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What do agri-environmental measures actually promote? An investigation on AES objectives for the EU 2000-2006 rural development program

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Abstract

This paper provides an analysis of the importance implicitly attached by local stakeholders to different environmental objectives in agri-environmental schemes in Europe. For at least 20 years, increasing the sustainability of agriculture has been a major policy concern in Europe. However, the relative importance of specific objectives of agri-environmental schemes is rarely quantified, and this strongly affects the ability to assess the actual effectiveness of such schemes. This paper adopts a methodology based on the use of the concept of «weight» as a quantitative measure of the importance of each objective. The objectives have been identified using a hierarchical grid of indicators based on the EU framework for the mandatory evaluation of agri-environmental schemes. The quantification of weights was based on a questionnaire submitted to more than 70 stakeholders in 10 case study regions in different EU countries. The results highlight different regional profiles, denoting strategies with very different objective-related agri-environmental scheme specialisations, with some programs focusing on specific individual environmental issues such as landscape and biodiversity, and others focusing on several environmental objectives. Such results emphasise the need to integrate academic and institutional evaluation exercises in the measurement of the policy priorities, hence enabling to provide robust evaluations of policy effectiveness.

Additional key words: agri-environmental schemes; environmental policy objectives; expert opinion; weights.

Resumen

¿Qué promueven los programas agroambientales? Investigación sobre los objetivos agroambientales del programa europeo de desarrollo rural 2000-2006

En este artículo se ofrece un análisis de la importancia que los distintos agentes implicados conceden a los objetivos ambientales de los programas agroambientales de la política europea. Durante los últimos 20 años, el aumento de la sostenibilidad de la agricultura ha sido una de las mayores preocupaciones en Europa. Sin embargo, la importancia que los objetivos ambientales específicos tienen en los programas agroambientales ha sido escasamente cuantificada, lo que dificulta la evaluación de la eficacia de este tipo de programas. En este artículo se utiliza una metodología basada en el uso del concepto de «peso» como una medida cuantitativa para evaluar la importancia de cada uno de estos objetivos. Los objetivos han sido identificados utilizando una jerarquía de indicadores que se deriva del propio marco europeo para la evaluación obligatoria de los programas agroambientales. Se realizó la cuantificación de los pesos mediante un cuestionario presentado a más de 70 agentes en 10 regiones de diferentes países de la UE. Los resultados ponen de manifiesto la existencia de diferentes perfiles regionales, que revelan estrategias muy diferentes en cuanto a la especialización de los programas agroambientales. Estos van desde programas focalizados en un aspecto ambiental muy específico, como el paisaje y la biodiversidad, a programas que tienen un enfoque ambiental más general, atendiendo a varios objetivos ambientales simultáneamente. Estos resultados subrayan la necesidad de integrar las evaluaciones académica e institucional con mecanismos de medida de prioridades políticas, de cara a permitir evaluaciones más sólidas de la eficacia de los programas agroambientales.

Palabras clave adicionales: medidas agroambientales; objetivos de la política medioambiental; opinión de expertos; pesos.

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Abbreviations used: AES (agri-environmental schemes), AHP (analytic hierarchy process), CAP (common agricultural policy), CBA (cost benefit analysis), CSA (case study area), DM (decision maker), EU (European Union), MCA (multicriteria analysis).

Introduction

More than 400 different policy measures concerning environmental issues in agriculture have been implemented in OECD countries (OECD, 2009). Of these, in the European Union (EU) agri-environmental schemes (AES) are the main policy option. AES are public payments designed to provide incentives to farmers to apply sustainable farming practices aimed at reducing the negative impact of agriculture on the environment, and preserving ecological elements such as landscape and biodiversity (European Commission, 2005).

AES have a long history in Europe. First introduced under reg. 2078/1992, they were confirmed and strengthened under reg. 1257/1999 and 1698/2005. In EU-15, during the period 2000-2005, AES represented the most relevant expenditure chapter of the Common Agricultural Policy (CAP) second pillar (about 45%) (European Commission, 2006). AES generally contain a very wide range of measures, addressing virtually all the main environmental issues connected to agriculture. Within the context of the EU legal framework, AES programs are designed at the local level (*e.g.* NUTS II regions in Italy). The decentralized design of the AES requires the identification of the specific environmental objectives, the choice of the measures and the selection of specific prescriptions composing each measure. The importance of the different objectives set out in AES constitute valuable information in order to: a) determine a program's strategy and understanding the *de facto* values guiding policy actions under AES; and b) allow for policy evaluations by measuring the effectiveness of the program. More precisely, the principal way to express the effectiveness of a policy can be identified through the comparison of objectives and results. Consequently, an unclear identification of the objectives does not allow the Decision Maker (DM) to evaluate adequately the program results during both the policy design and the implementation processes (Howlett and Ramesh, 1995; Weiss, 1998; Finn *et al.,* 2009).

In spite of this, neither the importance of each specific objective of a given AES, nor its expected target level are normally explicitly stated in the design process, and hence are not available in AES documentation (Oreade-Breche, 2005; Finn *et al.,* 2009). The objective of this paper is to evaluate the importance of different environmental objectives in the AES of 10 case study areas (CSA) in Europe. The measure of the importance is calculated using the formulation usually adopted in the calculation of weights in multi-criteria analyses (MCA). Weights are elicited through structured questionnaires submitted to a sample of stakeholders in each CSA.

There is abundant literature available on the assessment of agricultural policies, most of which are evaluated by way of a quantification of efficiency (ratio between costs and results) or the effectiveness (degree to which objectives are reached). Pearce (2005) distinguishes two main approaches to AES evaluation: a) monetary, based on the monetisation of costs and benefits, and their comparison, mainly undertaken by way of cost-benefit analysis (CBA) techniques [see Hanley *et al.* (1999) for a review of CBAs applied to AES]; and b) non-monetary, based on a set of appropriate indicators. Non-monetary information can be used directly in order to quantify the overall effectiveness or the cost-effectiveness of the AES, or can be used as an input for MCA (Hanley *et al*., 1999; Pearce, 2005).

Literature on AES, and on the assessment of the effects of agricultural practices on the environment, emphasise the need for an evaluation system able to quantify both the effectiveness and efficiency of changes in agricultural practices (Girardin *et al*., 2000; Carey *et al*., 2003; Klejin and Sutherland, 2003; Purvis *et al*., 2008). In addition, various authors have pointed out the weaknesses of both monetary and non-monetary approaches to express robust AES evaluations (Pearce, 2005). Such weaknesses concern the identification/elicitation of program/scheme priorities, the building of the baseline and counterfactual situation, the identification of appropriate indicators able to track the environmental change, and the measurement of cause-effect relationships between farm practices and environmental change (Klejin and Sutherland, 2003; Smith and Weinberg, 2004; Xabadia *et al*., 2008).

According to policy analysis literature, the effectiveness of a program is measured as the degree to which the objectives are achieved in terms of results or impacts (Howlett and Ramesh, 1995). In this context, evaluation difficulties can be divided into two groups: a) those related to the measurement of program outputs, impacts, or results; and b) those related to identification and quantification of objectives (Finn *et al*., 2009).

With regard to a), the measurement of the impacts of AES programs generally face a number of practical problems mainly due to the cost and time, which prevent accurately measuring the environmental benefits generated. Consequently, evaluations tend to focus on program outputs, rather than impacts (Primdahl *et al.*, 2003). The easiest, and most commonly used, proxy of the results is the uptake, often quantified either in hectares or number of farms participating in the program (Klejin and Sutherland, 2003; Purvis *et al.*, 2009). However, uptake indicators do not ensure an accurate measurement of the success of AES for at least for three reasons. First, stricter prescriptions usually generate higher implementation costs, which may in turn induce farmers to participate more readily in those measures that imply small changes in farming practices at a low cost (Klejin and Sutherland, 2003; Primindahl *et al.*, 2003). Second, even for the same measure, the payment mechanism may generate a self-selection of participants due to farmers opting to apply AES in marginal areas or areas with low compliance costs (Moxey *et al.*, 1999; White, 2002; Gren, 2004). In addition, when the legislator's enforcing mechanisms are not properly implemented, farmers can have opportunities to non-comply with the expected commitments (Choe and Fraser, 1999; Fraser and Fraser, 2005).

On the other hand, in the case of objective identification and quantification, due to the lack of clearly defined program objectives a proper evaluation of the effectiveness of matching results and objectives cannot be performed in most cases. The first difficulty encountered is that, in the majority of cases, AES simultaneously address several specific environmental objectives (Herzog, 2005). Moreover, the statement of these objectives differs across programs. The most common situation is that programs provide a statement of their objectives, but lack both a clear specification of the target level to be achieved for each objective, and of the ultimate importance of each objective (Latacz-Lohaman, 2001). As a result, most of the statutory evaluations rely on a qualitative assessment of the consistency between output and objectives, *e.g.* building on the location of the uptake with respect to environmental zoning.

There is little literature available on the evaluation of the objectives of agricultural policies, but that which exists can be divided mainly into institutional and academic evaluations. Within the first approach, the evaluation of the objectives of an agricultural policy is based on the identification of social demands as a proxy of public objectives. Such efforts are generally based on surveys directly addressed to citizens (see, for example, the annual publication of the Eurobarometer, European Commission, 2008 and previous years). Academic research, for its part, has paid more attention to the local beneficiaries or stakeholders of a specific program or instrument rather than the citizens. Following this approach there are basically three options for the identification and comparison of agricultural policy objectives: (a) using the content of official documentation (RDP, regulations, etc.) to analyse explicit or implicit prioritisations; (b) using the budget allocated to derive weights for the different objectives addressed; or (c) asking DM, stakeholders or experts directly to assess the relative importance of alternative policy objectives.

Option a) can be performed using methods connected to textual analysis, but these methods are limited to very specific policy contexts and to those cases in which both DMs and the decision process are clearly identified[1]. Options b) and c), for their part, can be performed using methodologies such as multi-criteria approaches in an attempt to provide judgments on policy objectives based on analyses of budgets, *ad hoc* surveys or expert interviews[2]. Quantitative approaches based on multi-criteria techniques are more suitable to clearly explain preferences through a numerical representation, and are widely adopted to determine the relative importance that DMs place on the decision criteria (objectives), and, to conduct comparisons of alternatives (Gómez-Limón and Atace, 2004).

Drawing from the most recent literature, this paper attempts to contribute to the identification and prioritization of the local objectives of AES.

Methodology

General approach

The importance placed on environmental objectives should reflect the preferences of a society with respect to different bundles of environmental goods. In this paper, such concept has been restricted to the

[1] See Erjavec and Erjavec (2009) for an application to the CAP using the Public Statements of the European Commissioner for Agriculture and Rural Development.

[2] See, for example, Duke and Aull-Hyde (2002) and Gómez-Limón and Atance (2004) for applications to land preservation policy in the State of Delaware (USA) and to the CAP in Spain respectively.

importance placed on different environmental objectives within the scope of a particular set of policies, *i.e.* AES.

In order to express such preferences, a quantitative measure of the value society attaches to each unit of each good is ideally necessary.

Non-monetary techniques, such as MCA, use the concept of weights. Formally, weights are the expression of the relative importance of each objective (indicator) in the objective function of the DM (Roy and Mousseau, 1998). As such, weights quantify trade-offs between the criteria considered in MCA; in fact, weights can be interpreted as a concept of marginal rates of substitution in economic theory (Stewart, 1992). Weights can also be thought of as analogous to prices as long as they express the unit importance of each objective in the DM's utility function (Pearce, 2005). However, they are expressed as an a-dimensional numerical coefficient, rather than in monetary terms.

Several methodologies have been proposed to elicit weights. These methodologies can be broadly grouped in two different approaches: statistical and subjective (Schoemaker and Waid, 1982). The former group includes mainly multiple regression models, while the latter approach includes analytic hierarchy process (AHP), trade-off estimation, SMART methods, swing weights and direct point allocation (Weber and Borcherding, 1993; Hayashi, 2000). Several authors have attempted to evaluate which method offers the best results (Borcherding *et al*., 1991, Olson *et al*., 1995; Easley *et al*., 2000; Pöyhönen and Hämäläinen, 2001), but overall none of these methods are dominant or display superior performance. However, several authors have pointed out that the methods that derive weights as a ratio (*i.e.* swing weights or AHP) have higher internal consistency compared to the others (Schoemaker and Waid, 1982; Borcherding *et al*., 1991; Stewart, 1992).

When the decision problem involves more than one stakeholder, weights have to be elicited from multiple actors and the issue of aggregation arises. The synthesis of several opinions can be obtained using two different approaches: group-based or individual-based (Tsiporkova and Boeva, 2006). The former approach is oriented toward obtaining a consensus within the group, mainly via discussion or negotiations. On the contrary, the latter approach is oriented toward using each individual response as a unit of decision-making and applying methods to synthesize judgments. In the latter approach, the weighting process begins by capturing single judgments by each agent, and follows with a synthesizing judgment. The family of functions that synthesize judgments belongs to the «quasi-arithmetic means» (see Aczek and Alsina, 1986 for a review) or the «singular value decomposition» (see Gass and Rapcsák, 1998 for a review).

This paper provides a measure of the importance of different objectives in AES based on the concept of weights used in MCA, where weights are identified with an individual-based approach, using direct rating and applying the quasi-arithmetic means as synthesizing judgment.

The methodology adopted can be divided into three phases: 1) definition of the evaluation framework and the set of indicators, 2) individual judgment elicitation; 3) weight calculation and testing for statistical differences from the average.

Definition of evaluation framework and set of indicators

In reg. 1257/99, the European Commission introduced a mandatory evaluation process for Rural Development Programs (RDP). This process was aimed at improving program performance, ensuring accountability and enabling an assessment of the achievement of both European and local objectives. The evaluation procedure concerning AES (measure 2f of the RDP) is based on a common set of environmental indicators that each administration must use to quantify the environmental benefits provided by the implementation of the AES. The complete list of questions adopted for the evaluation of environmental effectiveness of AES can be found in chapter VI of STAR document VI/12004/00 (European Commission, 2000)[3]. Starting from the institutional evaluation framework, a hierarchical structure has been developed in order to disaggregate the common questions and indicators proposed

[3] The structure of the official document is composed of three hierarchical levels which, from top to bottom, correspond to the common evaluation questions, the judgment criteria and the programme indicators. The set of common evaluation questions represent the issues most relevant at the EU level, and capture the program effects for each measure. The intermediate level is represented by the judgment criteria that represent «decisive factors» from which it is possible to evaluate the common questions. Finally, the indicators represent the elements from which to quantify the impact provided by the implementation of AES, and are expressed in either quantitative or qualitative terms.

Table 1. Hierarchical structure adopted

Environmental priority	Environmental factor	Environmental sub-factor	Indicator
Level 1	**Level 2**	**Level 3**	**Level 4**
Resources conservation	Soil		VI.1.A-1. Reduction of soil erosion VI.1.A-2. Prevention and reduction of chemical contamination of soils VI.1.A-3. The protected soil gives raise to further benefits at farm or societal level
	Water	Quality	VI.1.B-1. Reduction of agricultural inputs potentially contaminating water VI.1.B-2. Impeding the transport mechanisms (from field surface or root zone to aquifers) for chemicals (leaching, run-off, erosion) VI.1.B-3. Improved quality of surface water and/or groundwater VI.1.B-4. Water protection gives rise to further benefits at farm or societal level
		Quantity	VI.1.C-1. Reduction (or avoidance of increase) of the utilisation (abstraction) of water for irrigation VI.1.C-2. Water resources protected in terms of quantity VI.1.C-3. Protected water resources give raise to further benefits (farm or rural level, environment, other economic sectors)
Ecological improvement	Biodiversity	Fauna and flora	VI.2.A-1. Reduction of agricultural inputs (or avoided increase) benefiting flora and fauna has been achieved VI.2.A-2. Maintenance or reintroduction of crop patterns [types of crops (including associated livestock), crop rotation, cover during critical periods, expanse of fields] benefiting flora and fauna. VI.2.A-3. Targeting of species in need of protection.
		Habitat	VI.2.B-1. Conservation of high nature-value habitats on farmed land VI.2.B-2. Protection or enhancement of ecological infrastructure, including field boundaries or non-cultivated patches of farmland with habitat function VI.2.B-3. Protection of valuable wetland or aquatic habitats from leeching, run-off or sediments originating from adjacent farmland
		Genetic diversity	VI.2.C-1. Conservation of endangered breeds/varieties
	Landscape		VI.3-1. Maintain or enhance perceptive/cognitive coherence between the farmland and the natural/biophysical characteristics of the zone VI.3-2. Maintain or enhance perceptive/cognitive differentiation (homogeneity/diversity) of farmland VI.3-3. Maintain or enhance cultural identity of farmland VI.3-4. Protection or improvement of landscape structures and functions relating to farmland results in societal benefits/values (amenity values)

Source: STAR document VI/12004/00, Part B, Chapter VI (modified). In the table, the factors plus the sub-factors (when present) correspond to the seven common questions of the STAR document. Furthermore, the indicators presented in the table are the same and present the same codes as in the STAR document.

by institutional evaluations into four hierarchical levels (Table 1)[4].

Moving from top to bottom of the hierarchy, we identified four hierarchical levels: environmental priorities (level 1), environmental factors (level 2), environmental sub-factors (level 3) and indicators (level 4). Thus, with reference to Table 1, for example, the environmental priority «resource conservation», placed at

[4] The seven common questions have been collapsed into two main environmental priorities (level 1): resource conservation and ecological improvements (European Commission, 2005). The two environmental priorities can be considered as an aggregation of four different environmental factors (level 2): soil and water for resource conservation, and biodiversity and landscape for ecological improvement. Finally, water has been split into two environmental sub-factors (level 3) (quality and quantity) and biodiversity into three environmental sub-factors (fauna and flora, habitat and genetic biodiversity). The indicators (level 4) have not been changed with respect to the official documentation.

level 1 is composed of soil and water factors, that are located at level 2 (environmental factors).

The upper level (level 1) represents the importance of macro-environmental issues addressed by AES programs; it corresponds to a large extent to the distinction between those objectives that are often classified as reduction of negative externalities (resource conservation) and those that address positive externalities more directly (ecological improvement). Level 2 (environmental factors) represents the importance of each environmental factor (*ef*) within the environmental issues addressed by an AES program and level 3 (subfactors), which is the case only for land and water, represents the environmental factor specification (*i.e.* how important is water quality or water quantity with respect to the water factor). Finally, level 4 represents the importance of each indicator (*ind*) for each environmental factor or sub-factor (when present).

It should be noted that these four levels are qualitatively different. While the upper levels are closer to a concept of policy objectives related to specific environmental factors, the lower levels tend only to represent the technical measures of the upper objectives. In other words, while the importance of judgments for the upper level tends to represent a fully «political» judgment, the importance in the lower level is more similar to a technical judgment of the ability of some given measure (indicator) to represent the upper objective.

This hierarchical structure enables the quantification of the importance of each element in the upper level, as the sum of the importance of the elements of each group (*I*) immediately below them.

Individual judgment elicitation

The approach adopted in this paper is characterised by four main features: the use of an individual questionnaire; the design of a hierarchical series of questions to elicit the importance of the different environmental components for each level; the use of a ratio method to compare the importance of the different objects within the same level; and the decision to direct questions to stakeholders (not only to representatives of DM).

The rationale for using individual-based questionnaires stems from a combination of constraints due to budget constraints (that did not enable the use of r methods based on group meetings or large citizen surveys) and the need to involve several stakeholders in each CSA, representing different points of view and expertise related to AES.

The hierarchical structure of the questionnaire follows the structure of the hierarchical tree in Table 1, and was chosen in order to reflect the existing institutional evaluation framework. Accordingly, respondents should be more familiar with the structure of the questions and the results can hence be more easily matched with existing evaluation procedures. Following the hierarchical structure, in each question we asked the interviewee to express the relative importance of each element of the same group with respect to the upper level.

As mentioned above, the choice of this method is because ratio methods are considered the «better performing» of the weighting methods (Schoemaker and Waid, 1982; Borcherding *et al*., 1991; Stewart, 1992). The importance was expressed using a 9-point scale, allowing respondents to thoroughly differentiate the judgment while allowing for obtaining easy judgements and robust results (Saaty, 1980). In addition, the combined use of a hierarchical structure and the ratio method for comparison within each question helps reduce the size of the questionnaire compared to those of classical pair-wise comparisons.

Considering when the programs were designed, the questionnaire should ideally have been answered by representatives of the public administration who are able to interpret public (social or environmental) objectives, and who hold decision-making positions. However, this proved difficult to achieve for at least two reasons. First, the «true» importance of each objective cannot be obtained from the stated priorities of DMs due to the nature of the implementation mechanism which involves several institutions and stakeholders in the decision making process with different objectives and different levels of decision-making power (Howlet and Ramesh, 1995). Second, a direct consultation of policy makers could have resulted in strategic answers aimed at demonstrating that the AES objectives were those actually achieved. For these reasons, we chose to address individuals belonging to different stakeholder groups, and to ask them to provide their interpretation of the *de facto* importance attached to the different environmental objectives in the AES in their area. For each CSA, the target sample was composed of two individuals from each of the following four categories: a) university/research centre (social sciences, ecological studies and soil studies); b) public (agriculture) administration; c) farmers' associations; and d) environmental

Table 2. Sample description

Case study area	Total (#)	University/ Research centre (#)	Agricultural administration (#)	Farmers associations (#)	Environmental associations (#)
Flanders (Belgium)	10	3	3	2	2
Czech Republic	10	1	1	2	6
Finland	5	1	2	0	2
Lower-Normandy (France)	9	0	4	1	4
Brandenburg (Germany)	9	0	4	1	4
Ireland	12	6	1	0	5
Emilia-Romagna (Italy)	8	3	1	2	2
Veneto (Italy)	4	3	1	0	0
Friesland (the Netherland)	5	3	2	0	0
North-East England (United Kingdom)	5	0	2	0	3
Total	73	22	18	8	25

associations. The composition of the sample for each CSA is presented in Table 2.

Respondents were asked to identify first which element(s) within each group is/are more important with respect to the upper level objective, and then to assign the highest score (9) to this/these elements[5]. Then, the other elements of the same level were assigned a direct rating using a scale between 0 and 9, representing the importance of each element in comparison to the most important one previously identified. From this exercise, 73 sets of individual answers (one for each stakeholder) was collected with scores between 0 to 9 for all environmental elements (i) in each level (l).

Weight calculation and testing of statistical differences

The purpose of weight elicitation is to derive a set of weights for each environmental element i (w_i) that takes into account the priorities of the elements at the upper hierarchical level. The procedure can be split into two parts.

First, the set of individual weights (w_{ij}^l) has been obtained by two normalisation procedures from the questionnaire answers [Eq. 1]. This operation was undertaken firstly using the maximum value (max we) as a normalising factor for the elicited weights (w_{ij}^l) and secondly using the sum of the weights for all elements belonging to the same group:

$$w_{ij}^l = \frac{\dfrac{we_{ij}^l}{\max we}}{\sum_{i=1}^{I} \dfrac{we_{ij}^l}{\max we}} = \frac{we_{ij}^l}{\sum_{i=1}^{I} we_{ij}^l}\;; \qquad [1]$$

$\forall i \in I$ for each level $l = 1,2,3,4$.

with: l = hierarchical level ($1,2,3,4$); j = stakeholder; i = element; I = group; we_{ij}^l = relative importance of the element i within the group I as answered by stakeholder j for the level l; max we = maximum value among we_{ij}^l expressed by the DM within the same group (I).

The second part aims to obtain a single judgment (w_i) of environmental importance using a multiplicative function across levels and then an average across stakeholders.

The weight of each element i for the stakeholder j (w_{ij}) with respect of the full set of elements placed in the same level (l) is obtained through a multiplicative function between the weights of the elements present for all the upper hierarchical levels with respect to the environmental element [Eq. 2].

$$w_{ij} = \prod_{l=1}^{L} w_{ij}^l \quad \text{with } l = 1;2;3;4 \qquad [2]$$

The use of a multiplicative formulation instead an additive method is coherent with the hierarchical

[5] An example question is: «What is the relative importance of each water sub-factor (water quantity and water quality) to the water factor? Give an importance of 9 to the most important sub-factor and then choose a value from 0 to 9 for the other sub-factors in order to express their importance relative to the most important sub-factor». The entire questionnaire is available in Bartolini *et al*. (2007).

structure of the decision problem. In fact, considering the hierarchical structure, the value of the importance of a generic element w_{ij} is dependent on the element placed at the upper hierarchical level[6].

The synthesis of the judgment expressed by all stakeholders (w_{ij}) for the same element i has been undertaken using an arithmetical mean[7] of the weights derived by the answers provided by each of the J stakeholders involved in the same CSA [Eq.3].

$$w_i = \frac{1}{J}\sum_{j=1}^{J} w_{ij} \qquad [3]$$

In this way, the weight allows a direct comparison of the importance of each element of a level with all the other elements of the same level.

The Student t-test was used to verify which of the average weights across CSA differ significantly from the overall average.

Finally, a cluster analysis was undertaken for summarising the results. Such an analysis provided similar groupings of environmental prioritisation of AES among CSA. The cluster analysis was carried out using the data from the lower level of disaggregation. For these purposes a non-hierarchical k-means cluster was adopted using STATA software.

Case study and sample description

Ten CSA were selected in nine EU countries. Each CSA corresponds to the whole agri-environmental program (measure 2f of the RDP) implemented in a specific area. The CSA considered are heterogeneous in terms of NUTS level and reflect the level on which the agri-environmental program is implemented in each country. In fact, the subject of the analysis in each CSA is the whole program implemented. The CSA are distributed among the main European Regions: the survey includes CSA in countries of Northern Europe (Finland, North East England and Ireland), Centre Europe (Flanders, Brandenburg, Lower-Normandy, Friesland), the Mediterranean Area (Emilia-Romagna and Veneto) and one new Member State (Czech Republic). Implementation of AES are centralised at the national level for Finland, Ireland and the Czech Republic, and are decentralised to the Lander/region/province level for Emilia-Romagna, Veneto, Flanders, Brandenburg, Lower-Normandy, Friesland and North East England.

The measures implemented differ among CSA. The difficulty in providing an overview of measures is better understandable when considering the different number of measures implemented in each CSA. While in some CSA the measures implemented consist of less than 15 single practices (Emilia-Romagna, Veneto, Flanders and Ireland), in other CSA several packages of measures have been implemented (from 5 to more than 70) with each one constituting many practices (Lower-Normandy, Brandenburg, Friesland and North East England). As well as the numbers, the measure typologies are strongly diversified among CSA. Whereas, the measures implemented are generally horizontal, with a broad targeting (Flanders, Czech Republic, Emilia-Romagna and Veneto), in other CSA the measures are mainly vertical swith very deep and narrow targeting (Firesland and North East England). Other CSAhave implemented a combination of the two (Lower-Normandy, Brandenburg, Ireland and Finland). A full description of CSA and the menu of measures implemented in each AES are beyond the scope of this paper[8].

Results

Table 3 shows a comparison among CSA of the average weights attached to AES for level 1 and the average across all CSA. The results are depicted by comparing weights across CSA, the weights being expressed for each hierarchical level presented in Table 1. Only those statistically significant across CSA are commented.

[6] Using multiplicative function instead of an additive function helps consider within the analysis the zero value of the element placed on an upper level. This means, for example, that if one environmental element placed at level+1 has importance equal to zero, then the entire lower level has a zero value.

[7] Several works that address the synthesizing judgments among groups have discussed the relative advantages of different mathematical operators, notably arithmetic sum vs. multiplication. Some authors have identified advantages in adopting a geometrical means as aggregation function (Aczek and Alsina, 1986; Gass and Rapcsák, 1998). However, we have relied on the arithmetic mean in order to give the same importance to all stakeholders in the same group, and to avoid a zero weight among stakeholders leading the result of the whole group to collapse to zero.

[8] An exhaustive overview of the main socio-economic, environmental and demographic characteristics and the menu of different AES implemented in the CSA is available in Bonnieux *et al*. (2005).

Table 3. Weights for each environmental priority (level 1). In parenthesis, standard deviation

Case study area	Environmental priorities	
	Resource conservation	Ecological improvement
Flanders	0.61** (0.09)	0.39** (0.09)
Czech Republic	0.54 (0.12)	0.46 (0.12)
Finland	0.62 (0.12)	0.38 (0.12)
Lower-Normandy	0.54 (0.09)	0.46 (0.09)
Brandenburg	0.47* (0.03)	0.53* (0.03)
Ireland	0.59** (0.1)	0.41** (0.1)
Emilia -Romagna	0.52 (0.05)	0.48 (0.05)
Veneto	0.53 (0.08)	0.47 (0.08)
Friesland	0.32** (0.1)	0.68** (0.1)
North East England	0.21*** (0.12)	0.79*** (0.12)
Average	0.52 (0.14)	0.48 (0.14)

***,**,*: significance at 1%, 5% and 10% respectively.

The average of the environmental priorities across CSA shows balanced picture between resource conservation and ecological improvement priorities. However, resource conservation has a slightly higher importance at 0.52 with respect to 0.48 for ecological improvement. Only five CSA have significant differences with respect to the average of all individual weights. Among these CSA, Flanders and Ireland have placed greater importance in resource conservation priorities, which means that these AES have as their main objective the reduction of the negative externalities of agricultural activity on the environment. For their part, however, the CSA of Brandenburg, Friesland, and North East Region have implemented AES more focused on ecological improvements, via an increment of positive externalities. Furthermore, Table 3 shows a low standard deviation that expresses a rather high degree of consensus among stakeholders at this level of aggregation. Following Table 1, the environmental priorities can be further separated into soil, water, biodiversity and landscape elements (Table 4).

The averages of all CSA highlight substantial differences among the environmental factors. In fact, the averages of each environmental factor range from minimum values of 0.22 for both soil and landscape, to a maximum value of 0.30 for water, however they are not significantly different.

At this level of disaggregation, there are seven CSA with significant differences from the average value for at least one of environmental factors. Among these CSA both those undertaken in Friesland (Netherlands) and in North East England (United Kingdom) have more importance attributed to biodiversity and Landscape than soil and water factors. Only in Emilia-

Table 4. Weights for each environmental factor (level 2). In parenthesis, standard deviation

Case study area	Environmental factors			
	Soil	Water	Biodisversity	Landscape
Flanders	0.26* (0.06)	0.34 (0.09)	0.23 (0.05)	0.16*** (0.06)
Czech Republic	0.26 (0.1)	0.28 (0.06)	0.24 (0.08)	0.22 (0.07)
Finland	0.25 (0.06)	0.37 (0.08)	0.23 (0.08)	0.14* (0.07)
Lower-Normandy	0.21 (0.07)	0.33** (0.04)	0.24 (0.06)	0.22 (0.05)
Brandenburg	0.22 (0.03)	0.25 (0.04)	0.27 (0.07)	0.26 (0.08)
Ireland	0.21 (0.08)	0.38*** (0.07)	0.25 (0.06)	0.15*** (0.06)
Emilia -Romagna	0.26* (0.04)	0.26** (0.03)	0.25 (0.05)	0.23* (0.02)
Veneto	0.24 (0.03)	0.29 (0.05)	0.22 (0.07)	0.25 (0.07)
Friesland	0.13** (0.05)	0.19** (0.06)	0.33 (0.07)	0.35*** (0.05)
North East England	0.10*** (0.04)	0.11** (0.09)	0.41*** (0.04)	0.38** (0.09)
Average	0.22 (0.08)	0.3 (0.1)	0.26 (0.08)	0.22 (0.09)

***,**,*: significance at 1%, 5% and 10% respectively.

Table 5. Weights for each environmental sub-factor (level 3). In parenthesis, standard deviation

Case study area	Soil	Water		Biodiversity			Landscape
		Quantity	Quality	Fauna and flora	Habitat	Genetic	
Flanders	0.26* (0.06)	0.25 (0.11)	0.09 (0.05)	0.1 (0.02)	0.09 (0.03)	0.05** (0.02)	0.16*** (0.06)
Czech Republic	0.26 (0.1)	0.17** (0.05)	0.11* (0.04)	0.09 (0.03)	0.08 (0.02)	0.07 (0.04)	0.22 (0.07)
Finland	0.25 (0.06)	0.31 (0.09)	0.06 (0.04)	0.08 (0.04)	0.09 (0.03)	0.07 (0.03)	0.14* (0.07)
Lower-Normandy	0.21 (0.07)	0.23 (0.08)	0.1 (0.05)	0.08** (0.02)	0.1 (0.03)	0.06 (0.02)	0.22 (0.05)
Brandenburg	0.22 (0.03)	0.19 (0.06)	0.06 (0.05)	0.1 (0.01)	0.1 (0.03)	0.07 (0.03)	0.26 (0.08)
Ireland	0.21 (0.08)	0.35*** (0.09)	0.03*** (0.04)	0.08 (0.05)	0.12 (0.05)	0.05* (0.03)	0.15*** (0.06)
Emilia-Romagna	0.26* (0.04)	0.14*** (0.02)	0.13*** (0.03)	0.08 (0.02)	0.08* (0.01)	0.08** (0.02)	0.23* (0.02)
Veneto	0.24 (0.03)	0.18 (0.05)	0.11* (0.02)	0.08* (0.01)	0.07 (0.02)	0.07 (0.03)	0.25 (0.07)
Friesland	0.13** (0.05)	0.11*** (0.03)	0.08 (0.06)	0.12 (0.03)	0.13 (0.05)	0.08 (0.04)	0.35*** (0.05)
North East England	0.10*** (0.04)	0.22 (0.11)	0.08 (0.05)	0.1 (0.04)	0.09 (0.04)	0.07 (0.03)	0.38** (0.09)
Average	0.22 (0.08)	0.22 (0.11)	0.08 (0.05)	0.1 (0.04)	0.1 (0.04)	0.09 (0.04)	0.22 (0.09)

***,**,*: significance at 1%, 5% and 10% respectively.

Romagna (Italy) is the importance balanced among all environmental factors. In Ireland and Lower-Normandy (France), AES have high levels of importance concentrated on the water factor. CSA that have lower values with respect to all individual average weights for landscape elements are Flanders (Belgium), Finland and Ireland.

By separating water and biodiversity factors into sub-factor elements, it is possible to identify the relative importance of each indicator for this level of analysis (Table 5).

This level of analysis allows for a more detailed analysis of water and biodiversity factors. On this level, there are six CSA with significant differences with respect to the average of the sub-factors belonging to water and biodiversity factors (Czech Republic, Lower-Normandy, Ireland, Emilia-Romagna, Veneto, Friesland and North East England). The average shows that water quality has higher importance with respect to water quantity, while the three sub-factors of biodiversity (fauna and flora; habitat and genetic) are equally important. Emilia-Romagna (Italy), Czech Republic and Friesland (Netherlands) placed equal importance on both water quality and quantity with low importance attributed to water quality with respect to the average. In Ireland, however, the importance among water sub-factors is unbalanced in favour of water quality, with a value of 0.35.

Up until this level of analysis, the value of the standard deviation was quite low, as previously pointed out, which suggests a high degree of consensus among respondents. Table 6 depicts a comparison among CSA of the weights attached to AES for the environmental indicators.

Two environmental indicators belonging to the soil factor have high importance: soil erosion (VI.1.A-1) and chemical contamination of the soil (VI.1.A-2), with a value equal to 0.09. The other indicators with the highest importance belong to water quality and genetic biodiversity sub-factors. Such indicators constitute the reduction of inputs that are potentially contaminating the water (VI.1.B-1), the improved quality of surface water and ground water (VI.1.B-3) and the conservation of endangered breeds/varieties (VI.2.C-1).

Only Ireland, Emilia-Romagna Region, Friesland and North East England have very differentiated indicator weights. In Ireland the importance of diversification is concentrated with a high value of reduction of inputs that are potentially contaminating water (VI.1.B-1) and low value of indicators belonging to water quantity sub-factors (VI.1.C-1; VI.1.C-2; VI.1.C-3). In Emilia-Romagna, the indicator with the higher value is the reduction of used water for irrigation, and the indicators with the lower value are those belonging to water quality sub-factors (VI.1.B-1; VI.1.B-2; VI.1.B-3).

Finally, the results have been summarised identifying similar groups of AES design of based on environmental priorities. Using a cluster analysis based on average weights for each CSA, three different clusters of AES designs have been identified. The results of the cluster analysis are shown in Figure 1[9].

[9] The choice of the number of clusters applied has been obtained from the number of groups with a higher value of the Calinsk/Harabasz pseudo F-index.

Table 6. Weights for each environmental indicator (level 4). In parenthesis, standard deviation

Environmental factors	Indicators	Flanders	Czech Republic	Finland	Lower Normandy	Branden-burg	Ireland	Emilia-Romagna	Veneto	Friesland	North East England	Average
Soil	VI 1 A-1	0.11 (0.05)	0.10 (0.06)	0.13 (0.05)	0.10 (0.04)	0.10 (0.02)	0.07 (0.04)	0.11 (0.04)	0.08 (0.03)	0.03*** (0.02)	0.05** (0.02)	0.09 (0.05)
	VI 1 A-2	0.09 (0.03)	0.10 (0.06)	0.08 (0.01)	0.06*** (0.02)	0.11 (0.05)	0.12 (0.06)	0.09 (0.02)	0.10 (0.04)	0.10 (0.05)	0.04*** (0.02)	0.09 (0.05)
	VI 1 A-3	0.06 (0.05)	0.06 (0.04)	0.03 (0.04)	0.04 (0.05)	0.02 (0.02)	0.02*** (0.02)	0.05 (0.03)	0.06 (0.04)	0.00*** (0.01)	0.02 (0.02)	0.04 (0.04)
Water												
Water quality	VI 1 B-1	0.08 (0.05)	0.06* (0.03)	0.10 (0.05)	0.08 (0.04)	0.09 (0.03)	0.12*** (0.04)	0.05** (0.01)	0.06 (0.03)	0.03*** (0.01)	0.03** (0.02)	0.07 (0.04)
	VI 1 B-2	0.05 (0.03)	0.05 (0.02)	0.05 (0.01)	0.07* (0.03)	0.05 (0.03)	0.06 (0.04)	0.03*** (0.01)	0.03* (0.01)	0.03** (0.01)	0.01*** (0.01)	0.05 (0.03)
	VI 1 B-3	0.09 (0.07)	0.05*** (0.02)	0.10 (0.05)	0.07 (0.03)	0.05 (0.04)	0.13** (0.09)	0.05*** (0.01)	0.06 (0.02)	0.04*** (0.01)	0.03** (0.02)	0.07 (0.06)
	VI 1 B-4	0.03 (0.05)	0.02 (0.02)	0.04 (0.03)	0.01* (0.02)	0.00 (0)	0.04 (0.04)	0.01 (0.02)	0.02 (0.01)	0.00 (0)	0.01 (0.01)	0.02 (0.03)
Water quantity	VI 1 C-1	0.03 (0.02)	0.02 (0.02)	0.01 (0.01)	0.02 (0.02)	0.01 (0.01)	0.00*** (0.01)	0.05*** (0.01)	0.03 (0.01)	0.03 (0.03)	0.01 (0.02)	0.02 (0.02)
	VI 1 C-2	0.05 (0.03)	0.06 (0.03)	0.03 (0.02)	0.07 (0.05)	0.04 (0.03)	0.02** (0.03)	0.05 (0.01)	0.05** (0)	0.04 (0.04)	0.02** (0.02)	0.05 (0.03)
	VI 1 C-3	0.02 (0.02)	0.02 (0.03)	0.02 (0.02)	0.00 (0.01)	0.01 (0.02)	0.00*** (0.01)	0.02 (0.02)	0.02 (0.02)	0.01 (0.01)	0.00** (0)	0.01 (0.02)
Biodiversity												
Fauna and flora	VI 2 A-1	0.04 (0.01)	0.04 (0.02)	0.03* (0)	0.03** (0.01)	0.04 (0.01)	0.03 (0.02)	0.03 (0.01)	0.02 (0.01)	0.03 (0.02)	0.05** (0.01)	0.03 (0.02)
	VI 2 A-2	0.03* (0.01)	0.02** (0.01)	0.03 (0.02)	0.03 (0.01)	0.03** (0.01)	0.02** (0.01)	0.03 (0.01)	0.02 (0.01)	0.03 (0.02)	0.05*** (0.01)	0.03 (0.01)
	VI 2 A-3	0.03 (0.02)	0.03 (0.01)	0.03 (0.01)	0.03* (0.01)	0.03 (0.01)	0.03 (0.03)	0.03 (0.01)	0.03 (0.01)	0.06 (0.02)	0.06** (0.01)	0.03 (0.02)
Habitat	VI 2 B-1	0.03** (0.01)	0.03 (0.01)	0.04 (0.01)	0.03 (0.01)	0.03 (0.02)	0.05 (0.03)	0.03** (0.01)	0.03 (0.01)	0.05 (0.03)	0.07** (0.02)	0.04 (0.02)
	VI 2 B-2	0.04 (0.02)	0.02*** (0.01)	0.03 (0.01)	0.03 (0.01)	0.03 (0.02)	0.04 (0.02)	0.03*** (0.01)	0.02** (0.01)	0.05 (0.02)	0.06*** (0.01)	0.04 (0.02)
	VI 2 B-3	0.02 (0.01)	0.03 (0.01)	0.03 (0.01)	0.04* (0.01)	0.03 (0.01)	0.03 (0.01)	0.03 (0)	0.02 (0.01)	0.03 (0.03)	0.03 (0.02)	0.03 (0.01)
Genetic	VI 2 C-1	0.05** (0.02)	0.07 (0.04)	0.07 (0.03)	0.06 (0.02)	0.07 (0.03)	0.05* (0.03)	0.08** (0.02)	0.07 (0.03)	0.08 (0.04)	0.09 (0.04)	0.07 (0.03)
Landscape	VI 3-1	0.05 (0.03)	0.06 (0.03)	0.03 (0.02)	0.06 (0.02)	0.06 (0.03)	0.05 (0.03)	0.07 (0.01)	0.05 (0.02)	0.10** (0.03)	0.10 (0.05)	0.06 (0.03)
	VI 3-2	0.03*** (0.01)	0.05 (0.03)	0.05 (0.02)	0.06 (0.01)	0.08 (0.05)	0.03*** (0.02)	0.05 (0.01)	0.05 (0.02)	0.07 (0.04)	0.11** (0.03)	0.05 (0.03)
	VI 3-3	0.03* (0.02)	0.04 (0.02)	0.04 (0.02)	0.06 (0.03)	0.03 (0.02)	0.03*** (0.02)	0.06 (0.02)	0.07 (0.03)	0.09 (0.02)	0.07 (0.03)	0.05 (0.03)
	VI 3-4	0.04** (0.03)	0.07 (0.03)	0.04*** (0.01)	0.06 (0.03)	0.08 (0.04)	0.05** (0.02)	0.06 (0.02)	0.08 (0.02)	0.09* (0.02)	0.10 (0.08)	0.06 (0.04)

***,**,*: significance at 1%, 5% and 10% respectively.

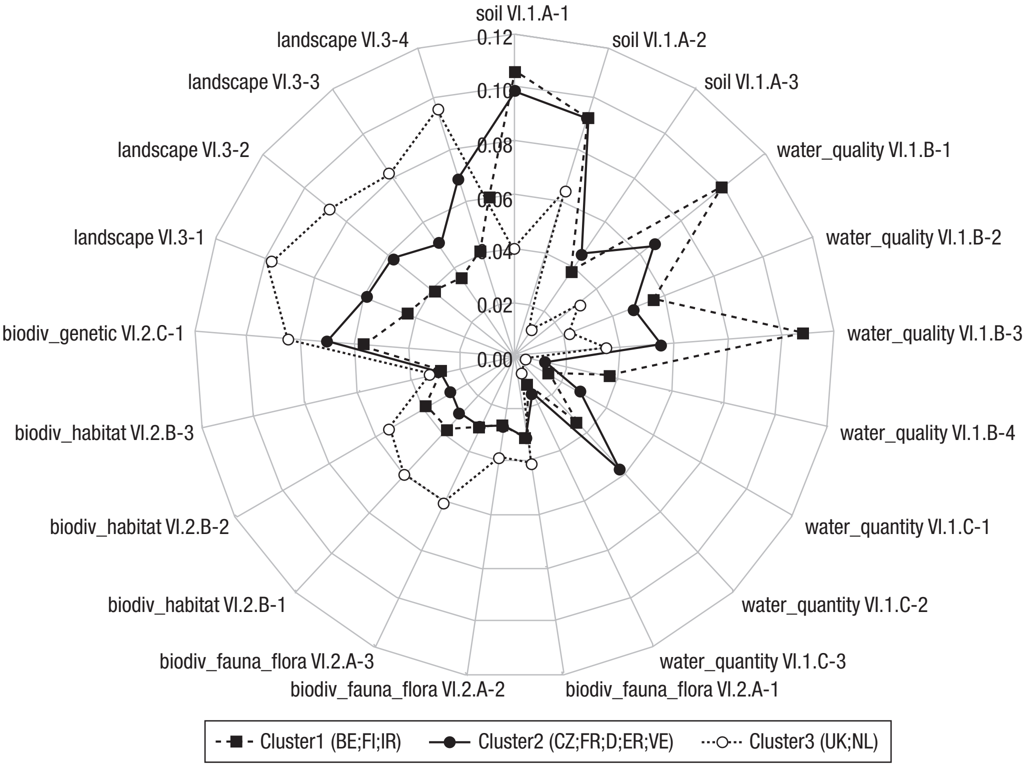

Figure 1. Average weights for each environmental indicator in the three clusters identified.

Figure 1 presents the average value of the weights for each cluster for each of the indicators in Table 1. Such values represent the centroid value of each indicator. The first cluster includes the AES for Belgium (Flanders), Finland and Ireland, which are mainly focused on the improvement of resource conservation such as soil and water quality. Specifically, the AES design is focused on soil erosion and chemical contamination of soil (indicators VI.1.A-1 and VI.1.A-1) and the protection of water quality, in particular concerning the reduction of agricultural inputs that can impact on the quality of ground water and surface water (indicators VI.1.B-1 and VI.1B-3). The second cluster included AES implemented in the Czech Republic, Lower-Normandy (France), Brandenburg (Germany) and Italy (Emilia-Romagna and Veneto) and which focus their attention mainly on soil elements (indicators VI.1.A-1 and VI.1.A-1) with less importance on other indicators. The third cluster, which includes North East England (United Kingdom) and Friesland (Netherlands) is mainly focused on the conservation of genetic biodiversity (indicator VI.2.A-1) and landscape preservation. Furthermore, the AES included in this cluster do not focus either on soil or on water aspects.

Discussion

The wide body of literature on AES efficiency/effectiveness draws attention to the design and targeting of measures and to the measurement of the «performance» of policies using indicators that are proxies of these two elements of policy evaluation. However, the measurement of the actual policy effectiveness, intended as the degree to which program objectives are reached, is rarely achieved in either scientific literature or evaluation practice. In particular, there is a significant gap in the literature on AES with respect to the definition, interpretation and assessment of the importance of program objectives, which is the key prerequisite for a robust evaluation of policy. In accordance with this lack of literature, we have developed a methodology that, using the concept of weights based on MCA approaches, allows a quantitative analysis of the importance of different environmental objectives.

The results confirm that the environmental importance of different AES objectives is rather varied across different CSA. Such information corroborates the literature, which points to a diversification of environmental objectives among AES, and enables a formal verification of the degree to which higher priority objectives are achieved.

In addition, the results clarify the distribution and diversification of importance across the different levels of the hierarchical structure. In particular, focusing on the higher hierarchical levels, it emerges that, in most CSA, the schemes are not designed to specifically focus on any of the specific environmental factors or sub-factors considered. Only in a few CSA (Friesland, North East England, Ireland and Finland) did the AES focus on specific environmental issues, such as landscape or water quality. On the contrary, at the lower hierarchical level, the difference among indicators is more evident across CSA. This reveals that, even when the same importance is placed on some specific environmental factors/sub-factors, the instruments (indicators) used to quantify the environmental factors/sub-factors can be very heterogeneous.

The results also suggest that a meaningful grouping of different regions can be undertaken based on similarities/differences in environmental priorities. The diversified priority profile of the different groups reinforces the need to compare policy effectiveness, taking explicitly into account the different relevance of various environmental priorities.

A potential limitation of this exercise is that environmental objectives may vary over time. In our case, the environmental importance was elicited by deliberately asking respondents to refer to the time at which the AES were designed. This was necessary to provide a clear time frame and is coherent with the idea that objectives are set at the beginning of the process, before policy is designed and implemented. In fact, the stakeholders' explicit answers to this question revealed that AES objectives were stable between 2000 and 2006. However, in since then the role of the CAP with respect to environmental issues, and specifically the role of the AES, was reviewed under different pressures, such as climate change and a water scarcity concerns. This may have possibly changed the importance of different objectives attached to AES. In this regard, further research could be focused on the analysis of the evolution of AES objectives over time and in prospect, to address upcoming policy design issues.

In spite of the simple nature of the approach used in this paper, and the approximation inherent in using a sample of stakeholders in order to interpret the social importance of specific policy objectives, the answers provided were generally considered straightforward and the opinions expressed confirm a rather satisfactory degree of consensus among respondents within the same CSA.

It should be stressed that, while this paper seeks to fill a knowledge gap on the importance of different environmental objectives, the methodology is not completely satisfactory. First, the *ex-post* elicitation of weights as practiced in this case is tentative and seems to be a somewhat biased application given that it is always difficult to clearly separate *ex-post* importance from judgments regarding AES outcomes. In addition, where the DM is in fact an institution, the direct elicitation of weights through interviews raises the problem of deciding who best represents the «social» weights to incorporate in a policy. This problem has no clear answer; hence, a large set of different respondents was selected for this study. From this point of view, the consistency of weights was positively surprising, which should also confirm the robustness of the results. However, this does not exclude the potential interest for analyses based on wider samples and explicit differentiation of weights across different stakeholder groups, particular in the context of potential *ex-ante* analyses. The evaluation carried out in this paper remains in the context of the objectives of the policy. A further issue concerns the respondence of these objectives to actual overall policy needs based on local environmental pressures and priorities. This is actually addressed in the statutory *ex-ante* evaluation of RDP, however mainly in a qualitative way. Respondence of AES objectives to actual (agri-)envirommental needs of the programming area would then be a potentially interesting area for research. At the same time, this would also need to consider potentially different strategies of different countries/regions related to focusing attention on a limited number of objectives (a subset of those potentially needing attention), also taking into account complementary policies and marketing strategies.

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