The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Valuing Externalities of Watershed Restoration and Erosion Control Projects in Mediterranean Basins: A Comparative Analysis of the Contingent Valuation and Replacement Cost Methods

María del Carmen Almansa Sáez
E-mail: calmansa@jazzfree.com

Javier Calatrava Requena
E-mail: javcal@arrakis.es

Paper prepared for presentation at the Xth EAAE Congress
'Exploring Diversity in the European Agri-Food System',
Zaragoza (Spain), 28-31 August 2002

Copyright 2002 by María del Carmen Almansa Sáez and Javier Calatrava Requena. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

VALUING EXTERNALITIES OF WATERSHEAD RESTORATION AND EROSION CONTROL PROJECTS IN MEDITERRANEAN BASINS: A COMPARATIVE ANALYSIS OF THE CONTINGENT VALUATION AND REPLACEMENT COST METHODS

Almansa Sáez, María del Carmen(1) y **Calatrava Requena, Javier**(2)

(1) Dpto. Gestión de Empresas. Universidad Pública de Navarra. Campus de Arrosadía s/n. 31.006 Pamplona. Tel. ++ 34 948 169378. Fax ++ 34 948 169404.
E-mail: calmansa@jazzfree.com

(2) Dpto. Economía y Sociología Agrarias. Centro de Investigación y Formación Agraria. Camino Purchil s/n. 18.080. Granada. Spain. Tel. ++ 34 958 267311. Fax. ++ 34 958 258510. E-mail: javcal@arrakis.es

SUMMARY

The methodology used for Economic Valuation of the Externalities generated by the Watershead Restoration and Erosion Control Projects in the Hydrographic Basins of the Mediterranean Slope, is based on the Replacement Cost Method. Environmental Economics, however, today offer us other methodological possibilities, whose application to the valuation of this type of project may prove to be of interest. It is the case of the Contingent Valuation Method used for the evaluation of the effects of the Watershead Restoration and Erosion Control Projects of the *Aljibe* Basin (Almería) Spain, presented here. The results obtained show that, in this case study, application of Contingent Valuation ascribes greater social profitability of the project, with 5.23 % of IRR (Internal Rate of Return), compared to the value obtained using classic methodology of 2.25%, thus enabling us to draw closer to the true socio-environmental value of this type of project. In any case, both possibilities rather than alternatives can be considered as complementary, by focusing on the valuation from different perspectives.

KEYWORDS: contingent valuation, replacement cost, cost-benefit analysis, restoration of basins, desertification, reforestation.

VALUING EXTERNALITIES OF WATERSHEAD RESTORATION AND EROSION CONTROL PROJECTS IN MEDITERRANEAN BASINS: A COMPARATIVE ANALYSIS OF THE CONTINGENT VALUATION AND REPLACEMENT COST METHODS

1. INTRODUCTION

In the Hydrographic Basins of the Mediterranean Slope, Basin Organisation practices are mostly directed towards soil protection, control of floods and refilling of aquifers. It concerns areas where water is positively scarce and desertification problems pose a serious threat to the natural heritage of future generations. Nevertheless, as these efforts are of special importance in this zone, the profitability indices obtained in the traditionally used practices of Economic Valuation (cost-benefit analysis), insufficiently reflect the real value given by today's society to the environmental externalities favoured by this type of project.

The difficulty of the economic valuation of the Watershead Restoration and Erosion Control Projects is well known, in all its phase: the identification of many of its effects, it quantification in physical terms and subsequently its valuation in economic terms. This is because a large proportion of the effects of these projects are externalities (also known as intangible effects); that is, there is no market for them and, therefore, they do not have a price. Examples of this are the contribution of tree cover to the conservation and improved quality of soil, the transcendental role of the tree masses in oxygen and carbon dioxide cycles, or the beauty of many forest landscapes.

The methodology valid today and usually used in Spain by Forestry Engineers to economically evaluate some of the externalities of the Restoration Projects of Basins is based on the model by J. Aguiló Bonnin (Aguiló, 1976; *Dirección General de Medio Ambiente* (General Environmental Committee), 1985; ICONA, 1987), which applies what is called the Replacement Cost Method (RCM). The basic points of the method consist in supposing that, as the absence of restoration works determines the annual and continual appearance of a series of damages, the correction of that damage would require annual investment; and that, by avoiding the restoration works that may be incurred with such costs, its total is a suitable measure of the benefit of investment. The model considers five beneficial effects of the investment in soil conservation: a) the preservation of soil quality; b) the prevention of physical damage to the soil; c) the increase in water availability through greater infiltration; d) the increase of water availability through surface storage; and e) the prevention of damages in dominated zones.

In parallel, as J. Aguiló recognises, there are other benefits of restoration he fails to include in his analysis due to the impossibility of their valuation, and that in fact may be more conclusive when deciding on the project, such as: the safety of human lives and population nuclei; increase of productivity in farming zones; avoidance of damage to infrastructure; saving of social costs due to floods; and refilling of aquifers; among others.

The Replacement Cost Method (RCM), on which the Aguiló Model is based, pertains to the so-called *Non-Demand Curve Approaches*, among which the following methods are also included: the effect on production or opportunity cost, the dose-response method, the preventative expenditure method and the averting or mitigating behaviour method. With other emphasis on valuation, in recent decades, in the heart of the Environmental Economics, the so-called *Demand Curve Approaches are developing*. The following are found within this latter approach: a) the so-called *expressed preference methods*, which rely on carefully structured surveys to elicit people's preferences about natural resources (contingent valuation methods and choice experiment or stated preference techniques); and b) the *revealed preference methods,* which use data from selected actual markets to extrapolate people's preferences for natural resources which are assumed to be reflected in these actual markets (the travel-cost method and the hedonic price method).

Both approaches are used in the environmental restoration projects, but it is important to highlight that the different nature and philosophy of both, make the monetary results obtained be logically of differing magnitude, and must be used as complementary measures in the decision-making process. The first approach pertains to what is known in the valuation of restoration projects as *Value-To-Cost Approach* (VTC), and would be more closely linked to an approach of Cost-Efficiency Analysis (CEA), that is, once society decides to carry out specific environmental restoration, and what must be decided is among alternative projects. The second approach pertains to the so-called *Value-To-Value Approach* (VTV), and is used in restoration projects to try to estimate the Total Economic Value (TEV) of the services generated by the project, requiring techniques capable of quantifying non-use values, such as the Contingent Valuation Method, and is more closely linked to the use of the Cost-Benefit Analysis (CBA), the result of which can be compared with other alternative projects important for society of a non-environmental nature.

In this way, one of the main objectives of this work was to verify whether the use of one/several of the economic valuation technique(s) from which the approach based on the demand curves developed, could enable us to get closer to the true value of social profitability of this type of project. Therefore, valuation of the Watershead Restoration and Erosion Control Project designed for the *Aljibe* Basin (Almeria), located in the far south-east of Spain, was chosen as a case study.

In the economic valuation of the technical document of the Restoration Project of the *Aljibe* Basin, the Aguiló methodology is applied with care, in order to evaluate monetarily part of the benefits of restoration, but as the authors themselves recognise, there are many other positive effects that fall outside of the said analysis. These results are compared with those obtained in a Contingent Valuation Exercise, designed and applied to try to estimate the monetary value of the entire effects of the project.

As well as the possibility of including non-use values, the CVM has enabled the study of other interesting aspects of a socio-environmental nature, in particular, the attitudes of the population more directly affected by the restoration measures, faced with the problem of desertification, so significant in this province that boasts the largest desertic area in the European Union. This is the first application of the CVM carried out in Spain in the specific case of this type of project, and probably one of the few existing to try to estimate the TEV of the restoration projects of basins in the specific case of the Basins of the Mediterranean Slope.

We can find applications in abundant literature trying to evaluate different benefits of the forest masses, but the applications centred on the benefits of soil protection are frankly few and far between. The economic valuation of the erosion processes are, on a global scale, still pending, as although these processes are of enormous importance, their quantification and evaluation are especially complicated due, among other matters, to the slow rate with which the said effects are shown, being on occasion scarcely perceived, affecting mainly future generations.

2. CASE STUDY

2.1 The project and scope of study

The Watershead Restoration and Erosion Control Project of the *Aljibe* Basin (De Simón *et al*., 1990; De Simón, 1993) was designed by the I.A.R.A. (Instituto Andaluz de Reforma Agraria) in collaboration with the Escuela Técnica Superior de Ingenieros de Montes de Madrid, but not executed. It covers an area of 8.830 Has. (64 %) of the Lubrín municipality (Almería), an area that experiences "accelerated" or "extremely accelerated" erosion processes in 82% of its territory. There are climatic (low average annual rainfall of 300 - 400 mm, which also occurs in the form of torrential rain) and orographic conditions (elevated slopes) which contribute to the desertification and environmental deterioration processes, but without doubt those with the greatest impact are those of human factors, both historical (deforestation processes), and the current use of land determined by the abandonment of farming land (47% of the municipality area is arable land – although only 20 % of this is effectively cultivated land- and 46 % is Mediterranean scrub in clear degradation) in a typical marginal mountain agricultural zone.

The main corrective action considered in the project is: a) maintaining farmland but improving the step slopes, b) reforesting 85% of the areas currently covered with degraded mediterranean scrub with indigenous species, initially with *Pinus halepensis* and subsequently introducing *Quecus ilex rotundifolia*, regenerating the remaining 15% of Mediterranean scrub, and c) to construct specific infrastructure of hydraulic correction.

The said project covers a time span of 100 years. Logically, this period was chosen by convention for the analysis, due to the long maturing period of the species, accentuated by the low rainfall of the area. The budget of material execution (once taxes and financial expenses are eliminated) amounts to 9.258.396 euros (1.540.467.402 pts.) The realisation of corrective measures (investment) is planned in the first six years, to which maintenance costs (supervision, maintenance and repair of water techniques and forestry treatments) must be added. Whereby it is deduced that, whilst the financial costs are supported by the present generation, the environmental rewards are seen within the medium to long term, thus affecting future generations. Therefore, due to the difficulty of monetary valuation of the environmental external factors, we are faced with a problem of intra-generational choice: how to value wellbeing that the project shall create for future generations? This final aspect is reflected in the discount mechanism, regarding which there is currently a lengthy discussion in the scientific field[1].

2.2 Stages in economic valuation of the project

Application of the CVM to the case study, within the widest context of economic valuation through CBA, has been carried out following stages set out below:

2.2.1. *Identification of the effects (costs and benefits) and of the possible conflicts: consulting experts and the population involved*

Identification of costs and benefits in the economic, social and environmental field, which the implementation of the project could generate, involved the initial stage in economic valuation of the project. Given the multidisciplinary nature of the project, numerous experts in various relevant areas of the study were consulted. Defining, among many other matters, various future scenarios of the zone both in the hypothetical case of the project start-up and that of its non-implementation. In parallel, members of the population concerned were consulted through qualitative techniques

---

[1] In long-term projects, the usual discount penalises future generations by laying little emphasis on the distant future; therefore, there is great controversy in the scientific community regarding the need (or not) of the modification of the traditional rate of social discount for intra-generational ethical considerations. The different viewpoints are difficult to reconcile as they are based on different environmental ethics and under which different concepts of sustainability underlie. To this respect, the author endorses the line of opinion regarding the need to adjust the fall in the social rate of classic discount, if we wish to include a certain level of intra-generational equity in the analysis.

(mainly semi-structured interviews), endeavouring to ensure representation of the different groups affected by the project.

TABLE 1 gives an outline of the costs and benefits identified. From the fieldwork carried out in this stage a conflict of a socio-economic, cultural and environmental nature was identified, which has been the central point in the approach of subsequent stages of work: although the project is supported by the majority of the population recognising, to a greater or lesser extent, the environmental benefits that would arise from this; another group, directly or indirectly related with the livestock sector of the municipality (26 % of the total sample), considers it a threat to their incomes, due to the reduction of the pasture area which, short and medium term, the project would cause.

TABLE 1
IDENTIFICATION OF COSTS AND BENEFITS DERIVED FROM THE RESTORATION PROJECT OF THE ALJIBE BASIN (ALMERÍA) SPAIN

BENEFITS	COSTS
Benefits derived from the increase in DIRECT USE VALUE: • Increase in agricultural productivity. • Benefits from wood production. • Indirect multiplying effect: Rural Tourism and others. • Direct multiplying effect: Job generation due to construction work, etc.	**Costs derived from the effects caused by a decrease in DIRECT USE VALUE:** Decrease in available surface for pastures as a result of implementing of permanent plant coverage.
Benefits derived from the increase in the INDIRECT USE VALUE OF PRODUCTION: • Increase in aesthetic and recreational use. • Increase in use for hunting. • Benefits derived from infrastructures needed to carry out construction work: improvements in forest trails, new roads and trails, firebreaks, etc.	**Costs derived from the effects caused by a decrease in the INDIRECT USE VALUE OF PRODUCTION:** Negative impact on the landscape due to: a) Construction work; b) new infrastructures; and, c) required hydraulic infrastructures.
Benefits derived from the increase (or that prevent the decrease) in the INDIRECT USE VALUE OF CONSERVATION: • Benefits derived from the maintenance and improvement of ecological values. – Benefits considered as priorities in a hydrologic-forestry restoration project: a) flood control, b) Refilling of aquifers, and c) Soil protection. – Other benefits derived from the maintenance and improvement of ecological values: a) CO_2 fixation; b) Regulation of climate conditions; c) Life-supporting functions; among others. • Maintenance of socio-cultural, scientific, educational, spiritual and historic values.	**COST OF CONSTRUCTION WORK AND MAINTENANCE.**
Benefits derived from the increase in FUTURE USE VALUE and EXISTENCE VALUE	

2.2.2. *Identification of the most ideal method(s) for the case study: The design and execution of the Contingent Valuation Exercise.*

Faced with the alternative of evaluating the groups with different methods, a Contingent Valuation Exercise on the project costs and benefits as a whole was chosen (TABLE 1). The said choice was due to the aforementioned advantages of the method, that is, flexibility and versatility of the methods to be used in a extensive scope of situations; and for being the only method capable of capturing both use (recreational for example) and non-use values (value of existence, among others). Faced with the choice of trying to evaluate different effects with different methods, as often occurs, we opt for the alternative of evaluating the effects of the project as a whole[2].

---

[2] The reason for this is that given that the population involved is affected by many of the effects simultaneously, it was not possible to correctly put a contingent valuation exercise into practice, designed to evaluate only some of the costs or benefits of the project: it is difficult to ask a livestock breeder, for example, to assess the aesthetic value of a greener,

The contingent valuation exercise was carried out in summer 1999, through personal surveys done by suitably qualified and advised interviewers. The sample size was a total of 334 individuals, both residents (whose population in 1995 was that of 1992) and visitors (approximately 5,000 tourists, the majority with close links to the municipality, spending on average 65 days there every year). For the group of residents, the survey took the form of a random sample of households stratified by socio-economic profiles (regarding gender, age and relations with or not families involved in the livestock sector) of the different population nuclei. With regard to the group of visitors, due to the lack of knowledge of their socio-economic characteristics, the sample was carried out trying to respect the variable genus (50% approximately), their connection with families whose incomes depend on the livestock sector (25% approximately) and the nucleus of population where they stayed or had a second home.

The survey and in general the contingent valuation exercise was designed, trying to avoid the typical biases of this methodology, with three main objectives: (A) To try to quantify the increase of wellbeing for the population most directly affected (not the only one, logically) due to the realisation of the project, compared to the alternative of non-realisation; (B) To study the attitudes and opinions of the respondents regarding diverse matters of a socio-environmental nature, both of this type of environmental restoration projects, and of different aspects related to the desertification processes; and (C) To obtain conclusions regarding other matters related with the validity of the CVM in general, as well as studying its suitability for the specific case of this projects[3].

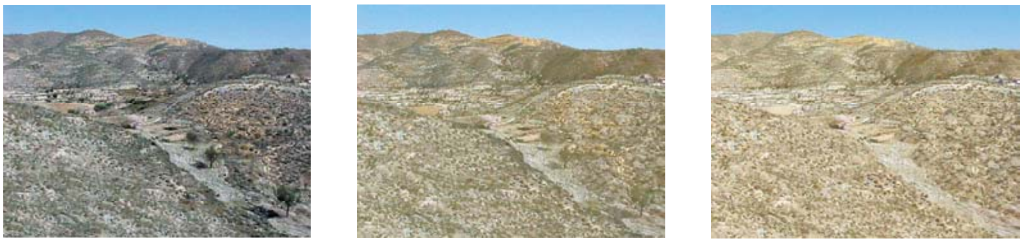
In this way, a survey was drafted, which among other questions includes in this order the following: (i) Valuation questions both on the project as a whole, and the different individual effects, using a scale of 0 to 10, and subsequently ranking them according to the level of importance; (*ii*) Questions regarding the simulation of the said market, designed in order to be able to identify the protest zeros; (*iii*) The comparison of the WTP of the *Lubrín* WREC Project with the WTP for an alternative project required in the municipality (an emergency centre), in order to - among other things- study the level of understanding of the proposed valuation game; (*iv*) Questions of a socio-environmental nature, devised to study the level of knowledge regarding the causes and effects of the environmental deterioration of the natural surroundings; as well as the importance given to the problems of desertification by respondents; and finally , (*v*) A set of questions of a socio-economic nature.

The informative package showed, in this order: (1º) the current situation of the zone affected by the project; (2º) the future situation of the zone in future scenarios within 50 and 100 years, if no corrective measures were taken of an environmental nature; (3º) a summary of the project, objectives and corrective measures; (4º) the future state of the zone in future scenarios within 50 and 100 years; and (5º) a summary of the effects of the project, with specific emphasis on the conflict between reforestation and pastureland. All this with the help of abundant photographic material, including photographs of four future scenarios (with or without project), which were carried out using a computer image retouching program (see Figure 1).

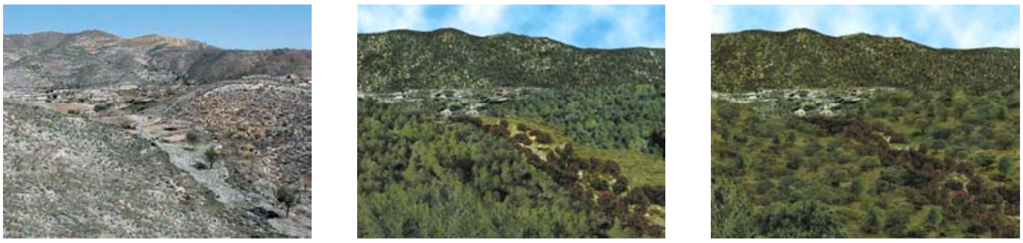
---

future landscape, without considering the problems (via income reduction) that may result in the short-term due to the temporary reduction of pasture land.

[3] Due to the lack of space we show only the results of objectives (A) and (B).



PRESENT (year 0) **WITHOUT PROJECT (year 5 0)** **WITHOUT PROJECT (year 100)**



PRESENT (year 0) **WITH PROJECT (year 5 0)** **WITH PROJECT (year 100)**

Figure 1: Photographs of four future scenarios of the WREC Project of Lubrín

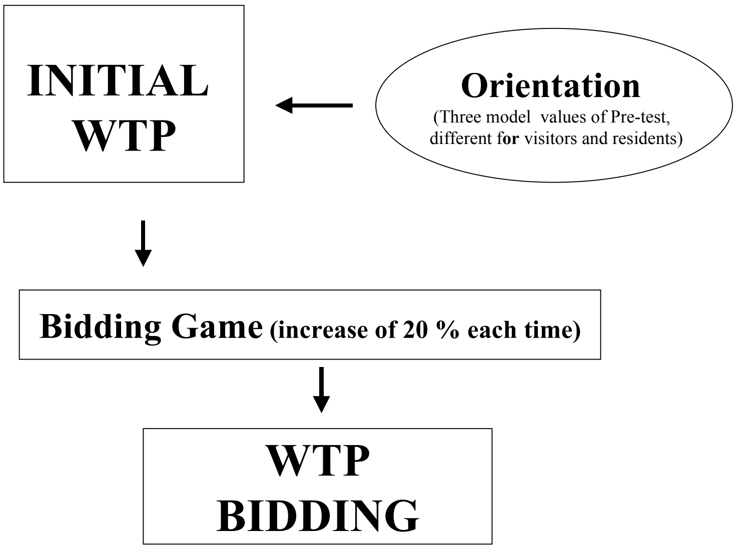

INITIAL WTP
Orientation
(Three model values of Pre-test, different for visitors and residents)
Bidding Game (increase of 20 % each time)
WTP BIDDING

Figure 2: Outline of the question format used in theWREC Project of Lubrín

The market simulation, consisted in questioning respondents about their willingness-to-pay (WTP), if they were in favour of the project, or for the willingness to accept economic compensation (WTA) of those although in favour of the project, recognising its environmental benefits, would vote against its realisation due to the expected drop in income (stock breeders)[4]. The payment vehicle and program used was a municipal tax (monthly or annual, according to the choice of the respondent) for collaborating in the start-up and maintenance of the project, if the respondent was a resident; or alternatively a voluntary fund if the respondent was a visitor. The question format was a mixed, open-ended model with orientation and subsequent bidding (the outline of which can be seen in Figure 2), designed especially for this case study, after testing different formats in the pilot surveys.

---

[4] The insufficient number of responses in terms of WTA obtained in the CV exercise, led them to reject these for subsequent phases of the analysis.

This mixed format endeavours to benefit from the advantages of the open-ended format, in turn avoiding the high level of protest responses typical of this format, consequence of the disorientation of the interviewee. Therefore, three orientation values were used (different for residents and visitors) that were included in the pilot survey (they were modal values). The subsequent bidding process tries, in turn, to avoid anchorage on these points of orientation, endeavouring to obtain the maximum WTP value of the respondents. The fact that this bidding process starts from an amount indicated by the individual, avoids the problem that they tire of the procedure, stopping randomly, as with traditional bidding games, which starts from a closed-question.

2.2.3. *Analysis of the results and estimation of the annual net profit*

a) *Analysis of the results and conclusions of the CV exercise.*

With regard to the valuation question (objective A) the results demonstrate that, as expected, residents and visitors behave as two different collectives with regard to the central variable of the study (amount of WTP). Testing the hypotheses

$$H_0: WTP_{Residents} = WTP_{Visitors}$$

using the non-parametric Mann-Whitney U test, the mean bid for residents was statistically different form the visitors mean bid, at the 0.01 level.

TABLE 2 shows some of the main statistics for the WTP dichotic variable yes or no and the continual variable amount of WTP. This latter variable is that obtained after the bidding process, being the mean increase between the $WTP_{Initial}$ and the $WTP_{Bidding}$ of 55 %, significant increase that supports the use of the bidding process in the chosen form.

TABLE 2
Selected summary statistics for Willingness To Pay (pts./month)

Treatment	Residents	Visitors	Total
Sample size	186	148	334
Non-Responses[1]	13	22	35
Outliers[2]	4	2	6
Usable Responses	169	124	293
Number WTP > 0	122	106	228
Number WTP = 0	47	18	65
Mean WTP ≥ 0	**1420** (1621)[3]	**990** (1117)[3]	-
Median WTP ≥ 0	1000	833	-
Mean WTP > 0	**2026** (1606)[3]	**1181** (1136)[3]	-
Median WTP > 0	1500	833	-

[1] A total of 334 completed surveys were obtained, however there were 35 non-responses to the contribution WTP question (protest responses).

[2] Outliers are identified as WTP ≥ 10.000 pts./month (by SPSS treatment).

[3] Number in parentheses are standard deviations.

As is deduced in the above table, 68% of residents surveyed showed WTP for the project, compared to 25% that showed Unwillingness To Pay (true zero) and the remaining 7% is catalogued as protest response (does not participate in the proposed market). For the group of visitors, a slightly higher percentage showed WTP for the project (73 %), obtaining half of the true zeros (12 %) and slightly more than double the protest responses (15%). From both cases, it is possible to conclude that:

a) The high number of individuals with WTP and the relatively high amount of WTP, indicate the importance that the respondents give to the need for environmental restoration in the area, upon which the future of the municipality relies.

b) The relatively small number of protest responses, especially if we compare it to other contingent valuation studies carried out in Spain, show a point in favour of the efforts made so that the respondents understand the proposed valuation game; as well as the advantages of the orientation mechanism of the question format used.

c) The difference of the total amounts of WTP between both parties also appears to be reasonable, with the groups of visitors, logically being lower, but also high due to the strong links they have with the area.

Later we move to the validation of the contingent valuation exercise, as a step prior to that of aggregation, validation through the econometric models that explain what variables lead the individuals to give higher or lower valuation. The result of this estimate supports the theoretic validity of the contingent valuation model, as the sign of the co-efficients that accompany the main variables has to coincide with that predicted by the economic theory.

There is certain controversy in literature on the most ideal model-type to fashion the open-ended contingent valuation question format. The fact that the dependent variable is censured by the left to a zero value, leads one to think that the appropriate action is to choose a TOBIT model (Tobin, 1968), as the estimate for the Ordinary Least Squares (OLS) leads to some estimators of the downward bias parameters, due to the existence of a high number of zero responses in the contingent valuation exercise. In fact, for the estimate of the function, the TOBIT technique uses all the observations, that is, both those on the limit (*in our case, the zero value) and those above it, therefore, other techniques are preferred that only take into account the observations that are above the said limit (Mcdonald and Moffit, 1980). Works in which, due to the censure of the dependent variable the use of a Tobit model is justified include Boyle *et al.* (1996), Brown *et al.* (1996), León (1994), Pruckner (1995) and Whithead *et al.* (1995). Also Halstead *et al.* (1991), reach the conclusion that the Tobit model is the correct econometric model to apply in the open-ended contingent valuation question format, although as pointed out it is necessary to take special care in choosing (and thus eliminating) the protest responses of the sample, as done so in this work. It is important that the protest responses are separated from the true zeros, as the presence of protest responses introduces biases in the empirical analysis, biasing the mean WTP towards zero.

Thus, in our case the dependent variable amount of WTP (pts/month) concerns a continual variable which includes the true zeroes, but not the protests, and in which the extreme values have been eliminated. The list of independent variables used for the TOBIT analysis are shown in TABLE 3.

TABLE 3

Independent variables considered in the TOBIT analysis for both groups of respondents (residents and visitors).

REL_STOCKBREEDER ✪(1): variable dummy that takes the value 1 when the resident interviewed belongs to the population group linked to the livestock sector (is a stockbreeder or belongs to a family unit whose income depends totally or partially on livestock or another related activity), and 0 to the contrary.

STOCKBREEDING ✪: discreet variable that represents the scoring, on a scale of 0 to 10, that the respondent has given to the short and long-term effects that the project would have on stockbreeding.

DESERTIFICATION: ordinal variable that, between 1 and 6, indicates the positions in which the respondent placed the problem of desertification in the question of ordering of the municipality's main problems.

DAMAGES ✪: variable dummy that takes the value of 1 if the respondent suffered material damages in the last floods in the municipality (1997) and 0 to the contrary.

DAYS_YEAR(2): continual variable of the total number of days that the visiting respondent spends in the municipality per year.

DWELLING ✪(2): variable dummy that takes the value 1 when the visiting respondent has their own dwelling in the municipality and takes the value 0 to the contrary.

AGE ✪: continual variable that represents the age of the respondent.

SEX ✪: variable dummy that takes the value 1 if the respondent is a man and 0 if it is a woman.

INSIDE: variable dummy that takes the value 1 when the respondent (resident or visitor) lives or is housed inside the project area, and 0 to the contrary.

NUCLEUS: variable dummy that takes the value 1 when the respondent (resident or visitor) lives or is housed within the nucleus of the municipality, and 0 to the contrary, that is, in the neighbouring areas (including those outside the project area).

STUDIES1: variable dummy that takes the value 1 for the group of respondents without qualifications or with or without primary education, and 0 to the contrary.

STUDIES2: variable dummy that takes the value 1 for the group of respondents with secondary education, and 0 to the contrary.

STUDIES3: variable dummy that takes the value 1 for the group of respondents with higher education, and 0 in the other cases.

HOUSEHOLD_INCOME ✪: discreet variable that represents the household income of the respondent. It includes values from 1 to 8, with income increases of 50.000 pts. Thus, the value 1 is for the group whose household income is under 50,.000ptas up to a value of 8 for the group whose household income is above 350.000 pts.

IND_ INCOME: discreet variable that represents the individual income of the respondent, this being the income of the individual living alone or independent, or the consequence of dividing the income of the household unit among its members. It takes values between 1 and 5, at intervals of 50.000 pts. The value 1 is for the group whose income is below 50.000 pts. and the value 5 for the group whose income is above 200.000 pts.

(1) Exclusive variable of the group of residents ; (2) Exclusive variable of the group of visitors

✪ Variables that have been representative, for some of the levels of significance considered, in some of the TOBIT models analysed.

The Tobit model has been estimated for the residents, which is shown in TABLE 4.1, obtaining three variables representative of a socio-economic nature:

- Pertaining to a household whose income is directly or indirectly related to the livestock sector of the municipality, indicating the negative coefficient sign on belonging to this population group (keeping the rest of the explicative variables constant) with a lower WTP, as was foreseen.

- The age of the respondent residents is also related to the amount of WTP, in the sense that the individuals of a younger age (negative sign of the coefficient) have greater WTP[5].

- Sex also influences the amount of WTP for this group of respondents, with the group being men (positive sign of the co-efficient) that shows a greater WTP for the WREC of Lubrín[6].

TABLE 4.1
Results of TOBIT Analysis (Residents Group) of factors affecting Willingness-To-Pay for Restoration Lubrín Basin Project.

Variable	*Estimated coefficient*		*t-ratio*
CONSTANT	1554.43	***	3.372
REL_STOCKBREEDER	-889.11	***	-3.254
AGE	-17.41	**	-2.080
SEX	914.74	***	3.364
σ	2028.18	***	14.751
Log-likelihood function = -1144.581			
Sample size = 169; Observations at zero = 47; Non-zero observations = 122			

*** Significant at 1 % confidence level; ** significant at 5 % confidence level

In an attempt at modelling the WTP amount responses including other variables beyond those of a socio-economic nature, a second model has been considered for the residents group, which considers socio-economic variables together with other types of variables, such as the fact of having suffered or not material damages by floods or the valuation that is given to the effects of the project on the livestock sector. Thus, the model of TABLE 4.2 shows as representatives the variables AGE and SEX, with the same sign and interpretation as the previous model, but also includes:

- The valuation (on a scale of 0 to 10) of the effects produced, both short (harmful) and long-term (beneficial) for the livestock sector of the municipality. This variable, logically is closely linked to whether the respondent is a member or not of a family involved in the sector, therefore both are not included simultaneously. The positive sign of the coefficient indicates that, the lower the valuation of the project effects on livestock the lower the amount of WTP of the respondent, as would be expected.

- The fact of having suffered (or not) material damages in recent significant floods in the municipality (year 1997). The negative sign of this co-efficient indicates that the greater the occurrence of having suffered from floods, the lower the amount of WTP, which *a priori* is not as expected. This fact, however, has a logical interpretation, which we can give due to the qualitative information detailed in the fieldwork: the individuals who had recently experienced floods where annoyed with the Administration for not having, in the large majority of cases, conceded a subsidy for these effects. This highlights the implicit line of protest among the group of respondents, towards a project that in some way is related with the Administration [7].

---

[5] which can be linked to two facts: (a) the older individuals (especially the group aged 65 or above) show a lower WTP as they believe that due to the long-term nature of the project, they will benefit less, and (b) lower income level (the majority live only on retirement pensions)

The variables level of education and level of income have not been introduced in the model as they are correlated with the age variable. In the municipality, the older residents are those with the lower level of education (the majority only have primary education or no education). Although both variables neither appear as signifcant possibly due to the lack of sincerity in this question in the residents group a fact that the interviewers could verify (but with difficulty avoid).

[6] This is due, as we deduce from our fieldwork, to two factors: (a) the great uncertainty shown during interviews by the female group, and (b) less involvement in farming tasks as possible cause for less knowledge (causes and consequences) and concern for environmental problems of the municipality.

TABLE 4.2
Results of TOBIT Analysis (Residents Group) of factors affecting Willingness-To-Pay for Restoration Lubrín Basin Project.

Variable	*Estimated coefficient*		*t-ratio*
CONSTANT	717.19		1.222
STOCKBREEDING	192.42	***	2.949
AGE	-21.82	**	-2.541
SEX	629.50	**	2.263
DAMAGES	-760.17	***	-2.771
σ	2002.88	***	14.786

Log-likelihood function = -1140.638

Sample size = 169; Observations at zero = 47; Non-zero observations = 122

*** Significant at 1 % confidence level; ** significant at 5 % confidence level

For the visitors group, the Tobit model has estimated that specified in TABLE 5.1, in which we can observe how[8]:

- The variable of opinion regarding the effects of the project on the livestock sector appears again with the same sign and interpretation as that for the residents group. As has already been commented it concerns a group with close ties to the municipality for which it seems logical that they share the same posture regarding the “massive reforestation and pasture” conflict.

- The household income level[9] appears as a representative variable, and its positive sign indicates that the higher the level of income the greater the amount of WTP, which coincides with the predictions of the economic theory.

- The housing type appears as representative variables, that is if the visitor owns or not their own property in the municipality, or alternatively stays at the home of friends or family (there is no other form of accommodation in the municipality). The negative sign of this variable indicates that the WTP amount is less for the group owning their own property, than for those who do not. This is explained because the group of visitors without property are, normally, the children (and other family members) who went away to study and work (due to the few economic possibilities of the municipality) and who return to visit their parents. They are, therefore, a younger group and with a higher level of education[10]. On the other hand, through their close ties with the municipality, the visitors group with their own properties shares, to a greater extent, the negative opinion of the project's effect on the livestock sector.

---

[7] In Spain, forestry action of a corrective nature has been carried out traditionally by the Administration, although the current forestry policy cedes this task to the private owner.

[8] The socio-economic sex variable fails to appear in the model considered. The fact that sex is not included in the representative variables is coherent with the intuition obtained in the fieldwork, in which the two factors representative of the sex variable in the residents group, do not occur here; from which it is deduced that, with the levels of significance considered, there is no distinction of the amount of WTP between sexes for the group of visitors.

[9] The individual income level variable, however, is not representative. The choice between household and individual income in the contingent valuation exercises of the literature appears unclear, however, it seems logical to suppose what really is important is the economic level of the family to which the respondent belongs, causing certain distortion on considering in a same variable the unipersonal household income and the personal income obtained on dividing the household between the number of members dependent on those earnings.

[10] The negative sign of age is a common result of many contingent valuation studies. The youngest individuals often have greater probability of giving a positive response to the WTP and a greater WTP than the mean. These individuals tend to show greater preference for environmental goods, which is explained in the literature due to their higher level of

TABLE 5.1

Results of TOBIT Analysis (Visitors Group) of factors affecting Willingness-To-Pay for Restoration Lubrín Basin Project.

Variable	*Estimated coefficient*		*t-ratio*
CONSTANT	-891.39	*	-1.784
STOCKBREEDING	114.50	**	2.160
DWELLING	-326.25	***	-3.950
HOUSEHOLD_INCOME	214.79	***	3.749
σ	1191.38	***	14.260

Log-likelihood function = -916.6204

Sample size = 124; Observations at zero = 18; Non-zero observations = 106

*** Significant at 1 % confidence level; ** significant at 5 % confidence level;
* significant at 10 % confidence level

In what follow, we show some of the results obtained linked with B objective of the study. The information of a socio-environmental nature, generated by the contingent evaluation exercise in the Aljibe basin, is extremely abundant, therefore we shall limit ourselves to highlighting some of the more relevant aspects:

- The project as a whole is valued with a mean score of 8.8 (scale 0 –10), showing 95% of the sample vote in favour of the realisation of the project. With regard to the ranking in importance of the effects of the project, we find that the "ecological and economic effects" derived from this take precedent, giving similar importance to both. This leads us to suppose that, on the one hand, the population surveyed has understood the transcendence of the environmental restoration project (or another alternative) for the area, and on the other hand, the importance shows the emphasis that the population places on economic factors.

- Secondly, are the "benefits of avoiding or minimising floods", it is not unusual given that practically half of the sample (68% residents and 32 % visitors) confirm to have suffered material damage during the last flood of 1997, with a mean value of 4,928 euros (820,000 pts).

- Thirdly, are the "benefits for the future generations"; and finally in fourth place with similar importance, the "benefits of moral satisfaction" and the "recreational benefits". The reason that these types of benefits occupy the last places in importance, is because they are considered as "luxury reasons", somewhat amoral or egoistic; that is, no matter how important the moral satisfaction of the project realisation is for the respondent, it often appears unethical to consider "his" moral satisfaction more important than the economic benefits for the municipality, for example.

- The above is highlighted in the question (scale from 0 to 10) of rating the project effects, which is shown in the following table, from which it can be observed how the benefits of moral satisfaction and those derived for the future generations enjoy a predominant position here.

---

use and expectations of future use. The results in the bibliography likewise show that the individuals with a greater level of formal education tend to appear more inclined to contribute monetarily to preserve the environment.

TABLE 6

Valuation (0 to10) of the foreseeable effects of the WREC Lubrín Project

Effect	*Valuation*
• Enjoy a natural green environment (recreational benefits)	9.20
• Moral satisfaction for caring for “our people” and nature (value of existence)	9.13
• Benefits derived for our children, grandchildren... (future generations)	9.05
• Minimisation of the risk of flooding and damages	9.02
• Possibilities of new future economic activities	8.83
• Benefits of an ecological nature (establishment of CO2, bio-diversity, etc.)	8.76
• Increase of agricultural activity	8.53
• Population increase of species of hunting value	8.09
• Effects on livestock: short and medium-term losses, long-term benefits	7.19

- Almost all respondents (93 %) perceived environmental deterioration in the areas, considering as causes of this (in an open-ended, multiple choice question): the consequences of abandonment of farming (49 %), the damages caused by forest fires (35 %), the rainfall shortage (34 %) and the damages due to flooding (25 %). Therefore it is possible to conclude that the population of the study area is perfectly aware of the factors that have led to environmental decadence of the natural surrounding area of the municipality.

- In spite of the above, however, the problem of desertification plays a secondary role on the list of priorities, taking 4th place in importance, only before two problems considered of little significance, the deficiencies of the educational services (5th place) and deficiencies in the recreational and cultural services (6th place). Above the problems derived from desertification of the area is the deficient health care services (1st place), the ageing of the population (2nd place), unemployment and lack of economical perspectives (3rd place).

b) *Process of aggregation*

The monetary valuation of the average individual of both samples (residents and visitors) has to be added for the whole representative population, in order to obtain the social benefits of the WREC Lubrín project. In the addition process there are two aspects that can incite discussion. Firstly, it is necessary to choose between the mean and median as a relevant statistic in order to determine the monetary valuation. Secondly, it is necessary to define the relevant population for which the project benefits considered are extended.

Both the mean and the median present theoretical and empirical arguments that can be used in the aggregation process. In this case study, the mean has been chosen as a statistic for the added wellbeing, as a certain consensus appears to be in literature regarding the fact that, the mean is the suitable criterion for the cost-benefit analysis, due to the fact that it is more coherent with the criterion of paretiana potentiality.

With regard to the problem of population definition, this is a matter that arises during the initial stages of the contingent valuation exercise, but that it is here where mainly the consequences of the said choice are shown. Obviously, the benefits of environmental restoration of the surrounding area of Lubrín can be extended to other groups of population that have not been considered, such as the other residents of the Almería province, well aware of the problems of desertification of the area. Therefore, the added result has to be considered, for this aspect, a conservative value. In this way, it is obtained that the total *annual net benefit of the project* is around 506,797 euros/year (84,324,000 pts/year).

2.2.4. *Calculation of the profitability indices and comparison of the results obtained with both methodologies*

Given that the benefits of the project take place at different moments in time, in order to be able to compare the added results of both methodologies it is necessary to apply a specific discount rate. Using a social discount rate of 4 %[11], the net Profit of the Project amounts to 12,915,834 euros (2,149,013,917 pts.) with the use of the CVM, whilst the RCM is estimated at 6,852,271 euros (1,140,122,000 pts.).

Using the amount obtained of 506,797 euros/year as an estimate of the monetary value of the total project effects, it has been compared with investment and maintenance costs of the project in a Cost-Benefit Analysis (CBA), obtaining an IRRN (Internal Return Rate) of 5.23 %. On the other hand, the value of the IRR for this project, once the J. Aguiló methodology is applied (results published in De Simón, 1993) is a considerably lower figure of 2.25 %.

Thus, considering this discount rate of 4% the project surpasses the condition of positive Net Present Value (NPV>0) in the first case, but not in the second. A coherent result if we take into account that the methodology applied captures a great number of economic values (in the wide sense of the "economic" term defined by Environmental Economics), with which it enables us to move closer to the true socio-environmental profitability value of the project studied.

A sensitivity analysis shows how, the NPV moved in a wide interval, according to the discount approach considered (TABLE 7).

TABLE 7. Net Present Value of the WREC Lubrín project

Discount rate	*Net financial cost*	*Net environmental benefit*	*Net present value*
5 %	-10,258,177 €	10,561,814 €	**303,637 €** (50,520,868 pts.)
3 %	-11,704,032 €	16,494,672 €	**4,790,643 €** (797,095,874 pts.)
1 %	-18,474,235 €	32,262,304 €	**13,788,068 €** (2,294,141,539 pts.)

3. CONCLUSIONS

When the ACB approach is used as an assessment tool of the basin restoration projects, the contingent valuation method (CVM) is presented more as an alternative to the replacement cost method, as an interesting complementary possibility for the monetary valuation of externalities generated by this type of project, which can help us get closer to the social profitability of this project type.

The CVM has in its favour the power (or attempt) to capture many of the effects outside the previous analysis in its valuation, some so important for this project type such as the importance that the affected population gives to the enjoyment of the restoration benefits for future generations. Furthermore, the method enables the obtaining of complementary information of a socio-environmental nature. But, it is necessary to accept that the monetary values obtained are bias values for various factors and in various senses, with many being quite frankly difficult to avoid no matter how much hard work is put into it. For that, the value obtained from the addition can be taken as an orientative monetary value of the consequential increase of wellbeing from the proposed environmental change.

---

[11] The discount rate used for CBA has been the subject of ongoing debate. Currently, the European Member States use a range of discount rates, ranging from 3% to 8%, while the European Commission employs a rate of 4 %.

4. BIBLIOGRAPHY

Aguiló Bonnin, J. (1976): *Evaluación de inversiones en la ordenación agrohidrológica de cuencas*. ICONA, Servicio de Publicaciones del Ministerio de Agricultura. Madrid.

Bergstrom, J.C., Dillman, B.L. and Stroll, J.R. (1985): Public environmental amenity benefits of private land: The case of prime agricultural land. Southern Journal of Agricultural Economics 17, 139-50.

Boyle , K.L., Johnson, F.R., McCollum, D.W., Desvouges, W.H., Dunford, R.H. and Hudson, S.P. (1996): Valuing public goods: Discrete versus Continuos contingent valuation responses, Land Economics, 72 (3), 381-396.

Brown, T.C., Champ, P.A., Bishop, R.C. y McCollum, D.W. (1996): Wich reponse format reveals the truth about donations to public goods?. Land Economics, 72(2), 152-166

Brookshire, D.S., Randall, A. and Stroll, J.R. (1980): Valuing natural resource service flows. American Journal of Agricultural Economics, 62(3): 478-88.

De Simón Navarrete, E. *et al.*(1990): *Proyecto de restauración hidrológico forestal de la cuenca alimentadora de la rambla de Aljibe (Almería)*. IARA y Escuela Técnica Superior de Ingenieros de Montes de Madrid.

De Simón Navarrete, E.(1993): *La restauración hidrológico-forestal en las cuencas hidrográficas de la vertiente mediterránea*. Informaciones Técnicas núm. 22/93 de la Consejería de Agricultura y Pesca. Junta de Andalucía, Sevilla.

Dirección General del Medio Ambiente (1985): *Metodología para la evaluación de la erosión hídrica*. Servicio de Publicaciones del MOPU. Madrid.

Halstead, J.M., Lindsay, B.E., and Brown, C.M. (1991): Use of the Tobit Model in Contingent Valuation: Experimental Evidence from the Pemigewasset Wilderness Area. Journal of Environmental Management (1991) 33, 79-89.

Hanley, N. (1988): Using Contingent Valuation to Value Environmental Improvements. Applied Economics, 20, 541-549.

ICONA (1987): *Evaluación de beneficios derivados de las inversiones en restauración hidrológico-forestal y conservación de suelos en cuencas torrenciales. Aplicación a la cuenca del río Adra.* Fundación Conde del Valle de Salazar, Escuela Técnica Superior de Ingenieros de Montes.

León, C.J. (1994): La valoración contingente del paisaje de los parques naturales del centro-occidente de Gran Canaria, Tesis doctoral, Departamento de Economía Aplicada, Universidad de las Palmas de Gran Canaria.

Maddala, G.S. (1983): Limited Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press.

McDonald, J.F. and Moffitt, R.A. (1979): The use of Tobit analysis. Review of Economics and Statistics 62, 318-321.

Pruckner, G.J. (1995): Agricultural Landscape cultivation in Austria: an application of the CVM. European Economic Review, 22,173-190.

Tobin, J. (1958): Estimation of relationships for limited dependent variables. Econometrica 26, 24-36.

Whithead, J.C., Blomquist, G.C., Haban, T.J. y Clifford, W.B. (1995): Assesing the validity and reliability of contingent values: a comparison of on-site users, off-site users and non-users, Journal of Environmental Economics and Management, 29, 238-251.

Nom du document : 311-Almansa-calatrava
Dossier : C:\Documents and Settings\gilles\Bureau\EAAE
Modèle : C:\Documents and Settings\gilles\Application Data\Microsoft\Modèles\Normal.dot
Titre : VALUING EXTERNALITIES OF WATERSHEAD RESTORATION AND EROSION CONTROL PROJECTS IN MEDITERRANEAN BASINS: A COMPARATIVE ANALYSIS OF THE CONTINGENT VALUATION AND REPLACEMENT COST METHODS
Sujet :
Auteur : gesas upna
Mots clés :
Commentaires :
Date de création : 07/03/2002 22:11
N° de révision : 2
Dernier enregistr. le : 07/03/2002 22:11
Dernier enregistrement par : GILLE
Temps total d'édition : 1 Minute
Dernière impression sur : 07/03/2002 22:11
Tel qu'à la dernière impression
    Nombre de pages : 16
    Nombre de mots : 6 945 (approx.)
    Nombre de caractères : 39 587 (approx.)