Andalusian demand for non-market goods from mountain olive groves

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Abstract

Agricultural multifunctionality is the recognition of the joint exercise of economic, environmental and social functions by this sector. In order to make this concept operative for the design of public policies, it is necessary to estimate the social demand for such functions. The main objective of this article is to present an empirical application in this line. For this purpose we have taken the agricultural system of mountain olive groves in Andalusia (Southern Spain) at risk of abandonment after the decoupling of the EU subsidies as a case study. The economic valuation technique used is the Choice Experiment. According to the results, there is a different contribution of each attribute to the improvement of the Society level of utility. Thus, and taking into account its WTP for each attribute, keeping rural population in their villages and fighting soil erosion seem to be the most valued functions by Andalusian citizens. It follows the improvement of the visual quality of the rural landscapes and the reduction of food residuals. Finally, althoug the results suggest a significant demand for the different functions, this demand is heterogeneous, depending on the socio-economic characteristics of the individuals.

JEL classification: Q11, Q18, Q24.

Key-words: Agricultural multifunctionality; Economic valuation; Choice experiment, Olive groves, Andalusia (Spain)

1. Introduction and objectives

Following the decoupling of the UE olive oil subsidies after the Mid-term review of the CAP (CE 864/2004), olive grove owners are entitled to receive up to 95% of the subsidies in the base period (from 1999/00 to 2002/03) as area payment with no need of olive harvesting. Therefore, a large number of olive growers, mostly located in mountain area whose yields are lower and costs of production higher, will opt for the abandonment of these lands. According to a preliminary study, the break-even point for the olive production is located at a yield of 2,000 kg/ha. In Andalusia, Southern Spain, more than 40% of the olive plantations are below this minimum yield -in addition of an average slope higher than 15%-. Both circumstances suggest a clear risk of abandonment. As Beaufoy y Pienkowski (2000) point out, the abandonment of these mountain areas has implications of economic (lower production of local olive oil), social (depopulation of rural areas), environmental (soil erosion) and cultural nature (change of traditional landscape).

Since the production function of the these agricultural systems is at stake, it seems relevant to assess the importance that the Society attaches to the non-market goods provided from olives plantations in mountain areas. Hence, we carried out a survey on the Andalusian population using the choice experiments (CE) addressing the importance and their willingness to pay for the following non-commercial functions: provision of landscape, soil erosion control, food security and maintenance of rural population in rural areas. The whole set of this non-commodities output is what it is actually known as multifunctionality of agriculture.

2. Methodology

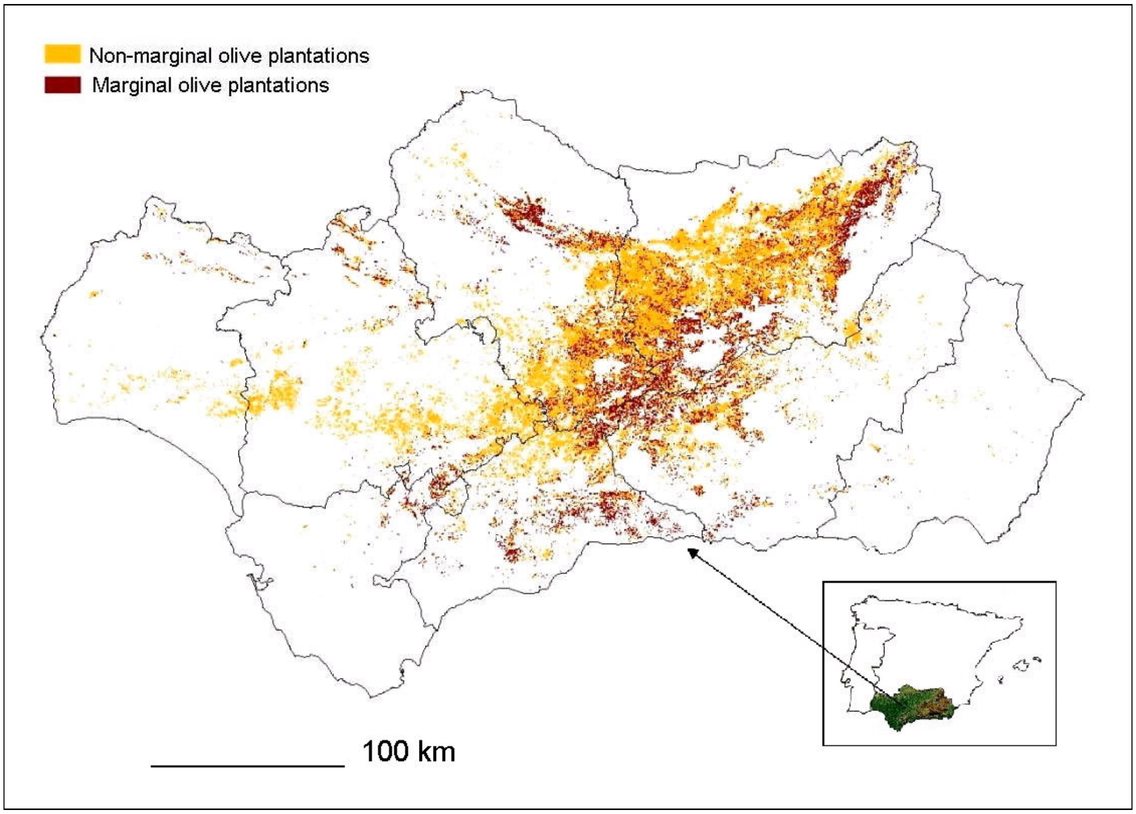
Hall *et al*. (2004) describe the array of techniques available to valuations of the whole set of goods and services provided by the agriculture. Of these techniques, we opted for the choice experiment (hereafter, CE) due to its suitability for evaluating "complex goods", i.e., goods that comprise several parts or attributes, as is the case of agricultural multifunctionality (a set of externalities).

CE involves the characterization of the object of study, in our case agricultural multifunctionality, through a series of attributes which can be combined to create hypothetical scenarios to be evaluated by the subject. Usually, the number of scenarios shown to the interviewee is three, the first one being the *status quo* (current levels of the various attributes) with zero additional cost, and the other two representing changes in the levels of one or more attributes. The new levels imply an improvement over the *status quo* situation and involve an extra cost for the subject that, in most cases, is paid via his/her annual taxes. Furthers details of this methodology can be found in Bennett and Blamey (2001), Louviere *et al*. (2000) and Adamowicz *et al*. (1998).

3. Case of study

The following map shows the olive plantations in Andalusia with average slope higher than 15% and average yields lower than 2,000 kg olive/ha.

Map 1. Olive plantations in Andalusia with risk of abandonment



As Map shows, a large proportion of olive groves in Andalusia, more than 40%, (some 560.000 ha), might be at risk of abandonment from a productive point of view. Yet, a multifunctional approach to this low input-low output agricultural system of high environmental and cultural value could reveal otherwise.

4. Empirical application of the CE

4.1. Determination of attributes and their levels

The choice of attributes should be based on two objectives: first, the information gathered must be relevant to policy-makers for the design of policy instruments; second, the scenarios presented to the public through these attributes must be realistic and easy to understand. In order to meet both of these conditions, the choice of attributes in this research was based on focus-group discussions (Aaker and Day, 1986; Malhotra and Birks, 1999) and the results of a poll carried out on 3,192 Andalusian households about the functions that the agriculture plays in our society (IESA, 2004). These attributes, as well as the appropriate variables to represent them and their levels, were available for the present study. Table 1 summarizes the results:

Table 1. Attributes, variables and levels used in the CE

Atribbutes	**Proxy variables**	**Levels**
Visual quality and preservation of biodiversity	Percentage of other fruit trees in the mountain areas	*Status quo*: Only olive groves (0% other fruit trees) Level 1: 10% of the area with other fruit trees Level 2: 20% of the area with other fruit trees
Prevention of soil erosion	Rate of of soil erosion in t/ha/year	*Status quo*: 13 t/ha/year Level 1: 5 t/ha/year Level 2: 1 t/ha/year
Food security	Amount of residuals in the food	*Status quo*: Current level Level 1: Half of the current level Level 2: Minimum level of residuals
Keeping farmers in rural areas	Percentage of abandoned farms after policy reform	*Status quo*: 50% of farm abandonment Level 1: 25% of farm abandonment Level 2: 10% of farm abandonment
Additional cost of the alternative	Levy on income tax	*Status quo*: 0 euros/hab/year Level 1: 10 euros/hab/year Level 2: 20 euros/hab/year Level 3: 40 euros/hab/year

4.2. Experimental design

Following an orthogonal fractional factorial design, in which only a chosen fraction of full factorial experiment is selected, we estimate all main effects. This statistical design enables us to reduce the number of sets from the initial 3^5x3^5 in the full design to 27 sets. Even so, this number was still too high to be presented to the subjects. Therefore, we decided to separate them into blocks: the 27 sets were randomly divided into three blocks of four sets and three blocks of five sets.

4.3. Sample selection

Following a quota sampling design on six out of the eight provinces of Andalusia, which account for 98.5% of the mountain plantations in Andalusia, we interviewed 353 citizens. The quota variables were province and town size, aiming to capture differences of valuation due to the relative importance of the olive plantations in the province and the rural appreciation of the agricultural sector.

4.4. Econometric modelling

As most CE empirical studies suggest (see for example Mazzanti, 2003), the inclusion of socio-economic variables as explanatory variables improve the predictive capabilities of the econometric model. Therefore, we opted for the following hybrid conditional logit (CL) model specifications:

- **Model H1.1**: Hybrid CL model with *ASC* and S_{pn} interactions and continuous coding variables.
- **Model H1.2**: Hybrid CL model with *ASC* and S_{pn} interactions and dummy codification of the variables.
- **Model H2**: Hybrid CL model with X_{kj} and S_{pn} interactions and continuous coding variables.

where:

ACS = constant (Alternative Specific Constant)

j = 1…J, representing the selected alternative within the set C_n

k = 1…K, representing the attributes which characterize alternative j.

X_{kj} = value of attribute k in alternative j.

p = 1…P, representing the socio-economic characteristics of individual n.

S_{pn} = socio-economic characteristic p of individual n

The socio-economic variables included in the analysis are: sex (SEX), age (AGE), household income (INC), education level (EDU), size of the population of the municipality (POP), household size (FAM), village of childhood (CHI) and knowledge of the agriculture of the area (KNO).

5. Results

5.1. Multifunctional valuation of the mountain olive plantations

Table 2 shows the results for the whole population of the hybrid CL models with ASC and S_{pn} interactions.

Table 2. Hybrid CL models with ASC and socio-economic variables interactions

Hybrid CL model with continuous coding variables (Model H1.1)				**Hybrid CL model with dummy coding variables (Model H1.2)**			
Variables	***Coeff.***	***St. Dev.***	***p-value***	***Variables***	***Coeff.***	***St. Dev.***	***p-value***
ASC	1.4238	0.5790	0.0139	***ASC***	1.1932	0.5816	0.0402
LANDSCAPE	0.0185	0.0043	0.0000	***LANDSCAPE1***	0.4014	0.0871	0.0000
EROSION	-0.0779	0.0073	0.0000	***LANDSCAPE2***	0.4346	0.0902	0.0000
FOOD SEC.	-0.0036	0.0008	0.0000	***EROSION1***	0.7088	0.0873	0.0000
KEEP POP.	-0.0159	0.0022	0.0000	***EROSION2***	0.9904	0.0915	0.0000
TAX	-0.0297	0.0031	0.0000	***FOOD SEC. 1***	0.2349	0.0846	0.0055
ASC×SEX	-0.8367	0.2650	0.0016	***FOOD SEC. 2***	0.3838	0.0835	0.0000
ASC×AGE1	-0.4514	0.2399	0.0598	***KEEP POP. 1***	0.7437	0.0888	0.0000
ASC×AGE2	-1.5813	0.3376	0.0000	***KEEP POP. 2***	0.6260	0.0893	0.0000
ASC×INC1	0.2412	0.2490	0.3328	***TAX***	-0.0329	0.0033	0.0000
ASC×INC2	0.2263	0.3808	0.5524	***ASC×SEX***	-0.8493	0.2653	0.0014
ASC×EDU1	-0.2203	0.2503	0.3788	***ASC×AGE1***	-0.4637	0.2404	0.0537
ASC×EDU2	0.2521	0.3202	0.4311	***ASC×AGE2***	-1.6024	0.3385	0.0000
ASC×FAM	0.2309	0.0928	0.0129	***ASC×INC1***	0.2470	0.2493	0.3219
ASC×POP1	0.6593	0.3082	0.0324	***ASC×INC2***	0.2412	0.3821	0.5279
ASC×POP2	0.3105	0.2863	0.2782	***ASC×EDU1***	-0.2201	0.2506	0.3798
ASC×CHI	-0.7034	0.2902	0.0154	***ASC×EDU2***	0.2416	0.3206	0.4512
ASC×KNO	0.0380	0.1226	0.7566	***ASC×FAM***	0.2346	0.0929	0.0116
				ASC×POP1	0.6701	0.3084	0.0298
				ASC×POP2	0.3062	0.2867	0.2855
				ASC×CHI	-0.7089	0.2907	0.0148
				ASC×KNO	0.0460	0.1228	0.7079
N	*1559*			***N***	*1559*		
LL(0)	*-1327.1*	***LL(θ)***	*-1174.4*	***LL(0)***	*-1327.1*	***LL(θ)***	*-1158.9*
LLR	*305.22(0.000)*	***pseudo R^2***	*0.1150*	***LLR***	*336.36 (0.000)*	***pseudo R^2***	*0.1267*

N: number of observation.
LL(0): Log-likehood with ASC.
LL(θ): Log-likehood with all the variables.
LLR: Log-likehood ratio = -2(*LL(0)- LL(θ)*).

According to these results, all parameters are statistically significant; hence all the attributes considered are significant determinants of social welfare. Moreover, in Model H1.1 all the attributes coefficients have the expected signs, according to the Economic Theory. Thus, the positive sign of LANDSCAPE attribute implies higher levels of utility as the levels of this attribute increases. Conversely, the negative signs of the EROSION, FOOD SEC. and KEEP POP. indicate an utility reduction as soil loss, presence of residuals and farm abandonment increase, respectively.

Likewise, in Model H1.2 we reach the same conclusions since the positive signs of all coefficients suggest an utility increase as the *status quo* situation changes toward states with moderate (level 1) and strong (level 2) level of improvement.

The economic interpretation can be obtained from the implicit prices (IP) of the attributes, that is, the willingness to pay (WTP) for higher utility levels from changes in the attributes levels. Since these estimates are stochastic, it is usual to calculate their confidence intervals. In this study we employed the method of Krinsky and Robb (1986) through 1000 random repetitions. The results appear in Table 3.

Table 3. Implicit prices and confidence intervals for each attribute (€/individual/year)

MODEL H1.1			***MODEL H1.2***		
Atribute	***IP***	***95% C.I.***	***Atribute***	***IP***	***95% C.I.***
LANDSCAPE	0.62	(0.30 ; 0.98)	***LANDSCAPE1***	12.20	(6.80 ; 18.21)
EROSION	-2.62	(-3.48 ; -1.95)	***LANDSCAPE2***	13.21	(7.10 ; 19.91)
FOOD SEC.	-0.12	(-0.18 ; -0.06)	***EROSION1***	21.55	(15.36 ; 29.26)
KEEP POP.	-0.53	(-0.75 ; -0.38)	***EROSION2***	30.11	(22.95 ; 40.27)
			FOOD SEC.1	7.14	(2.00 ; 12.52)
			FOOD SEC.2	11.66	(6.47 ; 17.90)
			KEEP POP.1	22.61	(16.23 ; 30.23)
			KEEP POP.2	19.03	(13.15 ; 26.06)

All implicit prices in Table 4 are statistically different from zero. According to the results in Model H1.1, people in Andalusia are thus WTP on average €0.62/year for an increase of 1% of other fruit trees to improve the visual quality of the mountain landscape, €2.62/year for 1 tonne of soil loss lower that the current level, €0.12/year for 1% reduction of the current level of residuals and €0,53/year for 1% reduction of the expected level of farm abandonment. This proves that agricultural multifunctionality is actually demanded by the public. These differences in implicit prices offer signals of the general public's preferences for particular aspects of the agricultural multifunctionality regarding these particular agricultural systems.

On the other side, the results of Model H1.2 suggest a relatively stronger public's preference for moderate improvement of all attributes. Thus, for example, people are WTP €12.20/year for an improvement from the current situation of the landscape to an increase of 10% of other trees. However, their WTP is only €13,21/year for twice as much of other trees.

5.2. Heterogeneity of public preferences

Using the interactions between ACS and the socio-economic variables in the hybrid CL models H1.1 and H1.2 enable us to assess the overall valuation of multifunctionality depending on the socio-economic characteristics of the respondents. Thus, women (SEX=0) value more than men the multifunctionality of these agricultural systems. Likewise, young people, large families and people living in large cities favour more the provision of these public goods.

In order to differentiate this analysis for each attribute we estimate the hybrid CL model that includes the interactions between the attributes and the socio-economic characteristics of the respondents (Model H2). The results appear in Table 4.

Table 4. Hybrid CL model for the socio-economic variables (Model H2)

Variables	*Coeff.*	*St. Dev.*	*p-value*
ASC	*1.3537*	*0.1375*	*0.0000*
LANDSCAPE ×FAM1	*0.0279*	*0.0083*	*0.0008*
LANDSCAPE ×FAM2	*0.0134*	*0.0075*	*0.0725*
LANDSCAPE × EDU2	*0.0256*	*0.0093*	*0.0058*
EROSION × POP2	*-0.0444*	*0.0133*	*0.0009*
EROSION × EDU1	*-0.0487*	*0.0130*	*0.0002*
EROSION × EDU2	*-0.0795*	*0.0156*	*0.0000*
EROSION × CHI	*-0.0246*	*0.0114*	*0.0304*
FOOD SEC. × SEX	*0.0057*	*0.0015*	*0.0002*
FOOD SEC. × FAM	*-0.0020*	*0.0003*	*0.0000*
KEEP POP. × SEX	*-0.0071*	*0.0031*	*0.0203*
KEEP POP. × INC1	*-0.0110*	*0.0034*	*0.0014*
KEEP POP. × EDU2	*-0.0125*	*0.0043*	*0.0040*
TAX × POP2	*-0.0111*	*0.0054*	*0.0402*
TAX × EDU1	*-0.0118*	*0.0051*	*0.0213*
TAX × EDU2	*-0.0215*	*0.0066*	*0.0012*
TAX × CHI	*-0.0239*	*0.0045*	*0.0000*
N	*1559*		
LL(0)	*-1327.1*	***LL(θ)***	*-1170.5*
LLR	*313.16 (0.000)*	***pseudo*** R^2	*0.11799*

According to these results, the LANDSCAPE attribute is more valued by people living in medium and large towns (15,000–50,000 and > 50,000 inhabitants, repectively) and people with higher education levels. The same citizens seem to value highly the EROSION attribute in addition to people whose childhood had place in rural areas. FOOD SECURITY is favoured, as expected, by women and large families. Finally, the KEEPING RURAL

POPULATION attribute is relatively more valued by women, people with average income (€1,500-3,000/month) and people with higher education degrees.

6. Conclusions

The main finding of this study is the identification of a social demand for public goods and services provided by the mountains olive groves. This support for agricultural multifunctionality is heterogeneous in its perception by the citizens and the valuation of the various attributes that the concept involves.

Taking into account the impact of an overall improvement in the attribute levels and the socio-economic characteristics of the respondents, the results suggest that women, people with higher education levels, urban citizens and families with more than three members are those who benefit most from the provision of public goods by agriculture.

There is a different contribution of each attribute to the improvement of the Society level of utility. Thus, and taking into account its WTP for each attribute, keeping rural population in their villages and fighting soil erosion (with €22.61 and €21.55/individual/year, respectively) seem to be the most valued functions of the mountain olive groves by Andalusian citizens. It follows the improvement of the visual quality of the rural landscapes (€12.20/individual/year) and the reduction of food residuals (€7.14/individual/year).

Finally, the results of this study support the new orientation of the CAP which makes decoupled payments on compliance with a range of environmental, food safety, animal and plant health and animal welfare standards, as a result of which, the cross-compliance requirement of the EU agricultural support will, presumably, promote a net increase in social welfare. Yet, according to the results of this research, some efforts should be done to allow cross-compliance to reinforce the objetives of keeping rural population in rural areas and the improvement of the landscape.

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APPENDIX. POSTER

Andalusian demand for non-market goods from mountain olive groves

1. Introduction

- Olive groves abandonment due to changes in EU subsidies
- Effects of land abandonment

Biodiversity. It varies depending on the scale of observation (Holl and Crone, 2004; Conti and Fagarazzi, 2004).

In general, the abandonment of cultivated fields the non-human controlled expansion of forest leads to a reduction of biodiversity.

Soil erosion.
+ some authors claim a better control of erosion after the invasion of a dense shrub that reduces water runoff (Cernusca et al., 1996; Tasser et al., 2003).

- García-Ruiz et al. (1996) find negative effects like the invasion of riparian vegetation that block rivers and the degradation of man-made structures that reduce erosion (e.g. terraces in olive groves), or even desertification as a consequence of repeated fires (Gonzáles Bernáldez, 1992).

Cultural landscapes.
Although people tend to assume that natural landscapes are synonymous of ecological quality, the former may not imply the latter (Nassauer, 1992).

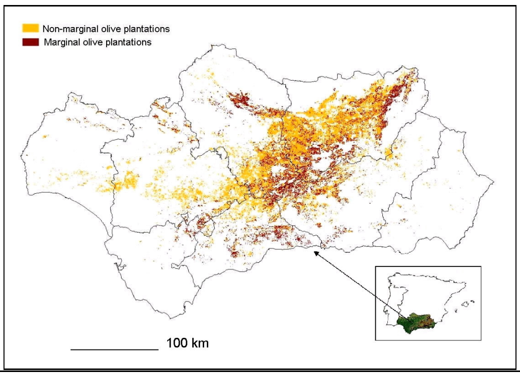
Moreover, from an aesthetic point of view, this natural reafforestation could have a negative impact on the visual quality of these traditional landscapes, especially for locals (Hunziker, 1995).

2. Methodology

- Use of choice experiments (CE)
- Econometric models

3. Case study

- Marginal olive groves in Andalusia

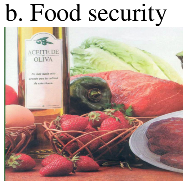


4. Implementation of CE

- Selection of attributes

a. Landscape and biodiversity

b. Food security



c. Prevention of soil erosion

d. Keeping rural population in rural areas

5. Results

- Comments on results: Hyrid CL models with *ASC* and S_{pn}

Hybrid CL model with continuous coding variables (Model H1.1)				Hybrid CL model with dummy coding variables (Model H1.2)			
Variables	*Coeff.*	*St. Dev.*	*p-value*	*Variables*	*Coeff.*	*St. Dev.*	*p-value*
ASC	1.4238	0.5790	0.0139	*ASC*	1.1932	0.5816	0.0402
LANDSCAPE	0.0185	0.0043	0.0000	*LANDSCAPE1*	0.4014	0.0871	0.0000
EROSION	-0.0779	0.0073	0.0000	*LANDSCAPE2*	0.4346	0.0902	0.0000
FOOD SEC.	-0.0036	0.0008	0.0000	*EROSION1*	0.7088	0.0873	0.0000
KEEP POP.	-0.0159	0.0022	0.0000	*EROSION2*	0.9904	0.0915	0.0000
TAX	-0.0297	0.0031	0.0000	*FOOD SEC. 1*	0.2349	0.0846	0.0055
ASC×SEX	-0.8367	0.2650	0.0016	*FOOD SEC. 2*	0.3838	0.0835	0.0000
ASC×AGE1	-0.4514	0.2399	0.0598	*KEEP POP. 1*	0.7437	0.0888	0.0000
ASC×AGE2	-1.5813	0.3376	0.0000	*KEEP POP. 2*	0.6260	0.0893	0.0000
ASC×INC1	0.2412	0.2490	0.3328	*TAX*	-0.0329	0.0033	0.0000
ASC×INC2	0.2263	0.3808	0.5524	*ASC×SEX*	-0.8493	0.2653	0.0014
ASC×EDU1	-0.2203	0.2503	0.3788	*ASC×AGE1*	-0.4637	0.2404	0.0537
ASC×EDU2	0.2521	0.3202	0.4311	*ASC×AGE2*	-1.6024	0.3385	0.0000
ASC×FAM	0.2309	0.0928	0.0129	*ASC×INC1*	0.2470	0.2493	0.3219
ASC×POP1	0.6593	0.3082	0.0324	*ASC×INC2*	0.2412	0.3821	0.5279
ASC×POP2	0.3105	0.2863	0.2782	*ASC×EDU1*	-0.2201	0.2506	0.3798
ASC×CHI	-0.7034	0.2902	0.0154	*ASC×EDU2*	0.2416	0.3206	0.4512
ASC×KNO	0.0380	0.1226	0.7566	*ASC×FAM*	0.2346	0.0929	0.0116
				ASC×POP1	0.6701	0.3084	0.0298
				ASC×POP2	0.3062	0.2867	0.2855
				ASC×CHI	-0.7089	0.2907	0.0148
				ASC×KNO	0.0460	0.1228	0.7079
N	1559			*N*	1559		
LL(0)	-1327.1	*LL(θ)*	-1174.4	*LL(0)*	-1327.1	*LL(θ)*	-1158.9
LLR	305.22(0.000)	*pseudo R²*	0.1150	*LLR*	336.36 (0.000)	*pseudo R²*	0.1267

- Comments on WTP for multifunctionality

MODEL H1.1			MODEL H1.2		
Atribute	*IP*	*95% C.I.*	*Atribute*	*IP*	*95% C.I.*
LANDSCAPE	0.62	(0.30 ; 0.98)	*LANDSCAPE1*	12.20	(6.80 ; 18.21)
EROSION	-2.62	(-3.48 ; -1.95)	*LANDSCAPE2*	13.21	(7.10 ; 19.91)
FOOD SEC.	-0.12	(-0.18 ; -0.06)	*EROSION1*	21.55	(15.36 ; 29.26)
KEEP POP.	-0.53	(-0.75 ; -0.38)	*EROSION2*	30.11	(22.95 ; 40.27)
			FOOD SEC.1	7.14	(2.00 ; 12.52)
			FOOD SEC.2	11.66	(6.47 ; 17.90)
			KEEP POP.1	22.61	(16.23 ; 30.23)
			KEEP POP.2	19.03	(13.15 ; 26.06)

-Comments on socio-economic charactaristics and valuation of multifunctionality (Model H2)

Variables	*Coeff.*	*St. Dev.*	*p-value*
ASC	1.3537	0.1375	0.0000
LANDSCAPE×FAM1	0.0279	0.0083	0.0008
LANDSCAPE×FAM2	0.0134	0.0075	0.0725
LANDSCAPE × EDU2	0.0256	0.0093	0.0058
EROSION × POP2	-0.0444	0.0133	0.0009
EROSION × EDU1	-0.0487	0.0130	0.0002
EROSION × EDU2	-0.0795	0.0156	0.0000
EROSION × CHI	-0.0246	0.0114	0.0304
FOOD SEC. × SEX	0.0057	0.0015	0.0002
FOOD SEC. × FAM	-0.0020	0.0003	0.0000
KEEP POP. × SEX	-0.0071	0.0031	0.0203
KEEP POP. × INC1	-0.0110	0.0034	0.0014
KEEP POP. × EDU2	-0.0125	0.0043	0.0040
TAX × POP2	-0.0111	0.0054	0.0402
TAX × EDU1	-0.0118	0.0051	0.0213
TAX × EDU2	-0.0215	0.0066	0.0012
TAX × CHI	-0.0239	0.0045	0.0000
N	1559		
LL(0)	-1327.1	*LL(θ)*	-1170.5
LLR	313.16 (0.000)	*pseudo R²*	0.11799

6. Conclusions

- On methodology
- On attributes more valued in multifunctionality
- On socio-economic characteristics of respondents depending on their preferences