The recreational value of forests under different management systems

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Abstract

Forest degradation is a severe threat to the provision of ecosystem services, such as timber production, biodiversity and hydrogeological protection. Forest abandonment is one of the main causes of forest degradation in Mediterranean areas where the low value-added of forest activities affects economic sustainability. This issue requires urgent restoration actions which must be supported by cost-benefit analysis that comprises all forestry activities that generate income, including the recreational ones. In effect, while the impact of forest management systems on timber production is well studied, the impact of recreational values is not. The present article intends to demonstrate that different forms of forest management result in a differing willingness to pay (WTP) for maintaining the recreational use of forests. We collected 248 questionnaires from respondents who confirmed their WTP for the maintenance of the recreational function of forests under three management systems: coppice, active conversion to high forest, and the natural evolution of forests. Moreover, we tested the influence of certain socio-demographic variables on individual WTP. Users elicited a high preference for conversion to high forest, while natural evolution was the least preferred management system.

Moreover, males and users with higher levels of education had a greater WTP for conversion to the high forest approach.

Keywords: forest management, contingent valuation, payment card, random effects interval model.

Introduction

Restoring degraded forests is a critical issue, which deserves attention as degradation processes jeopardize the provision of essential forest services, such as the production of wood and biomass, the supply of non-wood products, watershed protection, and biodiversity conservation (Ciccarese et al. 2012; Schirpke et al. 2014; Jacobs et al. 2015; Ceccarelli et al. 2015). The recognition of the multifunctional role of forest areas has resulted in a growing interest in sustainable forest management (SFM), that is, the way in which a forest is managed in order to prevent degradation, thereby ensuring income-generation activities, sustaining employment and increasing environmental benefits, such as carbon sequestration and clean water. SFM postulates that economic and environmental sustainability must both be accomplished in order to prevent forest degradation. The challenge represented by this twofold goal requires future-oriented monetary cost-benefit analyses of several preventative actions, supported by scientific evidence and knowledge.

Especially in Mediterranean forests managed for firewood production, which are characterized by a very low or negative economic balance, one of the main causes of forest degradation is the abandonment of forest areas. Indeed, timber production is the main income-generation activity, which has several points of weakness, for example, cash flows are delayed over time and (very often) the market price of wood products from these areas is unable to cover the utilization costs. This situation is exacerbated, among other issues, by some peculiar features of the geographic locations of several forest parcels, such as higher steep slopes or inadequate forest road networks, which contribute to rising production costs (Bernetti et al. 2009; Sacchelli et al. 2013). These drawbacks result in very low forest value added. As an example, in Italy, the value added per forest hectare is €41 and, in Spain, it is €75, while the average value added in other EU countries is almost €127 per hectare (Eurostat 2011). Therefore, investigating all factors related to the economic sustainability of SFM applied to forests dedicated to firewood production, is crucial for identifying additional "potential monetary revenue", as well as supporting policy design for contrasting abandonment and generating sound monetary cost-benefit analyses for preventing forest degradation.

In general, the aforementioned management systems mainly have a wood productive purpose, and their effectiveness in sustaining timber production is significantly covered in the literature, as well as their impacts on forest environmental functions, such as soil protection, water regeneration and biodiversity maintenance (Backéus et al. 2006; Riera et al. 2012; Tao et al. 2012; Marinelli et al. 2013; Bottalico et al. 2016). However, scant attention has been devoted to their impact on an additional pivotal forest activity, i.e., the recreational use of forests.

Recreational functions play an important role in contemporary societies and rural economies. According to the State of Europe's Forest report (2015), 90% of forest and other wooded lands were reported as being available for recreational purposes. Moreover, 75% of countries reported that, in 2010, at least 90% of their forest and other wooded lands granted access to the public for recreational purposes. The importance of this function is documented by a huge body of literature (see, among others, Loomis 2005; Zandersen and Tol 2009; Voces Gonzales et al. 2010; Baerenklau et al. 2010).

The current article intends to demonstrate the capacity of management approaches[1] to impact individual WTP for maintaining forest recreational functions, which in turn could open up additional potential revenue streams, as mentioned above, which are useful for economic balance. This hypothesis is supported by Holgén et al.'s (2000) seminal analysis of the relationship between the recreational values of forests and four different silvicultural systems: natural regeneration using seed trees, single tree selection, artificial regeneration after clearcutting, and natural regeneration using advance growth.

[1] *System* and *approach* are used as synonyms in the article.

Our main idea starts with evidence of the strong correlation between territorial planning and the individual behaviour of users (see, among others, Romano et al. 2014; Cozzi 2015; Boncinelli et al. 2015a,b; Riccioli et al. 2016). Moreover, as argued by several scholars (Horne et al. 2005; Nielsen et al. 2007; Bestard and Font 2009; Dhakal et al. 2012; Edwards et al. 2012; Zandersen and Termansen 2013), the demand and preferences for recreational services are directly related to forest site characteristics. These characteristics can include the composition of tree species, mix of stand types, age and health of trees, areas of open land within a forest site and landscape variety, with all these factors directly or indirectly related to forest management treatments. Hence, a specific management model could substantially affect one or more of the aforementioned features.

A specific questionnaire was administrated to a random sample of potential users, who were shown photos to illustrate the selected management approaches: (*i*) traditional coppice; (*ii*) active conversion to high forest; (*iii*) natural evolution of forest management. With the use of a contingent valuation elicitation method (CVM), we confirmed the respondents' WTP for the maintenance of forest recreational activities in the context of the selected management approach. The photographic sets were related to three typical forest management systems, which reflected the most common forest approach found in Italy, namely, the coppice approach. We collected the photographic sets from five sample areas located in Tuscany (Italy)[2]. The potential income related to the recreational value of the forest was quantified through the WTP for the maintenance of forest stands. The conservation of forests using one of the three types of management listed above let to avoid the degradation of selected forests due to abandonment phenomena.

One additional aspect, which previous research has not addressed, is related to the estimation of WTP in relation to forest areas by considering different management forms based on the coppice approach. This management system, compared to the high forest approach, offers less valuable wood (it is essentially firewood). However, the maintenance of this type of management approach has

[2] The areas are related to the LIFE FutureForCoppiceS project, LIFE14 ENV/IT/000514.

positive repercussions at an economic, social and environmental level. Indeed, alongside the benefits resulting from the conservation of high forests (prevention of abandonment, proper water management), the coppice approach provides revenue streams that are less delayed over time and represents a non-fossil source of energy (Nicolescu et al. 2017).

The quantification of monetary value related to recreational function allows us to establish indicators at the political level, by quantifying alternative revenues that could fill the gaps related to current policy strategies, which do not provide sufficient and specific support to forest recreational activities. Moreover, the recreational value of forests to the public also poses difficulties to landowners, firms utilizing forests or other forest associations in taking advantage of these potential resources, since, in most cases, potential users are free to enter. Therefore, they can be compensated by public authorities for maintaining and providing recreational functions.

In sum, the present article intends to demonstrate that different forest management systems result in differing WTP for maintaining the recreational use of forests, such that we are able to identify what has the greater impact in terms of increasing users' recreational value.

Methods and data

Stated preference valuation method

Contingent valuation is a method widely adopted for estimating the economic value of forest ecosystem services (see among other works based on this method, Molina et al. (2016); Voltaire et al. (2017); Kniivila (2006) or Tao et al. (2012)). With the CVM, involving the use of questionnaires and interviews, individuals are placed in a realistic, credible but hypothetical market transaction and asked about their WTP (a sum of money) for a change in the availability of a given good or service or for improving or maintaining the quality of an environmental resource (Voltaire et al. 2017). Based on the concept of consumer welfare, WTP is related to the market price and consumer surplus of a specific good.

Boyle et al. (1996) and Venkatachalam (2004) listed, as the main types of WTP elicitation techniques, the price list, the bidding game, the payment card, and open-ended and single- or double-bounded dichotomous choice approaches. However, combinations of these approaches are possible (Hu et al. 2011). The method used in this article is based on a revised multiple price list method (Andersen et al. 2006), which involves a payment card for multiple choices. In other words, the respondent provides his/her maximum WTP for each forest management system using a monetary range of WTP. Our approach is very similar to that adopted by Alphonce et al. (2014) to estimate consumers' WTP for different food safety regulations by combining a multiple price list with a payment card.

The payment card method has some advantages e.g. the payment card is easy to implement due to a lower cognitive burden for respondents, it shows lower rates of non-response, and the starting point bias is mitigated (Ready et al. 2001; Cameron and Huppert 1989). On the other hand, this method could possibly be affected by range bias, centering bias or end point bias (Mitchell and Carson 1984; 1989). However we choose this method since our respondents were voluntary participants, thus a selection of easy-to-handle and easy-to-understand methods was crucial to avoid a high refusal rate or the failure to complete the survey. Therefore, our methods and survey were determined so as to minimize the statistical burden and completion time.

In our implementation of the multiple price list, respondents with presented with the three different forest management approaches in columns, with the available responses in rows. The respondents had to indicate yes or no for 12 price intervals. The lowest level was €0.00 (no WTP at all), while the highest was €22.00. Each interval was different by €2.00. The elicitations were provided at the same time for each management system by each respondent. In this manner, the respondents could compare them and demonstrate their preferences in a relative framework.

We established the WTP bid range by analysing annual users in case studies in previous works (Bernetti et al. 2009; Sacchelli et al. 2013); in turn, for each user, we calculated an average amount per year, which was required for the optimal maintenance of a forest (about €11 per year). The upper bound was set at twice this value. More specifically, using a classic payment card, the respondents were asked to choose one value that represented their maximum WTP. The WTP of the respondents was then assumed to be located above the chosen value and below the next higher value (when such a value existed).

Questionnaire design and survey

The questionnaire was structured in three sections. The first part asked for the respondents' socio-demographics information, such as age, gender, level of education and occupation. The second part collected the respondents' preferences related to landscape types (not only for recreational use), such as urban, mountainous, rural and coastal landscapes, and typical agricultural and forest landscapes, such as crops, heterogeneous agricultural areas[3], pasture, high forest and coppice. Using a five-point Likert scale (from 1=less appreciated to 5=very appreciated), respondents provided information about their aesthetic evaluation of these typical landscapes in Tuscany. In the third part, each respondent provided his/her WTP for maintaining forests for recreational use under the management approaches observed. The interviewers asked for the WTP for all types of recreational activities (none in particular was specified). We allowed the respondents to freely express their favourite forest activity. The respondents disclosed their elicitations after they received information about the three different forest management approaches. The hypothetical scenario included a supplement to income tax at a regional level, that is, the payment method with which we expected them to pay for maintaining the recreational value of the forest area.

We illustrated the management systems to the respondents using photographs in order to strengthen the reliability of answers, given that, as noted by Scarpa et al. (2009), verbal descriptions are subject to individual interpretation and past experience. We photographed examples of each management system in five sample areas located in Tuscany (with a total of 15 pictures). The pictures

[3] Heterogeneous agricultural areas are considered as temporary crops associated with permanent crops, cropping systems, and particle complexes. Areas are predominantly occupied by agricultural fields with significant natural areas and areas of agricultural woods.

were captured during the same season, i.e., the spring of 2016. The respondents received a random set of three pictures, one for each management system (Figure 1). This experimental procedure was followed to avoid imposing specific preferences for a particular area. The selected areas were located in three provinces in Tuscany (Figure 2): Alpe di Catenaia and Valtiberina (Province of Arezzo), Alberese and Colline Metallifere (Province of Grosseto), and Caselli (Province of Pisa).

A pilot test was carried out to ensure that the questionnaire was clearly and properly worded. The pilot was conducted between May and June 2016 in the University of Florence during the delivery of masters courses in forest science. A total of 30 students participated in the pretest stage, with the questionnaire modified according to the issues that emerged. The final questionnaire was administrated to forest users in Tuscany by professional interviewers in a face-to-face interview between July and September 2016. We obtained 248 valid questionnaires. Descriptive statistics of the sample are described in Chapter 3.

Econometric model

A straightforward analysis of WTP, obtained by the payment card approach, is to simply regress the stated card values on different explanatory variables. Cameron (1987) showed that this form of hedonic analysis is generally inefficient and ignores the important notion that the chosen card values only reflect the lower bound of a respondent's WTP. Considering this, we modelled the WTP in relation to a random-effects interval data regression model, which takes into account that data are recorded in intervals; hence, the true unobserved respondents' WTP lies in the known interval. The general assumption behind this model, as noted by Tian et al. (2011) and Cameron and Trivedi (2005), is that a respondent's WTP is located randomly between the chosen value and the next larger value on the payment card. Moreover, a random-effects analysis allows for inference about the population from which the sample is drawn.

Therefore, considering that the elicitation of WTP was obtained by using monetary intervals, the estimation of WTP was based on a random-effects interval data regression model. With C as coppice, H as conversion to high forest and E as natural evolution, along with coppice set as the baseline, Equation 1 shows the model.

$$WTP_{ij} = \alpha + \gamma_1 E + \gamma_2 H + \varepsilon_{ij} \tag{1}$$

where WTP_{ij} is the dependent variable (WTP) of *i-th* respondent related to *j-th* forest management system, α is the intercept, and γ_1 and γ_2 are the estimated coefficients, i.e., the WTP difference between the three forest management approaches. *E* and *H* are the effect-coded dummy variables representing the natural evolution and high forest management systems, respectively, while ε_{ij} is the error term. To account for the random effects, we spilt the residual ε_{ij} into two components. The component ζ_i is specific for each subject and constant for each *j-th* forest management system, and the idiosyncratic component ξ_{ij} is specific to each *j-th* forest management system for each *i-th* respondent. We then obtain the following model:

$$WTP_{ij} = \alpha + \gamma_1 E + \gamma_2 H + \xi_i + \xi_{ij} \tag{2}$$

As stressed by Rabe-Hesketh and Skrondal (2012), ζ_i is the random deviation of *i-th* respondent to the overall mean and is often called a random intercept, which represents individual differences due to the respondent features not included as covariates in the model. The random intercept ζ_i has variance σ_u, interpretable as between-subject variance, while the residual ξ_{ij} has variance σ_e, namely, within-subject variance. The proportion of the total variance between subjects is called interclass correlation or ρ, which expresses how much of the total variability is explained by subjects.

A secondary objective of this research is to test which individuals' socio-demographic characteristics influence the WTP for forest management systems. Indeed, several studies have demonstrated a strong correlation between the value of recreational forest activities and the characteristics of users. For example, Walsh (1984) observed that young people are more attracted to forest activities. In addition, cultural level is positively related to recreational activities. Chaudhry et al. (2007) found a correlation between professional jobs and the WTP for an environmental fund. On the topic of forest conservation, Lockwood et al. (1993) and Pouta et al. (2000) observed that older people are often found to have a lower WTP than others. Kniivila (2006) confirmed this claim with a conservation analysis, finding that older people (mainly belonging to the male gender) generally have a lower WTP. Tao et al. (2012) states that education and income are the most important determinants in terms of whether or not respondents are willing to pay for forest protection. Tempesta and Thiene (2006) reported the same findings, in that a lower title degree and a lower income are both correlated with lower WTP. Zandersen and Termansen (2013) observed, as prosperity and average incomes increase, individuals are more willing to spend on leisure and recreational activities in forests. Based on the above-mentioned literature, the hypothesis of this paper originates from the following: the characteristics of being older in age and being male will have a negative impact on WTP, while being more educated and having a higher income will have a positive impact on WTP.

Therefore, a second model was used in order to test the relationship between WTP and socio-demographic factors. Eight combinations were tested: four socio-demographic variables, namely, age, gender, education and occupation (where occupation was used as a proxy for income), and two forest management approaches, namely, conversion to high forest and natural evolution of forest (coppice was set as the baseline approach). Hence, on introducing the socio-demographic variables, Equation 2 is rewritten as follows:

$$WTP_{ij} = \alpha + \gamma_1 E + \gamma_2 H + \sum_{c=1}^{C} \beta_{ec} \cdot (d_{ic}) E_{ij} + \sum_{c=1}^{C} \beta_{hc} \cdot (d_{ic}) H_{ij} + \varepsilon_{ij}$$

(3)

where d_{ic} equals the *c-th* socio-demographic explanatory variable of the *i-th* respondent, $d_{ic}E_{ij}$ and $d_{ic}H_{ij}$ are the interaction variables between socio-demographic factors and forest management approaches, and β_{ec} and β_{hc} are the coefficients of the interactions terms.

Case study

Tuscany is located in the centre of the Italian peninsula (Figure 2). The territory is mostly hilly (66.5%) with some plains (about 8.4% of the territory) and major mountain ranges (25.1% of the region). The climate is characterized by an average annual temperature of around 16°C, with annual rainfalls of around 600-700 mm. Tuscany is covered by 1,151,000 ha of forests, representing 50% of the total area of the region (2,300,000 ha). Forests are largely composed of oak species (turkey oak, pubescent oak and evergreen oak). Broadleaf species represent 38% of the total forest area (about 414,000 ha). The most popular forest management system is coppice, which is applied to 725,000 ha (63% of total forest), while high forest covers 207,000 ha (18% of the total broadleaf forest) (INFC 2005).

Results and discussions

The sample of 248 respondents was almost equally composed by males and females. Concerning the age variable, the most representative group is the cohort younger than 35 years old (40% of the sample) following by the respondents aged between 35 and 50 years. Better educated participants was well-represent in the sample. Most of the participants are workers (30%) or students (29%). Our sample, compared to the overall population in Tuscany, shared similar statistical details (ISTAT 2016). Indeed, the Tuscan population comprises over 3.7 million inhabitants (48% male and 52% female), with 31% made up of young people (aged under 35 years), and 22% and 21% respectively aged between 35 and 50 years and between 51 and 65 years. Employed people (including self-employed) represent 42%, while unemployed people equal 9.5% of the total inhabitants in Tuscany.

The results from the questionnaire concerning preference towards a landscape in Tuscany (Table 1) show that a mountainous landscape received the highest rating, with a percentage equal to 69% of answers assigning scale values equal to 4 and 5 on the Likert scale. Respondents rated a coastal landscape with a maximum value of 65%, followed by a rural landscape (42%) and an urban landscape (6%). In addition, the Likert scale was used to analyse the respondents' answers concerning the aesthetic degree of agricultural and forest landscapes. High forest received the highest rating with a percentage equal to 75% (4 and 5 on the Likert scale), while coppice received the second highest percentage (65%). This information was useful in highlighting the respondents' degree of knowledge and appreciation in relation to forest areas. The respondents' choices reflected a high degree of importance to forests and emphasized how WTP values are given conscientiously. Heterogeneous agricultural areas revealed a percentage equal to 48%, followed by pastures (35%) and crops (25%).

A general analysis of WTP related to the three different forest management approaches can be performed simply by using the frequencies of WTP elicited for them. Figure 4 indicates that natural evolution received a large number of 0 values for WTP, while conversion to high forest prevailed as the favourite management system for respondents with higher levels of WTP. When analysing the simple means of the respondents' WTP, conversion to high forest attracted a WTP equal to €8.64 per person per year, followed by coppice (WTP equal to €7.44 per person per year) and natural evolution (WTP equal to €6.52 per person per year).

In order to test the differences in WTP for forest recreational functions under different management systems, a random-effects interval data regression was performed following the model in Equation 1. The results are given in Table 2.

The results show significant differences between the WTP values for coppice and evolution to high forest, as well as between coppice and natural evolution of forest. The constant coefficient, €6.37, reflects the grand WTP mean (the mean of all management systems for all respondents). The highest WTP was given to evolution to high forest (€7.60 per year), while respondents gave a lower WTP for natural conversion (€5.18 per year). This is likely due to the fact that natural evolution is perceived as impenetrable scrub, while coppice is less appealing (from an aesthetic point of view) due to frequent forest maintenance activities (i.e., thinning). The rho value is equal to 53%. This reveals that, despite a great heterogeneity of subjects, a large part of the variance results from the differences across panels, i.e., the management systems. This confirms the existence of differences in users' WTP for forest recreational value according to the management systems.

In the second phase, the effects of socio-demographic variables on WTP were evaluated. As mentioned above, we wanted to test whether certain socio-demographic groups have different levels of WTP for each forest management approach. The results are shown in Table 3. As in the previous model specification, the results show that significant differences occur between WTP values for coppice and evolution to high forest, and between coppice and natural evolution of forest. In this case, the highest WTP was given to conversion to high forest (€7.85 per year), followed by coppice with a WTP equal to €6.47. Respondents gave a lower WTP for natural conversion (about €5.00 per year). These results are similar to those reported by Zandersen and Richard (2009), while a review of several studies in Europe indicate that forest recreation values range from €0.66 to €112 per trip with a median of €4.52. Of the eight combinations of socio-demographic variables and forest management systems tested, only two combinations were seen as statistically significant predictors of WTP with a 95% confidence level, i.e., the degree of education and gender influenced WTP for conversion to high forest. Female users had a lower preference compared to males for natural evolution of forest. Meanwhile, educated individuals had a greater WTP for the recreational use of naturally evolved forest. Whether socio-demographics factors only impact WTP in the case of conversion to high forest is unclear from our data.

Despite the particular nature of our research goal, the results obtained concerning the determinants of preference are consistent with the results of similar studies. Management systems influence not only timber production but also the recreational value of a forest. In our work, women's evaluation had a negative influence on WTP, which differs from the results observed by Kniivila (2006). However, as stated by Ressurreicao et al. (2011), the impact of gender on WTP for natural resources is uncertain because the literature on this topic is mixed (Berrens et al.997; Bord and O'Connor997; Brown and Taylor 2000; Birol et al. 2006). Having a higher level of education had a positive influence on WTP, which is consistent with the observations of Tempesta and Thiene (2006) and Tao et al. (2012).

Other combinations of management systems and socio-demographics characteristics had no effect on WTP. However, our findings are in line with other studies on environmental goods, such as Cameron and Englin (1997) or Ressurreicao et al. (2011), i.e., the variables of age, education and occupational status were not statistically significant.

Conclusions

To limit degradation phenomena, forests need appropriate sustainable management systems that consider different socio-environmental contexts and, in particular, economic sustainability. Therefore, when investigating the impact of the adoption of a specific system on all potential forest sources of income, it is critical to consider timber production and recreational use. As described in Chapter 1, several researchers have studied the relationship between management systems and timber production. However, very little is known about the impact of a specific system on recreational value. In particular, the novelty of the present article is the attention paid to different forest management approaches involving coppice. Considering the widespread application of the coppice approach in Europe (about 23 million ha in the Mediterranean area and about 8.5 million ha in EU countries facing the northern rim (Forest Europe 2015)), our findings could provide data and information useful to improve the design of several environmental policies.

In this article, the monetary quantification of the recreational function could be considered an additional income stream (to timber production) to supplement income tax on a regional scale. Thanks to a regional tax, public administrations could provide economic support to landowners, firms utilizing forests or other forest associations in supporting the sustainable management of coppice.

Our findings have established that the aforementioned management systems influence not only the supply of fuelwood, but also forest recreational value. The WTP analysis has revealed that natural evolution produces lower revenues than conversion and traditional coppice approaches. However, this low recreational value could be widely compensated by lower management and administration costs. That said, this management system could lead to abandonment phenomena with related environmental problems, such as less efficient water management and increased susceptibility to fires.

We can observe that the utility function of users is affected by elements, which in turn are influenced by the forest management systems analysed. It is important to keep in mind that this paper mainly investigates the use value of forest resources. This is because many respondents have a direct relationship with the estimated good resulting from recreational functions. However, the fact that some of the interviewees (e.g., housekeepers, retired people) expressed a non-use value for forest recreational functions cannot be ignored.

Investigating the recreational aspects, in the course of analysing the responses from potential forest users, we identified a forest user's profile. Indeed, the statistically significant user's profile, which refers to a male user with a high level of education, reveals a higher WTP for the conversion to high forest approach. This type of information could help stakeholders to direct future planning actions using the preferences of this particular user segment in terms of their WTP for recreational functions.

The evidence that men have a greater WTP than women could be related to the fact that male users usually perform activities in the forest that women do not normally enjoy, such as mountain biking, hunting and mushroom picking. Instead, the high level of education could lead to the organization of innovative activities in the forest, such as recreational activities for children, psychopedagogical pathways, culinary initiatives related to non-wood products, and concerts and book readings).

Some issues that could be included in future research are represented by the characteristics of the examined landscapes (in term of forest types, composition, i.e., the size of parcels, density, distribution, age of tree species) and their connections with human activities (e.g., road network density, distance/proximity from/to agricultural crops). These factors contribute to forming a varied landscape that is more attractive than a homogeneous one, although they were not included in the present analysis because WTP was mainly examined in terms of the impact of different forest management systems on recreation activities, regardless of the aesthetic characteristics involved.

Inevitably, WTP estimates could be influenced by certain distortions related to the CVM. Kula (1994), Venkatachalam (2004) and Hu (2006a,b) identified several concerns related to the psychological attitude of respondents and the description of hypothetical markets. For example, as respondents often have limited knowledge of the topic under investigation, they may be indirectly influenced by the interviewer. Some distortions can be related to misunderstandings, resulting in respondents attributing a generic value to the good in question. Moreover, the non-commitment distortion concerning the hypothetical market results in respondents' tendency to overestimate their WTP.

An additional concern of the present study could be related to the photographic set used to represent each forest management approach. As argued by some authors (Roth 2006; Acar and Sakici 2008; Wang et al. 2016), the subjectivity (angle and position of shooting, camera model, etc.) related to photos can influences users' preferences. We tried to mitigate this bias by using a photographic set shot during the summer, with the images taken by entering into the forest, as well as randomizing the presentation for the respondents. Moreover, in order to create a homogeneous photographic set, the photos were taken with a clear sky, approximately in the early hours of the afternoon in order to ensure the same solar angle for each shot.

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Table 1 - Descriptive statistics for variables

Variable	Description		Mean	SD
Typical landscape	Likert scale from 1= less appreciated to 5 = very appreciated	a) Rural landscape	3.27	1.10
		b) Mountainous landscape	3.95	1.01
		c) Coastal landscape	3.99	0.94
		d) Urban landscape	1.83	0.97
Agricultural and forest landscape	Likert scale from 1= less appreciated to 5 = very appreciated	a) Crops	2.65	1.20
		b) Heterogeneous agric. areas	3.46	1.01
		c) Pasture	2.91	1.21
	Likert scale from 1= less appreciated to 5 = very appreciated	d) High forest	4.12	0.97
		e) Coppice	3.74	1.09
WTP	Values in the payment card (interval values from 0 to 22 euros per year)	1) Coppice	7.44	5.13
		2) Conversion to high forest	8.64	5.31
		3) Natural evolution	6.52	5.66

Table 2 - Random-effects interval data regression of forest management systems

Variables	Coef.	Std. Err.	p-values
Conversion to high forest	1.23	0.20	0.000
Natural evolution	-1.19	0.21	0.000
Constant	6.37	0.30	0.000
σ_u (Standard deviation of individual effect)	4.08	0.25	0.000
σ_e (Standard deviation of residual)	3.84	0.16	0.000
ρ (Interclass correlation)	0.53	0.04	
Log likelihood	-1644.28		
Wald $Chi^2(10)$	46.70		0.000
Observations	744		
Respondents	248		

Table 3 - Random-effects interval data regression with socio-demographic explanatory variables

Variables	Coef.	Std. Err.	P>|t|
Conversion to high forest	1.48	0.35	0.000
Natural evolution	-1.38	0.36	0.000
Age*conversion to high forest	-0.63	0.70	0.368
Age*natural evolution	0.72	0.71	0.310
Gender*conversion to high forest	-0.85	0.41	0.035
Gender*natural evolution	0.76	0.41	0.065
Education*conversion to high forest	1.28	0.54	0.017
Education*natural evolution	-0.91	0.55	0.096
Occupation*conversion to high forest	-0.09	0.43	0.832
Occupation*natural evolution	-0.14	0.43	0.753
Constant	6.37	0.30	0.000
σ_u (Standard deviation of individual effect)	4.10	0.24	0.000
σ_e (Standard deviation of residual)	3.79	0.15	0.000
ρ (Interclass correlation)	0.54	0.04	
Log likelihood	-1637.59		
Wald Chi^2 (10)	61.01		0.000
Observations	744		
Respondents	248		

Figure Captions

Fig. 1 Example photos of forest management systems taken in Caselli: panel a) coppice; panel b) conversion to high forest; panel c) natural evolution of the forest

Fig. 2 Sample areas from the photo collection

Fig. 3 General statistics on respondents

Fig. 4 Frequencies of WTP