Impact of the CAP reform on small-scaled grassland regions in Bavaria, Germany

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Abstract: The CAP reform of 2003 will change farmer's business environment in Europe. This paper analyses the impact of the reform on the land use in southern German grassland regions. The assessment will be based on model calculations for two typical grassland regions. Each study area represents one village with its specific farm structure and natural conditions. These regions differ in their excellence with respect to agricultural use. In Southern Germany small to medium sized family farms is the most frequent type of farming. We use a regional land-use model that conceives farms as independent agents aiming at maximum individual utility. Farm agents optimize their farm organisation with the help of a linear-programming algorithm that takes into account natural, economic and personal restrictions. Interactions between farms take place on the land market, which is modelled as an equilibrium market. It becomes clear that the CAP reform of 2003 has various significant consequences with respect to grassland use. In particular the decreasing profitability of dairy farming will relatively promote low-intensive forms of grassland use, including mulching. If some payments (e. g. agri-environmental payments) remain coupled to livestock production area-wide agriculture can be maintained even in marginal areas. Land rents will generally increase in more marginal areas due to the effects of decoupling.

Keywords: CAP-reform, linear programming, land-market simulation, agent-based modelling, farmers attitude, policy analysis

1. Introduction

The reform of the European Common Agricultural Policy (CAP) in 2003 is expected to have far-reaching consequences for future land use in Europe. With the reform more or less all payments were decoupled from production incentives. After a transition period where

payments remain partly linked to a historic reference a flat regionalized area payment will be implemented in Germany. Small-structured and marginal regions might be particularly affected because the profitability in such regions is low and a general withdrawal of agriculture is probable. Due to the often multifunctional character of European agriculture, such a withdrawal of agriculture is of consequence not only for farmers, but would also be relevant to the public in general (HEIßENHUBER et al., 2000). In particular is to point out that a great portion of Central Europe's biodiversity is linked to low intensity farming systems (e. g. PAIN & PIENKOWSKI 1997). Especially low intensity use of grassland provides habitats for endangered species.

In southern Germany grassland use is strongly linked to cattle farming. In this sector the consequences of the CAP reform are expected to be of extraordinary importance, because cattle farming has been supported until now by a wide variety of policy measures. In particular the decoupling of subsidy payments from production will alter the relative competitiveness of cattle farming activities. From an economic perspective it is to mention that about 5% the total milk produced in the Europe Union originates from Bavaria (EUROSTAT 2005). This amount is equivalent to 25% of the German or 70% of the Dutch milk production. Therefore changes in the extent of dairy farming in Bavaria might have an impact on European milk prices.

But land use is not determined only by agri-political factors. There are a huge number of further determinants such as agricultural structure, natural site-conditions and non-agricultural factors. For instance, alternative employment opportunities and family structures greatly influence farmers' decisions to either continue with the prevailing farming system, to change, or to abandon production and lease farm land (BALMANN, 1997). In Bavaria like in other regions of the EU different types of farming exist next to each other. Especially part time is in most areas of particular importance. If the threshold of 19'200 EUR standardized gross

margin is used to distinguish part-time from full-time farming approximately 50% of Bavarian farmers can be considered as part-time farmers (EUROSTAT 2005). In 2003, these farmers used nearly a fifth of the agricultural land. These values are slightly lower than the averages for the EU15. In 2000 over 60% of European farmer could be considered as part time farmers using about 25% of the agricultural land.

This paper tries to assess the consequences of the CAP reform for land use in grassland regions. Therefore two study areas were selected, one with low intensity and one with a high intensity. The areas show significant differences with respect to essential agronomic (e.g. productivity) and ecological traits (e.g. endangered species, landscape's aesthetic values). For the assessment an approach is used allowing for the consideration of farmers' individual attitudes which are rooted in empirical data in a multi-agent model. Exactly such individuality is often of great importance for future land use, because even comparable farms will react differently to identical changes of economic conditions, and the measures taken to adapt to the new conditions will depend to a large extent on the attitudes of the farmers concerned (cf. VAN DEN PLOEG 2003). The model is based on previous works by KANTELHARDT (2003) and SCHEMM (2004).

2. Structure of the model

In order to assess the impact of currently changing policies, a wide variety of agri-economic land use models is applied (cf. LAMBIN et al., 2000; AGRARWAL et al., 2002; PARKER et al., 2001 and HARE & DEADMAN, 2004). These models vary several aspects, in particular the type of the modelled entity, the time frame and the type of interaction(s) among the entities. The basic entity of our model is the single farm. Each farm is depicted by an individual agent. Each agent tries to optimize its utility by using a linear programming algorithm. The agent can choose among different investment options and activities. The different agents vary with

respect to their available work force, the valuation of fixed assets, the valuation of their labour and the income level they want to derive from agriculture. In our study areas a large number of farms compete with each other for various resources, especially land. Therefore we chose a model framework that considers the market interactions amongst the farmers. In a market module the demand of the respective agents is aggregated with the help of a modified version of the sequential simplex algorithm. Land is clustered into up to five interconnected land markets. We chose a time horizon of five to ten years which allows farmers to make fundamental investment decisions. Thus changes in the agricultural structure, such as growth or shrinkage of farms, concentration processes and abandonment of farms can be considered in the model calculations.

In general land-use model consider only labour as non-physical factor. This factor is accounted for by considering the average capacity of available man power per farm in a standardised form such as agricultural working units (AWU). But one must be aware that, particularly on family farms, the working time that a farmer is willing to dedicate to agriculture is limited by the extent of the farmer's off-farm employment, the personal desire for leisure and the time needed for regeneration. Therefore the farm organisation and the actions taken by the farmer depend not only on the economic excellence but also on personal values, rules and norms (ROMERO and REHMAN, 1989, p. XI). But empirical data on personal values and norms is hard to obtain and it is even harder to quantify the impact of certain settings for economic models. Consequently only a few models integrate non-physical factors into the optimisation process of the modelled land users (e. g. HAPPE & BALMANN 2002, ROUNSEVELL et al. 2003 and BERGER 2000). In most cases the implementation of these factors is based on ad-hoc assumptions. Like EVANS & KELLEY (2004), we opted for a different approach. We assume that the farm is currently optimally organized and derive a set of variables describing the farmer's current attitudes. Principally we regard the farmer's attitudes

as a black box that consists of several manipulated variables which represent factors as the personal planning horizon, the desired farm income, the leisure demand and desired wages. These variables are set to ensure that the acreage, management intensity, endowment with assets and labour demand of each modelled farm corresponds to its real world counterpart. In the course of policy-analysing scenarios the values for the manipulated variables remain unchanged.

For further information on the technical implementation and calibration of the model see (ROEDER et al. (in press)).

3. Study regions, input data and scenarios

Two *study areas* are selected which represent typical sites for diary farming in Bavaria. The first study area represents regions were the fodder for diary cattle is exclusively produced on grassland. This type I situation is typical for the mid-mountain ranges of eastern Bavaria and the areas in the ultimate vicinity of the Alps. In the second type of regions a significant part of the dairy cattle's fodder is silage maize. This situation is typical for the 'Tertiäre Hügelland' of Southern Bavaria. Table 1 depicts some key figures for the two study areas.

- The Type I grassland region is located in the 'Upper Allgäu' (UA). The study area covers an area of 730 ha grassland and contains no arable land. The grassland is currently cultivated by 25 quite homogenous farms mostly concentrating on milk production. Tourism and nature conservation are important factors. Especially the use of rough pastures is crucial for the maintenance of the regional biodiversity (Lederbogen et al. 2004).
- Type II grassland is represented by a sample region situated in 'Lower Allgäu' (LA). The region is 500 ha grassland and 200 ha arable land. Farms are mainly run full-time (14 farms), and part-time farming is of minor relevance. Most farms concentrate on milk

production. However, three farms run mixed farm systems. The average farm size is 66 livestock unit (LU) per farm, twice as large as in UA. Tourism and nature conservation in this region is of minor importance.

Table 1: **Description of the study regions**

	Upper Allgäu (UA)	**Lower Allgäu (LA)**
Area grassland [ha]	730	500
Area arable land [ha]	0	200
Farms full-time / part-time	15 / 10	14 / 6
Fam Type Dairy / Suckler / Heifer / Mixed	23 / 1 / 1 / 0	17 / 0 / 0 / 3
Average Farm Size [LU/farm]	33	66
Importance of tourism	medium to high	no tourism
Natura 2000 relevant	yes	no
Compensatory allowance [EUR/ha]	150	50

Data basis includes a survey involving local farmers in both regions. Furthermore, an analysis of corresponding IACS data (Integrated Administration and Control System of the European Union) took place. This data set contains statistical information concerning land use and livestock husbandry. Costs of buildings and machinery as well as the data on labour demands and yields have been calculated with the help of an extensive set of regional and national reference data (cf. ROEDER et al. (in press)).

The central question of this paper is to assess the consequences of the CAP reform on grassland use. As a reference point, a first *scenario* describes the initial situation before the start of the reform. Two further scenarios, which mainly differentiate the price levels for agricultural products, describe probable situations after the full implementation of the reform in the year 2013. At this point in time, direct payments will be fully decoupled and an area payment of about 300 EUR/ha will be implemented. The assumptions concerning prices and subsidy payments can be taken from table 2.

Table 2: **Definition of the scenarios**

	Initial Situation	**Scenario I**	**Scenario II**
Price level for agricultural products	Medium price level for beef and very high price level for milk [1)]	Medium price level for beef and high price level for milk [2)]	High price level for beef and low price level for milk [3)]
Area payment	0	300[4)]	300
Direct payments	coupled	decoupled	decoupled
Cultural landscape program	up to 200 EUR	100 EUR	100 EUR
Compensatory allowance	locally defined	locally defined	locally defined

[1)] 2.6 EUR/kg beef; 35 cent/kg milk; [2)] 2.6 EUR/kg beef; 31 cent/kg milk; [3)] 3.2 EUR/kg beef; 26 cent/kg milk; [4)] the actual level was uncertain at the time of the calculation; currently the premium level is supposed to reach 320 EUR / ha

4. Results

In the marginal region *Upper Allgäu* (UA) land use in the current situation is dominated by mowing pastures (45% meadows and 34% pastures) that are used with a high intensity (tab. 3). At about 20%, low and medium intensity grassland is of minor importance. In Scenario I, after implementation of the CAP reform, mulching gains in importance and reaches a level of 22%. This affects pasture land and meadows to almost the same extent. In Scenario II, due to the decreasing milk price and increasing beef prices, the structure of animal husbandry changes dramatically: dairy farming is almost entirely replaced by heifer fattening. This also affects land use where medium-intensity hay production is clearly extended. At the same time high-intensity grassland cultivation decreases. This means that employment in agriculture is shrinking. Consequently some farms are abandoned.

Table 3: **Model results in the Upper Allgäu**

Results Upper Allgäu			**Initial situation**	**Scenario I**	**Scenario II**
Grassland use (in % of total area)	**Low**	meadow	5	7	7
		pasture	2	1	1
	Medium	meadow	13	8	70
		pasture	0	0	7
	High	meadow	45	36	6
		pasture	34	28	5
	Total	**meadow**	**64**	**50**	**83**
		pasture	**36**	**29**	**13**
	Mulching		**0**	**22**	**3**
Average land rent			**50**	**260**	**310**
Live stock (LU/ha UAA)	Dairy		1.22	1.00	0.07
	Suckling		0.04	0.03	0.00
	Heifer		0.05	0.00	0.55
	Total		**1.31**	**1.03**	**0.61**

In the more productive region *Lower Allgäu* (LA) grassland use is dominated currently by high-intensively used meadows (tab. 4). This high intensity of fodder production can also be observed on arable land where, at 49%, the cultivation of silage maize dominates land use. Dairy farming is by far the most important type of agricultural production. Scenario I does not provoke fundamental changes. Despite a slightly decreasing milk price, dairy farming remains the most profitable production method for the majority of the farmers. Mulching of grassland therefore does not appear in this scenario. On arable land silage maize is replaced with cash crops due to the fact that some farmers convert to pork production. In Scenario II the modification of product prices shows a major impact on land use. Dairy farming is given up to a large extent and is replaced by bull, heifer or even pig fattening. The consequences for grassland use are dramatic; it is almost abandoned and replaced by mulching (60%). Similarly, set aside is gaining slightly in importance on arable land and replaces, together with the extension of cash crops, the cultivation of silage maize.

Table 4: **Model results in the Lower Allgäu**

Results Lower Allgäu		Initial situation	Scenario I	Scenario II
Grassland use (in % of total area)	meadow	94	99	34
	pasture	6	1	6
	Mulching	0	0	60
	Total	**100**	**100**	**100**
Arable land use (in % of total area)	Silage maize	49	27	19
	Cash crops	42	65	68
	Set aside	9	8	13
	Total	**100**	**100**	**100**
Land rent		300	350	230
Live stock (LU/ha UAA)	Dairy production	1.32	1.28	0.36
	Suckling cows	0.16	0.01	0.00
	Bull	0.04	0.00	0.19
	Pigs	0.00	0.54	0.34
	Heifer	0.00	0.00	0.15
	Total	**1.52**	**1.83**	**1.05**

It must be pointed out that the model results predict that pig fattening will gain in importance. But introducing pig fattening on a farm means a substantial change for the farmer. It is therefore doubtful whether all farmers would take such a decision even if the opportunity was offered. Instead, it is expected that farmers will keep dairy farming as long as they are able to realise their personal aims. Otherwise there is a high probability that they will give up farming rather than re-structure their farms for pig fattening.

5. Discussion

The model calculations show that the impacts of the CAP reform on grassland cultivation differ in the two study regions. In the Upper Allgäu the CAP reform leads to a lower intensity of grassland use as a consequence of declining milk prices. While in Scenario I dairy farming decreases by roughly 20%, dairy farming disappears completely in Scenario II as a consequence of the drastically reduced milk price. Heifer fattening gains in importance because of higher beef prices and the opportunity to raise heifers at low costs at the rough pastures. Overall animal husbandry declines by 50%. The expansions of low intensity livestock husbandry systems together with the area wide use of the grassland will in tendency

improve the habitat quality for endangered species. One reason for the area wide use of grassland by livestock is the fact that a relevant share of subsidies will still be coupled to animal husbandry even after the implementation of the CAP reform.

This applies in our calculations to the grassland-related area payment in the Bavarian cultural landscape program and to the compensatory allowance. Further calculations show that the decoupling of the area and compensatory allowance from livestock leads to a significant increase of mulching with a conservation of the currently existing farm structure.

In the more productive region Lower Allgäu the CAP reform does not induce important land use shifts as long as the milk price does not decrease to world market level. The decoupling in combination with a moderate decline of the milk price might even lead to increasing land use intensity since dairy farming is continued at its current extent and a few farms start pig fattening. A very low milk price leads to dramatic land use shifts in this region. In contrast to UA dairy farming will be continued at significant level but meat production will be the most important source of agricultural income. The fodder for the regional stock will be mainly produced on arable land. 60% of grassland is mulched and the rest is used for low-intensity heifer fattening.

Like other models our calculations predict substantially increasing land rents on land of low agricultural value (cf. HENNING et al 2004 p.169, HÜTTEL 2005). This is a consequence of the decoupling of subsidies from production, the introduction of an area payment and a coupling of this payment to land. The high land rents indicate that financial supports benefit mainly the landowner but not the persons cultivating the land. However, it is expected that the high rent level predicted by the model results will not be realized in reality. With increasing profitability farmers' attitudes towards wage will shift towards higher wages and higher profits. Consequently it is assumed that the higher profitability will be shared by landowner and tenant and price levels will be lower than the model results indicate. Furthermore it is

important to point out that the market simulated within this model is limited to agricultural land and does not include payment entitlements.

In general, the model results indicate a declining stock of roughage feeders in all study areas. This result is principally backed by various other studies (cf. HENNING et al. 2004 p.160 ff., GAY & OSTERBURG 2005, HÜTTEL et al. 2005). HENNING et al. (2004) point out that this reduction will concern mainly the more intensively cultivated regions and support our results. In contrast GAY & OSTERBURG (2005) assume that this reduction will mainly affect marginal areas. In both studies most of the reduction can be attributed to a massive decline in the number of suckler cows. Similar to HENNING et al. (2005) and WEINMANN et al. (2005) we conclude that the intensity of forage production will decline.

In our view the integration of farmers' attitudes demands the modelling of individual farms attempting to achieve their individual interests. In order to cope with this problem, a multi-agent technique that allows for the consideration of individual farms is the means of choice. Regarding the layout of the applied model, some aspects must be challenged. This concerns in particular the integration of farmers' attitudes. Due to the fact that we consider farmers' attitudes to be a black box, we avoided surveying personal aims in detail. Although the application of this method does increase the quality of the results (cf. KANTELHARDT et al. 2005), it is obvious that this way of implementing farmers' attitudes indirectly is not sufficient for entirely describing farmers' decision making processes. Even if this approach explains previous developments, it is questionable if this data can be extrapolated into the future. This applies in particular for to date unique occurrences such as the decoupling process in the current CAP reform. In order to predict future developments it is not sufficient to change only the economic and policy framework but it is also necessary to estimate changes in farmers' attitudes. Otherwise model results tend to be trapped in historic

situations. The most relevant change of attitudes takes place during the generational handover of farms.

6. Literature

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