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Demand for non-commodity outputs from Spanish extensive agricultural systems[1]

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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 to support 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 two empirical applications in this line. For this purpose we have adopted the agricultural system of mountain olive groves in Andalusia (Southern Spain) at risk of abandonment after the decoupling of the EU subsidies and the agricultural system of cereal steppes in Tierra de Campos (North-western Spain). The economic valuation technique used is the Choice Experiment. The results suggest the existence of a significant demand for the different functions, although the demand is heterogeneous, depending on the socio-economic characteristics of the individuals surveyed.

Key-words: Agricultural multifunctionality; Economic valuation; Choice experiments, extensive agriculture, Andalusia, Castilla-León (Spain).

Introduction and objectives

According to the OECD, multifunctionallity is a "positive" concept encompassing the three different roles played by agriculture in the EU: a) producing food and fiber products, b) preserving the rural environment and landscape and c) contributing to the viability of rural areas and a balanced territorial development. This definition suggests that multifunctional agricultural production comprises both market and non-market goods (commodities and non-commodities). The former comprise mainly, although not exclusively, food and fiber products, while the latter include environmental and social functions, which in most cases also have public good characteristics.

As Blandford and Boisvert (2002) and Randall (2002) point out, these non-commodity outputs (NCOs) are territorially specific, providing mainly local benefits. Because of this, policies set at the national level may not ensure their optimum provision, and they should be formed at local level. This new perspective, opposed to the traditional view of the agricultural

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sector as primarily a commodities supplier, ought to imply changes in the current geographical distribution of EU subsidies, making local governments key actors in terms of highlighting the NCOs to be targeted and contributing via local/regional taxes to their provision.

In considering the empirical analysis of multifunctionality we find two clear approaches: (a) that of focusing on the *supply side* of the agricultural systems (provision of commodities and non-commodities outputs) and (b) that which focuses on the *demand side*, taking into consideration social welfare changes due to variation in the supply of different outputs. The combination of both approaches is necessary in order to determine the optimal provision of goods and services from the agricultural sector from a social point of view. In theory, once the optimum has been located, the agricultural policy authorities will be in a position to design appropriate policy instruments to correct market failures existing in real world.

As a revision by OECD (2001) shows, the vast majority of empirical studies have taken the first approach, i.e. they analyse specific related issues in terms of the joint production of agricultural outputs (commodities and non-commodities), market failures or options for ensuring the provision of non-commodity outputs from multifunctional agriculture. However, the present study aims to expand the relatively sparse literature on the demand side of multifunctionality (Lima e Santos 2001; Randall 2002; Hall *et al*. 2004).

The choice of two extensive agricultural systems, the pseudo-steppes of North-Western and the mountain olive groves of Southern Spain, is justified by the progressive decoupling of the subsidies received by both sectors (75% for cereals and 95% for olive oil). The consequence of this policy change is a sizable number of farms due to abandonment, especially in the case of olive growers, mostly located in mountain area whose yields are lower and costs of production higher.

Since the production function of these agricultural systems is at stake, it would appear to be relevant to assess the importance that society attaches to the non-market goods provided by these two agricultural systems. We therefore carried out two surveys of Castilian and Andalusian citizens using the Choice Experiments procedure to address their willingness to pay for these non-commercial functions.

Methodology

Approach to multifunctionality valuation

As Randall (2002) points out, the management of the multifunctional concept should involve the *joint valuation* of all the externalities generated in the production of agricultural commodities. By doing so, we avoid the adding-up problem (the sum of the parts usually exceeds the total), as Hoehn and Randall (1989), and Hoehn and Loomis (1993) demonstrate.

In order to carry out the analysis, not only does the valuation approach has to be determined, but also its scope. In this research we selected the *agricultural system* as our unit of analysis on the basis of three aspects: (a) the homogeneity of the externalities generated in the process; (b) the prospect of contributing to the design of policy instruments with local and geographically wider implications; and (c) the possibility of making case study comparisons with other cases.

Valuation technique: the Choice Experiments

Hall *et al*. (2004) describe the array of techniques available to valuations of the whole set of goods and services provided by the agriculture. They outline five possibilities: (a) opinion surveys; (b) the use of proxies to estimate public preferences; (c) consensus methods (focus groups, public juries, interviews, Delphi method); (d) monetary valuation; and (e) multicriteria techniques. Of these techniques, Hall *et al.* favour monetary valuation since, unlike the other alternatives; this technique relies on the same theoretical axioms as those that underpin consumers' decision processes. Within the range of monetary valuation techniques some alternatives are available for assessing the multifunctionality of agricultural systems, namely, the Contingent Valuation and the Choice Experiments (hereafter, CE). In this study we opted for the latter 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 in each choice set 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 Hensher *et al*. (2005), Bennett and Blamey (2001) and Louviere *et al*. (2000).

Some empirical applications of this methodology to environmental and agricultural issues can be found in the seminal works of Adamowicz *et al*. (1994), which evaluated the public's recreational preferences for Canadian rivers, Boxall *et al*. (1996) and Adamowicz *et al*. (1997) for Canadian hunting areas. Afterwards, the number of studies using this stated preference method has rapidly increased to make it one of the most frequently employed analytical methods. Spanish works include the empirical studies of Mogas *et al*. (2005) on the valuation of Catalonian forest externalities, and of Colombo *et al*. (2005), who analysed the problem of soil erosion in Southern Spain.

Cases of study

A.1. Mountain olive groves in Andalusia

Any definition of mountain olive groves requires us to consider both physical (primarily slope and soil type) and economic aspects. As far as the first category is concerned, Guzmán (2004) adduces two physical criteria; the average inclination (slope) of the plantation being greater than 15% and the poor agronomic quality of the soil. This classification enables us to estimate the surface area of mountain olive groves in Andalusia at around 220,000 hectares (ha), i.e. approximately 16% of the total area given over to olives in Andalusia.

From an economic perspective, mountain olive groves, which are also known as "low productivity" or "marginal" groves, are typified by poor crop yields and high production costs. The coming into effect of the latest revision of the Common Market Organisation (CMO) for olive oil, which involves the decoupling of 95% of the price subsidies received until now by oil producers, has placed such groves beneath the threshold of profitability. For this reason we can assume that a large share of such growers will discontinue their productive activity.

A.2. Multifunctionality of mountain olive groves in Andalusia

Like other extensive agricultural systems (low input, low output), mountain olive groves tend to be found in areas of high environmental and landscape value. From a socioeconomic point of view, they represent an important element in income generation in rural zones at risk of depopulation and with virtually no alternative sources of agricultural income. Other functions in addition to their primary function of producing oil are:

- Generation of secondary activities: production of quality products, generally produced under the label of denominations of origin.
- Generation of tertiary activities: support for leisure activities and the maintenance of local production systems.
- Control and distribution of water in the headwaters of local hydrological resources (limitation of water runoff and erosion).
- Provision of traditional agricultural landscapes.

In line with this classification of non-commercial functions of mountain olive groves, the present study analyses the multifunctional character of this particular agricultural system in a quadruple perspective: a) provision of landscapes of high visual quality and the conservation of biodiversity, b) control of erosion, c) provision of safe healthy food, and d) maintenance of rural population levels.

Regarding the first of these aspects mentioned above, it is sufficient to note that the intrinsic characteristics of mountain olive groves give them a high visual quality due to their location in high-altitude zones and in many cases, the use of vegetable cover and the presence of other species of bushes and trees, particularly in the cases of organically farmed olive groves.

The problem of soil erosion is particularly serious where olive groves planted on slopes steeper than 10% are concerned, a category that includes all mountain olive groves. Some studies (Pastor *et al.* 1999) estimate that soil losses in such zones are currently greater than 80 tonnes/ha/year, which implies a loss of the upper layers of the soil (Cuesta 2005). This erosion has the direct negative effect of reducing agricultural production, to which we must add the progressive desertification of the territory, the sedimentation of reservoirs, the contamination of water resources, etc. (Colombo *et al*. 2005).

The supply of safe and healthy food is a requirement that has been progressively emphasized in the successive reforms of the CAP. In the case of the agricultural system being analysed here, as in other agrarian sectors, the healthiness of the food produced (olive oil in this case) is dependent on the presence of residues of phytosanitary products (Raymond *et al*. 2005), which depends in turn on the system of production in use.

B.1. The pseudo-steppes of Tierra de Campos

The pseudo-steppes are ecosystems whose landscape is characterized by sparse vegetation, with an almost complete absence of trees, an either flat or slightly undulating horizon and an annual rainfall below 600 mm. The Autonomous Community of Castilla y León in Northwestern Spain has vast areas of such pseudo-steppes, mainly covered by rain-fed cereals, which give these agricultural areas the name of "cereal steppes".

The area of study, Tierra de Campos, belongs to this type of ecosystem, accounting for almost two thirds of the total area of cereal steppes in Castilla y León. With a total of 948,198 hectares, the area of study includes 267 municipalities. Most of this territory is devoted to farming (84% is considered as usable agricultural area (UAA), with a clear predominance of annual crops (95% of UAA). The principal crops are cereals (58.0%), industrial crops (7.3%), forage (6.6%) and protein crops (2.6%). Permanent crops, largely vineyards, account only for 0.5% of the agricultural land. Fallow takes up 20.1% of the UAA. Livestock is relatively important in the area, with 226,701 major livestock units (MLU) (35% sheep, 27% pigs, 26% cattle and 10% poultry).

Two key aspects make this area of study suitable for the valuation of multifunctionality: first, there is a certain homogeneity in terms of ecological features and land use (generation of similar externalities all over the territory); secondly, this agricultural system is a representative case of extensive farming (low input-low output) close to marginality, an aspect that gives the multifunctional aspects of the agricultural activity greater relevance.

B.2. Multifunctionality of the agricultural sector in Tierra de Campos

The current state of agriculture in this region offers an excellent example of how a modern primary sector contributes to several different societal functions. From an economic perspective, the agricultural sector is the second most important economic activity in Tierra de Campos. There are approximately 18,587 farms for whose holders agriculture is the only source of income. Furthermore, the input-output tables show a strong interrelationship with other economic sectors such as agro-industry, agricultural input suppliers, transport enterprises, banking, etc., making agriculture a key sector for the whole regional economy. The non-commercial functions include:

Social and territorial functions. The agricultural sector employs the equivalent of 12,589 full-time workers (Agricultural Census year 1999; INE, 2001), representing 28.5% of the labor force of the region, well above the Spanish average of 5.6% and that of the EU-15 (4.0%). The average farm size (48.2 ha) implies, in rain-fed agriculture, a familiar type of production which keeps the population in rural areas, one of the social objectives of the CAP. This function is particularly important in Tierra de Campos where depopulation is an acute problem, with the area currently one of the most sparsely populated territories in Europe, with 11 inhabitants/km2 (84.4 in Spain and 120 in the EU-15).

Environmental functions. Most of the territory in Tierra de Campos is dedicated to rain-fed cereals and fallow. Due to this low input agricultural system, a number of positive externalities are provided by farming. For example, agricultural land provides suitable habitats for 21 endangered species, among them the great bustard (Otis tarda) (the world's most important reserve of this species), the little bustard (Tetrax tetrax), Montagu's harrier (Circus pygargus), the lesser kestrel (Falco naumani), etc. Because of this degree of biodiversity, almost a quarter of the area of study (221,475 ha) is actually included in the Natura 2000 Network.

Empirical application of CE

Bennett and Blamey (2001) have described the phases involved in the design and implementation of CE. In accordance with these authors and in connection with case study we have the following phases:

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 satisfy both of these conditions, the choice of attributes were based on previous studies and surveys carried out in the two regions. Once the set of attributes were chosen, their relevance was subsequently discussed in three different focus groups; one comprising university lecturers in the field of agricultural economics, another made up of managers from the public sector, and one of potential interviewees (formed by leaders of local society - trade-unions, cultural associations and neighborhood communities - representing the general population analyzed). All of them agreed that, in both cases, the selected functions were the most important. Additionally, the monetary attribute (cost of the alternative) that the CE needed to be implemented had as well been included. Furthermore, appropriate proxy variables to measure these attributes were required. For this purpose we were helped by a focus-group discussions that also contributed in the determination of their levels, as Table 1 shows:

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

Attributes	Proxy variables	Levels
	CEREAL STEPPES IN TIERRA DE CAMPOS	
Contribution to the rural economy	Full-time employees in the agricultural sector (*EMPLOY*)	12,600* 14,000 16,000
Maintaining the population in the rural areas and preserving the cultural heritage	Percentage of farmers living in the municipality where the farm is located (*LIVING*)	70%* 80% 90%
Maintaining biodiversity	Number of endangered species (*ENDANGER*)	21* 15 9
Provision of healthy products	Food safety (residues) due to the management of farming systems (*FOOD SAF*)	Conventional* Integrated Organic
Cost of production of public goods	Levy on income tax (*TAX*)	0 €/citizen-year* 10 €/citizen-year 20 €/citizen-year 50 €/citizen-year
	MOUNTAIN OLIVE GROVES IN ANDALUSIA	
Visual quality and preservation of biodiversity	Percentage of other fruit trees in the mountain areas (*LANDSCAPE*)	0%* 10% 20%
Prevention of soil erosion	Rate of soil erosion in t/ha/year (*EROSION*)	13 t/ha/year* 5 t/ha/year 1 t/ha/year
Food security	Amount of residuals in the food (*FOOD SAF*)	Current level (100%)* Half (50%) Null (0%)
Keeping farmers in rural areas	Percentage of abandoned farms after policy reform (*KEEP POP*)	50%* 25% 10%
Cost of production of public goods	Levy on income tax (*TAX*)	0 €/hab-year* 10 €/hab-year 20 €/hab-year 40 €/hab-year

* Levels of *status quo*.

Experimental designs

Following an orthogonal fractional factorial design, in which only a chosen fraction of a full factorial experiment is selected, we estimate all main effects. This statistical design enables us to reduce the number of sets from the initial $3^5 x 3^5$ in the full design to 27 choice sets[3]. Even so, this number was still too high to be presented to the subjects (Swait and Adamowicz 2001). 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. Figure 1 shows one of these choice sets.

Figure 1. Example of choice set

Block 1 ***CHOICE 3***		***No intervention***	***Option A***	***Option B***
Visual quality and preservation of biodiversity		**Exclusively olive groves (0% other fruit trees)**	**20% other fruit trees**	**Exclusively olive groves (0% other fruit trees)**
Prevention of soil erosion		**Soil loss: 13 ton/ha.year**	**Soil loss: 5 ton/ha.year**	**Soil loss: 1 ton/ha.year**
Food security		**Residual level: Current (0% reduction)**	**Residual level: Half (50% reduction)**	**Residual level: None (100% reduction)**
Keeping farmers in rural areas		**Farm abandonment: 50%**	**Farm abandonment: 10%**	**Farm abandonment: 50%**
Additional cost of the alternative		**0 €**	**20 €**	**40 €**
Supposing these options are the only ones available, which would you prefer?		☐	☐	☐

Sample selection

First, the target population of the study comprises citizens above the age of 18 living in the provinces of Andalusia with olive groves and in Tierra de Campos. In doing so, we focus our attention on the local demand for this type of goods. The decision is based on the impossibility of determining *a priori* the geographical limits of the population that would be interested in the provision of such goods by this agricultural system. Furthermore, the bias due to the embedding effect (see Kahneman *et al*. 1991; Randall and Hoehn 1996) from selecting non-residents would be increased. Yet, although there is a positive willingness-to-pay for these goods among non-residents they were not included in the study. This limitation should be considered when analyzing the aggregate values obtained.

Following a quota sampling design (Barnett 1991) on the six provinces of Andalusia with mountain olive groves and Tierra de Campos we interviewed 353 and 401 citizens, respectively. The quota variables were sex, age, area of olive groves, province and town size. The last quota variable aimed to capture differences of valuation due to the urban/rural appreciations of the agricultural sector.

Data codification

For the quantitative variables we have applied two coding possibilities: (a) direct and linear continuous coding, and (b) the use of dummy variables. The former approach gives the average marginal willingness-to-pay (mean of individuals' implicit price of the attribute) for the range of variation considered, while the latter estimates the marginal propensity to change from the *status quo* situation to a certain level of the attribute. Since in our study we have opted for both approaches, it is possible to test whether or not the demand for non-market goods and services is convex, in correspondence with our common belief that increasing consumption of one good implies declining willingness-to-pay for that good, other things constant.

Econometric modelling

As most CE empirical studies suggest, the inclusion of socio-economic variables as explanatory variables tends to improve the predictive capabilities of the econometric model. Therefore, we opted for the following hybrid CL model specifications:

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

The socio-economic variables included in the analysis are: gender (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). All these socio-economic variables, except KNO, are included in the models as dummy variables.

Results

Multifunctional valuation of mountain olive groves in Andalusia

The following table shows the results for the whole population of the hybrid CL models with ASC_j and S_{pn} interactions (models H1 and H2).

Table 2. Hybrid CL models with ASC and socio-economic variables interactions for mountain olive groves

Hybrid CL model with continuous coding variables (Model H1)				**Hybrid CL model with dummy coding variables (Model H2)**			
Variables	***Coeff.***	***St. Dev.***	***p-value***	***Variables***	***Coeff.***	***St. Dev.***	***p-value***
ASC	1.42	5.79×10^{-1}	0.0139	***ASC***	1.19	5.82×10^{-1}	0.0402
LANDSCAPE	1.85×10^{-2}	4.32×10^{-3}	0.0000	***LANDSCAPE1***	4.01×10^{-1}	8.71×10^{-2}	0.0000
EROSION	-7.79×10^{-2}	7.25×10^{-3}	0.0000	***LANDSCAPE2***	4.35×10^{-1}	9.02×10^{-2}	0.0000
FOOD SAF.	-3.56×10^{-3}	8.35×10^{-4}	0.0000	***EROSION1***	7.09×10^{-1}	8.73×10^{-2}	0.0000
KEEP POP.	-1.59×10^{-2}	2.15×10^{-3}	0.0000	***EROSION2***	9.90×10^{-1}	9.15×10^{-2}	0.0000
TAX	-2.97×10^{-2}	3.07×10^{-3}	0.0000	***FOOD SAF. 1***	2.35×10^{-1}	8.46×10^{-2}	0.0055
ASC×SEX	-8.37×10^{-1}	2.65×10^{-1}	0.0016	***FOOD SAF. 2***	3.84×10^{-1}	8.35×10^{-2}	0.0000
ASC×AGE1	-4.51×10^{-1}	2.40×10^{-1}	0.0598	***KEEP POP. 1***	7.44×10^{-1}	8.88×10^{-2}	0.0000
ASC×AGE2	-1.58	3.38×10^{-1}	0.0000	***KEEP POP. 2***	6.26×10^{-1}	8.93×10^{-2}	0.0000
ASC×INC1	2.41×10^{-1}	2.49×10^{-1}	0.3328	***TAX***	-3.29×10^{-1}	3.26×10^{-3}	0.0000
ASC×INC2	2.26×10^{-1}	3.81×10^{-1}	0.5524	***ASC×SEX***	-8.49×10^{-1}	2.65×10^{-1}	0.0014
ASC×EDU1	-2.20×10^{-1}	2.50×10^{-1}	0.3788	***ASC×AGE1***	-4.64×10^{-1}	2.40×10^{-1}	0.0537
ASC×EDU2	2.52×10^{-1}	3.20×10^{-1}	0.4311	***ASC×AGE2***	-1.60	3.39×10^{-1}	0.0000
ASC×FAM	2.31×10^{-1}	9.28×10^{-2}	0.0129	***ASC×INC1***	2.47×10^{-1}	2.49×10^{-1}	0.3219
ASC×POP1	6.59×10^{-1}	3.08×10^{-1}	0.0324	***ASC×INC2***	2.41×10^{-1}	3.82×10^{-1}	0.5279
ASC×POP2	3.11×10^{-1}	2.86×10^{-1}	0.2782	***ASC×EDU1***	-2.20×10^{-1}	2.51×10^{-1}	0.3798
ASC×CHI	-7.03×10^{-1}	2.90×10^{-1}	0.0154	***ASC×EDU2***	2.42×10^{-1}	3.21×10^{-1}	0.4512
ASC×KNO	3.80×10^{-2}	1.23×10^{-1}	0.7566	***ASC×FAM***	2.35×10^{-1}	9.29×10^{-2}	0.0116
				ASC×POP1	6.70×10^{-1}	3.08×10^{-1}	0.0298
				ASC×POP2	3.06×10^{-1}	2.87×10^{-1}	0.2855
				ASC×CHI	-7.09×10^{-1}	2.91×10^{-1}	0.0148
				ASC×KNO	4.60×10^{-2}	1.23×10^{-1}	0.7079
N	*1559*			***N***	*1559*		
LL(0)	*-1327.1*	***LL(θ)***	*-1174.4*	***LL(0)***	*-1327.1*	***LL(θ)***	*-1158.9*
LLR	*305.2 (0.000)*	***pseudo R^2***	*0.115*	***LLR***	*336.34 (0.000)*	***pseudo R^2***	*0.127*

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)*).

At a 99% confidence level, we reject the null hypothesis that all coefficients are jointly or simultaneously equal to zero (significance of the Log-Likelihood Ratio –LLR– values). The goodness of fit of both models can be assessed through the McFadden's *pseudo*-R^2. In our case, the values are similar to those obtained in other empirical works (Boxall and Adamowicz 2002; Mazzanti 2003 or Mogas *et al*. 2005). Nevertheless, the H2 model yields slightly better results.

According to these results, all attributes are statistically significant; hence all the attributes considered are relevant determinants of social welfare. Moreover, in Model H1 all the attribute coefficients have the expected signs according to economic theory. Thus, the positive sign of the LANDSCAPE attribute implies higher levels of utility as the levels of this attribute increases. Conversely, the negative signs of EROSION, FOOD SAF. and KEEP POP. indicate reductions of utility in terms of soil loss, presence of residues in food and an increase in farm abandonment, respectively. Likewise, in Model H2 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) levels of improvement.

The economic interpretation of these models can be obtained from the 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, the confidence intervals were calculated by using the Krinsky and Robb (1986) bootstrapping procedure from 1000 draws. The results appear in Table 3:

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

MODEL H1			**MODEL H2**		
Attribute	***IP***	***95% C.I.***	***Attribute***	***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 SAF.	-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 SAF.1	7.14	(2.00 ; 12.52)
			FOOD SAF.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)

Note: IP in model H1 are measured in €/individual/year, accounting for a marginal increase (one unit more) in the attribute considered. In model H2, IP are also measured in €/individual/year, but in this case the amount reported is the willingness-to-pay for changing from the *status quo* situation to a certain level of the attribute.

In order to compare the results from both models the reader should bear in mind the differences in the interpretations of the various regressors: in model H1 (continuous coding) they represent a marginal increase in utiility from one extra unit of the attribute; in model H2 (dummy coding) the regressors correspond to the utility improvement due to changes from the *status quo* situation to the proposed levels of improvement of each attribute.

All implicit prices in Table 4 are statistically different from zero. According to the results in Model H1, people in Andalusia are thus WTP on average €0.62/year for an increase of 1% in other fruit trees than olives 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 a 1% reduction of the current level of residues in food and €0.53/year for a 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 some indication of the general public’s preferences for particular aspects of agricultural multifunctionality.

From the results of Model H2 Compensating Surplus (CS) welfare measure can be obtained for different scenarios associated with multiple changes of attributes, using the equation proposed by Hanemann (1984):

$$CS = -\frac{\ln\sum_k e^{V_{k1}} - \ln\sum_k e^{V_{k0}}}{\beta_m} = -\frac{V_0 - V_1}{\beta_m} \qquad (7)$$

where V_0 is the utility for the status quo alternative, V_1 represent the utility of the proposed scenario change and β_m is the estimated parameter of the monetary attribute.

Using the above calculation, the WTP for the moderate improvement from the current situation (i. e. changes to LANDSCAPE1, EROSION1, FOOD SAF.1 and KEEP POP.1) and the further one (changes to LANDSCAPE2, EROSION2, FOOD SAF. 2 and KEEP POP.2) has a WTPs of 63.50 and 74.01 €/individual/year, respectively. Likewise, the WTP for any combination of improvements in the level of attributes can be obtained. Thus, multiplying the individual implicit prices obtained by the whole population (5,664,580 Andalusians above the age of 18, according to 2001 census), we reach an aggregate WTP of 359.70 and 419.24 MEur, respectively. In order to put these figures into perspective, it is worth mentioning that the EU expenditure of the olive oil Common Market Organization on this type of olive grove is only 80.13 MEur.

Heterogeneity of public preferences in Andalusia

Using the interactions between ACS and the socio-economic variables in the hybrid CL models H1 and H2 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 (i.e. the whole set of attributes included in the models). Likewise, young people, large families, people living in large cities and/or brought up in rural areas are more in favour of the provision of these public goods.

Conversely, income level was not significant, indicating that the attributes considered in the multifunctional analysis do not exhibit high-income elasticity (or “luxury goods” in the economics literature) and suggesting an income elasticity lower than one, as Kriström and Riera (1996) point out for other environmental public goods. According to these authors, low-income populations value this type of goods more highly, whereas their high-income counterparts have easier access to these goods away from local agricultural systems, and therefore tend to diminish their valuation.

Overall, these results indicate that there is a wide heterogeneity in the demand for multifunctional agriculture, depending on certain socio-economic characteristics of the respondents.

The corresponding results for the hybrid model of Tierra de Campos are shown in Table 4.

Table 4. Hybrid CL models with ASC and socio-economic variables interactions for cereal steppes of Tierra de Campos

Hybrid CL model with continuous coding variables (Model H1)				**Hybrid CL model with dummy coding variables (Model H2)**			
Variables	***Coeff.***	***St. Dev.***	***p-value***	***Variables***	***Coeff.***	***St. Dev.***	***p-value***
ASC	1,2806	0,7879	0,1041	***ASC***	1,1357	0,7892	0,1501
EMPLOY	0,0002	0,0000	0,0000	***EMPLOY1***	0,4908	0,0732	0,0000
LIVING	0,0193	0,0037	0,0000	***EMPLOY2***	0,7593	0,0767	0,0000
ENDANGER	-0,0485	0,0062	0,0000	***LIVING1***	0,2668	0,0732	0,0003
INTEGRATED	0,4174	0,0749	0,0000	***LIVING2***	0,3812	0,0747	0,0000
ORGANIC	0,3727	0,0736	0,0000	***ENDANGER1***	0,3712	0,0728	0,0000
TAX	-0,0169	0,0019	0,0000	***ENDANGER2***	0,5773	0,0742	0,0000
ASC × SEX	-0,7100	0,3806	0,0422	***INTEGRATED***	0,4281	0,0756	0,0000
ASC × AGE1	-0,6455	0,4616	0,1620	***ORGANIC***	0,3849	0,0747	0,0000
ASC × AGE2	0,0716	0,6470	0,9118	***TAX***	-0,0165	0,0020	0,0000
ASC × INC1	0,7821	0,4718	0,0974	***ASC × SEX***	-0,7102	0,3805	0,0420
ASC × INC2	-0,1063	0,7318	0,8845	***ASC × AGE1***	-0,6427	0,4621	0,1642
ASC × EDU1	-0,2051	0,3579	0,5666	***ASC × AGE2***	0,0618	0,6470	0,9239
ASC × EDU2	-0,7476	0,4643	0,1073	***ASC × INC1***	0,7749	0,4716	0,0964
ASC × FAM	0,3185	0,3828	0,0009	***ASC × INC2***	-0,1067	0,7319	0,8841
ASC × POP1	-0,0317	0,3855	0,9345	***ASC × EDU1***	-0,2039	0,3575	0,5685
ASC × POP2	1,4717	0,4265	0,0006	***ASC × EDU2***	-0,7502	0,4643	0,1061
ASC × CHI	-0,6805	0,3754	0,0499	***ASC × POP1***	-0,0324	0,3854	0,9329
ASC × KNO	-0,3202	0,1466	0,0290	***ASC × POP2***	1,4780	0,4268	0,0005
				ASC × FAM	0,3172	0,3823	0,0010
				ASC × CHI	-0,6884	0,3754	0,0466
				ASC × KNO	-0,3181	0,1464	0,0298
N	*1.788*			***N***	*1.788*		
LL(0)	*-1.433,6*	***LL(θ)***	*-1.292,0*	***LL(0)***	*-1.433,6*	***LL(θ)***	*-1.286,4*
LLR	*283,17 (0,000)*	***pseudo R^2***	*0,09877*	***LLR***	*294,27 (0,000)*	***pseudo R^2***	*0,10264*

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, all the attributes coefficients have the expected signs according to economic theory. Thus, in Model H1, the positive sign of EMPLOY and LIVING attributes implies higher levels of utility as the levels of these attributes increase. With respect to the dummy variables INTEGRATED and ORGANIC, these types of farm management are preferred to their conventional alternative. Logically, the negative sign of the ENDANGER coefficient represents higher utility as the level of this attribute decreases (the fewer endangered species the better). The coefficient signs in Model H2 have a similar interpretation.

To analyze the results of Model H1 and H2, we need to bear in mind the different interpretation of the coefficients in both models. Whereas in Model H1 the coefficient indicates the average marginal utility gained from an increase of one unit in the level of the attribute inside the range of variation under consideration, coefficients in Model H2 represent the marginal utility derived from the change from the *status quo* situation to the proposed levels of improvement in the sets.

Likewise, the economic interpretation can be obtained from the IP of the attributes, that is, the willingness-to-pay (WTP) for higher utility levels from changes in the attributes levels. The results appear in Table 5.

Table 5. Implicit prices and confidence intervals for each attribute (€/individual.year)

MODEL H1			**MODEL H2**		
Attribute	**IP**	**95% C.I.**	**Attribute**	**IP**	**95% C.I.**
EMPLOY	1.284×10^{-2}	(0.009 ; 0.017)	EMPLOY1	29.93	(19.73 ; 41.72)
LIVING	1.145	(0.683 ; 1.725)	EMPLOY2	46.16	(34.24 ; 61.62)
ENDANGER	-2.868	(-4.00 ; -2.02)	LIVING1	16.27	(7.43 ; 26.44)
INTEGRATED	24.93	(15.52 ; 35.74)	LIVING2	23.25	(13.93 ; 35.56)
ORGANIC	22.34	(13.45 ; 33.76)	ENDANGER1	22.57	(13.72 ; 33.75)
			ENDANGER2	35.01	(24.01 ; 50.21)
			INTEGRATED	26.21	(15.63 ; 38.96)
			ORGANIC	23.65	(14.13 ; 35.51)

People in Tierra de Campos are thus WTP on average €0.012/year for an increase of one full-time employee in the agricultural sector, €1.15/year for a 1% increase in the number of farmers living in the same municipality as their farms, €2.87/year for one less endangered species and €24.93/year and €22.34/year for a change in the current agricultural production system to integrated and organic farming systems, respectively. Although these differences in prices could be interpreted as an indicator of relative public preferences for some multifunctional aspects of the agricultural production, it would be safer to consider them from a ranking perspective rather than in terms of their absolute values.

The low valuation of the creation of farm employment obtained in comparison with other studies (Colombo et al., 2005; Bennett et al., 2004) is worth noting. In fact, the aggregate valuation for the local population, €2,565/year (0.012 x 213,749 inhabitants), falls far below the minimum level of subsidy needed to maintain a full-time worker in the agricultural sector (the current CAP support level is equivalent to €7,277/year, and even so, between 1989 and 1999 the area lost 30% of its agricultural labor force). This result supports the public impression in Tierra de Campos that employment in other sectors of the economy makes a greater contribution to the social welfare of society. However, for a more accurate answer, the WTP of non-residents living in nearby cities, or even in cities further a field, such as Madrid (250 km away), should be considered in the analysis.

The apparent paradox of higher valuation of integrated agriculture in comparison with organic farming can be explained on the grounds of two general ideas in the area of study: (1) some people perceive integrated agriculture as a more “modern” system of production and therefore safer, and (2) a considerable proportion of the population considers organic products as being of poorer quality due to their smaller size, less regular shape and color, etc.

Considering the results of Model H2, there is clear WTP for both moderate (EMPLOY1 + LIVING1 + ENDANGER1 + INTEGRATED) and further (EMPLOY2 + LIVING2 + ENDANGER2 + ORGANIC) improvements in the current situation. Thus, the aggregate WTPs of Tierra de Campos are 20.30 and 27.37 million Euros, respectively. Likewise, the

WTP for any combination of improvements in the level of attributes can be obtained. To put these figures into the correct perspective, we can indicate that direct CAP payments in the region add up to 91.70 million Euros. Nevertheless, it should be borne in mind that these WTPs are not absolute values suitable for comparison with CAP expenditure. They merely represent society's preference for improvements in the current attribute levels, i.e. their marginal value.

Heterogeneity of public preferences in Tierra de Campos

As in the previous case, we analyze the interactions of the attributes with the constant (ASC), using lineal and direct coding. According to these results, an overall improvement of the levels of the attributes is most highly valued by women (interaction ASC×SEX1 statistically significant), average income households between 1,500 and 3,000 Euros per month (interaction ASC×INC1 statistically significant), urban citizens (interaction ASC×POP2 statistically significant), full-time workers (interaction ASC×LAB1 statistically significant) and average and large family size with three, four and more than four members (interactions ASC×FAM1 and ASC×FAM2 statistically significant). Therefore, and maintaining the other socio-economic variables ceteris paribus, those respondents revealed a higher WTP. Conversely, respondents with higher levels of education (interaction ASC×EDU2 statistically significant), and better knowledge of agriculture (interaction ASC×KNO statistically significant), are, ceteris paribus, more reluctant to pay for this type of goods (higher probability of choosing the status quo alternative). Behind these apparently surprising results it may be possible to identify an attitude of protest to the current provision of public goods by agriculture. According to this idea, for these individuals the CAP does not provide the right incentives to farmers; therefore, for them, different payments should be implemented instead of higher taxes.

Conclusions

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

The use of choice experiments has revealed a methodology that is capable of estimating the relative values that people place on these attributes. The estimation of these indirect utility functions could turn out to be useful as a means of evaluating agricultural policy measures in terms of their impact on social welfare.

In any case, it must be borne in mind that the results are limited to the two areas of study, although they could be extrapolated to other agricultural systems with extensive farming activities which are close to marginality from a competitive point of view, but relevant from the perspective of provision of positive externalities.

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, average-income households, urban citizens, full-time workers and families with more than three members are those who benefit most from the provision of public goods by agriculture.

Finally, all these findings could be translated into certain rough policy implications. First, the local nature of multifunctionality (different provision of NCOs) suggests that agricultural policy should be developed at the local level to ensure maximum social welfare. Thus, although the latest CAP reforms have increased national/regional power as far as specific policy decision-making is concerned, a further implementation of the subsidiarity principle could be claimed. Second, also as a general statement, the results of this study could be regarded as supporting the new orientation of the CAP based on decoupled payments. In fact, these payments, subject the compliance with a range of environmental, food safety, animal and plant health and animal welfare standards and the modulation of the total amount of payments obtained by individual producers, could be regarded as an improvement in the economic incentives given to farmers in order to effectively provide NCOs to society (compared with previous agricultural price incentives or coupled payments). Lastly, the particular results obtained can be useful as a means of guiding the implementation of agricultural policy at local level. In this sense, the resulting WTPs for the different attributes should be considered as insights of societal priorities regarding the performance of the agricultural sector. In any case, it should be noticed that in order to optimize policy decision-making, other related issues need to be tackled, such as the real jointness in agricultural production, the non-agricultural provision of NCOs, etc. A good deal of empirical research is thus still needed to implement the concept of agricultural multifunctionality in real policy-making.

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