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SIMULATED EXCHANGE VALUE METHOD: APPLYING GREEN NATIONAL ACCOUNTING TO FOREST PUBLIC RECREATION

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ABSTRACT

While applied national accounts are based on market costs and outputs, non-market valuation techniques yield estimates for consumer or Hicksian surplus. To integrate non-market values in national accounts we propose the Simulated Exchange Value method, which simulates the whole market (demand and cost functions) to obtain exchange values. We focus on forest public recreational services because they are relatively close to markets and have been frequently valued using non-market valuation techniques. We apply this method to the public visitor recreational services of the woodlands of *Alcornocales* Natural Park (southwestern Spain). We estimate the cost function using available data on government costs incurred in the provision of recreational services and we estimate the demand function through contingent valuation. Using both functions, we analyze two potential solutions for the simulated market: monopoly and perfect competition. The results show for monopoly and for perfect competition, respectively, a net operating margin of €0.74/ha and of €0.61/ha, and a total social income of €3.14/ha and of €3.23/ha.

JEL classification: H41, Q26, Q56.

Keywords: national accounts, total income, accounting prices, contingent valuation, environmental services.

Contents

INTRODUCTION

Research into economic valuation for unpriced environmental assets and flows mainly focuses on the demand side. Techniques are developed aimed at obtaining accurate and efficient willingness to pay/accept estimates that translate the unpriced consumption of environmental goods and services (hereinafter, environmental services) into a monetary value. This has given rise to numerous designs and elicitation formats in an attempt to identify and reduce potential effects and biases occurring in the valuation process (Welsh and Poe, 1998; Breffle and Rowe, 2002; Alberini et al., 2003). Although there is no doubt as to the importance of these aspects for environmental valuation (Loomis, 2005), less attention has been paid to the integration of the unpriced environmental values with market values in the conventional system of national accounts (SNA) (Kriström, 1999; Vincent, 1999; Kriström and Skånberg, 2001). This integration requires the whole market to be considered, i.e. the demand (consumption of environmental services) and supply (production function) side, since the provision of these environmental services relies on market costs usually incurred by government bodies and private non-profit organizations. Policy-maker decisions based solely on the demand side could be misleading since the cost function contains relevant information for forest policy and management designs.

However, while applied national accounts are based mainly on market outputs and cost exchange values, non-market valuation techniques yield estimates of consumer surplus or different types of Hicksian variations, which generally cannot be integrated homogenously with market exchange values accruing from market cost and output transactions[1]. Total income measurement requires both market and non-market values to be aggregated homogenously according to applied national accounting criterion (United Nations et al., 2003), that is, using real or imputed exchange values.

This paper uses the Agroforestry Accounting System (Campos, 1999 and 2000; Caparrós et al., 2003) to integrate homogeneously market and non-market values of forest public recreational services. Although this green accounting framework has been previously applied to the marketed and non-marketed activities of several forests and woodlands (Caparrós et al., 2003; Campos and Caparrós, 2006; Campos et al., 2007a; Campos and Caparrós, 2009), these studies assumed a linear demand function and fixed cost function for public recreational services. In this paper we analyze the public recreational services relaxing the two assumptions just mentioned and discussing the *pros* and *cons* of different payment-vehicles for estimating the non-market values.

However, our main focus is a detailed discussion of the Simulated Exchange Value (SEV) method (Caparrós, 2000; Caparrós et al., 2003; Campos and Caparrós, 2009), which imputes an exchange value (price times quantity) for the environmental services derived from a single point on the demand curve, instead of using consumer or Hicksian surplus measures. We estimate this exchange value using the cost and the demand functions for two potential market solutions: monopoly and perfect competition.

We apply this proposal to the public visitor recreational services of the protected woodlands of *Alcornocales* Natural Park (ANP), which is located in the Andalusia region (southwestern Spain). The results show for monopoly and for perfect competition, respectively, a net operating margin of €0.74/ha and of €0.61/ha and a total social income of €3.14/ha and of €3.23/ha.

The next section describes the methodological framework: the Agroforestry Accounting

1 When using a voluntary contribution as the payment-vehicle there is no consumer surplus because it is possible for it to be collected entirely in the simulated market.

System, the applied CV and the SEV method. Then we present the results and discuss the methodological framework and the implications of the applied results for the potential market of public recreation in ANP. We close with the conclusion section.

Methodology

In Spain in general and in ANP in particular, most woodlands are privately-owned and landowners have the right not to allow the public free-access. However, public recreation exists because public roads partially cross private properties and free access to visitors is provided in the case of some woodland owned by regional or local governments. Thus, recreational services are of free access but not cost-free since part of the regional and/or local government budgets is devoted annually to their provision.

For the ANP case study, governments' market costs (expenditure) associated with public recreation have been estimated through interviews with managers and enterprises involved in the ANP public recreational activities. These costs come from four activities carried out directly or funded by the regional government in ANP: visitor center management, forest warden services, and infrastructure maintenance and construction (only for replacement). We assume that the ANP visiting rate is not high enough to produce congestion and other environmental "bads" (e.g., wildlife disturbance) that need to be estimated as environmental costs. We estimated the unpriced output from these activities through a CV survey of public visitors. Market outputs (e.g., internal investment) were estimated following national accounting criterion. All estimations correspond to 2002 and are presented in euros per hectare. Costs and outputs are then integrated in the Agroforestry Accounting System.

- The Agroforestry Accounting System

The Agroforestry Accounting System (AAS) extends the Economic Accounts for Agriculture and Forestry (Eurostat, 2000) integrating homogeneously and for overall activities non-market outputs and their associated market costs to estimate the total social income (Campos, 1999 and 2000; Caparrós et al., 2003). The AAS applied to the ANP public recreational services employs the production account and the fixed capital balance for this purpose[2].

The production account incorporates all economic flows (outputs and costs) from the recreational activity in the accounting period (one year). The final output (FO)[3] is disaggregated into gross internal investment (GII) and recreational services (RS). The total cost (TC) includes labor (L)[4], intermediate consumptions (IC) and fixed capital consumption (FCC). The difference between FO and TC gives the capital net operating margin (NOM) of the activity:

$$NOM = FO - TC = GII + RS - L - IC - FCC. \quad [1]$$

2 The AAS also employs the work-in-progress balance that accounts for variations in the goods produced during more than one accounting period. This balance account refers to goods such as timber and crops but there are no final goods such as those for the ANP public visitor recreational services.

3 There is no intermediate output (IO) associated with the ANP public visitor recreational services.

4 No self-employed labor is used in the ANP public visitor recreational services activity.

The fixed capital balance records the variations in man-made (machinery, equipment and infrastructures) and natural (land) durable assets involved in the operating process during the accounting period. This account considers the initial fixed capital (FCi), the internal (FCie) and external (FCee) fixed capital entries, and the final fixed capital (FCf) associated with the public recreational services during the accounting period. The FCi and the FCf can be man-made (FCi_{MM} and FCf_{MM}) or land (FCi_L and FCf_L). No capital entries are associated with the land during the accounting period, then $FCi_L = FCf_L = FC_L$. The fixed capital revaluation (FCr) is the residual value of this account:

$$FCr = FCf - FCi - FCie - FCee. \quad [2]$$

From these two accounts, we estimate the total social income (TI), or Hicksian income, as the sum of the net value added (NVA) and the social capital gain (CG) in the accounting period (Caparrós et al., 2003). The NVA, measured as the remuneration of production factors, is the sum of L and NOM. The CG is the sum of FCr and FCC. We add FCC to the GC to avoid double accounting since it has already been considered in the TC and, implicitly, in the FCr:

$$TI = NVA + CG = L + NOM + FCr + FCC. \quad [3]$$

In our application, we assume that prices are constant during the accounting period and that the activities are in steady-state, implying that machinery, equipment and infrastructures are perfectly divisible and constantly replaced. Thus, for the recreational activity, GII is equal to the replacement cost of the fixed capital consumption (FCC), FCC equals −FCr[5] and there is no CG. Therefore, TI is equal to NVA (Campos and Caparrós, 2006)[6].

From the AAS, we estimate the capital profitability rate (r_c) based on the capital income (CI)[7] and on the immobilized commercial capital (IMC) figures. The IMC represents the average value of the commercial resources used in the accounting period. It is calculated on the basis of those resources incurring a social opportunity cost. Thus, since the land associated with public recreation has no opportunity cost[8], the formula for the IMC only includes initial man-made fixed capital (FCi_{MM}), external fixed capital entries (FCee), intermediate consumption (IC) and labor (L):

$$IMC = FCi_{MM} + 0.5*(FCee + IC + L). \quad [4]$$

The r_c is estimated dividing the CI by the IMC. Due to the steady-state assumption, r_c is equal to the operating profitability rate (r_o):

$$r_c = CI/IMC = NOM/IMC = r_o. \quad [5]$$

The land capital value (FC_L) associated with the public recreational services of ANP is not known since these services are consumed in public land that is not marketed. Thus, no direct market value for FC_L can be estimated. The only way to estimate a value for FC_L is by discounting the social capital income deriving exclusively from the land (land capital income), assuming that it is constant over an infinite time horizon. The land capital income is the capital income

5 We assume there are no sudden fixed capital destructions (FCd).

6 This TI does not consider subsidies net of taxes.

7 The CI is the remuneration of the government capital investment and is calculated adding the CG to the NOM. Due to the steady-state assumption, the CI equals the NOM.

8 Output from land as natural asset for recreational services is a joint production factor with market output from land. We assume that governmental bodies did not buy land exclusively for recreational purpose at ANP.

that remains when the remuneration of the immobilized commercial capital is removed from the total value of the capital income. In perfect competition, since the capital income only remunerates commercial capital (see below), the land capital income is zero. In monopoly, the land capital income is the difference between the total capital income and the part of this capital income that remunerates the immobilized commercial capital.

- Contingent valuation

In the CV survey, ANP public visitors were asked to indicate their willingness to pay (WTP) for their day-visit to the ANP rather than forgo it. We used a simple-dichotomous (SD) question formulated using as the payment-vehicle either an increase in the trip-expenditure (trip-expenditure question) or an entrance-fee (entrance-fee question) (see Appendix for the wording of the questions). This question was followed-up by an open-ended question in order to identify protest responses (when respondents gave a zero amount or "don't know/don't answer" to this open-ended question, they were asked the reason for their answer).

The entrance-fee payment has been widely used for valuing free-access recreational use in forests and woodland. However, since the establishment of entrance-fees for accessing forests and woodland is not a common practice in Spain, respondents may reject this payment-vehicle or act strategically. As shown by Campos et al. (2007b), within the Spanish context, the trip-expenditure question (Bishop and Heberlein, 1979; Cooper and Loomis, 1992; Boyle, Welsh and Bishop, 1993) is a better alternative.

We estimate logit regressions and mean WTP values for the SD question following Cameron (1988; 1991). We do not use additional explanatory variables for these regressions because the WTP from the models without additional explanatory variables is an unbiased estimator of the WTP from the models that include explanatory variables (McFadden and Leonard, 1993) and because it permits to use the highest number of observations available from the survey. We present models including protest zeros (D model) and without protest zeros (DP model). A detailed analysis of these CV questions and their corresponding models with explanatory variables can be found in Oviedo et al. (2005) and in Campos et al. (2007b).

For the design of the survey we established two focus groups, and a pre-test survey made to 115 ANP public visitors through face-to-face questionnaires. In the pre-test, we used open-ended questions to obtain the bid vector for the SD question. The final survey included 900 completed questionnaires that were conducted face-to-face in ANP public recreational areas and tracks between June 2002 and May 2003.

- Simulated Exchange Value (SEV) method

The central normative national accounts framework (United Nations et al., 2003) proposes the use of prices from similar markets as a first alternative when no direct market prices for environmental services are observable. Hultkrantz (1992) and Matero and Saastamoinen (2007)

apply this method to non-timber products partially traded in markets in Sweden and Finland, respectively. When no price from similar markets exists, the temptation is to use consumer surplus or any other Hicksian surplus measurement obtained with non-market valuation to integrate environmental services' output values in accounting systems. However, these measurements involve the assumption that all consumers of these services would pay their maximum WTP in the simulated market. This is too strong an assumption if the objective is to simulate a market and to obtain an exchange value to be integrated in national accounts.

Some applied studies employ welfare measurements as output values for environmental services jointly with other market values (Skånberg, 2001), even though this inconsistency has been highlighted in the literature. United Nations et al. (2003: 407) state that "[…] contingent valuation […] gives an average willingness to pay figure which includes an element of consumer surplus […]. This poses a problem […], since the national accounts exclude consumer surplus." Cairns (2008: 420) points out that "NNP [*net national product*] is defined net of consumer's surplus […]. Rather, national-accounting prices are market price, usually defined at the margin", and Cairns (2003: 59) states that "[…] the analyst should recognize that incorporating consumers' surpluses into the values of environmental goods makes them non-comparable to other goods in net national product".

The SEV method (Caparrós, 2000; Caparrós et al., 2003; Campos and Caparrós, 2009) proposes to simulate prices for cases where neither direct market price nor prices from similar markets exist, e.g., the public recreational services of ANP. This method makes use of the cost (supply) and demand (estimated through non-market valuation) functions of the studied environmental services in order to calculate their potential output exchange value (price times quantity) from a single point on that demand curve. Thus, the potential price is estimated based on the value sought for the economic variable considered relevant in the market simulation analyzed (e.g., revenues, capital profitability, etc.). This simulated price (P) multiplied by the corresponding quantity (Q) gives the output exchange value to be integrated in the AAS as a non-market output.

For the ANP public recreational services simulated market, the relevant variable is the capital profitability rate (r_c) sought by the woodland manager/owner in each market solution analyzed. In a monopoly, the price (P) is set to maximize the capital profitability rate ($r_{c\text{-}mp}$). In perfect competition, the recreational services would be marketed only if the price (P) resulted in the minimum desired capital profitability rate ($r_{c\text{-}pc}$), below which the woodland manager/owner would not be interested in entering the market as she/he would incur losses[9]. Thus, the price for the recreational services would be between the two prices, resulting in $r_{c\text{-}mp}$ and $r_{c\text{-}pc}$, respectively. To the recreational services output exchange value, we add the value of the gross internal investment of the corresponding point in the cost function to obtain the final output value for the public recreational services (see Methodology).

For constructing the variable cost function, we assume that in ANP all costs associated with the construction of visitor centers and recreational infrastructures as well as with the management of visitor centers are fixed, since they are spent as soon as the recreational activities start. The remaining costs (forest warden services and maintenance of recreational infrastructures) are

9 Based on Pearce (1993), we choose for our case study a minimum social rate of 2.5% for this type of investment. Although the election of this rate is arguable, it does not affect the purpose of presenting our methodological accounting framework and allows for performing the application.

assumed to increase with the number of visits to ANP, since the more visits there are, the more wardens are needed to control recreational activities and the more resources are required for infrastructure maintenance. The unavailability of temporal panel data for these costs has meant that we have had to assume that they grow linearly with the number of visits until the total cost of the ANP recreational activities in 2002 are reached.

Case study

Alcornocales Natural Park (ANP) is Mediterranean woodland located in southwestern Spain, in the Andalusia region. In 2002 it covered 170,025 hectares (at present it covers 167,767 hectares) in a humid area, with an average annual rainfall of 620 mm, with not very high mountains (the highest peak, *El Aljibe*, reaches 1,087 m). Almost 50% of its surface corresponds to pure cork oak stands. Cork extraction, grazing and hunting as well as recreational and ecological functions (e.g., it is the last woodland where birds stop in their migration to Africa) are important in ANP. In 1989, ANP was declared a protected "Natural Park", a category similar to the V protection category for natural areas of the International Union for the Conservation of Nature (IUCN, 1994).

Results

Of the 900 CV questionnaires completed, 450 included the trip-expenditure question and 450 the entrance-fee question (Table 1). The invalid answers due to protest[10] were significantly higher in the entrance-fee question (Z statistic = 9.00), whilst the "don't know/don't answer" responses did not vary significantly between both question types (Z statistic = 0.54)[11] (Table 1). Table 1 also shows the bid vector used in the SD question.

[Table 1]

Table 2 reports regression coefficients and mean WTP results of the SD question models for each wording (trip-expenditure or entrance-fee). To avoid possible effects derived from the trip-expenditure question, we removed from these models the value ascribed to other natural areas visited in the same day and to the round trip to ANP, which represents 3.1% of the value (Campos et al., 2007b). In Table 2 we have reduced this percentage from the original values of the intercept parameters and of the mean WTP. For the entrance-fee models, we do not reduce these values since the entrance-fee only affects the area where it is established. In addition, as Campos et al. (2007b) shows, the effects of this payment-vehicle reduce the WTP and are already incorporated in the respondents' answers.

Based on Campos et al. (2007b), the preferred model is the DP model for the trip-expenditure question, offering a mean WTP of €21.52/visit (Table 2). To obtain the demand curve for this model, we use the distribution function of the logit regression. This function offers the probability that a certain bid (price) is paid, which represents the proportion of recreational visits that

10 The protest responses were *Natural areas should have neither boundaries nor limitations*, *It is a public area and we do not have to pay*, *We should not have to pay to enjoy natural areas* and *We already pay enough taxes*.

11 In both tests, the critical value for the *Z statistic* at the 5% level is 1.96. We did not use a χ^2 test because at least one term of the contingency matrix had an expected frequency below 5.

would pay that price. Thus, in the logit distribution function, we replace the probability value by the corresponding percentage of visits (Q). For setting Q, we need to know the total number of visits that the ANP received in 2002. The information obtained from the CV survey and from interviews with ANP managers permitted to estimate a total of 80,715 public visits in 2002 (Oviedo et al. 2005).

Thus, the demand curve for the trip-expenditure DP model takes the following form: $Q = 1/1 + \exp(-2.5960 + 0.1206 * P)$, where P is the price for the recreational visit (the bid in the CV question). Since we are interested in estimating the price that would be paid for a certain number of visits, we isolate P to the left-side of this equation, and we obtain: $P = \left[\ln\left(Q/80,715 - Q\right) - 2.5960\right]/-0.1206$. In the function, Q ranges from 0 to 80,715 and the demand curve will offer the P that would be paid by any point of Q in the simulated market. This function is represented graphically in Figure 1.a.

On the supply side curve, the total cost (TC) function takes the following form: $TC = 635,893.50 + (9.54 * Q)$. Based on this function, we obtain the gross internal investment (GII) function, which is part of the final output and has the following linear form: $GII = 201,430.32 + (1.79 * Q)$. These two functions are expressed in euros but final numbers are presented in euros per hectare. Figure 1.b shows the final output function simulated with the trip-expenditure question and the total cost function. Both functions provide the solution for the market simulations (points A and B; see below).

[Figure 1.a and 1.b]

In the case of the entrance-fee question, the DP is also the preferred model with a mean WTP of €11.03/visit (Table 2) and the demand curve takes the following form: $P = \left[\ln\left(Q/80,715 - Q\right) - 1.5272\right]/-0.1384$. This curve is shown in Figure 2.a. The TC and GII functions are the same as those in the trip-expenditure scenario because the payment-vehicle only affects the demand for recreational services. Thus, Figure 2.b shows the final output function simulated with the entrance-fee question and the total cost function. In this figure, we see that the demand never covers the recreational services' provision cost and the net operating margin is negative for any point of Q (Figure 2.b). Therefore, the entrance-fee scenario has no solution for the market simulation.

[Figures 2.a and 2.b]

This is one of the reasons why further AAS and income analysis in the paper will focus on the results of the trip-expenditure model for the demand side. In addition, Campos et al. (2007b) show that for obtaining true WTP values when valuing free-access recreational services in Spanish forests and woodlands and in ANP in particular, the trip-expenditure payment vehicle is a better option than the entrance-fee.

For each market solution analyzed (monopoly and perfect competition) with the increase in trip-expenditure scenario, we work with the function for the capital profitability rate: $r_c = CI/IMC = NOM/IMC = \left(FO - TC\right)/IMC$, estimated based on the demand and the cost functions. Substituting in equations [4] and [1] the values for the corresponding variables, the function for r_c is:

$$r_c = \frac{13.78 \cdot Q - 434,463.18 - \left(\frac{Q}{0.1205} \left[\ln\left(Q/80715 - Q\right) \right] \right)}{3,974,784.09 + \left(3.87 \cdot Q\right)}$$

In the monopoly solution, which implies maximizing this r_c ($r_{c\text{-}mp}$), Q is set at 36,322 visits for a P of €23.20/visit (point A in Figure 1.a). In perfect competition, the solution involves to estimate the Q and the corresponding P that offers the minimum capital profitability rate ($r_{c\text{-}pc}$) required to enter the market, set at 2.5%. This occurs at point B in Figure 1.a, for a Q of 44,393 visits and a P of €19.87/visit. Figure 1.b shows the corresponding points A and B in the final output function and total cost function for each market simulation. The difference between the final output and the total cost is higher (higher net operating margin) in the monopoly solution point (Figure 1.b).

Table 3 shows the main AAS indicators for monopoly and perfect competition. The recreational services output represents 76% of the final output in both cases and this final output is 1.13 higher than the total cost in monopoly and 1.10 times higher than the total cost in perfect competition. Labor represents the main source of the total cost (42%) in both solutions. In monopoly, the recreational services' net operating margin is €0.74/ha and when we add labor we obtain a net value added of €3.14/ha. In perfect competition, the net operating margin is €0.61/ha and the net value added is €3.23/ha (Table 3).

As expected, the net operating margin's contribution to the net value added is higher in monopoly (24% as opposed to 19%), whilst labor's contribution to the net value added is higher in perfect competition (81% as opposed to 76%). In perfect competition, the lower capital profitability results in a market with more recreational visits at a lower price and higher total cost as a consequence of these additional visits. However, the net value added is higher in this market solution since the higher labor compensates the lower net operating margin in respect to the monopoly solution.

[Table 3]

The fixed capital balance (Table 4) shows that the public recreational services in ANP rely considerably on man-made capital since initial and final man-made fixed capital reach a value of €22.10/ha in both market solutions. For this man-made capital, the only difference between the fixed capital balances for each market solution comes from the different internal fixed capital entries (Table 4). Land capital value only exists in monopoly, with a value of €5.20/ha (Table 4), which has been calculated by discounting the land capital income (the difference between the capital income from monopoly and the capital income from perfect competition) at the rate of 2.5%. Immobilized commercial capital in the accounting period is €24.20/ha in monopoly and €24.39/ha in perfect competition (Table 3). Thus, we obtain the result that the maximum achievable r_c is 3.1%; whilst in perfect competition, r_c matches the established 2.5% (Table 3).

[Table 4]

DISCUSSION

Our accounting framework goes beyond simply reporting non-market output values obtained with CV or other related techniques, as is usually done in the literature of non-market valuation, and, using the SEV method, we estimate the total social income from forest public recreation, since we incorporate the supply and other market output. However, this methodological framework still presents some shortcomings, which we discuss now, together with the results from our application to the ANP.

We have simulated a variable cost function, estimated on the basis of the ANP public visits in the studied year. Although this simulation allows for estimating the cost associated with a concrete number of visits paying a price, it relies on linearity assumptions as to growth in the variable cost and presents some problems, especially in the first segment of the function. As a solution, we could have assumed that all costs are fixed but that would have involved a probable underestimation of the total income. The variable cost function allows for a more complete analysis of the potential market values associated with public recreational services, which is what made us use this function. However, we consider that further research and discussion on this issue are required.

Another shortcoming is the fact that we worked in a partial equilibrium model. Since we used a market simulation, the money not currently paid for the environmental services, if actually paid, would have to be taken from other sectors of the economy. This could change the relative prices of the economy, thus impacting on other sectors. However, the payments would probably be small and therefore have a modest impact on relative prices and, in addition, national accounts already include imputed values for services for which no money is paid, such as those provided by owner-occupied housing. To keep gross domestic product invariant as to whether a house is owned or rented, national accounts treat home ownership as if the owner-occupants rent their homes to themselves (BEA, 2007).

Accepting these shortcomings, our application shows that when using the trip-expenditure CV question, the provision of public recreation in ANP was justified economically in 2002 by the generation of a positive social total income in both market solutions analyzed. This criterion for assessing the provision of environmental services can be considered in absence of irreversibility, as is the case here. Otherwise, *minimum safe standard* or *maximum tolerable cost* criteria would be more appropriated (Bishop, 1978).

The two markets solutions analyzed in our simulation represent two boundaries, a maximum and a minimum capital profitability rate for the forest manager/owner. However, one question remains: which one of these two solutions for our application would be closer to reality? In the monopoly solution, the valued services have to be of a unique nature, implying no competition in the market. This assumption can be defended in our case study since the ANP is a relatively unique environmental asset with a considerably large extension. The *Grazalema* and *Doñana* Natural Parks, the closest significant natural areas in the region, are relatively different ecosystems. The former is a limestone and rocky landscape with groves of oak woodlands. The latter is a wetland with groves of stone pine forest. It is likely that these two areas would not affect the public visitor's decision to pay for visiting ANP due to the differences that make the three of them different environmental assets. In addition, our survey shows that 78% of the surveyed visitors were from *Cádiz* (the province where ANP is located), which implies the predominance of short visits of no longer than one day. This reduces the impact of potential substitutes because the long distances needed to reach them would imply a type of recreational visit different than the current one. The survey also shows that only 40% of the respondents

were aware of an area similar, and at relatively the same distance, to ANP.

The perfect competition case offers a solution in which the presence of multiple substitutes would imply that the woodland manager/owner was price taker given the market equilibrium. This solution would be less likely in ANP, due to the absence of competition, as discussed above. However, it is important to note that, following the criterion of the public manager for ANP recreational activity, perfect competition could be the solution. In this case, acceptance of the minimum profitability rate would involve a lower price for the recreational visit and an increase in the number of visits to ANP, which would generate more surplus. In any case, further research into these market solutions is needed. It is necessary to work with different valuation scenarios for supply and demand and to consider alternative solutions, such as monopolistic competence.

Although our application focuses in a publicly-managed land, the results are also relevant for private landowners interested in this potential market. Comparing the two payment-vehicles used, there is some evidence that the institutional context drive public visitors, when faced with the entrance-fee question, to state a WTP that is lower than their real one (Campos et al., 2007b). Thus, when this valuation scenario is used, there is no potential market for recreational services. It can be argued that this reduction in WTP could be translated to a real WTP if a payment for the recreational visit were actually implemented through an entrance-fee. However, it can also be argued that after a period of adaptation to the new context, the public visitor WTP would adjust to the real maximum one which is believed to be obtained with the trip-expenditure question. In this case, the results for this payment-vehicle are more useful for the landowners within a long-term perspective.

CONCLUSIONS

This paper has discussed the Simulated Exchange Value method, which allows for integrating homogenously market and non-market economic values into any national accounting system to measure the total social income derived from environmental services. We have focused on the integration of forest public recreational values in the Agroforestry Accounting System but similar values could be integrated in alternative accounting systems with minor variations in the method. This represents an advance in the incorporation of environmental services in national accounting to estimate national income, employing non-market valuation methods that reflect social preferences instead of attributing subjective values to these services.

The application of these methods to the public recreation of ANP shows that when the non-market output exchange value is estimated through the increase in trip-expenditure CV question, the total social income is positive in the two markets solution analyzed: monopoly and perfect competition. The use of simulated variable cost allowed for a more flexible analysis of the simulated markets and offered an approximation of the different output and cost exchange values in each market solution.

The applied CV survey has shown that the WTP obtained with the entrance-fee question seems to be affected by visitors' rejection to this payment-vehicle and that for this payment vehicle the simulated market would not take place. It is important that this be taken into consideration within the context of the potential implementation of a market for recreational services in ANP or in any other free-access forest and woodland. Performance of the CV survey with the entrance-fee and increase in trip-expenditure payment-vehicles provided us (and landowners and managers) with more information about a potential recreational services market. However, evidence exists to show that the trip-expenditure question is better to elicit true WTP values within the analyzed context.

National accounting can be extended to include non-market environmental services provided by forests or other ecosystems when appropriate valuation techniques are used and when the supply side is considered in order to use the SEV method. This integration has to observe national accounting criteria for being able to estimate a homogenous total income figure associated with environmental services not traded in markets but which form part of consumers' utility function when they are willing to pay for them. Future research must focus on the potential of the presented methods for other environmental services and ecosystems so as to keep extending national income measurement to the contribution of nature and the environment.

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TABLES AND FIGURES

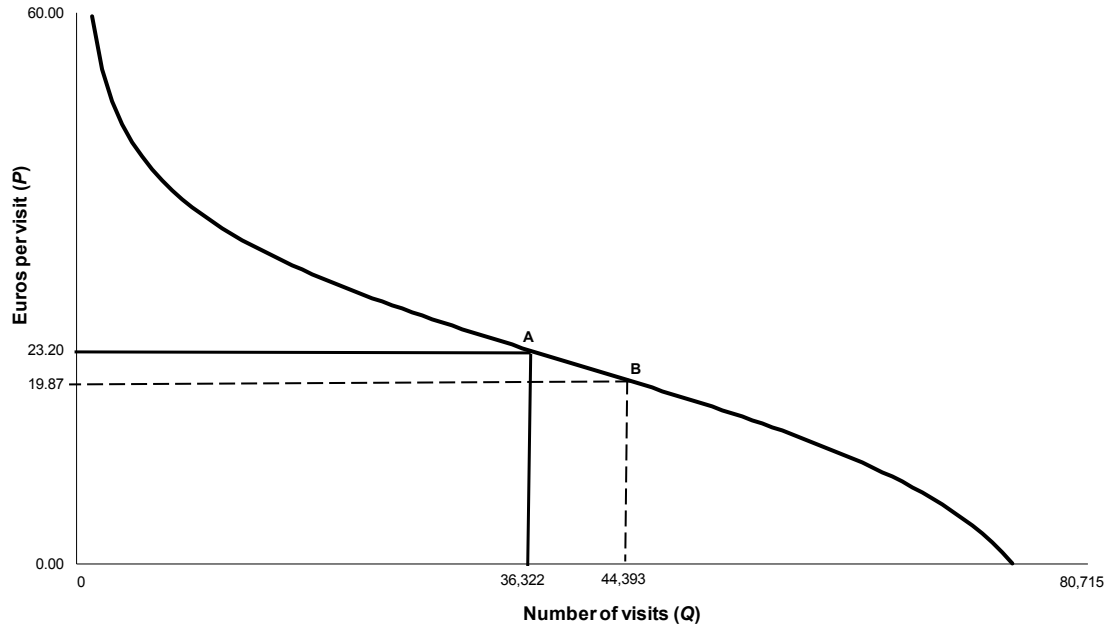

Figure 1.a. Demand function for the public visitor recreational services of *Alcornocales* Natural Park (trip-expenditure DP model)

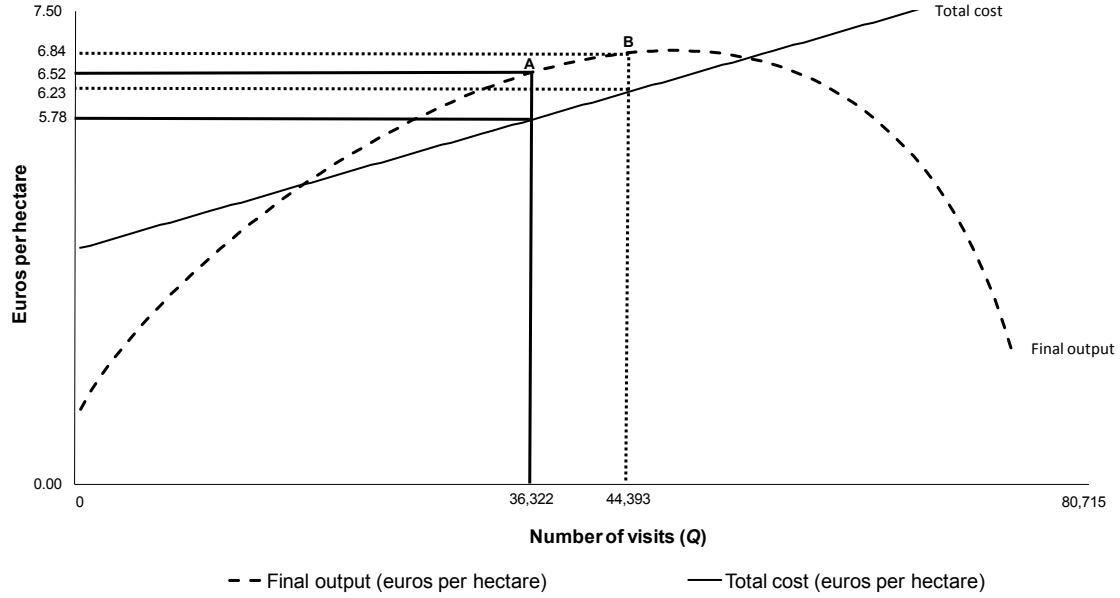

Figure 1.b. Total cost and final output functions for the public visitor recreational services of *Alcornocales* Natural Park (trip-expenditure DP model)

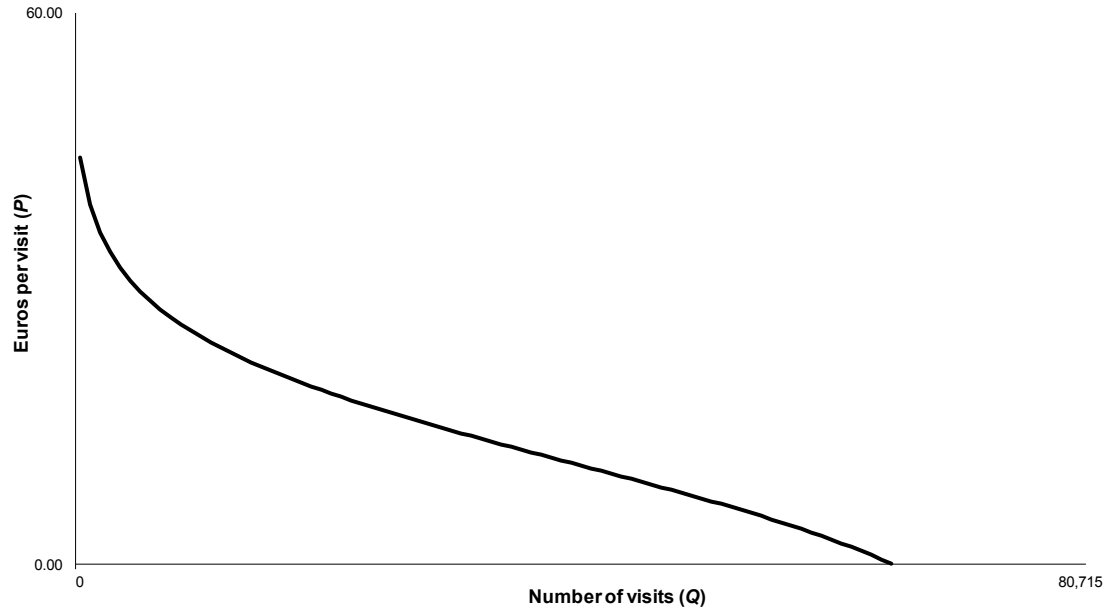

Figure 2.a. Demand function for the public visitor recreational services of *Alcornocales* Natural Park (entrance-fee DP model)

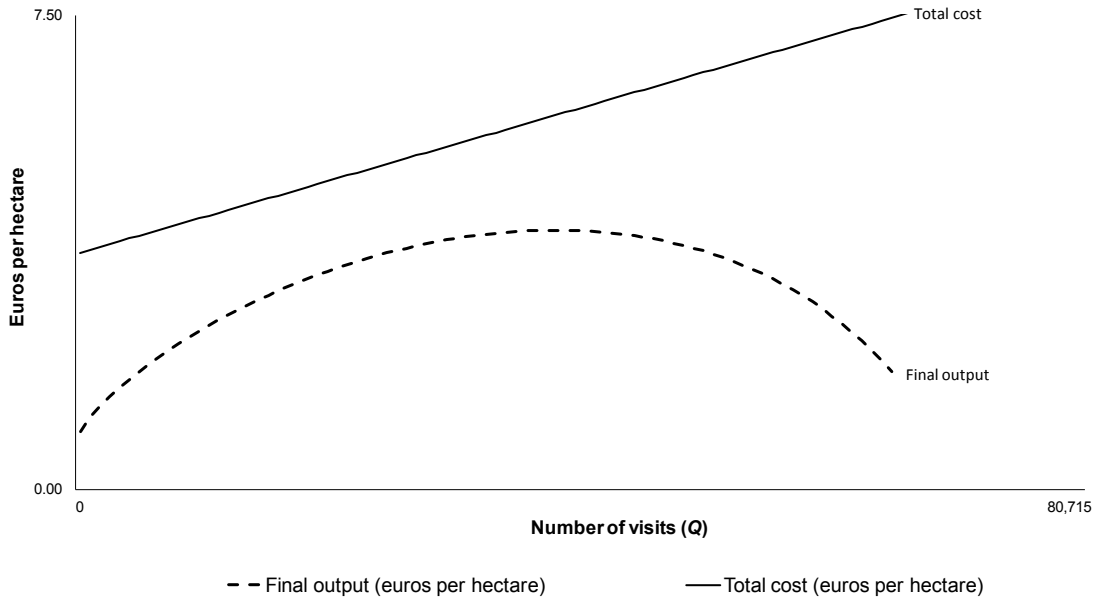

Figure 2.b. Total cost and final output functions for the public visitor recreational services of *Alcornocales* Natural Park (entrance-fee DP model)

Table 1. Contingent valuation survey for the public visitor recreational services of *Alcornocales* Natural Park

Class	Trip-expenditure question	Entrance-fee question
Completed questionnaires	450	450
Invalid answers (%)	5	24
Protest response (%)	3	23
Don't know/don't answer (%)	2	1
Bid (€ per-visit)	€1, €2, €4, €8, €15, 30€	€1, €2, €4, €8, €15, 30€

Table 2. Contingent valuation results. Regression models and mean willingness to pay values (estimations without explanatory variables)

Class	Trip-expenditure question [(a)]		Entrance-fee question [(a)]	
	D model	DP model	D model	DP model
Intercept	2.3076***	2.5960***	0.7836***	1.5272***
	(0.1999)	(0.2225)	(0.1500)	(0.1879)
Bid	-0.1118***	-0.1206***	-0.1213***	-0.1384***
	(0.0119)	(0.0126)	(0.0155)	(0.0176)
Mean willingness to pay (€ per-visit)	20.64	21.52	6.46	11.03
	(1.42)	(1.41)	(0.88)	(1.01)
n	444	429	442	340

n: observations

Standard errors are shown in brackets.

[(a)] The D model is simple-dichotomous and includes all valid answers; the DP model is simple-dichotomous and excludes protest-responses.

Table 3. Indicators of the Agroforestry Accounting System for the public visitor recreational services of *Alcornocales* Natural Park. Monopoly and perfect competition (2002 €/hectare)

Variable	Monopoly	Perfect competition
Final output (FO)	6.52	6.84
Gross internal investment (GII)	1.56	1.65
Recreational services (RS)	4.96	5.19
Total cost (TC)	5.78	6.23
Intermediate consumption (IC)	1.80	1.94
Labor (L)	2.40	2.62
Fixed capital consumption (FCC)	1.58	1.67
Net operating margin (NOM)	0.74	0.61
Net value added (NVA)	3.14	3.23
Capital profitability rate (r_c)	3.1%	2.5%
Immobilized commercial capital (IMC)	24.20	24.39

Table 4. Fixed Capital Balance for the public visitor recreational services of *Alcornocales* Natural Park. Monopoly and perfect competition (2002 €/hectare)

Variable	Monopoly			Perfect competition		
	Land	Man-made	Total	Land	Man-made	Total
Initial fixed capital (FCi)	5.20	22.10	27.30	0.00	22.10	22.10
Fixed capital entrances (FCe)	-	1.58	1.58	-	1.67	1.67
Internal (FCie)	-	*1.56*	*1.56*	-	*1.65*	*1.65*
External (FCee)	-	*0.02*	*0.02*	-	*0.02*	*0.02*
Final fixed capital (FCf)	5.20	22.10	27.30	0.00	22.10	22.10
Fixed capital revalorization (FCr)	0.00	-1.58	-1.58	0.00	-1.67	-1.67

Appendix: Contingent valuation questions

Entrance-fee question

[Imagine that, besides the funding already allocated by Government for the management of recreational areas, reception centers and paths (maintenance and surveillance), these infrastructures partly depended on money paid by visitors.]

Would you pay an entrance-fee (ticket) per person of …… euros (……pesetas) to access the recreational areas and paths rather than forgo the enjoyment provided by today's visit? Bear in mind that we are asking you to imagine a real payment, and that whatever you spend you would then be unable to spend on other things, and if you did not wish to pay an entrance-fee to access the recreational areas and paths you could still use public roads.

□ yes □ no □ don't know

Trip-expenditure question

[As you know trip-costs have changed in the last decades (i.e. gas prices have gone up and down relatively independently of generalized increases in prices and live costs). Now we are going to ask you to imagine that total expenditures of your visit increase for this reason, even though you realize exactly the same activity you have done (same transport, same food ...).]

If the total expenditures of your visit today would have been ..... euros per person (……. pesetas) more than the quantity you have just calculated, would you still have come today? Bear in mind that we are asking you to imagine a real payment and that whatever you spent you would then be unable to spend on other things.

□ yes □ no □ don't know

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