

CHAPTER 10. ASSESSING LONG-TERM IMPACTS OF AGRI-ENVIRONMENTAL MEASURES IN GERMANY

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Abstract

This contribution describes the development of agri-environmental measures in Germany and presents an evaluation approach for the assessment of long-term impacts.² Farm accounts of 18 600 farms over 13 years (1989-2002) have been used to select samples of farms participating in agri-environmental schemes and similar farms not participating in these schemes, using a cluster analysis. For each farm with high agri-environmental payments, five similar farms receiving no or low levels of environmental payments (“non-participants”) were selected. The results show that farms participating in agri-environmental schemes have reduced their land use intensity and production per hectare, compared to non-participants, with organic farms showing notably higher rates of extensification. Although considerable income effects can be observed, there is no clear “windfall profit” situation, because participants significantly improve their environmental performance. For such management changes, appropriate incentives are needed in order to compensate for risks involved. Analysis of farm accounts can provide valuable insights into long-term farm developments. However, certain impacts of farming, e.g. in the area of erosion and biodiversity, are not “visible” in the accounts. Therefore, the presented approach is only one element in a methodology mix to be applied when evaluating agri-environmental schemes.

Introduction

Incentive-oriented agri-environmental measures have become an important instrument of environmental policy in German agriculture since the late 1980s. A major driving force of this development has been the increased EU co-funding for agri-environmental schemes. After defining agri-environmental payments, in the first part of this contribution the development of these measures and regional differences within Germany are briefly described. In the second part, methodology and results of an evaluation approach are presented.

Federal structure of Germany

Within the federal structure of Germany, the regions are mainly responsible for implementing agri-environmental policies and especially for incentive schemes at farm level. In the following, the

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1. Institute of Rural Studies, Federal Agricultural Research Centre (FAL), Germany.
 2. The phrase “agri-environmental measures” in this paper generally refers to payments provided to farmers for undertaking certain specified activities beneficial to the environment.

term *Länder* is used for the German Federal States, the administrative regions mainly responsible for design and implementation of agri-environmental measures. Note that within each *Länder*, the agricultural ministries are generally responsible for agri-environmental measures, although the environmental ministries or departments are also often involved. Full names of the German *Länder*, and the abbreviations used in the tables and figures are included in Table 1.

Definitions and differentiation of agri-environmental measures

Characteristic features of agri-environmental measures in the EU are that participation is voluntary and temporary, and that a premium is paid both as compensation and as an incentive to participating farmers who are implementing or keeping up the desired environmental activities. The different measures are combined in agri-environmental programmes, sometimes divided into general landscape stewardship and special contractual nature conservation programmes. Environmental assets produced by farmers have the quality of public goods that are considered not to be satisfactorily provided by the market. For that reason, governmental intervention in order to improve the supply of environmental amenities can be justified (Bromley, 1997). Environmental performance has to go beyond legal standards of “good farming practice”, which have to be complied with anyway (Niendieker, 1998). In the case of mandatory standards, the polluter-pays-principle applies, whereas agri-environmental support is borne by the society and thus does not imply additional limitations of property rights for the farmer (Benninger, 1996; Hampicke, 2000).

Agri-environmental measures, where participation is voluntary and the farmer can return to the former management practices when the support expires, differ from measures in water protection and nature conservation areas commonly applied in Germany. Here, property rights of farmers are restricted by mandatory rules, without compensation within the scope of social obligations or with compensatory payments for stronger restrictions.

To date, agri-environmental measures implemented in Germany have been, nearly without exception, oriented towards practices, and not towards the ecological outcome, as the prescribed activities are expected to have a positive effect on the environment. The particular environmental results on individual farms are only rarely taken into account for the determination of payments. The premium is calculated on the basis of additional costs and income foregone that are to be expected due to compliance with the requirements for average farm conditions.

Measures for so-called “horizontal” extensification, which are offered for the entire agricultural area (Deblitz, 1999), mainly target the protection of abiotic resources, thus reducing the burden on environmental goods such as atmosphere, soil and water. An example is the reduction of fertiliser or pesticide use. There are measures applied at the whole farm level, to farm branches (*e.g.* grassland) or to single plots, and often combinations of different measures are possible. The contribution of extensification measures to conserve wildlife biodiversity is normally limited.

In contrast, measures which are especially designed for protection of species and habitats are implemented within certain target areas or applied only to defined habitats within a *Länder*. Predominantly, they are carried out on a single plot level, and are characterised by compliance with a very extensive management and often by detailed prescriptions for maintenance. Agricultural production is generally less restricted under extensification measures with abiotic protection objectives than under measures that target nature conservation, where the focus is on maintenance of extensive land use rather than limiting land use intensity.

Development of agri-environmental measures in Germany

Historical perspective

Since 1987, the European Community (EC) has enabled its member states to pay environmental support to agriculture within less favoured areas with endangered environment, co-financed by the EC. According to Article 19 of the “efficiency-regulation” (Regulation (EEC) 797/85 and amending regulation 1760/87), the EC contributes 25% to the eligible cost of these measures. Specific nature conservation measures, *e.g.* extensive field strips for wild flora, and grassland measures, had been applied already before 1987, but at a rather low scale, especially in Baden-Württemberg and Bavaria in the south of Germany (Naturlandstiftung Hessen, 1992; Grafen and Schramek, 2000). As a result of Regulation (EEC) 797/85, programmes for nature conservation that had so far been exclusively financed by the *Länder* were considerably expanded with the help of EC funds, both regarding scope and funds. Due to broader use of EC support, the resources spent by the *Länder* increased strongly in the early 1990s.

The increase in funds for agri-environmental measures was accompanied by an expansion of the eligible measures to include less demanding, horizontal extensification measures and a standardised processing of the applications by the agricultural administrations. This applies especially to south-west Germany: In 1992, Baden-Württemberg and Bavaria reached a proportion of over 60% of the German expenditure for regional agri-environmental programmes (Schulze-Weslarn, 1991; Naturlandstiftung Hessen, 1992; Zeddies and Doluschitz, 1996). In Baden-Württemberg, the higher EC contribution of 50% to the pilot programme “MEKA” played an important role in its development. Table 1 shows the development of agri-environmental support per hectare since 1986/87. As a result of EU co-financing, the budgetary contributions of the *Länder* increased at a slower rate during the 1990s compared to the increase in the total budget.

Table 1. Development of support for agri-environmental and extensification programmes

Laender	Art. 19 Efficiency-Reg. (&MEKA)	EC-Extensification progr.	Efficiency-Reg. & EC-Extensification (total)		Reg (EEC) 2078/92		Reg (EC) 1257/99		Changes in 2004-2006 compared to beginning of 90ies				
			total	Land	total	Land ¹⁾	total	Land ¹⁾	total	Land ¹⁾	total		
1986-87	1990-92	1992/93	Beginning of 90ies		1998-1999		2004-2006		planned budget				
in € per hectare utilised agricultural area (UAA) p.a. ²⁾										%			
Schleswig-Holstein	SH	1,5	5,1	3,5	8,6	4,6	3,8	1,4	10,0	2,9	15	-38	162
Lower Saxony	NI	0,7	4,4	4,7	9,0	4,3	4,2	0,9	18,1	2,4	101	-44	337
Northrhine-Westfalia	NW	2,7	3,0	2,3	5,3	2,8	7,0	2,1	32,7	9,3	521	237	366
Hesse	HE	0,5	13,6	17,6	31,2	14,2	26,9	13,5	39,3	19,5	26	37	46
Rhineland-Palatinate	RP	0,8	25,9	7,1	33,0	21,0	26,2	13,1	39,2	18,6	19	-12	50
Baden-Württemberg	BW	0,2	48,8	6,2	55,0	38,0	54,0	27,0	104,4	52,2	90	37	93
Bavaria	BY	4,6	19,3	4,9	24,2	15,5	71,9	35,9	70,0	34,3	190	121	-3
Saarland	SL	0,7	4,4	10,5	14,9	5,7	36,4	7,8	50,2	10,8	237	91	38
Brandenburg	BB	.	5,1	12,6	17,7	6,7	17,1	4,3	38,6	8,4	118	26	126
Mecklenburg-Westp.	MV	.	3,8	13,0	16,8	5,7	15,2	3,3	16,7	3,7	0	-36	10
Saxony	SN	.	16,9	6,1	22,9	14,0	58,1	14,5	67,0	12,2	192	-13	15
Saxony-Anhalt	ST	.	0,0	4,0	4,0	0,9	13,7	1,9	25,2	3,5	524	281	84
Thuringia	TH	.	0,0	9,5	9,5	2,1	44,1	11,0	50,6	12,3	434	476	15
Germany	D	2,1 ³⁾	12,5	6,8	19,3	10,9	31,1	12,8	44,4	16,5	130	52	43
National total in Mio. € p.a													
Germany	D	24,3 ³⁾	214,5	116,8	331,3	187,2	534,0	220,3	706,9	283,9			

1) Share of fund of each Land estimated according to share of GAK measures in 1998; for 2004-06 the same share has been applied.

2) UAA always for 1999; amounts in DM converted into € (1 € = 1,95583 DM). 3) 1986-87 only old (western) Laender

Source: OSTERBURG and STRATMANN (2002), based on VOGEL (1988), KÖNIG (1993), LOTZ (2001), MEHL and PLANKL (1995), OSTERBURG and BASSOW (2003).

Another programme has been the extensification scheme of the EC according to Regulation (EEC) 4115/88, which aimed at reducing overproduction. Extensification contracts were offered between 1989 and 1992 for a period of five years. In Germany, about 70% of the funds were used to support organic farming (König, 1993). The federal government set up a national framework plan within the Common Task “Improvement of Agricultural Structures and Costal Protection” (GAK) and financed 70% of the national share. Consequently, the *Länder* only had to raise 22.5% of the total extensification premium. Support of organic farming was concentrated in regions with unfavourable natural conditions (Schulze-Pals, 1994) and, due to structural changes after reunification, in the new German *Länder*.

Increase of agri-environmental measures under Regulation (EEC) 2078/92

As part of the 1992 CAP reform, Regulation (EEC) 2078/92 introduced agri-environmental programmes as an obligatory “flanking” measure for member states. In addition to environmental objectives, the aims of these programmes were to reduce surplus production and provide income support for farmers. In contrast to the extensification scheme, the maintenance of desirable land management practices could now be supported.³ The maximum EC contribution was fixed at 50%, increasing to 75% in objective 1 regions, including the *Länder* of eastern Germany. The higher level of financial assistance from the European Agricultural Guidance and Guarantee Fund (EAGGF), Guarantee Section widened the financial scope of the *Länder*. In all of the *Länder*, new agri-environmental programmes were drawn up, and because of the favourable co-financing, existing programmes were transferred into new support schemes. The funds to support agri-environmental programmes in Germany that were co-financed by the EU rose till the end of the 1990s by about 60% as compared to the situation before the introduction of Regulation (EEC) 2078/92.

The implementing regulation, Regulation (EEC) 746/96, stipulated that the “incentive component” of agri-environmental payments beyond compensation is not to exceed the amount of 20% of income foregone and additional costs for compliance. Furthermore, systematic control of compliance with the standards, monitoring and evaluation of the programmes by the member states as well as an obligation to report to the European Commission was provided for. These standards, that were more precise as compared to Article 19 of the “efficiency-regulation”, aimed at a better quality when designing and implementing the programmes. But at the same time, only little guidance was given regarding the individual contents of the programmes. This was a decisive factor contributing to a great variety of measures.

In Germany, the national government was involved in financing selected measures through the GAK. With the financial support of the EU and of the federal government, the *Länder* were left with a share of only 20% in the old, and 10% the new (eastern) *Länder*. This support is especially important for grassland extensification and organic farming. Support measures for nature conservation and maintenance of landscape is explicitly excluded by the framework of the GAK and falls completely in the competence of the *Länder* (Schlagheck, 2001). Only about 10% of the entire costs according to Regulation (EEC) 2078/92 result from measures that are co-financed by the national government, as just the *Länder* with high agri-environmental support carry out their programmes without contribution of the GAK in order to gain more flexibility. This includes Baden-Württemberg, Bavaria, Rhineland-Palatinate and Saxony. Thus, nationwide harmonisation of measures through the GAK remained limited.

3. For details regarding the implementation of Regulation (EEC) 2078/92 in Germany see Niendieker, 1998.

In the course of implementing Regulation (EEC) 2078/92, agri-environmental support in the *Länder* remained at different levels. Support payments, referring to the total area of the *Länder*, varied between under EUR 5 to over EUR 50 per hectare. In 1999, Baden-Württemberg, Bavaria and Saxony alone spent more than 70% of the entire expenditures in Germany according to Regulation (EEC) 2078/92 (Lotz, 2001). The amount of the premium and the requirements for comparable measures differed substantially between the *Länder*. Besides natural and structural differences, these variations result from different procedures for calculating the premium and varying political priorities (Plankl, 1998).

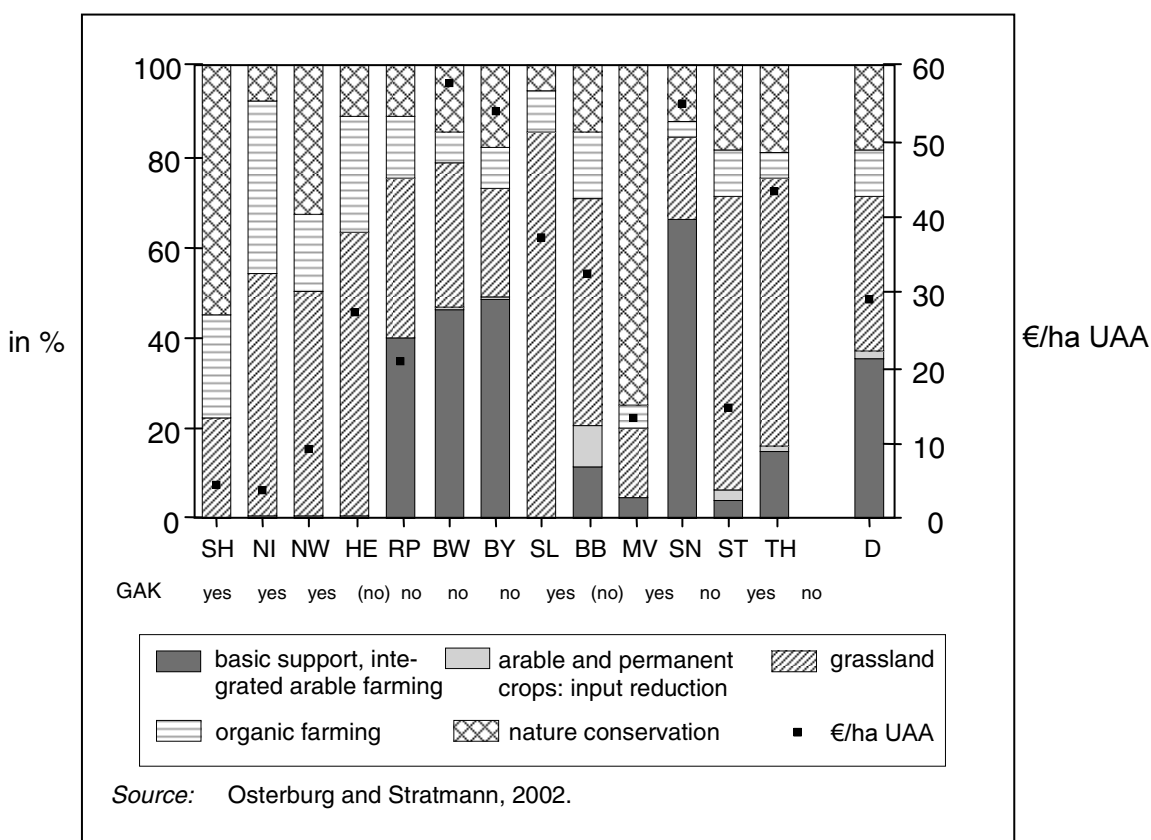
Obviously, the favourable EU co-funding for agri-environmental schemes as well as the fact that administrative cost have to be borne at member state level had impacts on regional agri-environmental policy decisions. In the *Länder* not involved with the GAK, programmes were expanded to cover measures with less demanding requirements. These are, for example, basic support in Bavaria and Saxony, integrated methods (green manuring) in Rhineland-Palatinate and conservation tillage in Baden-Württemberg. Extensification of grassland with abiotic objectives became very important both inside and outside GAK-support. This measure dominates the programmes of Hesse, Brandenburg, Saxony-Anhalt, Thuringia and Saarland. In the north-west of Germany and in Saxony-Anhalt and Mecklenburg, stronger budgetary restrictions have led to less available funds for agri-environmental support (Mehl and Plankl, 1995).

In general, specific nature conservation measures accounted on average for about 20% of agri-environmental support, and organic agriculture was promoted with 10% of the agri-environmental budget in 1998 (Figure 1). Measures with differentiated payments, *e.g.* those dependent on soil quality, made up less than 2% of the entire agri-environmental support in Germany. When excluding measures for nature conservation, the proportion of horizontal agri-environmental measures with a uniform, regional hectare payment (flat-rate payments) can be estimated to be about 80% of total agri-environmental support.

Within the *Länder*, it could be statistically proven that the support for horizontal measures with flat-rate payments was concentrated in less favoured regions and in areas with lower livestock density (Osterburg, *et al.*, 1997). Compared to favoured locations, more farms in these less favoured regions participate in agri-environmental programmes as their compliance costs with the requirements of the programme are lower and thus flat-rate payments calculated for average farm conditions constitute a higher incentive. Furthermore, farm accounting data shows that participation is concentrated on farms that already have more extensive production conditions. An exception is the agri-environmental measures for soil conserving practices and the cultivation of cover crops, which are easier to implement in more intensive farms. These measures reach high rates of acceptance even on better soils in Baden-Württemberg and Saxony (Osterburg, 2001).

From an administration point of view, measures differentiated between target areas and measures for nature conservation within small target areas show structural disadvantages. Regional differentiation and more specific requirements increase the efforts for administration and control. The average size of contract area and the amount of support paid per contract is especially low for specific nature conservation measures. In comparison, measures tied to the whole or part of the farm, such as those for integrated production, the extensification of grassland or organic agriculture, cover larger areas per contract. Measures at the plot level take up an average position. In 1998, the area under nature conservation measures represented about 10% to the total area supported in Germany, absorbed about 20% of total support, but 34% of contracts, due to the smaller areas per contract (Table 2). These structural disadvantages result in relatively high administration cost and might limit further expansion of those nature conservation measures.

**Figure 1. Agri-environmental support according to Regulation (EEC) No. 2078/92, 1998
EUR per hectare and distribution of funds with regard to groups of measures**



**Table 2. Support according to Regulation (EEC) No. 2078/92, 1998
(area per contract, average payments and share of specific nature conservation measures)**

	Germany	North	Middle	South	East	Germany	North	Middle	South	East
	Area supported per contract in hectare					Average payments in € per hectare				
Basic support	45	.	.	38	312	28	.	.	26	37
Arable land (whole farm)	46	14	14	.	57	126	104	148	.	126
Arable land (single plots)	9	.	.	6	119	71	.	.	82	43
grassland (whole farm)	37	24	43	27	46	112	133	135	63	119
grassland (single plots)	9	.	.	9	33	92	.	.	90	135
Conversion arable to grassland	12	6	7	.	17	335	396	307	.	326
Integrated arable farming	103	.	54	.	528	148	.	167	.	132
Organic farming	32	27	43	21	131	164	146	168	177	153
Nature conservation measures	3	8	3	2	19	206	137	240	242	173
Share of nature conservation measures in % of total support										
area	9	23	7	7	11					
budget	19	27	11	21	21					
number of contracts	34	51	50	33	37					

North: Schleswig-Holstein, Lower Saxony, Northrhine-Westfalia; Middle: Hesse, Rhineland-Palatinate, Saarland
South: Baden-Württemberg, Bavaria; East: New (eastern) Laender

Source: Own analysis based on support statistics of the Laender for the year 1998, OSTERBURG and STRATMANN (2002).

Agri-environmental measures as a part of Rural Development Programmes according to Regulation (EC) 1257/1999

Within the reform of EU agricultural policy in 1999, the Agenda 2000, the continuation and strengthening of agri-environmental measures has been a centrepiece of support for rural areas. In addition, EU requirements for programming, implementation and evaluation of these measures were defined more precisely. The support of all rural development measures laid out in Regulation (EC) 1257/99 is to be planned, implemented and evaluated within one programme, creating chances for a stronger integration of agri-environmental programmes with other support measures. Environmental objectives of agri-environmental measures are described more precisely in Article 22 of Regulation (EC) 1257/99 than in the former regulation, whereas aims referring to income and markets are not mentioned any more. Financial contribution by the EU for agri-environmental measures as well as the demands concerning the incentive component of the premium remained unchanged.

Based on the experiences made with the former programmes, the *Länder* have further developed their agri-environmental measures, but there are only few fundamentally new approaches. Conservation tillage, which so far has been promoted in Baden-Württemberg, Bavaria, Brandenburg and Saxony, are now eligible as well in Rhineland-Palatinate and within target areas of North Rhine-Westphalia. In Bavaria and Baden-Württemberg, “environmental farm management” has been included as a new measure, which requires, among other standards, to undertake analysis of soil and manure, and to keep records in connection with the use of fertilisers and pesticides.

Furthermore, the national government has revised the GAK measures to include a 10-year set-aside and field strips (Lotz, 2001), which shows a less strict separation from nature conservation measures compared to the 1990s. After all, in Baden-Württemberg a result-oriented approach for promotion of species-rich grassland was introduced. In this measure, farmers have to record the occurrence of botanical key species on their land. The existence of a minimum number of species is rewarded with an additional premium, improving both farmers awareness and targeting of support. However, payment calculation for this measure is difficult as no clear technical measure is prescribed.

An analysis of the *Länder* rural development plans prepared for the EAGGF Guarantee section, as well as the operational programmes for the EAGGF Guidance section for all other measures in the new *Länder*, shows that in Germany an increase in the total resources of up to EUR 720 million per annum up till 2006 has been planned for agri-environmental measures, including EU co-financing (Osterburg and Bassow, 2002). This corresponds to an increase of about 40% compared to the situation at the end of the 1990s. However, differences in agri-environmental measures and support budgets in the German *Länder* will remain.

According to the “horizontal regulation” Regulation (EC) 1259/1999, member states can optionally reduce direct payments of the EU market and price policy and use this money for accompanying measures, notably agri-environmental measures. The national “modulation” at a rate of 2% in Germany from 2003 onwards will be used for agri-environmental measures, so the national contribution may rise by further EUR 80 million (BMVEL, 2002). Modulation money was spent for the first time in 2004. The favourable national co-funding of 80% instead of 60% offered in the GAK (Lammen-Ewers and Jäger, 2002) has motivated most *Länder* to use national co-funding and implement new “modulation measures” nationally defined in the framework of the GAK. These measures comprise crop rotation measures, green cover crops, conservation tillage, emission-reduced spreading of liquid manure and field strips. Thus, modulation money will be mainly used for simple, standardised measures which are comparatively easy to administrate. Furthermore, the chosen

measures guarantee a quick allocation of funds, as most farms are eligible and could easily implement these measures.

After the 2003 Luxembourg decisions on a new EU agricultural reform, national modulation will be ceased by 2005 and replaced by EU obligatory modulation pursuant to Regulation (EC) 1782/2003, with a rate of initially 3% reduction of direct payments, increasing to 5% from 2007 onwards. As the use of these modulation funds will be opened for more than only accompanying measures, impacts on further expansion of agri-environmental measures are still unclear. More decisive for the future of agri-environmental measures will be budget restrictions resulting from the total amount and allocation of EU funds within the enlarged EU25.

Conclusions for evaluation

For rural development programmes pursuant to Regulation (EC) 1257/1999, the EU Commission has provided a standardised evaluation framework (EU COM, 2000) for the mid-term evaluation (2000-2003) and an *ex post* evaluation (2000-2006) to be carried out. Chapter-specific common evaluation questions for agri-environmental measures comprise predominately analysis of support statistics and the quantification of selected net effects (water pollution through nitrates, and biodiversity protection). Chapter-independent cross-cutting questions focus on structural and socio-economic overall-impacts, such as market and income effects.

Agri-environmental programmes have a long history in Germany. Therefore, long-term impact analysis is needed to complement short-term evaluations of only one support period. However, the diversity of measures makes it difficult to assess impacts at the level of single measures, and when comparing data the different *Länder* policies have to be taken into account. Standardised, “horizontal” measures with flat rate payments per hectare, calculated for average farming conditions are dominating the programmes of most *Länder*, and in addition to active steps towards extensification, also the maintenance of desired land management practices is supported. A crucial question for evaluation is therefore how to analyse possible dead-weight effects of agri-environmental support, *i.e.* whether farmers would have managed their land more extensively even without support, and whether the payments lead to sizeable income effects instead of mainly compensating for economic losses due to scheme participation.

Evaluation of long-term effects of agri-environmental measures

Theoretical considerations on design, implementation, acceptance and impacts of agri-environmental schemes

The broad framework for the design of agri-environmental programmes according to Regulation (EEC) 2078/92 during the period from 1993 until 1999 offered opportunities for new regional policies. Due to the high flexibility for programme design, measures could be adapted to local socio-economic and environmental conditions. Further, agri-environmental payments could also be used for farm income support or structural policies. The non-environmental objectives of Regulation (EEC) 2078/92 – contribution to appropriate farm incomes and accompanying the changes of the market organisation – gave justification for programmes aiming not exclusively at environmental problems. The favourable co-financing of the programmes has been an additional incentive for the *Länder* to provide considerable budgets for income-generating programmes. In contrast, the objectives of agri-environmental measures stated in Regulation (EC) 1257/1999 are focused exclusively on landscape and environment. Nevertheless, the new schemes did not change substantially compared to the previous programme period.

The acceptance of voluntary agri-environmental measures by farmers depends on their environmental attitude, availability of information and technical assistance, as well as on the behaviour of their neighbours. Other factors are programme requirements, hectare payments and the level of expected income effects due to programme participation (Schulze Pals, 1994; Lettmann, 1995). Income effects are determined by the restrictions of the specific agri-environmental measure, natural and climatic conditions, production intensity and yields in the initial situation as well as the specific socio-economic conditions of eligible farms.

Because participation is voluntary, it can be assumed that the cost expected by farmers due to programme attendance is at least covered by the payments. Uniform payments per hectare for voluntary standard measures, calculated for average farm conditions, result in a concentration of participation in less intensive farms. Those farms face comparatively lower costs of adaptation and thus might realise certain income effects from agri-environmental payments (Osterburg, *et al.*, 1997; Osterburg and Stratmann, 2002). Measures with strong restrictions and hence high impacts on the farm income are likely to be less accepted by farmers. Because of the risk involved in the compliance with severe restrictions like total renouncement of agro-chemicals, even high payments may not compensate for possible income losses expected by many farmers.

For an evaluation of the impacts of agri-environmental measures, three effects have to be analysed:

- the improvement of environmental conditions (improvement effect);
- the maintenance of environmentally friendly land-use systems which otherwise would have been abandoned or converted into more intensive systems (conservation effect);
- other intended and not intended effects (side effects).

For many measures with less severe restrictions, it can be supposed that a certain proportion of participants do not have to change their farm management at all because they already comply with the programme requirements. In these farms, effects of agri-environmental programmes are limited to the maintenance of environmentally friendly land use systems (Latacz-Lohmann, 1998), and even this maintenance could have happened without support. In order to identify such dead-weight effects and to provide evidence on effects connected to agri-environmental support, a reference system without agri-environmental support has to be defined, *e.g.* an empirically observable group of “comparable” farms without agri-environmental support. A simple comparison of participants and non-participants at one point in time is not suitable for such an analysis, because of the self-selection of participants, *e.g.* the bias towards more extensive regions and farms makes it difficult to select appropriate reference farms not participating in agri-environmental schemes. In such comparisons it remains unclear whether differences between participants and non-participants can be attributed either to self-selection effects, or to developments induced by participation.

Methods and data base

For the following analysis, accounting data of farms participating in agri-environmental schemes are analysed and compared with farms without such payments. The accounting data stem from a private accounting enterprise, providing accounts of a large number of farms over many years. In comparison, in the national Farm Accounting Data Network (FADN) only a low number of identical farms can be analysed over a longer period of time. About 18 600 farm accounts over 13 years (1989-2002) are used to select farms participating in agri-environmental schemes, to find comparable farms

not participating in such schemes and later to analyse their respective development.⁴ The same analysis has been carried out for the period 1989-99 (Osterburg, 2001).

Average payments per hectare for agri-environmental schemes in the two year periods 2000/01-01/02 and 1997/98-98/99 were used to classify the farms. These payments comprise all premium or compensations paid for agri-environmental objectives, e.g. measures according to Regulation (EEC) 2078/92 as well as payments for obligatory measures in watersheds or nature reserves. Payments could not be further disaggregated into single measures, with the exception of organic farming. For the two-year base period, 1989/90-90/91, no data on agri-environmental payments is available but it is assumed that payments played only a minor role in the beginning of the 1990s.

For a sub-sample of farms, accounting data about purchased mineral nitrogen fertiliser in the two years 1999/00-00/01 were analysed. Based on information about land use, yields and livestock, a simple nitrogen balance including mineral fertiliser, livestock manure and total uptake of harvested plants (not including leguminous N-fixation and atmospheric N-deposition) has been calculated.

The data allow for a “with/without – before/after” comparison, comparing farms receiving agri-environmental payments with farms without such payments, but similar to participating farms in the base situation. In this way, an empirical reference group is provided. For each farm in the sample with high agri-environmental payments (“participants”) in 2000/01-01/02 and 1997/98-98/99 respectively, five similar farms receiving no or few environmental payments (“non-participants”) were selected by means of cluster analysis. Criteria for similarity include 15 indicators for soil quality, farm structure, income and land use intensity in the base situation 1989/90-90/91 before the advent of agri-environmental measures. For the scale-independent aggregation of selection variables, a z-transformation is carried out. This method has been first described by Schulze-Pals (1994) who analysed farms recently converted to organic farming and used this cluster method for the selection of comparable conventional farms.

The following formula has been used for the cluster analysis:

$$d_{pi} = \sqrt{((z_{p1} - z_{i1})^2 + (z_{p2} - z_{i2})^2 + \dots + (z_{pm} - z_{im})^2)}$$

with $z_{im} = (y_{im} - \bar{y}_m) / s_m$ (Z-transformation)

d_{pi} = Euclidean distance between farm p with high agri-environmental payments per hectare and farm i in the sample of farms with no/low agri-environmental payments per hectare

y_{im} = Variable y_m of farm i

\bar{y}_m = Arithmetic average of variable y_m in the sample of farms

s_{im} = Standard deviation of variable y_m in the sample of farms

z_{pm} = Z-transformed variable z_m of farm p with high agri-environmental payments per hectare

z_{im} = Z-transformed variable z_m of farm i in the sample of farms with no/low agri-environmental payments per hectare

4. Results presented here include the German *Länder* of Lower Saxony, Northrhine-Westfalia, Rhineland-Palatinate, Baden-Württemberg and Bavaria, and only dairy and cattle farms.

For the cluster analysis, the following variables were used:

- region (German land)
- farm type (dairy and cattle, arable, etc.)
- soil quality index
- utilised agricultural area (UAA) per farm in hectares
- hired land in hectares and payments for hired land per farm
- farm income (representing the remuneration for all land, capital and labour)
- farm profit (family farm income, representing the remuneration for the family-owned land, capital and labour)
- cereal yield per hectare
- grassland in hectares per farm
- livestock units per farm
- dairy cows per farm and milk production per farm
- expenses for fertiliser, for pesticides and for feed concentrates.

For each farm with a high level of cumulative agri-environmental payments of EUR 100 or more per hectare, five farms with the lowest Euclidean distance out of the sample of farms with no/low agri-environmental payments per hectare were selected as the most similar farms. However, in Baden-Württemberg (BW) and Bavaria (BY), almost no farms without agri-environmental payments can be found, and due to accumulation of different measures payments, the average per-hectare payment was EUR 200 and more. Therefore, the sample of comparable farms in these two *Länder* comprises farms with relatively lower payments per hectare of around EUR 75 per hectare in BW and EUR 38 per hectare in BY. The difference in support between the two farm groups comprises at least EUR 100 per hectare, so that the comparison presented here shows the overall effect of around EUR 100 of agri-environmental payments per hectare for organic farming or for other agri-environmental measures.

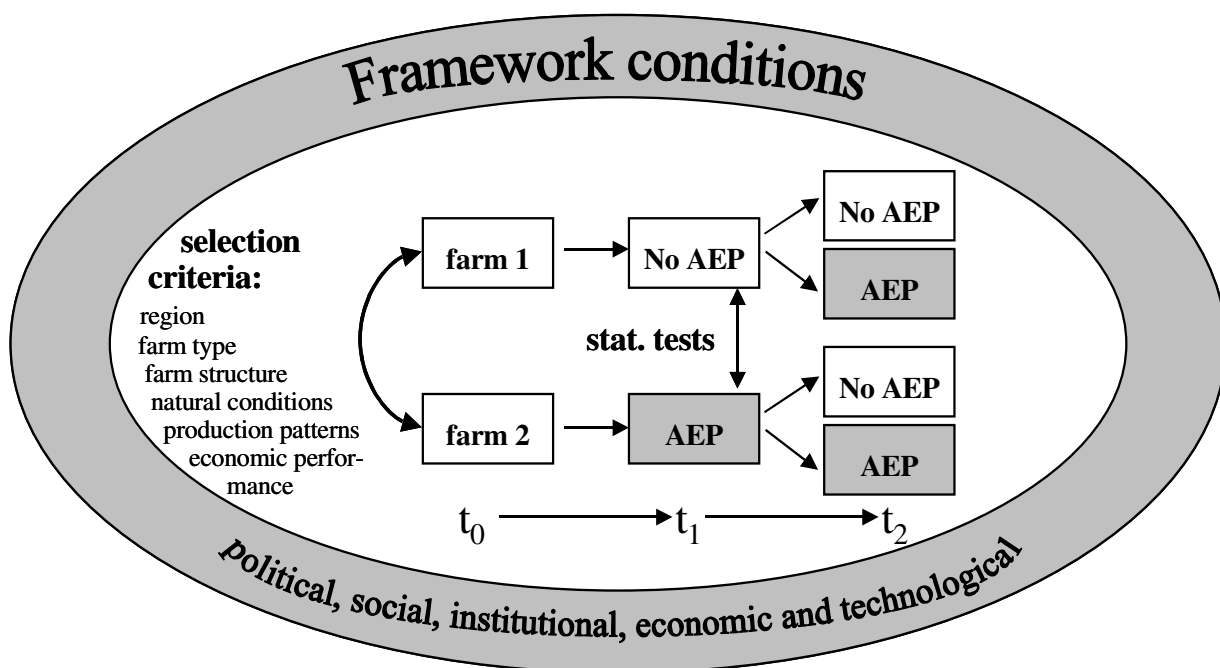
After establishing the sample of comparable farms with no/low agri-environmental payments, the criteria for the selection of comparable farms are used as indicators for the impact assessment, analysing changes of structure, income and land use intensity between 1989/90-90/91 and 2000/01-01/02 (or 1997/98-98/99 respectively). Differences between farm samples in the base situation and with respect to changes between the periods were statistically tested with non-parametric statistical tests according to WILCOXON.

Figure 2 illustrates the “with/without – before/after” comparison. It is assumed that framework conditions are similar within the different *Länder* so that sub-samples for each of these regions have been established. For the base situation t_0 , before the broader introduction of agri-environmental payments, similar farms are selected according to selection criteria providing that important natural, structural, management and economic characteristics are covered. For farm 1, later participating in

agri-environmental programmes (AEP), a similar farm 2 is selected which is not participating in such schemes. Statistical tests are conducted in order to compare the development of the two farm samples in time t_1 .

With the new support period t_2 , the analysis gets more complicated, as both farm 1 and 2 can decide on participation, so that the samples split up into 4 new groups. Thus, at a later time farm comparisons become more difficult as the history of programme participation turns out to be a new explaining variable for farm performance. This splitting up of farm samples can result in statistical problems because it becomes more complicated to properly analyse time series and to provide statistically significant evidence with shrinking sample sizes. For the analysis conducted and the results presented in the following, no further differentiation of farms in t_2 has been realised, although farms might have ceased, changed or started their participation in agri-environmental schemes in the new support period after the year 2000. It has to be considered that in 2000/01 many farms started a new support period, possibly with different measures and payments per hectare. As the date of receipt of agri-environmental support changed for some programmes, support per farm might have virtually declined between 1997/98-98/99 and 2000/01-01/02. This can explain differences between farm samples in both periods.

Figure 2. “With – without / before – after” comparisons based on similar farms



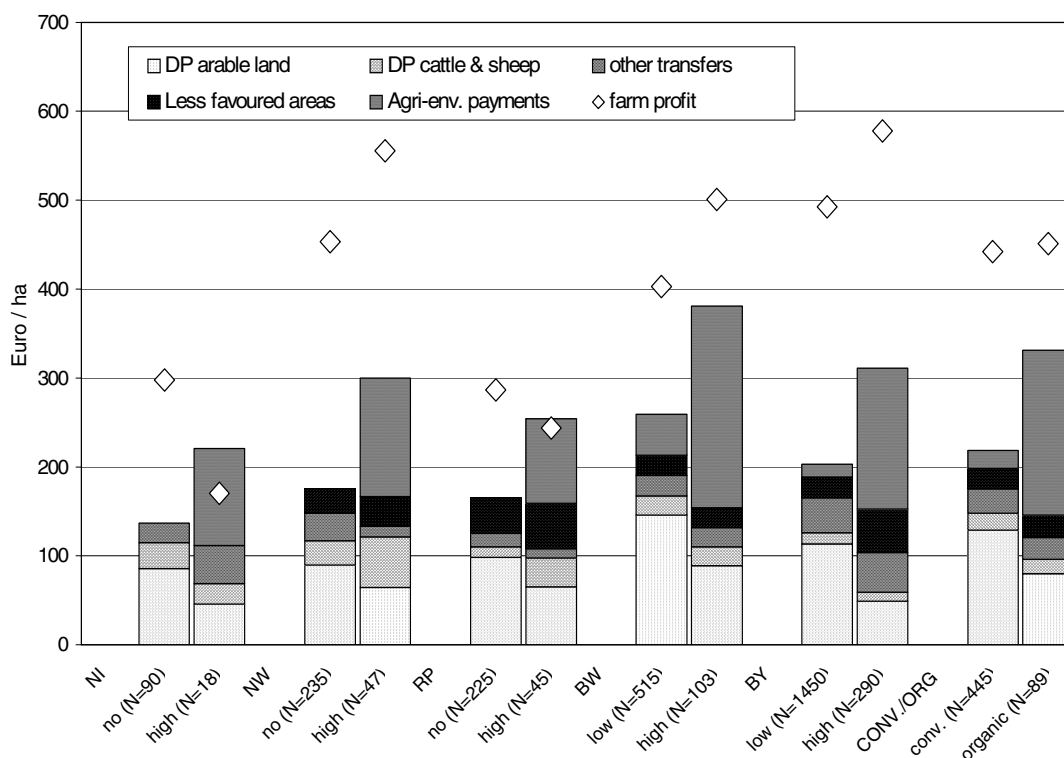
Source: adapted from Offermann and Nieberg (2001).

Results

The analysed 592 dairy and cattle farms participating in agri-environmental schemes in 2000/01-01/02 (854 farms in 1997/98-98/99) generally show a lower production intensity in the base situation (1989/90-90/91) compared to non-participants. In many cases, differences are already statistically significant in the base period, although a cluster analysis for the selection of similar farms has been used. Figure 3 shows similarities of support payments between the farm groups in 2000/01-2001/02.

Participants in agri-environmental schemes tend to receive less direct payments (DP) per hectare for arable crops. However, the most striking difference regarding public transfer payments results from different agri-environmental payments. Thus, differences in farm development might be contributed to these payments.

Figure 3. Transfer payments to farms with and without (or low) agri-environmental payments in 2000/1-01/02¹



Note:

1. See Table 1 for Länder acronyms; N: number of farms.

Source: Own calculations based on accounts of identical farms (LandData).

The following differences between the two farm groups (participants and non-participants) have been tested with regard to selected indicators.

1. No statistical significant difference between farm groups in the base situation, but in the year 2000/01-01/02 (or 1997/98-98/99, respectively). This more obvious difference can be either a maintenance effect (participants show a steady state while non-participants increase intensity) or an improvement effect (participants reduce intensity while non-participants show a steady state).
2. Statistical difference between farm groups in the base situation, but also significant differences in the change between 1989/90-90/91 and 2000/01-01/02 (or 1997/98-98/99, respectively) in percent of the base situation or in terms of absolute changes.

Table 3. “With/without – before/after” comparison: changes in comparable dairy and cattle farms with and without (or low) agri-environmental payments between 1989/90-90/91 and 2000/01-01/02 (and 1997/98-98/99, respectively)

		NI		NW		RP		BW		BY		conv./organic ¹⁾		
		low	high	low	high	low	high	low	high	low	high	conv.	org.	
Agri-environmental payments	Euro/ha	0	127	0	136	0	109	41	220	20	159	18	196	
Number of farms	n	320	64	175	35	355	71	775	155	2450	490	195	39	
Changes in % of 1989/90-1990/91): sample in 1997/98-1998/99¹⁾														
grassland	ha	%	5	27	5	20	30	61	29	29	7	16	-2	46
milk production per farm	to	%	25	22	26	21	45	28	35	24	28	23	22	4
milk production per ha forage area	to/ha	%	5	-9	5	-8	7	-17	6	-3	16	3	15	-24
farm income (factor remuneration)	Euro	%	2	19	14	35	12	32	6	21	6	24	-7	19
farm profit (farm factor remuneration)	Euro	%	-18	-6	-2	25	-2	23	-14	3	-6	16	-21	-4
difference of farm profit in % of AEP		%		18		94		81		53		82		42
Changes in % of 1989/90-1990/91): sample in 2000/01-2001/02¹⁾														
Utilised agricultural area (UAA)	ha	%	21	36	21	24	39	42	43	40	23	21	32	37
rented land	ha	%	34	57	8	15	43	54	70	67	70	43	70	83
area of extensive arable crops ²⁾	ha	%	-9	95	-18	7	-10	-31	-16	-5	-12	8	-12	38
fertiliser purchase per ha UAA	Euro/ha	%	-43	-72	-52	-80	-56	-72	-49	-52	-45	-61	-38	-78
pesticide purchase per ha arable land	Euro/ha	%	-32	-46	-16	-30	-34	-40	-18	-30	-11	-23	-25	-99
grassland	ha	%	10	35	20	31	35	69	36	36	8	23	20	34
forage maize	ha	%	64	-1	32	-14	76	-54	28	9	24	-1	25	-24
cattle&sheep-LU per ha forage area ³⁾	LU/ha	%	-3	-37	2	-23	-8	-27	-13	-16	2	-11	-1	-17
milk production per farm	to	%	46	-22	57	-5	62	8	41	33	40	34	46	22
milk production per ha forage area	to/ha	%	11	-55	26	-28	10	-32	6	-3	22	5	20	-10
cereal yield per ha	to/ha	%	32	16	44	34	11	9	16	5	25	11	19	-19
milk production per cow	to/cow	%	17	-9	21	4	14	19	22	21	24	20	21	12
agric. revenues (products and premia)	Euro/ha	%	-22	-57	-21	-48	-30	-48	-31	-30	-19	-28	-24	-33
farm income (factor remuneration) ⁴⁾	Euro	%	-5	-35	-10	-25	-5	-20	-12	9	-20	-8	-18	1
farm profit (farm factor remuneration) ⁴⁾	Euro	%	-27	-46	-22	12	-24	-22	-24	3	-28	-13	-26	-13
difference of farm profit in % of AEP		%		-52		119		0		69		57		32

2-years-average; **bold** numbers indicate significant changes at the 0.05 level: no significant difference in the base situation between farm groups with no/low and high agri-environmental payments per hectare, but significant differences between both groups with respect to changes, bold italic: Significant difference in change, but also in the base situation.

1) Comparison conventional and organic farming: farms of different Laender. 2) extensive: field grass, clover, rye, summer barley, oats. 3) LU = livestock unit.

4) Farm income: remuneration of all factors of the farm (capital, labour, soil); farm profit: farm income minus remuneration of factors not owned by the farm enterprise.

Source: Own calculations based on accounts of identical farms (LandData).

As a result of these test, the following observations have been made for farm changes between 1989-91 and 1997-99 (Table 3).

- Participants increased farm size and especially their grassland area more than non-participants, mainly through land rental, while the importance of forage maize decreased.
- Milk production per hectare of main forage area decreased on participating farms, while it increased in non-participating farms. Milk production per farm increased for both groups through acquisition of quota, although at a slightly lower rate for participating farms. However, in the sample of extensive farms for 2000/01-01/02, milk production increased

less or even declined compared to non-participants in Lower Saxony (NI), Northrhine-Westfalia (NW) and Rhineland-Palatinate (RP).

- Milk production per cow increased less on participating farms, although no statistically significant difference could be detected.
- Expenditure on mineral fertiliser and pesticides decreased for both groups, but especially fertiliser expenditure on participating farms.
- Cereal yields of participants increased less than those of non-participants.
- Organic farms show more pronounced extensification effects compared to selected conventional farms, *e.g.* a high reduction of expenditure on fertilisers and pesticides, as well as decreasing cereal yields and milk production per cow.
- The development of farm income (representing the remuneration for all land, capital and labour) was significantly more positive in participating farms compared to non-participants. This applies in most cases also to the farm profit. However, in 2000/01-01/02, participating farms in several *Länder* (NI, NW, and RP) showed significantly more negative farm income developments. An explanation is the BSE (bovine spongiform encephalopathy) crisis, which led to lower beef and higher milk prices, and might have affected participants, specialised in beef production, more than non-participants, specialised in milk production. In contrast, participating farms in Baden-Württemberg and Bavaria, and for organic farms, showed a significantly more positive income effect (or less negative) in 2000/01-01/02. These farms have increased milk production per farm so that the affects of the BSE crisis was different from farms specialised in extensive beef production.
- Differences in the development of farm capital and labour, as well as expenses for land rent were not statistically significant between farm groups. Nevertheless, different factor use (capital, labour and land) might have had an impact on farm income and farm profit.

The results show that a clear improvement, or at least maintenance effects, was realised in terms of land use intensity on farms participating in agri-environmental schemes in many cases. In addition – at least before the BSE crisis – a significant positive income effect could also be demonstrated as well as a larger farm expansion, mainly on grassland.

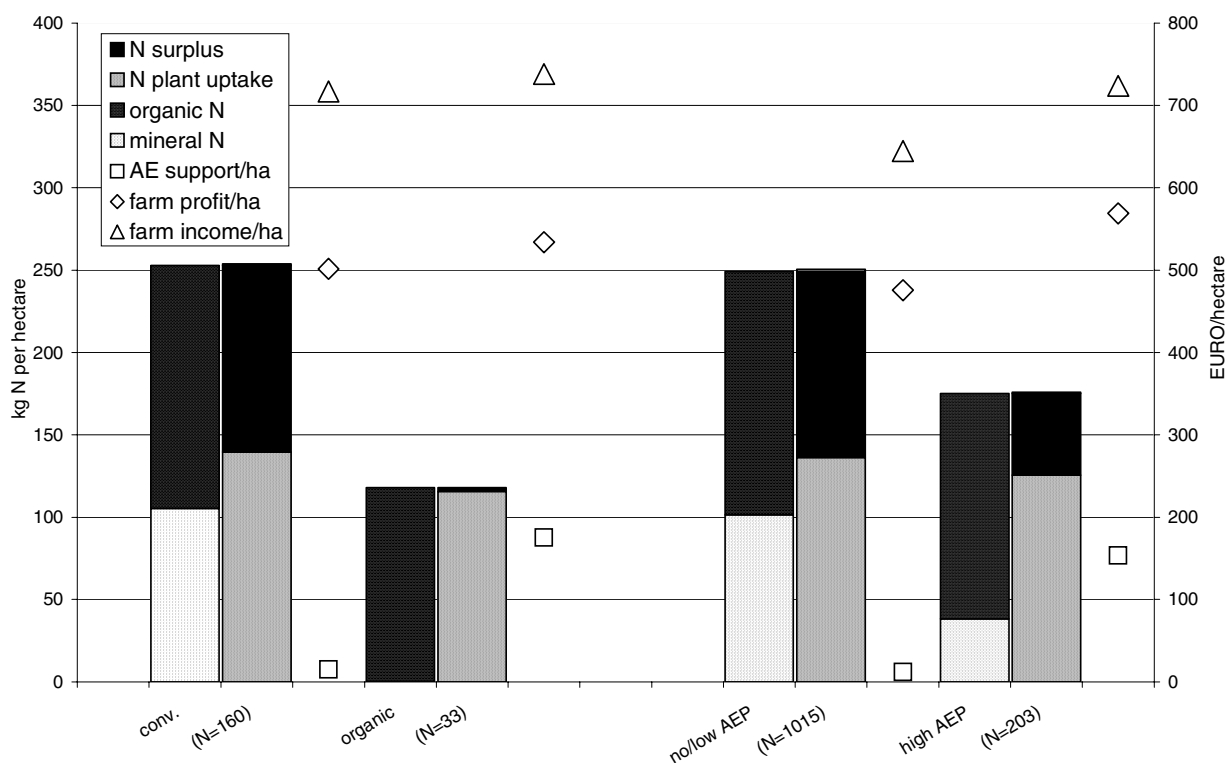
The positive income effect can be explained partially as a result of the flat rate payments, not adapted to the specific farm situation, and thus leading to over-compensation for scheme restrictions in more extensive farms. Evidently, a sizeable incentive is needed before farmers decide to participate in agri-environmental schemes. Because these figures are based on ex post data, it has to be considered that even the farmer is not able to exactly quantify the income impact before entering the scheme, so that ex post income effects can be regarded in part as a necessary incentive covering the ex ante risks of entering a scheme. Changes in labour input and farm assets, *e.g.* nutrient stocks in the soil, could not be taken into account, so a complete picture is not given (Osterburg and Stratmann, 2002). In some *Länder*, participating farms have specialised in extensive beef production (*e.g.* suckler cows). After the BSE crisis, these farms suffered more from price shocks compared to farms more specialised in milk production.

Another hypothesis to explain different income effects is that there is a bias between participants and non-participants with regard to management skills. As farm income developed significantly better in farms participating in agri-environmental schemes until 1997/98-98/99, it can be assumed that this

is due to the fact that better managers are also more likely to participate in the schemes. Participation therefore might be correlated with good management skills as the real explaining variable. However, it has to be considered that farm structure and economic performance in the base situation have been similar in the two groups of farms, so that the assumption of similar management skills holds at least for the base situation.

The results of a simplified nitrogen balance for a sub-sample of farms similar in 1989/90-90/91 are presented in Figure 4. Differences in mineral fertiliser input per hectare in 1999/00-00/01 are especially decisive for the resulting N-surplus. On dairy and cattle farms supported with high agri-environmental payments per hectare, the reduction in mineral fertiliser application leads to comparatively low loads of nitrogen surplus between 0 and 50 kg N/ha, while the surplus in reference farms exceeds 110 kg N/ha. As fertiliser application is even more restricted on organic farming, the results of agri-environmental support for organic farming are much more visible compared to other agri-environmental measures. Even when accounting for symbiotic nitrogen fixation, which might vary between 10 and 60 kgN/ha (Scheringer, 2002; Anger, *et al.*, 1997; Anger, 1997), participants in agri-environmental schemes show lower nitrogen surplus per hectare as well as per livestock unit or per metric tonne milk produced.

Figure 4. Nitrogen balances in dairy and cattle farms with and without (or low) agri-environmental payments in 1999/00-00/01¹



Note:

1. Without biological N-fixation; conv.: conventional farms with low agri-environmental payments (AEP) similar to actually organic farms in 1989/90-90/91; N: number of farms.

Source: Own calculations based on accounts of farms (LandData) from Lower Saxony (NI), Northrhine-Westfalia (NW) and Bavaria (BY).

Conclusions

The results show that farms participating in agri-environmental schemes have reduced their land use intensity and production per hectare, compared to non-participants, starting from a relatively low intensity level. Organic farms show a notably higher rate of extensification compared to farms participating in other schemes.

In addition, significant differences in farm income development and higher expansion of participants on the land market could be verified, showing considerable positive income effects connected with participation in agri-environmental schemes. Although income effects are observed, there is no clear “windfall profit” situation, because participants significantly improve their environmental performance compared to the group of non-participating reference farms. Obviously, considerable incentives are needed for voluntary agri-environmental payments in order to induce changes of farm management and to cover risks perceived by farmer in the *ex ante* situation. The picture of significant positive income effects became blurred after the BSE crisis, which has affected extensive beef production and thus especially farms participating in agri-environmental schemes. A result of the comparison between the periods 1997/98-98/99 and 2000/01-01/02 is that the assessed impacts on farm income are quite volatile. It is therefore recommendable to repeat such analyses over time considering changing framework conditions.

The analysis presented in this paper shows that the use of farm accounts can provide valuable insights into long-term developments of farms. The selection of non-participating farms which were similar to participants in agri-environmental schemes in the base situation provides an empirical, largely un-biased reference group. However, in regions with high agri-environmental support, it is difficult to select non-participating farm groups, as almost all farms receive such payments.

An advantage of the data base is that farm accounts are relatively objective data compared to questionnaires which might suffer from strategic answers. The availability of accounts of comparable farms over a long time span is a precondition for this empirical, bulk statistical approach. A shortcoming is that the particular agri-environmental measures could not be identified in the accounts because of availability and confidentiality of data. Thus, only the most evident changes correlated with high payments and conversion to organic farming could be statistically analysed.

Only a limited number of indicators for environmentally relevant performance can be deducted from farm accounts, and often these are indirect indicators such as monetary data for chemical inputs. Many impacts of farm management and particular land use patterns, *e.g.* in the area of erosion and biodiversity, are not “visible” in the accounts. Therefore, the presented approach is only one element in a methodology mix to be applied when evaluating agri-environmental schemes. It is planned to include such an analysis in the *ex post* evaluation for several *Länder*. Because even the proof and quantification of scheme effects is so difficult, the analysis of both effectiveness and efficiency of programmes remains a challenge for further research.

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