Impact of economic and political drivers on grassland use in the EU

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Abstract

The paper provides an insight into structures and recent trends of grazing livestock production (cattle, sheep, goats and equines) and their relation to forage area. Dairy production and grassland use are the focus of the study. The differing land use and farming conditions throughout the EU are briefly addressed as well as farm structural change. The dairy, beef and sheep sectors are highly dependent on policy interventions implemented as part of the EU Common Agricultural Policy (CAP). These policies have been subject to fundamental reforms during the last years. Expected short-term impacts of these agricultural policy changes on livestock production and land use are discussed and, as far as is possible, compared to recent empirical data. The influence of environmental policies is considered. Building on this analysis, the future prospects of grazing livestock and grassland use in the EU are examined and, finally, challenges for research are discussed.

Key words: Grassland use, farm structures, CAP reform, milk quota.

1. Introduction

Grassland and forage crops on arable land account for a large proportion of the utilized agricultural area (UAA) of the EU. In 2007, about 33 % of total UAA in the EU-27 were used as permanent grassland, and 11 % of UAA were cultivated with forage crops such as temporary grass and green maize (see Table 1). Grassland serves as forage area for cattle, sheep, goats and equines; therefore, we subsume these livestock categories as 'grazing livestock' in this paper. Beef and dairy production contribute significantly to EU agricultural income. According to the Economic Accounts for Agriculture of the EU-27 in the year 2007, beef and veal, sheep and goat meat amounted to 11 % and milk to 14 % of the total agricultural production value (values at factor prices, this means that taxes and subsidies related to production are not considered). Farms specialised in dairy, cattle-rearing and fattening, sheep, goats and other grazing livestock employed about 21 % of total EU-27 agricultural labour force in 2007 (Eurostat, 2010, in annual working units).
Beyond its contribution to meat and milk production, permanent grassland provides a number of environmental and social benefits. Compared to arable land, grassland is associated with a better conservation of soil against erosion, a reduced runoff and leaching of nutrients into surface and ground water (Briemle and Elsässer, 1997), and contributes to flood control. In the debate on climate change caused by anthropogenic greenhouse gas emissions, grassland is classified as an important carbon sink, due to higher organic matter contents compared to arable land use (IPCC, 2000). Further, grassland constitutes a characteristic element of European cultural landscapes, and the maintenance of semi-natural grassland habitats through traditional agricultural use is vital for the protection of biodiversity (Briemle *et al.*, 1999; Zdanowicz *et al.*, 2005). Within the Natura 2000 network established according to the Birds and Habitats Directives (79/409/EEC, 92/43/EEC), grassland constitutes the dominant type of agricultural land use. More than 18 % of EU's total grassland is located within designated Natura 2000 sites (Cooper *et al.*,

2009). Several types of semi-natural grassland habitats, which are of community interest according to Habitats Directive Annex I, are threatened either by agricultural intensification or farmland abandonment (Ostermann, 1998). Most of the beneficial environmental impacts of grassland are highly site- and management-specific. Also, long-term continuity of grassland use is of importance, especially regarding objectives related to biodiversity and storage of soil carbon. Temporary grassland contributes to environmental objectives such as soil and water protection, but regular ploughing and conversion to arable crops might be critical due to potential discharge of carbon and nitrogen, and is detrimental for biodiversity objectives.

Dairy, beef and sheep production as the main sectors sustaining Europe's grassland are associated with negative environmental impacts, such as water pollution due to nitrogen leaching, air pollution through ammonia emissions, soil degradation, e.g. due to overgrazing or maize cultivation, and on landscape and biodiversity, e.g. due to high intensity of grazing or mowing regimes (CEAS *et al.*, 2000; IEEP, 2007). Grazing livestock is causing a considerable share of agricultural greenhouse gas emissions, with methane emissions from enteric fermentation of cattle, sheep and goats accounting for about 30 % of direct emissions from agriculture in 2007. This is equivalent to 3 % of the EU-27's total greenhouse gas emissions (EEA, 2009). Additional greenhouse gas emissions related to cattle and sheep occur from manure management, nitrogen fertilisation of fodder crops, and agricultural land use of organic soils such as bogs and fens.

Statistics on grassland and other forage areas should be interpreted with caution, as not all types of grazed areas are reported and some areas reported as forage crops are not used by grazing livestock. EU statistics distinguish permanent grassland, rough grazing, temporary grassland and various arable forage crops (e.g. green maize). In EU statistical surveys, permanent grassland is defined as not being part of crop rotations for more than five consecutive years. It is used to grow herbaceous forage crops, either sown or natural (self-seeded), as pasture for grazing or for mowing in order to provide fresh forage for livestock kept indoors, or to produce hay or silage. Also, areas for rough grazing, e.g. semi-natural, low-yielding pastures, are permanent grassland. In contrast to permanent grassland, temporary grassland is part of arable crop rotations and thus it is seeded and regularly ploughed a few years later in order to establish other arable crops.

In statistical surveys, a proportion of permanent grassland might not be recorded, e.g. because parts of grassland are common land which does not directly belong to a particular farm, some areas are not continuously farmed but are used only in years of forage shortage, or areas used for pasture may serve mainly for other purposes (airports, military training areas, dikes). For instance, in France common lands and grasslands not managed by farmers were estimated at 1.5 million ha (Pointereau *et al.*, 2008), an area equivalent to almost 20 % of the permanent grassland reported in the Farm Structural Survey 2007. Other semi-natural vegetation types serving for rough grazing, such as heather, are not accounted for as grassland (Röder *et al.*, 2007). In recent years, production of energy crops has emerged as a new agricultural activity, e.g. in Germany (Taube *et al.*, 2007). Green maize and grassland for biogas production are still not reflected in official statistics, but influence the trends of the forage area reported. Further, statistical time series on grassland throughout the EU are incomplete and suffer from changing survey methods, e.g. regarding the minimum farm size included in the statistics.

In the following section, we analyse the utilisation of grassland in the EU and, in particular, its connection to dairy production. Subsequently, we focus on the implications of the EU's Common Agricultural Policy in the recent past. The paper closes with a brief

outlook on the future use of grassland in the EU and highlights some challenges for future research.

2. Spatial distribution, state and trends of grassland use

The statistical basis for the following analysis comprises EUROSTAT data, provided through the internet database (Eurostat, 2010), as well as a more disaggregated data set based on the 2007 Farm Structural Survey for the CAPRI model system (Common Agricultural Policy Regional Impact, see http://www.capri-model.org/). Cropper and Del Pozo-Ramos (2006) describe the long-term developments of livestock numbers in the EU. Declining dairy cow numbers have been the dominant trend since introduction of milk quota in 1984, which is often associated with losses of grassland area (Pointereau *et al.*, 2008). In middle and eastern Europe, grazing livestock herds diminished sharply in the 1990s during transition towards market economies (Röder *et al.*, 2007).

Table 1: Distribution of grassland and forage crops by EU Member States, and intensity indicators in 2007. Source: Eurostat 2010 (Farm Structural Survey 2007), Lutter (2009), own calculations.

EU member state	Code	perm. grassland	forage crops	forage area share of	grazing livestock	cow milk production
		Share of UAA		EU-27 total	per forage area	
		(%)	(%)	(%)	LU ha^{-1}	kg ha^{-1}
EU-15						
Austria	AT	54	8	2.6	0.77	1568
Belgium	BE	37	18	1.0	2.63	3911
Germany	DE	29	12	9.2	1.41	4087
Denmark	DK	8	18	0.9	1.75	6751
Spain	ES	35	3	12.4	0.71	698
Finland	FI	2	29	0.9	0.97	3172
France	FR	29	17	16.8	1.26	1918
Greece	GR	20	6	1.4	1.79	744
Ireland	IE	76	17	5.1	1.43	1344
Italy	IT	27	14	6.9	1.06	2161
Luxemburg	LU	52	18	0.1	1.61	2834
The Netherlands	NL	43	22	1.6	2.25	9301
Portugal	PT	51	10	2.8	0.61	747
Sweden	SE	16	36	2.1	0.77	1885
United Kingdom	UK	62	8	15.1	0.91	1228
EU-12						
Cyprus	CY	1	29	0.1	2.04	3175
Czech Republic	CZ	26	12	1.7	0.82	2138
Estonia	EE	30	24	0.7	0.42	1356
Hungary	HU	12	6	1.0	0.95	2390
Lithuania	LT	31	15	1.6	0.55	1645
Latvia	LV	36	22	1.4	0.31	829
Malta	MT	0	45	0.0	3.50	8655
Poland	PL	21	5	5.4	1.17	3004
Slovenia	SI	59	11	0.4	1.07	1561
Slovakia	SK	28	13	1.1	0.51	1225
Bulgaria	BG	9	3	0.5	2.11	3359
Romania	RO	33	6	7.0	0.75	992
EU-15		36	12	79	1.11	2005
EU-12		25	8	21	0.85	1780
EU-27		33	11	100	1.06	1958

The EU-27 dairy herd was decreasing between 2003 and 2007 at a rate of -1.6 % per year, due to increasing milk yield per cow and the administrative limitations on milk production (Cropper and Del Pozo-Ramos, 2006). Although most EU Member States have decoupled direct payments for suckler cows from production (Röder *et al.*, 2007), which were formerly paid per head, the herd size of other cows even slightly increased between 2003 and 2007 in the EU-27, and the effect was more pronounced in several EU-12 Member States.

The relative distribution of total forage area in the EU (Table 1) indicates that about 80 % of this area can be found in Germany, Spain, France, Ireland, Italy, United Kingdom, Poland and Romania. Between Member States, average stocking density of grazing livestock and milk production intensity differ within a wide range. The highest intensity is found in The Netherlands, Belgium and Denmark, whereas Austria, Spain, Portugal, United Kingdom and most of the EU-12 Member States are located at the opposite end of the gradient.

More than 80 % of the grazing livestock units in the EU-27 are cattle (Fig. 1), with dairy cows accounting for 30 % and 'other cows' (mainly suckler cows) for another 15 %. Suckler cows are of special importance in some EU-15 Member States, e.g. Spain, France, Ireland and United Kingdom, and also in the Czech Republic, while in most of the other EU-12 Member States, 'other cows' are of minor relevance. Sheep and goats represent about 12 % of the grazing livestock herd in EU-27, with shares above average in Mediterranean countries, United Kingdom and Romania. Equines contribute to less than 5 %, but are still more frequent in some EU-12 Member States.

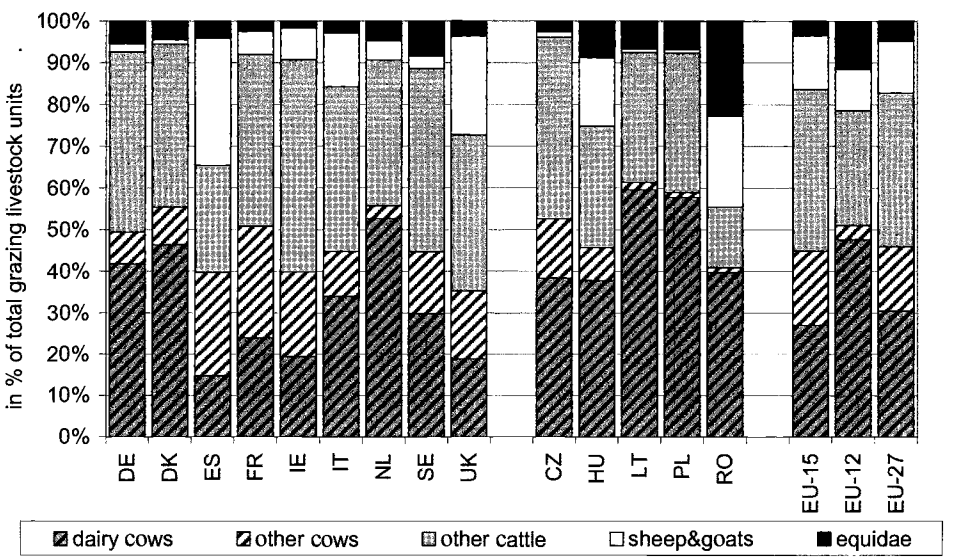

Figure 1: Composition of the grazing livestock herds in EU Member States. Source: Eurostat 2010 (Farm Structural Survey 2007), own calculations. Abbreviations see Table 1.

Fig. 2 depicts the average herd size of dairy and of other cows per farm, in combination with relative development of farms keeping dairy or other cows, respectively. Between 2003 and 2007, for the EU-27, on average each year about 6 % of dairy farms ceased milk production. This is a highly accelerated structural change, compared to the sectoral average of about 2.3 % of farms leaving the EU agricultural sector. Denmark, United

Kingdom and Czech Republic have the largest average dairy herds per holding. In spite of favourable structural conditions, we observe even in Denmark and Czech Republic a pronounced farm structural change. In these countries about 9 % of dairy farms ceased milk production per year between 2003 and 2007. In most other Member States, dairy farms terminated business at an elevated rate compared to the respective sectoral average.
In most of the Member States, farms keeping other cows have markedly smaller herd sizes per farm compared to dairy herds. The number of farms keeping other cows is more stable compared to dairy farms. This number is even increasing in the EU-12, especially in countries with the smallest farm structures. This leads to the conclusion that there is a broad, ongoing structural change of the dairy sector, with many smaller dairy farms changing to beef production based on suckler cows while ceasing milk production. In some EU-12 Member States, the category 'other cows' possibly still includes some subsistence production of milk. Through this process, forage area is kept under management, although in small farm structures.

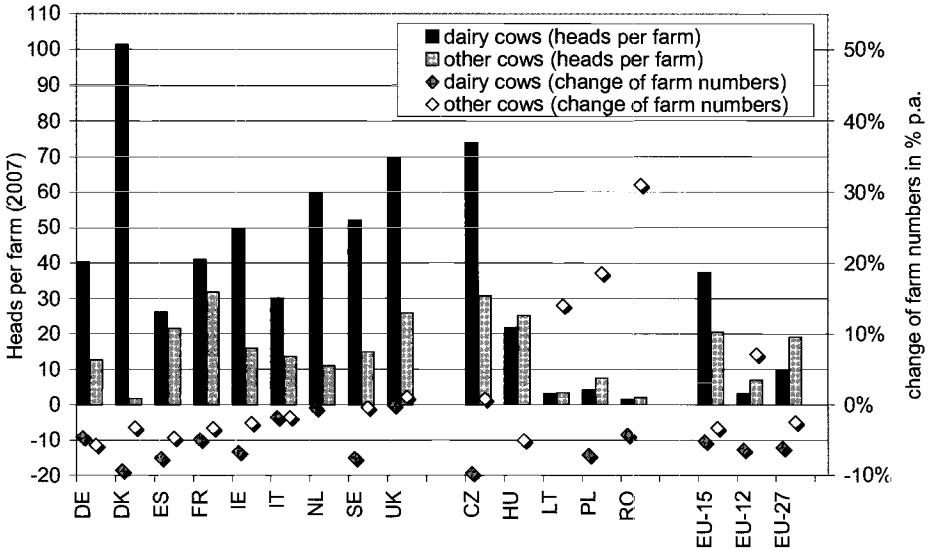

Figure 2: Average heads of dairy and other cows per farm in 2007, and change of farm numbers keeping dairy or other cows between 2003 and 2007. Source: Eurostat 2010 (Farm Structural Survey 2003, 2007), own calculations. Abbreviations see Table 1.

In the following, structures of specialised dairy farms and their relative importance for grassland use are investigated. Specialisation of farms according to the Community typology is measured in economic terms on the basis of the contribution of different production lines to the total potential gross value added (standard gross margin). In Fig. 3, specialised dairy farms (farm type FT41) are compared to the rest of farms keeping grazing livestock. Dairy farms are characterised by higher stocking densities per hectare forage area. On EU average, the difference is almost one livestock unit per hectare.
In several Member States, the structure of the forage area in dairy farms differs from other farms, notably in Denmark, Spain, France and United Kingdom. In these countries, specialised dairy farms cultivate more green maize and temporary grass and use less permanent pasture or meadows and rough grazing. In Fig. 4, the proportion of dairy cows kept in specialised dairy farms is presented as well as the relevance of these farms for use

of permanent grassland. In the EU-15, specialised dairy farms keep almost 80 % of all dairy cows, but utilize less than 20 % of the total permanent grassland. Only in Germany and The Netherlands, specialised dairy farms have a higher importance for grassland use. In some German regions more specialised in dairy production, such as Lower Saxony and Bavaria, the share of grassland in specialised dairy farms accounts for 50 % to 60 % of the total. Compared to the EU-15 in the EU-12, specialised dairy farms keep a smaller proportion of the dairy herd, as there exist more mixed farming systems.

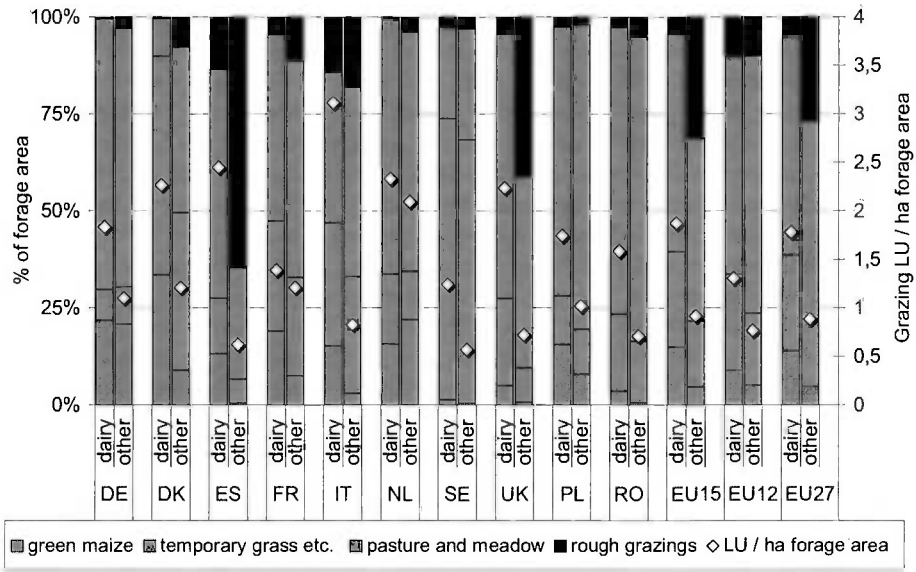

Figure 3: Composition of the forage area and stocking densities of grazing livestock in specialised dairy farms and all other farms in 2007. Source: Eurostat 2009 (Farm Structural Survey 2007, disaggregated data set for the CAPRI model system), own calculations. Abbreviations see Table 1.

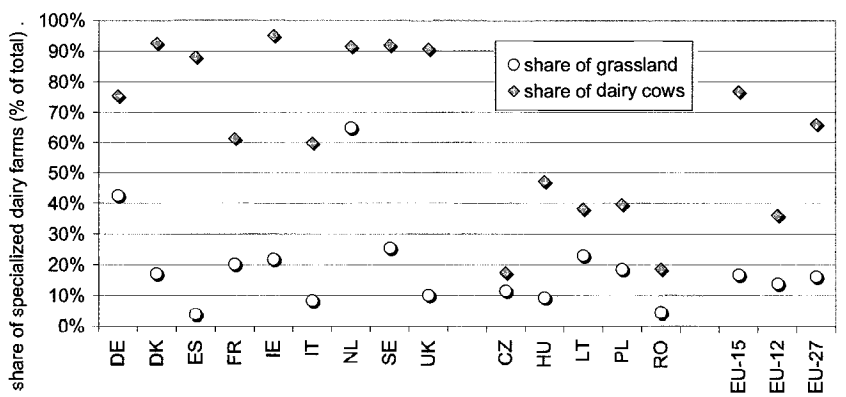

Figure 4: Dairy cows and permanent grassland in specialised dairy farms as a percentage of the sectoral total. Source: Eurostat 2009 (Farm Structural Survey 2007, disaggregated data set for the CAPRI model system), own calculations. Abbreviations see Table 1.

At the EU-27 level, about 66 % of total dairy cows, and about 33 % of total grazing livestock units, are kept in specialised dairy farms which manage about 16 % of EU's permanent grassland. The relatively low proportion of grassland in specialised dairy farms is explained through the high livestock densities on these farms, which are concentrated in the more productive grassland areas. Also, permanent grassland is less relevant because of the higher importance of green maize and temporary grassland as forage crops.
According to Alliance Environnement (2008), in larger dairy farms production intensity is higher in terms of livestock stocking density, milk production per cow and of mineral fertiliser purchase. Higher stocking densities and higher shares of green maize could also be found in larger farms of the Farm Structural Survey data set for Germany in 2007, when comparing dairy farms of different sizes at the regional level. Between 1999 and 2007, the average stocking density in German dairy farms remained stable. However, if the increasing milk yield per cow is considered, the nutrient turnover per hectare increases. During the same period of time, in all other farms in Germany average grazing livestock density per hectare of forage area decreased by about 20 %. This indicates a trend towards more pronounced structural differences between livestock farms.
National statistics do not reflect regional differences and spatial allocation of land use and livestock. As an example, Fig. 5 depicts the distribution of grassland in Germany, and the allocation of milk quota per hectare UAA at the level of municipalities (see also Lassen *et al.*, 2008 and 2009). Obviously, dairy production is concentrated in regions with high grassland shares, e. g. in lowlands and marshes of north-western Germany, low mountain ranges in the western and central regions, and in the pre-alps and low mountain ranges in the south of Germany. In eastern Germany, apart from mountain ranges in the south, there is less regional concentration of grassland and dairy production. In some grassland areas, e. g. the Black Forest in the south-west, and low mountain ranges of Thuringia in the centre of Germany, the incidence of dairy production is rather low. These are regions with structural difficulties or low grassland productivity, where grassland is mainly managed through suckler cows at low stocking densities.
Between 1975 and 2001, permanent grassland decreased by about 17 % in the EU-15; this is a rate of -0.7 % per year (Gobin *et al.*, 2006). Apart from the loss of agricultural land due to urbanisation, both conversion into arable land and afforestation or abandonment of farming contributed to this development (EEA, 2005).
In recent years, the trend of grassland losses has been halted or even reversed in several European regions. An analysis of grassland areas at national level between 2003 and 2007 shows that in Belgium and Germany the area of permanent grassland declined, while the area of arable land increased, indicating a conversion of grassland. However, net changes at the EU level were negligible in this period of time.
In Germany, the grassland area decreased at an annual rate of -0.8 % between 1990 and 2006, while arable land decreased at a rate of -0.05 % per year. Obviously, the overall loss of UAA due to urbanisation occurred mainly at the expense of grassland, due to parallel conversions of grassland into arable land. However, these net figures at national level mask the fact that there have been regions with increasing grassland area, especially in hilly and mountainous areas of western Germany (Gay *et al.*, 2004). In eastern Germany, the area of permanent grassland dropped after German unification by more than 20 % between 1990 and 1992, and increased again during the process of restructuring. This is an example for grassland areas remaining for a time outside the farm sector and agricultural statistics. Later, such 'land reserves' can be included into the farms again. Such aspects complicate the interpretation of net statistics of land use and call for more detailed analysis of net flows and gross changes (Gobin *et al.*, 2006, Pointereau *et al.*, 2008).

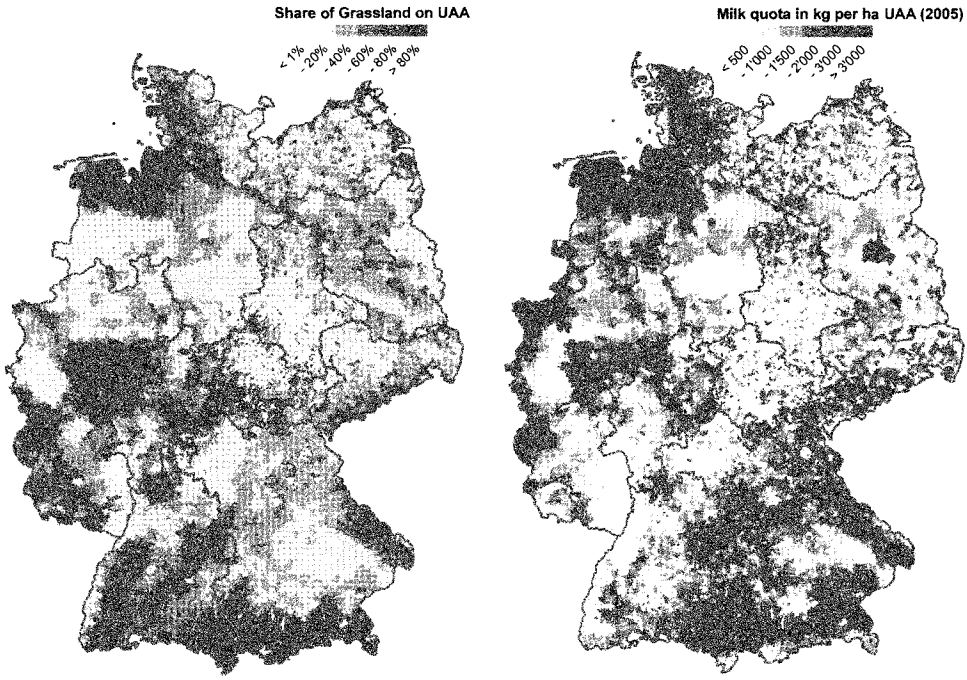

Figure 5: Distribution of permanent grassland in 2007, and milk quota per hectare UAA in 2005. Source: Forschungsdatenzentrum der Statistischen Ämter des Bundes und der Länder, Farm Structural Survey, 2007, data analysis based on Salhofer *et al.*, 2010, own calculations.

With regard to farmland abandonment, Pointereau *et al.* (2008) show that the risk of abandonment is higher on marginal grasslands, e.g. on slopes, poor or wet soils. Farmland abandonment is also influenced through small parcel sizes and poor transport infrastructure, and farm structural change with a decrease of mixed traditional farms. Based on Corine Land Cover data for 1990 and 2000, Osterburg *et al.* (2008) found general trends throughout the EU of arable land expansion in lowlands at the expense of pasture, and pasture expansion as well as set-aside on slightly sloped land and at higher altitudes. Due to afforestation and transitional woodland creation, forest area increased on marginal, less productive land at altitudes and on more inclined terrain, mainly used as pasture beforehand. Over longer periods, farmland abandonment can reach relevant shares of UAA. Pointereau *et al.* (2008) identified 3.3 million hectares of abandoned areas in three EU Member States, equivalent to 2% of the total French UAA (1988-2000), 4% in Poland (1996-2002) and 8% in Spain (1989-1999).

3. Influence of policy measures and market forces on the grassland use

Farm structures, production activities and agricultural land use are subject to market and policy influences, of which the CAP plays a central role. For the use of grassland, several CAP instruments are relevant, namely the direct payments, milk quota, rural development measures of the so called Pillar 2, such as investment aid, agri-environmental measures (AEM) and Less Favoured Area (LFA) allowances. Further, the CAP has established rules for

the maintenance of permanent grassland through eligibility rules and minimum requirements as precondition for the receipt of direct payments.

First, we will look at direct payments and milk quota. The recent CAP reform (Mid Term Review reform, based of the Luxemburg decisions of 2003 and Regulation 1782/2003) has initiated a fundamental change of agricultural policies (see also Osterburg and von Horn, 2006; Röder *et al.*, 2007), comprising the introduction of a largely area-based 'single farm payment' (SFP) for EU farmers, decoupled from production, and cross compliance (CC). This means the linkage of direct payments to compliance with environmental, food safety, animal and plant health and animal welfare standards ('statutory management requirements', SMR), as well as the requirement to keep all farmland in 'good agricultural and environmental condition' (GAEC). Further elements were reduced intervention prices for milk products, with a partial compensation through decoupled payments, and options to maintain a proportion of direct payments coupled at Member State level, especially for arable crops, cattle and sheep. Member States were allowed to choose a historic SFP model, with individual payment entitlements based on historic farm production activities in 2000-2002, or regional flat rate payments. Several Member States decided to introduce hybrid systems, with elements of both payment models, and dynamic elements, i.e. a transition towards regionally harmonised payment levels. In the EU-12 Member States a fully decoupled single area payment was introduced, and only Malta and Slovenia opted for the SFP model. Especially in the EU-12, payment entitlements may not cover the total of the potentially eligible land. This implies that there is scope for farmland abandonment, or land abandoned during the transition period may not be activated (Osterburg *et al.*, 2008).

Historic SFP models allocate a larger part of direct payments towards more intensive farms. Due to the newly introduced, decoupled milk premia, specialised dairy farms benefit from this distribution through payment levels above average. On the other hand, regional flat rate models tend to relocate payment to the advantage of more extensive farms, e.g. livestock farms with low stocking densities, and give incentives to declare agricultural land which has not been included in the support system previously. In all schemes, a payment entitlement can be 'activated' with one hectare of arable or grassland managed subject to cross compliance minimum standards, regardless whether this land is used for production or not.

Several Member States retained coupled payments, e.g. for suckler cows, sheep and goats. Calculated on the basis of animal numbers in the year 2003, a significant share of the EU-15 livestock herd benefits from coupled payments (Röder *et al.*, 2007), e.g. about 60 % of the suckler cow herd of EU-15 (Osterburg *et al.*, 2008). However, according to the last changes of the CAP ('Health Check', Regulation 73/2009) special beef and slaughter payments shall be fully decoupled until 2011, while coupled payments for suckler cows, sheep and goats may be retained. This exemption takes into account the potential problems of decoupling: decreasing grazing livestock herds and resulting changes of land management. However, up to now even in Members States with fully decoupled payments, such as Germany, the suckler cow herds remained stable, while sheep numbers have declined by a few percent.

The milk quota introduced in 1984 has limited the expansion of dairy production in the EU and, depending on the national and regional rules for quota transfers, the quota regime has contributed in some Member States, such as France and Italy, to maintain dairy production in less favoured areas (Alliance Environnement, 2008). In Germany, quota transfers were restricted to 27 trading regions, thus 'ring-fencing' regional dairy production. By summer 2007, trading regions have been merged into a western and an eastern German region. Quota transfers in 2008 within the western region show a clear concentration of dairy production in regions with a high share of grassland. Increase of quota due to transfers in 2008 only reached

about 2 % of the 2006 level in the *Laender* Lower Saxony and Schleswig-Holstein (Lassen *et al.*, 2009).
The Health Check reform determined the expiry of the milk quota by 31 March 2015, with a 'soft landing' through a stepwise increase of the quota by 1% per year between 2009 and 2013. Due to the worldwide economic crisis starting in late 2008, farm commodity prices dropped sharply. Especially the dairy sector was affected. The production value for milk of EU-27 decreased by more than 20 % in 2009 compared to 2008, or by 10 % compared to 2005 (EUROSTAT, data of the economic accounts for agriculture), calling the concept of 'soft landing' into question. For comparison, production values for beef decreased only by about 5 % from 2008 to 2009. In Germany, as also in other Member States, flanking measures such as additional investment aid and animal welfare measures for dairy cows are planned as a response to the increased pressure on the dairy market. Also, marketing strategies for premium products, e.g. according to rules for protected denomination of origin (PDO), Protected Geographical Identification (PGI), or organic farming, are of increasing importance for sustaining dairy and cattle farms in less productive areas (Cropper and Del Pozo-Ramos, 2006).
In Fig. 6, support levels per hectare UAA are presented for German farms in 2006. Decoupled direct payments have been still partly dependent on the historical model and thus were much higher in more intensive dairy and cattle farms. Harmonisation of direct payments started in 2009 and will converge at the average level depicted at the left side of the figure by 2013. We stratify farms into a low (ext), medium (med) and high (int) intensity level. Low-intensity farms represent "high nature value" (HNV) farms (see Osterburg *et al.*, 2008, for more details). These farms are most dependent on additional Pillar 2 support. While investment aid supports individual, expanding farms, AEM and LFA payments can reach significantly higher support levels especially in low-input regions and farm groups. Fig. 6 illustrates the high dependency of the income (profit) plus wages for external labour of dairy and cattle farm on transfer payments.

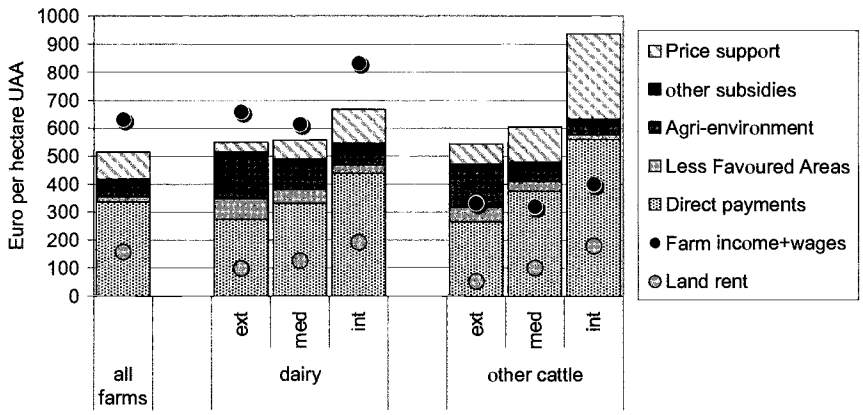

Figure 6: Support payments in German dairy and cattle farms in 2006. Source: German FADN (Farm Accountancy Data Network), price support for beef according to OECD (2009), own calculations.

In the following we describe requirements attached to EU support policies influencing the maintenance of grassland. The EU Member States have determined cross compliance conditions for keeping eligible land free of shrubs and other invasive plants. The cost incurred for minimum land maintenance according to GAEC standards can be understood

as the 're-coupled part' of the decoupled, area related payments. On plane land maintenance costs e.g. through mulching are comparatively low, while for pastures in mountainous areas there might be no alternative for extensive grazing in order to keep the land open. Thus, in such areas a higher effect of 're-coupling' to livestock production occurs. In addition, several Member States (e.g. Austria, France, Ireland, Lithuania, Poland, Spain, Sweden) have defined additional requirements in order to keep grassland in productive use, such as minimum stocking levels of grazing livestock, or the removal of forage after cutting. These rules intend to ascertain a minimum livestock density and avoid farmland abandonment.

Prior to 2005, permanent grassland converted into arable land after 1992 was not eligible for arable crop payments. This rule intended to avoid an expansion of arable production and certainly has decelerated conversions into arable land. However, ploughing of grassland was allowed to compensate for losses of arable land due to urbanisation (Gay *et al.*, 2004). In 2005, this area-specific disincentive for conversion of grassland was removed, as the SFP entitlements can be activated on any eligible land. In order to restrict larger conversions of grassland, Regulation 1782/2003, Article 5 (2), required the EU Member States to prevent a significant decrease of the share of 'permanent pasture' as percentage of agricultural land, compared to the 2003 level. The new Regulation 73/2009 contains equivalent requirements. Permanent pasture is used synonymously with permanent grassland. Most Member States require an authorisation even before the maximum reduction of the grassland ratio (10%) is reached (Alliance Environnement, 2007). In Portugal, authorisation is needed for all grassland conversions. Italy and Spain implemented a general prohibition of conversion of permanent pasture, mainly for reasons of erosion control, and in Belgium (Flanders), Greece and Poland grassland area has to be maintained at the farm level. In Austria, conversion on steep hills and along water courses is banned, and in UK the conversion of semi-natural grassland. In other Member States, the ratio of permanent grassland may decrease by up to 10 % between 2005 and 2013; this is a rate of -1.3 %, exceeding historic average loss rate. Obviously, restrictions on grassland conversion can be seen as another form of 're-coupling' of direct payments, as grazing livestock systems are benefiting from these rules.

The grassland ratio is calculated at regional or national level. Within larger, non-homogeneous regions, significant land use changes may occur without meeting the Cross Compliance threshold level for the grassland ratio, as marginal arable land might be converted into grassland. This allows for more area being converted into arable use on sites more suitable for cropping. Through an analysis based on spatially disaggregated parcel data of the Integrated Administration and Control System (IACS) of four German *Laender*, flows of land use change were traced back in order to identify grassland losses between 2005 and 2007 (Osterburg *et al.*, 2009). Losses of grassland through conversion into arable land occurred at a rate of -1.3 % per year, in parallel to conversions of arable land into grassland at a rate of +0.5 %. In three German *Laender*, the grassland ratio had dropped by more than 5 % until 2009. Obviously, the cross compliance rules have been an incentive for a rapid conversion of grassland before restrictions at the farm level are implemented. Also, the rules allow for further spatial segregation of grassland use, as long as there are no site-specific restrictions.

Environmental mandatory standards according to regional, national and EU legislation restrict the conversion of grassland in designated areas, e.g. of the Natura 2000 network. Restrictions according to the Birds and Habitats Directive are connected to the Cross Compliance rules for permanent pasture. Regionally defined, area or site-specific restrictions may go beyond Cross Compliance, but are not always consistently enforced (Osterburg *et al.*, 2009).

In addition, there are mandatory rules for the control of emissions from livestock production. EU Nitrates Directive defines limits on manure spreading per hectare, and thus puts restrictions on the expansion of dairy production in intensive, specialised farms (Lassen *et al.*,

2009). 'Derogations' (exemption from the limit of 170 kg N from animal excretion per hectare) have been implemented in several Member States such as The Netherlands, Denmark, and Germany, allowing for higher manure application rates on intensive grassland. These rules fuel further concentration in the dairy sector, as the limit of 170 kg ha^{-1} N according to Nitrates Directive is alleviated.

4. Prospects of grassland use in the EU

The abolition of milk quota in 2015 will affect land use and farm structures. In spite of expected pressure on milk prices, most model based scenario analyses expect an increase of dairy production in the EU by 2020, as well as a significant relocation of production capacities (Gömann *et al.*, 2009; IPTS *et al.*, 2009). However, exact forecasts for dairy production are problematic, as the sector has been strongly regulated for a long period. For suckler cows and sheep, declines due to decoupling are expected (Röder *et al.*, 2007; Gömann *et al.*, 2009), although in the short term, decoupling has not shown severe impacts on the suckler cow and sheep herds. Considering the relevance of direct payments and Pillar 2 support for dairy, beef and sheep farms, especially those with lower intensity levels, future CAP budgets and support measures are key factors determining the future of grassland use.
With regards to the future development of dairy production, Lassen *et al.* (2009) and Lutter (2009) use a mixed methodology comprising analysis of market shares, of local production factors, of production costs, and farm interviews in order to complement and verify outcomes of economic modelling. They expect a further concentration of dairy production in productive grassland areas. Increasing competition on arable land, due to favourable developments of crop prices and promotion of energy crops, will negatively affect production conditions for milk in arable areas.
The following results are based on a farm survey conducted in the first quarter of 2010 by the international networks EDF (European Dairy Farmers) and agri benchmark dairy. The analysis is based on a sample of 1453 German dairy farmers. Data of farms with farmers older than 55 years and without successor, and of farms which will quit dairy production due to recent market developments were removed from the analysis. Based on the farmers' expectations about the future development of dairy production in their region the regions were grouped into regions of growth and regions of reduction. To characterise a region appropriately, a minimum of five farms are required per county. Only regions where more than 50% of the participating farmers stated that they expect an increase or decrease in dairy production in their region are taken into account. Regions with expected increases of production are concentrated in marsh areas at the coast of Lower Saxony. Regions with expected reduction are mainly located in Lower Bavaria and southern parts of Lower Saxony.
The average milk yield of the surveyed farmers is about 8900 kg per cow and year in growing regions, and the average amount of milk produced per hectare of land used for the dairy is about 11700 kg. These figures do not differ much from the production intensity in regions with expected decline. Farmers in growing regions on average have larger herds of more than 100 cows per farm, and use more grassland on their farm compared to those in regions of reduction. Milk production is already the predominant form of agricultural activity in these regions. The results indicate that current centres of milk production in Germany remain important dairy producing regions and one can expect even a further concentration.
In the past, dairy farmers in both regions grew at the same pace. Until 2015, dairy farmers in growing regions plan on average to increase the number of cows by 12 cows per farm and year, while farmers in the other regions intend to grow by six cows. Land rental payments are expected to increase by 22 % or 16 % in regions of growth or reduction,

respectively. The survey also shows that farmers in all regions intend to increase the annual milk yield per cow. With only little increase in farm land, this implies that the intensity of milk production per hectare will further increase. The survey data suggests that the increase of intensity will be higher in regions with expected growth (+ 2800 kg ha^{-1}) compared to regions of reduction (+ 1600 kg ha^{-1}). These results imply that grassland will most probably be used even more intensively than today on specialised dairy farms. This coincides with the results of the *ex-post* analysis in chapter 3. On the background of ongoing farm specialisation, intensification and spatial concentration in the dairy sector, the fate of grassland that is not needed anymore for milk production remains open.

The Uruguay Round Agreement on Agriculture has been a key factor for market liberalisation in the EU in the 1990s, both regarding the reduction of tariff protection, domestic support and export subsidies. A future agreement of the World Trade Organisation (WTO) according to the current state of negotiations would result in major changes concerning market access for agricultural commodities: Tariff cuts of 48% to 73% (for sensitive products, such as beef, tariff cuts would be roughly half as high), and the abolition of export subsidies (Brockmeier and Pelikan, 2008). Beef, veal and sheep meat prices would come under pressure due to the high market prices support of 35 % as percentage of commodity gross farm receipts (OECD, 2009), while dairy products would be affected by the abolishment of export subsidies. Thus, lower prices and a higher price volatility are expected. For arable crops, more positive price developments are predicted, so that pressure on forage production on arable land would increase (OECD-FAO, 2009). The further expansion of energy crops on arable land will increase the competitive pressure on the land market. In 2008, German UAA used for biogas production alone was estimated to be around 0.5 million hectare (DBFZ, 2009), and a further increase is expected; thus strong incentives for additional grassland conversion will prevail.

Finally, environmental policies will continue to influence the developments in the dairy, beef and sheep sector, both through regulation, e.g. regulation Nitrates Directive or for controlling ammonia emissions, and through incentive payments in order to keep valuable grassland sites under management. Farming systems based on ruminant livestock will be increasingly in the focus of climate protection policies, although their role is ambiguous. Livestock farms are key sources of emission, but also preserve grassland as an important carbon sink. On the other side, preservation of grassland can not be proclaimed as an invariable objective, as there are other use opportunities which should be weighted against environmental benefits of grassland conservation. For instance, due to raising biomass demand, competition between traditional grassland, its use for biomass, and afforestation or short rotation coppice will increase. Discussions may challenge CAP payments which support livestock production systems identified as key emitters of greenhouse gases, while oppressing larger land use shifts towards more environmental-friendly biomass production.

5. Conclusions and challenges for research

The dairy sector of the EU is passing through an accelerated structural change which is heading towards larger, more specialised and, in terms of milk production per hectare forage area, more intensive farms. Structures of farms keeping suckler cows or sheep remained comparatively more stable during the recent past, in spite of the decoupling of direct payments. However, there is an ongoing trend towards lower livestock densities in the less intensive farming systems, thus absorbing parts of grasslands not used anymore by dairy production. Several challenges arise for policy-oriented research: What will be the competitiveness of the dairy, beef and sheep sector in future, as dependency on CAP support is still high, and markets will be further deregulated? How to improve resource

efficiency and decrease detrimental external effects of intensive dairy production systems? How far there is scope to integrate these systems into a concept of grassland conservation and more extensive management of valuable sites, e.g. using grazing heifers? How far and where should extensive grazing livestock systems be maintained through public intervention and new marketing concepts, considering objectives related to climate protection and biomass demand? Last but not least, a more coherent concept is needed how to steer land use in the EU in particular regarding the preservation of ecologically valuable grassland.

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