Green payment and agroforestry landscape: cost-benefit analysis in the territory of Teverina

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Summary

Green payment (or greening) is one of the main aspect of Common Agricultural Policy (CAP) 2014-2020. With this instrument continues the process started especially with the Fischler reform in order to justify public spending, ensuring the first pillar payments to farmers producing public goods. Regarding the agroforestry landscape, the greening in several territories, especially those in inner and hilly areas, will maintain the current characteristics such as the simultaneous presence of different crops, including pasture, forest and landscape features.
The effectiveness of greening in terms of benefits and costs is one of the most interesting aspects to be analyzed, considering the application rules and the financial budget of this environmental instrument. In this study has been carried out a cost-benefit analysis in an territory called Teverina. The benefits of agroforestry landscape were evaluated using the Contingent Valuation Method.
The main results show a ratio of benefits-costs that seems to justify public spending to maintain the current landscape. In conclusion, the analysis shows that the greening is in accordance to the new objectives of the CAP and in general to those of Europe 2020 strategy, with several negative aspects that are discussed.

Key words: greening payments; sustainability; cost/benefit analysis; contingent valuation

JEL Classification codes: C10, Q18, Q57

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1. INTRODUCTION

The sustainable management of natural resources and climate action together form one of the three post-2013 objectives of the CAP, and are addressed by replacing the existing direct payments under Pillar 1 with a basic payment, supplemented by an additional payment conditional on farmers respecting certain 'agricultural practices beneficial for the climate and the environment'. This so-called 'green (henceforth, greening) is financed in part (30%) from national direct payment envelopes, and requires, among other things, crop diversification and the maintenance of existing grassland. The novelty of this approach lies in its attempt to define and fund EU-wide mandatory green standards through Pillar 1 direct payments (Matthews, 2013). The greening comprise three basic elements: diversifying cultivation, the maintaining of permanent grassland and the maintaining of the Ecological Focus Areas.

The greening continues the process started especially with the Fischler reform in order to justify public spending, ensuring the first pillar payments to farmers producing public goods. Regarding the agroforestry landscape, the greening in several territories, especially those in inner and hilly areas, will maintain the current characteristics such as the simultaneous presence of different crops, including pasture, forest and landscape features.

The current financial crises and low rates of economic growth have placed government expenditures under extraordinary pressures and governments are obliged to look for the ways in which they can make radical reductions. In a context of severe pressures to reduce levels of public expenditure, there is considerable scope to allocate funds more cost-effectively in support of the agri-environment, In the reform of the Common Agricultural Policy (CAP) it will be important to deliver the environmental objectives of agricultural policy more cost-effectively (Hodge, 2009).

The effectiveness of greening in terms of benefits and costs is one of the most interesting aspects to be analyzed, considering the application rules and the financial budget of this environmental instrument. In this study has been carried out a cost-benefit analysis in an territory called Teverina. The benefits of agroforestry landscape were evaluated using the Contingent Valuation Method (CVM).

The CVM studies in Italy mainly concerned the preservation of existing rural landscape against possible sources of degradation, but there were also studies aimed at assessing the importance of improving landscape, for example through the planting of forests on the plains or the laying of underground high voltage transmission lines. Both donations and taxes were used as payment vehicle. For taxes, two different contingent market formulations were proposed. Sometimes an increase was assumed in order to preserve the landscape in its current form and so people were asked to state their WTP. In other cases it was proposed to waive a reduction in taxes paid in order to continue to pay subsidies to farmers whose interventions ensure the conservation of the landscape (Marangon and Temepesta, 2001; Tempesta and Thiene, 2004; Idda et al,, 2006).

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The main results show a ratio of benefits-costs that seems to justify public spending to maintain the current landscape. In conclusion, the analysis shows that the greening is in accordance to the new objectives of the CAP and in general to those of Europe 2020 strategy, with some negative aspects that are discussed.

In the next paragraph, the greening practices are described and a literature overview on the greening is shown. After illustrating the main elements of the methodology, the study area and the main sample characteristics are analysed. The paper ends with the results, their discussion and some final considerations.

2. BACKGROUND

The European Council and the European Parliament have recently published the new CAP regulations for 2014–2020. These regulations concern supporting rural development through the European Agricultural Fund for Rural Development (No, 1305/2013); the financing, management, and monitoring of the CAP (No, 1306/2013); the rules for direct payments to farmers under support schemes within the framework of the CAP (No, 1307/2013); and the common organization of the markets for agricultural products (No, 1308/2013).

One of the main new features of the 2014–2020 regulations is payment for agricultural practices that are beneficial for the climate and the environment (henceforth, greening payment). This payment earmarks 30% of the currently available national envelope for the implementation of sustainable farming practices.

The requirements of this measure are in addition to cross-compliance constraints, which are requirements intended to protect the basic environmental conditions necessary to agriculture. These constraints comprise three basic elements:
-   diversifying cultivation by growing at least two crops on farms where the arable land exceeds 10 ha, and at least three crops where arable land exceeds 30 ha, and by limiting the main crop to 75% of the arable land and the two main crops to 95% of the arable land;
-   maintaining permanent grassland at the national, regional, or farm level;
-   maintaining at least 5% (7% from 2017) of the arable land of farms larger than 15 ha as Ecological Focus Areas; these areas may take the form of fallow land, terraces, landscape features, buffer strips, hectares of agro-forestry, strips of eligible hectares along forest edges, areas with short-rotation coppice, afforested areas, areas with catch crops or green cover, or areas with nitrogen-fixing crops.

The system provides for greening equivalency, whereby environmentally beneficial practices already in place may be used instead of these basic requirements. For example, organic producers or farmers who participate to (or who are involved in) agro-environmental schemes will not have to meet additional requirements, as their practices are accepted as already providing clear ecological benefits. To avoid double funding under these conditions, payments made through rural development programs must take into account the basic greening requirements.

The greening payment acts as a remuneration for the production of public goods (environment, landscape, biodiversity), in line with the objectives of the Strategy Europe 2020 for smart sustainable and inclusive growth. In particular it can be an effective and important instrument to maintain ecosystem diversification, biodiversity and landscape, and could promote agroforestry and other sustainable management practice that facilitates farmland transition to strong multifunctionality (Barbieri and Valdivia, 2010).

Several studies on the possible impact of greening in Europe have been conducted in recent years. Some studies have a qualitative nature, and others use econometric and mathematical programming approaches.

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Allen et al. (2012) argue that the Ecological Focus Areas have the greatest potential, with much of this potential depending, in practice, on precisely how proposals evolve, the final form they take, the scope for tailoring interventions to local circumstances, the behaviour of EU Member States, and the response by farmers. The PBL Netherlands Environmental Assessment Agency (Westhoek et al. 2012) pointed out that the impact of crop diversification and permanent grassland measures will be negligible, as most farms already meet these criteria. They argue that the most effective measure would be the EFA criteria, where changes will be seen in the levels of production and GHG emissions in the EU.

Chiron et al. (2013) analysed the potential impacts of future CAP land use on the abundance of the 20 farmland bird species included in the French Farmland Bird Indicator (FBI). Chiron et al.'s study demonstrates that the relative abundances of specialized farmland bird species depend on both crop-cover type and the total area being cultivated. Model predictions show a general decline in the abundance of farmland birds between 2007 and 2020. The loss of farmland birds is predicted to be less pronounced in the greening scenario, although the predicted FBI values have relatively large errors. To optimize the effectiveness of the CAP on biodiversity at the national and continental levels, policies should be tested at smaller levels, such as regions or farmlands; the policies that represent the best options for biodiversity at these sublevels should then be combined to create a national plan.

Schulz et al. (2014) explored farmers' prospective responses to the greening. Their analysis was based on discrete choice experiments using a sample of 128 German farmers. Participants were asked to choose between a greening option, which had a given set of management prescriptions, and an 'opt-out' alternative, which offered a set cut of the single direct payment. Schulz et al. found that farmers' choices were driven by greening policy attributes, personal and farm characteristics, and interactions between these two groups of variables. While farmers overall perceived greening as a costly constraint, not all farmers were equally affected, nor were all greening provisions regarded as equally demanding. Specialised arable farms on highly productive land and intensive dairy farms were most likely to opt out of greening and voluntarily forgo part of their single payment entitlements.

Villanueva et al. (2015) perform an ex-ante assessment of AES in permanent cropping, analyzing several issues that have received little attention from researchers, such as Ecological Focus Areas (EFA) and collective participation. Their results show that almost half of the farmers would be willing to accept it up to 2% for low monetary incentives per additional 1% of the farmland devoted to EFA, while the rest would do it for moderate-to-high monetary incentives per additional 1% of EFA. However, for a high share of EFA (e.g., 5–7%) higher incentives would presumably be required due to the intrinsic spatial restrictions of olive groves.

Wąs et al. (2014) used a farm-optimization model with PMP techniques to estimate the potential effects of greening for 218 types of Polish farms. They found that a majority of Polish farms were already compliant with the new requirements, and that the adjustment of the remaining farms to the new requirements created only small changes in cropping structure and had a negligible impact on the income generated by the Polish farming sector. The Shannon index was used (Shannon, 1948) to verify crop diversification requirements for different types of farms.

Ahmadi et al (2015) explore how Scottish beef and sheep farms might be affected by the greening and flat rate payments under the current CAP reforms using an optimizing farm-level model. The results show that the greening measures of the CAP did not have much impact on net margins of most of the beef and sheep farm businesses, except for 'Beef Finisher' farm types where the net margins decreased by 3%. The move to regionalized farm payments increased the negative financial impact of greening on most of the farms but it was still substantially lower than the financial sacrifice of not adopting greening measures.

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Regarding the studies using the mathematical programming methodology, the modelling of greening measures is missing. Solazzo et al (2014) show the greening measures implementation in a positive mathematical programming model. However their study refers to old proposals of the European Commission, European Parliament and Council.

3. METHODOLOGY

The Contingent Valuation (CV) method is a widely used nonmarket valuation method especially in the areas of environmental cost–benefit analysis and environmental impact assessment (Mitchell and Carson, 1989; Cummings et al., 1986). Its application in environmental economics includes estimation of non-use values, nonmarket use values or both of environmental resources (Venkatachalam, 2004).

The CV method was originally proposed by Ciriacy -Wantrup (1947) who was of the opinion that the prevention of soil erosion generates some 'extra market benefits' that are public goods in nature, and therefore, one possible way of estimating these benefits is to elicit the individuals' willingness to pay for these benefits through a survey method. However, Davis (1963) was the first to use the CV method empirically when he estimated the benefits of goose hunting through a survey among the goose-hunters. This method gained popularity after the two major non-use values, namely, option and existence values, have been recognised as important components of the total economic values in environmental economics literature, especially during the 1960s. While the conventional revealed preference methods such as travel cost method are not capable of capturing these non-use values (Smith, 1993), the only method that is identified for estimating these values is the contingent valuation method (Desvousges et al., 1993).

The conceptual paradigm is the Hahnemann model (1989), where a response function due to the utility concept of the neoclassical theory is formulated. The basic assumption is that the individual utility derives from both the environmental good that income.

A utility function $u(j,Y,s)$ is associated with each individual, where j is a binary variable representing the environmental good, Y is income and s is a vector of socioeconomic characteristics.

The determination of each function is not easy, so a stochastic function is assumed

$$u(j,Y,s)=v(j,Y,s) + e_j \qquad (j=0,1)$$

where e_j is the stochastic error.

By the formulation of the question YES / NO, the interviewee answers YES only if:

$$v(1,Y-x_i, s) + e_i \geq v (0, Y, s) + e_0$$

where x_i is the bid subjected to interviewee.

The answer YES or NO to be understood as a random variable whose probability distribution is equal to:

$$Prob(YES|x_i)= Prob[v(1, Y-x_i, s)+ e_1 \geq v (0, Y, s) + e_0]$$

Assuming a distribution logistics for the stochastic component and a linear form for deterministic component, getting following logit-linear model

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$$Prob(YES|x_i) = \frac{1}{1+e^{-(\alpha-\beta x_i+\gamma s)}}$$

On the basis of what has been proposed by Hanemann (1989) and Cooper and Loomis (1992), the Willingness to Pay (WTP) can be calculated in the following way

$$WTP = -\frac{\alpha}{\beta}$$

where α is the estimated coefficient relative to the intercept and β that relating to the bid variable.

4. ANALYSIS EMPIRICAL

4.1.   Study area

Territory of *Teverina* is based at the north - east of Tuscia, near Viterbo (Italy). There are six municipalities forming the Teverina:

- Bagnoregio (72,61 km^2 for about 3,680 inhabitants);
- Castiglione in Teverina (19,96 km^2 for about 2,430 inhabitants);
- Celleno (24,59 km^2 for about 1,360 inhabitants);
- Civitella d'Agliano (32,89 km^2 for about 1,700 inhabitants);
- Graffignano (29,12 km^2 for about 2,350 inhabitants) and
- Lubriano (16,56 km^2 for about 960 inhabitants).

As rural territories are characterized by low population density and depopulation; historical-cultural heritage and archaeological monuments; predominantly agricultural sector; small family farms; natural and semi-natural ambience, In others words the area of *Teverina* is rural territory that offers history, ambience, landscape and typical products (Panin and Cortignani, 2011).

Table 1 shows that most of the total agricultural area of the study area is represented by utilised agricultural area and woodland.

Table 1. Total Agricultural Area in hectares and relative percentage of various components. For each municipalities and total.

Municipalities	Total Agricultural Area	Utilised agricultural area	Arboriculture area	Forest area	Other agricultural area
	ha	%			
Bagnoregio	5,758	70.4	1.4	20.4	7.8
Castiglione in Teverina	1,422	77.3	1.0	10.7	11.0
Celleno	1,916	82.0	0.7	9.0	8.2
Civitella d'Agliano	2,113	74.4	1.1	13.1	11.4
Graffignano	1,494	74.5	0.2	18.6	6.7
Lubriano	898	82.9	0.2	9.5	7.4
Total	13,601	74.7	1.0	15.7	8.6

Source: own elaboration on 2010 Agricultural Census

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Table 2 shows that most of the Utilised Agricultural Area of the study area is represented by arable land and permanent grassland and pasture.

Table 2. Utilised Agricultural Area in hectares and relative percentage of various components. For each municipalities and total

Municipalities	Utilised Agricultural Area	Arable land	Vine	Permanent crops	Vegetable	Permanent grassland and pasture
	ha			%		
Bagnoregio	4,054	72.0	0.5	5.5	0.4	21.6
Castiglione in Teverina	1,100	64.6	15	9.3	0.0	11.0
Celleno	1,572	72.4	0.6	8.1	0.4	18.5
Civitella d'Agliano	1,572	57.5	15.8	12.7	0.2	13.7
Graffignano	1,112	77.4	3.0	15.5	0.4	3.7
Lubriano	745	74.9	1.7	6.4	0.4	16.6
Total	10,155	69.8	4.8	8.6	0.3	16.4

Source: own elaboration on 2010 Agricultural Census

4.2. *Survey and main sample characteristics*

The surveys were filled by direct interview. Photos of current landscape and possible alternative that can be achieved without the CAP payments, are been shown to the various interviewees.

The current landscape is in line with the greening practices. It is diversified, with the presence of more crops, permanent grassland and EFA elements. The greening could maintain this kind of landscape until 2020.

The alternative landscape was modified from the original photo with the GIMP software. This landscape provides the prevalence of a single crop, the elimination of some EFA elements and converting a part of the permanent grassland in arable. Therefore, a typical landscape of intensive agriculture carried out in the hills was obtained. The prevalent autumn-winter cereal could be the wheat.

Comparing these two types of landscape, to the interviewee was asked if he was willing to pay a certain annual amount to maintain the current landscape. The payment instrument is the tax.

Additional socio-economic data and attitudinal and behaviour towards the environment and its resources have been detected. The table 3 shows the main sample characteristics.

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Table 3. Main sample characteristics (n=150)

Age	%
<30	24.7
31-50	36
51-70	28
>70	11.3
Educational level	%
degree	28.7
others	71.3
Gender	%
male	53.3
female	46.7
Household income	%
0 - 15,000	24.7
15,000 - 30,000	37.3
30,000 – 45,000	24
45,000 – 60,000	9.3
> 60,000	4.7

Source: own elaboration on survey data

5. RESULTS

5.1. Estimation results

A logit-linear model was used to estimate the parameters and to define the WTP of the sample. After several tests the model that has given the best responses in terms of significance is the one with the following parameters:

- BID: amount proposed to the interviewee;
- OCC: dummy variable that identifies occupation with fixed monthly income;
- FAM: variable that expresses the dependent family members number;
- FEM: dummy variable that identifies the female interviewee;
- AGE: variable that identifies the age of the interviewee;
- FARM: dummy variable that identifies those who see farming as a source of future income;
- LAND: dummy variable that identifies the owners of agricultural land;
- BRAND: dummy variable that expresses the deep knowledge of product and territory brands;
- SUST: dummy variable that expresses the importance of sustainability for the territorial development1;
- CROPS: dummy variable that identifies the presence of more crops such as most relevant aspect for the landscape;
- HISTC: dummy variable that identifies the historical center as the main element to be protected.

The following table report the main estimation results.

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[1] Sustainable territorial development has been framed with three aspects: 1) knowledge of environmental and landscape policies and actions; 2) participation in the processes of planning and land management for the social and economic development of the territory; 3) strengthening the tradition, culture and local products for the social and economic development of the territory

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Table 4. Estimation results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.71	0.88	1.94	0.05
BID	-0.02	0.01	-3.44	0.00
OCC	2.29	0.68	3.38	0.00
FAM	-0.86	0.51	-1.70	0.09
FEM	-0.89	0.47	-1.89	0.06
AGE	-0.01	0.01	-0.93	0.35
FARM	1.12	0.46	2.41	0.02
LAND	-0.43	0.45	-0.96	0.34
BRAND	0.29	0.60	0.49	0.63
SUST	2.63	0.74	3.55	0.00
CROPS	0.94	0.44	2.14	0.03
HISTC	-0.89	0.48	-1.85	0.06
McFadden R-squared	0.30			
Obs with Dep=0	77	Obs with Dep=1		73

The most significant variables in addition to the BID, are OCC and SUST. The occupation with fixed monthly income leads to a higher probability to affirmative response as the Importance of sustainability for the territorial development.

After that, there are other variables that influence positively the affirmative response on the willingness to pay: FARM e CROPS. Concerning the second varibiabile, it could mean that the crop diversification practice can have positive and beneficial to society, at least in terms of landscape. This is a very intreressante result, since there is much debate about the effectiveness of the practice as it has been set in terms of agro-environmental.

Other variables that are less significant are FAM, FEM and HISTC. Considering the coefficients signs, it is less willing to pay, those with a larger number of dependent family members, who is of female gender and who identifies the historical center as the main element to be protected.

Once estimated the α and β parameters, it's possible to calculate the sample WTP that is equal to 94.8 €/family/annual.

Assuming the theoretical conditions at the base of perfectly competitive market, this value can be considered as the marginal benefit of the various users of the landscape

5.2.   *Cost-benefit analysis*

To obtain the total benefits resulting from the current agroforestry landscape, the median value must be multiplied by the the number of resident households. This value according to ISTAT data is equal to 5,507. The total benefits divided by the total agricultural is equal to 38.4 € (Table 5).

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Table 5. Cost-benefit analysis of the *Greening*

Benefits	Costs	Benefits / Costs
€ 521,834	€ 1,278,494	40.8%
€/ha 38.4	€/ha 94.0	40.8%

Regarding the policy costs, it was hypothesized a unitary greening payment equal to 94 €/ha and that all the total agricultural area is affected by greening. So the total cost seems to be the maximum cost that can be achieved.

Comparing benefits and costs, is achieved a ratio of about 41%. This percentage is high considering that the estimated benefits are those due mainly and/or exclusively by the visual perception of the current agroforestry landscape.

6. DISCUSSIONS AND CONCLUSIONS

The analysis conducted has tried to quantify in monetary level the value of agroforestry landscape which has the characteristics desired by greening.

Through direct interviews to a residents sample, 150 valid survey were compiled in order to obtain different data and information on the sample. An econometric model has allowed to obtain the WTP of the sample and the influence of different variables on the response.

The effectiveness of greening in terms of benefits and costs is one of the most interesting aspects to be analyzed, considering the application rules and the financial budget of this environmental instrument.

While in terms of the politic costs, the monetary quantification appears to be less problematic, benefits require the use of specific methods that can quantify in terms of monetary value of the goods that have no market. Among these certainly one of the most applied is contingent valuation.

From the methodological point of view, the application of this method seems appropriate and in particular the estimated conduct is robust and significant in statistic terms.

The main result shows a high ratio of benefits to costs (approximately 41%) that seems to justify public spending to maintain the current landscape considering that in addition to the benefits of visual perception of the landscape, the greening should provide additional benefits such as biodiversity conservation, mitigation and adaptation to climate change and other environmental in general.

The high ratio of benefits and costs may be due to the fact that respondents have perceived by comparing photos other type of environmental benefits over the side mainly aesthetic.

In fact among the variables that most influence the likelihood to affirmative answer there is that relating to the sustainable territorial development. A citizen sensible and expert of environmental policies is willing to pay more to maintain the current landscape and therefore information, dissemination and awareness raising activities on issues regarding the environment and the landscape seem needed.

Another important variable in statistical terms and in the current social context is related to occupation with fixed monthly income. Those who have more certainty of a fixed monthly salary are willing to allocate the own income to public goods.

In conclusion, the analysis shows that the greening is in accordance to the new objectives of the CAP and in general to those of Europe 2020 strategy.

In fact to obtain a social and territorial cohesion in a context of financial and environmental sustainability, the maintenance of territories agroforestry is one of the first steps required. In these territories,

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the landscape plays a key role because it generates a number of benefits that make it more attractive and more competitive all the territorial system.

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