variables at sub-regional (district) and municipal level.

With respect to the methodology, we applied a parametric approach (Probit model) to explain the probability of farmers' AEMs adoption conditional upon three broad categories of determinants: farm and farmer characteristics, the geographical context and, finally, the political and institutional environment. With respect to the last category of determinants, we expect that variable proxy of the transaction costs involved in the political bargaining process - such as membership in a specific farmer organization, the 'ideology' orientation of the district and the degree of homogeneity of farmer interests - might influence the probability of individual participation in the AEMs.

The paper will be structured as follow. In the next Section (2) we summarize the conceptual framework for understanding the issues of AEMs adoption. A background of the Lombardy institutional context will be given in Section (3). Next, Section (4) presents data and variables, while Section (5) describes the econometric model and results. At the end some concluding comments.

Conceptual framework

The conceptual model to study the factors affecting the adoption of AEMs follows the micro-economic modelling framework developed in Vanslembrouck et al. (2002) and Dupraz et al. (2003), and recently applied by Barreiro-Hurlé and Espinosa-Goded (2007) and Barreiro-Hurlé et al. (2008). According to this literature, the determinants of AEMs adoption can by divided into *extrinsic* and *intrinsic* factors (see Vanslembrouck et al 2002). The former rely on programme characteristics, like the nature of the specific agro-environmental scheme, and market conditions (supply and demand) for both food and environmental goods. Differently, the latter rely on *farm* characteristics like size, location, type of farming, and *farmer* characteristics like age, education, and composition of the family farm. More recently, a further factor has been included in the analysis of the AEMs adoption: the 'governance structure' often called 'social capital' (see Jongeneel et al., 2008; Barreiro-Hurlé et al., 2008; Mathijs, 2002), that emerges from the interaction between the extrinsic and intrinsic factors with the political and institutional context.

Following Barreiro-Hurlé et al. (2008), the farmers choice to up-take AEMs is based on the assumption that they derive utility from four key components: the economic benefit (*m*), the provision of agri-environmental goods (*v*), farmer individual characteristics (Z^U), and farmer' social capital (Z^{SC}).

The farmer problem can be expressed as follow:

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

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

$$v > 0 \tag{3}$$

Thus, farmers maximize their utility given by equation (1), subject to restrictions (2) and (3). Restriction (1) imply that farmers economic benefit is derived from the farm activity (*a*) and their participation in AEMs (*b*), minus the transaction costs (*c*) due to their participation in the AEMs. More specifically, the economic benefit from farming (π^R) is a function of relevant prices (p), the area devoted to AEMs (v) and farm technical characteristics (Z^{π}). The benefit from AEMs participation depends by the premium (ρ) multiply the intensity level v. The transaction costs (TC) component is a function of farmer (Z^U), contract (Z^C) and farm ((Z^{π}) characteristics, as well as farmer social capital (Z^{SC}). Finally, restriction (3) simply recalls the logic of the AEMs, namely that in order to obtain a subsidy the level of agri-environmental goods production should be greater than a minimum level, actually defined by the good farming practice.

The modelling framework above suggests the following basic relationships. First, an increase in the income derived from farming (a), as an effect of say food price increase, should reduce the environmental goods provision - and thus the income coming from the AEMs (b) - because it increase the opportunity costs of AEMs. Differently, an increase of the AEMs premium ρ, or of the marginal utility of environmental provision, should increase the surface devoted to AEMs. Moreover, a reduction in the transaction costs component necessary to implement AEMs (c), should increase the provision of environmental goods (v).

It should be pointed out that all the previous papers that have used a similar framework in studying different determinants of AEMs adoption, are based on survey data, collected among the population of AEMs eligible farms. From this point of view, the main contribution of our paper is to work on data coming from the entire population rather than just on a restricted sample. This presents both advantages and drawbacks. The key advantage of working on the entire population is to overcome the problem of sample selection bias, always present in this kind of analyses. However, this happen at the costs of some over-simplification in term of our ability to control for 'all' relevant factors affecting the AEMs adoption. The second main contribution of the analysis is to pay particular emphasis to the identification of factors affecting transaction costs, referring on several district level political-institutional variables. More specifically, our basic assumption is that interaction within the specific local institutional environment affects the bargaining process between farmers and local institutions and should in turn influence farmers decision about AEMs adoption.

Background

In Italy from 1997[2] many agricultural and rural development competences were devolved from the central administration to the regional ones. At the same time some Regions partly devolved such matters to sub-regional administrations. This is the case of the Lombardy Region, which, among other things, in 1998 has delegated its 11 provincial administrations to directly collect and manage farmers' demands for public policy contributions[3].

[2] See Dlgs (legislative decree) n. 143/1997.
[3] See Regional Law n. 11/1998.

Thus, the process of political decentralisation has also involved the implementation of the EU Rural Development Policy. The Council Regulation (EC) n. 1257/99 allowed Member States (MS) to retail Rural Development Programmes to the geographical level deemed to be the most appropriate, in order to adapt them to the different agronomic, environmental, economical and political conditions. Consequently, in line with its institutional situation, Italy choose to implement 21 RDPs, each for every administrative Region. In Italy, then, the relevant decision-making bodies for Rural Development Policies implementation are represented by regional administrations. Pointing our attention to the Lombardy RDP 2000-2006, and particularly to the AEMs, we observe that sub-regional level, namely the Provinces, are involved in such implementation process.

Table 1 summarize the competencies assigned to the regional and to the provincial administrations, respectively. Particularly regional administration defines schemes structure (presenting aims, contents, level of payments, controls etc.) and notifies its proposal to the EC for definitive acceptance. On the other hand Provinces practically manage the RDP bureaucratic process, in this way representing an interface between farmers and regional administration.

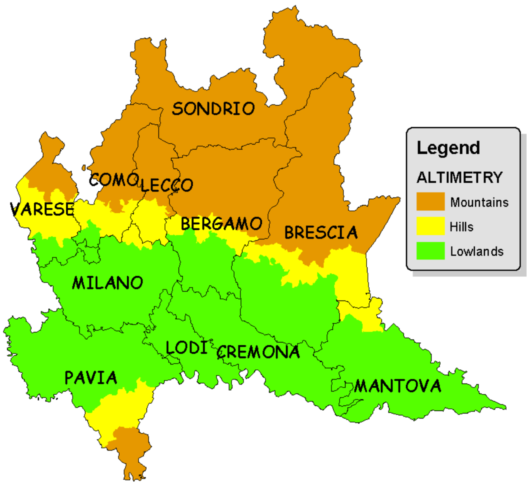
AEMs represent, in financial terms, the most important policy instrument within the Rural Development Programme (RDP) 2000-2006 of the Lombardy region. During the programme implementation AEMs have absorbed about 328 millions of Euros, 165 of which deriving from EAGGF contribution (36% of the total public expenditure in Lombardy RDP, 45% if we consider only EAGGF allocation). Over 215.000 hectares were under agri-environmental commitments, corresponding to the 20% of the regional utilized agricultural area (UAA).

Within the AEMs framework farmers could choose among five different categories of schemes:

- farming input reduction and integrated production (AEM1);
- organic farming (AEM2);
- management of meadows and pastures (AEM3);
- landscape conservation, restoration and creation (AEM4)
- breeds in danger of being lost (AEM5).

In appendix A.1 the commitments, the eligibility criteria and the amount of the annual public support related to each scheme are summarized. given its specificity and its poor implementation rate, AEM5 will not be considered in the present analysis.

Table 1 – Institutions involved in the implementation of AEM in Lombardy RDP 2000-2006.

<table>
<tr><td>The Lombardy Region
</td><td>AEM implementation process in the RDP 2000-2006 of the Lombardy Region</td></tr>
<tr><td rowspan="2">The 11 provinces of the Lombardy Region
</td><td><u>Regional Administration</u>
• Defines schemes typologies following Reg, (EC) 1257/99 prescriptions;
• Defines aims, commitments, eligibility criteria, amount of aids, controls and monitoring procedures following Reg, (EC) 1257/99 prescriptions;
• Sets priorities for the implementation of agri-environmental contracts.</td></tr>
<tr><td><u>Provincial Administrations</u>
• Collect and process farmers' demand for agri-environmental premiums;
• Set additional priorities for agri-environmental contracts implementation;
• Promote AEM and help farmers in administrative tasks;
• Provide technical assistance;
• In more practical terms there is a inter-institutional political bargaining processes between the regional administration and the provinces competing for financial resources allocation.</td></tr>
</table>

Data and measures

In order to analyse factors affecting farmers participation in AEMs we use data extracted from the agricultural information system of the Lombardy Region (SIARL). SIARL is the instrument by which regional administrations collect and process farmer's demand for public contributions (and consequently for RDP funds). In the SIARL dataset information concerning farm and farmers characteristics and CAP administrative proceedings are contained. These data have been integrated with territorial, institutional and political information in order to control for several potential determinants of the AEMs participation.

With respect to a survey approach, the exploitation of SIARL dataset allow us to work with a sample representing almost the entire universe of Lombardy farms. Thus problems of sample representativeness have been totally overcome. On the other hand we lack of some information which are only directly available by survey (for example farmers attitude toward environment and institutions). We partially reduce that problem by replacing missing sample information with proxy variables measured at very detailed territorial level.

Because of the pluriennial nature of AEMs commitments, we faced also the problem of choosing a reference year. This choice has been done excluding initial implementation years of Lombardy RDP for which the SIARL dataset was not representative of the actual farmers adhesion rate. As a consequence, 2005 has been considered enough representative, because in that year old commitments had been almost exhausted and all new Reg. (EC) 1257/99 contracts were been carrying out.

In 2005 there were 10.793 farms participating in at least one agri-environmental scheme with a public expense of about 45 millions of Euro. The most adopted scheme was AEM1 and AEM3, while AEM2 and AEM4 represents a small share of the total AEMs expenditure (see Table 2).

The size of the selected sample correspond to 62.454 farms, containing more than 97% of the farms implementing AEMs in the 2005 (10.483 farms). Not all farms contained in the dataset meet the AEMs eligibility criteria (see appendix A.1), thus not eligible farms have been excluded from the analysis. Since eligibility criteria vary among the schemes, the number of eligible farms changes if we refers to a scheme rather than to another (see Table 2). Furthermore sample size is influenced by a lack of observations for some variables.

Table 2 - Farmers participation and public funds expenditure in the AEM (2005).

Scheme	AEM_TOT (At least 1 scheme)	AEM1	AEM2	AEM3	AEM4
Sample	62.454	62.454	62.454	62.454	62.454
Eligible farms	58.766	37.396	40.409	43.412	58.766
Adhesions	10.483	3.555	443	5.801	2.324
Expenditure in € (2005)	45.922.813	25.394.003	3.106.996	14.493.273	2.928.540
% of expenditure (2005)	100%	55,3%	6,8%	31,6%	6,4%

Dependent variables

The dependent variable, *AEM_all*, is a dichotomous variable indicating if eligible farms participates (1) or does not participate (0) in AEMs. We consider farms participating in at least one AEMs scheme. However, because agri-environemntal schemes differ in term of their asset specificity (see Barreiro-Hurlè et al, 2008), we expect that factors affecting participation will vary across the different instruments.

Thus, to test this hypothesis we will also consider participation choices within each scheme. To do that we have created four different dichotomous dependent variables, namely *AEM_1*, *AEM_2*, *AEM_3*, and *AEM_4*, each of them representing a different sub-sample selected according to specific eligibility criteria.

Independent variables

Farm and farmer characteristics

The traditional literature on farmers willingness to participate in AEMs shows that variables related to farms and farmers characteristics are the main factors explaining adhesion to agri-environmental schemes. Given the lack of reliable information about family and nonfamily agricultural labour force, our key variables aimed to depict the farm level contest are mostly related to farm characteristics (rather than farmers'one). The variables related to farmer characteristics are: farm heads age (*age*), which is also a proxy of the education level; the percentage of property land (*landown*); and the average farmer income of the farm district[4] (*farmer_income*).

Differently, farm characteristics considered are farm economic size (*esu*), the type of farming distinguished among field crops (*field_crop*), permanent crops (*permanent_crop*) and dairy (*dairy*), the farming intensity expressed by the number of livestock units per hectare (*lsu_ha*) and the number of horsepower per hectare (*hp_ha*), and finally the area share of grasslands and pastures (*pasture*) indicating the inverse degree of farming intensity as well. A description of the explanatory variables is reported in Table 3.

Table 3 – Variables explanation.

Variable	Description and measurement
Farm characteristics	
esu	Number economic size units per farm
lsu_ha	Number of livestock standard units per hectare
hp_ha	Number of horsepower per hectare
field_crop	Dummy variable indicating field crops type of farming
permanent_crop	Dummy variable indicating permanent crops type of farming
dairy	Dummy variable indicating dairy specialized type of farming
pasture	Share of pasture and grasslands on the agricultural utilized area
Farmer characteristics	
age	Age of the farm holder
landown	Share of the property land on the total agricultural area
farmer_income	Average farmer income of the 'farm district' (Euro)
'Social capital'	
investment	Dummy variable indicating farms participating in the 'investment in agricultural holdings' RDP measure
lfa_payment	Dummy variable indicating farms taking the LFA payment
Income	Average income of the 'farm district' (Euro)
education	Share of the population having an education level ISCED 3 or upper
participation	Share of participation in the regional Lombardy elections (2005) at the municipal level
greens	Share of votes obtained by the Green Party in the regional Lombardy elections (2005) at the municipal level
left	Share of votes obtained by the left-oriented parties in the regional Lombardy elections (2005) at the municipal level
councillor	Dummy variable indicating province's agriculture councillor coming from the regional parliament majority party.
euroskeptic	Share of votes obtained by the euroskeptic parties in the regional Lombardy elections (2005) at the municipal level
beds	Number of beds per inhabitant in accommodation establishments at the 'tourism district' level

[4] The 'farm district' is an territorial classification based on census agricultural data. It indicates an homogeneous area from the agricultural point of view. In Lombardy there are 87 'farm districts'.

agtourism	Number of rural tourism establishments per inhabitant at the 'tourism district' level
Sisa	Dummy variable indicating if farmer is enrolled to Sisa farmers group
Copagri	Dummy variable indicating if farmer is enrolled to Copagri farmers group
Cia	Dummy variable indicating if farmer is enrolled to Cia farmers group
Confagri	Dummy variable indicating if farmer is enrolled to Confagricoltura farmers group
Coldiretti	Dummy variable indicating if farmer is enrolled to Coldiretti farmers group
Location and other determinants	
pillar_1	Dummy variable indicating farms receiving the CAP single payment
plain	Dummy variable indicating if farm is located in a lowland area
mountain	Dummy variable indicating if farm is located in a mountain area
periurban	Dummy variable indicating if farm is located in a periurban area
park	Dummy variable indicating if farm is located in a municipality included in a natural park
nzv	Dummy variable indicating if farm is located in a 'nitrate vulnerable zone' according to the Directive (91/676EC)

Social capital characteristics

In our framework 'social capital' is intended to capture the complex relations existing between farms and the socio-economic and institutional environment. In fact farmers are part of a complex social network in which different categories of stakeholders act (farmer groups, commodities and public goods consumers, taxpayers, institutions, etc.). The nature and the size of the relationship within this social network and, generally speaking, the social, economic and institutional context in which farmers operate, should be considered as an important determinant of their choices. In this work we extend such assumption at the AEMs implementation.

As proxy variables for social capital we include in the analysis the average per capita income of the 'farm district' (*income*), the education attainment of the population (*education)*, the tourism intensity (*beds, agtourism)*, the share of specific political parties and the 'ideology' orientation at the municipal level[5] (*greens, euroskeptic, left*[6]), and the political affiliation of the province agriculture councillor (*councillor*). These variables should proxy for socials needs, demands and farmer attitude toward agri-environmental issues, and the political orientation of the district.

Furthermore the farmer participation in RDP measures other than AEMs, like farm investments (*investment*) and less-favoured areas payments (*lfa_payment)*, should reveal the familiarity with EU policies and thus reducing the transaction costs involved in their activation.

[5] In Lombardy there are 1547 municipalities.

[6] For the classification of left-oriented and euroskeptic parties we follow Kemmerling and Bodenstein (2006), who include in these categories parties and political movements enrolled in specific EU Parliament political groups.

Finally, an other institutional dimension considered is the farmers' affiliation to a specific farmer organization distinguishing among five different existing associations (*sisa, copagri, cia, confagri, coldiretti*). Membership in a farmers organization has been proxy by the proceedings of the single farm payments[7], so the use of these variables leads to exclude from the sample many farms without CAP Pillar I funds. For that reason they have been treated in a second model in which *pillar_1* variable is appropriately excluded to avoid collinearity problems.

Location and other determinants

For different reasons, also farm geographical location should represent relevant factors affecting farmers participation in policy instruments. This is even more true if we refer to a policy intervention strongly related to rural areas management like AEMs. The considered territorial levels are related to altimetry (*mountain*, *plain*), to the periurban location (*periurban*), to the presence of a natural park (*park*) and to the inclusion of the farm in a 'nitrate vulnerable zone' (*nzv*). Moreover it is important to emphasise that the few regional priorities on AEMs implementation are in fact related to mountain areas, and natural and rural parks[8]. Thus controlling for location should represent an ex-post evaluation of the actual role played by Regional priorities. On this ground also *nzv* verifies if AEMs targeting in environmentally sensitive areas has been reached.

Finally *pillar_1* variable has been included in the model both to represent farmers income integration through CAP Pillar I and, more generally, to verify the more general issues of overlapping between Pillar I and Pillar II payments.

Econometric model and results

Econometric model

Our dependent variable is a dichotomous choice variable taking on the values one when a farmer participates to at least one agri-environmental scheme, and zero if he does not. In this circumstance using standard last square methods are inappropriate. Thus, the econometric model is based on a binary response model, where we are interested in the so called response probability, namely the probability that a farmer up-take an AEMs for various values of endogenous variables.

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[7] In Italy farmers' demands for the single farm payment are forwarded by technical assistance services of the farmers groups each year. On that subject we think that farmers membership is correctly explained by this issue.

[8] From 1974 the Lombardy Region has established several parks (22% of the total regional area is protected). The main characteristics of Lombardy parks is that they include many agricultural areas; some of them are exclusively or mostly dedicated to the preservation of agricultural landscape.

Following the previous literature, we model this probability as the latent variable, $y*$, in a Probit model[9]. This latent variable represent the conditional participation in the AEMs, and can be interpreted as the result of the farmer utility maximization process, discussed in Section 2. Formally, we have:

$$y* = \alpha + \beta x_i + u_i \qquad (4)$$

$$Y_i = \begin{cases} 0 & if \quad y* \leq 0 \\ 1 & if \quad y* \geq 0 \end{cases}$$

where $y*$ is the latent variable reflecting the marginal utility from AEMs adoption; Y_i is a binary variable reflecting what we really observe, namely whether the farmer up-take AEMs or not and takes the value 1 when the latent variable is positive and 0 when is negative; x_i are the independent variables related to farm, farmer and other determinants of the adoption choice; α and β are the estimated model constant and coefficients parameters, respectively.

Denoting with $\Phi(\bullet)$ the cumulative normal distribution function and σ the standard error, the probability of up-taking an AEMs is then defined by $P(y* \geq 0) = \Phi(x' \beta_k / \sigma)$. The parameters β/σ are estimated via maximum likelihood estimator (MLE), correcting the standard errors for unknown correlation of the residual within each district.[10]

Results

Table 4 reports MLE results of five different models, related to the adoption of both all types of AEMs, and of the four different schemes considered. In selecting the final specification we adopt the following strategy (see Jongeneel et al 2008). In a first step we model a specification that considers the effect of several potential determinants of the AEMs adoption (see Table 3). Then, we simplify it giving emphasis on both theoretical consideration and the robustness of the different determinants. Moreover, for comparability and symmetry, we choose to include in the final specification the same set of variables for all five models. The criterion adopted for the final specification is to include a variable only if it turn out to be significantly different from zero in at least one model.

Figures in the Table 4 report the marginal effect (dF/dx) calculated at the sample mean, that is, the change in predicted probability associated with changes in explanatory

[9] As suggested by Vanslembrouck et al (2002) both Logit and Probit models are appropriate for this kind of binary response problem. The fundamental differences between these models is the assumption about the cumulative distribution function (CDF): logistic CDF in the case of Logit and normal CDF for the Probit model (see Wooldridge 2002).

[10]. By measuring some farmer and social capital characteristics at district instead of farmer level, we potentially introduce some unknown form of correlation between each individual error at district level. In order to eliminate such potential distortion we measure robust standard errors clustered at district level

variables (see, e.g., Greene 2003), as well as their respective *p-values*. All five models have significant χ^2, meaning that all regressors are jointly significantly different from zero, thus the set of our explanatory variables plays a role as a whole in explain the probability of farmer's AEMs. Indeed, the fraction of correct predictions is quite high ranging from 83.8% for the overall model to 99% for organic farming.

However, the goodness of fit, measured by McFadden (Pseudo) R^2, are quite low but in line with similar studies (see e.g., Vanslembrouck et al 2002; Barreiro-Hurlé et al 2008; Jongeneel et al 2008). For the overall model (*AEM_all*) the Pseudo R^2 is equal to 0.2, and it ranges between 0.11 (organic farming), and 0.26 (management of meadows and pasture). Thus, several other unknown factors are at work in explaining the AEMs adoption, other than those considered here. However, in valuating this general conclusion it should be reminded the huge dimension of the sample employed for this analysis, counting more than 50.000 farmers!.

In what follows we discuss the results by grouping the set of explanatory variables into the above mentioned categories of determinants.

Table 4 – Estimation results for the general model and the single schemes.

Model	AEM_All		AEM_1		AEM_2		AEM_3		AEM_4	
Parameter	dF/dX	*p-value*	dF/dX	*p-value*	dF/dX	*p-value*	dF/dX	*p-value*	dF/dX	*p-value*
Farm characteristics										
ESU	0,0222	*0,000*	0,0063	*0,001*	0,0003	*0,499*	0,0114	*0,000*	0,0060	*0,000*
LSU_HA	-0,0023	*0,000*	-0,0019	*0,017*	-0,0005	*0,003*	-0,0005	*0,005*	-0,0002	*0,018*
HP_HA	-0,0004	*0,000*	-0,0003	*0,005*	-0,0001	*0,000*	-0,0002	*0,020*	-0,0001	*0,130*
FIELD_CROP	0,0456	*0,049*	0,0789	*0,000*	0,0017	*0,136*	-0,0538	*0,000*	0,0231	*0,000*
PERMANENT_CROP	0,0295	*0,191*	0,1474	*0,000*	0,0046	*0,007*	-0,0838	*0,000*	0,0059	*0,148*
DAIRY	0,1568	*0,000*	0,0129	*0,467*	-0,0025	*0,023*	0,1298	*0,000*	0,0061	*0,213*
Farmer characteristics										
AGE	-0,0019	*0,000*	-0,0010	*0,000*	-0,0002	*0,000*	-0,0003	*0,070*	-0,0007	*0,000*
LANDOWN	-0,0353	*0,000*	-0,0087	*0,027*	-0,0005	*0,601*	-0,0161	*0,004*	-0,0006	*0,780*
FARMER_INCOME	-0,0059	*0,491*	-0,0052	*0,309*	-0,0002	*0,497*	-0,0005	*0,947*	-0,0022	*0,099*
Social capital										
INVESTMENT	0,1192	*0,000*	0,0721	*0,000*	0,0069	*0,000*	0,0127	*0,045*	0,0390	*0,000*
LFA_PAYMENT	0,3572	*0,000*	0,1447	*0,000*	0,0068	*0,000*	0,1307	*0,000*	-0,0023	*0,847*
INCOME	0,0116	*0,012*	0,0016	*0,612*	0,0002	*0,359*	0,0058	*0,280*	0,0027	*0,002*
EDUCATION	0,0014	*0,317*	0,0009	*0,295*	-0,0002	*0,069*	0,0023	*0,019*	0,0002	*0,495*
GREENS	-0,0065	*0,285*	-0,0143	*0,000*	0,0005	*0,190*	0,0092	*0,068*	-0,0041	*0,006*
EUROSKEPTIC	-0,0052	*0,001*	-0,0046	*0,000*	-0,0001	*0,109*	0,0007	*0,543*	-0,0025	*0,000*
LEFT	-0,0006	*0,552*	0,0009	*0,040*	0,0001	*0,028*	-0,0015	*0,158*	0,0000	*0,782*
Location and others										
PILLAR_1	0,0888	*0,000*	0,0318	*0,000*	-0,0001	*0,897*	0,0302	*0,002*	0,0260	*0,000*
PLAIN	-0,0958	*0,004*	-0,0405	*0,064*	-0,0080	*0,000*	-0,0398	*0,228*	0,0026	*0,656*
MOUNTAIN	0,0083	*0,850*	-0,0018	*0,956*	0,0001	*0,970*	0,1831	*0,000*	-0,0046	*0,829*
PARK	0,0129	*0,324*	-0,0239	*0,001*	0,0008	*0,257*	0,0364	*0,005*	0,0101	*0,010*
NZV	-0,0029	*0,893*	-0,0190	*0,005*	-0,0001	*0,928*	0,0245	*0,250*	-0,0007	*0,862*
No. Of observation	54177		37142		40101		43346		54177	
Chi square (*p-value*)	0,000		0,000		0,000		0,000		0,000	
Pseudo R2 (McFadden)	0,203		0,2593		0,1111		0,2653		0,1469	
Fraction of correct predictions	83,8%		91,5%		99,1%		88,7%		95,7%	

Coefficients X 100: farmer_income (1000), Income, landown, Esu

Farm characteristics

Farm characteristics seem to strongly affect adhesion to AEMs as a whole and referring particularly to the single schemes. Farm economic dimension (*esu*) increase the probability of the AEMs adoption activation, except for organic farming scheme that is insignificant. Literature results are very contrasting on this topic (see Defrancesco et al., 2007; Mann, 2005). However this positive relation could be explained in terms of adhesion transaction costs (that are mostly fixed costs) incidence on income that is higher in small farms than in bigger ones, thus discouraging the formers to up-take. Moreover small farms, many of which are part-time farms, probably lack adequate entrepreneurship and sufficient information about these voluntary policy instruments.

As economic size is not necessarily correlated to farming and capital intensity, here we represent this issue by using *lsu_ha* and *hp_ha* variables. In this case the signs of coefficients are always significantly negative, confirming the well-known adverse selection effect in AEMs implementation (Hart and Latacz-Lohmann, 2005; Latacz-Lohman, 2004). Thus more intensive farms are less likely to participate in AEMs. In fact such farms usually incur higher opportunity costs in complying with program commitments. This consideration appears particularly true if we refer to the higher negative marginal effect in *AEM_1* equation (input reduction), which is a scheme involving more farm management changes than others (Barreiro-Hurlè et al., 2008).

With regard to farming type the probability of a dairy farm to participate in AEMs is 15% higher than others specializations, a result in line with evidence reported by Jongeneel et al. (2008). Differently, *AEM_1* adoption is more likely for permanent crops type of farming. Finally, also field crops specialization affects some what the probability of AEMs up-taking, in *AEM_all*, *AEM_1* and *AEM_4*.

Farmer characteristics

As expected *age* affects negatively the probability of entering in AEMs, in line with the large part of previous evidences (see, e.g., Vanslembrouk et al. 2002; Bonnieux et al. 1998). Thus, elder farmers show a low propensity towards measures involving a strong change respect to usual farming practices. However in contrast with Barreiro-Hurlè et al. (2008) also *AEM_3,* comparable with their “traditional farm management” scheme, shows a negative age coefficient, even if marginal effect is smaller than other schemes. *farmer_income* is generally insignificant, except for *AEM_4*. Nevertheless this variable was calculated as a mean of the ‘farm district’, so as previously highlighted variables related to farming intensity better explain, the role of opportunity costs in discouraging participation.

Finally we note that the share of property land (*landown*) affects negatively farmers willingness to participate in AEMs, indicating that landlord are less concerned in public goods production than tenants.

Social capital

With respect to 'social capital' variables, evidence has been found that farmers participating in other RDP measures (*investment* and *lfa_payment*) are more likely to participate in AEMs. This effect appears quite plausible if we think that some transaction costs related to adhesion could be spread among different measures. In any case this finding would indicate that a greater familiarity with RDP measures increases implementation probability.

The per-capita income (*income*) at district level increases the probability of farmers participation in agri-environmental schemes. According to Bimonte (2002) the income level is a good indicator of social demand for amenities and public goods and, more generally, of environmental sensitivity. Moreover it is important to know that the level of development goes hand in hand with the quality of institutions. *Education* seems, at least partially, to confirm this assumption, but its estimated effect on the probability of adhesion is significantly positive only for *AEM_3*.

Interestingly, also ideology orientation influences the participation in AEMs probability, confirming the Vandermeulen et al. (2006) et Hackl et al. (2007) interpretations about the influences of institutions and local policies on the uptake of agri-environmental and multifunctional-oriented commitments. Particularly left parties share (*left*) positively conditions probability that farmer joins both *AEM_1* and *AEM_2*. Such evidence appears in line with the notion that left-oriented political movements take more care of environmental issues. Nevertheless the *greens* variable results seem at odd with the last statement. This apparent contradiction could be in part explained considering that, in Lombardy, Green Party electorate tends to have a quite low political power and lacks of a strong territorial variability [11]. Consequently we ascribe environmental concerns to the entire left coalition to which Green Party belongs.

Moreover farmers are less likely to participate in AEMs where the share of euroskeptical parties (*euroskept*) is higher. At first glance this statement could indicate a refuse or a limited information about EU policy instruments; in a more deepened level has to be taken into account that in Lombardy region euroskeptiks are mostly represented by Lega Nord party, which members have often reaffirmed the strengthen of productive role of agriculture *vs* the environmental one, giving strong emphasis to competitiveness priority[12].

To complete the discussion on social capital the role exerted by farmers associations has to be clarified. As said above to do this we resort a second model applied to a smaller sample (see Table 5). Notably, the effect of other variables has no changed with respect to the 'general' model, confirming the robustness of our specification. In the sample, all the five

[11] In 2005 Lombardy regional election the Green Party took 2,5% of total votes and did not run in Sondrio Province.

[12] For example during the recent discussion about the CAP 'Health Check' the Italian Minister of Agriculture, from Lega Nord, claimed for a reduction of proposed rate of modulation from Pillar I to Pillar II.

existing organizations are represented. First of all Coldiretti (catholic-oriented), representing 61% of farmers in the sample, followed by Confagricoltura (traditionally representing landlords, right-wing oriented), CIA (left-wing oriented), and other two minor organizations SISA (moderate left-wing oriented) and Copagri (recently born from an agreement between agronomists and agricultural contractors associations).

Outcomes give evidence to the fact that farmers enrolled in *sisa* and *copagri* –with respect to *coldiretti*, the omitted reference dummy - are respectively more likely to participate in AEMs, of the 7% and 8,5%, respectively. Not particular effects have been highlighted with respect to the three other main organizations, except for *cia* in *AEM_2*, confirming the traditional positive attitude toward organic farming of left-wing orientation. An interpretation of this outcome could suggest the idea that in small organizations transaction costs are lover also because the level of technical assistance is more deepened (for example we think to the agronomists involvement in *copagri*). This interpretation appears particularly true if we think to the AEMs implementation needs as long-term planning requiring substantial change in farming activities.

Table 5– Estimation results for models including farmers organizations.

Model	AEM_All		AEM_1		AEM_2		AEM_3		AEM_4	
Parameter	dF/dX	*p_value*	dF/dX	*p_value*	dF/dX	*p_value*	dF/dX	*p_value*	dF/dX	*p_value*
Farm characteristics										
ESU	0,0232	*0,000*	0,0035	*0,019*	0,0001	*0,705*	0,0135	*0,000*	0,0078	*0,000*
LSU_HA	-0,0024	*0,000*	-0,0012	*0,028*	-0,0003	*0,010*	-0,0005	*0,007*	-0,0003	*0,014*
HP_HA	-0,0008	*0,000*	-0,0005	*0,000*	-0,0001	*0,002*	-0,0002	*0,019*	-0,0003	*0,001*
FIELD_CROP	0,0667	*0,005*	0,0591	*0,000*	0,0011	*0,195*	-0,0560	*0,000*	0,0315	*0,000*
PERMANENT_CROP	0,1302	*0,000*	0,1370	*0,000*	0,0057	*0,002*	-0,0744	*0,000*	0,0261	*0,001*
DAIRY	0,1878	*0,000*	0,0166	*0,208*	-0,0019	*0,019*	0,1513	*0,000*	0,0110	*0,107*
Farmer characteristics										
AGE	-0,0023	*0,000*	-0,0009	*0,000*	-0,0001	*0,000*	-0,0006	*0,002*	-0,0009	*0,000*
LANDOWN	-0,0317	*0,000*	-0,0024	*0,449*	-0,0004	*0,640*	-0,0249	*0,000*	0,0005	*0,847*
FARMER_INCOME	-0,0094	*0,382*	-0,0058	*0,185*	0,0000	*0,843*	-0,0015	*0,874*	-0,0034	*0,076*
Social capital										
INVESTMENT	0,1075	*0,000*	0,0525	*0,000*	0,0028	*0,000*	0,0114	*0,134*	0,0498	*0,000*
LFA_PAYMENT	0,2439	*0,000*	0,0240	*0,388*	0,0074	*0,000*	0,1249	*0,000*	-0,0168	*0,331*
INCOME	0,0175	*0,005*	0,0032	*0,270*	0,0002	*0,222*	0,0084	*0,201*	0,0044	*0,000*
EDUCATION	0,0038	*0,013*	0,0009	*0,133*	0,0000	*0,951*	0,0030	*0,010*	0,0007	*0,174*
GREENS	-0,0126	*0,114*	-0,0124	*0,000*	-0,0002	*0,355*	0,0087	*0,141*	-0,0076	*0,001*
EUROSKEPTIC	-0,0054	*0,006*	-0,0046	*0,000*	-0,0001	*0,035*	0,0010	*0,500*	-0,0034	*0,000*
LEFT	-0,0005	*0,690*	0,0007	*0,091*	0,0001	*0,057*	-0,0018	*0,174*	0,0001	*0,656*
SISA	0,0704	*0,009*	0,0530	*0,000*	0,0201	*0,001*	-0,0108	*0,518*	0,0251	*0,027*
COPAGRI	0,0858	*0,001*	0,0139	*0,286*	0,0302	*0,000*	0,0332	*0,068*	0,0121	*0,063*
CIA	-0,0012	*0,940*	-0,0095	*0,106*	0,0070	*0,000*	0,0037	*0,753*	-0,0113	*0,090*
CONFAGRI	0,0092	*0,468*	-0,0022	*0,543*	0,0027	*0,003*	0,0075	*0,526*	0,0009	*0,852*
Location and others										
PLAIN	-0,1005	*0,025*	-0,0416	*0,033*	-0,0052	*0,000*	-0,0447	*0,240*	0,0027	*0,765*
MOUNTAIN	0,0865	*0,234*	0,0171	*0,719*	0,0014	*0,372*	0,2179	*0,000*	-0,0012	*0,975*
PARK	0,0247	*0,133*	-0,0177	*0,005*	0,0001	*0,808*	0,0428	*0,005*	0,0138	*0,016*
NZV	-0,0082	*0,751*	-0,0183	*0,004*	-0,0008	*0,205*	0,0233	*0,340*	-0,0021	*0,720*
No. Of observation	38447		30076		32477		35424		38447	
Chi square (*p_value*)	0,000		0,000		0,000		0,000		0,000	
Pseudo R2 (McFadden)	0,2116		0,2599		0,1579		0,2701		0,1339	
Fraction of correct predictions	81,7%		93,2%		99,2%		87,7%		94,5%	

Coefficients X 100: farmer_income (1000), Income, landown, Esu

Location and other determinants

Outcomes of variables related to farm location highlight the failure of agri-environmental schemes territorial targeting (see Table 4). *Mountain*, *park* and *nzv* are largely not significant; furthermore surprisingly farm location in nitrates sensitive areas reduces probability of activate *AEM_1*, which is the more concerned scheme to tackle with water pollution problems. Once again opportunity costs in adhesion –nitrate vulnerable areas are usually intensive farming contests in Lombardy – probably discourages farmers inclination towards AEMs. An exception to the above-mentioned failure is represented by the increasing in probability in *AEM_4* implementation characterizing farms placed in *parks*, where landscape amenities demand is more developed.

Finally p*illar_1* positive marginal effect denotes a discrete overlapping between Pillar I and agri-environmental payments, thus redistributive effects of AEMs would seem to be rejected.

Concluding remarks

In this paper we study the determinants of AEMs farmers adoption in Lombardy region, with the aim to disentangle farm and farmer determinants from political institutional ones. Working with the 'universe' of farms eligible to AEMs (more than 50,000) and with four different AEMs schemes, we confirm several previous evidence about the effect of both farm and farmer characteristics on the AEMs adoption. At the same time our results give a general confirmation to the idea that the local institutional framework, by affecting the complex interaction between farms, local stakeholders and government bodies, conditions the farmers probability to uptake AEMs.

In particular, main evidences from our analysis highlight how intensive farming seem to discourage AEMs implementation, while farmers' participation in other RDP measures exerts a positive effect. On the 'social capital' side we found that local institutions substantially influence adhesion to AEMs; however the weight of 'social capital' variables seems less important than farm and farmer characteristics one. Furthermore territorial location variables, reflecting regional administration priorities, does not seem to significantly affect the AEMs uptake.

This evidence leads us to highlight three main linked issues. Firstly a confirmation of the adverse selection phenomenon, notably the fact that farmers entering in AEMs are those that easily accomplish the measure commitments (i.e. extensive farms). Secondly the failure of specific territorial targeting of AEMs tend to suggest that processing and selection of farmers demands for AEMs have not taken properly into account environmental local needs. Finally our analysis seems to suggest that AEMs implementation, due to lack of selection, is finalised to favour a fund-spending approach rather than a quality based spending.

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Appendix A

Description of the agri-environmental schemes in the Lombardy RDP 2000-2006

COMMITMENTS	
AEM1	• to respect regional rules about integrated production • to apply a fertilization plan based on the nutrient balance principle; • to apply a five-year rotation of three crops at least (only for arable crops); • to maintain green cover in the permanent crops; • control and technical certification of the spreading machinery; • to apply the commitments on the whole UAA • duration of the commitments: 5 years.
AEM2	• to respect the provision of Reg. (EC) 2092/91about organic production; • to apply the commitments on the whole UAA; • duration of the commitments: 5 years.
AEM3	• (AEM3-a) to convert arable crops into meadows -only in the lowlands and the hills; • (AEM3-bcd) to maintain meadows with obligation of minimum 2/3 cuts per year; • (AEM3-e) to manage alpine pastures ensuring a minimum level of grazing livestock density (0,5-1,4 lsu/ha) – only in the mountains; • prohibition of chemical inputs utilization; • good management of meadows and pastures; • duration of the commitments: 5 years.
AEM4	• creation and management of hedgerows, agro-forestry systems, buffer areas, wetlands etc.; • maintenance and management of the agro-forestry systems for 10 years at least.
ELIGIBILITY CRITERIA	
AEM1	• at least 1 ha of UAA for arable crops or 0,5 ha of UAA for permanent crops (in the mountains) • at least 2 ha of UAA for arable crops or 1 ha of UAA for permanent crops (in the lowlands and the hills) • farms with only meadows or pastures are not eligible.
AEM2	• at least 1 ha of UAA for arable crops or 0,5 ha of UAA for permanent crops; • farms with only meadows or pastures are not eligible.
AEM3	• at least 1 ha of UAA for each intervention, except pasture management which require at least 10 ha of UAA; • farms with only meadows or pastures are not eligible.
AEM4	• depending on the intervention typology.
ANNUAL SUPPORT	
AEM1	• from 50 €/ha to 550 €/ha (depending on the crop)
AEM2	• from 50 €/ha to 740 €/ha (depending on the crop) for maintaining organic farming • from 50 €/ha to 815 €/ha (depending on the crop) for conversion to organic farming
AEM3	• 500 €/ha for conversion of arable crops into meadows (in the lowlands and the hills) • 240 €/ha to maintain meadows (in the lowlands and the hills) • 180 €/ha to maintain meadows (in the mountains) • 50 €/ha to maintain and manage pastures (in the mountains)
AEM4	• depending on the intervention typology.