

# Using the life satisfaction approach to economically value the health and wellbeing benefits of forest and green space visits in Italy

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## ABSTRACT

Despite increasing attention and growing evidence of the health benefits of spending time in forests and green spaces (GS), very few studies have attempted to place an economic value on these benefits. The life satisfaction approach represents a promising method of non-market valuation that could capture holistically the health and wellbeing benefits of such environments. Employing primary data from a representative sample of 1400 respondents in Italy, we present value estimates from the life satisfaction approach and the well-established contingent valuation method. We find that visiting forests and GS at least once in the past year is associated with higher life satisfaction. Using the marginal rate of substitution between income and forest/GS visits, our results indicate that an additional €11,171 in annual income would increase life satisfaction by the same amount as visiting forests/GS in the past year. This value is complemented by estimates of stated willingness to pay (WTP) from the same sample using the contingent valuation method. WTP per forest/GS visit is estimated as €18 and aggregate annual values are calculated based on visit frequency. Results from both methods complement each other, providing estimates of both experienced and decision utility, offering more comprehensive information to policy and decision makers. Both methods indicate that forests and green spaces are important contributors to health and wellbeing, associated with significant economic values. This is the first paper to use the life satisfaction approach to value the benefits of forest and GS visits in Italy, making an important contribution to the literature.

## 1. Introduction

Forests, trees and green spaces provide a variety of important services that benefit human well-being (Kindler, 2016; Primmer et al., 2021). From climate change mitigation and the provision of raw materials to offering spaces for recreation, these environments hold immense potential to enhance human well-being in numerous ways. Global trends such as urbanisation, and the rising prevalence of lifestyle-related non-communicable disease and mental distress has increased the awareness of the potential of forests to have a positive impact on human health (Meyer and Botsch, 2017). A wealth of literature now demonstrates the therapeutic effects of spending time in forests and more generally green spaces (GS), highlighting how these environments, through a variety of pathways, affect our physical, mental, social, and spiritual well-being (e.g., Dodev et al. (2020); Karjalainen et al. (2010); Nilsson et al. (2011)). Understanding these potential benefits is crucial for the development of

appropriate policies to optimise their provision (Frumkin et al., 2017), including human health as a recognised forest ecosystem service (Konijnendijk et al., 2023). In this regard, economic valuation is an important tool as it is comprehensible to policy-makers and can aid in the integration of these values into decision making (Vilá et al., 2022). To date, there is limited research translating these observed health benefits into monetary values (Chen, 2020; Hinde et al., 2021; Konijnendijk et al., 2023; Mann et al., 2024), while the ecosystem services literature itself fails to adequately acknowledge these therapeutic benefits (Chen et al., 2019; Frumkin et al., 2017). While some attempts have been made (Buckley et al., 2019; Henderson-Wilson et al., 2017; Saraev et al., 2021), our understanding of the economic value of the health and wellbeing benefits derived from forest visits remains limited and incomplete, particularly in the Italian context, where there is growing interest in the general topic (Visintin et al., 2024) and in forest therapy (Meneguzzo and Zabini, 2022). These benefits are often less intuitive

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and harder to quantify in comparison to the biophysical benefits (Donovan, 2017). This is in part attributed to their non-market and public good characteristics, meaning that individuals cannot (easily) be excluded from consuming them (non-excludability) and that many individuals can benefit from the same good without diminishing the ability of others consume it (non-rivalry) (Amacher et al., 2014). As a result, market prices do not usually reflect the true health value of visiting these spaces, often undervaluing them (Hanley et al., 2009). This could lead to inefficient forest policies that do not fully recognise the benefits of providing these services (Donovan, 2017; Mann et al., 2024). In such cases, non-market valuation is often necessary. Several non-market valuation methods have been developed by economists to estimate the monetary value of non-market and public goods such as ecosystem services, based on stated or revealed preferences (such as (Bartczak (2015); Scarpa et al., 2000) and Paletto et al. (2024)). However, despite many years of methodological advancements and hundreds of studies, there is still no consensus on the most effective or reliable technique, and each method features various shortcomings (Ambrey and Fleming, 2011).

Using data from a primary survey of a representative sample of Italian citizens, this paper: (1) applies an alternative and promising non-market valuation method, i.e., the Life Satisfaction approach; (2) applies a conventional Contingent Valuation method; and (3) provides insights from both methods for decision and policy makers. This paper aims to contribute to both theory and practice through the following key aspects. We contribute to the scant literature on the economic valuation of the health and wellbeing benefits of spending time in forests. We apply the LS approach for the valuation of non-market goods, advancing methodological developments in the field of forest ecosystem service valuation (Marta-Pedroso et al., 2014). To the best of our knowledge, this is the first attempt to value these benefits in Italy using this approach. Additionally, we provide evidence to policymakers on the value of forest ecosystems' contributions to public health and wellbeing. The paper is structured as follows: the methodology section describes the data collection and the evaluation methods employed. The results section presents the models and value estimates from the LS and CV methods. The discussion section presents reflections on both methods. Lastly, our key findings are summarised in the conclusions section.

## 2. Methodology

### 2.1. Data collection

Data was collected using an online questionnaire in November 2024. The questionnaire was developed and tested by the authors, while the data collection was implemented by a professional market research company ensuring a representative sample of the Italian population and anonymity according to data protection laws. The questionnaire was structured as follows: The first section asked respondents if they had visited forests or green spaces (GS) over the past year. Respondents who reported no visits to forests or GS were directed to the final section of the survey, while those who indicated visitation proceeded to the second section. The second section collected information from visitors regarding the frequency and characteristics of their visits and presented the WTP exercise. The third and final section collected information on respondents' subjective wellbeing and other socio-economic and demographic factors. Following best practice guidelines (OECD, 2013), the life satisfaction question was posed before any other sensitive questions, such as health or income, to reduce the chances of biased answers. Respondents were asked to state their current life satisfaction on an 11-point scale with the following question:

*“All things considered, how satisfied are you with your life as a whole nowadays? Please answer using this card, where 0 means extremely dissatisfied and 10 means extremely satisfied.”*

Subsequently, we asked respondents additional demographic and socio-economic questions. Respondents' income was collected based on

their selection from a range of proposed income classes, adjusted to the Italian context. Following the literature (Hudson et al., 2019; Jones, 2021) we converted this categorical income variable into a continuous one by using the midpoints of the income intervals, aiming to reduce any potential biases from measurement error.

### 2.2. Sample characteristics

In total, the questionnaire was answered by 1400 individuals from a representative sample of the Italian population in terms of age and gender. The North-East Italian regions of Veneto and Friuli Venezia Giulia were over-sampled, and hence all data was weighted to ensure representativeness of the sample. Regarding the frequency of forest/GS visits, 16.6 % of respondents reported no visits in the 12 months previous. The largest group of respondents (26.67 %) reported visiting 'often,' defined as once or twice a month. Both annual and monthly income had a high level of missing data (16 %). Among those who provided income information, the mean annual income was €28,703.88, which is slightly lower than the national average of €32,450<sup>1</sup> per annum (OECD, 2023). In terms of gender, our sample was representative, with 48 % being male (ISTAT, 2025a). Similarly for age, our sample is representative of the adult Italian population when compared to national statistics with 21 % aged 18–34, and 27 % over 65 (see Table 1). Unemployment is slightly higher in our sample than national statistics (8 % compared to 6 %) (ISTAT, 2025b). Our sample is more educated with 35 % having a university degree compared to the national average of 20 % (EUROSTAT, 2025).

### 2.3. Evaluation methods

In valuing public goods such as ecosystem services deriving from forest visits (e.g., health and well-being), Stated Preference (SP) methods estimate monetary values by asking people to state their preferences about hypothetical contingent markets through survey questions (Champ et al., 2003). On the other hand, Revealed Preference (RP) methods extrapolate a value from revealed behaviour in existing markets taken as a complement or substitute for the non-market good. SP methods are a popular choice, being theoretically capable of estimating both use and non-use values. While SP techniques are thought to effectively capture values for familiar goods or single impacts (Li et al., 2019), they may fall short when assessing more complex, non-material goods. For example, the health benefits of forest visits stem from a complex network of interrelated pathways that collectively impact wellbeing. In such cases, it may be difficult for SP methods to capture this value. Similarly, RP methods rely on different assumptions, such as market equilibrium, which may not always hold.

#### 2.3.1. The life satisfaction approach

The Life Satisfaction (LS) approach (also known as the experienced preference method) represents a relatively new alternative and promising method for environmental and non-market valuation. Building on recent developments in subjective wellbeing (SWB) research in economics and based on two key assumptions: (1) that SWB can act as an empirical estimate for individual welfare, and (2) that environmental amenities are among the factors that contribute to quality of life, this method extracts an implicit WTP for environmental goods. This approach avoids some of the primary criticisms of SP and RP methods. It is less of a cognitive burden for respondents and reduces the risk of strategic answers that plagues SP methods (Frey et al., 2010; Tsurumi and Managi, 2015). When compared to RP techniques, the LS approach does not rely on the strict assumption of market equilibrium or perfect information. Notably, it is suggested that this approach may be particularly suitable in estimating the welfare consequences of health impacts

<sup>1</sup> 2023 figures.

**Table 1**  
Details of variables used in the estimation of the life satisfaction model and WTP analysis from the contingent valuation scenario (source: own elaboration).

Variable	Definition	Mean /prop	sd
<b>Continuous variables</b>			
Log income	Natural log of yearly income	10.04	0.738
<b>Categorical variables</b>			
Life satisfaction	Life satisfaction scores on a scale of 0–10	6.71	
GS visitor	1 if visited forests/GS in last year, 0 otherwise	0.83	
Male	1 if male, 0 if female	0.48	
University degree	1 if university degree, 0 otherwise	0.35	
Married	1 if married/in a civil partnership, 0 if single/widowed/divorced	0.63	
Good health	1 if in good health, 0 otherwise	0.57	
Carer	1 if informal carer for friends or family, 0 otherwise	0.32	
Social contact with friends	1 if in regular contact with friends, 0 otherwise	0.72	
Social contact with family	1 if in regular contact with family, 0 otherwise	0.88	
Satisfied with house	1 if satisfied with home, 0 otherwise	0.74	
Living in rural area	1 if living in rural area, 0 otherwise	0.21	
Local area safety	1 if respondent believes local area is safe, 0 otherwise	0.66	
Child under 16	1 if child under 16 in household, 0 otherwise	0.24	
Forest satisfaction	1 if satisfied with frequently visited forest/GS, 0 otherwise	0.65	
Age	Age of respondent according ranges		
18–34	Respondent is aged 18–34	0.21	
35–49	Respondent is aged 35–49	0.23	
50–65	Respondent is aged 50–65	0.29	
over 65	Respondent is aged over 65	0.27	
Employment	Current occupation		
	Employed	0.55	
	Unemployed	0.08	
	Student	0.03	
	Retired/don't work	0.33	
GS visits	Frequency of forest/GS visits in last year		
	No visits	0.17	
	Rarely (once or twice)	0.09	
	A few times (once every 3–4 months)	0.24	
	Often (once or twice a month)	0.27	
	Very often (several times a month)	0.17	
	Frequently (several times a week)	0.06	
	Everyday	0.02	

Note: sd = standard deviation; prop = proportion, figures rounded to two decimal points.

(Frey et al., 2010). This method can capture externalities affecting individual welfare, even those unrecognised by the individuals themselves, as it indirectly derives an implicit WTP rather than a direct WTP from responses to hypothetical scenarios or observed market behaviour. In the context of forest and GS, and the multiple and overlapping ways in which these spaces contribute to human health and wellbeing, the LS approach may be particularly relevant (Frey et al., 2010; Jones, 2021). Thus far, it has been less frequently applied than conventional SP and RP techniques. However, interest is growing and it has been applied to value various environmental goods such as green space (Ambrey and Fleming, 2014a; Kim and Jin, 2018; Tsurumi and Managi, 2015; Watt et al., 2018), air quality (Ahumada and Iturra, 2021; Levinson, 2012; Welsch, 2007), scenic amenity (Ambrey and Fleming, 2011), and protected areas (Ambrey and Fleming, 2012).

In practice, the LS approach utilises data from SWB surveys and estimates a micro-econometric model where SWB (most commonly represented by overall life satisfaction), is a function of socio-economic and demographic characteristics, supply of environmental amenity (in this

case forest and GS visits), and other control variables. By assuming that life satisfaction is a proxy for individual utility, the marginal utility of forest and green space visits, and the marginal utility of income can be measured.<sup>2</sup> Therefore, the trade-off ratio or marginal rate of substitution (MRS) between income and forest and GS visits can be derived. In this case, assuming that forest/GS visits contribute positively to life satisfaction, we calculate the equivalent variation (EV), i.e., the amount of income needed to keep individual utility constant for a change in forest/GS visits (Ferreira and Moro, 2010; Fujiwara et al., 2011). The EV represents the monetary value for forest and GS visits. Regarding the interpretation of life satisfaction scores, there seems to be a lack of consensus in the literature whether they are cardinal or ordinal in nature (de Vries et al., 2023; Frey et al., 2010). The majority of studies interpret life satisfaction scores as cardinal, following evidence from (Ferrer-i-Carbonell and Frijters, 2004) indicating that both ordinal and cardinal interpretations yield comparable results and that the cardinal interpretation of OLS coefficients is more intuitive. The ordinal measure assumes that life satisfaction is a continuous and latent personal variable that is only observed in discrete intervals, and probably better reflects the data generating process. Given the ordinal nature of the life satisfaction scores that comprise our dependent variable, it is more appropriate to use an ordered model for the life satisfaction regression. The WTP calculations depend directly on the estimated coefficients, and hence the choice of model is critical (Manning et al., 2016). However, as additional robustness checks, we also estimated ordered logit and OLS regressions, which yielded reasonably similar results (see supplementary materials). Therefore, we estimated different versions of the following function:

$$LS_i = a + \beta_1 \ln(Y_i) + \beta_2 G_i + \beta_3 X_i + \varepsilon_i \quad (1)$$

Where  $LS_i$  is the life satisfaction score of individual  $i$ ,  $\ln(Y_i)$  is the natural log of the respondent's income (accounting for diminishing marginal return of income on life satisfaction),  $G_i$  is a dummy equal to 1 if an individual visited forests/GS in the last year and 0 if they never visited,  $X_i$  is a vector of explanatory demographic and socioeconomic characteristics, and  $\varepsilon_i$  is the error term. We employed an aggregated dummy variable for forest/GS visits as this allowed us to calculate a single coefficient for the MRS between income and forest/GS visits.<sup>3</sup> A monetary value for a marginal change in  $G_i$ , i.e., moving from a non-visitor to a visitor of forest or green spaces, can be valued using the model in Eq. (1). This change can be valued by a change in income ( $Y_i$ ) if this holds individual well-being constant. By taking the average correlation with LS of moving from a non-visitor, to a forest/GS visitor,  $\beta_2$  and combining it with the income coefficient  $\beta_1$ , we can monetise the change in LS attributed to forest/GS visits using the MRS. Setting  $\partial LS = 0$  (holding life satisfaction constant) we fully differentiate Eq. (1) and solve for the MRS between income and forest/GS visits obtaining:

$$MRS = - \frac{\frac{\partial LS}{\partial Y}}{\frac{\partial LS}{\partial G}} = Y \frac{\widehat{\beta}_2}{\widehat{\beta}_1} \quad (2)$$

Where  $Y$  is average income from our sample,  $\widehat{\beta}_1$  is the estimated coefficient on log of income and  $\widehat{\beta}_2$  is the estimated coefficient of forest/GS visits dummy from the LS regression. Assuming that forest/GS visits contribute positively to welfare we remove the negative sign from Eq. (2) (Jones, 2021). Given that our model includes the natural log of income, we adjust to:

$$MRS = Y - e^{\left[ \ln(Y) - \frac{\widehat{\beta}_2}{\widehat{\beta}_1} \right]} \quad (3)$$

By substituting in the estimated regression coefficients on income

<sup>2</sup> See supplementary materials for a detailed description of the empirical strategy followed.

<sup>3</sup> See the supplementary materials for the results of the disaggregated models.

and forest/GS visits and mean income, we calculate the welfare value of forest/GS visits for average respondents in our dataset (Italy). The details of the variables included in the final models are given in Table 1. We estimated 90 % confidence intervals for the coefficients in our regression model allowing for the calculation of the upper and lower bound values for the MRS, taking into account uncertainty in our coefficient estimates. In addition to the average MRS, we estimate the MRS stratified by income quartiles to have a more comprehensive understanding of the differential impacts by income. All statistical analyses were undertaken in R studio (Posit team, 2024).

### 2.3.2. The contingent valuation method

The LS approach was implemented alongside the well-established Contingent Valuation (CV) method. Given the relative novelty of the LS approach applied to this topic, we chose to implement it alongside the well-established CV method for the following reasons. First, the CV method is relevant as it has been widely implemented in the environmental field (Carson and Hanemann, 2005), particularly for valuing forest ecosystem services (Barrio and Loureiro, 2010; Mutandwa et al., 2019; Riera et al., 2012) and in the health field to value new programmes or health benefits (Smith, 2003). Furthermore, as our data was obtained from a primary data collection, it was possible to integrate the WTP questions into the questionnaire. Given the popularity of the CV method and the output of a single value, unlike discrete choice experiments, this method was deemed more suitable for integration into our questionnaire.

CV is a stated preference method that elicits monetary values for non-market goods (Mitchell and Carson, 1989). Through survey questions, CV estimates monetary values by asking respondents their WTP for a hypothetical change in the provision of a good or service. By creating a hypothetical market scenario, the method aims to elicit responses that represent how people would behave in a real market situation, therefore producing values that reflect genuine economic choices. The bid design chosen was the single bound dichotomous choice (SBDC) format as it is incentive compatible and best mimics consensus over a policy referendum (Carson and Groves, 2007). In the WTP section, respondents were first asked if they would be willing to pay an out-of-pocket contribution for a single visit to a forest or green space, that would go directly to the maintenance and improvement of these areas for health and wellbeing purposes. Following this, respondents who answered positively were asked if they would be willing to pay a certain amount of money. Respondents were presented at random one of the following bid amounts (1, 2, 3, 4, 5, 10, 15, 20, 30 euro per visit) in order to identify a WTP function. We chose a voluntary contribution as the payment vehicle. As forests/GS are commonly freely accessible to the public, proposing a change via a fee or tax might have introduced strategic behaviour from respondents inherently opposed to mandatory costs for access. In the SBDC format, respondent  $i$  is presented with two options:  $GS_0$  and  $GS_1$ . Here,  $GS_0$  represents the current situation with no additional cost, while  $GS_1$  denotes the proposed change associated with a certain cost  $A$ . Following random utility theory (Hanemann, 1994), the indirect utility function can be written as:

$$U_i = v(y_i, GS) + \varepsilon_i$$

Where  $v(-)$  is the deterministic component of utility,  $y_i$  is income and in this case  $GS$  represents the health benefits from forest/GS and  $\varepsilon_i$  is the random component of utility (error term). Here  $GS$  is assumed to have a positive effect on utility and so the proposed change from  $GS_0$  to  $GS_1$  represents a better situation. The probability of a positive response to the proposed change with the cost of  $A$  is therefore:

$$Pr(Yes) = Pr\{v(y_i - A_i, GS_1) + \varepsilon_{i1} \geq v(y_i, GS_0) + \varepsilon_{i0}\}$$

Assuming a linear form for the utility function and that the error term follows a logistic distribution, a binary logit model can be estimated for the probability of accepting the contribution:

$$Pr(Yes\{GS|A\}) = \frac{1}{1 + e^{-(\alpha + \beta A_i + \gamma X_i)}}$$

Where  $\alpha$  is the constant term representing baseline utility when all covariates are zero,  $\beta$  is the coefficient on the bid amount measuring the effect of changes in the bid on the probability of a “yes” answer,  $A_i$  is bid presented to individual  $i$ , and  $\gamma X_i$  represents the influence of a vector of individual characteristics (e.g., income, age, gender), weighted by their respective coefficients. The parameters were estimated using maximum likelihood estimation for logistic regression models in RStudio (Posit team, 2024).

## 3. Results

### 3.1. Results from life satisfaction approach

#### 3.1.1. Main regression results

The average life satisfaction score reported by respondents was 6.71. The distribution of the scores is left-skewed (see Fig. 1), where the majority of respondents report scores of 7 and above and a much smaller proportion report scores lower than 4.

Table 2 presents the results of the final model specifications of the life satisfaction model, estimated using an ordered probit model with maximum likelihood estimation. Additional specifications and sensitivity analyses are available in the supplementary materials. The univariate Model 1 includes only our key dummy variable for forest/GS visitor. In Model 2, standard socio-demographic variables which are shown in the literature to influence life satisfaction were added. Model 3 includes additional controls for social connections. Our preferred specification is Model 4, as it includes place-based controls and has a higher pseudo R-squared value, indicating better data fit compared to other models. The significance of the threshold estimates confirms that each category of life satisfaction corresponds to a distinct range on the underlying latent scale (Table S3, supplementary materials). The positive coefficient (0.144) indicates that visiting forests/GS at least once in the last year increases the likelihood of reporting higher levels of life satisfaction. This effect is significant at the 10 % level. Income was found to be strongly and positively associated with life satisfaction, significant at the 1 % level. Respondents who are married, employed, in good health and with social connections are associated with statistically significantly higher levels of life satisfaction. We find that the perception of safety in their local area is significant and positively associated with life satisfaction. Age was significantly and negatively associated with life satisfaction, signifying that satisfaction decreases with age. Rural dwellers were associated with a statistically significantly lower satisfaction compared to those living in urban areas. Neither gender nor education display a significant association with life satisfaction in our sample.

#### 3.1.2. Monetisation of the life satisfaction effects

We calculated the monetary impacts of forest/GS visits for the average respondents in our dataset by substituting mean annual income (€28,703.88) and the estimated coefficients on income and forest/GS visits from Model 4 into Eq. (3). The estimates from the MRS indicate that visiting forests/GS in the last year is equivalent to a €11,171 increase in average income (rounded to the nearest euro). In other words, our model estimates that an additional €11,171 in annual income would increase life satisfaction by the same amount as visiting forests/GS at least once in the past 12 months. Table 3 presents these primary estimates alongside additional estimates based on income quartiles and 90 % confidence intervals.

### 3.2. Results from contingent valuation method

The results from the CV method come from a reduced sample size of 626 respondents. Non-visitors were excluded from the second section of

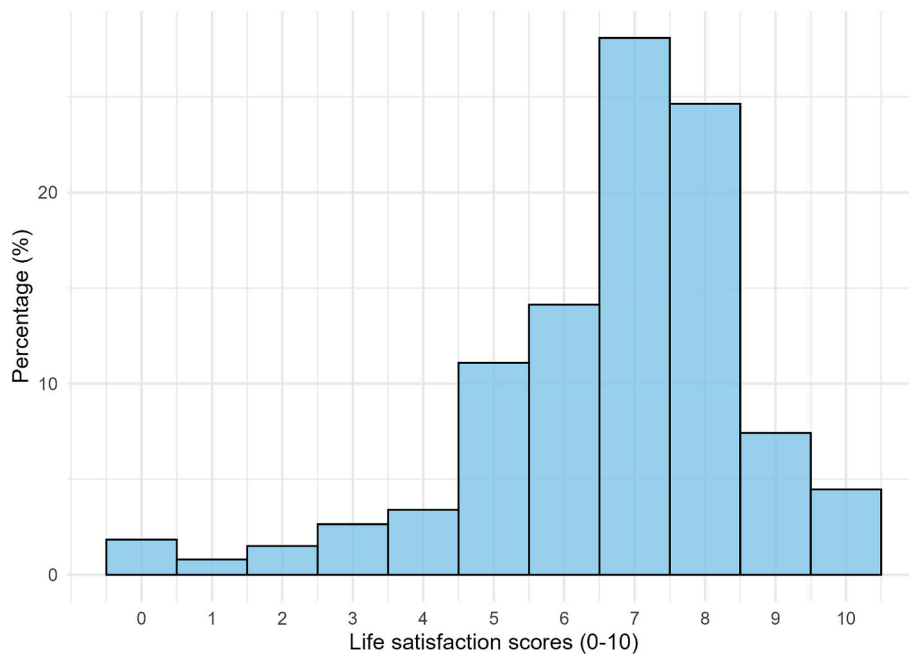


Fig. 1. Distribution of life satisfaction scores from sample  $N = 1400$ , source: own elaboration.

the questionnaire and hence did not answer the WTP section. Additionally, an initial filter question asking respondents if they would be willing to pay a contribution further reduced the sample size of those presented with the WTP bid values. In general, the bid response data mirror expectations based on economic theory; The proportion of positive answers to the WTP question generally decreases as the bid value increases (see Fig. 2).

Median WTP was estimated using a simple logistic regression (accounting for survey weights), including only the bid variable as a covariate (Table 4, Model 1). Median WTP was estimated as €18 per visit (rounded to the nearest euro). Furthermore, following best practice for CV studies (Bateman and Großbritannien, 2002) we investigated the drivers of WTP by estimating different specifications of the logit model (using the variables defined in Table 1), see Table 4 for model results. We find a statistically significant and negative relationship between the frequency of forest/GS visits and WTP. We found that age was only significant in the older age category of over 65 and was negatively associated with WTP. Being male was associated with a negative WTP. Notably, we found that having a child under 16 in the household and being satisfied with a frequently visited forest/GS were associated with increased WTP. We did not find any significance for the effects of income or life satisfaction on WTP.

In order to estimate a yearly WTP, we performed additional calculations based on the estimated frequency of yearly visits (as defined in Table 4<sup>4</sup>) to aggregate the daily WTP. The estimated yearly WTP ranges from €27 for those who visit “rarely (once or twice)” to €6541 (rounded to the nearest euro) for those who visit every day (see Table 5).

## 4. Discussion

### 4.1. Estimates from the life satisfaction model

The coefficient estimates from our preferred Model 4 generally conform to prior expectations. The model fit is relatively good, with a pseudo R-squared of 0.1067, which is higher than other LS studies

<sup>4</sup> See supplementary materials for a full description of the calculation of the annual visits.

employing ordered probit models such as Ambrey and Fleming (2011); de Vries et al. (2023). As expected, variables such as forest/GS visits, marriage, employment, income, social contacts, good health, satisfaction with living conditions and local area all display a positive and statistically significant association on life satisfaction e.g., Dolan et al. (2008); Fernandez et al. (2019); Fujiwara et al. (2011); Watt et al. (2018). The coefficient for visiting forests/GS (0.144) indicates a relatively important association between visits and life satisfaction. This effect is similar in magnitude to that of having social connections with friends and family (coefficients 0.195 and 0.212 respectively). It is more than half the size of the effect of being married (coefficient 0.230) and slightly over one-fourth the size of the effect of good health (coefficient 0.526). Other studies have found large associations between non-market goods and life satisfaction. For instance, Ambrey and Fleming (2011) found an association of 0.5553 between life satisfaction and high levels of scenic amenity. While Dolan and Metcalfe, 2008 estimated that an urban regeneration scheme was associated with a 0.477-point increase in life satisfaction from OLS regression. However, it is important to acknowledge that our forests/GS variable is only significant at the 10 % level. As additional control variables were added (see trend from Model 1 to Model 4) the magnitude and significance of the variable decreased. This may suggest the presence of omitted variable bias (OVB) in our model, whereby our forest/GS visit variable may be picking up the effects of some other unobservable characteristic included in the error term. However, we followed optimal methods (Fujiwara et al., 2014) in controlling for the majority of important determinants of life satisfaction as suggested by (Dolan et al., 2008), strengthening the reliability of our results, despite the constraints posed by cross-sectional data. Regarding our value estimates, the MRS was €11,171. Intuitively, this seems like a high value for visiting forests or green spaces at least once in the past year, especially when compared to the average income of our sample (€28,703.88). However, our finding that the LS approach produces seemingly exaggerated values is not an uncommon finding (Fernandez et al., 2019). Large estimates shouldn't be disregarded, as they result from the methodology's conceptual framework where the MRS is estimated by the slope of indifference curves, potentially yielding large values if the curve is very convex (Welsch and Ferreira, 2014). Previous studies such as Newman et al. (2010) who found that visiting the cinema at least once a week was equivalent to €17,529.629 per year.

**Table 2**  
The estimated life satisfaction models using ordered probit (source: own elaboration).

Variable	Model 1	Model 2	Model 3	Model 4
GS visitor	0.381*** (0.074)	0.189** (0.077)	0.171** (0.078)	0.144* (0.080)
log income		0.310*** (0.044)	0.304*** (0.044)	0.292*** (0.045)
Male		0.016 (0.058)	0.044 (0.058)	0.050 (0.058)
University degree		0.003 (0.063)	-0.003 (0.063)	-0.014 (0.065)
Married		0.272*** (0.062)	0.241*** (0.062)	0.230*** (0.063)
Age 35–49		-0.285*** (0.089)	-0.265*** (0.090)	-0.321*** (0.091)
Age 50–65		-0.223** (0.090)	-0.211** (0.091)	-0.279*** (0.093)
Age over 65		-0.331*** (0.113)	-0.304*** (0.114)	-0.399*** (0.115)
Unemployed		-0.312*** (0.113)	-0.262** (0.113)	-0.221* (0.116)
Student		-0.526*** (0.174)	-0.522*** (0.174)	-0.457** (0.178)
Retired/domestic worker		0.128 (0.085)	0.135 (0.085)	0.157* (0.086)
Good health		0.662*** (0.061)	0.613*** (0.062)	0.562*** (0.063)
Informal carer			0.010 (0.062)	0.056 (0.063)
Social contact friends			0.303*** (0.067)	0.195*** (0.069)
Social contact family			0.317*** (0.091)	0.212** (0.093)
Satisfied with conditions home				0.457*** (0.072)
Living in rural area				-0.173** (0.072)
Local area is safe				0.270*** (0.067)
Observations	1400	1370	1370	1370
AIC	5427.6	5053.4	5012.1	4946.7
BIC	5485.3	5168.3	5142.7	5192.2
RMSE	3.80	3.78	3.78	3.78
Pseudo R-squared	0.005	0.078	0.087	0.107

Standard errors are reported in parentheses. \*\*\*, \*\*, \* represents coefficient significance at 1, 5, 10 % levels respectively. Regional controls were also included in Model 4 but for the sake of brevity are presented only in the supplementary materials. Omitted cases are: Non-visitor forest/GS; Female; No university degree; not married; Age 18–34; Employed; Bad health; Not an informal carer; Not having social connections friends; Not having social connections with family; Unsatisfied with conditions of home; Living in an urban area; Local area is unsafe.

**Table 3**  
Implicit WTP/MRS from the LS approach calculated using upper and lower bound confidence intervals and stratified by income quartiles (source: own elaboration).

Income Quartiles	Income	Lower	Estimated value	Upper
Min.	€3500.00	€193.18	€1362.13	€1851.31
1st Qu.	€17,500.00	€965.90	€6810.66	€9256.56
Median	€25,000.00	€1379.85	€9729.51	€13,223.66
Mean	€28,703.88	€1584.28	€11,170.99	€15,182.81
3rd Qu.	€35,000.00	€1931.79	€13,621.32	€18,513.12
Max.	€95,001.00	€5243.49	€36,972.53	€50,250.44

Note: Qu. = Quartile. Lower and Upper is calculated using 90 % confidence intervals of income and GS visits variables.

Blanchflower and Oswald (2004) estimate that to compensate for unemployment, men would require an increase in income of €94,812.48 and that a “lasting marriage” is worth €158,020.80 per annum. While

(Dolan and Metcalfe (2008) estimated that an urban regeneration scheme was worth €38,509.12 per annum and (Ambrey and Fleming, 2011) estimated that high levels of scenic amenity was worth €107,439.57 of yearly income.<sup>5</sup> In terms of directly comparing our results with other studies on forest visits, this presents a challenge, as few existing studies estimate values for health and wellbeing benefits derived from such visits. The closest study that we identified is Watt et al. (2018), who estimated a substantially lower MRS of €2822.60 per year for visiting local park or green space more than once per month. However, this value is relatively close to our lower bound estimates of €1584.28. This difference in estimates could be attributed to the methodological approach followed in Watt et al. (2018), where the income coefficient was estimated in a separate model, in order to attempt to estimate the endogenous effect of income on life satisfaction.

4.2. Estimates from the contingent valuation method

The results from our logistic regressions (Table) from the CV method conform to theoretical expectations with a negative and statistically significant coefficient on our bid variable, indicating that as the price of the bid increases, the probability of being willing to pay decreases. Once again, comparing our WTP estimates with existing literature proves challenging, given the limited number of similar studies that specifically estimate health and wellbeing benefits for green spaces. However, Henderson-Wilson et al. (2017) attempt to estimate the value of health benefits through a program for maintenance and park access in Victoria as €34.52<sup>6</sup> per annum. This result is very different to our value of €18 per visit which reaches yearly values of up to €6541 when aggregated. This perhaps demonstrates evidence of scope effects, a well-known limitation of CV methods (Carson, 1997; Pouta, 2005), whereby the value obtained for one visit is not significantly less than the value obtained for yearly access. The results from our multivariate Model 2 revealed that the frequency of forest/GS visits was statistically significant and negatively associated with WTP. At the outset, this may seem counterintuitive, as we expected that those who visit more frequently, would be willing to pay more as they appreciate the benefits from these visits. However, a possible explanation is that frequent visitors have a lower WTP because if required to pay a contribution per visit they would incur higher overall costs compared to those who visit less often. We found that having a child under 16 is positively associated with WTP, which could be explained by a higher appreciation of the health benefits provided by forest visits. Perhaps parents who have children are more aware of the potential benefits of visiting these spaces as they observe the benefits experienced by their children, or equally they may have had positive experiences themselves in their childhood spending time in forests. These findings provide noteworthy insights into who may be willing to pay for the health benefits of green spaces.

4.3. Insights from methods

Although not directly comparable, we believe the LS and CV approaches to valuing the health and wellbeing benefits of forest visits applied in this paper can be complementary (Frey et al., 2010). The LS approach, measuring experience utility (an ex-post concept), seems to produce higher monetary values than the CV method, which measures decision utility (an ex-ante concept). Experience utility represents actual satisfaction derived after an event, while decision utility is based on prospective assessments and stated WTP for hypothetical scenarios. In theory, experience and decision utility should correspond, but differences often occur in practice (Kahneman and Sugden, 2005; Welsch and Ferreira, 2014). This is partly due to the lack of ability of individuals to evaluate the utility consequences of real or hypothetical choices (Welsch

<sup>5</sup> Original study values were converted to current euro prices by the authors using the average yearly exchange rate and Inflation calculators.

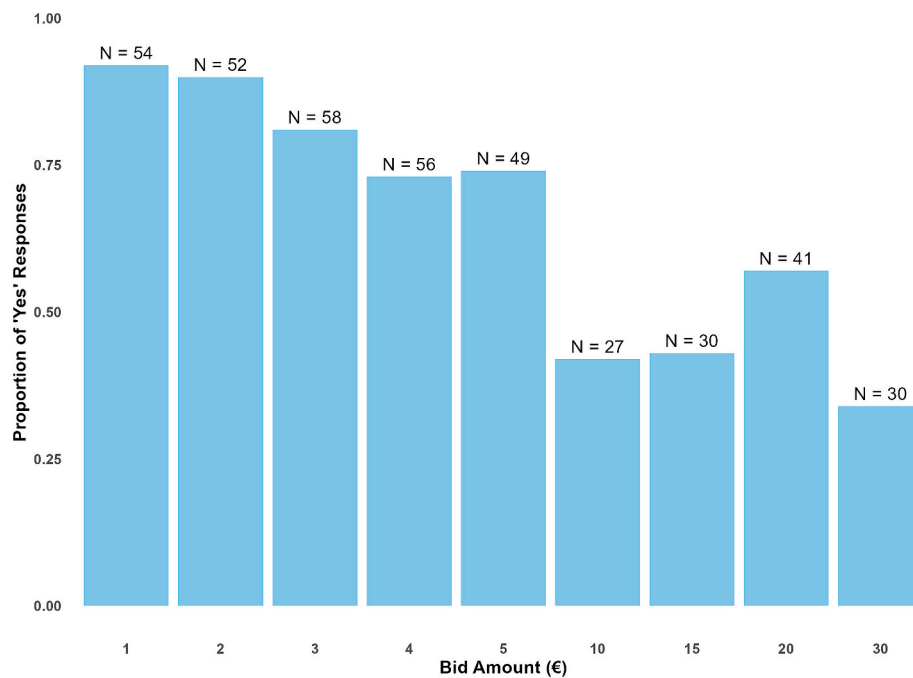


Fig. 2. Frequency and proportion of 'yes' responses per bid (source: own elaboration).

Table 4

The estimated logit models for WTP using the CV method (source: own elaboration).

	Model 1	Model 2
Beta ( $\beta$ )		
Annual income		-0.000 (0.000)
Life satisfaction		0.110 (0.073)
GS visits once every 3/4 months		-0.751 (0.486)
GS visits once or twice a month		-1.072** (0.482)
GS visits several times a month		-1.515*** (0.521)
GS visits several times a week		-1.228** (0.623)
GS visits everyday		-1.776** (0.709)
Age 35–49		-0.123 (0.372)
Age 50–65		-0.224 (0.340)
Age over 65		-0.615* (0.368)
Male		0.431* (0.234)
Child under 16		0.882*** (0.283)
Satisfied with forest visited		0.600** (0.256)
Constant	1.476*** (0.170)	1.393* (0.758)
Bid	-0.082*** (0.011)	-0.089*** (0.011)
Observations	626	625

Standard errors are reported in parentheses. \*\*\*, \*\*, \* represents coefficient significance at 1,5,10 % levels respectively.

and Ferreira, 2014), undermining SP techniques (Frey et al., 2010). The fact that the LS approach seems to produce higher monetary values than the CV method, reflects these key differences. In this study, the LS approach measures experienced utility from forest/GS visits, which are

Table 5

Direct WTP from the CV method, aggregated using visitor frequency categories and estimated number of annual visits (source: own elaboration).

Visit frequency	%	Estimated visits	Annual WTP
Don't visit	0.17	0	€ -
Rarely (once or twice)	0.09	1.5	€26.88
A few times (once every 3–4 months)	0.24	3.5	€62.72
Often (once or twice a month)	0.27	18	€322.56
Very often (several times a month)	0.17	42	€752.64
Frequently (several times a week)	0.06	156	€2795.52
Every day	0.02	365	€6540.80

usually free. When asked to state WTP for a good typically consumed for free, it's logical that the WTP for a marginal improvement would be lower than the value of experienced utility. Applying both methods provide complementary estimates of experienced and decision utility, offering decision-makers a more complete value estimate, representing not only what individuals say they would pay, but also the effects on utility after visiting. The LS approach, less subject to biases from distorted perceptions, is suggested as being particularly useful for estimating health benefits (Frey et al., 2010). However, to avoid relying solely on one method, we provide estimates from both approaches, hoping to better inform decision makers with information on both perceived value and experienced benefits.

#### 4.4. Policy implications

These findings provide valuable insights for forest policy and the forestry sector. Both methods suggest that forests and green spaces in Italy have a substantial economic value in terms of contributing to health and wellbeing. This emphasises the importance of forests and green spaces not only as ecological resources and aesthetic components of the landscape, but as vital contributors to public health and wellbeing. For policymakers and forest managers, these results highlight the need to consider the health benefits of forests in land-use decisions. To this avail, forests and green spaces could be expanded while also considering accessibility, so that more individuals can benefit from visiting these areas. This is particularly relevant in urban or peri-urban

areas, where access to nature is often limited and the potential number of beneficiaries is high. Urban forestry offers current and future benefits for community and environmental well-being, addressing pressing challenges such as urbanisation, climate change, and public health (Mahajan et al., 2024). By strategically expanding and improving access to urban forests and green spaces, cities can enhance resilience and quality of life for their residents. Furthermore, our value estimates offer a tangible metric that can be integrated into decision making regarding forestry projects and policies. Our estimates are some of the first in Italy to attempt to quantify the wellbeing benefits of visiting green spaces, and hence provide critical information that can be considered in cost-benefit analysis or presented to policy makers who require monetary estimates in order to justify future investments in forests and green spaces.

#### 4.5. Limitations

This study has the following limitations. First, our data is cross-sectional in nature, and hence we cannot control for unobserved individual heterogeneity. Nonetheless, our model has a relatively good pseudo R-squared, higher than other studies in the literature (i.e., Ambrey and Fleming, 2011; de Vries et al., 2023). Therefore, we believe that our model controls for the main determinants of life satisfaction, reducing the estimation biases. Regardless, our results are useful in aiding further methodological exploration and future studies with richer longitudinal or experimental data. Second, the LS approach estimates depend on accurately measuring the marginal utility of income, which assumes income is exogenous in our model. Endogeneity concerns regarding income variables in life satisfaction regressions have been raised in the literature (Ambrey and Fleming, 2014a, 2014b; Welsch and Ferreira, 2014). Solutions to address this issue include employing instrumental variables or substituting windfall income for household income in regression models (Ambrey and Fleming, 2014a, 2014b). Notably, Ambrey and Fleming's (2014a, 2014b) study demonstrates that when accounting for endogeneity in household income, the effect of income is higher and WTP estimates can be considerably lower. Although our tests for endogeneity in the income variable yielded negative results (see supplementary materials for full results), it is important to acknowledge the compelling and well-explored arguments in the literature that highlight this issue and its implications for WTP estimates. An additional consideration is the sensitivity of WTP estimates to the functional form of income in the life satisfaction model. Ambrey et al. (2017) show that changing the income specification can dramatically affect monetary valuations, where WTP estimates were halved. Therefore, the selection of functional form significantly influences the estimation of monetary values using the LS approach. We acknowledge the implications of our study's reliance on a single functional form and encourage that future research considers exploring alternative specifications.

Third, our forest/GS visits variable may be subject to selection effects, such that those who visit forests frequently may already be those who are happier or more satisfied with their lives. As a result, our estimated coefficient may also be affected by endogeneity. This means that confounding factors related to the characteristics of individuals who self-select into visiting forests or green spaces might be driving the observed association, rather than the visits themselves. If present, selection bias may lead to an overestimation of the impact of forest/GS visits on life satisfaction, hence inflating to some extent our value estimates. We tested for potential endogeneity of our forest/GS visits variable using an instrumental variables approach, with distance to the nearest forest as an instrument. The test did not indicate significant endogeneity (results presented in the supplementary materials). However, due to data limitations, we tested for endogeneity only on the visitors in our sample ( $N = 1170$ ). The results suggest that endogeneity is not an issue within this group, offering a reasonable indication for our broader analysis. However, we acknowledge that a risk of selection bias

remains. We therefore advise interpreting these results with caution, while keeping in mind the implications of potential endogeneity. Nevertheless, the existence of evidence supporting the beneficial effects of forest and green space visits on human health and wellbeing (e.g. Karjalainen et al., 2010; Konijnendijk et al., 2023; Nilsson et al., 2011) encourages the approach followed in this study. We recommend that future research could benefit from investigating these relationships while controlling for other types of outdoor visits e.g., visiting beaches or lakes, to address risks of OVB. Additionally, employing a two-stage least squares regression with a valid instrument for the full sample could help isolate the exogenous effect of forest/GS visits on life satisfaction, building on the preliminary indications presented in this study. Finally, it is worth noting that our CV scenario and subsequent WTP estimates were derived from a subset of our sample who visited forests or green spaces. These individuals may have a higher appreciation for and a higher WTP than those who never visit.

#### 5. Conclusions

This study provides monetary estimates for the health and wellbeing benefits of forests and green spaces in Italy. Using primary data from a representative sample of the Italian population, we present and discuss value estimates derived from two non-market valuation techniques: the LS approach and the CV method. This work is novel, as this is the first application of the LS approach to value the benefits of forest visits in Italy, where interest in forest wellbeing services is growing. We find that visiting forests and GS is associated with a positive effect on life satisfaction. Using the MRS, the LS approach provides estimates for the benefits of visiting forests/GS in the past year, expressed in terms of an increase in annual income that brings the same benefit to life satisfaction scores. Sensitivity analyses using income quartiles show that as income increases so does the MRS. This MRS or implicit WTP captures experience utility and is complementary to our estimates of decision utility using the CV method. The CV method estimated a direct WTP per visit. Aggregate values are estimated based on visit frequency categories. Additionally, we find that direct WTP is influenced by having children and the frequency of visits, providing insights for future forest policy. Keeping in mind the study's limitations, our finding that visiting the forest or a green space in the last 12 months has the same impact on life satisfaction as an increase in annual income of greater than €11,000, should be carefully considered. Moreover, the regression models provide quantitative insights into the estimated effect of forest and green space visits in terms of life satisfaction scores. This information is valuable in its own right, even before monetary conversion. Further research is needed with richer data, in order to investigate further these associations and value estimates. Our findings underscore the importance of green spaces as valuable contributors to public health and wellbeing, with associated monetary values that may be of interest to decision-makers and policymakers. As the forestry sector continues to evolve, integrating these health and well-being considerations into forest management practices and green space planning could lead to increased recognition of the importance of protecting and maintaining these environments, which could ultimately increase societal wellbeing.

#### CRedit authorship contribution statement

**Aisling Sealy Phelan:** Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Gianluca Grilli:** Writing – review & editing, Methodology, Formal analysis. **Elena Pisani:** Writing – review & editing, Supervision. **Laura Secco:** Writing – review & editing, Supervision, Methodology, Conceptualization.

#### Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Chat GPT and

Lucrezia AI in order to aid in the writing process of the article. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Co-author Laura Secco is part of the Editorial Board as assistant editor of *Forest Policy and Economics*. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.forpol.2025.103640>.

## Data availability

Data will be made available on request.

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