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The role of agroforestry networks in landscape socioeconomic processes: the potential and limits of the contingent valuation method

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Abstract

Agroforestry networks can be a means to achieve landscape amelioration. Some authorities of the Lagoon of Venice drainage basin (Italy) are planning, amongst other actions to control pollution in the Lagoon, to reintroduce agroforestry by means of a GIS-supported design procedure. The goals of this paper were to assess (i) the contingent valuation (CV) (willingness to pay and willingness to accept) of agroforestry networks and its relationship with socioeconomic and agroforestry role variables, (ii) the coherence between agro-economic policies and farmers expectations, (iii) the relationship between the value of agroforestry as a "shared good" and water quality (non-point source pollution). Respondents associate a positive value/preference to the agroforestry network implementation, although this value is strongly affected firstly by their identity with the landscape and secondly by their income. The motivations of farmers' evaluation are precise and the agroforestry network is considered not only as an "ethical object" but also as a concrete element of their own cultural and economic world. In this case the contingent value (in particular, in terms of acceptance) increases with the farmer's economic capacity, and the farmer's valuation is not linked only to the "good" but also to the "service" offered for implementing it. The expectations of farmers regarding an agroforestry plantation were lower than European Union incentives at the time of survey, and a lack of results in this field is probably linked to poor information and to bureaucratic difficulties. Even if there is general knowledge on water quality, there is little awareness on the non-point source pollution control effect of agroforestry buffer plantations, either in the common people or in those who are environmentally trained (e.g. planning university students). In every case the agroforestry "shared good" evaluation is high enough to permit efficient and supported intervention policies. These results confirm that landscape choices strongly involve issues of identity, perceived rights and evaluation capacity that cannot be simply resolved in terms of preference cost benefit analyses, but a clever use of the CV allows an identification of these same limitations and a partial estimation of them.

Keywords: Landscape; GIS; Agroforestry; Networks; Contingent valuation; WTP; WTA; Agro-environmental policies; Landscape preferences and values

1. Introduction

Agroforestry can be a means to achieve landscape amelioration from an environmental and economic point of view (Franco, 2000), and for this reason

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may be implemented at several levels. For example, the European Union (EU) and some countries are promoting agroforestry policies to preserve rural landscapes (EU rules 2078/92, 2080/92, now EU rule 1257/99), and some authorities of the Lagoon of Venice drainage basin (Italy) are developing actions to control Lagoon pollution which include the development of agroforestry networks (Progetto Siepi©); by means of a GIS-supported planning procedure (PLANLAND®©; Franco, 1997).

Considerable attention is focused on the conservation implications and environmental effects of an ecological network (e.g. Hudson, 1991; Forman, 1995), but socioeconomic and socio-cultural impacts of an agroforestry network (Burel and Baudry, 1995; Colletti et al., 1993) are not frequently taken into consideration. Landscape resources (water quality, beauty, nature) are mostly a public or mixed good, and their improvement is also a public good. In order for resource allocation in landscape planning and management to be efficient, the effects and the values that individuals and society place on the non-market aspects of landscape and landscape structures must be considered.

We believe that it is not useful to consider landscape management problems in terms of independent categories (e.g. nature conservation, aesthetic valuation, economic cost and benefits, etc.) if we want to understand and subsequently manage the landscape. Rather we believe that in dealing with agroforestry networks, socio-cultural (landscape perception and valuation) or socioeconomic (impact of agroforestry systems on society and farmland economy, "willingness to pay" for agroforestry) landscape processes have to be considered as ecological functions as are biotic fluxes or hydrological fluxes, linked to landscape structures in a landscape ecology perspective (Forman, 1995; Naveh and Liberman, 1994; Burel and Baudry, 1999). This is the approach used in the GIS-supported procedure mentioned above.

This study was undertaken in order to evaluate the impact of an agroforestry network on social, cultural and economic processes in the Venetian landscape. The aims were (1) to evaluate social awareness of non-point source pollution and of the roles of agroforestry networks (Mannino et al., 2001), (2) to estimate the contingent valuation (CV) of an agroforestry network, (3) to evaluate the correlation between existing policy (benefits for agroforestry plantation) and farmers' expectations, (4) to assess the role of both the existing and the planned network on the perception of landscape value (Franco et al., 2001). This paper describes the results of (i) the CV of agroforestry networks and its relationship with socioeconomic and agroforestry systems' role variables, (ii) the coherence between agro-economic policies and farmer expectations, (iii) the relationship between the valued "shared good" and water quality (non-point source pollution).

2. Materials and methods

The research was conducted in 1999 in the Venice Municipality (Venice, Italy), and carried out largely by means of a survey. The survey was constructed to allow cross verification, to test the affordability of responses and to reduce "CV methods" problems (Burgess et al., 1995; Edwards and Anderson, 1987; Kealy et al., 1990; Mitchell and Carson, 1989; Moser and Dunning, 1986; Simon, 1994; Whitehead et al., 1993; Walsh et al., 1990). For example, to verify the coherence between "willingness to pay" (WTP) and "willingness to accept" (WTA) values, or between these values and the value assigned to the agroforestry roles in landscape.

Respondents were contacted in one of two ways: non-university students were contacted by telephone prior to being sent the survey, whereas surveys were given directly to university students. Mailing was chosen for a number of reasons: (1) to reduce social desirability; (2) to increase the context effect (the survey can be examined before responding); (3) to adapt the response timing to the respondent and not to the interviewer; (4) to eliminate interviewer bias and (5) to allow time for the respondent to think about their response (Cameron and Huppert, 1989; Dilman, 1991; Moser and Dunning, 1986).

Mailing was preceded by a telephone call to (1) explain the scientific nature of the survey (to reduce the respondent's diffidence), (2) try to make the respondent aware of the value of their contribution and (3) understand why individuals may choose not to respond to the survey (Frey, 1989; Loomis and King, 1994).

The surveys were divided into several sections.

The first section aimed to identify the socioeconomic characteristics of each respondent.

The second section was to assess the respondent's awareness of pollution problems in their county of

residence. Fourteen pollution sources were selected and the respondent was asked to rate each of these on a scale of 1–10.

The third section was developed to estimate the value given by respondents to Best Management Practices (for which the respondent was asked to rate a number of sentences using four levels of agreement) and to estimate the value given by respondents to some positive and negative roles of agroforestry networks in the landscape (to be rated using a 10-point scale, Table 1).

The fourth section regarded the CV research, which is the object of this paper.

2.1. Respondents

A stratified random sample of farmers, Lagoon residents (Venice and Islands) and non-Lagoon residents (inland/farmland) were selected from the telephone directory. Farmers were contacted by means of Farmers' Unions. The statistical "universe" considered consisted of 320 families and 60 university students of Architecture (following a course on urbanism and planning) and Environmental Sciences. The total number of respondents was 196.

The socioeconomic distribution within the sample (in particular, for more precise data such as age, educational status, residence, or family size) was consistent with the socioeconomic characteristics of the Venice municipality as a whole, therefore the sample can be treated as representative of the study area.

2.2. Farmer respondents

Farmers are directly involved with the issue in question, and for this reason were considered with great care in this analysis. 82% of respondents were middle-aged males, with a low educational status and had small families. Forty-two percent of respondents

Table 1
Standardised mean values of agroforestry network roles in the landscape expressed by the whole sample in a 1–10 scale[a]

Agroforestry role variables	Mean	Homogeneous judgement groups						
Bank protection and consolidation	5.4	xxxx						
Landscape aesthetics	5.3	xxxx						
Protection of slopes against erosion	5.0	xxxx						
O_2 emission and CO_2 absorption (decrease of greenhouse effect)	4.9	xxxx						
Industrial area, roads, waste disposal and quarry masking	4.5		xxxx					
Windbreak effect and improvement of a positive microclimate for crops	4.5		xxxx					
Hosting for pest predators and pollination	4.2		xxxx					
Protection against air pollution (dust)	3.6			xxxx				
Wildwatching improvement	3.5			xxxx				
Protection against noise	3.3			xxxx				
Rivers and Lagoon protection against pollution	3.1			xxxx	xxxx			
Increase in recreation	3.1			xxxx	xxxx			
Management costs	2.9				xxxx			
Secondary rural production (mushrooms, silver fruits, herbs, etc.)	2.7				xxxx	xxxx		
Creation of a negative environment for water weed and consequent improvement of banks management	2.7				xxxx	xxxx		
Game increase	2.5				xxxx	xxxx	xxxx	
River depuration	2.5				xxxx	xxxx	xxxx	
Reduction of shading for crops	2.2					xxxx	xxxx	xxxx
Machinery hampering	2.1					xxxx	xxxx	xxxx
Vineyard support	2.0						xxxx	xxxx
Firewood production	2.0						xxxx	xxxx
House protection from weather	1.9							xxxx
Water and nutrients competition with crops	1.8							xxxx
Honey production	1.6							xxxx
Timber production	0.5							
Limitation on field market	0.4							

[a] Values are ranked in order of assigned importance and are grouped according to statistical differences (Duncan test).

cultivated <5 ha, and many of them were part-time farmers. Most of the respondents cultivated one or two types of crop, with between 41 and 79% of the total surface area covered by one dominant crop.

The business and demographic characteristics were compared to those of the Commune and of a relevant Farmers' Union. This revealed a very good correspondence between the characteristics of the sample and that of the entire category, therefore the sample may be considered representative of farmers in the Municipality of Venice.

2.3. Dependent variables

CV estimates were treated as dependent variables. The CV format was open-ended, and the valuations were defined in three ways.

- In the first question, the respondent was asked to express their "willingness to pay" to implement agroforestry networks (WTP variable) as a citizen in the municipality.
- In the second question, the respondent was asked to express their "willingness to pay" to implement agroforestry networks assuming they were a farmer ("WTP farmer" variable).
- In the third question, the respondent was asked to express their "willingness to accept" agroforestry systems (WTA variable) assuming they were a farmer.

WTP categories were between 0 and 258 €; "WTP farmer" and WTA between 0 and 103 €.

The potential difference in the preference/valuation of the estimated good, or the difference in differences in attitude regarding the good in the socioeconomic classes was assessed by comparing the three types of CV.

Each citizen was asked to indicate his personal WTP a year per ha of their property, assuming they were a farmer. In doing so, an indication of the value of hedgerows with respect to the farmer's activity was obtained, and the citizens attitude with respect to farmers was assessed.

An analysis of farmers' WTA was carried out to assess the relationship between EU agroforestry incentives and farmers expectations. A comparison of values expressed by farmers and non-farmers was used both to estimate the theoretical relationship between WTP and WTA (Colletti et al., 1993), and the consistency of non-farmers "WTP farmer" and WTA estimates.

2.4. Independent (explicative) variables

The independent variables used were of a socioeconomic and qualitative nature, and were based on the values assigned by respondents to the role of an agroforestry network in the landscape.

The "socioeconomic variables" (categories) and their representation in the sample are reported as follows.

Socioeconomic vriables	Classes
Sex	Males 67%, females 33%
Age	1: 0–25 Years 18%; 2: 25–40 years 25%; 3: 40–60 years 36%; 4: >60 years
Educational status	1: Primary school 37%; 2: high school 50%; 3: graduate 12%;
Job	1: Farmers 23%; 2: students 22%; 3: employees and professionals 21%; 4: retired workers and housewives 29%; 5: other (unemployed) 5%
Family	1: 1–2 Persons 32%; 2: 3 persons 27%; 3: 4 persons 50%; 4: >4 persons 17%
Income	(in this case only 60% of respondents answered) 1: 0–12.970 34%; 2: 12.9700–23.348 42%; 3: >23.348 24%
Residence location	1: Venice and Islands 21%; 2: Mestre and suburbs 40%; 3: inland-farmlands 39%
Total farm surface (only farmers)	Hectares
Percentage of hired cultivated land (only farmers)	Percentage of farm surface
Number of crops (only farmers)	Number of crops in the farm
Farm main crop (only farmers)	1: Maize; 2: soybean; 3: chard; 4: horticulture; 5: greenhouse; 6: alfalfa; 7: orchard; 8: vineyard; 9: organic farming

Variables concerning the role of agroforestry networks (agroforestry role variables) were based on the values assigned by the respondents to the 26 potential roles reported in Table 1.

2.5. Procedure

To reduce the subjectivity of ratings for agroforestry role scaling, an "origin-adjusted rating" scaling procedure was chosen due to its simplicity and robustness when compared to other more complex procedures, given the statistical representativeness of the sample. The *i* value given by the *j* respondent was substitute by the difference between the mean value of respondent *j* and the value of *i*.

A parametric analysis of variance (ANOVA) was used to make statistical comparisons. Parametric assumptions were estimated using visual and numerical methods and non-parametric Kruskal–Wallis ANOVA were used when violations of the parametric assumption were detected, given that scoring methods rely on an ordinal scale when sub samples analysed are not representative (lacking in normality). When no differences were detected between the parametric and non-parametric ANOVA results, the Duncan test was utilised to detect homogeneous groups and/or significant differences.

Explorative multiple linear regression models were applied to assess the functional relationship between the considered variables. Standard or forward stepwise multiple linear regression models were used. Furthermore, Ridge regressions were carried out in order to reduce problems arising from collinearity of variables and to obtain more straightforward selections (StatSoft, 1995). The size of the farmers sub sample (33 respondents) placed some limitations on the statistical confidence of the results. Commercial software packages were used (STATISTICA©, EXCELL©, SYSTAT©, STATGRAPHICS©)

3. Results

3.1. The influence of socioeconomic variables on the contingent values distribution of the sample

3.1.1. Willingness to pay

Ninety-one percent of the sample responded to the WTP question; the mean value was 41 € and the most frequent value was 23 €, the latter being suggested as optimum by 17% of the sample. 50% of respondents indicated WTP values between 6 and 49 €, and 11% were not willing to pay anything, giving non-values to the analysed good.

Table 2
Statistically significant differences (Duncan test) of the willingness to pay (WTP) and willingness to accept (WTA) between the job classes of the whole sample[a]

Main effect: job	Probabilities for post-Hoc tests				
	Farmers	Students	Employees and professionals	Retired workers and housewives	Other
WTP					
(mean values)	(75.36)	(21.79)	(46.58)	(20.51)	(19.92)
Farmers		*0.00*	*0.04*	*0.00*	*0.00*
Students	*0.00*		0.09	0.63	0.89
Employees and professionals	*0.04*	0.09		0.20	0.08
Retired workers and housewives	*0.00*	0.63	0.20		0.57
Other	*0.00*	0.89	0.08	0.57	
WTA					
(mean values)	(102.35)	(82.96)	(97.32)	(60.78)	(106.81)
Farmers		0.36	0.80	0.06	0.82
Students	0.36		0.47	0.27	0.28
Employees and professionals	0.80	0.47		0.08	0.66
Retired workers and housewives	0.06	0.27	0.08		*0.04*
Other	0.82	0.28	0.66	*0.04*	

[a] Significant values are in italics.

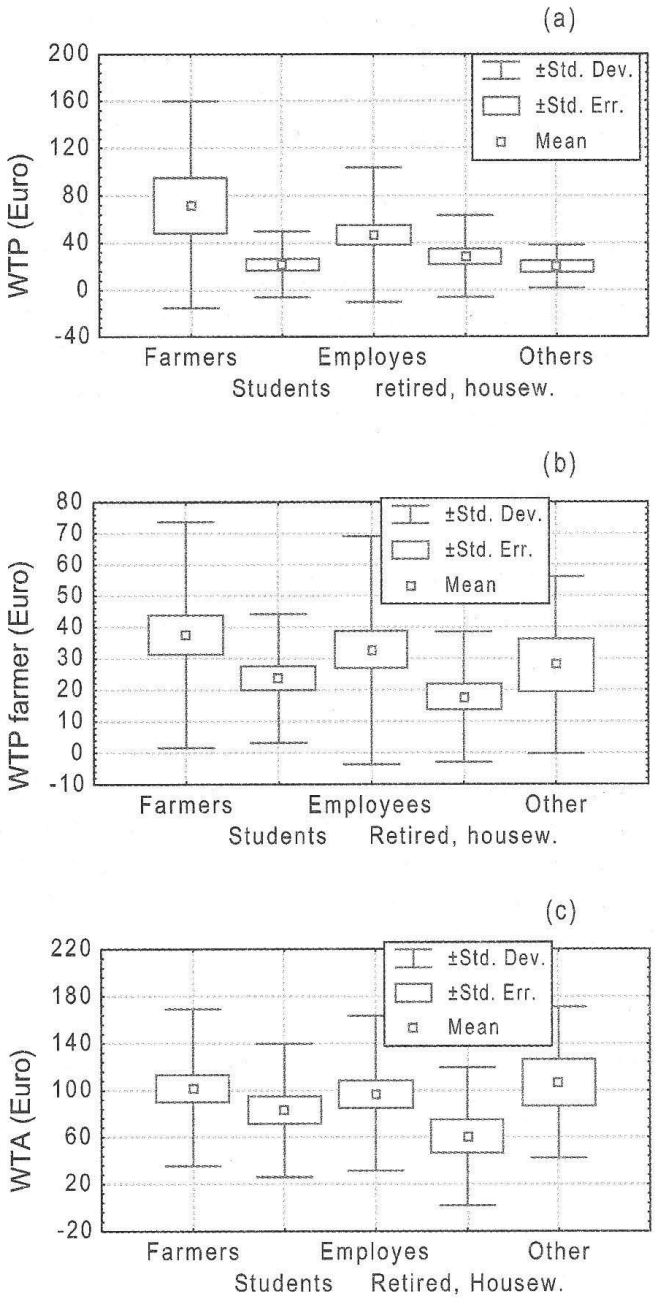

Fig. 1. Box plot of contingent valuation for the different job classes of the sample: (a) WTP; (b) "WTP farmer" and (c) WTA.

Some socioeconomic variables significantly influenced the WTP distribution of the sample. Farmers gave a significantly higher WTP than other job categories, in particular students Table 2, Fig. 1.

The most frequent WTP value of farmers was 65 €; the values proposed reached 245 € and only 5% of this statistical strata were not willing to pay anything.

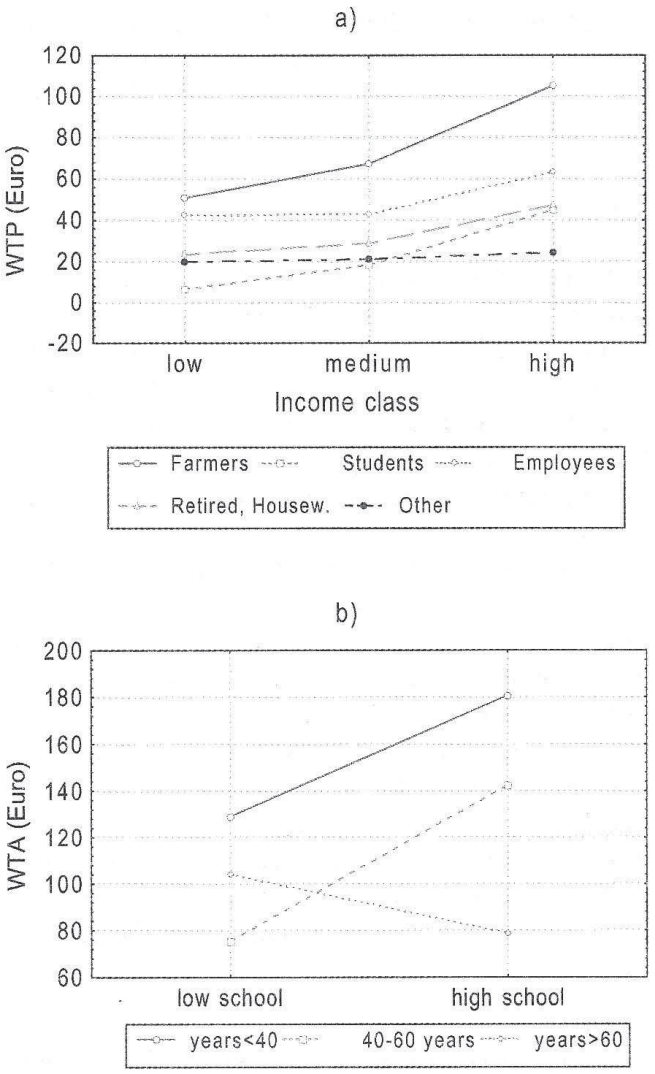

Fig. 2. Plot of (a) distribution of WTP vs. job and income classes, (b) distribution of farmers' WTA vs. age and study title classes.

Income also influenced responses, although differences were not found to be more significant if farmers were eliminated from the sample (Fig. 2). Thus, it is availability of farmers to pay (which is proportional to farm income) which influences differences found within the whole sample.

Farmland residents expressed a higher WTP than urban (Mestre) or Lagoon (Venice and Lagoon Islands) residents (Fig. 3). The willingness to pay anything was particularly high for Lagoon residents.

3.1.2. Willingness to pay assuming to be a farmer (WTP farmer)

Eighty-two percent of respondents answered this question, with a mean value of 30 €; more than half of

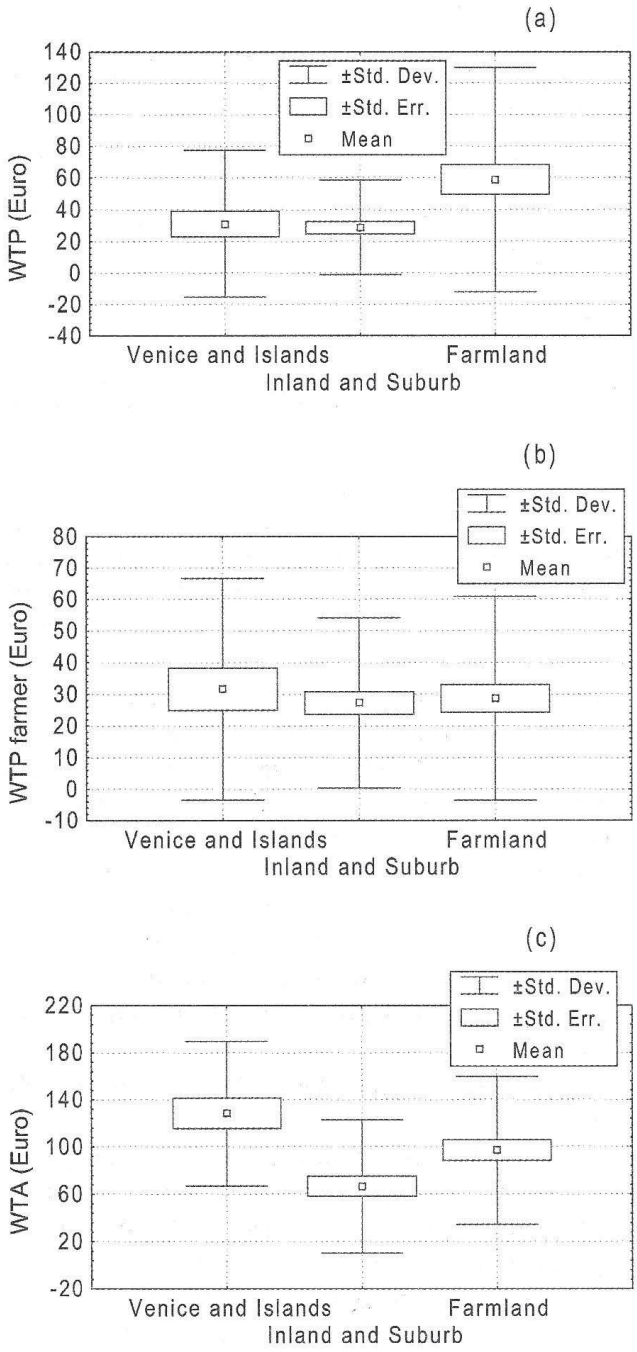

Fig. 3. Box plot of the contingent valuation for the different residence classes of the sample: (a) WTP; (b) "WTP farmer" and (c) WTA.

the sample had a "WTP farmer" lower than the mean value and the willingness to pay anything assuming they were a farmer was lower than the WTP of respondents. The only socioeconomic variable that significantly influenced the distribution of "WTP farmer" in the sample was the job (Table 2, Fig. 1). Farmers again expressed a higher "WTP farmer" than other job classes (significantly higher than housewives and retired workers). Hypothetical "WTP farmer" in the other categories is linked to other economic possibilities (income), as for WTP.

3.1.3. Willingness to accept

Only 73% of respondents answered the WTA question, which is a lower percentage than for WTP. With the exception of farmers, it was obviously simpler for respondents to express a willingness to pay for something rather than to imagine a realistic payment for the hypothetical plantation of an agroforestry system in their "own" field. The most frequent values were between 101 and 204 €. Only 6% of respondents expressed a null WTA. These zero WTA values corresponded to the same respondents as values of WTP and "WTP farmer" which were equal to zero or very low; so for these respondents the estimated good was assigned a low or null value in all three types of contingent values. Fourteen respondents assigned the maximum value (204 € year/ha) of WTP; it was found that for corresponding WTP and "WTP farmer" values: (i) two respondents assigned very low values WTP and "WTP farmer" (expressing in this way the low value assigned to the good), (ii) all other respondents assigned very high values to WTP and "WTP farmer"; in these cases all three types of contingent values are coherent with the high value assigned to the good. So, in general terms, the theoretical relation between WTP and WTA is confirmed (Colletti et al., 1993). Again, the ANOVA detected an influence of job classes on the distribution of the WTA in the sample, although this was less significant than for WTP and "WTP farmer". Moreover, the distribution was very similar to WTP (Fig. 1), except for unemployed respondents who tended to ask for more money than they were willing to pay (for obvious reasons). These findings reinforce the hypothesis that theoretical links between WTA and WTP do exist.

The final variable which significantly influenced the WTA distribution was residence (Table 3, Fig. 3): all residence classes expressed significantly different WTA values, and Lagoon residents expressed higher values. Particularly high values of WTA correspond to farmers and "non-farmer" Lagoon residents.

Table 3
Statistically significant differences (Duncan test) of the willingness to pay (WTP) and willingness to accept (WTA) between the residence classes of the whole sample[a]

Main effect: area location	Probabilities for post-Hoc tests		
	Venice and Islands	Mestre and suburbs	Farmland
WTP			
(mean values)	(31.03)	(28.92)	(58.95)
Venice and Islands		0.85	*0.01*
Mestre and suburbs	0.85		*0.01*
Farmland	*0.01*	*0.01*	
WTA			
(mean values)	(128.45)	(66.47)	(97.06)
Venice and Islands		*0.00*	*0.03*
Mestre and suburbs	*0.00*		*0.03*
Farmland	*0.03*	*0.03*	

[a] Significant values are in italics.

3.2. The influence of socioeconomic variables on the contingent values distribution of farmers

3.2.1. Willingness to pay, willingness to pay assuming to be a farmer

Farmers with higher incomes expressed a higher WTP. The mean value is higher than the median (Fig. 2), showing that high values are more frequent. Farmers with larger farms declared significantly higher WTP values than farmers with intermediate sized farms, but not significantly greater than farmers with low surface area farms (Table 4). Similar results were obtained for "WTP farmer".

Table 4
Statistically significant differences (Duncan test) of the farmers' willingness to pay (WTP) according to farm surface area classes[a]

Main effect: farm surface	Probabilities for post-Hoc tests			
	<5 ha	5–10 ha	11–40 ha	>40 ha
WTP				
(mean values)	(51.56)	(20.66)	(14.20)	(73.59)
<5 ha		0.09	0.05	0.21
5–10 ha	0.09		0.71	*0.01*
11–40 ha	0.05	0.71		*0.00*
>40 ha	0.21	*0.01*	*0.00*	

[a] Significant values are in italics.

Table 5
Principal statistics of the farmers' willingness to accept (WTA) for agroforestry plantation and range values of European Union incentives (at the survey time) for the same activity

WTA statistics	Farmers WTA (€/ha/year)	EU incentives (€/ha/year)
Minimum	0	103.29
25% threshold value	56.81	
Median	100.71	
Mean	102.35	
75% threshold value	157.52	
Maximum	204.00	245.32

3.2.2. Willingness to accept

Fifty percent of farmers expressed a willingness to accept between 57 and 158 € years/ha for agroforestry plantations; the median was 101 €, which was higher than the median for the whole sample; the distribution is relatively normal.

The expressed WTA was not higher than EU incentives for agroforestry plantation at the time of research (EU rules 2078/92, 2080/92, and now EU rule 1257/99). EU incentives were higher than farmer's expectations for the same kind of activities (hedgerows plantation or reclaim) (Table 5).

Farmers had no problems in answering this question, in fact, the number of WTA and WTP respondents was equal. The mode was coincident with the maximum WTP value proposed, expressed by 18% of the sample (Fig. 1).

Age and educational status did not significantly affect the WTA distribution of the sample, but do show an interesting influence. Excluding categories for which the number of respondents was not sufficient, (graduate = two respondents, <25 years = one respondent) it was found that WTA decreases with age, in particular, for those with a low educational status (Fig. 2). In other words young farmers with higher school training tend to place a higher value on this kind of mixed good.

Farmers with a higher income tended to express higher WTA values, in particular, significantly higher than the WTA of farmers with an intermediate income; farm area (correlated to farm income) was another factor which positively influenced WTA values (Fig. 4), with a slight opposite trend for smaller farms, where part-time agriculture often has a marginal effect on family income and represents more of a cultural

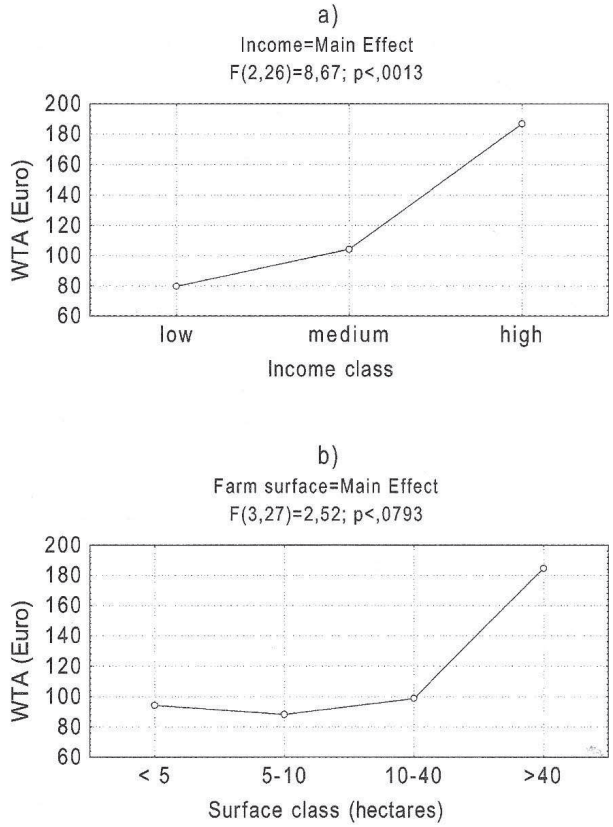

Fig. 4. Plot of the farmers' WTA values vs. (a) income classes, (b) farm surface classes.

than an economic activity. In this case, the mixed good is over-estimated with regards to the agricultural market.

In other cases, registered trends can be largely linked to the progressive marginalisation of plant activities and management of economic flows within the farm business, above all in relation to a modernisation and mechanisation of the activity itself.

Farmers with an intermediate farm (smaller than 40 ha) expressed a mean WTA lower than EU incentives for hedgerow plantations. In all cases, regardless of the farm's income, farmers expectations were completely covered by the EU benefits range (Table 5).

3.3. The functional relations between the contingent values and independent (explicative) variables in the whole sample

None of the multiple linear regression models tested for the three types of CV (WTP, "WTP farmer", WTA) with the explicative variables (socioeconomic and of agroforestry network role) gave significant results. This implies that none of the independent variables can explain the CV variability of the mixed good analysed with a sufficient probability or inference confidence.

3.4. The functional relations between the contingent values and independent (explicative) variables in the non-farmer sample

3.4.1. Willingness to pay

Only WTP values were analysed for the non-farmer sample, because this is not influenced by the error resulting from the margins of uncertainty affecting "WTP farmer" and WTA estimations.

ANOVA analyses suggest that results for the whole sample are not significant, although they become significant if the sample is divided into farmland residents and the others.

The WTP of non-farmer respondents living on farmland is explained by the selected independent variables better than that of the others.

The most significant independent variables selected regard the historical and cultural effects of this kind of plantation on the landscape (improvement of banks management, secondary rural productions, amusement). Less significant variables were represented by more typical agronomic or socioeconomic effects. The cut-off of these variables had a very low influence on the model significance (in terms of variance explained, regression probability and inference robustness) (Table 6).

Regression models selected for non-farmer respondents who do not live on farmland were always less significant than those for farmland residents (Table 6). They were dominated by explicative variables not necessarily linked to the rural world (income, house protection) or only in a general way to it (mushrooms, silver fruits, herbs, firewood). Also the less significant variables were not necessarily linked in a socio-cultural way to the rural landscape, but basically to the relation of hedgerows with private property or landscape aesthetics. In this case too the less significant variables do not substantially increase the inference power of the model.

Table 6
Regression summary of the willingness to pay (WTP) of non-farmers (a) who live on the farmland (b) who do not live on the farmland

	β	S.E. of β	B	S.E. of B	$t(15)$	P-level
(a) Farmland non-faremer respondents[a]						
Intercept			77.70	36.35	2.14	0.05
Secondary rural production (mushrooms, silver fruits, herbs, etc.)	0.52	0.16	10.54	3.27	3.22	0.01
Increase of recreation	−0.49	0.16	−10.84	3.61	−3.00	0.01
Creation of a negative environment for water weed and consequent improvement of banks management	0.46	0.17	9.93	3.70	2.68	0.02
Hosting for pest predators and pollinators	0.38	0.17	9.89	4.38	2.26	0.04
Management costs	−0.31	0.17	−6.40	3.54	−1.81	0.09
Banks protection and consolidation	−0.29	0.18	−6.88	4.39	−1.57	0.14
Machinery hampering	−0.22	0.16	−4.59	3.40	−1.35	0.20
Timber production	0.22	0.17	7.30	5.69	1.28	0.22
Age	−0.17	0.14	−0.71	0.60	−1.19	0.25
	β	S.E. of β	B	S.E. of B	$t(49)$	P-level
(b) Lagoon and city non-farmer respondents[b]						
Intercept			−10.93	19.18	−0.57	0.57
Income	0.42	0.11	0.00	0.00	3.72	0.00
Secondary rural productions (mushrooms, silver fruits, herbs, etc.)	0.45	0.12	6.91	1.92	3.59	0.00
Firewood production	−0.24	0.12	−3.88	1.85	−2.10	0.04
House protection from weather	−0.25	0.12	−3.95	1.99	−1.98	0.05
Limitation on field market	0.22	0.11	3.65	1.91	1.91	0.06
Age	0.19	0.11	0.45	0.25	1.78	0.08
Protection against noise	−0.20	0.12	−2.72	1.62	−1.68	0.10
Landscape aesthetics	−0.17	0.12	−2.77	1.92	−1.44	0.16

[a] $R = 0.84$, $R^2 = 0.71$, adjusted $R^2 = 0.54$; $F(9.15) = 4.16$, $P < 0.007$, standard error of estimate: 40.325.
[b] $R = 0.0$, $R^2 = 0.41140920$, adjusted $R^2 = 0.32$; $F(8.49) = 4.2812$, $P < 0.0006$, standard error of estimate: 34.004.

3.5. The functional relations between the contingent values and independent (explicative) variables in the farmer sample

3.5.1. Willingness to pay

The best regression model estimation for farmers WTP presented the following socioeconomic explanatory variables: total farm area including the number and types of crops, and farm income (Table 7).

Identified relationships can be evaluated qualitatively in the correlation graph. The model computed only using agroforestry role variables was not very significant and included mostly variables linked to the technical and agronomic aspects of agroforestry plantation.

The mixed model was relatively significant, even with inference robustness problems (collinearity, lack of linearity and normality); the explanatory variables selected were related to the farm (total surface and dominant cultivation) or linked to the rural life (honey production, game increase) (Table 7).

3.5.2. Willingness to pay assuming to be a farmer

Models computed for "WTP farmer" were more efficient and were characterised by new explanatory socioeconomic variables, even farm characteristics (percentage of hired farm surface) or personal nature (age and educational status) (Table 8). The model computed only with agroforestry role variables explained only 30% of "WTP farmer" variance, and is dominated by two main variables: machinery hampering (a farm cost) and valuable timber production (maximising of farm benefit).

The mixed model does not improve the robustness of the "socioeconomic model" and maintains the main variables selected in the last two models (farm income, percentage of hired farm surface, machinery hampering, valuable timber production). Other less significant variables selected were of an agronomic nature (windbreak and pollination effect) or of very generic kind (amusement, air pollution protection) (Table 8).

Table 7
Regression summary of the farmers' willingness to pay (WTP)

	β	S.E. of β	B	S.E. of B	$t(23)$	P-level
(a) Socioeconomic variables[a]						
Intercept			72.52	35.85	2.02	0.05
Farm surface	0.71	0.17	2.40	0.59	4.10	0.00
Main cultivation	0.46	0.15	14.98	4.81	3.12	0.00
Number of cultivation	−0.22	0.16	−18.95	13.90	−1.36	0.19
Income	−0.20	0.19	−19.96	19.10	−1.05	0.31
	β	S.E. of β	B	S.E. of B	$t(16)$	P-level
(b) Socioeconomic and agroforestry landscape role variables[b]						
Intercept			−139.52588	124.43801	−1.12	0.28
Farm surface	0.57	0.12	3.15936	66754.0	4.73	0.00
Banks protection and consolidation	0.39	0.12	36.60216	11.76531	3.11	0.01
Main cultivation	0.17	0.13	9.46441	7.25485	1.30	0.21
Honey production	−0.31	0.14	−15.67214	6.79251	−2.31	0.03
Machinery hampering	−0.20	0.13	−11.01326	7.04035	−1.56	0.14
Hosting for pest predators and pollinators	−0.20	0.13	−13.06206	8.74170	−1.49	0.15
Game increase	0.22	0.13	12.46939	7.64832	1.63	0.12
Firewood production	0.15	0.14	7.84525	6.99727	1.12	0.28

[a] $R = 0.76$, $R^2 = 0.58$, adjusted $R^2 = 0.52$; $F(4.23) = 8.1867$, $P < 0.00029$, standard error of estimate: 53.888.
[b] $R = 0.88$, $R^2 = 0.79$, adjusted $R^2 = 0.68$; $F(8.16) = 7.4947$, $P < 0.00034$, standard error of estimate: 78.698.

Table 8
Regression summary of the farmers' willingness to pay in their own farm (WTP farmer)

	β	S.E. of β	B	S.E. of B	$t(21)$	P-level
(a) Socioeconomic variables[a]						
Intercept			56.47	31.46	1.80	0.09
Rent (%)	0.41	0.14	0.33	0.11	2.94	0.01
Age	−0.40	0.15	−18.96	7.25	−2.62	0.02
Farm surface	0.39	0.18	0.59	0.27	2.22	0.04
Main cultivation	0.27	0.14	4.09	2.14	1.91	0.07
Income	0.35	0.18	16.96	8.91	1.90	0.07
Educational status	−0.23	0.16	−15.47	11.00	−1.41	0.17
	β	S.E. of β	B	S.E. of B	$t(20)$	P-level
(b) Socioeconomic and agroforestry landscape role variables[b]						
Intercept			−22.88	23.24	−0.98	0.34
Income	0.43	0.18	20.79	8.91	2.33	0.03
Rent (%)	0.37	0.17	0.30	0.13	2.23	0.04
Timber production	−0.37	0.17	−7.79	3.57	−2.18	0.04
Increase of amusement recreation	0.26	0.17	3.71	2.34	1.58	0.13
Vineyard support	0.18	0.16	2.93	2.60	1.13	0.27
Farm surface	0.20	0.19	0.30	0.28	1.08	0.29

[a] $R = 0.81$, $R^2 = 0.65$, adjusted $R^2 = 0.56$; $F(6.21) = 6.6724$, $P < 0.00046$, standard error of estimate: 24.367.
[b] $R = 0.71$, $R^2 = 0.50$, adjusted $R^2 = 0.35$; $F(6.20) = 3.3665$, $P < 0.01850$, standard error of estimate: 29.361.

Table 9
Regression summary of the farmers' willingness to accept (WTA)

	β	S.E. of β	B	S.E. of B	$t(22)$	P-level
(a) Socioeconomic variables[a]						
Intercept			6.45	26.96	0.24	0.81
Income	0.63	0.16	51.01	12.68	4.02	0.00
Educational status	0.35	0.16	39.39	17.80	2.21	0.04
Number of crops	−0.19	0.15	−13.55	10.97	−1.24	0.23
	β	S.E. of β	B	S.E. of B	$t(24)$	P-level
(b) Socioeconomic and agroforestry landscape role variables[b]						
Intercept			−139.05	64.77	−2.15	0.04
Income	0.61	0.16	51.58	13.70	3.76	0.00
Firewood production	0.32	0.14	7.63	3.36	2.27	0.03
Windbreak effect and improvement of a positive microclimate for crops	0.32	0.16	10.11	4.91	2.06	0.05
Educational status	0.23	0.17	26.29	19.87	1.32	0.20

[a] $R = 0.78$, $R^2 = 0.61$, adjusted $R^2 = 0.55$; $F(3.22) = 11.401$, $P < 0.00010$, standard error of estimate: 41.563.
[b] $R = 0.73$, $R^2 = 0.54$, adjusted $R^2 = 0.47$; $F(4.24) = 7.1806$, $P < 0.00060$, standard error of estimate: 46.515.

3.5.3. Willingness to accept

The socioeconomic model selected for WTA was sufficiently robust (as for "WTP farmer") and was explained by farm income, educational status and number of crops (Table 9). The model computed using only agroforestry role variables was not significant (30% of variability explained) and was characterised by variables linked to its role in the protection of landscapes and the environment. The mixed model presented a lower inference capacity compared to the "socioeconomic model", and was characterised by the socioeconomic variables already selected (farm income and educational status) and by two variables on the agronomic role of agroforestry plantation Table 9.

4. Discussion

4.1. The influence of socioeconomic variables on the contingent values distribution in the sample

4.1.1. The whole sample

Farmland residents expressed a greater WTP than citizen or Lagoon residents, and the frequency of null WTP increases from farmland to the Lagoon. This is a first suggestion that WTP for agroforestry networks increases with socio-cultural identity to the rural landscape.

Income also influences WTP, but this is only significant when considering farmers only, which express the highest WTP amongst all job categories. We would have expected that university students (planning students) would place greater importance on the landscape role of this structure, however their mean WTP value was no higher than that of other categories and significantly lower than that of farmers.

The distribution of "WTP farmer" amongst job classes is very similar to that of WTP (Fig. 1). Considering that this kind of valuation could be easily done only by the farmers, this distribution confirms the interpretative effort of the non-farmer respondents and the validity for comparison purpose of the CV estimate. Moreover, the frequency of the null values was lower than the WTP estimate: this is probably due to the respondents association of the landscape structure "mixed good" (the agroforestry network) to the agriculture activities or to the "landscape of the farmers" more than the landscape intended as common good.

The result that the farmers expressed a higher "WTP farmer" than others is probably due to two reasons: they did not feel penalised by the fact that only their job category was asked to pay for this common (mixed) good, and they place a higher value on a good which they feel is connected to their activities or to their socio-cultural identity.

significantly linked to WTP, rather these can be explained by "farm" socioeconomic variables, in particular, the farm surface area, which is related to farm income (Table 7). So, it is the farm's investment capability which influences the value of this mixed good, that is not really felt as a "shared" good by farmers, but somewhat linked to the farm economic unit. Another explanatory variable is the type of cultivation: the more crops which are not annual intensive, the more the agroforestry good is valued.

Variables concerning the role of agroforestry do not have a strong explanatory capacity, and the ones selected are clearly linked to the role of these systems in the rural landscape (not simply in "a landscape"): game increase, for example, is linked to the heritage of rural people.

The WTP estimation by farmers is based on a coherent evaluation related to their experience as a farmer and in the rural world in general, and is not based on superficial, generic preferences.

As seen in the results, estimation of "WTP farmer" was linked to a real and used land, not to an imaginary one (Table 8). The socioeconomic explanatory variables were linked more closely to farm and farmer details (e.g. hired farm surface, farmer age and educational state) than that selected for WTP. In this case the higher values correspond to younger and more trained farmers, with higher incomes and farm surfaces and with higher risk propensity (e.g. not only mono cultivation).

The agroforestry role variables alone produce a less significant model, dominated by direct (maximise the benefits and minimise the costs) or indirect (protect the farmhouse) farm needs. In the mixed models, agronomic and farm considerations are dominant (Table 8).

Even for "WTP farmer" "the good" is valued (and not simply preferred) by mean of coherent and precise considerations, and, regarding WTP, show a growing weight of personal/farm factors: percentage of farm surface rent, the (farm) income, maximisation of profits (valuable timber).

As seen in the results, the variables that influence the farmers' WTA (Table 9) are different from that of farmers' WTP (Tables 7 and 8). Among the socioeconomic variables the trend of age and educational status is the slightly different of the "WTP farmer". In the latter case, the values diminished with age and then with educational status. Instead WTA is more influenced by the farmer's educational status (with a peak for 26–39 years old) and by the cultivation diversity.

Comparing these results with that of the WTP estimate, it seems clear that evaluations by more entrepreneurial farmers (younger, with a degree and higher income) place a higher value on the provision of a service to society, and not only on the realisation of a useful good (business investment) within their own farm or community: therefore not only is the estimate of the good important, but the good including the service itself.

Even for the poorly significant models estimated with the agroforestry role variables similar differences are detected. In this case, the variables selected are not linked to the farm costs/benefits, but are linked to farmland protection. It seems that in this case too there appears to be a distinction between paying for a personal good and being paid for a service.

Also in mixed models it seems that younger, trained and energetic entrepreneurs are more likely to recognise the value of the service at the farm and landscape scale.

5. Conclusions

The respondents of the Venice municipality associate a positive value to the shared mixed good "agroforestry network", and judge its presence and implementation in the rural landscape ethically correct, but this value/preference is strongly affected by some socioeconomic variables: the perceived value grows with the respondent's identity to the considered rural landscape (defined in terms of residence and job categories) and with economic status (income).

The distribution of the various CV estimates between the job and the residence categories shows that the values expressed assuming they were a farmer are coherent with those expressed as normal citizens, so that estimations are efficient even if non-farmer respondents must make estimations in the absence of real judging parameters. Thus the relationship between WTA and WTP is confirmed (Colletti et al., 1993).

These relations have been useful in investigating respondent's attitudes towards this landscape structure. The role of agroforestry networks are for instance

Even for WTA, the distribution among the job class is very similar to WTP (Fig. 1), and this seems again to confirm the quality of the response effort and the theoretical relationships between the three types of CV estimate. These results are supported by the CV coherence (high values of WTP correspond to high values of WTA and vice versa) with the exception of Lagoon residents who expressed low WTP values in correspondence with high WTA values. In this particular case, the under valuation of the "mixed good" is denoted by the request for a lot of money to make it available to society.

4.1.2. The farmers sample

Both for "WTP farmer" and WTA, the most effective comparison values are those made by farmers, as they are more capable of estimating plantation costs and management. Farmers expressed a higher willingness to pay for the "good" of their own farms (WTP farmer) than they would have paid as a normal citizen (WTP). This is probably due to the feeling of personal investment in addition to the social shared investment, or to a higher value placed on a good they consider as their own, and not common.

It may seem strange that the farmers with greater finances available, which expressed the highest WTP for hedgerows, is the group that expressed the highest contributions for such practices (Fig. 4). This is possibly due to a higher farm value of representatives of this class, which tend to maximise the economic margins on their economic activities.

The higher willingness to pay of smaller farms compared to intermediate farms is probably linked to the differences in economic considerations of part-time farmers. Given that their farms are normally very little, nearby the old family house and this is a rich area, we can suppose that most of part-time farmers consider the crops more as a cultural than an economic fact, and therefore are willing to place a smaller risk/cost for this kind of good.

As expected, the WTA values of farmers is much less dispersed than other job classes. Younger farmers with a higher educational status and larger farm surface area are willing to accept higher compensations, that is those farmers with higher entrepreneurial vigor with a clearer view on the role of offering services to the community that this activity implies, or of the new role (not only productive) that management of agricultural landscapes claims.

In every case the mean WTA value expressed is lower than the EU benefits for these types of activities (plantation and/or restorations of agroforestry systems) at the survey time.

4.2. The functional relations between the contingent values and independent (explicative) variables

4.2.1. The whole sample

None of the regression models estimated for the whole sample give sufficient results in terms of inference significance, so even an explorative utilisation of these models could be wrong.

These results probably are due to the dispersion and statistical noise of the CV data (linked to the judgement uncertainty) and of the different agroforestry role values within and between the different socioeconomic classes. Actually the functional relations significantly increase when considering single socioeconomic categories.

4.2.2. The non-farmer sample

As expected from the ANOVA, the evaluation of "the good" becomes significant if the sample is divided into farmland and non-farmland residents.

As seen in the result section, the awareness (at least of a socio-cultural nature) of the links between agroforestry plantations and rural landscape is clear to farmland residents. In this case the good estimation (WTP) is largely explained by variables that express this cultural heritage (that are only secondarily explicitly agronomic) (Table 6).

Non-farmland residents, on the other hand, have a less clear perception of these complex links, or they have lower cultural awareness concerning these. Actually, the independent variables selected have a weaker explanatory power for WTP, and are linked to very generic aspects of the relationship between agroforestry network and landscape (increase of mushrooms or flowers, landscape embellishment) or to the private property (protection of the house, problems for selling).

4.2.3. The farmers sample

In the result section has been described how none of the "general" socioeconomic variables results are

under-valued in terms of a structure belonging to its own cultural landscape (interaction system between man and territory) by Lagoon residents (low values of WTP, high values of "WTP farmer" and higher values of WTA). All this in a very ancient cultural landscape and in a highly restricted area (radius of 20 km). This attitude of subtle contempt as regards of all belonging typically to farmland, linked to an ancient attitude of Venice citizens (Pianetti et al., 1987; Soriani and Zanetto, 1998; Turco and Zanetto, 1992) has been pointed out in other parts of the research (Mannino et al., 2001; Franco et al., 2001).

The good evaluation increased when some personal (and not shared) investment or benefit factors are apparent, such as farmers estimation of "WTP farmer" and WTA.

It was also reported in the quoted paper that in general all respondents (i) agreed with "best management" practices and/or agroforestry network plantations for optimum landscape management, (ii) declared the willingness to plant agroforestry systems (hedgerow buffer strips) as a farmer, an attitude considered ethically or politically correct by non-farmers and farmers alike. However, these declarations were characterised by a valuing capacity and coherence (that were defined by the dispersion and differentiation of each variable in each socioeconomic categories) that grow with the rural landscape identity (residence, knowledge/experience, direct landscape management).

This non-homogeneous uncertainty among several socioeconomic categories makes it difficult to detect a clear functionality between the CV measures and the explanatory variables in the whole sample, that is instead detect inside the socioeconomic categories that better discriminate the CV.

Non-farmer WTP is driven by identity with the rural landscapes. Those who live there evaluate these landscape structures not simply in terms of a general preference, but in terms of the value several sociocultural heritages and of an awareness linked to ancient hydraulic and rural economy roles, and only secondarily to precise agronomic roles. Non-farmland residents probably tend not to value this heritage (that they are loosing), and their lower preference of the shared good is defined by less clear and specific links to the protection of the property or with a generic landscape make up.

Farmers are the real operators of landscape amelioration by means of agroforestry network plantations, and on the basis of the results of this investigation (e.g. they express higher CV values), twin research (Mannino et al., 2001) and other studies (Cudlìnová' et al., 2000) they are capable of making clear judgements on the linkages between landscape management and agroforestry networks because they are familiar with technical and economic problems related to planting and managing, and they can give the reference values of WTP and WTA.

Various considerations do affect the different types of farmers' Contingent Values, but these are never the same as non-farmer considerations.

The WTP (simply pay a tax like everybody) is driven by economic availability, by the attitude towards cultivation diversity and by the old role of hedgerows in the rural landscape (firewood, banks consolidation, game increase). These reasons are different from those suggested by non-farmers: even as a normal citizen the "shared mixed good" is felt not only as an "ethical object" (in every case linked to a real cost and for this to the income), but as a concrete object belonging to their own cultural and working world.

In the case of the "WTP farmer" and the WTA in the valuation, the personal/farm considerations grow. The estimate is proportional to the farmers' age, training, propensity to risk, business capacity and efficiency. In the particular case of part-time farmers the evaluation of the good is based more on cultural than agro-economic factors, and is over valued with respect to parameters of business vitality.

Moreover the comparisons of WTP and WTA values show that farmers value the good not only as a good (shared or private), but also as a service offered to the community for the management and amelioration of the landscape; and this capacity is linked to farmers' entrepreneurial capacity.

All of this indicated that the new entrepreneurial generation, the main operators of future transformations in the agricultural world, are clearly capable of putting into perspective the value offered by incentives for agroforestry.

This result is particularly significant considering that EU incentives for the implementation of agroforestry networks are higher than the revealed expectations. In the area considered in this study, the success

Table 10
Comparison between (1) the estimated willingness to pay for agroforestry network implementation in the principal socioeconomic classes, (2) the potential agro-environmental social investment due to taxation corresponding to the different WTP values estimated, (3) the social investment estimated for non-point source pollution control obtained by agroforestry buffer plantation in a real planning tool for the Lagoon drainage basin scale (Piano Regionale per il disinquinamento della Laguna di Venezia)

Social class	Willingness to pay for agroforestry plantation	Willingness to pay for agroforestry plantation in one's capacity of farmer	Correspondent community investment for agroforestry implementation based on contingent valuation ((hypothetical tax) × (county families)/(county rural surface))		Estimated cost for agroforestry implementation to reduce non-point source pollution
	WTP (€/year)	WTP farmer (€/ha/year)	WTP (€/ha/year)	WTP farmer (€/ha/year)	
Farmers	75.36	36.55	1811.63	878.65	
Non-farmers who do not live on farmland	39.16	29.34	941.39	705.32	
Non-farmers who live on farmland	28.8	16.62	692.34	399.54	
Mean values	41.23	28.69	991.16	689.70	138.81

of the agro-environmental policy linked to agroforestation (EU rules 2078/92, 2080/92, 1257/99) was very low at the time of survey.

This aspect is not linked to the awareness or the expectations of farmers about the issue, but to other and more trivial problems (redistribution instruments at the local level, activities necessary to carry out bureaucratic practices, misinformation of farmers).

In a twin study (Mannino et al., 2001), it emerged that there is in general little substantial knowledge on the part of citizens, interviewed farmers (who tend to misconceive the problem) and university students on the role of agroforestry networks in controlling non-point source pollution (for a review, see Franco, 2000). Inhabitants of Lagoon landscapes are the most aware of the problems in rivers and Lagoon landscapes, but due to a lack of knowledge and interest do not coherently connect the potential role of hedgerows to non-point source pollution control.

The declared contingent values for this "shared mixed good" by each significantly different socioeconomic category is strongly higher than the estimated expenses for agroforestry implementation by local authorities; in this case for the specific aim of non-point source pollution control (Table 10).

This mean that (i) even if there is sufficient awareness on water quality problems, there is a general and specific (e.g. university students) lack of knowledge on the role of agroforestry buffer networks in non-point source pollution control, (ii) even without this knowledge, the value placed upon agroforestry networks is great enough to permit efficient and supported intervention policies, (iii) in this last case it seems that it could be feasible to shift the role of farmers from mere production to agroenvironmental landscape management, most of all in young, trained end economically efficient operators.

The general results of this research support the criticisms of "CV method" for landscape evaluation, e.g. the evaluation of a public good or environment which is shared by several individuals or communities that try to use it (O'Neill and Walsh, 2000). The first is that the landscape structure examined (the shared good) is simply preferred and not valued by a great part of the sample.

The second is that the shift from "mere preference" to "coherent valuation" of this landscape structure grows in proportion to the identity of the respondent with the rural landscape: at one extreme are the Lagoon citizens, at the other farmland farmers.

These results (i) confirm that landscape choice strongly involves issues of identity, perceived rights and evaluation capacity that cannot be resolved in terms of preference cost benefit analyses (O'Neill and Walsh, 2000; Arler, 2000), (ii) a clever use of the "CV method" allows an identification of these same limitations and a partial estimation of them.

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