Demand for non-commodity outputs from Extensive Agricultural systems

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1. Introduction and objectives

According to OECD, multifunctionality is a "positive" concept encompassing the three different roles played by agriculture within EU: a) producing food and fibre products, b) preserving the rural environment and landscape and c) contributing to the viability of rural areas and a to balanced territorial development. This definition suggests that multifunctional agricultural production comprises both market and non-market goods (commodities and non-commodities). The former mainly comprise, although not exclusively, food and fibre 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, mainly providing local benefits. Because of this, policies set at the national level may not ensure their optimum provision, and they should be issued at local level. This new

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. According to the results, each attribute included in the concept of Multifunctionality gives a different contribution to the improvement of the utility at social level. Thus, and taking into account its willingness to pay (WTP) for each attribute, the obtained results suggest the existence of a significant heterogeneous demand for the different functions depending on the socio-economic characteristics of the individuals surveyed.

Key words: Agricultural Multifunctionality, economic valuation, Choice experiments, extensive agriculture, cereal steppes, olive groves (Spain).

Résumé

La multifonctionnalité agricole exprime l'idée que l'activité agricole peut remplir en même temps des fonctions économiques, environnementales et sociales. Pour soutenir les plans de la politique publique et afin de rendre opérationnel ce concept, il est nécessaire d'estimer la demande sociale de telles fonctions. L'objectif principal de cette étude est l'évaluation et l'analyse de la demande sociale de deux écosystèmes en particuliers: les oliveraies de montagnes de l'Andalousie, à risque d'abandon suite au découplage des subventions de l'UE, et les steppes de céréales en Tierra de Campos. La technique des 'Choice Expriments' a été appliquée pour avoir une évaluation économique de la demande en question. Les résultats suggèrent l'existence d'une demande significative des différentes fonctions. Telle demande est caractérisée par une hétérogénéité qui est en fonction des caractéristiques socio-économiques des individus étudiés.

***Mots-clés:** Multifonctionnalité agricole, évaluation économique, «Choice Expriments», steppes de céréales, oliveraies de montagne.*

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

By considering the empirical analysis of multifunctionality, we find two clear approaches: (a) focusing on the *supply side* of the agricultural systems (provision of commodities and non-commodities outputs) and (b) focusing on the *demand side*, taking into account the 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 by the agricultural sector from a social point of view. In theory, once the optimum has been located, the agricultural policy authorities are in the position to set up appropriate policy instruments to correct the market failures existing in the real world.

As a revision by OECD (2001) shows, most empirical studies follow the first approach, i.e. they analyse specific related issues in terms of joint production of agricultural outputs (commodities and non-commodities), market failures or options for ensuring the multifunctional agriculture's provision of non-commodity outputs. However, the

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present study aims at expanding the relatively sparse literature on the demand side of multifunctionality (Lima and Santos, 2001; Randall, 2002; Hall *et al.*, 2004).

The choice of two extensive agricultural systems, the pseudo-steppes in the North-West and the mountain olive groves in the South of 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 the abandonment of numerous farms, especially olive-growing farms, that are generally located in mountain area and whose yields are lower and production costs are higher.

Since the production function of these agricultural systems is at stake, it is 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 on Castilian and Andalusian citizens using the Choice Experiments procedure to address their willingness to pay for these non-commercial functions.

2. Methodology

2.1. Approach to the 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, we need to determine not only the valuation approach 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.

2.2. Valuation technique: the Choice Experiments

Hall *et al.* (2004) describe the range of available techniques to evaluate 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 the monetary valuation since, unlike the other alternatives, this technique relies on the same theoretical axioms ruling the consumers' decision processes. Among the monetary valuation techniques, some alternatives are available for assessing the multifunctionality of agricultural systems, namely the Contingent Valuation and the Choice Experiments (hereafter, CEs). In this study we opted for the latter due to its suitability to evaluate "complex

goods", i.e. those goods that comprise several parts or attributes, such as the agricultural multifunctionality (a set of externalities).

The CEs technique involves the characterization of the object of study, in our case the agricultural multifunctionality, through a series of attributes that can be combined to create hypothetical scenarios to be evaluated by the subject. Usually, in each choice set, three different scenarios are shown to the interviewee: the first one is the *status quo* (current levels of the attributes) with zero additional costs, and the other two represent changes in the levels of one or more attributes. The new levels imply an improvement in 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 seminar works by Adamowicz *et al.* (1994) who evaluated the public's recreational preferences for Canadian rivers, Boxall *et al.* (1996) and Adamowicz *et al.* (1997) did the same for Canadian hunting areas. Afterwards, the number of studies using this stated preference method has rapidly increased until becoming 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.

3. Cases of study

3.1. 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 olive-growing areas 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 enforcement of the latest revision of the Common Market Organisation (CMO) for olive oil, which involves the decoupling of 95% of the price subsidies so far received by oil producers, has placed such groves under the profitability threshold. For this reason, we can assume that a large share of such growers will stop its productive activity.

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 socio-eco-

nomic 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. Besides producing oil, other functions are:

– Generation of secondary activities: production of quality products, generally produced with the label of registered designation of origin.
– Generation of tertiary activities: support for leisure activities and 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 tune 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 conservation of biodiversity, b) control of erosion, c) provision of safe healthy food, and d) maintenance of rural population levels.

Regarding the first of the above-mentioned aspects, 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 cover crops and the presence of other species of bushes and trees, particularly in the case of organic 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 more superficial soil layers (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 following CAP reforms. In the case of the agricultural system being analysed here, as in other agrarian sectors, the healthiness of the produced food (olive oil in this case) is dependent on the presence of residues of phytosanitary products (Raymond *et al.*, 2005), which depends on the production system in use.

3.2. 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 wide areas of such pseudo-steppes, mainly covered by rain-fed cereals that 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 main 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% swine, 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); second, this agricultural system is a representative case of extensive farming (low input-low output) close to marginality, an aspect that gives greater relevance to the multifunctional aspects of the agricultural activity.

The current state of agriculture in this region offers an excellent example of how a modern primary sector can contribute 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 agri-food industries, 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, 1999; INE, 2001), representing 28.5% of the labour force of the region, well above the Spanish average of 5.6% and the 15 EU states average (4.0%). In rainfed agriculture, the average farm size (48.2 ha) implies a familiar type of production that keeps the population in rural areas, one of the social objectives of CAP. This function is particularly important in Tierra de Campos where depopulation is an acute problem, since this area is currently one of the most sparsely populated territories in Europe, with 11 inhabitants/km^2 (84.4 in Spain and 120 in the 15 EU member states).

– *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, the arable 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*), the Montague'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.

4. Empirical application of CEs

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

4.1. Determination of attributes and their levels

The choice of attributes should be based on two objectives: first, the collected information 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 was based on previous studies and surveys carried out in the two regions. Once the set of attributes was chosen, their relevance was subsequently discussed in three different focus groups; one involving 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 the local society, of trade-unions, of cultural associations and of neighbouring communities - representing the general analysed population). 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 CEs needed to implement had been included. Furthermore, appropriate proxy variables to measure these attributes were required. For this purpose we were helped by focus-group discussions that also helped in the determining their levels, as Table 1 shows:

4.2. 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*.

4.3. Sample selection

First, the target population of the study includes citizens over 18 living in the olive-growing provinces of Andalusia and in Tierra de Campos. In doing so, we focused our attention on the local demand for this type of goods. The decision was 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 was a positive willingness-to-pay for these goods among non-residents, they were not included in

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
Supplying of healthy products	Food safety (residues) due to the management of farming systems (*FOOD SAF*)	Conventional* Integrated Organic
Cost of public goods production	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%
Soil erosion prevention	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 (*KEEPING POP*)	50%* 25% 10%
Cost of public goods production	Levy on income tax (*TAX*)	0 €/inhabitant/year* 10 €/ inhabitant /year 20 €/ inhabitant /year 40 €/ inhabitant /year

* Levels of *status quo*.

the study. This limitation should be considered in the analysis of 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, olive-growing area, province and town size. The last quota variable aimed at capturing differences of valuation due to the urban/rural appreciations of the agricultural sector.

4.4. Data codification

For the quantitative variables, we have applied two coding possibilities: (a) direct and linear continuous coding, and (b) use of dummy variables. The former approach gives the average marginal willingness-to-pay (mean of individuals' implicit price of the attribute) for the considered range of variation, 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 being constant.

4.5. Econometric modelling

As most CEs 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 municipality population (POP), household size (FAM), village of childhood (CHI) and knowledge of the agriculture of the area (KNO). All these socio-economic variables, with the exception of KNO, are included in the models as dummy variables.

5. Results

5.1. 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 – *Hibrid 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	$5.79{\times}10^{-1}$	0.0139	ASC	1.19	$5.82{\times}10^{-1}$	0.0402
LANDSCAPE	$1.85{\times}10^{-2}$	$4.32{\times}10^{-3}$	0.0000	LANDSCAPE1	$4.01{\times}10^{-1}$	$8.71{\times}10^{-2}$	0.0000
EROSION	$-7.79{\times}10^{-2}$	$7.25{\times}10^{-3}$	0.0000	LANDSCAPE2	$4.35{\times}10^{-1}$	$9.02{\times}10^{-2}$	0.0000
FOOD SAF. KEEPING	$-3.56{\times}10^{-3}$	$8.35{\times}10^{-4}$	0.0000	EROSION1	$7.09{\times}10^{-1}$	$8.73{\times}10^{-2}$	0.0000
POP.	$-1.59{\times}10^{-2}$	$2.15{\times}10^{-3}$	0.0000	EROSION2	$9.90{\times}10^{-1}$	$9.15{\times}10^{-2}$	0.0000
TAX	$-2.97{\times}10^{-2}$	$3.07{\times}10^{-3}$	0.0000	FOOD SAF. 1	$2.35{\times}10^{-1}$	$8.46{\times}10^{-2}$	0.0055
ASC×SEX	$-8.37{\times}10^{-1}$	$2.65{\times}10^{-1}$	0.0016	FOOD SAF. 2	$3.84{\times}10^{-1}$	$8.35{\times}10^{-2}$	0.0000
ASC×AGE1	$-4.51{\times}10^{-1}$	$2.40{\times}10^{-1}$	0.0598	KEEPING POP. 1	$7.44{\times}10^{-1}$	$8.88{\times}10^{-2}$	0.0000
ASC×AGE2	-1.58	$3.38{\times}10^{-1}$	0.0000	KEEPING POP. 2	$6.26{\times}10^{-1}$	$8.93{\times}10^{-2}$	0.0000
ASC×INC1	$2.41{\times}10^{-1}$	$2.49{\times}10^{-1}$	0.3328	TAX	$-3.29{\times}10^{-1}$	$3.26{\times}10^{-3}$	0.0000
ASC×INC2	$2.26{\times}10^{-1}$	$3.81{\times}10^{-1}$	0.5524	ASC×SEX	$-8.49{\times}10^{-1}$	$2.65{\times}10^{-1}$	0.0014
ASC×EDU1	$-2.20{\times}10^{-1}$	$2.50{\times}10^{-1}$	0.3788	ASC×AGE1	$-4.64{\times}10^{-1}$	$2.40{\times}10^{-1}$	0.0537
ASC×EDU2	$2.52{\times}10^{-1}$	$3.20{\times}10^{-1}$	0.4311	ASC×AGE2	-1.60	$3.39{\times}10^{-1}$	0.0000
ASC×FAM	$2.31{\times}10^{-1}$	$9.28{\times}10^{-2}$	0.0129	ASC×INC1	$2.47{\times}10^{-1}$	$2.49{\times}10^{-1}$	0.3219
ASC×POP1	$6.59{\times}10^{-1}$	$3.08{\times}10^{-1}$	0.0324	ASC×INC2	$2.41{\times}10^{-1}$	$3.82{\times}10^{-1}$	0.5279
ASC×POP2	$3.11{\times}10^{-1}$	$2.86{\times}10^{-1}$	0.2782	ASC×EDU1	$-2.20{\times}10^{-1}$	$2.51{\times}10^{-1}$	0.3798
ASC×CHI	$-7.03{\times}10^{-1}$	$2.90{\times}10^{-1}$	0.0154	ASC×EDU2	$2.42{\times}10^{-1}$	$3.21{\times}10^{-1}$	0.4512
ASC×KNO	$3.80{\times}10^{-2}$	$1.23{\times}10^{-1}$	0.7566	ASC×FAM	$2.35{\times}10^{-1}$	$9.29{\times}10^{-2}$	0.0116
				ASC×POP1	$6.70{\times}10^{-1}$	$3.08{\times}10^{-1}$	0.0298
				ASC×POP2	$3.06{\times}10^{-1}$	$2.87{\times}10^{-1}$	0.2855
				ASC×CHI	$-7.09{\times}10^{-1}$	$2.91{\times}10^{-1}$	0.0148
				ASC×KNO	$4.60{\times}10^{-2}$	$1.23{\times}10^{-1}$	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 R²	0.115	LLR	336.34 (0.000)	pseudo R²	0.127

N: number of observation.
LL(0): Log-likelihood with ASC.
LL(θ): Log - likelihood with all the variables.
LLR: Log- likelihood 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 and Mogas *et al*., 2005). Nevertheless, the H2 model yields slightly better results.

According to these results, all attributes are statistically significant; hence, all the considered attributes 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 KEEPING 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 to say the will-

ingness 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)
KEEPING POPULATION	-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)
			KEEPING POP.1	22.61	(16.23 ; 30.23)
			KEEPING 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 reported amount 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 utility 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 than 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):

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

where V_0 is the utility for the status quo alternative, V_1 represents 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 KEEPING POP.1) and the further one (changes to LANDSCAPE2, EROSION2, FOOD SAF. 2 and KEEPING POP.2) has 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, by 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 M euros 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 M euros.

5.2. 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 evaluation of multifunctionality depending on the socio-economic characteristics of the respondents. Thus, women (SEX=0) give the multifunctionality of these agricultural systems more value than men do (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) pointed out for other environmental public goods. According to these authors, low-income populations give more value to this type of goods, 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.

5.3. Multifunctional valuation of the cereal steppes in Tierra de Campos

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

According to these results, all parameters are statistically significant; hence, all the attributes considered are significant determinants of the 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 with respect 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 are, the better it is). The coefficient signs in Model H2 have a similar interpretation.

Table 4 – *Hibrid CL models with ASC and socio-economic variables interactions for 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 R²	0,09877	LLR	294,27 (0,000)	pseudo R²	0,10264

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

To analyse 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.

Similarly, the economic interpretation can be obtained from the IP of the attributes, that is to say the willingness-to-pay (WTP) for higher utility levels from changes in the attributes levels. The results appear on 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 municipality where their farms are located, €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, respetively. 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, equal to €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 labour 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 far away, 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 colour, 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 suit-

able for comparison with CAP expenditure. They merely represent society's preference for improvements in the current attribute levels, i.e. their marginal value.

5.4. Heterogeneity of public preferences in Tierra de Campos

As in the previous case, we analyse 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 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-sized families of 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 on 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.

6. 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 citizens and in the valuation of the various attributes this 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 the 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 the highest 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 subsidiary principle could be claimed. Second, 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 with 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 obtained results can be useful as a means of guiding the implementation of agricultural policy at local level. In this sense, the resulting WTP for the different attributes should be considered as insight of societal priorities regarding the performance of the agricultural sector. In any case, it should be noticed that in order to optimise 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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