Multifunctional agriculture: evaluation of non-production benefits using the Analytical Hierarchy Process

Multifunkční zemědělství: evaluace mimoprodukčních přínosů s využitím analytického hierarchického procesu

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Abstract: Sustainable land use in agriculture involves the management of economic, environmental, and social services. In order to make the widely accepted concept of sustainable multifunctional agriculture operative for the design of agricultural policies, it is necessary to estimate the social demand for non-production outputs. This paper addresses the issue of matching agricultural policy with public preferences and willingness to pay for the possible non-production benefits that agriculture may deliver. Given the diversity of economic, social and environmental services, and the diversity of public needs, the reported study attempts to simplify and evaluate a very complex set of multifunctionality issues and to investigate the policy relevant trade-offs using the combination of the Contingent Valuation (CV) and the Analytical Hierarchy Process (AHP) methods. The results obtained demonstrate the existence of a significant public demand for the investigated non-production outputs included in the multifunctionality concept in the Czech Republic.

Key words: multi-functionality of agriculture, non-commodity outputs, non-market evaluation, Contingent Valuation, Analytical Hierarchy Process

Abstrakt: Pro hodnocení udržitelnosti multifunkčního využití půdy v zemědělství je nezbytné analyzovat produkční, environmentální a společenské přínosy daného způsobu zemědělského hospodaření. Předpokladem adekvátního ocenění mimoprodukční funkce zemědělství ze strany státu a zároveň efektivního využití finančních prostředků státního rozpočtu je analýza společenské poptávky a kvantifikace mimoprodukčních přínosů zemědělství. V příspěvku jsou shrnuty výsledky evaluační studie zaměřené na ocenění komplexních mimoprodukčních přínosů zemědělství. Netržní evaluace je založena na kombinaci metody kontingentního hodnocení netržních přínosů zemědělství a metody analytického hierarchického procesu, která byla využita pro dekompozici komplexní hodnoty přínosů mimoprodukčních funkcí a stanovení hodnoty přínosů dílčích mimoprodukčních funkcí. Dosažené výsledky indikují existenci významné společenské poptávky po zkoumaných nekomoditních výstupech zemědělství, zahrnovaných do konceptu multifunkčního zemědělství ČR.

Klíčová slova: multifunkčnost zemědělství, nekomoditní výstupy, netržní evaluace, kontingentní hodnocení, analytický hierarchický proces

In common with other EU member states, Czech agriculture has to reflect that the system of agricultural support is reappraised. The emphasis on non-market agricultural outcomes, both environmental and social, marks a change from the traditional support for market production. This development has led to discussion about the purpose of the sector support and the role of public preferences in determining the range and form of compensation of farmers for the provision of non-commodity outputs.

It is widely accepted that agricultural production is intrinsically multifunctional. All agricultural production modes or systems lead to a bundle of market and non-market outputs ranging from economic, environmental to social and cultural goods and services. Agricultural policy is formed as the *trade-offs*

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between interests of producers, consumers and government but also between the *social goals* of equity (in terms of the desirable income distribution in society) and efficiency of production and consumption of a bundle of jointly produced agricultural outcomes. An efficient policy should be compatible with the free trade requirements and thus motivated by the genuine concern to improve the overall efficiency of the rural resource use. While government policies the attempt to approximate public preferences, an increasing emphasis on evidence-based value for money in all spending decisions suggests that some attention should be paid to the explicit measurement of public demand and the use of demand information in the budgetary process (Brubaker 2004).

As a part of the development of agro-environmental policy, policy-makers and researchers have attempted to evaluate the public benefits of reform using an array of methods to measure the value of non-market outputs from agriculture also in the Czech Republic (Křůmalová 2002; Kubíčková 2004). While the environmental economic techniques have been used to reveal the values attached to specific public goods, it was recognised that further research should be attempted to gain insights into the nature of the trade-offs that are inherent in public preferences over the range of non-commodity outcomes. Hall et al. (2004) reviewed published evidence on how agri-environmental reforms might be matched to measured public preferences and concluded, that the totality of the existing studies provides only a partial evidence base for informing the trade-offs that might be relevant in the policy design.

The reported evaluation study is set against a background of the policy decision-making process that limits the likely resources directed towards the supply of non-commodity outcomes. The aim of this paper is to determine the values placed by society on the competing outputs of multifunctional agricultural production, and the trade-offs people make between them. Emphasis is on the evaluation of non-market outputs that encompass both environmental and social benefits. The economic valuation technique used relies on the combined implementation of the Analytical Hierarchy Process (AHP) and the Contingent Valuation (CV). First the AHP was employed to examine the trade-offs between different identified functions of agriculture and their outputs in non-monetary context. In the second stage, the complex monetary value of non-market benefits was estimated using the open-ended CVM question and the estimated value then being decomposed according to the attributed preference weights. The aggregate monetary value for the non-market benefits provided by agricultural production and the partial values for each of the attributes are presented.

Our research was carried out within a particular geographical area, the Region of South-East (NUTS 2, Czech Republic). Thus, the results of our evaluation study are not necessarily directly transferable to other areas. However, the interest of this research lies both in its approach, which emphasises the necessity of the determination of social demand before developing policy instruments, and its methodology, which can be employed in any other geographical area.

MATERIAL AND METHODS

Sustainable agriculture is considered to be intrinsically linked to the concept of multifunctionality. The term of multifunctionality was formally defined for the first time by the European Commission (EC 1999), as the recognition of three different functions of agriculture in the EU:

– *production function* (producing food and fibre – market outputs)
– *environmental function* (preserving rural environment and landscape – positive/negative externalities, non-market outputs)
– *socio-economic function* (contributing to the viability of rural areas and a balanced territorial development – positive/negative externalities, non-market outputs).

The agricultural policy underlying rationale is to address the complex interdependence of economic, environmental and social effects of land use in agriculture, taking into account market and non-market outputs. It requires an optimal identification of the public objectives and an implementation of the adequate policy instruments.

The evaluation in the policy context aims at rationalising policy-making process by systematically structuring all relevant aspects of policy choices (the assessment of impacts of alternative possibilities). It is considered as a continuous activity that permanently takes place during the policy-making process and different kinds of evaluation can be distinguished in a policy analysis. The reported evaluation study aims to investigate the consumer's attitudes and values of different agricultural outcomes and their Willingness to Pay (WTP) for non-commodity outputs. To estimate social demand for non-market output of agriculture, the preference methods of non-market evaluation was suggested. Especially direct methods of non-market evaluation can value agricultural non-market outputs in its entirety: taking into account the whole bundle

of varying attributes. Thus the reason for applying the Contingent Valuation method (CV) in this case is its ability of measuring the complex value of the non-market outputs to a wide range of 'users' (Dunn 1974).

Contingent valuation method

Contingent valuation studies with respect of policy evaluation can provide useful insights for designers and users of surveys eliciting the public's comprehensive budgetary preferences. The logic of the Contingent Valuation (CV) studies is that of inferring the distribution of economic benefits in a target population from the statements of WTP elicited from a random sample of respondents (for more information about CV see Hanley et al. 1997).

The stated preference valuation methods ideally require survey respondents to make the informed value judgements on the non-market good under investigation. This requires the information on these goods to be presented to the respondents in a meaningful and understandable format, which in turn will enable them to express their preferences consistently and rationally.

However, the public's preferences for non-market outputs of agriculture are not well formed and very few people have an idea of what the values of the relevant trade-offs between non-markets outputs are. Considering that the separate valuation of each output of multifunctional agriculture through an individual CV study (due to the series of "instrumental biases") could lead to seriously biased estimations, the AHP as a complementary technique to CV was suggested (see also Kallas et al 2007; Hall et al 2004). It is based on the assumption, that the individuals'/society utility functions are additive. The sum of the partial utilities $U(F_i)$ for each attribute is equal to the total utility of the complex good $U(MF)$:

$$U(MF) = U(F_1, F_2..., F_n) \quad (1)$$

where F_i represents agricultural function i.

Assuming the following linear utility function specification, AHP allows us to estimate w_i for each agricultural function/output i:

$$U(MF) = w_1F_1 + w_2F_2 +... + w_nF_n \quad (2)$$

hence the WTP for an individual function/output of multifunctionality is as follows:

$$WTP_F = w_1 WTP_{MF} \quad (3)$$

Assuming an additive utility function, multiplying the attribute weights by the corresponding aggregated WTP provides estimates of the WTP for various levels of the attributes.

The AHP method

The AHP method was originally created by Saaty (1980) as a structured but flexible technique for making decisions in a multi-criterial context. The method is based on approaching complex decision problems using a hierarchical structure. It allows setting up a range of preference choice sets without including a price attribute. Respondents make pair wise comparisons between the identified agricultural functions/outputs (targets of policy support). From these observed choices preference weights w_i and preference order can be derived. However, the AHP does not directly include a valuation of the respondent preferences, which has been estimated using the open-ended contingent valuation question.

The agricultural policy-decision problem can be understood by examining a hierarchical structure of agricultural functions and its possible outputs (policy goals). In our case, according to the information gained from the literature review, the hierarchical structure was designed and explained in three levels: the complex agricultural outcome at the highest level of the structure, functions of agriculture (type of outputs) at an intermediate level and main outputs of different functions forming the base of the structure. Figure 1 shows this three-level structure.

Within this hierarchical structure, the relative importance or weighting of each criterion or subcriterion (w_i) is obtained from paired comparisons of the criteria. Such paired comparisons are rather easier to understand and answered by respondents than the simultaneous comparison of all objectives

Table 1. The AHP pair wise comparison scale

Degree of importance (w)	Definition
1	Both outputs are equally important
3	Very slight importance of one output over the other
5	Moderate importance of one output over the other
7	Demonstrated importance of one output over the other
9	Extreme or absolute importance of one output over the other

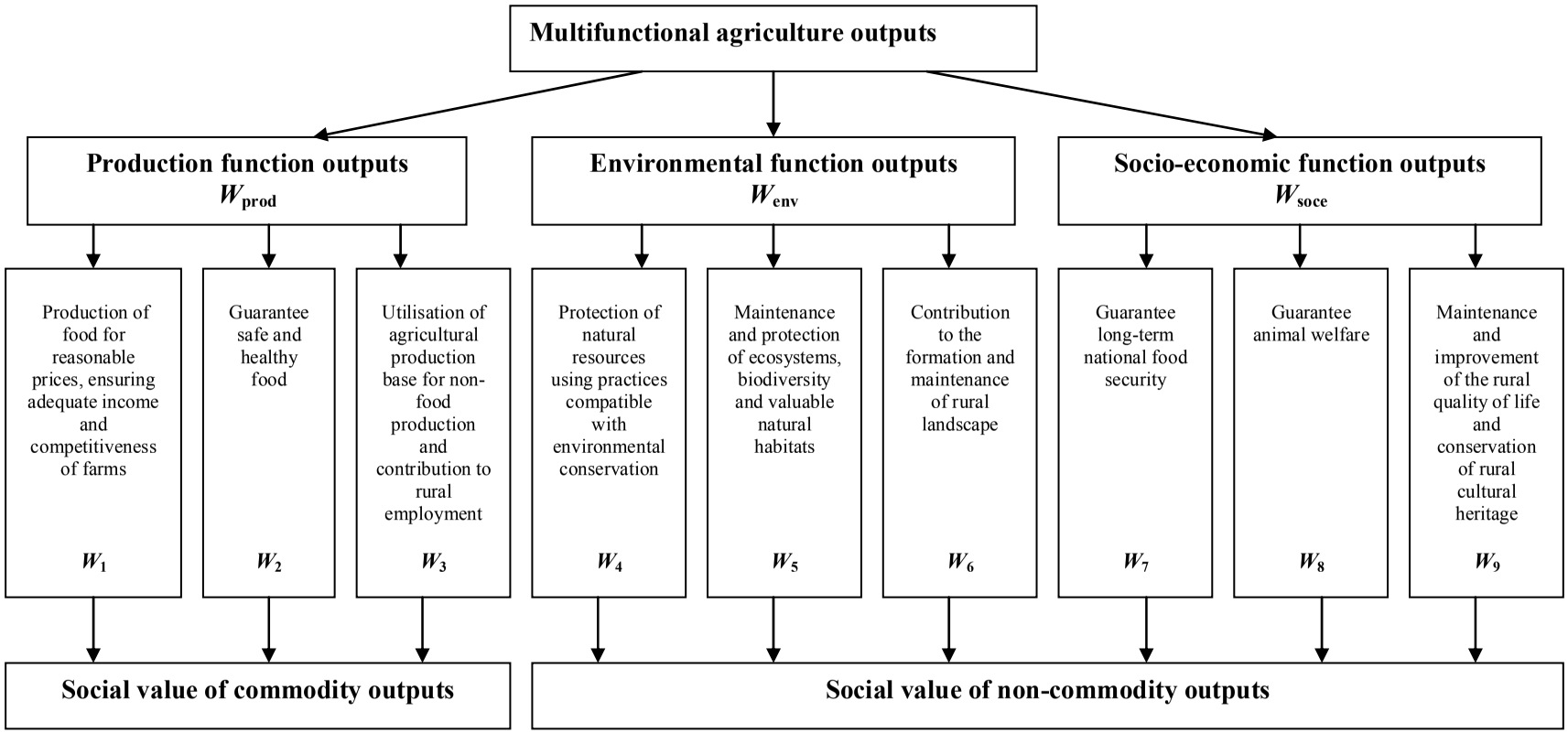

Figure 1. Hierarchical structure used to value agricultural multifunctionality

within the same structural level. In order to utilise these comparisons, Saaty (1980) proposed and justified the use of a 1–9 scale, as shown in Table 1. As in most empirical studies using the AHP, we used this linear scale in our research, since it is intuitive and easy to deal with by previously untrained respondents.

Thus, in order to determine the weightings assigned to each of the proposed multifunctionality attribute, the respondents (representing the society as a whole) must make two kinds of comparison; first, pair comparisons between the functions multifunctional agriculture (three sets of pair comparisons in the present case), and secondly, pair comparisons between the specific outputs of each function. Each respondent thus generates three Saaty's matrixes A, where a_{ij} represents the score obtained from comparing the sub-criterion i and the sub-criterion j.

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & a_{ij} & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (4)$$

This square matrix possesses two key properties:
(a) its principal diagonal is filled by 1's ($a_{ii} = 1$ for any i) and
(b) it verifies reciprocity among pair comparisons (if $a_{ij} = x$ then $a_{ji} = 1/x$).

If the respondent is perfectly consistent, the scores given to pair comparisons actually represent the rations among weightings allocated to the corresponding sub-criteria by a perfectly rational decision-maker:

$$a_{ij} = w_i/w_j \quad (5)$$

for any i and j.

The hierarchical structure of the AHP implies that the *specific weightings* (w_i) obtained for each level should always add up to one (i.e.: $w_{prod}+w_{env}+w_{soce} = 1$, $w_1 + w_2 + w_3 = 1$, etc.). Therefore, if we subsequently wish to compare the relative importance allocated to the different specific outcomes (objectives) proposed, it is necessary to obtain the corresponding *normalised weights* (w_i') as shown in Figure 2. These normalised weights are obtained by multiplying each of the weight of the sub-criterion by the weight of the criterion immediately above it in the hierarchical structure, i.e., $w_1' = w_{prod} \times w_1$, etc. Thus, the normalised weights for all the specific objectives once again add up to one, and each w_i' becomes an indicator of the importance of output i across the whole set of the specific agricultural function outputs considered.

Initially, the AHP decision technique was designed for individual decision-makers, but it was promptly extended for group decisions (Easley et al. 2000). For these purposes, Aczél and Saaty (1983) propose the geometric average method to aggregate the pair comparisons of the Saaty's matrixes ($A_k = a_{ij}$) from the m people who make up the group (sub-index k) to obtain the aggregated Saaty's matrix:

$$A = a_{ij} \sqrt[m]{\prod_{k=1}^{k=m} a_{ijk}} \quad (6)$$

Finally, the vector of weights for the different criteria derives from this aggregated matrix. Along the same lines, Gass and Rapcsàk (2004) propose as an alternative using the arithmetic average or the geometric average to aggregate the w_{ik} weights from each person k:

$$w_i = \frac{\sum_{k=1}^{k=m} w_{ik}}{m} \quad \text{or} \quad w_i = \sqrt[m]{\prod_{k=1}^{k=m} w_{ik}} \quad (7)$$

in order to estimate the representative weightings for the whole group. We adopted the second option referred as *aggregation of individual preferences (AIP)* in our study, because of according the Forman and Peniwati (1998), the AIP method estimated by the geometric average, is more appropriate for group decisions in the social field.

DESIGN AND IMPLEMENTATION OF THE CASE STUDY

The study was conducted in the Region NUTS II South-East (Czech Republic). Although the limited transferability of study results was emphasized, it is worth taking into account the importance of agriculture for this region. Agricultural land covers 60% of the total area of 13 919 km^2 of this region. The total population is 1 647 929 inhabitants and HDP per capita is approx. 12 906 € (54% of the EU average). Agriculture generates from 5.1% (in the Region NUTS III South Moravia) to 12.6% (in the Region NUTS III Vysočina) of Region's employment, both values being higher than the national average (4.8%). Although from the private point of view, farming is at the marginal of economic performance in some areas, it still has an important role from the social point of view in terms of the ratio of the actively farmed land in the LFA with the highly valued agricultural landscape (45.1% of the region's total agricultural land).

The principal challenges in the CV study design were to identify what aspects of the complex agricultural output needed to be communicated to the

general public, thus forming the focus of the valuation exercise. We also needed to design effective ways of conveying the information. The feedback from pilot surveys on focus groups using verbal descriptions of the multiple functions of agriculture and their outputs indicated that the large volume of new information about the bundle of agricultural outputs requiring presentation led both to the confusion and respondent fatigue. The adoption of a more visual and interactive approach was therefore considered more suitable. We used a verbal description supported with a written Information Pack with pictures visualising the hierarchical structure of agricultural outputs (Figure 1). Following the presentation of this information, respondents were provided with an opportunity to discuss and clarify with the interviewer any issues of outstanding confusion. The pair-wise comparisons were framed in the form of question: how important is the option A relative to the option B? The options here were agricultural functions/outputs. The cognitive burden was thus reduced as the comparisons of importance were always between two functions or outputs instead of the evaluation of a large bundle of outputs. Moreover, as it is assumed that the respondent is consistent in judgements about any pair criteria, following the use of the reciprocal allows only $n\,(n-1)/2$ comparisons to be made where there are n criteria.

The problem with the CV application is also how to deal with the negative WTP. This problem has been discussed in a series of articles. It is widely accepted that the WTP on theoretical backgrounds can be negative. According to Kriström (1995), the correct way of the CVM application is to gather the information from the respondents that allows for a distinction to be made between zero, negative and protest WTP bids. This was done by the inclusion of the follow-up questions in the survey instrument that ask for the respondent's motives for stating a zero bid in order to distinguish the following categories of respondents:

1. stating WTP > 0
2. stating WTP = 0 or synonymous reply
   a. being indifferent, 'true' WTP = 0
   b. having a negative WTP, WTP < 0
   c. defined as protest bidders

The feedback from the respondents of the pilot survey indicated that the majority of respondents understood the concepts presented. Following the presentation of the Information Pack, the respondents were asked to complete a questionnaire.

The survey consisted of a sample of 408 valid questionnaires returned by a sample drawn from the total population in the region South-East, i.e. of 1 646 929 inhabitants. The sample points were selected across this region. Again, a sub-stratification was determined using a quota system based on social grade, age and gender.

The questionnaire consisted of the following basic elements:

– investigation of the existence of genuine concern for the support of multifunctional agriculture and the provision of non-commodity services by agriculture
– pair comparisons among the various agricultural functions and their outputs. This information was used to implement the AHP analysis
– WTP evaluation questions. This information was used to implement the Contingent Valuation analysis
– socio-economic questions.

VALUATION RESULTS AND DISCUSSION

Social preference on the aggregate scale

The application of the methodology described above to the elements of the sample enables us to obtain the weightings that the sample assigns to each individual agricultural output/objective of the agricultural policy. The responses for the pair-comparison question were coded along a nine-point scale as set in the Table 1 and the reciprocal of relevant rating was assigned (if $a_{ij} = x$ then $a_{ji} = 1/x$). The preference ratings, and their reciprocals, were collected in four comparison matrixes for each respondent, specific weights (w_i) were then estimated which are consistent with the relativities between the agricultural functions or outputs/policy objectives contained in the matrix by calculating the geometric mean of each row and normalising them by dividing by the sum of geometric means for each row. Then the normalized specific weights (w_i') were calculated and all results were aggregated.

The final results are shown below in Figure 2.

From these results, we can derive that the sample of citizens of the Region South-East considers the production function as the most important function of agriculture, followed by the environmental function and the socio-economic function. Altogether, the production function benefits generate approximately 44.8% of the economic value of complex agricultural output while the environmental functions generate 31.8% and the socio-economic function 23.4%. The finings indicate a remarkable importance of non-production functions of agriculture for the respondents

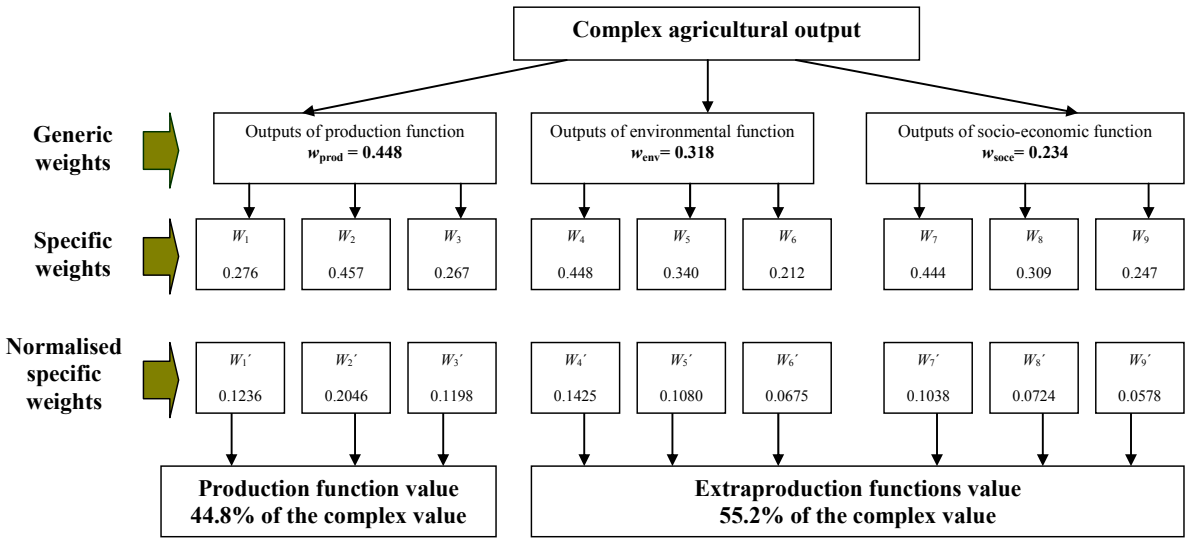

Figure 2. Results of agricultural function outputs weightings

(55.2% share of the value of complex economic output) and correspond to the objective implicit in the concept of agricultural multi-functionality; that of guaranteeing an appropriate level of output provided by agriculture, in their productive, environmental and social dimensions.

Based on the normalised weight for the identified agricultural outcomes, we can set the preference order for the investigated commodity and non-commodity outputs (policy objectives). The relative importance of each output and thus the possible trade-offs within policy options are quantified using the normalized weights, which also represent the share of each identified output in the value of the complex agricultural output. The ranking of preference for agricultural outputs that can be used for the priority setting by policy-makers is shown in Table 2.

To guarantee the safe and healthy food was identified as the most preferred and valuable outcome/service of agriculture delivered to society that creates almost 20.46% of the total benefit derived from multifunctional agriculture. Second highly valued outcome is according to our results the protection of natural resources (14.25% of the total benefit) followed by the production function outcomes – production of food for reasonable prices (12.36%) and utilization of agricultural production base for the non-food production (11.98%). The animal welfare, landscape maintenance and contribution to rural life quality and cultural heritage was valued relatively lower,

Table 2. The preference order of identified agricultural outcomes

Preference order	Type of agricultural outcome	Function	Normalised specific weight
1.	Guarantee safe and healthy food	production	0.2046
2.	Protection of natural resources using practices compatible with environmental conservation	environmental	0.1425
3.	Production of food for reasonable prices, ensuring adequate income and competitiveness of farms	production	0.1236
4.	Utilisation of agricultural production base for non-food production and contribution to rural employment	production	0.1198
5.	Maintenance and protection of ecosystems, biodiversity and valuable natural habitats	environmental	0.1080
6.	Guarantee long-term national food security	socio-economic	0.1038
7.	Guarantee animal welfare	socio-economic	0.0724
8.	Contribution to the formation and maintenance of rural landscape	environmental	0.0675
9.	Maintenance and improvement of the rural quality of life and conservation of rural cultural heritage	socio-economic	0.0578

however, the relative difference between their shares in the total benefit derived from agriculture is still considerable.

In conclusion, the citizens of the Region South-East of the Czech Republic are willing to support domestic agriculture, primarily as a producer and provider of the safe and high-quality food. The findings show also the high importance of environmental externalities and a relatively lower importance of socio-economic externalities for our respondents.

Table 3. WTP for non-commodity outputs of agriculture – CV data analysis results

Variable	Unit	Value
n	Resp.	408
WTP > 0	%	63.24
WTP = 0	%	36.76
WTP < 0	%	3.19
Protest	%	26.47
*n**	Resp.	277
MEAN (*n*)	CZK/p/month	84.90
MEAN (*n**)	CZK/p/ month	125.05
MEAN (WTP)	CZK/p/month	134.26
MEDIAN (*n*)	CZK/p/month	50
MEDIAN (WTP > 0)	CZK/p/month	100
MODUS (WTP > 0)	CZK/p/month	100
STDEV (*n*)	CZK/p/month	114.18
TRIMMEAN (95%)	CZK/p/month	50
MIN WTP	CZK/p/month	5
MAX WTP	CZK/p/month	1 000

*n** = shows the total of genuine zeros plus positive WTP bids; 1 € = 31.30 CZK

CV results

Following the priority settings, the respondents were asked the open-ended CV question whether and how much they would be willing to pay through their annual taxes to support the non-commodity outputs of the non-production functions. This established three groups of respondents: those prepared to pay in principle, non-payers and protesters. Of the total sample of 408 respondents, 258 (63.24% of the total sample) stated a positive WTP. Of the 150 respondents refusing to pay anything (36.76% of all respondents), 140 gave a reason. Within these, 19 (4.66% of the total sample) were classed as "genuine zeros", only 13 (3.19% of the total sample) as "negative WTP", and 108 respondents were classed as "protest bidders": this gives an overall protest level 26.48% of the total sample. The most common reasons for protesting were that the respondents did not believe that their money would be used for the stated purpose and that it is unfair to ask people for the contribution. It can indicate the need to ensure the transparency of the proposed policy programs. This suggestion can be supported also by the fact that only 21.57% of respondents stated, that they trust the right redistribution of their money through the state budget.

Table 3 shows the results of a descriptive statistic analysis of the open-ended CV data set results. As usual in the CVM studies, both the median WTP 50 CZK/p/month and the trimmed mean WTP 50 CZK/p/month lie below the true mean WTP

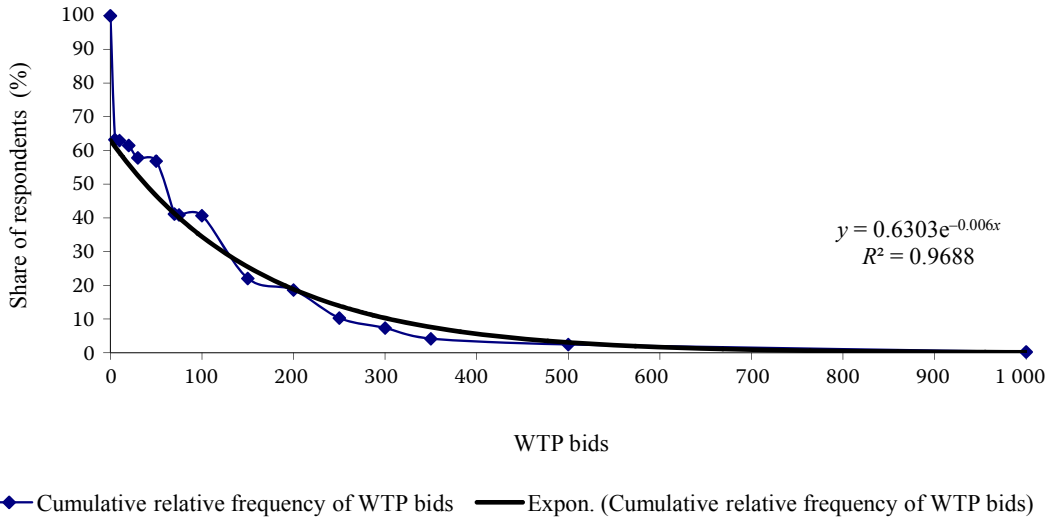

Figure 3. WTP bid curve for extraproductional services of agriculture in the Region South-East (CZ), (*N* = 408)

84.90 CZK/p/month; this is due to the influence on the latter of the values in the upper tail of the distribution. The standard deviation WTP 114.18 CZK/p per month is less than twice the mean, which is somewhat lower than is often the case in the CV. The lowest non-zero bid was 5 CZK/p/month and the highest 1 000 CZK/p/month. If we have the ambition to measure some sheer value of the non-market benefits of agriculture, it seems relevant to exclude from the sample the respondents having the negative WTP and the respondents defined as protest bidders, since we do not have any information on their preferences for these agricultural services. The mean of WTP (n^* = 277) is 125 CZK/p/month.

Public demand for non-commodity outputs in the Region South-East can be also described in terms of the relationship between the WTP bids (price of non-commodity output) and amount of respondents willing to pay that amount of money (the share of respondents with the WTP ≥ WTP bid). We found that an exponential functional form (Figure 3) fitted this data set best in terms of explanatory power and the acceptable R^2 value.

The AHP results presented above (Table 2) were based on an aggregate calculation of the attribute and quality weights. For this analysis, those weights were calculated on an individual basis. The calculations were carried out in the same manner as before, but repeated for each respondent who stated a WTP amount or genuine zero. This allowed the individual WTP amounts to be decomposed according to the overall weightings given to each non-market output of agriculture. The individual WTP for each identified service of agriculture by the means of estimation are presented in the Table 4.

In order to estimate the annual non-market benefits of the non-production functions of agriculture in the Region South-East, the sample WTP figures were grossed up into the aggregate value figures. The relevant population of potential beneficiaries was taken to be 1 646 929 inhabitants of the Region South-East (CZ). This is not to deny that people living in the rest of the Czech Republic derive benefits from the non-production functions of agriculture. However, due to the sample size and distribution, using this population would provide more relevant total benefit figures. Table 5 presents the results of the WTP aggregation using different combinations of the WTP estimates and the relevant population.

As is shown above, the most conservative estimation of the annual aggregate benefits of extra-production functions of agriculture for the population of the Region South-East is 461.99–784.45 mil. CZK per year.

The pilot application of the AHP-CV evaluation in the Czech Republic limits the possibility of comparison of our results with the results of other studies. However, there are some results of the partial evaluation of landscape services of agriculture (Křůmalová 2000; Kubíčková 2004), which can be used. The dif-

Table 4. Decomposition of WTP according to the overall weightings given to each non-market output of agriculture

Type of agricultural outcome (AO)	Share of the complex value of AO (%)	Normal. specific eights of non-market AO	Mean WTP (CZK/p/month)			Median WTP (CZK/p/month)		
			n	*n**	WTP > 0	*n*	*n**	WTP > 0
Environmental functions	31.82	0.576	48.67	71.70	76.98	25	50	50
Protection of natural resources using practices compatible with environmental conservation	14.25	0.258	21.65	31.90	34.25	9.34	19.10	21.44
Maintenance and protection of ecosystems, biodiversity and valuable natural habitats	10.81	0.195	17.31	25.51	27.38	7.60	16.35	16.67
Contribution to the formation and maintenance of rural landscape	6.75	0.122	9.71	14.29	15.35	3.86	8.33	9.70
Socio-economic functions	**23.36**	**0.424**	**36.22**	**53.35**	**57.28**	**13.81**	**30.45**	**36.60**
Guaranteed long-term national food security	10.38	0.188	16.55	24.37	26.17	4.63	12.97	14.60
Guaranteed animal welfare	7. 24	0.131	11.26	16.59	17.81	3.62	8.73	9.91
Maintenance and improvement of the rural quality of life and the conservation of rural cultural heritage	5.78	0.105	8.41	12.39	13.30	2.84	7.12	7.71
Extra-production functions	**55.18**	**1.000**	**84.90**	**125.05**	**134.26**	**50**	**100**	**100**

AO – agricultural output; n^* – shows the total of genuine zeros plus positive WTP bids; 1 € = 31.30 CZK

ference of results can indicate (besides the higher value of the landscape maintenance in certain area) that the CV valuation of the separate non-commodity outcome could be subject to a number of instrumental biases including embedding effects, part-whole bias and violation of the budgetary constraints of the individual respondents (Table 6).

CONCLUSIONS

The optimal agricultural support policy should be based among others on the identification of the public objectives that are to be achieved and a suitable choice of policy instruments to be implemented. This paper deals with the first part of the policy decision-making problem. It aims to analyse public preferences for agricultural outputs in terms of the relative weights that citizens assign to the various possible agricultural outcomes and to estimate the economic value of the non-market outputs.

The results show that overall *"to guarantee safe and healthy food"*, and *"protection of natural resources using practices compatible with environmental conservation"* are the most preferred services of agriculture. In terms of agricultural output areas, the order was that production functions were preferred to environmental functions, both being preferred to socio-economic functions. Significant weights have been assigned to outputs that can be linked to the public in the direct use sense (food and environment quality, non-food production that is consumed). The obtained weights of preferences for the *production of food for reasonable prices, ensuring adequate income and competitiveness of farms and long term national food security* can indicate social demand for competitiveness of domestic agriculture. Thus respondents from our sample derive utility not only from the healthy and safe characteristics of the food, but also from its origin, nevertheless the importance of the origin of food is much lower.

From the policy-making point of view, it is also worth to point out here, that weightings obtained from the AHP for the society as a whole are averages, coming from a wide range of positions in reality. In this socio-political context, the final policy-decisions will not necessary fit with the demand of the majority of society, but they are also dependent on the ability of social groups (lobbies) to push through their opinions. Thus the cluster analysis of the data set will be the subject of further research.

Generally, our sample of citizens of the Region South-East rejects none of the identified output of agriculture. The estimated value of the extra-production function output represents 55% of the total social utility derived from the complex agricultural output so our results indicate a significant public demand for extra-production functions of agriculture. Economic value of non-market benefits of extra-production functions of agriculture was estimated to be 50–85 CZK/p/month. This gives the aggregate value of non-commodity outputs of agriculture 462–785 mil.

Table 5. Aggregate value of extra-production function of agriculture by the different relevant population and WTP estimates (mil. CZK/year)

Relevant population for aggregation (Region South-East)	Population size	WTP (1 000 000 CZK/year) by the individual WTP estimate used				
		mean			median	
		n	*n**	WTP > 0	*n*	*n**
Total population	**1 646 929**	1 677.89	2 471.38	2 653.40	988.15	1 976.31
Adult population	**1 166 980**	1 188.92	1 751.17	1 880.14482	700.19	1 400.38
Economic active population	**769 976**	784.45	1 155.41	1 240.52	461.99	923.971

Table 6. Comparison of WTP for landscape services of agriculture

Author of the study	Study area	Non-commodity output	Method of evaluation	Mean WTP
Křůmalová (2000) *N* = 1000	Czech Republic	Landscape maintenance	CV Open-ended format	492.30 CZK/p/year
Kubíčková (2004) *N* = 1441	PLA White Carpatians	Landscape services in the PLA	CV Open-ended format	287.99 CZK/p/year
Miškolci (2008) *N* = 408	Region South-East	Contribution to the formation and maintenance of rural landscape	AHP-CV Open-ended format	116.52 CZK/p/year

CZK/year in the Region South-East. These results support the agricultural policy objectives derived from the multi-functionality concept – to guarantee a sufficient provision of public goods supplied by agriculture.

From the methodological point of view, we can conclude that the combination of the AHP and the CV methods can generate useful information for the policy-decisions under the conditions of complexity. However, the usefulness of the AHP method is not limited to estimating priorities among the various relevant criteria in a decision process and a complex WTP decomposition. Further research will be focused on the application of the AHP method to the selection of the most suitable agricultural policy measure under the multi-criterial framework.

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