Evaluating agri-environmental schemes.
The case of Tuscany

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Summary

The rural development plans in Europe, within the provisions of Axis Two of the Common Agricultural Policy, consider the opportunity to protect and enhance "environmental-friendly" farming systems. The present paper describes the role of organic farming measures in the promotion and safeguard of the High Nature Value in Tuscany. Using National Census of Agriculture data (2010) a Probit model was adopted, in order to estimate the probability of program enrolment. After that, both control and treatment groups were constructed implementing a Propensity Score Approach: selecting 13 explanatory variables which are presupposed to be independent from the outcome variable, the two groups were built on the basis of the propensity scores. The aim should be to have two similar groups, for which the only difference is the treatment itself. In our study the treatment variable is the total area under organic agriculture, while the outcome is the High nature Value. After having controlled and achieved a good balancing between the covariates, the mean effect of the program participation on the treated (ATT) was computed. It is obtained as a difference between the averages of the two groups. The result unexpectedly reveals that AES have not a statistically significant impact on both fauna and flora biodiversity. However, these results must be interpreted with caution because both the type of data (we used cross-sectional data) and the assumptions on which the methodology is based could have a relevant effect on the final outcome.

Keywords: agri-environmental payments; biodiversity;Tuscany; treatment effect.
JEL Classification codes: C21; Q18; Q56.

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1. INTRODUCTION

Greening agriculture is one of the biggest challenge that Europe is dealing with. Priority attributed to the enhancement and preservation of biodiversity, as well as the higher demand of organic products by "ethically responsible consumers", addressed the international community through a joined effort to switch toward "environmentally-friendly" activities (e.g. extensive agriculture).

After the Second World War, food self- sufficiency and crop productivity were considered as a priority for the society reconstruction (Kleijn and Sutherland, 2003). The framework established by the Common Agricultural Policy, based on subsidies and guaranteed prices for farmers, tried to reach these targets, resulting in an increased agricultural productivity. From an economic perspective, this assured positive effects to farmers. Otherwise, it incurred in several environmental costs.

The concept of "co-production", coined by Van der Ploeg, resumes the need to join rural development practices into the local ecosystem respect.

Agri-environmental schemes, introduced during the 80s, and become fully operational with EC Reg. 2078/ 92, represent the political response to this concern. They provide Member States with the obligation to implement them into their national regulation, although farmers' participation is completely voluntarily. Their main aim is to encourage farmers in adopting farming practices which are compatible with the safeguard of the natural landscape (EC, 2005), supporting them with a financing mechanism that, as envisaged by the EC Reg. 1698/2005, provides payments depending on the land use: 600 € per ha for annual crops, 900 € per ha for perennial crops, 450 € per ha for other land uses, and 200 € per livestock unit where schemes support the upkeep of endangered animal breeds.

The agricultural economic literature has investigated the role played by the European agri-environmental policy in enhancing biodiversity (Dwyer, 2013; Scheper *et al.*, 2013; Chabé-Ferret and Subervie, 2011; Jaraité and Kažukauskas, 2011; Schonhart *et al.*, 2010; Espinosa *et al.*, 2010; Kleijn *et al.*, 2006; Latacz-Lohmann and Hodge, 2003; Feinerman and Komen, 2002). Such literature reveals that a general assessment on the overall impact of AES is not possible, as different results have been encountered in both animal and plant species protection, depending on the specific characteristics of the landscape (Chabé-Ferret and Subervie, 2011; Kleijn and Sutherland, 2003). A growing part of the literature also looks at factors affecting farmers' participation in environmental measures, attempting to identify them (Hynes and Garvey, 2009; Defrancesco *et al.*, 2008; Siebert *et al.*, 2006; Vanslembrouck *et al.*, 2002; Damianos and Giannakopoulos, 2002; Wilson, 1997) and to assess the motives, values and attitudes behind them (Wossink and Van Wenum, 2003; Wynn *et al.*, 2001; Morris and Potter, 1995). For example, Siebert *et al.* (2006) argued that economic incentives are the prime factor "for participating in agri-environmental measures or in other programmes with environmental conservation objectives". Further studies, as those carried out by Defrancesco *et al.* (2008) highlighted that, besides income factors, also the relationship with neighbouring farmers and their opinions on environmentally friendly practices have a significant influence on the adoption of AEMs.

The main purpose of this paper is to provide a comprehensive evaluation of the implementation of *AES* in Tuscany, and of their contribution to the High Nature Value (*HNV*) of farmland. In particular the present paper focused on the adoption of Measure 214 a.1, concerning organic agriculture measures. In order to estimate the mean effect of program participation (the so- called Average Treatment on the Treated, *ATT*) on the outcome variable, a Propensity Score Matching approach was applied. The main idea is to measure what would have happened if treated individuals would have not participated in the program. This is undertaken constructing a model of the probability of participating in the treatment (a Probit regression), based on observed characteristics which are not affected by the program itself. Hence two groups of treated and untreated have been built, based on the closeness of the scores (Khandker *et al.*, 2010). After having controlled for the goodness of balancing between them the final step, consisting in the measurement of the *ATT*, has been run. Data used are extracted by the 6th National Census of Agriculture (2010), which contains information about both farms' characteristics and participation to AES.

The paper is structured in the following way. In section 2 the methodology, data and the case study are described . In Section 3 the analysis and findings are reported. Section 4 reports the discussion of results. Finally, section 5 concludes and some suggestion for further research is given.

2. METHODOLOGY AND DATA

2.1 Propensity Score Matching

The evaluation of the mean effect of participating in the agri-environmental program has been estimated using a Propensity Score Matching approach (*PSM*). It is a useful methodology as it reduces the "curse of dimensionality": the basic idea is to match treated and untreated units with the closest propensity scores. In other words two samples of enrolled and non-enrolled will be built, on the basis of estimated scores. These latter are computed selecting pre-treatment observable characteristics that are supposed to be similar between the two groups, as the only difference should be the treatment itself.

According to Rosenbaum and Rubin (1983), the *PSM* is a statistical model which predicts the probability of treatment assignment, i.e. participation to agri-environmental schemes, conditional on observed characteristics unaffected by the program (such as the pre-treatment socioeconomic characteristics). Analytically, it can be denoted as:

$$p(x) \equiv Pr(P=1 \mid X = x_i)$$

where the function $p(x)$ is the propensity score, that is, the propensity towards exposure to treatment, given the observed covariates X (Rosembaum and Rubin, 1983). As matching is a nonrandomized experiment, the propensity score function is unknown, so it may be estimated, maybe using a logit (or probit) regression model. Attendees of payments are then matched to those farmers who have similar propensity scores, but do not actually attend.

Two assumptions must be encountered to guarantee the validity of *PSM*: Conditional Independence and Common Support. The first criterion implies that "given a set of observable covariates X not affected by the treatment, potential outcomes Y are independent of treatment assignment T" (Khandker *et al.*, 2010). Formally, defining Y_i^1 as the outcome for participants and Y_i^0 the outcome for nonparticipants, conditional independence presupposes that

$$(Y_i^1, Y_i^0) \perp T_i \mid X_i$$

where X_i identifies the set of observable covariates X that are not affected by the treatment T. In other words, the outcome in the untreated state must be independent of the treatment assignment.
Hence the region of common support identifies the area within which a valid comparison group can be found (Ravallion, 2005), on the basis of the closeness of the scores between treated and untreated units:

$$P\ (T = 1|X) < 1\ .$$

Once a matched sample has been formed, the estimation of the treatment effect can be carried out. Different matching techniques can be selected in order to match each treated unit with a control one on the basis of the balancing score: the nearest-neighbor, the caliper or radius, stratification and kernel matching. The first one is the most frequently used, and it consists in matching each treatment unit to the comparison unit with the closest propensity score. Instead the caliper or radius matching imposes a maximum propensity distance (caliper), selecting only those untreated units whose propensity score is placed within a prespecified threshold. Otherwise stratification partitions the common support into different strata, within each of which the mean *difference* between the outcomes of treated and untreated is computed. The weighted average of these differences yields the overall program impact. Finally, in kernel matching a weighted average of all non- participants is used to construct the control group.
The average treatment effect could thus be calculated as

$$\text{ATE} = \text{E}(Y_i^1\text{-}Y_i^0)$$

which describes the expected effect of the treatment for the entire population.
Rather than the ATE, we are more interested to the average treatment on the treated (ATT) , that is, the mean effect for those who actually received the treatment:

$$\text{ATT=E}[(\ Y_i^1\text{-}\ Y_i^0\ \mid \text{T=1, X}\ )] = \text{E}[Y_i^1 \mid \text{T=1}] - \text{E}[Y_i^0 \mid \text{T=1}].$$

In the following paragraph a description of data we used, as well as of dependent, outcome and independent variables will be given.

2.2 Data

The empirical analysis is based on micro-data from the 6th General Agricultural Census (2010).The dataset is a cross-section farm survey conducted at national level, which provides information on the socio-economic farms' structure, such as area under cultivation, methods of production, labour inputs, farm management approaches, other related activities, as well as rural development programs attendance. The data we used regards 69.696 farms, mainly distributed in the provinces of Firenze (14.67%), Arezzo (18.5%) and Grosseto (16.85%). These data constitute the basis for assessing the impact of Tuscany farms participation to Measure 214, namely Agri-Environmental Payments, on the safeguard of both animal and crops safeguard. Specifically, our study concentrates on Measure 214.a1, concerning organic agriculture schemes.

Participation to organic farming is generally expressed as a dichotomous variable, defined as 1 in cases of farm enrolment, and 0 otherwise. The total area under organic production, T_BIO, has thus been selected as a useful indicator of farms involvement into the interested program. In so doing, we should better explain for the uptake in the organic farming payments. It suggests that less than 1% of the total number of investigated farms carry out this kind of practices. Control variables are age, sex, education of both the farm head and the farmers households components, type of farming, farm size and altitude.

A lot of studies over the last decade have been carried out, aiming at identifying factors affecting farmers' attitude in environmentally- friendly practices (Wynn *et al.*, 2001; Damianos and Giannakopoulos, 2002; Wossink and van Wenum, 2003; Vanslembrouck *et al.*, 2002; Siebert *et al.*, 2006; Defrancesco *et al.*,

2008; Hynes and Garvey, 2009). Siebert *et al.* (2006) argued that, in addition to the economic incentives, farm size, as well as education and age, are strongly correlated with AES participation.
Below a brief explanation of the selected variables is provided:

- Age: age of the farm head is expected to have a positive influence on the decision to participate to agri-environmental measures. In fact, older farmers may be less likely to accept innovation, as they are more risk adverse and have a lower likelihood of adopting new technology (Kabir *et al.*, 2013). In our dataset this is a continuous variable.
- Sex: we expect that farms headed by women have a higher probability to adopt environmental-sensitive practices. It is a dummy variable, equal to 0 if the farm head is man, 0 otherwise.
- Education: the number of years of education of the farm head is expected to have a positive relationship with the adoption of agri-environmental measures. In fact we suppose that more educated individuals are more exposed to sources of information about farming implications on biodiversity (Kabir *et al.*, 2013; Hynes and Garvey, 2009; Wynn *et al.*, 2001). The present variable has been defined equal to 0 for those farmers with a low educational attainment, 1 for those who received a high school diploma, and 2 for those ones who received a bachelor or master’s degree.
- Type of Farming (ToF): since the EC Regulation 1242/2008, it became one of the farm classification criteria. We used five of the eight ToF, regarding arable, horticulture and permanent farming, as well as animal production and mixed farms. We expect in particular that horticulture is positively correlated to organic agriculture.
- Farm size: this is illustrated by the farm total standard output (as the type of farming, it has become a new measure of farm economic dimension). We suppose that larger farmers are more prone to adopt *AES* respecting to the smaller ones, that we think might be more conservative. Differently from the other variables, it is a continuous one.
- Altitude: the assessment of organic agriculture impact cannot leave aside the altitude where the activity is performed. Following Signorotti *et al.* (2013) “the hill and mountain variables would be the most relevant to explain participation”. In this case only the mountain variable was included. It, as almost all the other ones, is a dummy variable, equal to 1 in cases of mountain location, and 0 otherwise.

The outcome of interest is the High Nature Value (*HNV*). It is a concept firstly introduced during the Nineties (Baldock and Beaufoy,1993) in order to emphasize the positive role of agriculture towards biodiversity (Trisorio and Borlizzi, 2011).
In fact, during the last decades a gradual decline of biodiversity interested the European territory, mainly due to intensification and monoculture agriculture.

A detailed definition of the *HNV* is given by Andersen *et al.* (2003), for whom the *HNV* identifies “those areas where agriculture is a major- usually the dominant- land use and where that agriculture supports or is associated with either a high species and habitat diversity or the presence of species of European conservation concern or both”. Two are the dimensions combined into the HNV concept, as Trisorio *et al.* (2010) and Trisorio and Borlizzi (2011) state: intensity of farming and biodiversity. Intuitively, the first one is synthetized by the following indicators: minimum or no tillage, absence of irrigation, crop rotation, green manure, grass covering and livestock density. Otherwise, the second one is identified by elements such as hedgerows, small areas of woodland, presence of olive groves, of rice fields, etc. Further criteria derived from Andersen *et al.* (2003), at which we add those of Corine Land Cover, are listed below:

- Highly proportion of semi-natural vegetation in the landscape.

- Presence of natural, semi-natural and structural elements of the landscape (i.e. natural grasslands, meadows, maritime and inside wetlands, heterogeneous areas, traditional orchards, dry stone walls, etc.).
- Presence of animal species of interest to the protection of biodiversity at a European level, as those identifies by Natura 2000 (i.e. sturgeon, wolf, the scrabble *Osmoderma eremita*, the butterfly *Euplagia quadripunctuaria*, the woodpecker *Picoides major*, etc.).

In the present work we used the variable *HNV* computed by Bartolini: it is a binary variable calculated at farm level, which takes the value of 1 in those areas where both the animal and plant biodiversity is preserved, and 0 otherwise. A new variable, *PERC_HNV*, was created in order to compute the percentage frequency of the outcome variable in the different provinces. To simplify the analysis of the distribution of the *HNV*, we define a discretional range, attributing the label *LOW* if the *HNV* is less than or equal to 0.3, *MEDIUM* if the *HNV* is greater than 0.3 and less than or equal to 0.7, and *HIGH* if it is greater than 0.7. The data we used reveal that, almost in all the nine provinces of Tuscany, there is a prevalence of areas with a low *HNV*. Only the provinces of Massa Carrara and Lucca show a higher percentage of areas with a high value of the *HNV*. The Table 1 below illustrates the frequencies of the outcome variable of all the provinces:

Table 1. Percentage frequency of the distribution of *HNV* in all the provinces of Tuscany.

	HNV (in percentage)		
Provinces	Low	Medium	High
Massa Carrara	54.19	27.84	17.97
Lucca	72.54	18.23	9.23
Pistoia	90.04	7.74	2.22
Firenze	77.4	20.14	2.42
Livorno	81.16	16.99	1.85
Pisa	77.94	20.04	2.02
Arezzo	77.43	19.78	2.79
Siena	74.09	24.26	1.65
Grosseto	72.20	25.09	2.71

Source: Author's calculation.

Turning now on data, below a summary of the selected control variables is presented (Table 2):

Table 2. Variables adopted in the Probit model.

Probit Model		
	Label	Description of the variable
Dependent variable	T_bio	Total area under organic production
Outcome variable	HNV	High Nature Value
Independent variables	Sexcapaz	Farm Head sex
	Etacapaz	Farm Head Age
	_edu_capaz	Level of education
	Tipo40	Farmers households' components with an age below 40
	Mont	Altitude of the farm
	Standard output	Value of the gross output
	OTE (01-02-03-04-08)	Type of farming
	Percrotaz	The utilised agricultural area (expressed in hectares) characterized by a crop variety
	Intens	The utilised agricultural area (expressed in hectares) characterized by high intensity farming

Source: own elaboration, based on the 6th General Agricultural Census (2010).

In the following section results and discussion are set out. STATA version 11.2 is used to implement all analyses. In particular the commands *psmatch2,* developed by Leuven and Sianesi (2003) to estimate the propensity scores, and the *pstest*, in order to test the covariates balancing, were applied.

2.3 Case Study

Tuscany landscape is characterized by the interpenetration between urban and rural areas (Regione Toscana, 2008). Particularly during the last decade of the century XX^th^, the region registered an increased extension of urban areas that, accompanied by an intensification and specialization of agriculture, provoked "a progressive growth of landscape homogeneity and a loss of those elements which once constituted its richness, as hedges, rows between fields, small scattered forests" (Fondazione Toscana Sostenibile, 2007).

According to the European legislation, Tuscany thus adopted agri-environmental schemes, with the aim of maintaining and promoting the environmental and landscape quality of rural areas.
Measure 214 of the Annex I of the rural Development Program 2007-2013 is the regional legislative instrument adopted for this purpose. It differentiates between organic and integrated agriculture.
Integrated agriculture, as defined by the Regional Law 25/1999, refers to "all techniques compatibles with natural environment protection, aimed at raising the level of consumers' health protection, realized privileging environmental sustainable practices and reducing synthetic chemicals use and negative effects for the environment" (Art. 2, R.L. 25/99).

Indeed *Organic agriculture* sustains the introduction and maintenance of organic methods of production (e.g. reduction of chemical fertilisers). Our study will concentrate on the latter.

3. ANALYSIS AND FINDINGS

3.1 Probit Regression

The first relationship we investigated regards the probability of farms to implement organic farming measures. The approach we adopted presupposes that the estimation of the propensity scores is determined by using a standard probability model (logit or probit). Therefore a probit regression model has been run, taking into account a set of observed covariates supposed to be related to the treatment:

$$P(T=1|X) = \Phi(\beta_0 + \beta_1 X)$$

where $\Phi(.)$ is the cumulative standard distribution function.
In order to respect the balancing property, a limited number of regressors should be used. For this purpose, we estimated an equation with 13 independent variables: sex and age of the farm head, his/her level of education, the number of household components with an age below 40 years old, the standard output, arable (OTE 01), horticulture (OTE 02), permanent crops (OTE 03), farms specialized in herbivores (OTE 04) and mixed farms (both crops and livestock; OTE 08), the areas characterized by crop rotation and intensive farming respectively (PERCROTAZ and INTENS respectively).

The initial step of the approach employed thus consists in estimating the probability of getting the treatment as a function of the observable pre-treatment covariates. The table summarizing the probit results is reported below:

Table 3. Probit regression results for participation to agri-environmental schemes.

MEASURE 214.A, EXPRESSED BY THE VARIABLE T_BIO	
_CONSTANT	-2.107 (-24.54)***
SEXCAPAZ	-0.05 (-1.31)
ETACAPAZ	-0.01 (-8.81)***
TIPO40	0.24 (3.11)***
SO	7.11e-12 (10.46)***
MONT	0.07 (1.69)*
OTE 01	0.04 (0.62)
OTE 02	-0.53 (-3.65)***
OTE 03	0.01 (0.21)
OTE 04	0.45 (6.74)***
OTE 08	0.32 (4.10)***
PERCROTAZ	0.78 (13.35)***
INTENS	-1.57 e-20 (-4.10)***
_EDU_CAPAZ	0.13 (5.60)***
McFadden's Pseudo R-squared	0.11
Prob> Chi^2	0.000

Source: Author's calculation. Standard Normal Z in brackets: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.

Our probit estimation reveals smaller farms (whose dimension is identified by the variable Standard Output) are those for which participation appears to be greater than for the larger ones. Surprisingly, farms of herbivores, as well as the mixed ones (OTE 04 and 08 respectively) are more likely to perform organic activities than those devoted to horticulture farming (OTE 02; contrary to our expectation, a negative correlation exists between the latter and participation to organic schemes). The young age of the household's components (TIPO40) positively affects treatment attendance, even this is partially contradicted by the negative value of the farm's head age (ETACAPAZ). This discrepancy might be due to a possible reluctance by the latter, that could be offset by the greater propensity to participate in the program by the other household's components. Also the education variable suggests a significant and positive influence on AES enrolment. Otherwise the farm head sex (SEXCAPAZ) has not a statistical significance, meaning that gender could not be considered a relevant factor for the current treatment.

As we expected, positive benefits from crop variety (PERCROTAZ) has been found, contrary to intensive farming practices (INTENS). Similarly, the altitude coefficient illustrates a 10% level of significance with respect to treatment assignment, even it is low enough.

The explanatory power of the variables, as reflected by the McFadden's Pseudo R-squared, is relatively high (11%), demonstrating an overall goodness of fit.

3.2 Propensity Scores and Balance checking

The propensity score matching algorithm assumes that, after having estimated the probability of enrolling in the treatment, the predicted values will be used to generate the propensity scores for all the treatment and control units. The command *psmatch2* is useful at this regard, guaranteeing the building of a matching sample. Different matching methods could be adopted: in this context three of them, namely the Nearest-Neighbor, the Caliper and the Kernel approaches have been implemented. In so doing, we should demonstrate any differences among the methods and the robustness of the results. A summary of the units falling within the common support is set out in Table 3:

Table 4. Summary of units on support.

PSMATCH2 OUTPUT		
Treatment assignment	Common Support	
	On support	Total
Untreated	60.071	69.071
Treated	625	625

Source: Author's calculation based on the implementation of the STATA 11.2 command psmatch2.

As the table above shows, the total number of treated and untreated units within the common support are equal to 625 and 60.071 respectively. After that, treated units have been matched with a sample of controls with similar propensity scores. The total number of both treated and control matched subjects, coming to the application of the Nearest Neighbor Matching command, is reported in Table 4:

Table 5. Treated and Control Groups.

Number of treated units	Number of control units
625	649

Source: Author's calculation.

In the follow-up phase, we check for the balance of the covariates. They are considered well balanced if the t-tests for equality of means in the treated and untreated groups is non -significant after matching, and if the standardized bias after matching is less than 5%. In fact, if the balancing is not achieved, another matching algorithm must be considered. Tables 6, 7 and 8 below illustrates the mean of both treated and control groups before and after matching, the absolute and reduced percentage bias as well as the t-test, given by the use of the three matching approaches cited above.

Table 6. Balance checking using the Nearest-Neighbor Matching.

Variable	Unmatched Matched	Mean (1) Treated	Mean (2) Control	% bias	% reduct |bias|	t-test t	t-test p>|t|
SEXCAPAZ	Unmatched	0.28	0.31	-5.9	72.6	-1.46	0.144
	Matched	0.28	0.27	1.6		0.29	0.771
ETACAPAZ	Unmatched	51.8	60.4	-58.6	98.5	-14.60	0.000
	Matched	51.8	51.7	0.9		0.16	0.874
TIPO40	Unmatched	0.064	0.021	21.2	91.7	7.26	0.000
	Matched	0.064	0.06	1.7		0.26	0.797
SO	Unmatched	2.4e+10	1.1e+10	65.3	97.1	19.48	0.000
	Matched	2.4e+10	2.5e+10	-1.9		-0.27	0.789
MONT	Unmatched	0.18	0.18	0.9	-395.4	0.21	0.831
	Matched	0.18	0.16	4.2		0.76	0.447
OTE01	Unmatched	0.25	0.17	18.3	82.3	4.87	0.000
	Matched	0.25	0.23	3.2		0.54	0.587
OTE02	Unmatched	0.01	0.05	-22.3	82.3	-4.35	0.000
	Matched	0.01	0.01	0.4		0.12	0.906
OTE03	Unmatched	0.39	0.59	-40.1	99.7	-9.93	0.000
	Matched	0.39	0.39	0.1		0.02	0.982

OTE04	Unmatched	0.17	0.05	37.8	90.0	12.98	0.000
	Matched	0.17	0.18	-3.8		-0.54	0.590
OTE08	Unmatched	0.08	0.03	20.8	100	6.68	0.000
	Matched	0.08	0.08	0.0		0.00	1.000
PERCROTAZ	Unmatched	0.21	0.05	56.4	95.9	20.88	0.000
	Matched	0.21	0.21	2.3		0.33	0.742
INTENS	Unmatched	6.3e+17	3.2e+18	-33.8	97.8	-6.31	0.000
	Matched	6.3e+17	6.8e+17	-0.8		-0.28	0.776
_EDU_CAPAZ	Unmatched	0.61	0.49	31.8	94.7	8.18	0.000
	Matched	0.61	0.6	1.7		0.28	0.777

Source: Author's calculation, based on the implementation of the STATA 11.2 command *pstest.*

Table 7. Balance checking using the Caliper Matching, with a 0.25 radius.

Variable	Unmatched Matched	Mean (1) Treated	Mean (2) Control	% bias	% reduct |bias|	t-test t	t-test p>|t|
SEXCAPAZ	Unmatched	0.28	0.31	-5.9	52.7	-1.46	0.144
	Matched	0.28	0.27	2.8		0.51	0.612
ETACAPAZ	Unmatched	51.8	60.4	-58.6	97.6	-14.60	0.000
	Matched	51.8	52.002	-1.4		-0.25	0.801
TIPO40	Unmatched	0.064	0.021	21.2	85.0	7.26	0.000
	Matched	0.064	0.06	3.2		0.47	0.636
SO	Unmatched	2.4e+10	1.1e+10	65.3	98.5	19.48	0.000
	Matched	2.4e+10	2.5e+10	-1.0		-0.14	0.887
MONT	Unmatched	0.18	0.18	0.9	-628.5	0.21	0.831
	Matched	0.18	0.16	6.2		1.13	0.260
OTE01	Unmatched	0.25	0.17	18.3	65.4	4.87	0.000
	Matched	0.25	0.22	6.3		1.07	0.285
OTE02	Unmatched	0.01	0.05	-22.3	91.2	-4.35	0.000
	Matched	0.01	0.01	2.0		0.63	0.526
OTE03	Unmatched	0.39	0.59	-40.1	92.7	-9.93	0.000
	Matched	0.39	0.40	-2.9		-0.52	0.603
OTE04	Unmatched	0.17	0.05	37.8	83.4	12.98	0.000
	Matched	0.17	0.19	-6.3		-0.89	0.373
OTE08	Unmatched	0.08	0.03	20.8	96.6	6.68	0.000
	Matched	0.08	0.08	0.7		0.11	0.916
PERCROTAZ	Unmatched	0.21	0.05	56.4	93.5	20.88	0.000
	Matched	0.21	0.20	3.6		0.53	0.596
INTENS	Unmatched	6.3e+17	3.2e+18	-33.8	96.8	-6.31	0.000
	Matched	6.3e+17	7.1e+17	-1.1		-0.40	0.689
_EDU_CAPAZ	Unmatched	0.61	0.40	31.8	87.0	8.18	0.000
	Matched	0.61	0.6	-4.1		-0.67	0.504

Source: Author's calculation, based on the implementation of the STATA 11.2 command *pstest.*

Table 8. Balance checking using a Gaussian Kernel Matching.

Variable	Unmatched Matched	Mean (1) Treated	Mean (2) Control	% bias	% reduct |bias|	t-test t	t-test p>|t|
SEXCAPAZ	Unmatched	0.28	0.31	-5.9	52.7	-1.46	0.144
	Matched	0.28	0.27	2.8		0.51	0.612
ETACAPAZ	Unmatched	51.8	60.4	-58.6	97.6	-14.60	0.000
	Matched	51.8	52.002	-1.4		-0.25	0.801
TIPO40	Unmatched	0.064	0.021	21.2	85.0	7.26	0.000
	Matched	0.064	0.06	3.2		0.47	0.636
SO	Unmatched	2.4e+10	1.1e+10	65.3	98.5	19.48	0.000
	Matched	2.4e+10	2.5e+10	-1.0		-0.14	0.887
MONT	Unmatched	0.18	0.18	0.9	-628.5	0.21	0.831
	Matched	0.18	0.16	6.2		1.13	0.260
OTE01	Unmatched	0.25	0.17	18.3	65.4	4.87	0.000
	Matched	0.25	0.22	6.3		1.07	0.285
OTE02	Unmatched	0.01	0.05	-22.3	91.2	-4.35	0.000
	Matched	0.01	0.01	2.0		0.63	0.526

OTE03	Unmatched	0.39	0.59	-40.1	92.7	-9.93	0.000
	Matched	0.39	0.40	-2.9		-0.52	0.603
OTE04	Unmatched	0.17	0.05	37.8	83.4	12.98	0.000
	Matched	0.17	0.19	-6.3		-0.89	0.373
OTE08	Unmatched	0.08	0.03	20.8	96.6	6.68	0.000
	Matched	0.08	0.08	0.7		0.11	0.916
PERCROTAZ	Unmatched	0.21	0.05	56.4	93.5	20.88	0.000
	Matched	0.21	0.20	3.6		0.53	0.596
INTENS	Unmatched	6.3e+17	3.2e+18	-33.8	96.8	-6.31	0.000
	Matched	6.3e+17	7.1e+17	-1.1		-0.40	0.689
_EDU_CAPAZ	Unmatched	0.61	0.40	31.8	87.0	8.18	0.000
	Matched	0.61	0.6	-4.1		-0.67	0.504

Source: Author's calculation, based on the implementation of the STATA 11.2 command *pstest.*

It is apparent from these tables that, unlike some difference between the Nearest-Neighbor results and those of the other two matching methods, the balancing is very good for all the covariates: in fact, almost all the absolute bias are less than 5% (except for the variable OTE04 in the Caliper and Kernel findings, which shows a small unbalance of -6.3%) and the t-tests are not significant in all the three cases. A comparison between Columns (1) and (2) indicates very small differences appear between the treated and control groups means (in some cases the values are equal) after matching. We can thus conclude that all the differences in means have been removed after matching. Furthermore, having tested there are not imbalances between the two groups, we can move on to the discussion of the average treatment effect of the program on the treated.

3.3 Treatment Effect

The second main relationship we are interested to analyse is the mean effect of attending the organic farming measures on the safeguard of the High Nature Value, i.e. the average treatment effect on the treated. It is obtained as a difference between the averages of the two control and treatment groups. Also in this case, we use various matching methods: the Nearest-Neighbor, the Caliper and the Kernel matching. Results are shown in Table 9, 10 and 11:

Table 9. Average Treatment on the Treated (NNM).

Variable	Sample	Treated	Controls	Difference	S.E.	T-Stat
HNV	Unmatched	0.24	0.20	0.041	0.009	4.85
	ATT	0.24	0.23	0.008	0.008	0.99

Source: Author's calculation.

Table 10. Average Treatment on the Treated (Caliper).

Variable	Sample	Treated	Controls	Difference	S.E.	T-Stat
HNV	Unmatched	0.24	0.20	0.041	0.009	4.85
	ATT	0.24	0.23	0.008	0.011	0.53

Source: Author's calculation.

Table 11. Average Treatment on the Treated (Kernel).

Variable	Sample	Treated	Controls	Difference	S.E.	T-Stat
HNV	Unmatched	0.24	0.20	0.041	0.009	4.85
	ATT	0.24	0.23	0.006	0.011	0.53

Source: Author's calculation.

As the tables evidence, no differences can be found between the three matching approaches as regards the average treatment effect: it is equal to 0.24 for the treatment group, and has a value slightly lower for the comparison one. The most surprising result emerges from the *T-statistics*, which are all not significant. This can be interpreted in terms of irrelevance of organic farming in promoting and safeguarding biodiversity.

In the next section some consideration will be suggested to try understanding the reasons behind this interesting finding.

4. DISCUSSION

Numerous studies have investigated the environmental effects of agri-environmental schemes in various part of Europe. For instance, Primdahl *et al.* (2003) examined the outcome effects of *AES* in nine EU Member States and Switzerland, demonstrating that the measures had a real protection effect. Also Signorotti *et al.* (2013), as well as Wynn *et al.* (2001), found a positive relationship between *HNV* and participation to the measures of organic farming.

Contrariwise, other studies have pointed out the heterogeneity of *AEMs* impact. Kleijn and Sutherland (2003) evidenced that the response in birds' species richness was divergent among countries. Similarly, Kleijn *et al.* (2006) claimed that, even plant species density was higher in those areas where *AES* were implemented, the same benefits were not encountered by endangered and uncommon species of farmland wildlife. Additionally, the European Commission (EC, 2005) stated that agricultural genetic resources protection of traditional animal breeds and crop varieties through agri-environmental measures generally shows poor performance.

In our study the Propensity Score Matching was used to analyse both the probability of participation to the agri-environmental schemes, i.e. organic measures, of the rural development plan 2007-2013, and their impact on the *HNV* in year 2010. In the probit model, applied to estimate the program participation probability, we considered the area under organic production, which better fit the extension of organic farming, as the treatment variable. The other independent variables are: sex, age and education of the farm head (another variable regarding age was added, as it explains the age composition of the household), farm dimension and altitude, and type of farming, as well as farming management. After that the mean effect of the treatment was computed. It reveals that organic farming is not a significant variable in promoting and protecting animal and plant species biodiversity. Thus the implementation of farming methods designed to reduce the use of pesticides, fertilisers and monoculture, as well as the soil degradation, is not consistent with the aim of promoting the richness of both flora and fauna.

A possible explanation for this might be attributed to the little stringent structure of agri-environmental schemes. In fact participation is voluntarily: in particular farmers are only required to commit themselves to respect *good environmental practices*, without being submitted to an ongoing monitoring. Moreover, the ex-post monitoring to which farms are subjected is rather slack (Mantino, 2008) and it is carried out by the Regions themselves. It is possible, therefore, that the evolution of the second pillar of the rural development policy, whereof agri-environmental payments are part, and specifically the inclusion of the direct support payments into it, could create a distortion. As Mantino (2008) argued this latter, as well as reforms after Agenda 2000, made the admissibility criteria less restrictive, as many production constraints were cut out. Farther, the compression of all the 22 measures listed in EC Regulation 1257/99 (*AES* are one of them) into a *great box*, namely Pillar Two, could have reduced the specificity of each single action. An implication of this extensive logic is that it allowed Member States to allocate European funding between different measures, in order to satisfy all the possible requirements, making the aims of the treatment studied more generalized A key policy priority should therefore be a more tailored and stringent agri-environmental policy, taking into consideration the specific needs of the areas where it is implemented (as Trisorio and Borlizzi, 2011, suggested). Moreover, an ongoing monitoring could have an *incentive-effect* on farmers, offsetting the less rigorous aspect of the free grants.

The findings of the present study are affected by some limitation, which are mainly attributable to both data and methodology adopted. The National Census of Agriculture provides cross-sectional data, that do not permit to provide a comprehensive overview of organic farming measures. As they refer only to 2010, it cannot state, in absolute terms, how much the organic measures are able or not to improve the diversity and density of flora and fauna species. For this purpose, the use of panel data would allow the measurement of a possible change in the *HNV* due to organic agricultural practices. Regarding the methodology, the balancing property presupposes the choice of some variables, at the expense of others that could be relevant to the impact of the final outcome. Certainly this is a limit of the model. Thus an argument for further research could be to apply Matching, integrating it with a Difference-in-Difference approach., to panel data: in fact, if data are available, a complete evaluation on the extent of the effects of conversion to organic farming on the *HNV* would be possible (as the study of Chabé-Ferret and Subervie, 2011 suggest).

5. CONCLUSIONS

The paper has examined the role of Measure 214 of the Tuscany rural development policy, specifically measure 214.a.1 regarding the organic schemes, in promoting and safeguarding plant and animal diversity. First results were obtained by a probit regression model, aimed at evaluating factors affecting farmers involvement into the treatment. They reveal that education of the farm head, as well as youth of the households' components, are positively related to farm enrolment. Also smaller farms are more prone to participate in the program, as well as mixed farms and the herbivores ones. Moreover, crop rotations is positively related to organic measures, contrary to intensive farming, that contrasts with organic farming. After that, the matching methods have been applied in order to match the two treated and control groups and to compute the Average Treatment on the Treated (*ATT*). The balancing check of the covariates demonstrated that it was good enough: the three properties, e.g. insignificance of the *t-tests* after matching, the reduction of absolute and percentage bias, and the means between the two groups, were encountered. As discussed above, this permits the validation of the *ATT* findings that, interestingly, indicate that organic farming schemes are not statistically relevant in protecting animal and plant biodiversity (as the *t-test* reveals). This result is confirmed in all the three matching algorithms adopted: the Nearest-Neighbor, Caliper and Kernel matching. In other words, organic farming is not sufficient to enhance biodiversity.

However, this study has several limitation. Firstly, cross-sectional data, as those of the National Census of Agriculture that we used, place some limits for the investigation of the extent of effective impact of organic schemes on the *HNV*. Additionally, the assumptions on which the methodology applied is based, e.g. the balancing checking, may generate partially deviant results.

One interesting direction for further research might be to apply both Matching and Difference-in-Difference to a panel data, which could permit to identify if the outcome of interest, e.g. the *HNV*, has been altered by the implementation of organic farming practices.

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