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Environmental effects of agri-environmental schemes in Western Europe

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Abstract

Agri-environmental schemes (AES) have been introduced as part of European Union's (EU) Common Agricultural Policy and are now an important part of this. A methodological approach to analyse the policy effects of AES is outlined, in which we distinguish between performance effects (on agricultural practices) and outcome effects (environmental impact). The performance effects are further approached including measurement of improvement and protection effects based on 12 indicators on changes/maintenance of land use and agricultural management.

Data from personal interviews of participating and non-participating farmers in AES measures in nine EU Member States and Switzerland were used to analyse policy effects, including single indicator effects on agricultural practices as well as combined effects at the agreement level. Significant effects were found for mineral N-fertiliser use, stocking density reduction, maintenance of a minimum livestock density and pesticides. For AES agreements regulating grassland management, fertiliser use and pesticides, clear indications of combined improvement and protection effects were found. In addition clear improvement effects of agreements regulating fertiliser and pesticides use on mainly arable lands were revealed. It is concluded that the approach presented including the 12 selected indicators has proven to be operational.

Keywords: Agri-environmental scheme; Agricultural landscape; Environmental impact; Indicator; Policy evaluation

1. Introduction

Agri-environmental schemes (AES) have been designed and implemented within Europe since the mid 1980s and by 1998 the areas under agri-environmental agreements covered 20% of the total agricultural area within the European Union (CEC, 1998). As a policy domain representing a new integrative approach and because of its fast development there has been much attention to the implementation of AES. A great number of references given to empirical studies of AES, including a few comparative texts are already available (De Putter, 1995; Whitby, 1996; European Parliament, 1998; Potter, 1998; Huylenbroeck and Whitby, 1999; Rønningen, 1998; Buller et al., 2000). Despite all this work few research results have been published on environmental effects of AES (Andreoli and Tellarini, 2000; Oñate et al., 2000; Kleijn et al., 2001).

This paper deals with measurement of environmental effects of AES and is based on an EU research project involving nine EU Member States (Austria, Denmark, France, Germany, Greece, Portugal, Spain, Sweden, United Kingdom) and Switzerland (Schramek et al., 1999). In these 10 countries, 22 case study areas (CSA) were selected and 1000 farmers within the areas were interviewed: 789 were participating in AES measures under the so-called Agri-environment Regulation (EC/2078/1992) while 211 were not participating. Utilising data from this study a methodological approach to AES effect measurement through indicators and cross-comparison of concrete results from the EU project are presented (Andersen et al., 1999).

2. Policy design and implementation of agri-environmental schemes

AES were introduced in Europe in the 1980s as a separate policy domain accompanying the Common Agricultural

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Policy (CAP) and with clear links to nature conservation, environmental protection, and landscape management. Starting as a Dutch initiative, and with EC-approval in 1985 of national subsidies to farmers within an agri-environmental framework, AES developed quickly to an EC co-funded option for Member States (Bennett, 1986; Baldock and Lowe, 1996). By 1987 England, Germany and The Netherlands had implemented AES. In 1990 Denmark, France, Ireland, Italy and Luxembourg followed, so before the 1992 reform of the CAP eight of the 12 EU countries had introduced AES. As part of the reform it became obligatory for the Member States to implement Reg. EC/2078/92, which was the legal framework for AES until 2000, and the EU co-financing share increased to 50% (75% for Objective 1 areas). Measured by uptake implementation of AES has been most successful in the new Member States (Austria, Finland, and Sweden), which had developed similar policies in the years preceding their entry (De Putter, 1995; Deblitz and Plankl, 1998; Buller, 2000). AES are now implemented under the Rural Development Regulations introduced with Agenda 2000 (EC/1257/1999 and EC/1750/1999) in all Member States.

The central objectives of Reg. EC/2078/92 are (1) to contribute to providing an appropriate income for farmers, and (2) to promote agricultural production methods compatible with environmental protection and conservation of nature and landscape. In addition, Reg. EC/2078/92 should accompany the changes introduced under the market regulations of the CAP that is to help reducing surplus production (Scheele, 1996; Buller, 2000). The environmental part of the objectives is rather broad, concerned with environmental protection, nature conservation, and landscape management and enhancement. Also the preservation of rare breeds and the promotion of organic farming methods, public access and training of farmers are mentioned in the list of possible activities to be supported under Reg. EC/2078/92.

Within the EU, AES are based on the subsidiarity principle of leaving all actions not necessary to achieve the objectives set in the EU Treaty to the Member States. Consequently, much room has been left for the Member States and regional authorities to design specific agri-environmental programmes and by 1997 more than 130 different ones have been approved (Buller, 2000). Some of these are horizontal oriented programmes applied for a large area (often the total utilised agricultural area-UAA-of the country). Others are targeted either to specific designated zones (such as the English Environmentally Sensitive Areas-ESA-and the Danish Sensitive Agricultural Areas) or to specific types of farming. Most of the signed agreements are for 5 years, but 10 and 20-year agreements also exist.

The implementation patterns of the different programmes are very different in respect to uptake, expenditure and integration with national and environmental policies. As the Commission states in an evaluation report: 'Each Member State, and frequently each region, has chosen their own method of implementation' (CEC, 1998, p. 24). This diversity in policy design and implementation, as well as the variations in landscapes and farming structures affected by the AES, appear clearly in the study presented. One could argue that the profound diversity of national and regional policy design and implementation is an indication that the subsidarity principle indeed has been working in respect to AES. However, this diversity is also one key reason explaining why the evaluation of Reg. EC/2078/92 is a difficult task.

3. Measuring effects of agri-environmental schemes—concepts and analytical framework

Although evaluation of AES is mandatory for the Member States, and although more than 150 monitoring and evaluation reports on AES impacts have been produced throughout Europe (CEC, 1998), the scientific literature on AES evaluation methodology and AES environmental effects is limited. Colman provides a list of assessment criteria for the measurement of the effectiveness of ESA, with the 'capacity to protect and enhance' being the first criterion of the list (Colman, 1994). The OECD has developed a so-called 'driving force–state–response' model with the purpose of clarifying the relationships between environmental change and public policy interventions, and identifying appropriate indicators (OECD, 1999). Relationships between regulation systems, agricultural systems and landscape systems have been analysed in Primdahl and Brandt (1997) and the usefulness of indicators as evaluation tools is dealt with by several papers in Brouwer and Crabtree (1999), Oñate et al. (2000) and Von Wirén-Lehr (2001). In spite of these efforts this important issue remains open both in terms of the analytical framework used in the evaluation and the measurement of AES effects. In a contribution by Kleijn et al. (2001) it was shown that AES in the Netherlands did not increase the number of target species (birds, grassland vegetation and the associated insect population). The study led to a debate in which the validity of some of the conclusions was questioned (Sutherland, 2002), and references were given by Carey (2001) to studies showing that AES in England have delivered positive effects on biodiversity conservation and wildlife enhancement (Sheldrick, 1997; Peach et al., 2001). The debate illustrated that effect measurement is indeed attended with methodological limitations but it was also pointed out (Carey, 2001) that monitoring and evaluation have had a positive role in the development of English AES.

Measurement and evaluation of policy effects based directly on environmental characteristics pose serious difficulties. The main limitations are the lack of linearity and immediacy (effects may very well lag behind the source of disturbance), unequivocal causality (effects are subject to a multitude of influences of which the policy to be evaluated is only one) and high cost of measurement (Peco et al., 1999). In order to deal with these problems analytically, a distinction can be made between *policy performances* and *policy outcomes* (Winter, 1994; Primdahl and Brandt, 1997; Oñate et al., 2000). The performances are the immediate effects, which in our study of AES include the uptake of agreements and the effects on agricultural practices as a result of the contractual obligations in the agreements. The policy outcomes are the effects of farming on the environment (e.g. water quality, biodiversity, scenic qualities, etc), which are clearly and ultimately the most important intended effects of agri-environmental measures. Thus, the impact model used in this study is (1) AES implemented ⇒ (2) effects on farming practices (performance) ⇒ (3) effects of policy regulated farming practice on environment (outcome). Due to the impediments for measuring AES outcome effects, our effort is devoted to quantify and evaluate performance effects as the first needed step for the appraisal of AES effectiveness.

In the literature, performance effects of AES are usually seen in a change perspective; that is, as improvements of agricultural practices from an environmental point of view. However, protection of existing values is also of interest as a policy effect. This is the case when policies help to maintain agricultural practices, which would otherwise change in an undesired direction. To keep this in focus we have therefore distinguished between *improvement effects* and *protection effects*. AES have improvement effects if positive changes are achieved as a result of the signing of agreements while protection effects occur if negative changes are avoided. This distinction is important from a nature protection point-of-view, especially when AES are evaluated in a long-term perspective over several 'agreement generations'. Improvement effects always deal with changes on agreement land itself; that is, improvements of certain specified environmental values depending on a change in agricultural practices on a given piece of land. They usually take place at the beginning of the agreement period when the policy goal is to improve an environmentally undesirable situation and can in most cases be achieved and detected earlier than protection effects. Protection effects concern existing environmental values depending on a continuation of an agricultural practice threatened by change (intensification or abandonment). Protection effects cause some special problems in evaluations since ultimately they can only be evaluated ex-post and require a control reference area comparable to the agreement area in question. Most improvement effects will be subject to protection obligations in agreements following the first one signed.

One final remark has to be made on our general framework and our analysis. We do focus on contractual obligations that are requirements written in the agreements. We thereby analyse whether or not the agreements achieve what they intend to achieve, using only stated goals at the level of concrete agricultural practices. This means that the environmental impact model on which the AES is based is taken for granted. The analysis however goes beyond simply verifying if farmers are doing what they are paid to do (compliance). This is done by focusing on the performance of the farmers with agreements relative to their performance prior to the signing of the agreement, and by comparing activities undertaken by farmers with and without agreement. Both of these analytical steps are needed to evaluate improvement effects and protection effects as mentioned above, which clearly is different from just testing compliance.

4. Data collection and analysis

The agricultural practices regulated through Reg. EC/2078/92 in the selected 22 case study areas (CSA) are divided into land uses and management practices (see Table 1). For the quantification of the nine selected agricultural practices, which have been identified as cross-nationally relevant, a total of 12 indicators have been generated. Data collection on the value of these indicators was made through personal interviews of 789 participating and 211 non-participating farmers in 22 CSA. The CSA have been selected to cover a wide range of agri-environmental agreements, environments, and farm types in nine EU countries (Austria, Denmark, France, Germany, Greece, Portugal, Spain, Sweden, United Kingdom) and Switzerland. More participants than non-participants were selected due to the need of a wide range of agreements with different obligations to be analysed with respect to the indicators.

Performance effects of AES on agricultural practices can be analysed at different levels using different points of departure. One important distinction is made between analyses targeted at specific agri-environmental issues (grouped in land use types and management practices), and analyses using the single agreement as a reference point. Both types of analysis have been carried out in our study, the first being referred to as the *agricultural practices analysis*, the second as the *agreement analysis*.

4.1. The agricultural practices analysis

The agricultural practices analysis is based on comparisons between the performance of farmers with specific types of agreements (AF) of relevance to the agricultural practice in question, and the behaviour of the rest of farmers (RF). The latter group refers to farmers without an agreement (non-participants) and farmers with agreements of no relevance to the agricultural practice in question. Not all the 12 indicators were relevant for all the measures, because this depends on the environmental objectives of the latter. It has to be emphasised that more than one indicator is often needed for measuring performance effects for a given agricultural practice. This is mainly because it can be

Table 1
Selected relevant agricultural land use and management practices and indicators for the environmental analysis of Reg./EC2078/92 in the case study area

Agricultural practices	Indicator[a]
Land use	
Permanent grassland	1. Permanent grassland/UAA (Permanent grassland area per utilised agricultural area (%))
Abandoned land	2. Abandoned land/UAA (Area of abandoned land per utilised agricultural area (%))
Hedges	3. Hedges/UAA (Length (m) of hedges per utilised agricultural area (ha))
Management	
Mineral N-fertilisers	4. Mineral N-Fertilisers CA/EA (mineral N-fertilisers usage on contracted area (CA) for agreement holders or eligible area (EA) for the rest of farmers)
Livestock density reduction	5.1. LU/UAA Reduction (Total livestock units (LU) per utilised agricultural area)
	5.2. RLU/Forage Reduction (Rough grazing livestock units (RLU) per grassland and fodder crops area)
Minimum livestock density	6.1. LU/UAA Maintenance (Total livestock units (LU) per utilised agricultural area)
	6.2. RLU/Forage Maintenance (Rough grazing livestock units (RLU) per grassland and fodder crops area)
Fallow land	7. Fallow land/AL (% Fallow land area per arable area (AL))
Crop diversity	8.1. Number of crops/AL (Number of crops planted per arable area (AL))
	8.2. Crops in rotation CA/EA (Number of crops in rotation on contracted area (CA) for agreement holders or eligible area (EA) for the rest of farmers)
Pesticides	9a. Pesticides (Actual (1997) intensity use of pesticides (qualitative))
	9b. Pesticides Changes from 1993 to 1997 (qualitative))

[a] The numbers and short names following are used for reference throughout the section.

relevant to measure the agricultural practices at different levels (agreement land/eligible land/total farm). Further, the desired direction of the effect is not always the same. In some situations reduction of stocking density is a stated objective and indicators must be constructed so that an increase in value is considered negative (indicators 5.1 and 5.2 in Table 1). In other cases keeping a minimum of grazing livestock density for the maintenance of extensive pastures is the goal and the indicator must reflect this (indicators 6.1 and 6.2 in Table 1). For all other indicators utilised in this study, however, only one direction of change can be considered to be positive or negative. As an example, an increase in abandoned land (indicator 2 in Table 1) is considered as negative for all agreements analysed for this indicator, because the policy objective in all the measures studied is to prevent land abandonment. The opposite example could be fallow land, where an increase is considered to be positive.

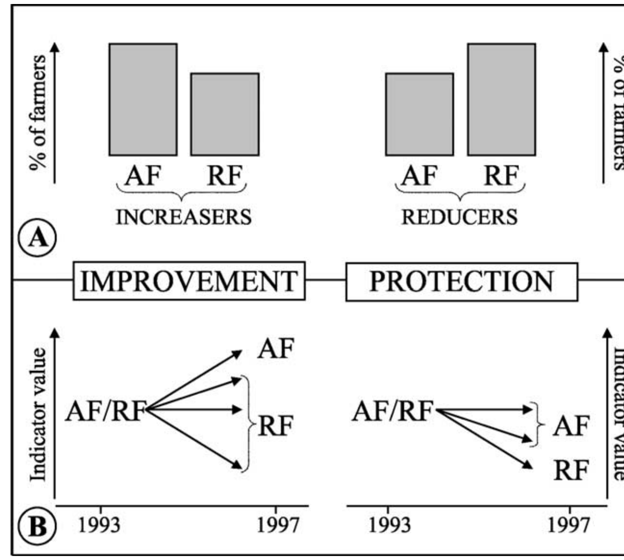

Fig. 1. Conceptual framework for analysing improvement and protection effects based on (a) proportion of farmers with positive (increasers) or negative (degraders) changes of the indicator value between 1993 and 1997 and (b) average change rate in indicator value between 1993 and 1997. In both cases an increase in the indicator value is considered to be positive and correlated with the environmental value; the 1993 level of the indicator value for the AF and the RF is the same in (b), although this is not always the case; the methodology applied for the determination of effects is not influenced by differences in the 1993 level between the AF and the RF. AF: agreement holders; RF: rest of farmers.

Following this approach, the agricultural practices analysis has been carried out in two ways: (1) a comparison of the proportion of AF and RF that increase, maintain or reduce the value of the specific indicator, and (2) calculation of the actual change rate between 1993 and 1997 for AF compared to the RF. The first calculations provide insight into the consequences of the investigated measures on agricultural practices in terms of the proportion of AF behaving in specific ways compared to the RF and are the basis for a first interpretation of improvement and protection effects (Fig. 1(a)). Effects are indicated when the distribution on increasers/maintainers/reducers differs significantly (χ^2 test: $P < 0.05$) between agreement holders and the rest of the farmers. Improvement effects are indicated when the proportion of the AF classified as increasers is larger than for the RF. Protection effects are indicated when the proportion of AF classified as reducers is smaller than for the RF. Note that improvement effects and protection effects can occur at the same time, which is not the case for the second set of calculations. The change rate analysis determines the magnitude of the effect[1]: the type of

[1] The average change rates of the agreement holders are compared to the average change rates of the rest of the farmers by means of a Student t-test for ratio variables. For indicators measured with ordinal or percentage variables the medians of both populations are compared by means of a Mann–Whitney U-test. For both cases the significance level used is $P < 0.05$. Near significant differences have been considered for probability values $P < 0.1$. The null hypothesis is that there are no effects of 2078-measures and thus averages (t-test) or medians (U-test) of agreement holders and the rest of farmers are not significantly different.

effect, improvement or protection is determined and quantified from the comparison of change rates between AF and RF (Fig. 1(b)). It should be noted that in the analyses of pesticide use, measurement of the extent of change has not been possible due to lack of reliable data. The use of pesticides is thus evaluated by comparing the actual intensity in the use of pesticides in 1997 for AF and RF, respectively (indicator 9a) and by using qualitative statements from the farmers on changes from 1993 to 1997 (indicator 9b).

The agricultural practices analysis has been carried out at two different aggregation levels, according to the CSA type and the farm type, respectively. The diversity in the implementation of Reg. EC/2078/92 corresponding to regional priorities and the variety of agricultural regions, which vary considerably in landscape, farming types/structures and agri-environmental issues, is also reflected in the selected CSA and interviewed farmers. In an attempt to find patterns that could be generalised in an inter-study areas comparison, CSA have been characterised on the basis of their main agronomic orientation (crop farming, husbandry or mixed) and their environmental problems (such as pollution, grassland reduction and degradation, loss of landscape diversity, removal of natural vegetation, intensification of livestock management, drainage, salinization, erosion, fire). On the basis of these parameters, the similarity (Jaccard index) of the 22 CSA was calculated and subjected to a multidimensional scaling (Jongman et al., 1987). The ordination analysis revealed two gradients, one according to the typology of farming (mainly arable-mainly husbandry) and the other reflecting the environmental problems (intensification-abandonment). The CSA were then roughly classified according to their position in the ordination space (Fig. 2). The resulting classes were:

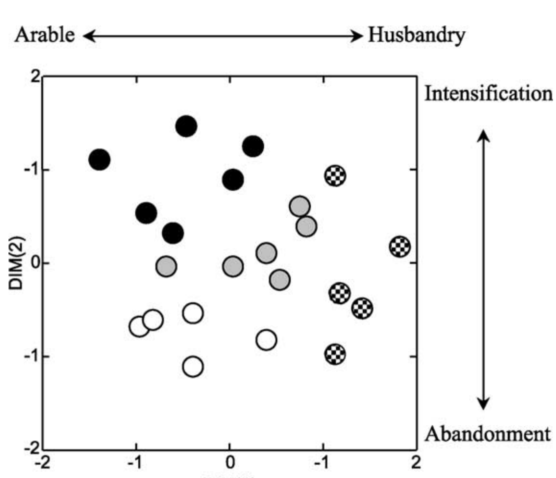

Fig. 2. Multidimensional scaling of the matrix case study areas versus environmental problems (stress = 0.1438) and resulting case study areas classes. Black: mainly intensive arable; blank: mainly extensive arable; grey: mainly intensive husbandry; punted: mainly extensive husbandry.

1. Mainly intensive arable, including 6 CSA.
2. Mainly extensive arable, including 5 CSA.
3. Mainly intensive husbandry, including 6 CSA.
4. Mainly extensive husbandry, including 5 CSA.

Simultaneously, farms were classified on the basis of the structural information provided by the questionnaires according to the following types and criteria:

1. Extensive grassland (> 50% of utilised agricultural area (UAA) as grassland and stocking density < 1.5 livestock units (LU) per ha. of grassland + forage crops).
2. Intensive grassland (> 50% of UAA as grassland and stocking density > 1.5 LU per ha. of grassland + forage crops).
3. Arable (> 50% of UAA under arable).
4. Permanent crops (more than 50% of UAA under permanent crops).
5. Agro-forestry (more than 50% of UAA under forest).

4.2. The agreement analysis

Agreements under Reg. EC/2078/92 rarely consist of only one contractual obligation. The analysis of the single indicators presented above is therefore supplemented by analysis of the overall effects of the agreement, combining several agricultural practices for each agreement. The general idea behind the agreement analysis is to analyse the overall effect (improvement and/or protection) and not the extent of the effect. This is done by analysing the participants' responses to a set of contractual obligations, rather than by focusing on single contractual obligations. Using this approach it is possible to record an agreement with an overall effect, but without effects for some of the contractual obligations, which may be useful for the evaluation of performance effects of different types of schemes or of the same scheme in different areas.

The nine agricultural practices analysed (Table 1) almost always occur in combinations in the individual agreement. Out of the 789 participants in our case studies, only 15 have no contractual obligations related to the nine investigated agricultural practices. Only three of the remaining 774 have to comply with contractual obligations related to only one of the nine practices. The analysis of the different combinations of contractual obligations in the agreements has shown that two kinds of combinations are very common: (1) agreements with contractual obligations for grassland, use of fertilisers and use of pesticides, and (2) agreements with contractual obligations on use of fertilisers and use of pesticides, but not for grassland.

The farmers identified in the two groups may also have contractual obligations related to others of the nine agricultural practices. In total, these two groups of participants comprise almost 95% of the participating farmers in the farm survey. Based on the classification of farmers as *increasers/maintainers/reducers* regarding individual agricultural practices (used in the agricultural practice analysis described above), the farmers have been re-classified at an aggregated level:

1. Improver, if the farmer changes agricultural practices in a positive direction for at least one contractual obligation (regardless of any negative changes).
2. Protector, if the farmer makes no negative or positive changes.
3. Degrader, if the farmer makes at least one negative change to an agricultural practice and makes no positive changes.

This classification of farmers is then compared for the relevant AF and non-participants to evaluate improvement or protection effects. Since it is the combinations of obligations rather the individual one which is analysed it is more meaningful to compare AF with non-participants that with ‘rest of farmers’ (RF). AF with a pre-2078 agreement have been excluded from the analysis since the reference period used (1993–1997) does not show the effects of previous agreements. Improvement effects are indicated when the proportion of AF classified as improvers is at least 5% larger than the same proportion of non-participants. Similarly, protection effects are interpreted to occur when the proportion of AF classified as degraders is at least 5% lower than the same proportion of non-participants. Both effects were stated when the distributions of AF and non-participants on improvers, protectors and degraders are significantly different (χ^2 test: $P < 0.05$).

5. Results

5.1. The agricultural practices analysis

Significant effects (at $P < 0.05$) have been found only for some agricultural practices. This is true for results from the analysis of the proportion of AF versus RF who increases, maintains or reduces the value of the specific indicator (Table 2), as well as for results from the analysis of the change rates between AF and RF (Table 3).

The most widespread effects were found for mineral N-fertiliser use (Tables 2 and 3, indicator 4.1) For all CSA types, except extensive husbandry areas where analysis has not been possible due to high participation rates (and therefore a limited sample of RF), significant or nearly significant effects have been found. For these three CSA types, a larger proportion of AF has decreased the use of fertilisers and the change rate analysis shows clear improvement effects in two of them. Similarly, improvement effects have also been found in four different farm types. The change rate analysis yields significant or near significant results for arable farms and intensive husbandry farms, but the analysis of the proportion of farmers making changes also indicates that improvement effects occur for extensive husbandry farms and permanent crop farms. For permanent crop farms, concurrent protection effects are also evident, as a larger proportion of the RF have increased their use of N-fertiliser compared with AF.

For the two indicators related to stocking density reduction (5.1 and 5.2), only nearly significant reductions in livestock units have been identified by the change rate analysis in intensive husbandry areas (Table 3, indicator 5.1). A larger proportion of the RF group has increased the livestock density on extensive grassland farms compared to AF, thereby indicating a protection effect (Table 2, indicator 5.1).

Agreements aiming at maintenance of a minimum livestock density have only been implemented in extensive husbandry areas, and significant improvement results have only been found in extensive grassland areas from the change rate analysis (Table 3, indicator 6.1).

Table 2
Improvement or protection effects based on the analysis of the proportions of agreement holders and rest of farmers making changes between 1993 and 1997

Indicator[a]	CSA types				Farm types				
	IA	ExA	IH	EH	EG	IG	A	PC	AF
1. Permanent grassland/UAA			–	–	–	–			
2. Abandoned land/UAA		–		–	×	×	–	×	–
3. Hedges/UAA		–	–	×	–	–	–	×	×
4. Mineral N-Fertilisers CA/EA	I	I	I	×	I	I	I	I/P	×
5.1. LU/UAA Reduction			–	×	P	–			×
5.2. RLU/Forage Reduction			–	×	–	–			×
6.1. LU/UAA Maintenance				–	–	×			–
6.2. RLU/Forage maintenance				–	–	×			–
7. Fallow land/AL		I					I	×	
8.1. Number of crops/AL	–	I					–	×	×
8.2. Crops in otation CA/EA	–	–					I	×	×
9b. Pesticides	I/P	I	–	×	×	–	I/P	I/P	–

CSA types: IA: intensive arable, ExA: extensive arable, IH: intensive husbandry, EH: extensive husbandry. Farm types: EG: extensive grassland, IG: intensive grassland, A: arable, PC: permanent crops, AF: agroforestry. Effects: the interpretation is based on a significant different distribution on increasers, maintainers and reducers between agreement holders and rest of farmers. I: improvement effect proportion of agreement holders making positive changes at least 5% larger than for the rest of the farmers, P: protection effect—proportion of agreement holders making negative changes at least 5% smaller than for the rest of the farmers, I/P: concurrent improvement and protection effect, –: no effect, ×: analysis has not been possible due to low sample of farmers, blank: Not relevant for the CSA type or farm type.

[a] See Table 1 for explanations on indicators.

Table 3
Improvement or protection effects based on the change rate in indicators for agreement holders and rest of farmers between 1993 and 1997

Indicator[a]	CSA types				Farm types				
	IA	ExA	IH	EH	EG	IG	A	PC	AF
1. Permanent grassland/UAA			–	×	–	–			
2. Abandoned land/UAA		–		×	×	×	–	–	–
3. Hedges/UAA		–	–	×	–	–	–	×	×
4. Mineral N-Fertilisers CA/EA	i	I	I	×	–	i	I	×	×
5.1. LU/UAA Reduction			i	×	–	–			×
5.2. RLU/Forage Reduction			–	×	–	–			×
6.1. LU/UAA Maintenance				I	–	×			–
6.2. RLU/Forage Maintenance				×	×	×			–
7. Fallow land/AL		–					–	×	
8.1. Number of crops/AL	×	–					i	×	×
8.2. Crops in rotation CA/EA	I	–					I	×	×
9a. Pesticides	–	I	I	I	I	I	I	–	–

CSA types: IA: intensive arable, ExA: extensive arable, IH: intensive husbandry, EH: extensive husbandry. Farm types: EG: extensive grassland, IG: intensive grassland, A: arable, PC: permanent crops, AF: agroforestry. Effects: I: improvement effect $P < 0.05$, i: improvement effect $P < 0.1$, –: no effect, ×: analysis has not been possible due to low sample of farmers, blank: Not relevant for the CSA type or farm type.

[a] See Table 1 for explanations on indicators.

Obviously, agreements regarding fallow land or crop diversity have been mainly implemented in arable areas and arable farms, and in consequence the non-arable types of areas and farms had to be excluded from this specific analysis. Improvement effects on fallow land are yielded by the analysis of the proportion of farmers increasing their fallow land (Table 2, indicator 7). For indicators on crop diversity, the analysis of the proportion of farmers making changes gave significant improvement effects for extensive arable areas and for arable farms (Table 2, indicators 8.1 and 8.2). For arable farms, these improvement effects are also evident from the change rate analysis, and are also detected for intensive arable areas, although this is not the case for extensive arable areas (Table 3, indicators 8.1 and 8.2).

Finally, for the use of pesticides a wide range of effects has been found. The comparison of actual use in 1997 between AF and RF indicates significant improvement effects in all CSA types except intensive arable areas, as well as in all farm types except permanent crop and agro-forestry farms (Table 3, indicator 9a). However, the analysis of the proportion of farmers making changes does not completely reflect these conclusions. Thus, improvement effects can only be interpreted for the two types of arable areas and for arable and permanent crop farms. In all these cases (except for extensive arable areas) concurrent protection effects were also found (Table 2, indicator 9b).

It is worth noting that the analysis of agricultural practices for the different indicators at the aggregated levels of CSA and farm types has only revealed significant or near significant improvement effects. No significant protection effects have been identified, although significant protection effects were found in some individual CSA (see Oñate et al., 2000). Nonetheless, the analysis of the proportions of farmers making changes indicates that protection effects occur, although still to a lesser degree than improvement effects. A relation of about 1:3 has been observed for protection versus improvement effects. In conclusion, the analysis of agricultural practices has shown significant or nearly significant effects in approximately one out of three of the performed analyses.

5.2. The agreement analysis

The behaviour of AF with contractual obligations on grassland area, fertiliser use and pesticides use differs significantly from the non-participants' behaviour (Table 4). The share of AF improving agricultural practices is twice as high (35%) as for non-participants (16%), and only 9% of the AF have made negative changes to agricultural practices, whereas the same figure for non-participants is 17%. This indicates that improvement as well as protection effects are occurring with this type of agreement.

Similarly, the analysis of agreements combining contractual obligations on a reduction of fertilisers and pesticides use (mainly agreements for arable land) shows a significantly different distribution for the two groups of farmers (Table 5). Even clearer improvement effects can be interpreted from this table. More than half of the AF has made improvements, that is, reduction in the use of fertiliser or in the use of pesticides. Less than one out of ten of the non-participants has done so. On the other hand, no protection effects can be interpreted from the analysis of this type of agreement. The same share of AF and non-participants (<10%) are degraders and have made negative changes, such as increases in the use of inputs.

Table 4
Proportion of agreement holders with restrictions on grassland area, fertiliser use and pesticides use, rated as improvers, protectors and degraders compared with non-participants

	N	Improvers (%)	Protectors (%)	Degraders (%)
Agreement holders	280	35.4	55.7	8.9
Non-participants	100	16.0	67.0	17.0
Total	380	30.3	58.7	11.1

χ^2 test: $P < 0.001$.

Table 5
Proportion of agreement holders with restrictions on fertiliser use and pesticides use, rated as improvers, protectors and degraders compared with non-participants

	N	Improvers (%)	Protectors (%)	Degraders (%)
Agreement holders	112	52.7	38.4	8.9
Non-participants	113	7.1	85.0	8.0
Total	225	29.8	61.8	8.4

χ^2 test: $P < 0.001$.

6. Discussion

Monitoring and evaluating the effects of AES require an analytical framework including operational concepts and indicators. The framework, the key concepts and the indicators utilised in this study have generally shown to be applicable. Besides this overall result, a number of experiences can be drawn from the work.

First, the distinction between performance effects and outcome effects is a critical one. In this study, focus has been on the performance effects, i.e. the effects the AES have on agricultural practices such as land use and management practices. Identification and measurement of policy performances require data on variables that are strictly related to the commitments stated in the voluntary agreements signed by participating farmers. These data must be obtained at the decision making level, that is at the farm level. Several other variables with environmental impacts may not be included in the list of commitments and thus are not appropriate for AES performance measurement. Should it be the case that such variables are changing negatively from the perspective of environmental quality, it would not be due to insufficient policy implementation, which may well produce the effects intended in the policy design. This also means that environmental impacts caused by policy performances may not always be easily separated from other factors. It is therefore important to state that the policy outcomes, which are the most important effects at the landscape level, can only be assessed with varying uncertainty in a broader context of influence. The main reason for this uncertainty is related to the difficulty in separating policy impacts from other influencing factors, i.e. to establish causality. The debate on the Dutch AES study mentioned in Section 3 (Kleijn et al., 2001) was mainly about this causality problem and the comparisons between areas with AES agreements and areas without. In any case, outcome indicators still have great interest for assessing the state of the environment and for identifying areas and resources at risk. This valuable information could assist the design and targeting of strategies and actions in the future. The ideal AES evaluation is therefore based on both performance and outcome measurements. The former reveal problems in the policy implementation process whereas the latter inform about the appropriateness of the policy design and of the impact model on which the design is based. However, the cost-effectiveness of AES in respect to specific environmental issues has to be studied using the performance effects approach.

A second notable point from the study is the importance of including the protection effects of AES. Although most political attention has been on the immediate improvement effects, they are mainly of interest in the first generation of agreements. As AES develop and second and third generations of agreements follow, the protection dimension becomes of growing interest. Analysing protection effects, especially over longer periods is, however, a difficult task requiring a research approach designed for follow-ups. This assertion is based on the fact that our agricultural practice analysis yielded a majority of improvement effects (related to the use of pesticides, N-fertilisers, livestock density and number of crops in rotation) in comparison to protection effects. Such results seem to be consistent with the objectives of the respective 2078-measures to improve certain kinds of farming practices. However, the high number of 'no data' and 'no effect' records must be considered. For first generation agreements, protection measures are of most relevance where the existing values are high, and that is often in less-favoured areas, where there may be few signs of the intensification trend and the threat of abandonment is more realistic. In those areas the take up levels can be expected to be extremely high resulting in few (or no) non-participants, and consequently lack of data may occur as a problem. The 'no effect' situation corresponds to cases in which both AF and RF/non-participants either do not change the value of the indicators or show exactly the same trend. The interpretation of these results may be linked to the design of the measures in terms of the imposed levels of restriction and obligation. If the stringency of the demands on agricultural practices imposed by the agreement commitments is not greatly differentiated from the values they reach in the study area in question, differences may not be detected between AF and RF. These situations appear to be more characteristic for measures which pursue protection effects in areas where the pressure towards intensification is not particularly high but where there is a threat of abandonment.

Limitations with effect measurement, as the ones described above are partly overcome in the agreement analysis, which yielded clear improvement and protection effects for agreements with combined grassland management, fertiliser use and pesticides use obligations. For agreements with combined fertiliser use and pesticides use, which are mainly targeted towards arable farming, very clear improvement effects were found. Since relatively few agreements have a single obligation only and since the individual farms may vary considerably, in respect to farming type and environmentally, studies based on combined indicators may be quite useful in comparative evaluations of AES performance.

Third, the issue of measurement precision and analytical approach should briefly be touched upon. Two ways of analysing of farming practice in respect to single policy obligations have been presented. The first (analysis of proportion of farmers) is appropriate for those cases in which only qualitative data are available. The second type (change rate analysis), which provides more exact data than the first should be used when quantitative information is at hand. Thus, the two type of analyses could be seen as complementary and useful when ESA and their effect on specific environmental problems are to be studied. The overall effect of each agreement (the agreement analysis) provides information on a relative general level but is useful when a single agri-environmental scheme is expected to result in different types of performance effects on different farms, which is often the case.

As a fourth measurement issue, time scale should be considered. AES objectives are usually related to protection and improvements of biodiversity, habitats, and cultural and scenic values; that are, to long-term landscape processes. In the results presented, changes over a very short period of time, 4 years, have been studied. The short time frame has been necessary for practical reasons, since we wanted to analyse policy effects across a large number of measures without any common (or comparable) monitoring system, that is, without any previous data. However, this short time frame has had several disadvantages, some of which have already been touched upon. Since only first generation of AES can be studied without data covering a longer timeframe protection effects would be 'under-estimated' compared to improvement effects. Also in respect to measurement of outcome effects, there are much greater difficulties using a short time framework compared to a longer term one, where all the 'noise' from non-policy relevant types of changes becomes relatively less important. The same is true for more 'structural' types of AES, such as for instance hedgerow measures, where significant improvements represent greater investments over a longer time frame than more 'functional' ones, such as the ones aiming at reductions in chemical inputs. In that respect, long time scales would have similar positive measurement consequences as large data samples.

Finally, the problems associated with the great variations in policy design and implementation should be mentioned. On the one hand, the great diversity of programmes and measures is, naturally, associated with the variations in landscapes within and between Member States. In this context, the vast number of different measures implemented could be seen as a proof of a well functioning subsidiarity principle. On the other hand, the diversity of measures makes it very difficult to develop suitable indicators and to evaluate the effectiveness of AES across all Member States.

7. Conclusion

A methodological approach to measure effects based on interviews with participating/non-participating (but eligible to participate) farmers has been presented and has proved to work in a study of 1000 farmers distributed in 22 case study areas in nine EU Member States and Switzerland.

Reductions in the use of nitrogen-fertiliser and pesticides were the most widespread type of obligations and significant effects of reductions of these factors were found in most of the case study area types and for most farm types. Significant effects, but less widespread, were found for indicators concerning livestock density, livestock maintenance, crop diversity and fallow land management.

For combined effects on the agreement level clear results of improvement, as well as protection effects, were found for agreements with restrictions on grassland management, fertiliser use and pesticide use. For agreements with restrictions on fertiliser use and pesticide use but not grassland management; that is, mainly agreements for arable farming, clear improvements effects were found, but no protection effects.

The 12 indicators identified have proven to work, although the 4 year period in which changes have been analysed is not long enough especially for the measurement of protection effects.

Follow-ups on the same samples of farms would enable for longer periods and the approach used in the presented study could be used to design such long-term monitoring projects.

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