How much do the common goods of rural and semi-natural landscape cost? A case study

Dranco, Daniel and Luiselli, Luca

Planland Org., Roma, Italy, Eni Group Environmental Department, Lagos (Nigeria)

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Daniel Franco[a], Luca Luiselli[b]

[a]Planland Org., via Paolo Giovio 1*- 00179 Roma, Italy
[b]Eni Group Environmental Department, Lagos (Nigeria) / Centro Studi Ambientali Demetra s.r.l., Roma, Italy
Corresponding author: daniel@danielfranco.org

Abstract

A Contingent Valuation (CV) was used to estimate the common goods' overall value of three landscapes (woodlands, wetlands, rural landscape) of the Province of Rome, to use them for policy and administration purpose. Both single and multi-bounded discrete choice models was used. The results are similar between models with a repeated maximum likelihood trend of decreasing mean values from rural landscape to wetlands. The statistical robustness of this trend can be explained by the different organization of multiple consequential and deontological motives that build up preferences. The value assigned by tax payers to common goods analysed sums to a large extent up to the province budget and mean direct use values per hectare are comparable (cropland) or much smaller (woodlands) than indirect and non use values. The indications obtained could be considered robust enough to address decisions and policies (like that of rural development) about how much to pay for common goods management services.

Key words

willingness to pay, Contingent Valuation, ecosystem services, public goods, Total Economic Value, multiple motivations distribution, pay for ecosystem services.

1. INTRODUCTION

In the last decades, several economic methods have been developed to estimate the monetary in-direct or the non-use values of ecosystem services (Hanemann, 1999). These ecosystem services (ES) do not have a market prices system for transferring them into decision processes. Indeed, even admitting that ES benefits are higher than the yields / timber alone, we almost never consider them in planning, policy making or programming because they are difficult to estimate in a comparable way (TEEB, 2009; Millennium Ecosystem Assessment 2003-5). Nevertheless, the paying for ecosystem services (PES) is increasingly considered a useful tool to pursuing sustainability in policy-making. PES has a growing role in the incoming European Rural Development Programs.

The aggregate of direct, indirect and non use values of ecosystems or landscapes is defined as Total Economic Value (TEV; see Figure 1; Cavatassi, 2004; Merlo e Croitoru, 2005;Tempesta & Marangon, 2004) .Both market and non-market methods do exist,.

The use of market methods to estimate non-direct values produces broadly comparable results if net values (of access costs) are considered. However, it presents some caveats because there is lacking of: (i) protocols to produce standard values; (ii) data linking the estimated damage with the cause; (iii) data on the relationships among ES and ecological functions allowing to apply the commercial or financial values to the whole ecosystem (Markandya et al., 2002; Clarkson & Deyes, 2002). Finally, the method is ‘backward looking’ and for forward-looking evaluations there is a need of estimates of the changes in services demand.

Among the non-market approaches, the Stated Preferences Methods assure the higher adaptability and reliability to a wide range of benefits, despite their weak point is that they depend on behavioural and hence quickly adaptive mechanisms.

This weakness has been reduced by protocols developed for this purpose. The Contingent Valuation (CV) seems the most robust approach to get the overall indirect and non use values of singles or overall ecological ecosystem/landscape goods/services, coupled with the motives that build up it (Carson *et al.* 2001; Fukahory & Kubota, 2003; Pagiola *et al.*, 2004; Stevens *et al.*, 2000).

CV is based on a survey to elicit the willingness to pay (WTP) for maintaining these goods/services (Green & Tunstall, 1991). In the case, of ecosystems not clearly connected with yields, the WTP represents the whole TEV (Tempesta & Marangon, 2004).

This paper describes a research used to estimate the non-market components of the TEV of three environments (rural landscape, woodlands, wetlands) of the Province of Rome, to be used as benchmarks in all negotiation or transaction processes allowed among private and/or public actors (environmental damage definition, land use change decisions, Paying for Ecosystems Services – PES – schemes activation, etc). Thus, we made: (i) a sound procedure to transparently select the most conservative estimates, (ii) a wide comparison of the elicited values and the observed behaviours reported in selected reviews (Cooper, 2009; Tempesta, 2007; Turner et al., 2003; http://www.evri.ca) in the reliability structure analyses (Franco & Luiselli, 2013).

The monetary estimates are public on a web-GIS (http://websit.provincia.roma.it:8080/Benicomuni), coupled with a complementary analysis of the awareness distribution in the tax payers about the ES valued to define: (i) the multiple motives supporting the services values; (ii) the profile traits related the different services' perceptions.

2. MATERIALS AND METHODS

The survey was carried out through three independent questionnaires, one for each environmental type. Overall, 124 interviewees were sampled in the pre-test and 1.612 in the true test. ES were classified according to Costanza et al. (1997), Leschine et al. (2004), Millenium Ecosystem Assessment (2003-2005) (Table 1). An internal evaluation procedure was done in order to remove biases and outliers from the sample (Franco & Luiselli, 2013).

The Province of Rome occupies the flat area of the Tiber Valley and borders the Tyrrhenian Sea to west. Its rural landscape is characterised by flat or hilly and mountainous landscape.

2.1 Surveys

Face-to-face interviews were carried out (Dillman, 1991; Moser e Duming, 1986; Tolley *&* Fabian, 1998). The interviewers were trained to maximize the performance homogeneity and to reduce interviewee wariness.

The questionnaire structure was set to identify and reduce biases (starting point, scenario rejection, free-riding) using the guidelines of the NOAA (Arrow *et al.*, 1993) and following literature (Alberini & Cooper, 2000; Bateman et al., 2002; Bateman et al., 2009; Buchli, 2004; Carson *et al.*, 2001; Groothuis & Whitehead, 2009; Hanley *et al.*, 2001; Jakobsson *et al.*, 2001; Mitchell e Carson, 1989; Mullarkey *&* Bishop, 1999; Meyrhoff *&* Liebe 2006; Pagiola et al., 2004; Poe et al. 2002; Rose et al. 2002; Strazzera *et al.*, 2003; Udziela e Bennet, 1997). The questionnaire consisted of four sections (Table 1).

We used close ended questionnaire formats (Bishop & Heberlein, 1979) to simplify the answering process by interviewee with a incentive compatible mechanism.

2.2 Interpolations

The samples' statistical representativeness are reported in

Table 2. The outliers were isolated and filtered by a cross valuation interactive procedure.

Mean WTP estimates (the most conservative ones) were pooled at both the province level and individual level to reduce the risk of data underestimation. Indeed, family groups of two people were 55% of the total, and those of three people were 76% of the total, with only 22% being single-income (ISTAT, censimento 2001; Provincia di Roma – aggiornamento al 2007; Agenzia delle Entrate – esercizio finanziario 2005; interpolation of the family groups from 2001 to 2007 on the basis of the increasing rate of the residents).

Estimates of the mean values of direct use were done by ISTAT 2008 and 2007 (utilised agricultural area added value) and by investigations on the wood-sale market (Speranadio *et al.*, 2009).

2.3 Econometric and statistical models

Two alternative models were used:

1. single-bounded discrete choice, i.e. using a univariate logit (Hanemann & Kanninen, 1999) on the first answers by the interviewees;
2. multi-bounded discrete choice (Bateman et al., 2001) using multinomial logit models, considering firstly only the dicothomic answers by the interviewees, and secondly adding the most significant explanatory variables into the modelling (Hosmer & Lemeshow 1989).

Mean WTP was calculated as in Hanemann & Kanninen (1998) by using the maximum likelihood procedure (Schwartz et al., 1997). Multinomial logit followed Hosmer & Lemeshow's (1989) modelling procedures. A maximum of 50 iterations was considered, and convergence was assessed at the 0.001 criterion; constant was included in the models.

The ratio between non auto-correlated predictors (r<0,70) and dependent variable in both univariate and multinomial logit models was calculated by a uniband logistic regression backward procedure (Luiselli, 2006a). Model validation was performed with (i) (-2 log) Likelihood test; (ii) goodness of fit (Pearson's chi^2 test); (iii) pseudo R^2; (iiii) percent of correctly classified cases. In the case of pseudo R^2 , the Nagelkerke test was used.

In multinomial models, model robustness was evaluated by F-value (α = 5%) and also by the second order Akaike Information Criterion (AICc; Burnham & Anderson, 2002; Hamer et al., 2006). The relative performance of alternative models was measured using the delta AICc (Vapnik 2000). The AICc penalizes the addition of parameters, and hence selects a model using a minimum number of parameters according to the principle of simplicity and parsimony (Burnham & Anderson, 2002); therefore, models with lowest ΔAIC were selected.

Analyses were done with STATISTICA (StatSoft release 10), SPSS (release 10.0) and writing the functions 8 and 9 for calculating means and medians in logit functions in R (R Development Core Team 2008).

3. RESULTS

The results of the pre-test, well distributed in the principal demographic parameters and coherent with expected biasing (Halstead *et al.*, 1992; Jakobsson *&* Dragun, 2001; Meyerhoff *&* Liebe, 2006), led to to keep the suggested bid in a *multiple bounded* closed format with values of 105, 125, 145 € in the upper tail, and 65, 45, 25 € in the below tail.

Filtered logistic functions showed that, in all uniband models, the maximum likelihood level was reached after the 8th iteration, with most coefficients being significant apart from β (*bid*) in wetlands and woodlands and α (constant) in rural landscape (Table 3).

In the multinomial models, the (-2*log) likelihood* diminished least than 1% only after the 12th iteration, with β coefficients being always highly significant. The sign of the β coefficient was always negative, demonstrating that it tended to increase with decreases of the suggested bid. The *log Likelihood* rejected the null hypothesis showing that $\beta \neq 0$, thus confirming the explicative role of the variable 'bid' within the model.

In the total samples (Table 3), β coefficient was never significant in either the uninomial or multinomial models.

Adding the most significant covariates (income, school degree , associationism, living distance from target environment) resulted in a single significant model for the total sample, with a comparable likelihood as that of the multinomial models based on a single bid (*Log Likelihood* 122.029, P<0.01*; Goodness of Fit* 1062.658, P<0.01; *Cox & Snell* and *Nagelkerke* R^2 1.0, P<0.01). In this case, no singly-taken covariates were significant.

Means and medians were generally consistently similar within environmental types by both uninominal or multinomial models, with some slight differences only found in woodlands (Table 4). Comparatively, the various models (i) did not show extreme kurtosis, (ii) tails were systematically shorter in multinomial models; (iii) there was a systematic higher breadth of the probability from the multinomial models. In addition, the probability of answering 'yes' was relatively low compared to the proposed bid (85 €), showing that this bid might have been a bit overestimated.

Values related to the rural landscape tended to be the least dispersed around mean values, yet remaining the mean and median values basically equivalent. (Figure 2).

4. DISCUSSION

Our study showed that the covariates were not informative in increasing the affordability of the means or the medians. We interpret this evidence as a by-product of a high collinearity with the dichotomous variable, which tend to grow from the sample with and without no bidders. The comparative use of different models and estimates allowed us to infer that the most robust model to estimate conservative central tendencies of WTP, with parameters such as mean or median, is in this case and for the three considered environment, the *multi-bounded discrete choice* without additional covariates apart from bid. Antony & Rao (2010) reported that double-bounded methods may produce more precise estimates of parameters and central tendency statistics of WTP, with narrower confidence intervals and differences tending to decrease by increasing the sample size and becoming negligible for medium size samples. Despite using medium sized samples, we got basically opposite trends, with our confidence limits being wider in multinomial models. We point out that this does not likely indicate a greater uncertainty of the considered parameter. Instead, it may indicate a the tendency of multi-bounded models to account for the multiple motivations that induce the variability in the respondent preference behaviour, thus reducing the distortion of a one-price market represented by one bound models. The good consistency between median and mean WTP and the increase of the similarity of the confidence limits of the three systems shows that the logistic functions are more unbiased and quickly tending asymptotically to zero.

The consideration of the no bidders 0 values and the variable distribution of 'yes-yes' or 'no-yes' answers in the multi-bounded models would have depressed the three samples mean, with higher percentage in the rural landscape (univariate model) and woodlands (multinomial model) sample. In particular, a higher frequency of the lower bids and/or a lower frequency of the higher bids tended to particularly depress the mean value of the multinomial models. An estimate not coupled with a careful survey design and polling, and a deep motivation analyses and outliers filtering would depress the mean WTP of 10- 40%.

As expected (Whitehead *et al.*, 2000), the mean and median obtained with the *one-bound* models were slightly higher than multi-bounded ones, (1-8%), confirming the coherence of the two approaches when conservatively used.

From both approaches it results that the values elicited were different for the three systems, with a maximum likelihood trend of decreasing mean values from rural landscape to wetlands. This was not expected in such a clear trend (Franco & Luiselli, 2014a, 2014b; Cooper, 2009; Tempesta, 2007; Turner et al., 2003; www.evri.ca). We interpret this by using the motives carrying the evaluations with a generally replicable approach. Apart from the purchasing capacity, the trend can be linked to the variable influence of the psycho -social and cognitive evaluation mechanisms. The figure of the elements explaining the preference in the wetlands case is probably consequent of a partial sharing of awareness. This could depend on low personal experiences (proximity to wetland), training (school degree, associationism) and a lower presence of socio-cultural references (Franco & Luiselli, 2014b) inducing to subjective norms (Ajzen, 1991) or intuitive preferences.

The marginal WTP differences between woodlands and rural landscape are unlikely due to low shared value perceptions or to the lack of cognitive references (discriminated by cultural belonging, specific experience or school degree). Instead, they may be due to a diverse composition of valuing motivations, and difficulties to exclude from the valuing services not accounted by the survey (yet hardly to be unconsciously excluded, timber, crops, range, etc).

About the different motivational composition of the woodlands compared to rural landscape, it results that the main differences regard: (i) a possible decreasing trend in the sense of belonging of the community coupled with a decreasing perception of well known services (hydrological); (ii) a dominating deontological role in the rural landscape preference, given the comparable judgment capacity of the equivalent ES in rural landscape and woodlands (Franco & Luiselli, 2014a).

5. CONCLUSION

The most conservative parameters of the central tendencies of WTP (mean values) are reported in Table 6. The results show that the overall value of common goods elicited by taxpayers sum up to a great part of the Province budget (year 2011: 597 Mn €) and that they were definitely comparable (rural landscape) or much grater (woods) than primary (market) direct use values.

From the econometric side it confirms that WTP is not simply motivated by the consequential reasons of the rational standard economic approach but by a wider spectrum of ethic and aesthetic reasons.

From the methodological side, it confirms that the use of monetary estimates of ES by warranty public bodies to support sustainable decision processes, makes sense only if admittedly coupled with the multiple motivations - linked to the multiple and interconnected ES (Buijs et al., 2006; Franco & Luiselli, 2014a, 2014b, IFEN, 2000; Turner et al. 2003) that generate them.

From the common sense side, it seems that is more sound to use a monetary aggregate combined with its community's motivational distribution to support a robust sustainable policy .than do not use it, because it does not fit with some not-so-reliable assumptions of a model based on a philosophic (utilitarian) approach (Ryana and Spash, 2012; Spash, 2009).

The results obtained and the system used to make them public could be easily repeated. If such tools would be made widespread available by guarantor bodies of public interest, they could provide to the public / private or the social / economic actors of robust negotiation basics to promote the re-consideration of non-market goods' role in decision making. They may also, stimulate a more coherent activation of PES schemes, like that emerging in the EU Rural Development Polices , which at present seem based on unconvincing estimation.

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Table 1 The questionnaire used in the survey.

Section 1

Wetlands

This survey is part of a wider research project on the wetland of Province of Roma, Lazio region.

Wetlands are low depth water areas like lagoons, deltas, marshes, ponds, etc

woodlands

This survey is part of a wider research project on the woodlands of Province of Roma, Lazio region.

Woods are larger than one hectare with a canopy cover higher than 10% and mature trees at least high 5 meters, which include forest lane or other little clearing, wooden strips larger than 20 meters and forestry plantation

Rural landscape

This survey is part of a wider research project on the rural landscape of Province of Roma, Lazio region.

One of the typical Roma rural landscape is that of mixed crops (more permanent crops than arable) grasslands, groves and old agricultural layout (embankments, terracing, dry masonry)

Section 2

Express your opinion about these statements

wetlands

1. Wetlands are important as water reservoirs and circulation control
2. Wetlands contribute to control green house gases based on C (like CO2) and climate change sequestering organic matter (that is plant, animal, litter, sediments)
3. Wetlands contribute to reduce environmental risks acting as a barrier against wind, waves, fires and erosion
4. Wetlands have a water purifying function
5. Wetlands contribute to biodiversity offering a habitat of several plants and animals (fishes, shellfish, water birds, mammals, reptilians)
6. Wetlands have a recreational function (visits, wildlife watching, and game)
7. Wetlands yield several categories of economic goods (wood, cane, fish, game, etc.).

woodlands

1. Woods are important to regulate water circulation and water reservoirs recharging
2. Woods contribute to control green house gases based on C (like CO2) and climate change sequestering organic matter (that is plant, animal, litter, sediments)
3. Woods contribute to reduce environmental risks protecting mountain slopes from

landslides, erosion and hydro-geological instability, and improving soils fertility

4. Woods contribute reducing water and air pollution

5. Woods contribute to biodiversity offering a habitat to several plants and animals (insects, birds, mammals, reptilians)

6. Woods have a recreational function (tourism, visits, wildlife watching, and game)

Rural Landscape

1. The observed rural landscape contribute to regulate water circulation

2. The observed rural landscape contribute to control green house gas based on C (like Co2) and climate change sequestering organic matter (that is plant, animal, litter, sediments)

3. The observed rural landscape contribute to reduce environmental risks protecting slopes from landslides, erosion and hydro-geological instability, and improving soils fertility

5. The observed rural landscape contribute to biodiversity offering a habitat to several plants and animals (insects, birds, mammals, reptilians)

6. The observed rural landscape has a recreational function (tourism, visits, wildlife watching, and game)

Section 3

The Region has approved an act to maintain these environments. The act financing it is based on a yearly tax of Euro 85,00. A referendum has been proposed to abrogate this act. If the referendum should be overtaken you would vote:

YES: you would pay less tax but you should renounce to the preservation of these environments

NO: you would contribute to the preservation of these environments, continuing to pay the tax.

Table 2 Sample representativeness: comparison between the percent distribution of main socio economic parameters of the sample and the province population

	pre-test				**test**			
	Province of Rome	**Wetland sample**	**Woodlands sample**	**Rural landscape sample**	**Province**	**Wetland sample**	**Woodlands sample**	**Rural landscape sample**
sex								
male	48	54	46	54	48	51	49	50
female	52	46	54	46	52	49	51	51
age								
17-30	16	23	25	34	16	22	19	23
30-44	29	34	33	26	29	31	29	33
45-64	32	28	25	30	32	29	27	27
>64	23	16	18	10	23	17	24	17
Study degree								
none	4	-	-	3	4	1	2	0
lower school	17	10	5	1	17	7	12	9
junior high school	29	16	11	13	29	14	18	18
high school;	36	40	43	45	36	48	42	44
bachelor's degree	2	11	8	11	2	11	8	11

master's degree	12		23		30		25		12		18		18		16	
PhD											2		1		2	
activity	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
housewife-student-unemployed	6	22	19	32	7	16	16	30	6	22	7	14	6	22	7	14
workman-pensioner	19	10	23	24	33	16	30	14	19	10	20	17	19	10	20	17
white collar, manager	18	15	33	30	40	41	37	35	18	15	15	17	18	15	15	17
free lance – professional	7	3	26	14	21	27	16	22	7	3	9	7	7	3	9	7

Table 3 Parameters and statistics of the logit models used to estimate the WTP of the samples not filtered and fitered of protest bids and other ouliers.

	Wetlands (n. 455)			Boschi (n. 452)			Rural landscape (n. 468)			Total sample (n. 1375)		
						Filtered Univariate Model						
Variable	*Coefficient*	*St.Er..*	*Prob.*	*Coefficient*	*St.Er..*	*Prob.*	*Coefficient*	*St.Er..*	*Prob.*	*Coefficient*	*St.Er..*	*Prob.*
Costante (α)	0,2989	0,0561	0,000001	0,3261	0,0669	0,0007	0,4055	0,9128	0,6569	0,4035	0,0709	0,00001
Bid (β)	-6,5016	5,6498	0,0926	-5,5257	5,6429	0,0914	-5,6821	1,3590	0,0006	-6,5235	5,6410	0,0914
		DF	*Prob*		*DF*	*Prob*		*DF*	*Prob*		*DF*	*Prob*
log likelihood	1774,885	1	0,00001	1770,970	1	0,00001	1768, 91	1	0,00001	161,107	1	0,00001
Goodness of Fit	1301,031	1	0,00001	1301,031	1	0,00001	1301,031	1	0,00001	356,004	1	0,00001
Nagelkerke - R2	0,244	1	0,00001	0,246	1	0,00001	0,247	1	0,00001	0,247	1	0,00001
% correct	65,63	1	0,00001	65,63	1	0,00001	98,57	1	0,00001	98,57	1	0,00001
						Filtered Multinomial Model						
Constant (α)	0,2877	0,7638	0,7064	-3,7512	1,3350	0,0050	0,4055	0,9128	0,6569	4,2272	0,9425	0,8385
Bid (β)	-6,526	2,05	0,0017	-6,1879	2,26	0,01	-6,1448	2,29	0,0001	-7,2704	2,30	0,01
		DF	*Prob*		*DF*	*Prob*		*DF*	*Prob*		*DF*	*Prob*
log likelihood	175,704	5	0,00001	138,006	5	0,00001	161,107	5	0,00001	136,293	5	0,00001
Goodness of Fit	1114,645	5	0,00001	2610,130	5	0,00001	356,004	5	0,00001	1191,613	5	0,00001
Nagelkerke - R2	1	5	0,00001	1	5	0,00001	1	5	0,00001	1	5	0,00001
% correct		92,48	0,00001	98,24	5	0,00001	92,66	5	0,00001	98,57	5	0,00001
	Wetlands (n. 537)			**Woodlands (n. 536)**			**Rural landscape (n. 539)**			**Total sample (n. 1612)**		
						Not Filtered Univariate Model I						
Variable	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*
Constant (α)	0,3997	0,0695	0,000001	0,500	0,0695	0,000001	0,5046	0,0705	0,000001	0,4680	0,057	0,000001
Bid (β)	-9,6697	5,6452	0,0867	-0,0985	0,1215	0,4176	-9,6752	5,6486	0,0867	-9,6707	5,6498	0,0870
		DF	*Prob*		*DF*	*Prob*		*DF*	*Prob*		*DF*	*Prob*
Log likelihood	1731,412	1	0,000001	1733,641	1	0,000001	1733,506	1	0,000001	1732,26	1	0,000001
Goodness of Fit	1301,031	1	0,000001	1301,031	1	0,000001	1301,031	1	0,000001	1301,031	1	0,000001

Nagelkerke - R2	0,268	1	0,000001	0,267	1	0,000001	0,267	1	0,000001	0,267	1	0,000001
% correct	68,92	1	0,000001	72,22	1	0,000001	70,20	1	0,000001	72,00	1	0,000001
Not Filtered Multinomial Model												
Variable	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*	*coefficient*	*St.Er.*	*Prob.*
Constant (α)	0,2642	0,8612	0,7590	-2,5514	1,3686	0,0623	0,475	0,8165	0,999	0,4055	0,9128	0,6569
Bid (β)	-7,9548	2,12	0,0004	-7,4662	2,33	0,001	-8,0179	1,95	0,0002	-7,9482	2,11	0,0001
		DF	*Prob*		*DF*	*Prob*		*DF*	*Prob*		*DF*	*Prob*
Log likelihood	110,077	5	0,00001	91,417	5	0,00001	101,783	5	0,00001	114,925	5	0,00001
Goodness of Fit	919,274	5	0,00001	1886,327	5	0,00001	338,002	5	0,00001	516,002	5	0,00001
Nagelkerke - R2	1	5	0,00001	1	5	0,00001	1	5	0,00001	1	5	0,00001
% correct	99,13	5	0,00001	99,19	5	0,00001	99,13	5	0,00001	99,07	5	0,00001

Table 4 Means, confidence intervals (Wald's method confidence intervals 95%) and medians calculated with logit models of the samples filtered and not filtered of protest bids and other outliers.

	Univariate Model					Multinomial Model			
	lower conf. limit.	*mean*	*upper conf. limit.*	*median*		*lower conf. limit.*	*mean*	*upper conf. limit.*	*median*
Wetlands	45	46	47	46		40	44	48	44
Woodlands	58	59	60	59		53	59	65	60
Rural landscape	64	70	77	71		60	64	68	66
Total sample	61	60	62	62		57	58	62	58
	Not filtered samples								
Wetlands	39	40	42	41		29	33	37	33
Woodlands	49	51	54	51		28	34	39	34
Rural landscape	50	52	53	52		54	58	62	59
Total sample	47	48	48	48		46	50	54	51

Table 5 Total and per surface unit aggregate values by tax payers. Per unit values are related to the land use actually utilised in the analysis and land use very near to it.

Environment	Type	Aggregated values	Surface estimation	Surface values	Corresponding mean primary direct use
		Tax payers (2005: 2.052.539	*ha*	*€ ha^{-1} $year^{-1}$*	*€ ha^{-1}*
Wetlands	*wetlands (source Ufficio GIS Provincia di Roma)*	*€ 90.003.835,15*			
	wetlands – considering temporary wetlands *(source Ufficio GIS Provincia di Roma)*				
Woodlands	*High wood (source: INFC*	*€ 121.777.138,87*	135.972	895,60	*78,35*

	2005 - Ufficio GIS Provincia di Roma)				
	Wood (source: INFC 2005 - *Ufficio GIS Provincia di Roma*)		139.149	895,60 - 875,16	
Rural landscapes	*Hilly rural landscape wit mixed crops (source: PTPG Roma)*	*€ 132.039.833,87*	*141.139,93*	1.391,54	*906,60*
	Hilly rural landscape wit mixed crops – with dense housing; Hilly rural landscape with olive yard prevalence (source: PTPG Roma)		184.930,52	1.391,54 - 1.016,77	*906,60*
	Rural Roman landscape of Tevere beyond (source: PTPG Roma)		267.623,24	1.016,78 - 707,89	*906,60*
total		*€ 343.820.807,89*			

Figure 1 Taxonomy of the main methods to estimate TEV components (from various authors, modified).

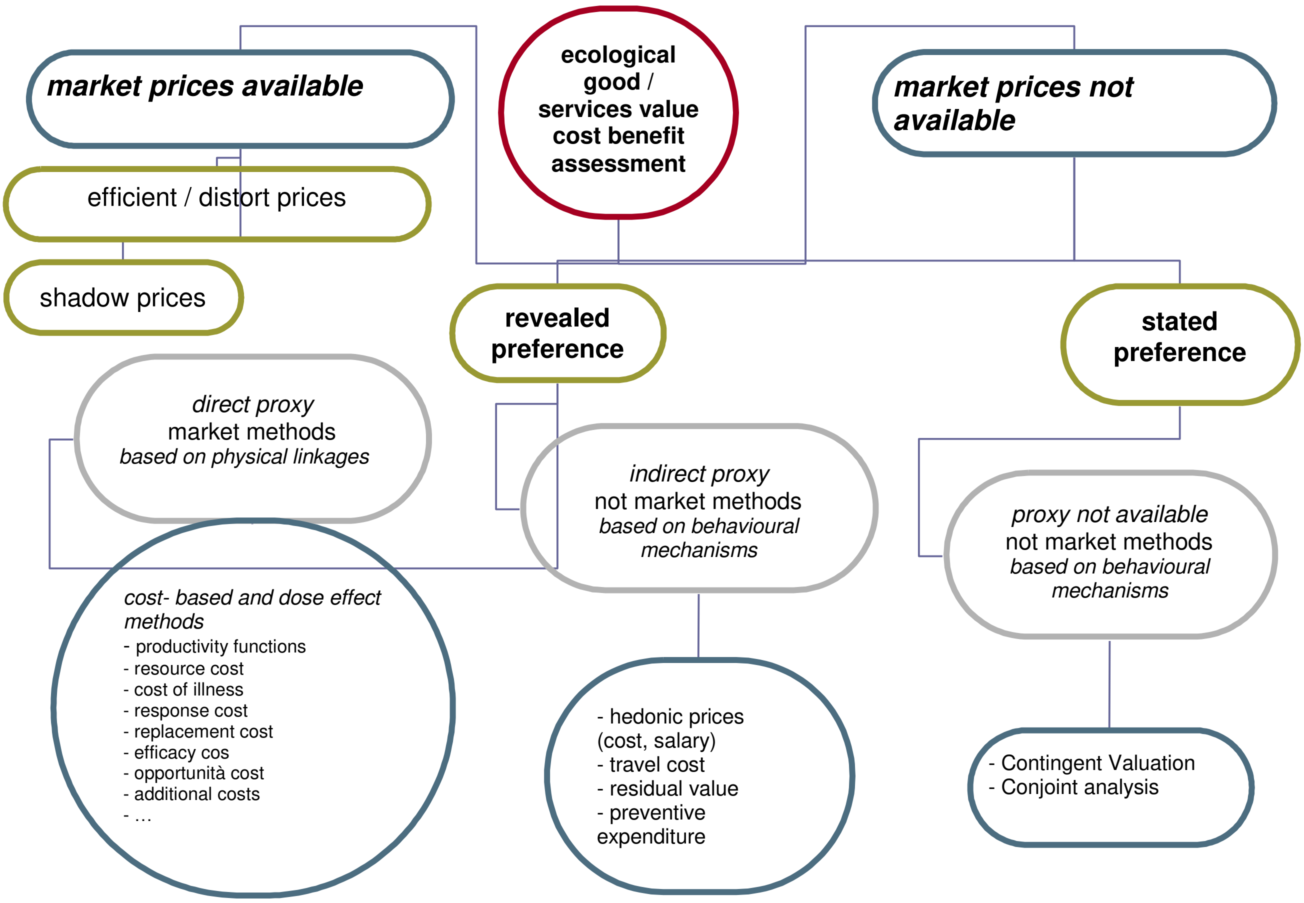

Figure 2 Set to 0 the mean values, are shown the confidence limits (P = 95%) distribution of the univariate (one - bounded) and multinomial (multi - bounded) models.