The economic value of olive plantation in rural areas. A study on a hill region between Italy and Slovenia

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Abstract - **This study was undertaken with the primary purpose of assessing the welfare gain to local residents resulting from olive trees. A secondary but important aim was to underline the multifunctional role of olive farming. In fact, we know that olive plantation has potentially socially benefits. In particular, it has potentially a lot of positive social effects in rural areas depending on plantation characteristics and farming practices. Therefore, the first section of this paper reviews the main features connected to the multifunctional role of olive farming. Multifunctional role of olive farming is well known in the EU, but it is still needed the institutional intervention in favour of farmers, due to the structural difficulties of olive production sector.**

Later sections concentrate on a survey carried out in order to estimate the economic value of the rural landscape, focusing in particular on olive trees in a hill region between Italy and Slovenia. From the conducted survey we gauged citizens' WTP to introduce olive trees in the landscape.

Survey data was collected by means of questionnaires. We applied the Contingent Valuation Method (CVM) in order to assess the citizens' Willingness To Pay (WTP) for specific rural landscape features. The paper ends with some conclusions about the positive results obtained in olive plantation valuation questions.

Keywords – **olive plantation, multifunctionality, willingness to pay, rural landscape valuation.**

I. INTRODUCTION

Olive farming is a multifunctional activity. In particular, it has potentially a lot of positive social effects in rural areas depending on plantation characteristics and farming practices. The first section of this paper reviews the main features connected to the multifunctional role of olive farming. Later sections concentrate on a survey carried out in order to estimate the economic value of the rural landscape, focusing in particular on olive trees in a hill region. This region straddles the national border between Italy and Slovenia (Collio and Colli Orientali del Friuli, in Italy, and Brda in Slovenia). Survey data was collected by means of questionnaires. We applied the Contingent Valuation Method (CVM) in order to assess the citizens' Willingness To Pay (WTP) for specific rural landscape features. The paper ends with some conclusions about the positive results obtained in olive plantation valuation questions.

II. MULTIFUNCTIONALITY OF OLIVE PRODUCTION

Multifunctionality is a feature of agriculture. In fact, primary sector is able to produce not only food and fiber, but also other goods. The most commonly mentioned other goods include environmental protection, food security and vitality of rural areas. They are said to be "public goods" and society values them [1,2].

Thereby also olive production has multiple functions: economic, but also environmental, social and cultural functions. In Italy, the multifunctionality of olive oil production is stressed, pointing out that it can vary tremendously depending on farming practices, on geographical and altitude conditions, but also on mechanize degree and productivity level [3].

In detail, from olive production it is possible to derive the traditional economic benefits from olive selling, but there are also other joined economic activities able to create earning. For example, tourism and gastronomy, receptivity and restaurant industry, handicraft and direct selling, recreation, etc. [4]. It is worthwhile to remember also the fundamental role of farming regarding olive quality and safety.

There are also other benefits that often are partially rewarded or go unrewarded in the marketplace. We refer, in particular, to environmental effects of olive growing. Olive trees are often planted in areas where it is impossible to produce other outputs, due to scarce accessibility. In these areas olive plantation represents an economic opportunity and contributes to environmental and biodiversity conservation. Moreover, as a result of their particular plantation characteristics and farming practices, this low-input traditional plantations have potentially an high landscape value. Olive tree, in fact, has graceful, billowing appearance and it is rather attractive because of its grayish foliage and gnarled branching pattern. This tree represents an important natural and cultural element for Mediterranean landscape. In this region olives and olive oil are common ingredients of everyday foods. Raw olives are sometimes sold, but the main output are olive oils, often produced commercially from small groves of olive trees. Into the past the olive tree was used also to generate large quantities of biomass for combustion. All these functions contributed to shape Mediterranean landscape.

Olive farming has positive effects on water management in uplands areas: it prevents soil erosion and runs-off to water bodies [5,6]. Olive trees play a role in flood control through tree-covered and root. Water management is guaranteed also by traditional stonewalls, that are now disappearing, but into the past were a typical landscape complement of olive slopes [6]. Therefore, we can argue that olive tree is a landscape complement, but also a water management element and it contributes to prevent soil degradation.

Referring to landscape functions, it is important to underline that also a wrong cultural behaviour is responsible for secular olive trees selling. Some Southern Italian regions export these ancient trees to areas with different climate conditions. There are two negative consequences (externalities) of this wrong practice: i) a negative environmental externality linked to the deprivation of a landscape element; ii) many mature olive trees are not able to survive in different climate conditions. During last years, we noted also some plucking up of secular olive trees in order to plant vineyards, in particular in Tuscany. A number of institutional national and local rules and sanctions have recently been introduced to avoid these aberrant practices.

As a result of the particular plantation characteristics and farming practices, olive farming has positive effects on biological diversity. These plantations avoid soil erosion that in some Italian regions is getting ahead (i.e. Puglia Region) and contribute to mitigate greenhouse effect. In fact, olive orchards are able to transform a significant part of carbon dioxide in humus and biomass. Moreover they have an important role in maintaining native plant and animal life and diversity.

Remarkable is also the contribute to the production of waste or residues (biomass) for bioenergy. However, waste and residues from olive oil production could also have negative effects on the environment. A wrong handle of dirty water created in olive oil production could pollute more than civil drainage water. Despite that these dirty water can be used as an organic fertilizer [7].

The listed environmentally benefits give to the olive farmers a special role: their multifunctionality is greater than that of a farmer and their land management function is essential.

Multifunctionality concept includes also the provision of some social benefits. Olive farming typically include contribution to the vitality of rural communities (through maintenance of family farming, rural employment and cultural heritage). It is worthwhile to remember some initiatives in favour of rural development such as Oil Roads or didactic farm-houses.

Olive farming gives also a significant contribution to the occupational opportunities. In fact, it offers part time occupation to unemployed or pensioner [8].

The olive farmers are often characterised by insufficient enthusiasm or scarce ability in approaching European Union rules [9]. Moreover small dimension of farms and precarious earnings due to self consumption render this sector vulnerable to abandonment.

In conclusion, olive farming revealed considerable structural difficulties needing public intervention. This institutional intervention is also fundamental to guarantee the provision of social benefits deriving from olive plantation.

III. METHODOLOGY

In this paper we illustrate a surveys carried out in order to estimate the economic value of the rural landscape, focusing in particular on olive trees in a hill region. This region straddles the national border between Italy and Slovenia. The Italian side includes two zones, Controlled Denominations of Origin "Collio" (which from here on will be referred to as COL), and "Colli Orientali del Friuli" (from here on referred to as COF). In Slovenia, the area covers the Goriska Brda (from here on referred to as BRDA).

Survey data was collected by means of questionnaires and through in person interview. Sample are composed by 200 Italian citizens and 200 Slovenian citizens. The sample was made up of a random selection of inhabitants from the area studied. We applied the CVM in order to assess the citizens' WTP for specific rural landscape features. In general the CVM is characterized by three elicitation formats: open ended, bidding game and dichotomous discrete choice [10,11,12,13,14]. The NOAA Panel [15] suggested the use of the dichotomous discrete choice format. Moreover, recent literature has confirmed that among elicitation formats it is the referendum context that fits individual behaviour more realistically. Regarding referendum format, social scientists appreciated the use of a familiar institution in its appropriate context, while economists found virtue in its incentive-compatibility [16,17,18,19]. The application of the dichotomous discrete choice requires the construction of scenarios that offer two different alternatives: one being the status quo policy at zero cost, the other having a cost (also called bid) related to the expenses involved in improving the landscape. More in depth, the hypothetical scenario should explain what the alternative policy will provide, how it will provide it, how much it will cost and how it will be paid for. Respondents are informed that a conservation policy for the rural landscape will cost money. The referendum format postulates the introduction of a national law, which respondents may accept or reject. The sample design distributes respondents over a range of different bids. The employed referendum format elicits the statements in the form of "Yes-No" WTP responses at given bid amounts [20,21].

The method requires that the respondent has an exact description of the resource. Because of the richness of attributes and levels of the landscape, two photographs were used; one portraying the status quo (i.e. the rural landscape under the current cultivation regime), and the other showing the improved landscape.

The hypothetical scenario and policy issue were described to the respondent as follows:

"Economic development and increasing wealth have caused environmental degradation. The rural landscape is undergoing change. In some hill areas traditional crops are being abandoned. Fields, which once contained olive groves, orchards, and meadows are now uncultivated and the features of the rural landscape are deteriorating. The main problem regards the conservation of the rural landscape for historical and cultural reasons. In order to improve the rural landscape olive trees will be replanted.

A popular initiative is going to propose a law providing subsidies for farmers involved in olive trees plantation programs. Taxes will increase as a consequence by an amount of € ____ per household. The popular initiative has to be signed by 15,000 people. Would you sign the popular initiative accepting to pay the bid amount?"

Two photos were submitted illustrating the two choice alternatives: landscape without olive trees (the status quo) and landscape with olive trees.

In the survey questionnaires asked for individual preferences regarding the qualitative features of the rural landscape.

IV. RESULTS

This section is divided into two parts. In the first we present the results of the qualitative analysis, and in the second the findings of the estimative analysis.

A. Qualitative analysis

In the first part of the questionnaire the respondents were asked about their personal socio-demographic characteristics (age, profession, income class) (Table 1, 2 and 3) and rural territory fruition (Table 4, 5, 6 and 7). The aim was to find out the characteristics, the habits and the preferences of territory users.

Tab. 1 Age class of respondents

Age class	Number	Percentage
Less than 29	66	16%
30-39	59	15%
40-49	78	19%
50-59	86	21%
60-69	67	17%
More than 70	44	11%
Total	400	100%

Source: our elaboration

Tab. 2 Profession of respondents and their father's profession

Profession of respondents	Number	Percentage
Farmer	10	2%
Part-time farmer	7	2%
Employee	152	38%
Entrepreneur	76	19%
Self-employed person	14	4%
Housewife/student	41	10%
Pensioner	99	25%
Total	399	100%
Their father's profession	**Number**	**Percentage**
Farmer	63	16%
Part-time farmer	13	3%
Employee	177	45%
Entrepreneur	54	14%
Self-employed person	22	5%
Housewife/student		
Pensioner	68	17%
Total	399	100%

Source: our elaboration

Tab. 3 Income class of respondents (€)

			0 - 5.000	5.001 - 10.000	10.001 - 15.000	15.001 - 20.000	20.001 - 25.000	25.001 - 30.000	30.001 - 40.000	More than 40.000	Total
Area	COF	Number	2	4	26	28	15	16	11	11	113
		Percentage	2%	4%	23%	25%	13%	14%	10%	10%	100%
	COL	Number		8	15	25	12	11	10	6	87
		Percentage		9%	17%	29%	14%	13%	11%	7%	100%
	BRDA	Number	23	38	46	21	20	15	8	5	176
		Percentage	13%	22%	26%	12%	11%	9%	5%	3%	100%
Total		Number	25	50	87	74	47	42	29	22	376
		Percentage	7%	13%	23%	20%	13%	11%	8%	6%	100%

Source: our elaboration

Tab. 4 Walks or playing

			Very often	Often	Seldom	Never	Total
Area	COF	Number	18	40	36	19	113
		Percentage	16%	35%	32%	17%	100%
	COL	Number	23	29	29	6	87
		Percentage	26%	33%	33%	7%	100%
	BRDA	Number	39	79	60	22	200
		Percentage	20%	40%	30%	11%	100%
Total		Number	80	148	125	47	400
		Percentage	20%	37%	31%	12%	100%

Source: our elaboration

Tab. 5 Hunt, fishing and mushroom

			Very often	Often	Seldom	Never	Total
Area	COF	Number	5	5	11	92	113
		Percentage	4%	4%	10%	81%	100%
	COL	Number	6	4	9	68	87
		Percentage	7%	5%	10%	78%	100%
	BRDA	Number	7	19	53	121	200
		Percentage	4%	10%	27%	61%	100%
Total		Number	18	28	73	281	400
		Percentage	5%	7%	18%	70%	100%

Source: our elaboration

Tab. 6 Participation to shows and other cultural activities

			Very often	Often	Seldom	Never	Total
Area	COF	Number	5	18	29	61	113
		Percentage	4%	16%	26%	54%	100%
	COL	Number	8	10	27	42	87
		Percentage	9%	11%	33%	48%	100%
	BRDA	Number	15	41	86	58	200
		Percentage	8%	21%	43%	29%	100%
Total		Number	28	69	142	161	400
		Percentage	7%	17%	36%	40%	100%

Source: our elaboration

Tab. 7 Purchase of local agroalimentary products

			Very often	Often	Seldom	Never	Total
Area	COF	Number	17	40	32	24	113
		Percentage	15%	35%	28%	21%	100%
	COL	Number	22	25	29	11	87
		Percentage	25%	29%	33%	13%	100%
	BRDA	Number	10	56	74	60	200
		Percentage	5%	28%	37%	30%	100%
Total		Number	49	121	135	95	400
		Percentage	12%	30%	34%	24%	100%

Source: our elaboration

The second one aimed at recording the preferences on landscape attributes. Two questions focused on attributes that may qualify the landscape, and elements that may worsen the landscape. Table 8 shows the percentages of preferences that respondents assigned to each attributes qualifying the rural landscape.

Tab. 8 Role of attributes in qualifying the rural landscape

	Very important	Quite important	Not very important	Not important
Trees and hedgerows	46%	43%	11%	1%
Woods	70%	26%	4%	1%
Poplar groves	22%	29%	36%	14%
Rivers	75%	23%	2%	
Ditches	56%	24%	14%	7%
Meadows	76%	22%	3%	
Orchards	59%	35%	6%	
Vineyards	51%	36%	11%	2%
Olive groves	52%	39%	8%	2%
Lone olive tree	47%	40%	12%	2%
Extensive plantation of olive trees	39%	34%	23%	5%
Local architecture	59%	32%	7%	2%
Dirt roads	30%	35%	27%	9%

Source: our elaboration

Departing from attributes chosen by respondents, the most preferred rural landscape is composed by meadows, rivers, woods, orchards and local architecture, ditches, olive groves and vineyards. Lone olive trees are considered very and quite important respectively by 47% and 40%. Crossing data by residence area and applying Anova statistical test, we founded that the three sub-sample assigned different value to different features. Trees and hedgerows are very important for people living in COL and COF, poplar groves are not important for BRDA and not very important for COL, ditches are very important for BRDA, lone olive trees, olive groves and extensive plantation of olive trees are very important in COF, local architecture is very important for COL and dirt roads are very important for COF and not very important for BRDA.

Table 9 shows the percentages of preferences that respondents assigned to attributes worsen the rural landscape.

Tab. 9 Role of attributes in worsen the rural landscape

	Very important	Quite important	Not very important	Not important
Urban buildings and industries	58%	30%	10%	2%
Broad roads	62%	25%	11%	3%
Pillars of high tension	54%	27%	17%	2%
Set-a-side	53%	27%	15%	5%
Weed	59%	19%	15%	7%

Source: our elaboration

Respondents agreed that broad roads, weeds, urban buildings and industries, pillars of high tension and set-a-side worsen the landscape. Nevertheless the three sub-samples assigned different value statistically significant. Pillars of high tension have a very important role in worsen the rural landscape for people living in COL and less for people living in BRDA, set-a-side is very important for BRDA and less for COL, and weeds are very important for BRDA and less for COL.

Economic valuation measures change in individual welfare associated with variations in environmental quality. The Compensative surplus (Cs) measures the quantity of income necessary for improvements that the individual is willing to pay.

Consider an individual i having an indirect utility function $U(j,Y)$, where j is a binary variable assuming value 1 if the event occurs, and 0 on the contrary, and Y is the income. We assume that:

1. $U(1,Y) > U(0,Y)$

WTP corresponding to the Cs respects the following equation:

2. $U(1,Y - WTP) = U(0,Y)$

Neoclassical economic theory assumes that the decision-maker has a perfect discrimination capability. In this context, however, the analyst is supposed to have incomplete information (unobserved alternative attributes, unobserved individual attributes, measurement errors) and, therefore, uncertainty must be taken into account.

The utility is modelled as a random variable in order to reflect this uncertainty. More specifically, the utility function can be separated into a deterministic component, V_{ij}, and a stochastic component, ε_j (j=0,1), capturing the uncertainty. The composed utility function introduces McFadden Random utility models [22] and the distribution of the error term, ε, determines the probability of choice [11,23].

Therefore (2) can be written as:

3. $V(1,Y - WTP) + \varepsilon_1 = V(0,Y) + \varepsilon_0$,

where $V(\ )$ is the mean of the casual variable $U(\ )$.

The interviewee will accept to pay the amount, bid_i, if and only if:

B. Estimative analysis

4. $V(1,Y - bid_i) + \varepsilon_1 \geq V(0,Y) + \varepsilon_0$

The probability of choice j is a casual variable whose probability distribution is given by:

5. $Prob(Yes|bid_i) = Prob V(1,Y - bid_i) - V(0,Y) \geq \varepsilon_0 - \varepsilon_1$

$= Prob\ F(\Delta V) \geq \eta$

$= F_\eta(\Delta V)$

$= 1 - G_{WTP}(bid_i)$.

where $F_\eta(\Delta V)$ is the cumulated density function (cdf) of $\eta = \varepsilon_0 - \varepsilon_1$ and $\Delta V = V(1,Y - bid_i) - V(0,Y)$.

The solution of the probability distribution function $Prob(Yes|bid_i)$ implies the specification of both stochastic $F_\eta(\Delta V)$ and deterministic component.

The approach to discrete dependent variable implies the adoption of logistic (model logit) and normal (probit model) cumulated density function, respectively:

6. $$F_\eta(\Delta V) = \int_{-\infty}^{\Delta v} \frac{1}{\sqrt{2p}} . e^{-t^2/2} dt$$

7. $F_\eta(\Delta V) = 1/(1 + e^{-\Delta V})$

whose distributions depend on the cumulated distribution of the error term. In principle, one should use logit if one assumes the categorical dependent reflects an underlying qualitative variable (hence logit uses the binomial distribution), and use probit if one assumes the dependent reflects an underlying quantitative variable (hence probit uses the cumulative normal distribution). In practice, these alternative assumptions rarely make a difference in the conclusions, which will be the same for both logit and probit under most circumstances. Prime among these circumstances is the fact that logit regression is better if there is a heavy concentration of cases in the tails of the distributions [16].

Logic models are more popular than probit models due to two reasons: the exponential logistic coefficients can be interpreted as odds ratios, and there are more diagnostic tools available in logistic regression. In this manner (5) can be rewritten as:

8. $Prob(Yes|bid_i)= F_\eta(\Delta V) =1/(1 +e^{-\Delta V})$

The assumption about the functional form of U is the linear form:

9. $U_j = \alpha_j+\beta Y$

where j=0,1, α_j is intercept, β is the marginal utility of income. ΔV can be written as:

10. $\Delta V = \alpha -\beta(bid_i)$, where $\alpha =\alpha_i -\alpha_0$. Combining (8) and (10) we obtained the cdf $F_\eta(\Delta V)$:

11. $Prob(Yes|bid_i)= F_\eta(\Delta V) =1/(1 +e^{-\alpha -\beta xi})$

Maximum likelihood estimators assess α and β values. It is important to note that whatever distribution is used, the parameters are not necessarily the marginal effects. The expected value (in the linear model mean equals median) of WTP is computed with the Hanemann formula for linear models [11]:

12. $E(WTP) = -\alpha/\beta$.

In Box 1 is possible to see the estimation output of the logit model.

Box 1 Estimation output of the logit model

```
Variable(s) Entered on Step Number
1..       BID

Estimation terminated at iteration number 3 because
Log Likelihood decreased by less than ,01 percent.

 -2 Log Likelihood      493,389
 Goodness of Fit        402,843

                     Chi-Square    df Significance

 Model Chi-Square        31,603     1        ,0000
 Improvement             31,603     1        ,0000

Classification Table for SI_NO
                 Predicted
                 0       1      Percent Correct
                 0   I   1
Observed     +-------+-------+
   0     0   I  219  I   35  I   86,22%
             +-------+-------+
   1     1   I  102  I   44  I   30,14%
             +-------+-------+
                      Overall  65,75%
```

Source: our elaboration

Table 10 reports the main results regarding the economic valuation of the rural landscape in relation to the conservation of olive tree introduction. The table shows the parameters estimates of the univariate logit model. Applying the (12) formula olive trees introduction policies in the study area produced a mean/median WTP of € 25.59 per household per year.

Collecting data from the General Registry Office, family and non-family household living in the study area are 33,076 in COL and COF [24] and 20,565 in BRDA [25]. Multiplying the social benefit by household number we assessed a benefit of € 1,372,802 (Table 11). These figures represent the subsidies that residents are willing to transfer to farmers in order to introduce olive trees in the landscape.

Tab. 10 Economic valuation of olive trees introduction

Number of observations	400
WTP/household/year (€)	25.59
α coefficient	0.4709
Standard error	*0.2116*
Wald test	*4.9533*
Significance	*0.0260*
β coefficient	-0.0184
Standard error	*0.0035*
Wald test	*28.3542*
Significance	*0.0000*

Tab. 11 Estimate of residents surplus

Areas	Family and non-family households Year: 2006 inferior	Family and non-family households Year: 2006 superior	Estimate inferior surplus	Estimate superior surplus
COL	7.705	22.634	197.189	579.258
COF	25.371	25.371	649.305	649.305
BRDA	20.565	20.565	526.308	526.308
Total	53.641	68.570	1.372.802	1.754.871

V. CONCLUSIONS

This study was undertaken with the primary purpose of assessing the welfare gain to local residents resulting from olive trees. A secondary but important aim was to underline the multifunctional role of olive farming.

Multifunctional role of olive farming is well known in the EU, but it is still needed the institutional intervention in favour of farmers, due to the structural difficulties of olive production sector.

Valuation could be particularly helpful for policy-makers, especially as concerns decisions on agricultural policy reform. Valuation can be used for pricing non-commodity agricultural outputs, and may help design schemes to obtain the optimum social mix of commodity and non-commodity outputs from rural land, in particular applying participative process. Policy makers tend to involve local communities in the decision process. It means that policy makers decide not only referring to economic but also to social and environmental indicators. This approach leads to draw up economic reports and more often environmental and social reports. The value that community assign to landscape attributes represents a valid indicator in environmental and social reports.

Therefore, from the conducted survey in Collio-Colli Orientali del Friuli (Italy) and in Brda (Slovenia) we gauged citizens' WTP to introduce olive trees in the landscape.

The findings give evidence to the fact that olive farming produces externalities that create benefits for residents.

From the results of this study it is possible to note that the interviewers' WTP in olive plantation valuation question is about € 25 per household per year. This seems to be a positive result encouraging not only public intervention, but also private initiatives.

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