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Agri-Environmental Programs and the Use of Soil Conservation Measures in Germany

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INTRODUCTION

As a part of the agricultural policy reform of the European Union (EU) in 1992, agri-environmental measures according to the Regulation (EEC) 2078/92 were introduced in order to support environment-friendly farm practice and landscape management. A few years after the introduction, widespread participation in agri-environmental programs in Germany can be observed. In 1997, more than 30% of agricultural land was managed under programs according to Reg. (EEC) 2078/92 (Bundesministerium für Ernährung, Landwirtschaft und Forsten, 1997). Only few EU member states, e.g. Austria, have higher rates of participation. This paper gives a short overview of the intermediate results of a research project on the implementation of the Reg. (EEC) 2078/92 in Germany and the impacts on agricultural production, farm incomes and the environment, with special attention to soil conservation measures. In order to identify impacts of the agri-environmental measures and the pattern of their spatial distribution, data on regional implementation of the schemes as well as farm data are analyzed.

State of the implementation of the Reg. (EEC) 2078/92 in Germany

The implementation of the Reg. (EEC) 2078/92 in Germany is carried out through agri-environmental programs of the *German Federal States*. The European Commission approves these regional programs as a precondition of financial support of the EU. Within a broad framework, the *Federal States* are free to choose their individual program design. There are only few complementary, agri-environmental programs on lower administrative level, mainly in water protection areas and nature reserves, but these programs are not funded by the EU. 50% of the budget for the programs according to Reg. (EEC) 2078/92 (75% in the eastern *Federal States*) is financed by the EU. The National Government co-finances 30% (15% in the eastern *Federal States*) of the budget for certain measures according to national guidelines for extensification (Mehl and Plankl, 1995). The objectives of the Reg. (EEC) 2078/92 are the protection of the environment, e.g. water conservation and the protection of landscape and biodiversity. Additional objectives are the reduction of surplus production in the EU (cereals, beef), and farm income support.

The majority of the programs are offered within an entire *Federal State* (horizontal programs), and thus they are not limited to specific target areas. These programs follow an action-oriented approach and promote environment-friendly farm management techniques. The most important requirements are restrictions on the use of chemical fertilizers and pesticides. For most measures, standard hectare payments are determined within a whole region (in UK: 'flat rate payments'), i.e. the amount of payments per hectare is not further adjusted to the conditions of participating farms. These payments are calculated on basis of average farm conditions within the region and ought to compensate for income losses due to compliance with program restrictions. Participation is voluntary, and contracts are made for individual plots, for whole branches of the farm enterprise (e.g. all permanent grassland) or for the whole farm (e.g. organic farming).

Grassland extensification measures are most important in the German programs and cover about 25% of total permanent grassland. On the other hand, extensification measures on arable land are less accepted by farmers. In some *Federal States,* green manuring and conservation tillage are supported and show relatively high rates of participation. Bavaria and Saxony provide a so called "basic support" for compliance with few management restrictions and therefore low hectare premia. Organic farming has an increasing importance, but by 1997, only 2.5% of total utilized agricultural area (UAA) has been converted to organic farming. The conversion of arable land into extensive grassland, the 20-year set aside for nature conservation and the establishment of landscape elements like hedgerows and field margins play a negligible role in the implementation of the programs. About 9% of the supported area, mostly grassland, can be attributed to specific nature or habitat conservation measures, while expenses for these measures account for about 20% of total budget.

In contrast to the European agri-environmental programs, the Conservation Reserve Program (CRP) in the USA provides hectare payments for only one main measure, which is set aside in environmentally sensitive areas. The allocation of areas follows an auction system, which is combined with a clear indicator system considering soil erosion, water conservation, wildlife and well-being of rural communities. There are no budget constraints but size targets are established (Osborn, 1997). In comparison to the CRP, the agri-environmental programs in Germany show highly diverse measures, which are mostly integrated into the production process. Programs have a broader and often not clearly structured bundle of objectives.

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

The broad framework for the design of agri-environmental programs according to Reg. (EEC) 2078/92 has offered opportunities for new regional policies. This corresponds to the principle of subsidiarity within the EU. Due to the high flexibility for program design, these policies are more differentiated and hence more adapted to local socio-economic and environmental conditions. However, agri-environmental payments might be used also for farm income support or structural policies. The non-environmental objectives of the regulation give justification for programs aiming not exclusively at environmental problems. The favorable co-financing of the programs is an incentive for the *Federal States* to provide higher budgets for this kind of programs. In the new EU agricultural policy reform (Agenda 2000) decided in March 1999, the objectives of the agri-environmental programs are focused exclusively on landscape and environment.

The acceptance of agri-environmental measures by farmers depends on their environmental attitude, availability of information and technical assistance as well as behavior of their neighbors. Other factors are program requirements, hectare payments and the level of expected income effects due to program participation (Schulze Pals, 1994; Lettmann, 1995). Income effects are determined by natural and climatic conditions, production intensity, and yields in the base situation, the specific socio-economic conditions of eligible farms and the restrictions of the specific agri-environmental measure. Because the programs are voluntary, it can be expected that the cost due to program participation is at least covered by the payments. Uniform payments per hectare for voluntary standard measures, calculated on an average basis, will result in a spatial concentration in less favored areas, where program participation leads to comparatively lower costs of adaptation (Osterburg et al., 1997). 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 of severe restrictions like the total renouncement of agro-chemicals, even high payments may not compensate for possible income losses expected by many farmers.

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 because they already comply with the program requirements. In these farms, effects of agri-enviromental programs are limited to the maintenance of environmentally friendly land use systems (Latacz-Lohmann, 1998). For an evaluation of the impacts of agri-environmental measures, three effects have to be analyzed:

- the improvement of environmental conditions (improvement effect)
- the maintenance of environmentally friendly land use systems which otherwise would be abandoned (conservation effect)
- other intended and not intended effects (side effects)

In order to provide evidence of these effects, a reference system without agri-enviromental support has to be defined.

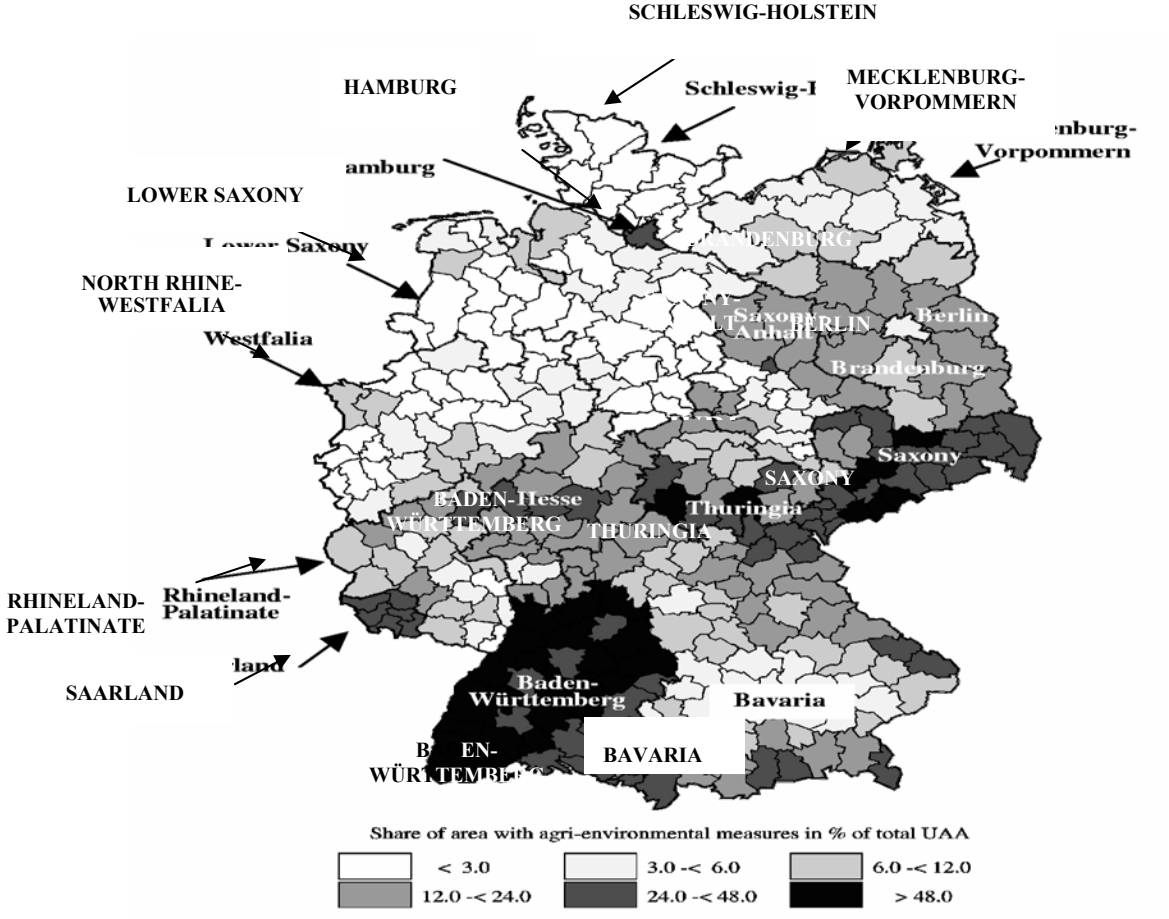
METHODS AND DATA BASE

For 1996, a complete data set on the implementation of measures under Reg (EEC) 2078/92 on county level for all *German Federal States* has been compiled and linked to a data bank on agri-environmental programs of the Federal States (Plankl 1996). This regional data allows for a detailed statistical analysis of typical measures and their spatial distribution.

In accordance with the considerations in chapter 3, regional indicators for the natural conditions (e.g. soil quality) and for the intensity of land use (e.g. average cereal yield or stocking rates) were selected. These regional indicators are significantly correlated, i. e. both soil quality and cereal yields are suitable indicators for regional farm conditions. For the statistical analysis, no information was available about other important factors, which have an influence on participation rates, e.g. budget constraints of the programs, environmental attitude of farmers or technical assistance. Because of incomplete and inter-correlated data, no multiple regression analysis was conducted (Bortz, 1989). The analysis used correlation coefficients according to Spearman, which identify bivariate correlation. In this way it can be tested whether there is correlation between the spatial distribution of participation rates and regional natural and farm characteristics.

In addition, bookkeeping data of farms participating in agri-environmental schemes is analyzed. About 22,000 farm accounts of identical farms over 10 years (1989-1999) are used to compare farms participating in agri-environmental schemes with non-participants and to analyze their respective development. Payments per hectare for agri-environmental schemes are used to classify farm data. These payments comprise all premia or compensations paid for agri-environmental objectives, e.g. measures according to Reg. (EEC) 2078/92 as well as payments for obligatory measures in watersheds or nature reserves. For each farm in the sample with high agri-environmental payments (‘participants’) in 1997-1999, five similar farms receiving no or few environmental payments (‘non-participants’) are selected through a cluster analysis. Similarity criteria include 15 indicators for soil quality, farm structure and land use intensity in the base situation 1989-1991, before the advent of agri-environmental measures. The following 15 variables were used for the selection: Soil quality index; utilized agricultural area (UAA) per farm in hectare; hired land in hectare and payments for hired land per farm; farm income (representing the remuneration for all land, capital and labor); farm profit (family farm income, representing the remuneration for the family-owned land, capital and labor); cereal yield per hectare; grassland in hectare per farm; livestock units per farm; dairy cows per farm and milk production per farm; expenses for fertilizer, for pesticides and for feed concentrates. For the scale-independent aggregation of selection variables, a z-transformation is carried out.

The following formula has been used for the cluster analysis:



Map 1. Share of area with agri-environmental measures according to Regulation (EEC) 2078/92 (without "basic payment for environmentally compatible agriculture" in Bavaria and Saxony) as a percentage of total UAA in Germany in 1996.

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

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; $\bar{y}_{im}$ = 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.

For farms with high agri-environmental payments, the 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 (reference group). A detailed description of this method is given in Schulze-Pals (1994). In Baden-Württemberg and Bavaria few farms without agri-environmental payments can be found. Therefore, the sample of conventional farms comprises farms with low payments per hectare, too. Another problem is that often the same, more extensive farms with no/low payments are selected and appear several times in the sample. Differences between the farm samples in the base situation and with respect to changes between 1998-91 and 1997-99 were statistically tested with a non-parametric statistical test according to Wilcoxon.

RESULTS

A comparison of the *Federal States* programs reveals a high variety of measures as well as clear differences of payments per hectare for similar measures. Inter-regional

Table 1. Correlation between regional rates of participation in agri-environmental schemes and regional farming conditions. Source: Author's calculations with data of the Federal States on the implementation of measures according to Reg. (EEC) 2078/92.

Correlation between	Environmental payments (DM/ha) and regional cereal yield		Grassland extensification (in % of total grassland) and stocking rate of ruminants per ha fodder area		Green mulching and conservation tillage (in % of total arable land) and soil quality index *	
Federal State	rs *	p	rs	p	rs	p
North Rhine-Westph.	**-0.721**	0.000	**-0.448**	0.012	**-**	-
Baden-Württemberg	0.091	0.605	**-0.442**	0.008	**0.520**	0.001
Bavaria	**-0.707**	0.000	**-0.402**	0.001	**-**	-
Saxony	-0.243	0.275	**-0.505**	0.017	**0.466**	0.029

rs: correlation coefficient (SPEARMAN), p: significance level; bold: significant at a level of 0.05; * a high soil quality index indicates good soil quality.

premia differences may lead to distortions of competitive conditions. Furthermore, the design of program requirements differs a lot, e.g. for grassland measures. Some *Federal States* established measures with few restrictions for selected plots. In other *Federal States* a farm is eligible only if the whole grassland area of the farm is signed up; the use of mineral fertilizer is prohibited on this grassland and stocking rates are restricted. The differences between regions possibly arise because some *Federal States* are aiming rather at positive farm income effects by implementing measures with less restrictive requirements than at ecological targets, while other *Federal States* offer only more restrictive measures. Württemberg, Bavaria and Saxony with their well established agri-environmental schemes comprise only a third of the agricultural area in Germany, but account for about two thirds of the total expenses for Reg. (EEC) 2078/92 in Germany. Almost half of these expenses are raised out of their *Federal States* budgets. On the other hand, the north-western *Federal States* face more restrictive budget constraints and do not seem to be willing to incur high expenses. The rate of implementation is comparatively low in these *States*.

The analysis of the regional data shows that regions with high participation in agri-environmental schemes coincide frequently with areas of poor natural conditions, e.g. with poor soils (especially in the north-east) or high altitude (in mountainous regions in the south). This can be explained with the comparatively lower adaptation costs of extensification measures in these regions and the flat rate payments applied. Low participation rates are recorded in regions with good soils and intensive arable farming as well as regions with a high concentration of pig and poultry production. An exception to this observation is green manuring (intermediate or cover crops) and conservation tillage, which are more concentrated in regions with high soil quality (see table 1). This is because these measures can be easily integrated into intensive arable farming systems, and the cost of implementation doesn't vary much between regions with different natural conditions.

The analysis of farm accounts shows similar results. Using a cluster analysis for the selection of similar farms, about 1,150 farms participating in environmental schemes show a lower production intensity in the base situation compared to non-participants. The following observations can be made for farm changes between 1989/91 and 1997/99 (2-year-averages):

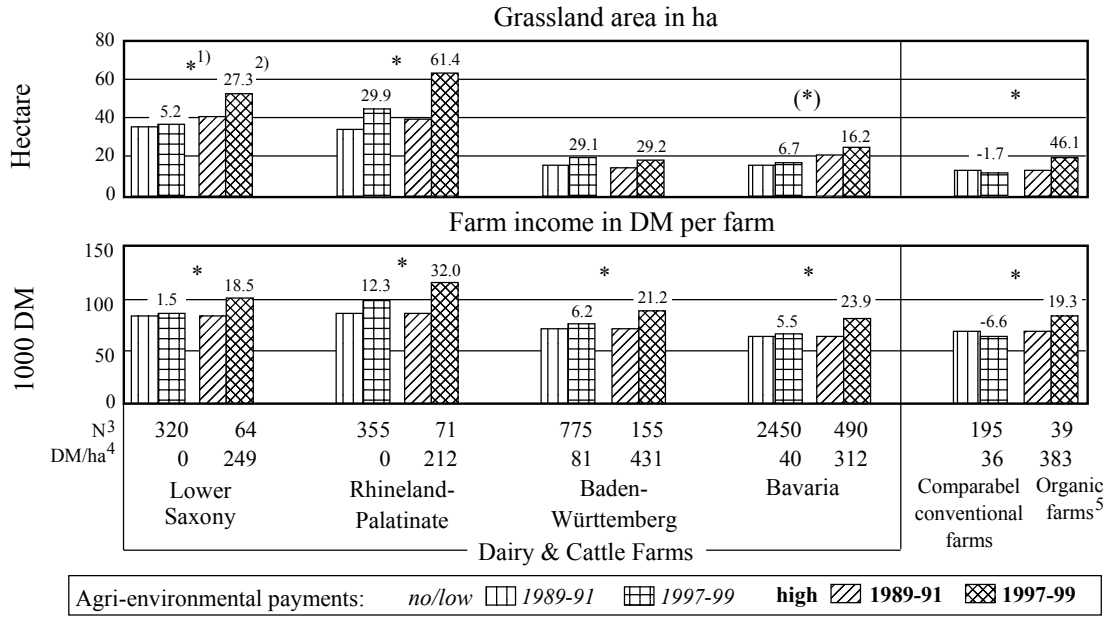
- Participants increased their grassland area more than non-participants, mainly through land rental (Figure 1), while the relative importance of forage maize decreased.
- Milk production per hectare main fodder area decreased, while in non-participating farms it increased. Milk production per farm increased considerably through acquisition of quota, but less than in non-participating farms.
- Cereal yields of participants increased less than those of non-participants.
- Expenses for mineral fertilizer decreased in most *Federal States* in both groups, but in most cases more in participating farms.
- Expenses for pesticides were reduced in participating farms, but increased in most cases in non-participating farms.
- Organic farms show more pronounced extensification effects (higher reduction of expenses for fertilizers, pesticides and feed concentrates, decreasing cereal yields and high reduction of livestock density).

The increase of farm income (representing the remuneration for all land, capital and labor) was significantly higher in participating farms than in non-participating farms (Figure 1). Differences of the change of farm profit per hectare UAA between participating and non-participating farms are difficult to analyze because of the different increase of UAA per farm.

Role of soil conservation measures in the agri-environmental programs

Soil conservation is mainly supported through three types of measures:

1) Introduction and maintenance of extensive grassland management
2) Green mulching (without fodder use) and conservation tillage (mulch seeding)
3) Conversion of arable land into permanent grassland on soils susceptible to erosion; set-aside for nature conservation; establishment of hedgerows and field margins



1: Asterisk indicates significance 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 until 1997/99. (*): Singificant difference in change, but also in the base situation.
2: Change between 1989/91 and 1997/99 in percent of 1989/91 (2-years-average)
3: N: Number of farms.
4: DM/ha: Agri-environmental payments in DM/ha in 1997-99.
5: Organic farming: Organic farms of different Federal States, mainly Bavaria.

Source: Own calculations on the basis of Land Data farm accounts of the years 1989/90, 1990/91, 1996/97, 1997/98, 1998/99

Figure 1. Changes in farms with no (or low) and high agri-environmental payments between 1989 and 1999.

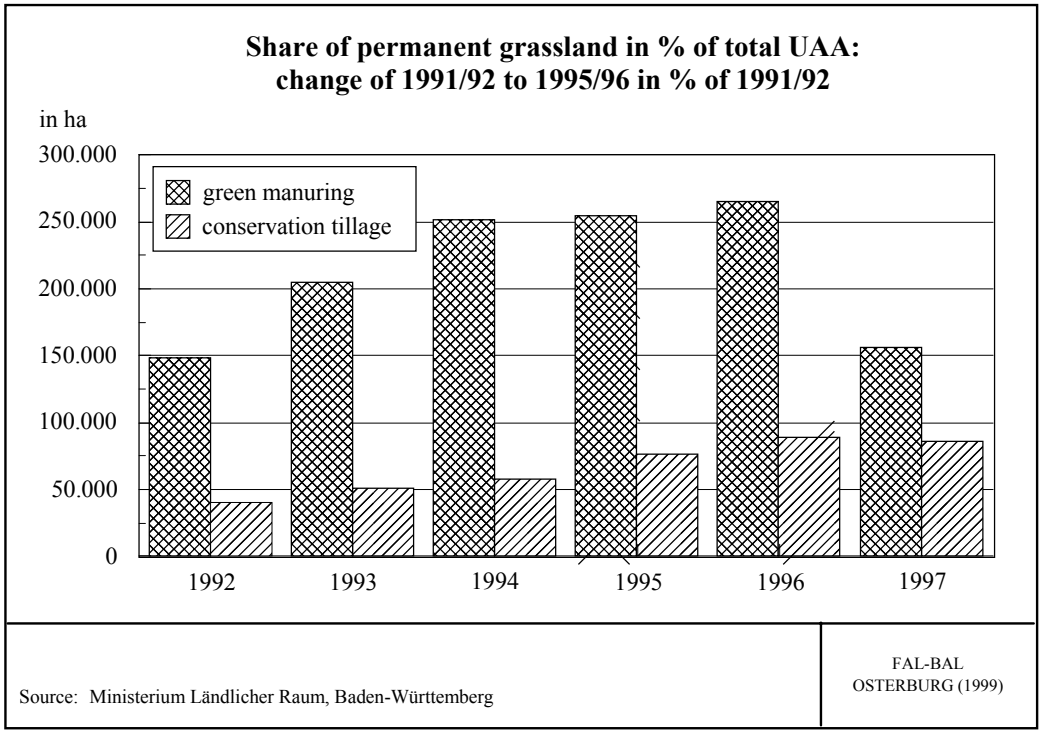


Figure 2. Development of area with green manuring (cover crops) and conservation tillage supported according to Regulation (EEC) 2078/92 in Baden-Württemberg 1992 – 1997.

The support for extensive permanent grassland is the most important measure; about 45% of total program budget is used for these measures. Green mulching and conservation tillage are elements of the programs only in the following *German Federal States*: Baden-Württemberg, Brandenburg and Saxony. Measures like the conversion of arable land, set-aside etc. reach less then 1 % of the total area managed according to agri-environmental schemes and are therefore not further considered here.

The agri-environmental programs have, at least in some regions, an direct effect on the use of permanent grassland (see figure 2). Through hectare payments for extensive grassland, the profitability of this land use increases in comparison to forage maize. Therefore, the area of permanent grassland increases in farms participating in agri-environmental grassland programs (see figure 1), and the area of forage maize is reduced. In addition, increased grassland area can be attributed to the program requirements, e.g. maximum stocking rates and reduction of mineral fertilizers. Between 1979 and 1995, in the western part of Germany almost 600,000 hectares of grassland were lost due to intensification of fodder production and livestock reduction. At the same time, the area of arable land increased. Grassland is an appropriate land use system especially on soils susceptible to erosion or degradation, e.g. on slopes, shallow or clay soils, in swamps, river beds and flood plains (Briemle and Elsässer, 1997). Because of its high productivity, the area of forage maize increased during the last 25 years, but because of the late soil coverage, it leaves the soil exposed to spring storms. The reduction of this crop can therefore be considered as a contribution to soil conservation.

The use of green manuring through intermediate crops is a widespread technique in Germany mainly in cattle and dairy farms where the crop is used as additional fodder. Green manure provides soil cover during autumn and winter and absorbs excess nitrates. Although significantly higher yields in crops succeeding green manuring and resulting economic benefits were observed in on-farm research (Brunotte et al., 1995), the use of green manure is relatively low in arable farms because only the cost of green manuring are considered. Better technical advice and the support through agri-environmental programs may help to increase the use of green manuring. In Baden-Württemberg, where green manuring is part of the agri-environmental programs, the use of this technique has reached 30 % of total arable land, a figure much above the average in Germany. In Brandenburg and Saxony, green manuring is also supported but covers only 2-3% of arable land because of the dry climate.

There exist much research on conservation tillage (mulch seeding) in Germany, but little information as to its implementation is available. Conservation tillage provides a good soil cover especially for crops seeded in spring and saves machinery and labor expenses. In Germany, it is most common for sugar beets. It is estimated that conservation tillage is used on about 10 % of the total area of sugar beets (Merkes, 1998). Support according to Reg. (EEC) 2078/92 in three *Federal States* has resulted in relatively high rates of acceptance, using conservation tillage on 7-8 % of total arable land in Brandenburg and Saxony and 10 % in Baden-Württemberg. Here, conservation tillage is used also for other crops than sugar beets and maize. In the first years of support, figures from these *Federal States* show increases of the supported area. However, only low growth rates are reported in Baden-Württemberg for the last years, showing that acceptance for this measure is still limited (see figure 2). In other *Federal States*, conservation tillage is also used, mainly on soils affected by erosion, but only in some cases, support is given on basis of water protection schemes. In Germany, different factors are limiting the acceptance of conservation tillage. Plowing is the dominant, traditional technology applied on about 90% or more of arable land. It is an important element of weed control, helps to combat diseases and insects, redistributes nutrients, and levels the field surface, e.g. after the harvest under wet conditions in autumn. According to Brunotte et al. (1995), the yields of sugar beets with conservation tillage are the same or even higher in comparison to plowing systems, and erosion as well as plant losses are significantly lower. Estimations for this crop indicate that conservation tillage reduced soil losses by 60% from 23.4 to 9 tons per hectare (Brunotte et al., 1995). For other crops, lower or more variable yields are observed (Roth et al., 1998). Especially cereals after cereals cause problems, e.g. because of fungus diseases, mainly *Helminthosporium* (Bartels and Schäfer, 1998). Because of high cereal yields, e.g. about 7 tons ha^{-1} for winter wheat on average in Germany, high amounts of straw are hampering the following seeding with conservation tillage in autumn. The weed control is more difficult, as in general conservation tillage needs a more intensive, site and situation specific management. Because of the reasons mentioned before, the use of conservation tillage in the whole crop rotation is more difficult than the application to only more suitable crops. The management of zero tillage is even more problematic. As a consequence, the possible saving of machinery cost is limited because of double mechanization. The risks of yield losses are high because of high yield levels, and there is an additional risk of higher expenses for pesticides. Thus, money saved through conservation tillage might be outweighed by additional cost. In larger farms, mainly in the eastern part of Germany, conservation tillage is more attractive, because savings in labor and machinery can be realized more easily. In the smaller family farms of western Germany alternative use of saved labor is limited.

A further promotion of conservation tillage should focus especially on technical advise. The provision of mulch seeding services to farmers, which cannot afford new machinery, could generate higher rates of acceptance. The support through agri-environmental programs can also accelerate the adoption process. However, such payments should not be designed as a permanent subsidy but as a premium for the period of introduction, e.g. in order to cover cost of risks and management adjustments.

Further development of "good agricultural practice"

In Germany, a code for environment-friendly farm management is defined, the so called "Good Agricultural

Practice". This means that agricultural practice has to be in accordance with several specific laws, taking into consideration new developments of agricultural techniques. Agri-environmental measures eligible for direct payments require restrictions, which are beyond the 'Codes of Good Agricultural Practice'. With the further development of the definition of good practice, certain measures supported through hectare payments might become obligatory and lose eligibility for payments. This happened in Baden-Württemberg, where more than 80,000 hectare with green manuring in water protection zones lost support according to Reg. (EEC) 2078/92 because this measure was declared obligatory through a change of the regional water protection regulation (Figure 2, change in 1997). The new German Soil Conservation Act, which came into force in March 1999, defines good agricultural practice for soil management. The soil quality has to be maintained and erosion control has to be applied considering site-specific characteristics. The new act will start a discussion whether soil conservation measures should be obligatory or have to be seen as environmental services society should pay for. Green manuring and conservation tillage could become parts of "Good Agricultural Practice" and therefore lose their eligibility for payments.

SUMMARY

Agri-environmental schemes according to Reg. (EEC) 2078/92, introduced with the 1992 CAP reform, were successfully introduced in Germany. In 1996, about 30% of Germany's UAA was supported according to this regulation. The regional implementation of the regulation and the different ways of financing have led to highly diverse measures, requirements and hectare payments. An analysis of regional data on participation in agri-environmental schemes shows that participation in agri-environmental measures is explicitly higher in areas with poor natural conditions and low land use intensity. On the other hand, green manuring and conservation tillage are concentrated in favored areas. A farm data analysis over 10 years showed a significant reduction of intensity in farms participating in agri-environmental schemes, resulting in a change of farm management, in addition to the maintenance of desired land use systems. The area of grassland increased in participating farms while the grassland area in non-participating farms increased much less or was even reduced. This effect contributes to soil conservation. Green manuring and conservation tillage is supported only in three *German Federal States* where the support obviously leads to higher rates of adoption. Nevertheless, the acceptance of these measures is still limited. The further development of the "good agricultural practice" which is expected to be applied without compensation payments might put direct payments for agri-environmental measures into question. The new German Soil Conservation Act will reinforce this discussion.

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