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A Model for the Economic Evaluation of Cultural Ecosystem Services: The Recreational Hunting Function in the Agroforestry Territories of Tuscany (Italy)

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Abstract: Cultural ecosystem services (CESs) are non-material benefits generated by natural and human ecosystems that substantially contribute to human wellbeing. Estimating the monetary value of CESs is challenging because there is no real market for these services and therefore there is no actual market price. This study seeks to define an economic evaluation method for these services, with special reference to a recreational CES that has so far received little discussion: hunting. We conducted an online survey in the province of Siena (Tuscany, Italy). The Consumer Surplus estimate of hunters was made using the travel-cost method with a detailed analysis of the annual expenditure on hunting activities, and a negative binomial statistical regression. The results reflect the nature of hunting activity and show the dynamics that have occurred over recent decades. In fact, whereas hunting used to be strongly connected to the rural world as it was an income supplement for local communities, nowadays it has turned into an elitist and almost exclusively recreational activity. In any case, knowing the economic value of ecosystem services constitutes an essential background for planning effective land management and development policies in the short and long term.

Keywords: cultural ecosystem services; economic assessment; travel-cost method; recreation; hunting; agroforestry territory; negative binomial regression

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1. Introduction

Nowadays, ecosystem services (ESs) are an increasingly studied field, and this topic is becoming more and more well-known and widespread even among the non-scientific community. Generally speaking, the condition of existence of a service requires the presence of an end user who can enjoy the benefit generated by the service; this benefit exists only in relation to the needs of the final beneficiaries [1]. There are numerous studies evaluating the connection between physical and mental human well-being and the goods or services generated by ESs [2]. The main international reports analysing the effects of ESs include the Millennium Ecosystem Assessment (MA) [3], the Common International Classification of Ecosystem Services (CICES) [4], and The Economics of Ecosystems and Biodiversity (TEEB) [5]. According to a classification shared by these reports, ESs can be classified into three categories: provisioning ecosystem services, such as food and fresh water; regulating ecosystem services, which affect, for example, climate, floods and diseases; and cultural ecosystem services which include recreation and spiritual values [3,6].

Regarding cultural ecosystem services (CES), there are several definitions in the literature. The MA identifies ten types of CESs including the spiritual, religious and recreational ones, i.e., all non-material benefits, which derive from the ecosystem and which people can enjoy [3]. Instead, the CICES approach distinguishes two macro-categories of CES: biotic and abiotic. In the first case they derive from the characteristics of the setting

or location of the environment that enables a recreational activity (e.g., nature walks) and determines their qualitative characteristics. On the other hand, in the second case abiotic services are characterised by the physical elements of the landscape that represent for people a cultural, religious or traditional emblem [4]. A predominantly economic interpretation is given by the TEEB, whereby CESs are defined as the ESs that generate so-called experiences for the users, such as cultural heritage, aesthetic values, recreation and tourism [5]. Other authors have further differentiated these services [7]. For example, following a more economic approach based on Costanza and Daly's studies, Natural Capital is defined as the stock of natural resources, including recreational services, which they can draw on to ensure a flow of goods and services for future generations [6,8]. Additionally, CESs have also been defined as all spaces in the environment and all cultural practices that generate benefits for people [9]. Even though different names have been used to define CESs [10], most authors agree that they are an interdependent function between people and environment [11,12].

In all studies, the most difficult challenge related to the definition of CESs is certainly represented by their quantification, especially in monetary terms. This is in fact a category of non-market, non-material and non-monetary services which are not traded on the market [9]. For this reason, some authors believe that for the research community it is still difficult to translate the value of CESs into economic terms [13–15]. On the other hand, numerous studies have shown that the economic value generated by the category of recreational services is extremely relevant [16–19] and can sometimes exceed the value of agricultural and forestry production [2,7]. In particular in Italy, it is recognised that CESs are widespread in forests and cultivated land [20].

The purpose of this study is to contribute to fill these research gaps by defining an economic evaluation method capable of estimating a particular category of CESs, which is one of the main recreational activities in the Tuscan and national rural territory: hunting. Specifically, this activity was investigated in order to estimate its recreational use value, which differs from the consumptive (e.g., sale of game meat) [21] and non-consumptive use value of wildlife (e.g., birdwatching) analysed in other studies [22]. In general, the literature offers numerous references for studying the economic valuation of CESs. In particular, the analysis of the hunting function is evaluated through different methods of monetary estimation depending on the objective to be pursued. For example, to estimate the Willingness To Pay (WTP) of hunters for hunting recreational services [23–26], Contingent Valuation (CV) is the most widely used strategy. CV has also been adopted in case studies related to the area examined by this research (Tuscany) [27,28]. Alternatively, the Hedonic Price Method (HPM) is used to identify those factors that primarily influence the cost of market activity the most [29–31]. In addition, the literature presents several case studies that use the method of Discrete Choice Experiments (DCE) to identify the preferences of hunters in the practice of hunting [32,33] or consumers in the purchase of products derived from hunting (i.e., game meat) [34,35]. Instead, the economic evaluation methodology used in the present research was the travel-cost method (TCM). First of all, it is the most widely used method in the literature for the assessment of CESs in general [11,12,36–41]. Moreover, there are many studies in the literature that use TCM to estimate the value of recreational activities such as hunting [37–40,42], in which travel, even of considerable length, is necessary to enjoy an activity practiced exclusively in rural areas far from urban contexts. In fact, because of this, the costs incurred for travel represent a significant factor within the total expenditure incurred annually by hunters that is worth investigating.

The research was carried out by means of a survey on the territory of the province of Siena (Tuscany region, central Italy) through the dissemination of online questionnaires. Through this survey, it was possible to analyse the hunting habits of recreational users in agroforestry areas. In the following paragraphs, the research is described in its main components. The *Materials and methods* section defines the study area and the research objectives and provides details about the economic evaluation method applied (TCM) and the econometric model used to carry out the statistical regression of collected data

(Negative Binomial Model). Then, the contents and sections of the survey conducted through online questionnaires are described. In the following *Results and discussion* chapter, an annotated overview of the results obtained is given. Finally, the *Conclusions* analyse the strengths and weaknesses, and summarise some reflections on possible applications of the method and on the strategies derived from the first results aimed at improving land management.

2. Materials and Methods

2.1. Study Area and Research Objectives

The Tuscany region is in central Italy. Around 1,160,000 ha (over 50% of the region's area) of its surface is covered by forests [43]. Over 90% of the territory is classified as rural [44], and the Utilised Agricultural Area covers over 750,000 ha [45]. In particular, the study area covers the province of Siena, located in the central-eastern part of the region (Figure 1). This is a territory developed over an area of over 3800 km^2, including 35 municipalities. With its population of 272,638 inhabitants, Siena is the most rural province in all of Tuscany. In fact, in relation to the territory, the province records the lowest density of the whole region, with around 72 inhabitants per km^2. The degree of urbanisation is also medium-low: in fact, 39.5% of the inhabitants live in only three municipalities with a population exceeding 20,000 inhabitants [46]. The province registers an old-age index that is not too different from the regional average (i.e., 214.8 and 211.4, respectively). As far as the level of education is concerned, there is a rather homogenous distribution on the regional territory, with the exception of the provinces where the Tuscan universities are located (Siena, Pisa and Florence). In fact, the percentage of persons with tertiary and higher-education qualifications in the province of Siena (16.5%) is much higher than the regional average (14.5%) and the national average (14.3%) [47]. The employment rate for men (57.4%) and women (44.2%) does not differ greatly from the regional average (56.4% and 42.0%, respectively) [47]. With regards to the economic profile, the Province of Siena is characterized not only by the historically leading sector of agriculture but also by other productive activities such as trade, construction, manufacturing and the food service and hospitality sector. In fact, alongside traditional accommodation facilities, a rich offer of agritourism has also recently been added [48]. In recent years, tourist flows have maintained an increasing trend until the beginning of January 2020, when a turnaround caused by the COVID-19 pandemic was recorded. In 2019, over 2 million arrivals and over 5 million tourist presences were recorded [49]. The agricultural area represents approximately 22% of the regional area (about 170,000 ha) [45]. The territory is home to one of the largest provincial forest areas in Tuscany. In fact, after Grosseto (17%), Florence and Arezzo (16%), the forest area in the Province of Siena covers about 168,000 ha, accounting for 15% of Tuscany's forests [43]. The main crops are vines and olive trees [50], while the wooded area consists mainly of broadleaf forests, in particular, oak, holm oak and turkey oak [43]. From a hunting point of view the territory is divided into two Territorial Hunting Areas (Ambiti Territoriali di Caccia)(Established at national level by Law No. 157 of 11 February 1992 and at regional level by Regional Law No. 3 of 12 January 1994), which represent the elementary units for hunting and wildlife management (Figure 1). In the hunting season of 2017–2018, the province counted over 16,000 hunters registered in the two Territorial Hunting Areas (THAs) [51]. Ungulate game hunting, migratory game hunting and sedentary game hunting (i.e., hares, pheasants and partridges), typical of the entire national territory, are practised in these places. It was decided to focus the investigation on a purely agroforest area to fill a gap in sectoral research, namely the fact that "the literature on the valuation of cultural ecosystem services is disproportionately located in urban areas" [11] with particular reference to the themes of urban parks [2,10,52,53]. This may be due to the fact that CESs in urban areas are characterised by a form of more direct experience and a more immediate visibility than those experienced in recreational practices in agroforestry contexts [11]. In fact, there are few studies on forest and rural areas [54,55].

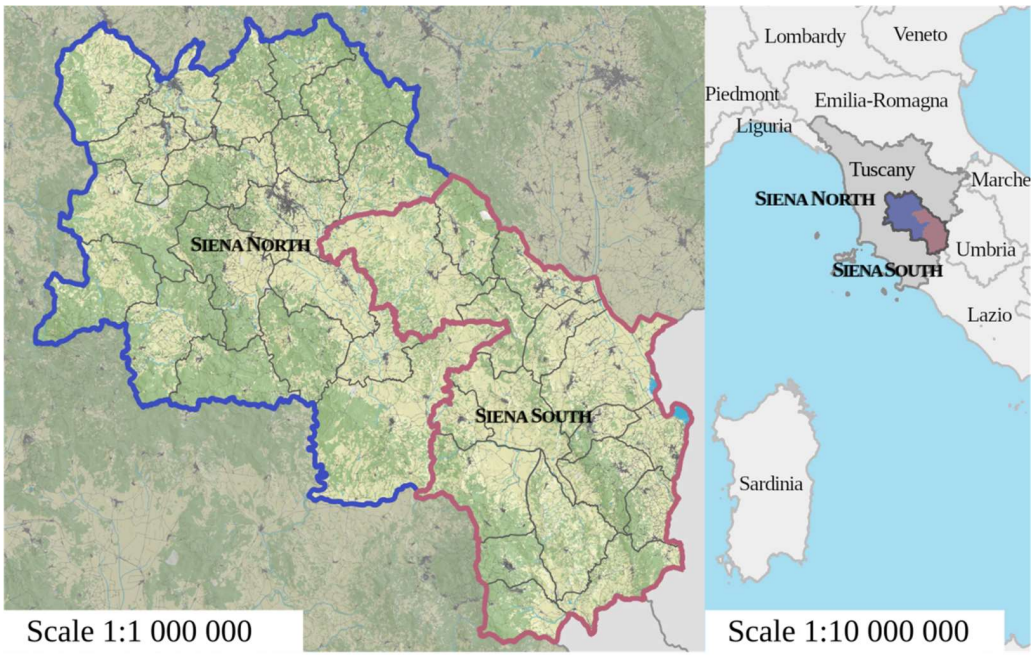

Figure 1. Overview of the study area: Province of Siena (Tuscany, Italy).

The recreational hunting function mainly concerns local residents, while few come from non-regional areas, and of these the vast majority who hunt in Tuscany (93%) come from six regions, i.e., Latium, Liguria, Lombardy, Emilia Romagna, Veneto and Umbria in descending order of importance [51]. For instance, less than 10% of the sample analysed in this study stated that they go hunting in regions other than the one of residence on an average of 9 hunting days per year. Reviewing the relevant literature, it was decided to focus research on the recreational hunting function, because, although it represents a high economic and social value for the territory, it has limited interest in the European scientific literature compared to the other types of CESs examined in numerous studies [16–18,56,57]. It is likely that this limited interest is influenced by the conflict raised by assessing as a positive externality an activity related to the killing of wildlife. On the other hand, many studies highlight the usefulness of hunting planning in order to improve local ecosystem balances in agroforestry settings. In fact, the progressive reduction of hunting activity in recent decades in Tuscany has led to a considerable increase in the population of ungulates, resulting in serious damage to crops and renewal of coniferous and deciduous forests [58]. For this reason, the evaluation was developed in an area where hunting activity is practised in both forest and agricultural environments.

2.2. The Travel-Cost Method

The methodology adopted is the travel-cost method, one of the most widely used methodologies for estimating the recreational value of this type of CES [37]. The recreational use value is a very important parameter to structure short- and long-term land management and to development policies that assess not only the values of market products (e.g., timber and agricultural products), but also the values of non-market services (e.g., landscape and recreation) generated by territories.

The monetary value of recreational activities like hunting is not easy to determine, as there is no real market for these services and consequently there is no market price. In economics, to estimate the benefits generated by non-market goods or services, different evaluation methods are used, which can be divided into stated or revealed preference methods [37,42,59]. Revealed preference methods relate the enjoyment of non-market environmental goods or services to the costs incurred for the purchase of market goods that are indispensable to benefit from the good or service under analysis [42]. Among

them, the travel-cost method (TCM), originally proposed by Hotelling [60], is based on the assumption that the recreational value of a site reflects the costs paid to visit the site itself, or of the economic sacrifice made by the user to enjoy that service [61]. A second assumption on which the TCM is based is that as the costs incurred increase, the frequency of visits to the site decreases [36,62]. The TCM was chosen for this study, as it is the most widely used method in the literature for the economic evaluation of recreational activities in natural and rural settings [11,36,37,39]. Moreover, this method has the advantages of keeping survey costs very low and ensuring easy processing of results [37].

Among the different types of TCMs proposed in the literature, in the present study it was decided to adopt the individual travel-cost method (ITCM) which investigates the relationship between the number of trips made by a person to enjoy a particular type of leisure activity and the personal expenses incurred in reaching that site [59]. It is not the intention here to examine in detail the ITCM, already extensively described in numerous studies such as those by Torres-Ortega et al. [59] or by Parsons [36].

What emerges from sector studies is that the TCM can refer to a wide range of cost variables that influence the frequency and willingness to visit a site [59]. This is because in cases such as the hunting activity, travel costs alone (i.e., fuel cost) cannot fully explain the demand function [36]. For this reason, the present study has developed a model that was as comprehensive as possible regarding the costs actually incurred by hunters for recreational hunting. In particular, in the model developed, three main types of costs have been identified: (1) fixed costs; (2) annual variable costs; and (3) daily variable costs. The first typology concerns the fixed costs that hunters have to pay every year in order to practice hunting. This category includes the costs related to fees and licences [37] (e.g., firearms licence for hunting, registration to THAs). On the other hand, the second type is represented by costs not directly linked to hunting trips but to the preparation and planning of hunting activities on an annual basis. This category includes, for example, the costs for the construction of fixed hunting posts, dog training, the maintenance of weapons and purchase of ammunition. These first two types of expenditure are not linked to each individual hunting trip, but in general to the activities carried out in the course of an entire hunting season (i.e., over the course of a year). For this reason, these costs were attributed to the different locations visited by the individual hunter, in proportion to the annual number of hunting days carried out at that location. Finally, the last type includes only the direct costs related to hunting outings (e.g., cost of petrol used to reach the site, out-of-home meal expenses). Table 1 summarises all fixed and variable cost items, aggregated by category.

Table 1. Cost categories used in the economic evaluation model.

Fixed Costs	Annual Variable Costs	Daily Variable Costs
Hunting license (sum of): -national fee: EUR 173.16 -regional fee: EUR 23.00 -medical certificate: EUR 76.00 -tax stamps [1]: EUR 48.00 -insurance [2]: EUR 114.00	Hunting mobility [4]: EUR 15.00 Maintenance of a fixed post [5] Feeding of live decoys for fixed posts [5] Feeding of hunting dogs [5] Hunting dog training [5] Hunting clothing [5] Munition purchase and weapon maintenance [5] Hunter training courses [5] Shooting practice [5] Creation of hunting trophies [5]	Out-of-home meals [5]: -breakfast -lunch
Registration to THA: - of residence [3]: EUR 100.00 -other within the Region: 50.00 EUR/each - other outside the Region: 150.00 EUR/each		Travel [6] -small car: 0.25 EUR/km -medium car: 0.34 EUR/km -four-wheel drive: 0.49 EUR/km

[1] Validity: five years. [2] Data provided by Federcaccia Toscana: mode of the maximum number of insured persons for the year 2021. [3] Compulsory registration. [4] For five hunting days in a regional THA different from those in which you are registered [5] Costs defined on the basis of questionnaire responses. [6] Proportional mileage costs [63].

2.3. Econometric Model

Thus, the ITCM is based on the inverse relationship linking the number of visits to the hunting site with the travel cost and a number of independent variables characterising the socio-economic profile and affecting the choices of individual hunters interviewed (e.g., age, level of household income, educational qualification). The dependent variable (i.e., number of visits to the hunting site) takes non-negative integer values; therefore linear models for normal response variables are not suited to this analysis [11,59,64]. Generalized linear models (GLM), in particular Poisson and negative binomial regression models, take into account both discreteness of count data and the left bound of the sample space in zero. A comprehensive account of GLM for count data is provided by Agresti [65]. Recreational visit models [11], as in this case study for the days spent at hunting sites, have response variable counts whose totals are not fixed in advance. Therefore, the reference model for the distribution of the response variable is the Poisson model [66,67], in which the mean and variance of the response variable coincide. Where the mean and variance of count distribution do not coincide, it is necessary to use the negative binomial model, which has an additional parameter (Theta) to specifically model overdispersion [11,37,64,67,68].Then, we assume that in Equation (1) $E(V \mid X)$, the expected number of trips to different hunting sites, is an exponential function of independent variables, such that:

$$ln(E(V|X)) = X' \times \beta \quad (1)$$

where X' is the row vector of explanatory variables affecting the expected number of trips and β is the column vector of the coefficients of these variables. The natural logarithm is the so-called link function relating the expected value and the linear predictor. In particular, after estimating the β coefficients of variables by maximum likelihood, the generic Equation (1) can be rewritten using the following demand function for hunting experience expressed by Equation (2):

$$E\,[V_i|\,X] = exp\left(\begin{array}{c}\beta_0 + \beta_{TC}TCOST_i + \beta_{OC}OCOST_i + \beta_M MOUNT_i + \\ +\beta_A AGE_i + \beta_{ED}EDU_i + \beta_I INC_i + \beta_{EX}EXP_i\end{array}\right) \quad (2)$$

where:

$E[V_i \mid X]$ = expected number of hunting days spent by each *i*th hunter;

$TCOST_i$ = travel cost borne by each *i*th hunter;

$OCOST_i$ = costs in addition to the travel costs incurred for hunting activities (i.e., fixed and annual costs) by the *i*th hunter;

$MOUNT_i$ = variable identifying whether the residence of the *i*th hunter is located in a mountainous municipality;

AGE_i = age group of the *i*th hunter;

EDU_i = the highest educational qualification obtained by the *i*th hunter;

INC_i = range of annual family income received by the *i*th hunter;

EXP_i = experience of the *i*th hunter in terms of hunting years.

Once the β coefficients of these variables have been estimated, it is possible to calculate the Consumer Surplus (CS), which corresponds to the difference between the maximum amount that a hunter would be willing to pay for a day's hunting and the cost actually incurred [68]. Thus, the CS per trip per hunter can be calculated using the following Equation (3) [11,38,59,67] which takes into account that the relationship with the dependent variable is exponential [64]:

$$CS = -\frac{1}{\beta_{TC}} \quad (3)$$

Once the value of the *CS* per trip per hunter is estimated, you can calculate the annual recreational-use value of hunting for the whole population of hunters in the study area (Province of Siena). To calculate this value, the number of hunters who chose one of the two THAs of the Province of Siena as their residence THA or additional THA during the 2017–2018 hunting season was used as the reference population. For the THA of Siena North,

10,626 hunters were registered, while for the THA of Siena South 5429 were registered. These values have been updated in proportion to the current regional population of Tuscan hunters (68,751) to 8694 and 4442, respectively, for the THA of Siena North and that of Siena South [51].

Thanks to the total number of hunters registered to each THA and to the estimated average annual value of hunting outings recorded for the sample analysed (i.e., 22 for Siena North and 24 for Siena South), the following Equation (4) [11] was applied to calculate the aggregate value of the CS for the Province of Siena:

$$ARUVH = \sum_{N=1}^{2} \left(-\frac{1}{\beta_{TC} THA^N} \times N^{\circ}{}_{hunters} THA^N \times avgN^{\circ}{}_{hunting\ days} THA^N \right) \quad (4)$$

where:

$ARUVH$ = annual recreational use value of hunting;
$\beta_{TC} THA^N$ = coefficient of the TCOST variable for the Nth THA;
$N^{\circ}{}_{hunters} THA^N$ = total annual number of hunters registered to the Nth THA;
$avgN^{\circ}{}_{hunting\ days} THA^N$ = average annual number of hunting days recorded for the Nth THA.

The results section discusses the results of the adopted model.

2.4. Data Collection

The survey involved the use of a structured online questionnaire via the Google Form application (https://www.google.it/intl/it/forms/about/ (accessed on 23 September 2021)). This choice was mainly dictated by the impossibility of undertaking face-to-face interviews due to the COVID-19 epidemic (SARS-CoV-2) starting between December 2019 and January 2020. However, this problem stimulated the use of information technologies, allowing to also check the degree of responsiveness to online surveys by the population of hunters, traditionally characterised by older people who are not particularly inclined to use computer devices [69]. Therefore, the absence of paper questionnaires may have led to some sampling bias because some older hunters have a limited or no IT background. Nevertheless, thanks to the cooperation of the local hunting associations who supported the less-experienced in the compilation of the online questionnaire, it was possible to achieve a very good degree of responsiveness and important benefits from the online survey, such as cost-effectiveness and speed of data collection [69]. Despite this problem, the use of the online survey is well established in the literature for estimating the value of ESs, and in particular, of CESs [13,54,70]. So, this study, despite some distortions linked to the prevalent sampling of more technologically advanced subjects, has led to good, albeit conditional, results.

In order to achieve high effectiveness and interpretability of the questionnaire, focus groups were organised with experts and representatives of local hunting associations to whom preliminary questionnaires were submitted. As confirmed by several studies, this made it possible to structure effective and comprehensive questionnaires [13,53,71], examining further organisational and management aspects of hunting practices sometimes unknown to research teams. To ensure general validity of the results, respondents were asked to refer to their hunting behaviour and habits before the start of the COVID-19 pandemic. This has been done in order to estimate the economic value of the annual recreational use value of hunting in agroforestry land under ordinary conditions.

In order to facilitate the filling-in of the questionnaire, mainly closed-ended questions were used in which it was possible to select one or more of the answers listed. This is because scientific evidence shows that this type of question allows a higher number of answers to be collected compared to open-ended questions [72]. Moreover, a survey with response alternatives facilitates statistical processing of final results [73]. Through the questionnaire it was possible to collect both quantitative information (e.g., travel costs or costs of maintaining dogs) and qualitative information (e.g., age, education or hunting experience). The questionnaire is divided into five main sections. (1) The first section

concerns the profiling of respondents (e.g., age, address of residence, years of hunting experience). (2) The second part concerns the general characteristics of hunting activity, such as the frequency with which this activity is usually conducted or the priority use of game (i.e., private use or sale). (3) In the third section, the questionnaire investigates the main costs of hunting (Table 1). (4) In the fourth section, the questionnaire includes a series of questions aimed at identifying at a municipal level the location of the hunting days spent by individual hunters during the hunting season. In addition, for each site, hunters were asked to indicate the annual frequency with which they visited those places. In this way it was possible to reconstruct the routes taken annually by each hunter from the place of residence to the different hunting grounds. Therefore, knowing the total distances travelled, the type of vehicle used (i.e., small car, medium car or four-wheel drive) and the average number of people with whom the hunter shares the hunting experience, it was possible to calculate the average annual travel cost of each hunter. (5) In the fifth and last section, the questionnaire aims to frame the socio-economic profile of respondents (e.g., family income bracket, educational qualification) as well as leave space for a short open-ended comment on the services offered by associations and local authorities responsible for land and hunting management. Before administering the questionnaire to the entire population of hunters in Tuscany, between December 2020 and January 2021, a pilot test was carried out on 41 subjects in collaboration with some local hunters' associations. The results of the pilot test allowed for the validation of the questionnaire, checking the correctness of its contents and the comprehensibility of the questions [74]. Disclosure of the final questionnaires to the entire population of hunters in Tuscany was achieved through the dissemination of links on the social channels of local hunting associations and local bodies involved in research (Facebook, Instagram, websites), as well as through some online hunting magazines and hunters' WhatsApp groups. A total of 296 questionnaires were completed, of which 66 are not counted because they related to hunters who hunt outside the survey area and 14 were incomplete. Therefore, the sample analysed is represented by 216 questionnaires completed in the period between February and May.

3. Results and Discussion

3.1. Visitor's Characteristics

The sample analysed (216 questionnaires) consisted almost entirely of men (99%) while only 1% are women. For this reason, given the low representation, the only three women present were eliminated to make the sample more homogeneous. Regarding age, more than 80% of the respondents were over 40 years old, and of these more than 55% were between 55 and 69 years old. In terms of educational qualifications, 73% obtained a secondary education diploma, whereas less than 22% completed graduate or postgraduate studies. With respect to residence, it emerged that almost 20% of the respondents live in a mountainous municipality. Regarding the economic profile, over 89% reported having an annual family income of less than EUR 70,000, and of these, 45% declare that they have an income less than EUR 35,000 per year. Examining the level of experience in hunting practice, more than 76% of the sample stated that they had been hunting for more than 20 years, while inexperienced hunters (with less than 10 years of experience in hunting activities) represented only 6% of the sample.

In addition to the variables used for structuring the regression model (Tables 2 and 3), the questionnaire also collected qualitative data that provide descriptive information on hunters' habits.

Table 2. Descriptive statistics of quantitative variables.

Variable	Definition	Mean	SD	Min	Max
V_i	Frequency of trips: hunting days.	24.27	16.72	1.0	80.0
TCOST	Travel Cost: average value of expenses incurred to reach hunting sites.	23.43	19.25	1.6	120.2
OCOST	Other Costs: average value of fixed and variable costs incurred for hunting activities, except travel costs	89.8	74.9	12.0	565.0

Table 3. Descriptive statistics of qualitative variables.

Variable	Definition	Mode	Cumulative Relative Frequency			
			1	2	3	4
MOUNT	Variable for the location of residence in a: non-mountainous municipality (1); mountainous municipality (2).	1	0.80	1	-	-
AGE	Age group: (1) <39; (2) 40–54; (3) 55–69; (4) >70	3	0.19	0.49	0.93	1
EDU	Educational qualification: (1) primary school; (2) high school or professional training; (3) bachelor's degree; (4) master's degree or postgraduate education	2	0.04	0.77	0.86	1
INC	Annual family income: (1) <35 kEUR /y; (2) 35 k-70 kEUR/y; (3) >70 kEUR/y.	2	0.40	0.89	1	-
EXP	Years of hunting experience: (1) <10; (2) 10–19; (3) >20.	3	0.06	0.24	1	-

For example, the survey shows that more than 69% of people practice hunting exclusively on weekends or holidays and less than 1% hunt for commercial purposes and not for self-consumption. This information suggests that the subjects surveyed practice hunting mainly for recreational purposes, thus attributing an economic value to the CESs generated by agroforestry areas. Moreover, 57% of hunters stated that their main type of hunting was hunting of migratory land game (e.g., thrust, woodcock, quail and woodpigeon), whereas 26% are mainly engaged in the hunting of sedentary game (i.e., hares, pheasants and partridges), and only 17% in hunting ungulates. Regarding hunting in private areas, which in Italy are known as Aziende Faunistico-Venatorie (Hunting and Wildlife Farms) and Aziende Agri-Turistico-Venatorie (Agricultural Tourism Hunting Farms), only 23% of subjects declared to be engaged in hunting activities inside these places. Finally, special attention was paid to annual ancillary costs related to hunting activity, i.e., the training of dogs, the maintenance of fixed posts and equipment costs (e.g., expenditure on the maintenance of arms and ammunition and clothing expenses) (Table 4).

Table 4. Descriptive statistics of the quantitative variables Other Costs.

Type	Description	Mean	SD	Min	Max
Annual variable costs	Maintenance of fixed post	286.4	510.1	0	2500
	Live decoys for fixed post	201.9	403.1	0	2500
	Feeding hunting dogs	597.4	620.1	0	2500
	Hunting-dog training	145.0	305.5	0	2500
	Hunting clothing	256.7	155.3	25	550
	Weapons and ammunition	293.5	216.2	0	650
	Training courses for hunters	22.8	55.5	0	250
	Shooting practice	106.1	151.3	0	550
	Creation of hunting trophies	30.5	80.3	0	550
Variable costs per day	Breakfast	58.0	48.9	0	216
	Lunch	235.5	342.1	0	2040

An examination of these types of costs shows that the main costs incurred by hunters are related to the feeding of hunting dogs (597.4 EUR/year on average) followed by weapons maintenance (average 293.5 EUR/year). Significant values are also recorded in the expenses for the maintenance of the fixed post (286.4 EUR/year). Instead, few invest in training courses or in the creation of hunting trophies. In terms of daily costs, 73% of hunters eat breakfast away from home, incurring a total average annual cost of EUR 58.0, while 47% eat lunch outside of the home, in bars (25%) or restaurants (21%), with a total average annual expenditure of EUR 235.5.

3.2. Regression Results and Consumer Surplus

The analysis of statistical regression models was conducted separately for each THA into which the Province of Siena is divided (i.e., Siena North and Siena South). This is in order to respect the greatest possible uniformity (morphological and ecological) within each area.

Examination of the results shows that the ratio of the variance to the mean is always greater than 1, both in the case of the sample of Siena North (10.9) and in the case of the sample from Siena South (14.9). This indicates the presence of overdispersion in the collected data and the need to prioritise the application of a negative binomial model rather than a Poisson model. In the present study, the regression model uses annual average travel costs (TCOST) as the main independent variable, while the other covariates are: average annual other costs (OCOST) (see Table 4); residence in a mountainous municipality (MOUNT); hunter's age class (AGE); hunter's educational qualification (EDU); hunter's annual family income (INC); and hunter's years of hunting experience (EXP). While the two variables related to cost (i.e., TCOST and OCOST) are quantitative, all the others are qualitative variables, divided into different levels described in Table 3.

As shown in Table 5, in both THAs, the coefficient of the variable TCOST is negative and highly significant confirming the assumption underlying the TCM that as the cost increases, the frequency of visits decreases. Furthermore, the results show that hunters living in mountainous areas hunt more frequently than those living in urban areas. There appears to be an inverse relationship between hunting frequency and cultural level. This confirms the findings in the literature that for recreational activities such as hunting and fishing, the demand for outdoor recreation tends to decrease as the cultural level increases. This phenomenon seems to be due to the increased knowledge users have about the recreational alternatives available [75]. Finally, age and income, in both THAs, do not seem to significantly influence the number of annual hunting days.

Table 5. Negative binomial model results for the hunting function.

	Siena North		Siena South	
Variables	**Coefficient**	**Std. error**	**Coefficient**	**Std. error**
Constant	2.963428 ****	0.315391	4.205264 ****	0.450059
TCOST	− 0.015264 ****	0.003443	−0.018382 ****	0.003673
OCOST	−0.003197 ****	0.000851	−0.004033 ****	0.001152
MOUNT2	0.295714 *	0.168105	0.334854 **	0.170441
AGE2	0.157951	0.199863	0.147443	0.351690
AGE3	0.049773	0.219873	0.238808	0.393124
AGE4	0.224158	0.289024	0.251554	0.484127
EDU2	0.080830	0.235871	-	-
EDU3	−0.529322 *	0.299176	−0.599908 *	0.339581
EDU4	−0.017702	0.273889	−0.769761 ***	0.282309
INC2	−0.144034	0.113451	−0.135866	0.172504
INC3	−0.011443	0.192834	0.369691	0.317498
EXP2	0.953155 ****	0.252867	−0.444670	0.418889
EXP3	0.583280 **	0.258152	−0.421933	0.415886
No of observation	174		52	
Theta	2.590		4.57	
2*Log-Likelihood	−1305.545		−372.057	
CS per visit per capita	EUR 46 ÷ 119		EUR 39 ÷ 91	

****, ***, ** and * represent 0.1%, 1%, 5% and 10% levels of statistical significance, respectively.

To estimate the range of the CS per visit per hunter with 95% probability, the lower and upper bounds of the confidence interval of the β_{TC} coefficient were calculated according to Equation (3) [37,59]. For the THA of Siena North, the lower limit (2.5%) of the βTC coefficient equals −0.022, while the upper limit (97.5%) equals −0.008. Consequently, the CS per visit per hunter per year is between EUR 45 and EUR 119. In the case of the THA of Siena South, the confidence interval of the β_{TC} coefficient is between −0.026 and −0.011, and the corresponding CS per visit per hunter per year (with 95% probability) is between EUR 39 and EUR 91. Therefore, applying Equation (4), the estimated annual recreational use value of hunting for the Province of Siena is between a minimum of EUR 12,956,040 and a maximum of EUR 32,462,220. Therefore, the annual recreational use value of hunting per hunter estimated for the study area is between EUR 986 and EUR 2471. These values are well above those identified in 2013 for the whole of Tuscany by the study of Marinelli and Marone [28] (i.e., 521 EUR/year) which estimated a total value of EUR 58,235,147 for the 89,142 hunters enrolled at the time. In fact, using the data estimated in this study for the Province of Siena, it is possible to calculate an approximate value for the entire Tuscany Region ranging from a minimum of EUR 67,809,128 to a maximum of EUR 169,900,281 for the current 68,751 registered hunters. In fact, even if on the one hand the number of hunters in Tuscany has halved over the last twenty years, the cost of hunting has risen so much as to cancel out the effect of this reduction. This phenomenon has transformed this activity, which was once strongly linked to the rural community that also practised it as a means of supplementing income, into an elitist and almost exclusively recreational activity.

4. Conclusions

This study analyses the value of the recreational hunting function in the Province of Siena using TCM. This is a function belonging to the CESs that, although representing a high economic and social value for the territory, is little-studied in comparison to other types of CESs (e.g., nature tourism) [16–18,56,57]. Therefore, the study represents a useful upgrade in the literature of the sector, both for the Italian national context where the recreational activity of hunting is strongly practiced, and also for the European context where the growing importance of the ESs provided by farms is recognised through the progressive

importance of the European economic policy of Rural Development [76]. Moreover, the flexibility of the TCM methodology adopted, guarantees an easy replication both in other territorial contexts and for other scales, such as at the regional or national level [59]. In addition, the data collection carried out exclusively with online questionnaires had the undeniable advantage of being able to develop the study during the current pandemic condition, even if, with respect to the type of CES analysed (i.e., hunting function), it did not guarantee a uniform sampling with respect to the population of hunters. This is because a large proportion of users are pensioners or rural dwellers, who have a reduced computer culture compared to young people and city dwellers [69]. Furthermore, it was not possible to define a spatialisation of the data because the sample collected, although significant for the purposes of the study, did not allow for adequate representativeness at the municipal scale. In fact, the limited number of records attributable to each municipality in which hunting is practised does not allow a demand curve to be constructed for each municipality observed. Therefore, a larger sample would have made it possible to carry out geostatistical analyses and territorial downscaling approaches with at least municipal detail [77]. A further aspect, which was not voluntarily examined, was travel-time cost, which is an important cost component in recreational experiences involving travel over relatively long distances [37,38,41].

Despite the imperfections identified, however, the results obtained represent a valid reference in the economic analysis of the recreational-use value of hunting in the areas analysed. In addition, the use of TCM has made it possible to estimate the value of a rural area in monetary terms, allowing simple and clear communication not only to the scientific public but also to political referents and civil society, regarding the importance of this type of service for the territory [59]. Knowledge of the real value of an area in terms of all of its potential should be the starting point for an effective management and enhancement policy. Indeed, the need to incorporate CESs into political strategies and decision-making processes is now widely recognised. However, since a standardised approach to quantifying these services has not yet been defined [63], research similar to that of the present study can contribute greatly to the definition of models capable of applying sustainable approaches in different contexts with a view to optimising available resources and enhancing the territory.

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