Survey on grasslands loss and proportion of grazed areas.

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Introduction

The Life DairyCLIM Life Project is a European Life project started on 1.10.2015 for 48 months. The general aim of the project is the development of feeding strategies to decrease greenhouse gases emissions and the estimation of the carbon footprint of dairy farming in Belgium, Luxembourg and Denmark. Globally agriculture is responsible for 18% of the production of greenhouse gases (GHG) (FAO, 2006). Out of these, methane mainly produced by cattle represents 76% of total emissions. However, the particular digestive tract with the presence of the rumen allows the ruminants to convert forage even of poor quality into milk and meat. For that reason, cattle are important for the global production of protein, especially in countries where climate is fit for a high proportion of grasslands. Thus, an objective of the Life Dairyclim project is to highlight the importance of grasslands in dairy farming as potential carbon sink contributing to the mitigation of GHG emissions from the agricultural sector. It aims also to increase grazing practice.

Grazing in other European countries.

Grazing is decreasing in most of European countries. A survey about grazing practices was published during the Grass day about the "Future of Grazing" on 7/9/2014. The Table 1 shows the figures provided by the participating countries.

Table 1. Grazing practices in other European countries (Grass day, EGF 2014, Aberyshtmith)

Country	Year reference	% of cattle grazing	Trend	Comments
Norway	2016	90 %	Slightly decreasing	
Sweden	2016	100 %		Welfare legislation – 6 weeks to 4 months outside
Finland	2016	70 %		Cows in tie stalls have to be outdoors for 60 days between 1/5 till 30/9
Ireland	2016	95-100 %	Stable	
United Kingdom	2016	80-90 %		95 % in Nothern Ireland 70% in Wales
The Netherlands	2014	70 %		Premium to support grazing
Belgium	2016	60-85% 90% in Wallonia	Decreasing in Flanders	
Luxembourg	2016	75%	Slightly decreasing	73% in 2014 – 75-85 % Free access in 2010
France	2016	75-95 %	90 % in 2014 – 90-95 % in 2011	
Switzerland	2016	80-97 %	75-90% in 2014 85-100 % in 2011	
Denmark	2016	25 %	Decreasing	25-30% in 2014 30-35 % in 2011
Germany	2016	10-50 %	Decreasing	42 % of dairy cows grazing in 2009

Austria	2016	40 %	Stable	25 % in 2011
Poland	2016	20 %	Quickly decreasing	
Estonia	2011	35 %		
Lithuania	2014	50-70 %		
Czech Republic	2016	3%	Deep decrease	20 % in 2010
Bosnia and Herzegovina	2011	5%		
Slovenia	2016	20 %	Slightly decreasing	25 % in 2010
Hungary	2016	2-3 %		Grazing dairy cows
Bulgaria	2016	50 % dairy cows		Only in small farms

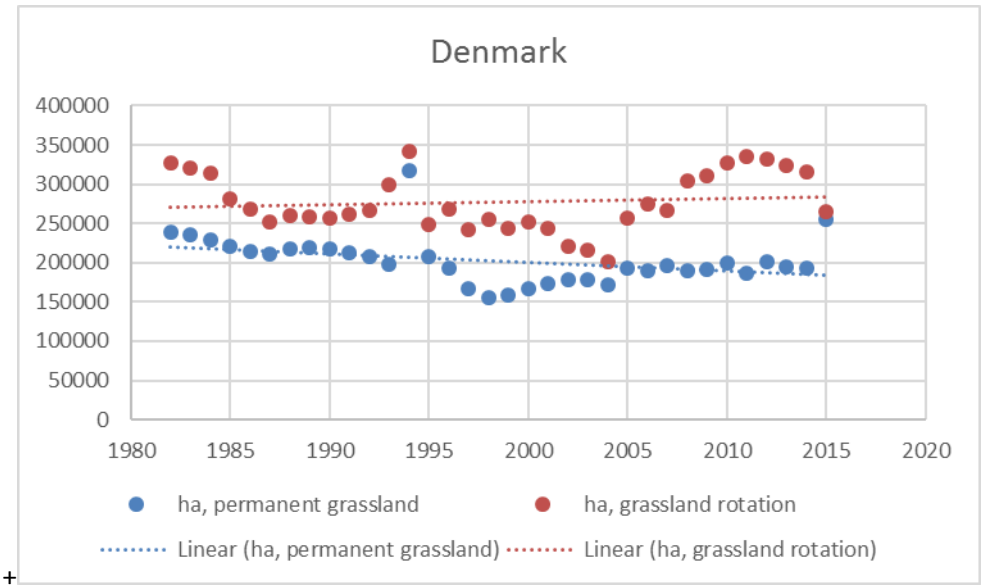
Grasslands – in the 3 partner countries

In Denmark there was 300.000 ha of high productive temporary grassland and 200.000 ha of less productive permanent grassland in 2015, out of a total agricultural area of 2.650.000 ha. The general trend shows a decrease in the area of permanent grassland by 0,5 % yearly, while there is a slight increase in the area of temporary grassland. (Figure 1). During the last 20 years the proportion of dairy cows grazing has decreased from 50% to now less than 25%. This means larger proportion of grassland has been used for cutting. More specific knowledge is needed about type of grassland production (production, utilization, use of manure, soil type and for temporary grassland, years of production and type of rotation) to estimate the effect of grassland on Carbon soil storage..

It has been reported from the Walloon government that on average 1.970 ha pastures/year have disappeared from 1980 to 2010. Following Statbel, a decrease of 67.308 ha of permanent grassland between 2014 and 2015 was observed in Wallonia. On the contrary, 80,043 ha more temporary grassland were counted. It seems due to the European policy impending the farmers to plough permanent grassland once they have reported them as temporary grassland. Consequently, a large number of farmers chose to state them as temporary ones.

On the contrary, in Luxembourg, the grassland situation is characterized as a consequence of a special agro-environment program as stable. Actually 69.094 ha of permanent grasslands were reported in 1970 compared with 66.923 ha in 2015, representing 2.171 ha less within a 45 year-period. The new EU-greening measures trends to further increase the part of permanent grassland but aside that, a decrease of the grazed part for agronomic management reasons is constantly detected. These figures show the difficulty to clearly assign grasslands to permanent or temporary grasslands although their potential as a carbon sink is very different. Defining criteria allowing differentiation between permanent and temporary grasslands and collecting data about evolution of these areas and about the percentage affected to graze are necessary to calculate the carbon sink that would be expected from preservation of grassland.

Figure 1. Evolution of permanent grassland in Denmark and in Wallonia



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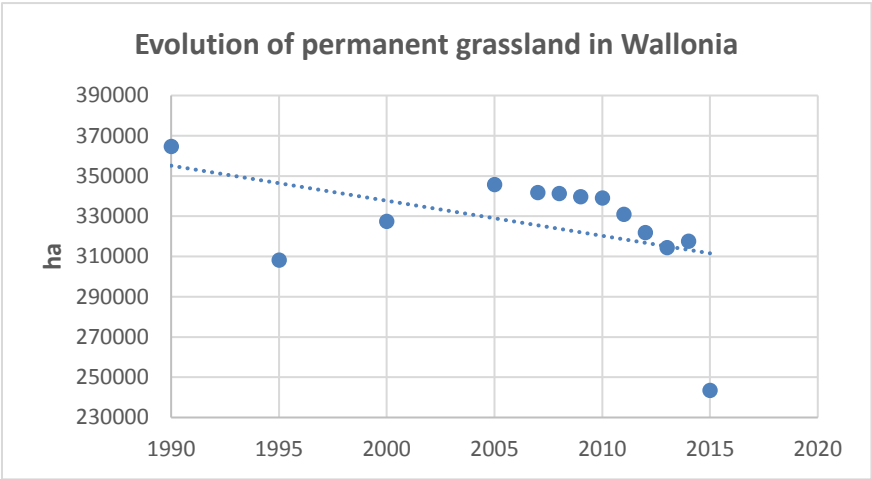

In this context, a survey among dairy farms in the three countries was set up. Special emphasis was made on the practices taking advantage from grassland in cattle feeding, for instance establishing the proportion between grazing and other systems and the ratio between permanent and temporary grassland.

Summary of survey

General overview of the specific context of each country

The first survey of the Life Dairyclim project was realized during winter 2015-2016 in the three countries. The main objective was to collect farming data from the grassland situation and the resulting agronomic consequences on a normal farm operation like feeding and land use of the other agriculture area of the farms. The aim was to highlight strategies that have potential to be used as mitigation strategies in the future.

The following table gives an overview about the used data.

Table 2.: General overview about the data collected from the survey and their representativeness

	National statistics (2013*)			DairyClim Surveystatistics		
	Number of Dairy farms	Number of dairy cows	cows per farm	Number of sended forms	Number of responded forms	% of the contacted Dairyclim farm pool
Belgium (Wallonia)*	3.234	203.441	63	3.152	1016	97,5
Denmark	3.381	561.000	166	2.550	386	15,1
Luxembourg	732	46.199	63	430	62	14,4

*For Wallonia, figures from 2015 in Statbel – Chiffres agricoles, 2015

Following received answers, the typical dairy farms of the 3 countries appear different. In Denmark, average farm size was estimated to 170 ha for conventional, with 18 % having more than 250 ha and 235 ha for organic dairy farms with 45% of more than 250 ha. Average of 170 dairy cows, withaverage milk yield (MY) of 9.250 kg EKM. In Belgium, farms are smaller: for 76% of dairy farms, the size was less than 100 ha, with an average of 50 to 100 cows. Milk yield was estimated at 8.000 liters/cow/y. In Luxembourg, 85% of the farms were smaller than 125 ha. A mean dairy farm is composed of 50-100 cows with an average MY of 8.000 to 10.000 litres/y.

The proportion of organic to conventional is 5% in Luxembourg, 10% in Belgium and 11% in Denmark. For organic farming is grazing part of the legislation, while in conventional farming it is a matter of decision of each farmer. As shown in table 3 is the proportion of conventional farms using grazing quit different between Denmark and the two other countries.

Table 3. Grazing at conventional dairy farms - 2014

		unit	Denmark	Belgium	LUX
Grazing		% of farms			
	Dairy cows		30	100	82
	Heifers		45	99	99

Data for the herds using grazing showed that in Belgium, most of dairy cows (96%) graze day and night, while this was only the case for 28% of the cows in Denmark.. In Luxembourg, grazed grass is part of cows' feed in 86% of the dairy cows while this figure reaches only 30% in Denmark. The

% of grazed grass in cows' feed in summer is estimated at 50% in Belgium, between 50-75% in Luxembourg and is estimated at less than 25% in Denmark.

Proportions of temporary and permanent grasslands are the following:

Table 3. Permanent and temporary grasslands inventoried in Belgium, Denmark and Luxembourg

	Belgium	**Luxembourg**	**Denmark**
Total agricultural area	78	126	170
Permanent grasslands	45,34 ha	61,72 ha	11 ha
Temporary grass	16,71 ha	33,40 ha	52 ha

A great number of relevant data were collected from those three countries and allows to derive relevant parameters to make a descriptive reporting over the situation in the three countries. For the first report, the data were not merged in one data structure but that is intended for the period after the second survey. So then, potential changes for the two years between the two surveys, for example for the grazing situation, could be filter out for the different countries.

Evaluation of the process

During the collection of the first survey results were detected a certain unexpected disparity between the national data.

The Luxembourgish agriculture for example is strongly characterized by a high proportion of wine producers and hobby farmers, often keeping horses which lead to a specific situation. So, it is difficult to compare the national Luxembourgish statistical data from Statec, a national Luxemburgish statistic institution, with the data from this survey. Because of this problem and nevertheless to allow a good comparison with the real agriculture structure in Luxembourg, a second separate data analysis were made comparing the survey datas with a data set of farms participating at a regular evaluation of some sustainability parameters, action organized by the CONVIS advisory department. This data set wasn't published in the survey report at this stage because it was not yet clear where those data, among additional other's, should or must be used afterwards for calculations and extrapolations in connection with the LCA evaluations on national and pilot farm level.

It should also be noted, that to be able to compare the survey data based on evaluated and suggested classes of this report, the special circumstances of the strong data dispersion between those three countries must be respected. So in Denmark, the number of large farms is much higher than in Belgium and Luxemburg or especially in Luxemburg, only a very small number of organic farms have participated at the survey. The major knowledge of this determination was, that selected classes must absolutely be adapted for the three countries and for all key parameters.

A number of comprehensive reviews has recently been published that describe options to mitigate greenhouse gases from livestock production and the second survey shall investigate these points. Other measures to improve the questionnaire and the interpretation of results will be:

1. simplify the questionnaire

2. organize special training courses for investigators who meet the interviewed farmers.

3. Allowing a feedback phone call by the project managers, particularly for the case when questionnaires were not fully or correctly completed. For approaching this strategy, the questionnaire cannot be anonymous as in the first survey.

4. The second survey will be planned in July 2019 so that the presence at agricultural fairs would enhance the answer rate. Help will be provided to the farmers for completing the questionnaire to avoid weird figures.

Other

Further analysis of data was performed country by country and summarized in the reports below.

1 Belgium

1.1 Introduction

Permanent grassland is considered to play a role in mitigation of greenhouse gas (GHG) emissions by sinking carbon. Studies have estimated the annual C storage rates between 22 and 44 g C/m^2/y (Soussana et al., 2010). Moreover, the use of grassland for grazing seems profitable by causing a decrease in feeding costs (Dillon, 2005). A positive effect on cows' health (Burow et al., 2011) has been recognized and the good image of grazing to consumers is regularly mentioned. However, increase in herd size and automation of herd management have contributed to decrease grazing and grassland areas.

This survey about grazing practices, perception and expectations of Walloon dairy farmers aims to provide an overview of the grazing practices in Wallonia. The farmers were also questioned about their perception of grazing and their vision for the future. This paper presents a summary of the received answers. A second survey is foreseen within a 4 years-delay to evaluate the evolution of this issue.

1.2 Material and Methods

Eighteen questions about grazing were formulated focusing on the description of the farm, of grazing practices and of perceptions and expectations. In Belgium, hard copies of questionnaires were sent to the Walloon dairy producers by the "Comité du Lait" on 10 December 2015. Questionnaires and information about the survey and the project were also disseminated in conferences for dairy farmers and by the internet. The questionnaires received after 31 March 2016 were not taken into consideration (4 forms).

1.3 Statistical analysis

The statistical analyses were performed using SAS (SAS Institute, 2002). Descriptive procedures were used (proc univariate – proc means) for the analysis of numeric values. Statistical differences between systems (organic vs conventional), grazing practices (zero-grazing vs grazing) and type of pastures (temporary vs permanent) were assessed by t-tests. The proc freq statement was used for the analysis of categorical variables. Chi-square test was used to test equality of proportions while the Fisher exact test was chosen to test the independence of the relative proportions of one variable with regards to the second variable. Cell-chi square option was used to identify parameters whose contribution to the chi-

square value was high so influencing importantly the p-value. Cochran Mantel Haenszel chi-square test was used for large categorical ranges.

1.4 Results

1.4.1 Context

Questionnaires were sent to 3.152 dairy producers and 1.016 completed forms were returned representing a 32,23% response. Nine hundred seventy-five were sent back by prepaid mail. 20 were collected during conferences or other meetings. 20 were sent back by mail (paid by the farmer). Nine forms could not be valorised: two came from Belgian Blue exploitations with low milk yield (MY). 6 were incomplete (only 1 sheet) and one was not completed at all. Out of the mostly completed ones, 14 did not indicate their exploitation system and thus could not be identified as conventional or organic (1.3% of answers). The forms where a change from conventional to organic system was mentioned were assigned following this rule: if the change from conventional to organic should occur in 2016, they were accounted as organic. If the change was expected in 2019 (the farms which start their conversion project), the forms were included in conventional systems. By using this repartition key, 90,7% answers were received from conventional and 9,3% from organic farms. These figures comply with the proportion of the two systems in Belgium (Anonymous$_a$, 2015). Almost 4 out of ten farms (37%) were specialised in dairy production, while 21,6 % produced meat and milk, 13.5% produced milk and cereals and finally 28% produced meat, milk, crops. The range of reported activities was statistically different in organic farms ($p<0.001$) with half of the organic farms being specialized in dairy production (52,2%). The majority of the farmers was over the age of 50 (59.3%). Seventy-eight % of the farms were owned by one person. No difference in age distribution was apparent in the different farm categories. In organic farms, only 13% identified more than one person working on the farm. Most helpers were aged of less than 30 y (58,33% - 7 answers). In 23 % of the conventional ones, more than 1 worker was identified on the farm. The age of most helpers was between 30 and 40 y (42,2%- 87 answers) while people aged of less than 30y represented 33,50% (69 answers).

1.4.2. Farm size and milk production levels

The agricultural area on 75,7 % of the farms was less than 100 ha and 86,2% of the farms had less than 100 dairy cows (Fig.1). Milk production was below 8.000 litres per cow per year in 70,7% all systems combined. The producers of more than 10.000 litres represented around 3,1% of the farms.

1.4.3. Comparison of organic systems with conventional ones

The activities developed on the farms differed in organic and conventional farms demonstrating a higher specialisation in dairy production in organic farms since 52 % of organic farms vs 35,9% in conventional ones produced only dairy products ($p<0,01$). Organic systems included small farms structures: 81,5% with less than 100 ha ($p>0.05$) – 93,5 % with less than 100 dairy cows ($p<0,05$) and a reported MY of less than 8000 litres in 98,9% of the farms ($p<0,001$). In comparison, figures from conventional farms are the following: 75,5% with less than 100 ha, 85,7% with less than 100 cows and a MY of less than 8.000 litres per cow and per year in 67,78 % of the conventional farms. Around 3%´of the conventional produced more than 10.000 litres/cow/y compared with only 1.1% in organic ones. The Holstein cows were the most represented breed with 79,2% (81,3% in conventional vs 57% in organic farms; $p<0,001$). Following the survey, 7,1% in conventional vs 8,7% in organic farms have more than one breed in the herd.

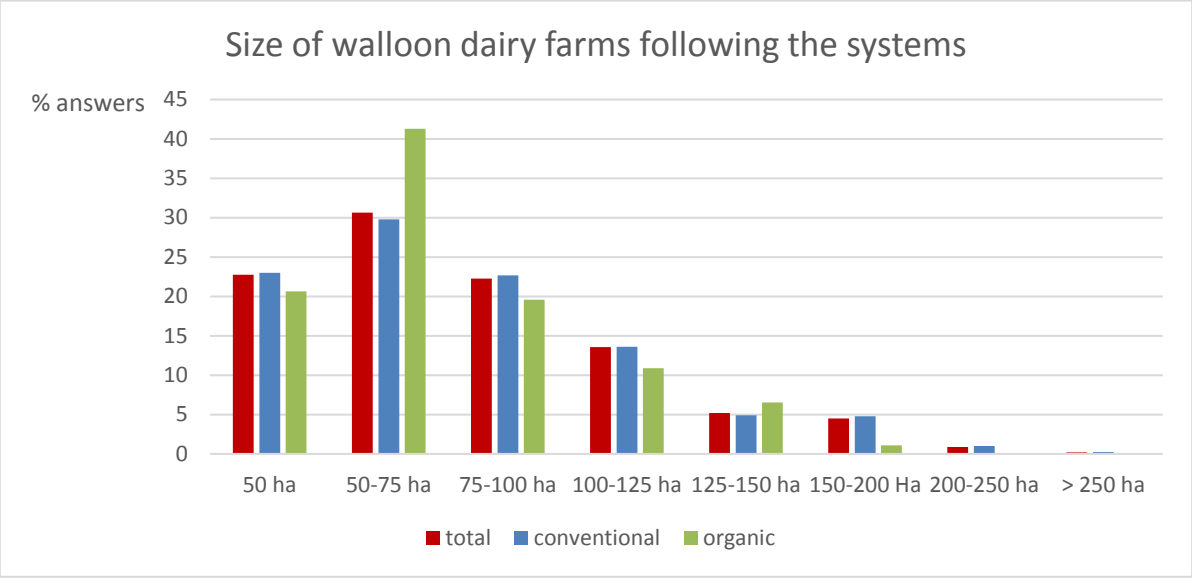

Figure 1.: Repartition of the size of Walloon dairy farms in conventional and organic farms (% answers): total and comparison within systems. The difference of distribution of surfaces between organic and conventional is NS for each range.

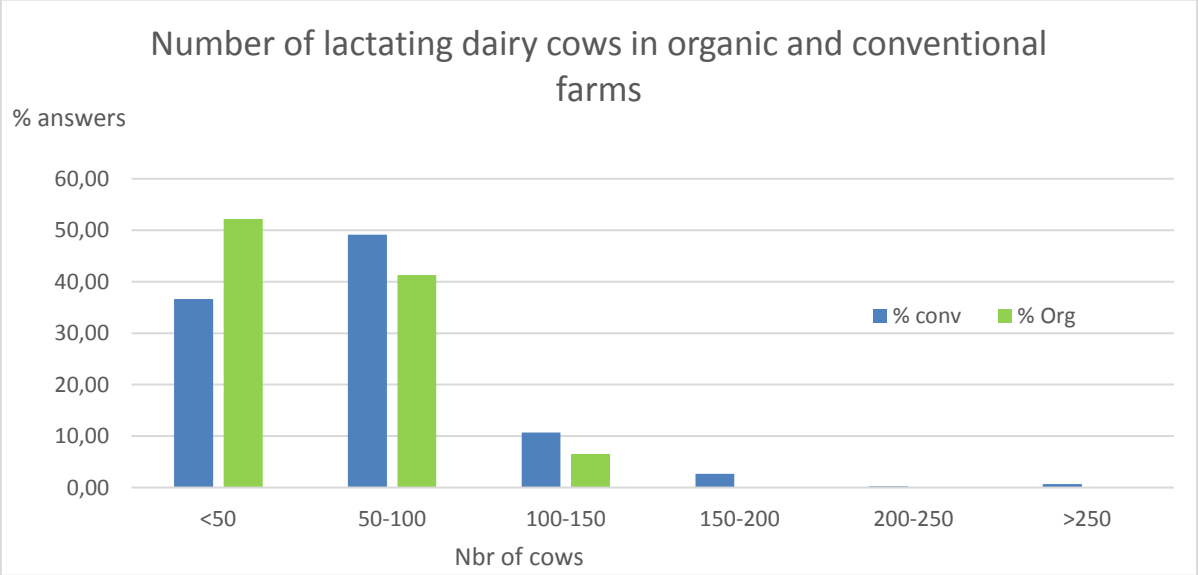

Figure 2.: Comparison of the number of dairy cows in conventional and organic farms. p<0,001

1.4.4. Comparison of zero grazing farms with grazing farms

Zero-grazing farms represent 35 answers with lactating cows had no access to grazing: 34 from conventional sector, one arising from an unidentified farm (no answer to the first question). Concerning access to pastures of other animals, 80% of young animals, 98% of heifers and 90,8% of dried cows were used to graze. Milk production was the main activity in zero grazing farms. Fifty-four % described milk production as their major activity vs 36,1% of grazing farms. Cereal cultivation occupies an important place in zero-grazing farms with 37% of answers (14,3% Milk + cereals – 22,9% milk-cereals

and meat). Zero-grazing herds were larger than farms with grazing: 28,6% of them had more than 150 cows compared with 2,4% of grazing herds with more than 150 cows (Fig.3). The agricultural area was higher than 125 ha for 25,7% of them vs 10% in grazing ones. The milk yield was over 8000 litres/cow/year for 71,4% in zero grazing herds compared with only 27,9% in grazing herds over this production level. Increased size of herd and of exploitation seems thus hinder grazing.

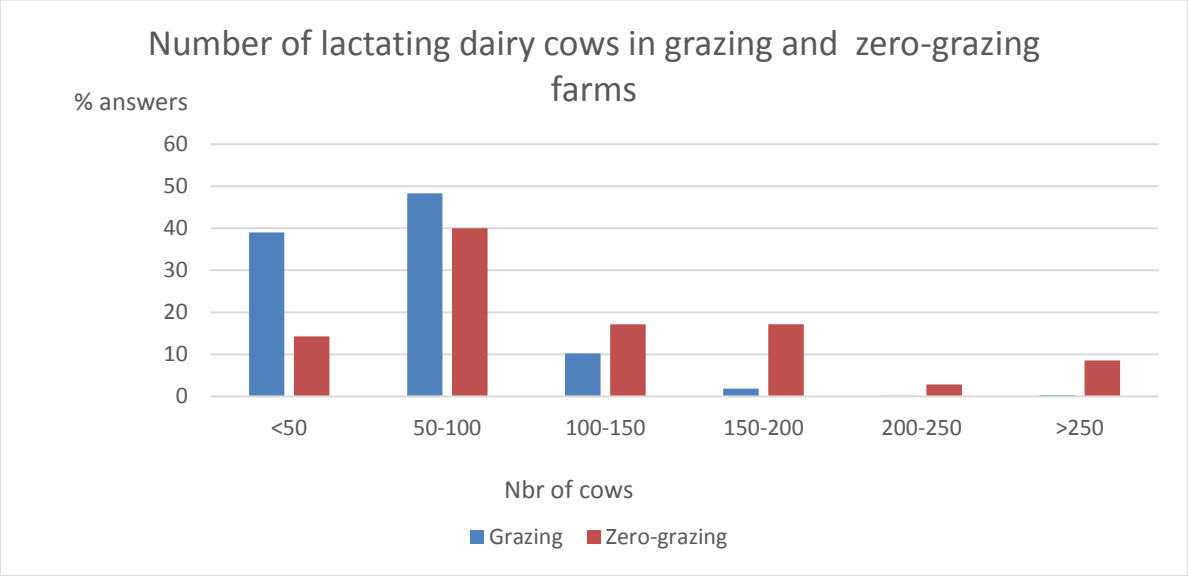

Figure 3.: Number of lactating dairy cows in zero-grazing and grazing farms

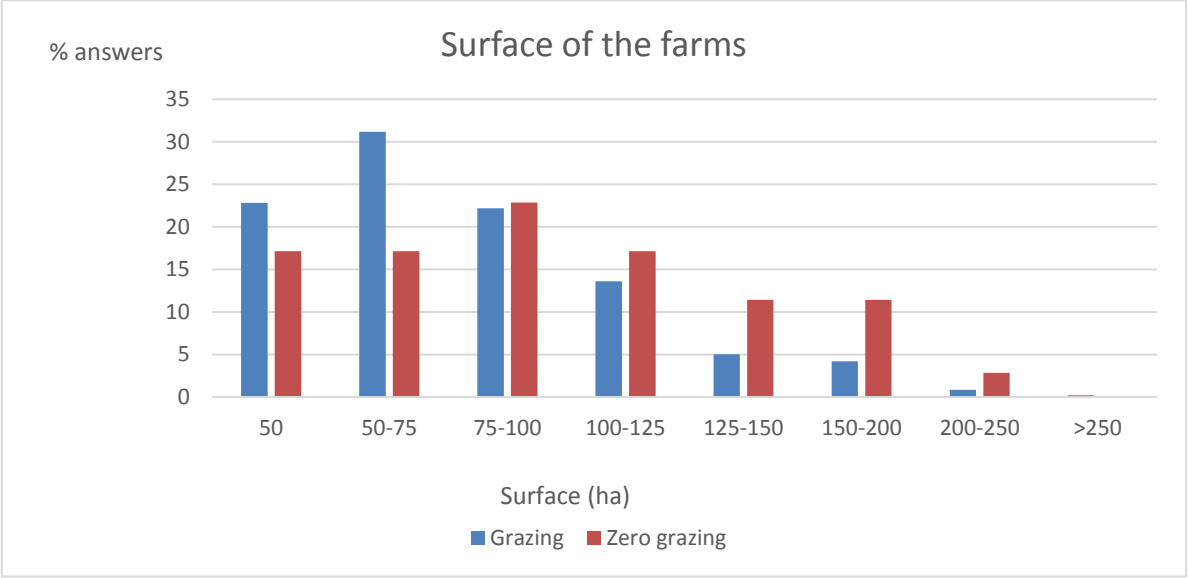

Figure 4.: Distribution key of surfaces in grazing and no-grazing farms

Table 1 . Statistical results of the comparison of several parameters between grazing and no grazing farms. Analysis of activity and surface comparison gave a trend (just below p=0,1)

Studied parameter	***p-value***
Activity specialisation	0,0975
Surface (ha)	0,0689
Nbr of dairy cows/farm	0,05
Milk yield per cow per year	<0001

1.4.5. Grazing practices

According to the survey, grazing was very common in Belgium with 96,5% of the farms grazing with their lactating cows. In the conventional farms, 79 % of the young animals, 98% of the heifers, 96% of the lactating cows and 90% of the dry cows were at pasture during 2015. In organic farms, not surprisingly, grazing was more usual with 92% of the young animals, 99% of the heifers, 100% of the lactating cows and 97% of the dry cows. The length of the grazing season was mostly 4 months and more (96%). Most farms grazed the lactating cows day and night (74%). Hectares available for grazing of lactating cows were on average 19,1 ± 14,5 ha (n=937) with median = 15,00 ha, minimum = 0, maximum = 77 ha. This amount differed following the systems: The mean grazeable area for dairy cows was 18,2 ± 14,4 ha in conventional systems (n= 843) compared with a mean area of 28,4 ± 13 ha in organic systems (n = 84; p< 0,001). Supplement feed was given to the lactating cows in 98% of farms during the grazing period. Moreover, 71 % the grazing farms used supplement all the time in conventional vs 38,4% in organic farms. Maize silage and concentrate mix were the most frequently used supplements during the grazing season (Fig.5). In most farms (77,2%), supplements given to the cows included more than one component. These mixtures were composed of maize silage + grass silage in 24,6% of the farms and for 59,6% of maize silage, grass silage and mixed compounds. Cereals were more rarely incorporated in the mixed supplements (cereals + mixed compounds: 8,6% and cereals +maize silage + grass silage: 7,2%).

Due to this high level of supplementation, intake of grass in summer period was evaluated to less than 50% of total dry matter intake in 42,3% of the farms (42,8% of conventional farms vs 13,6% in organic farms; p<0,001) (Figure 6). Only 3,4% of farmers estimated an intake of grass of more than 75% of total intake during the summer (3,4% in conventional farms – 27,3% in organic farms). It must be noted that 14,7% of farms cannot answer this question. In 9% of organic farms cows did not receive any supplement at all during the summer and 88% of the farms estimated an intake of grass of more than 50% of total intake. Only 3,4% organic farmers could not answer.

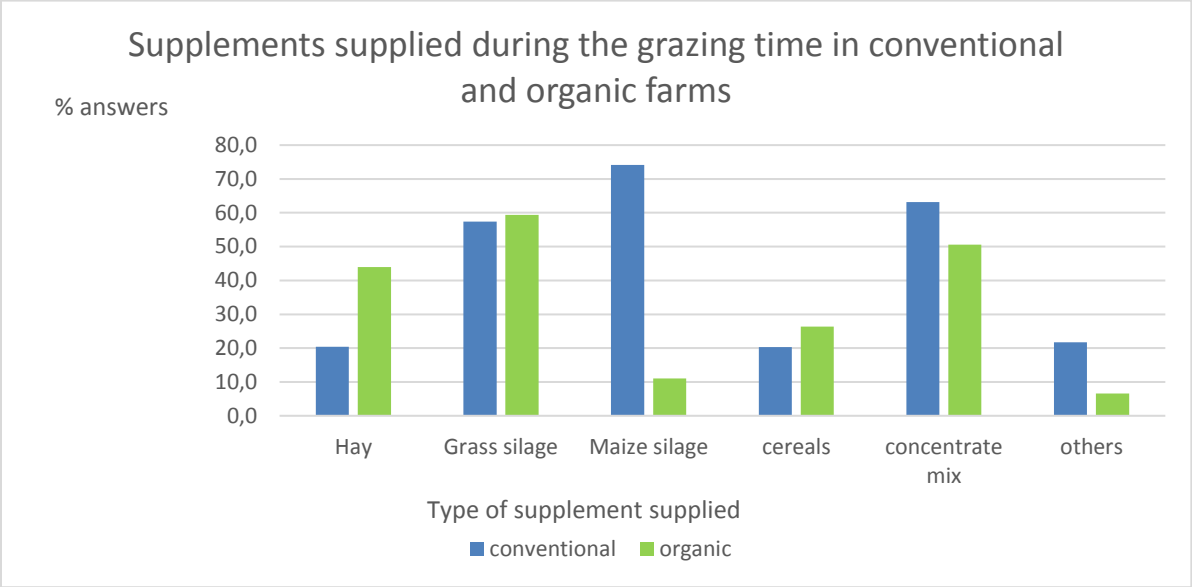

Figure 5.: Supplements supplied during the grazing time in conventional and organic systems.

The supplement allocated to lactating cows differs between the systems with a larger proportion of herbal products in organic farms with 74,7% of them supplying hay or grass silage or both compared with 60,1% of conventional ones ($p<0,001$). On the contrary, maize silage was the most frequently allocated supplement in conventional farms. Compound feeds were allocated in 60,8% of conventional farms compared with 50,5% in organic farms ($p=0,07$). The proportion of grass in the winter diet was estimated at more than 50% in 51% of the farms (48% of the conventional farms-86,8% of the organic farms, $p<0,001$). That is explained by the high percentage of grass silage incorporated in the winter cows 'diet in Wallonia.

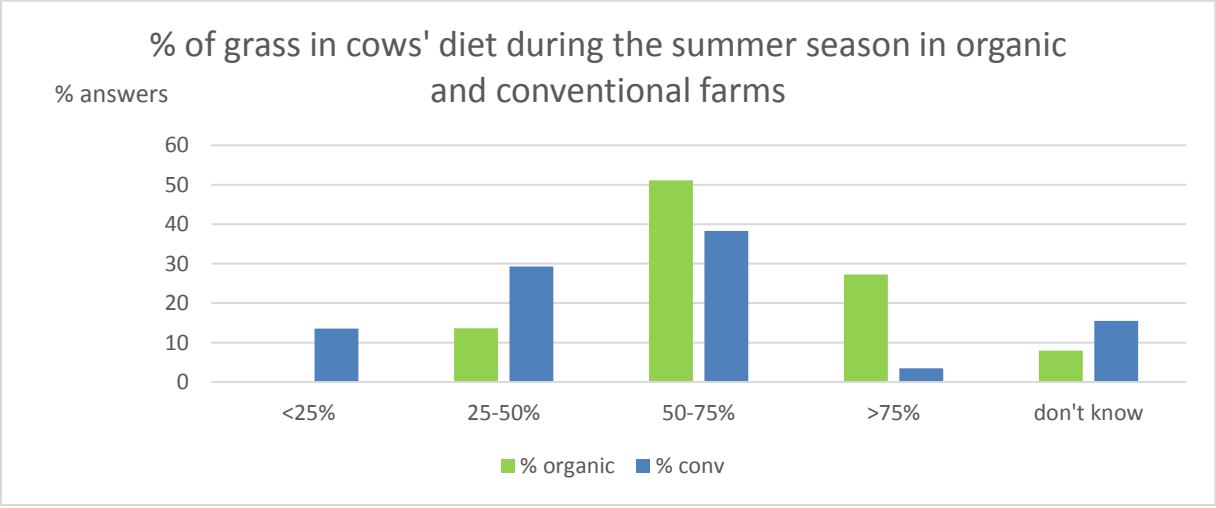

Figure 6.: Comparison of percentage of grass included in summer's diet in conventional with organic systems.

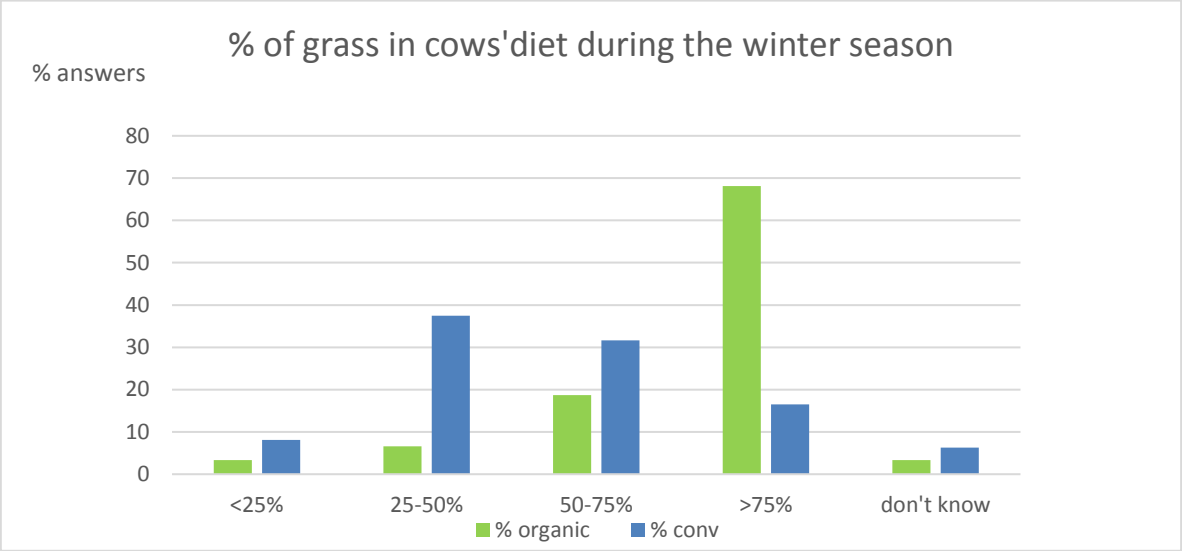

Figure 7.: Comparison of % of grass in cows' diet at barn in conventional and organic farms.

1.4.6. Opinion about grazing

The opinions about grazing differed between the systems. Conventional farmers considered that grazing, is beneficial for animal welfare (94%), landscape (81,8%), decreases production costs (76,8% of farmers) and is positive for environment (73,7%). Their expectations were to increase grazing at 42,2% of farms and keep it constant (39,9%), 4,5% expected to stop grazing and 13,4% expected to decrease this practice.

Among the organic farmers, a consensus opinion was more marked: 92,1% considered grazing decreased production costs, 99% that it was beneficial for animal welfare, 91,9% that it had a beneficial impact on landscape and on environment (88,3%). For organic dairy farmers, grazing was expected to be increased (56,3%) or kept constant (38,7%). Only 3,8% the organic farmer expected to stop grazing.

In zero-grazing farms, the opinions about grazing were very different. A majority (45,5%) declared that grazing did not decrease production costs compared with 30,3% claiming a positive effect on these costs. Only 42,2% thought that grazing is beneficial for cows' health, and respectively 30,3 % and 39,4 % estimated that grazing is positive for environment and landscape preservation.

1.4.7. Reasons of no grazing

The 35 no-grazing farms were questioned about the reasons for no-grazing. The answers can be divided into 3 topics: environmental, economic and management. Environmental reasons including poor weather condition, poor soil conditions and both were cited by 9/35 farmers. Management difficulties were cited by 27/35 non-grazing farmers. They included difficulty to manage cows in pasture (18/35), the distance to pastures (12/35) and limited grazeable areas (20/35). These factors are combined in some cases (13/27): distance and lack in grazeable areas were cited both together by 5 farmers out of 13, lack in grazeable areas and difficult management by 3 out of 13 and finally distance and difficult management by 5/13 farmers. Economic reasons including lower milk production at pasture and other economic factors were given in 40% of the answers (14/35).

1.4.8. Technical questions about pasture management

Several figures about the management of temporary and permanent grassland have been enquired: the area (ha), the average production (t/ha), the relative resource allocation (% of the production affected as silage, hay, grazing of lactating cows or of heifers, % unused). Should the grass production be used as a silage, the number of cuts had to be mentioned. Moreover the age of the temporary grasslands, the amount of organic and mineral fertilizer used (kg/ha) and the percentage of leguminous observed were requested. Out of the total received forms, 939 provided information about this question. Five hundred ninety-nine forms were consistent, that means that the sum of percentages of allocated resources reached 100%. Other forms were incomplete or presented some discrepancies. Only the consistent forms were used to determine the use of grass in permanent and temporary grasslands while all the completed forms were taken into consideration to determine the mean surface, production and fertilizer use.

The table 3 gives an overview of the figures describing the management of temporary grasslands.

Table 2.: Temporary grasslands: Figures reported from the surveyed dairy farms. SD: standard deviation, DM: dry matter

	N	*Mean ±SD*	*Median*	*Minimum*	*Maximum*
Surface (ha)	427	16,71 ± 21,33	10,00	0,40	153,00
Production (t DM/ha)	82	11,24 ± 3,59	11,00	4,00	20,00
Cuts (/grazing season)	421	3,13 ± 1,34	3,00	0,00	5,00
Organic fertilizer (kg/ha)	335	29,25 ± 17,69	30,00	0,00	120,00
Mineral fertilizer (kg/ha)	334	171,69 ± 193,64	150,00	0,00	1300

The table 4 gives an overview of the figures describing the management permanent grasslands.

Table 3.: Permanent grasslands: Figures reported from the surveyed dairy farms. SD: standard deviation. DM: dry matter

	N	*Mean ±SD*	*Median*	*Minimum*	*Maximum*
Surface (ha)	884	45,34 ± 28,78	40,00	3,00	200,00
Production (t DM/ha)	109	9,53 ± 3,09	10,00	1,00	18,00
Cuts (/grazing season)	861	2,31 ± 1,57	3,00	0,00	6,00
Organic fertilizer (kg/ha)	620	27,30 ± 32,66	25,00	0,00	500,00
Mineral fertilizer (kg/ha)	644	148,85 ± 193,64	173,71	0,00	2870

A statistical analysis was performed to compare the different parameters of temporary with permanent grasslands. Significant differences were observed between surfaces, the average surface of permanent grasslands being greater than temporary ones while a lower production and less cuts reported on permanent grasslands. The use of organic and mineral fertilizers was not significantly different (p >0,05). Some figures provided regarding the use of mineral fertilisers seem weird (for instance, the maximum value for permanent grassland was 2,870 kg/ha) letting suggest that data were expressed in other units than suggested by the questionnaire. No detail was available to allow further contact with the surveyed farmers and to verify the validity of the answers. To get a more precise overview of the use of mineral fertilisers, a study by class was performed: class 0: 0 kg/ha, class 1: between 0-150 kg/ha, class 2: between 150-300 kg/ha, class 3: between 300-600 kg/ha and finally class 4: over 600 kg/ha. A comparison between these levels of mineral fertilisation was made between temporary and permanent grasslands (Figure 8). This analysis shows that the use of fertilisers over 600 kg/ha was marginal (1,83% of answers on temporary grasslands and 1,42% on permanent grasslands).

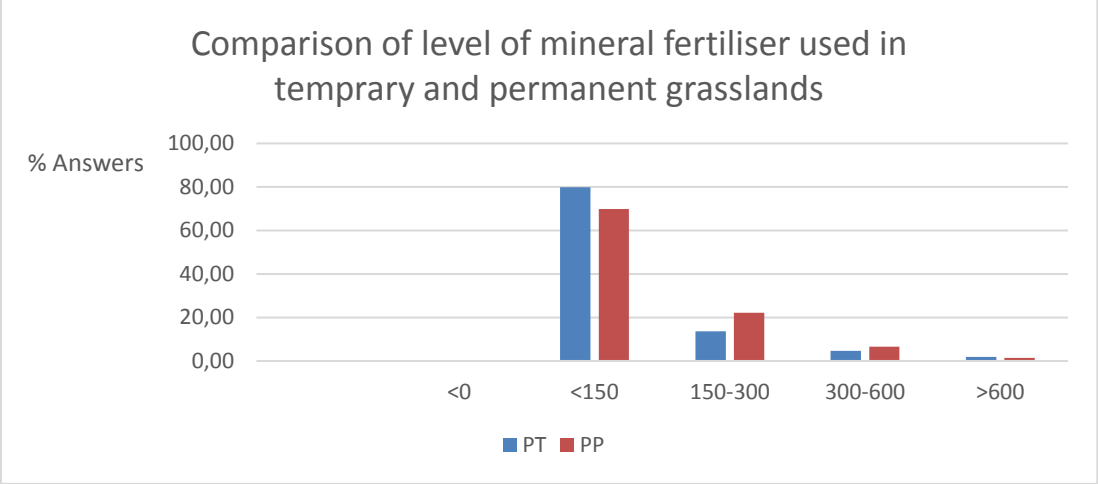

Figure 8.:Comparison of use of mineral fertiliser on temporary and permanent grasslands.

The parameters of temporary and permanent grasslands were compared with regards with the conventional an organic system.

*Table 4.: Comparison of production parameters in temporary and permanent grasslands: impact of the system. Values: mean ±standard deviation. DM: dry matter. *: p<0,05 ***: p<0,001. NS: non significant.*

	PT			PP		
	Conventional	Organic	p-value	Conventional	Organic	p-value
Surface (ha)	16,13 ±21,16	23,48±20,91	*	44,54 ±28,19	54,56±33,25	***
Production (t DM/ha)	11,22 ± 3,49	11,33 ± 5,32	NS	9,57 ± 3,07	9,09 ± 3,67	NS
Cuts (/grazing season)	3,12 ± 1,34	3,23 ± 1,22	NS	2,30 ± 1,59	2,40 ± 1,42	NS
Organic fertiliser (kg/ha)	29,23 ±17,78	29,40±18,11	NS	27,02 ±32,00	31,03±38,21	NS
Mineral fertiliser (kg/ha)	177,4 ±198,8	117,7±140,8	*	155,5 ±179,9	90,46 ± 65,6	***

In temporary and permanent grasslands, surfaces were significantly larger in organic systems. The evaluated production, the number of cuts and the amount of organic fertiliser were not statistically different between the systems. The use of mineral fertiliser was lower in organic systems.

1.4.9. Temporary grasslands: Age and percentage of leguminous

The age of temporary grasslands was reported equal or superior to 2 y for 72% of answers. No difference was observed between the systems by the chi-square test while the Fisher-test provided a p-value slightly over the significance level (p=0,06).

The percentage of leguminous was mostly around 20%. The chi-square test was significantly different between organic and conventional systems with a higher frequency of % of leguminous observed in conventional farms and more observed values ≥ 40% of leguminous in organic ones.

1.4.10. Use of grass produced on temporary and permanent grasslands

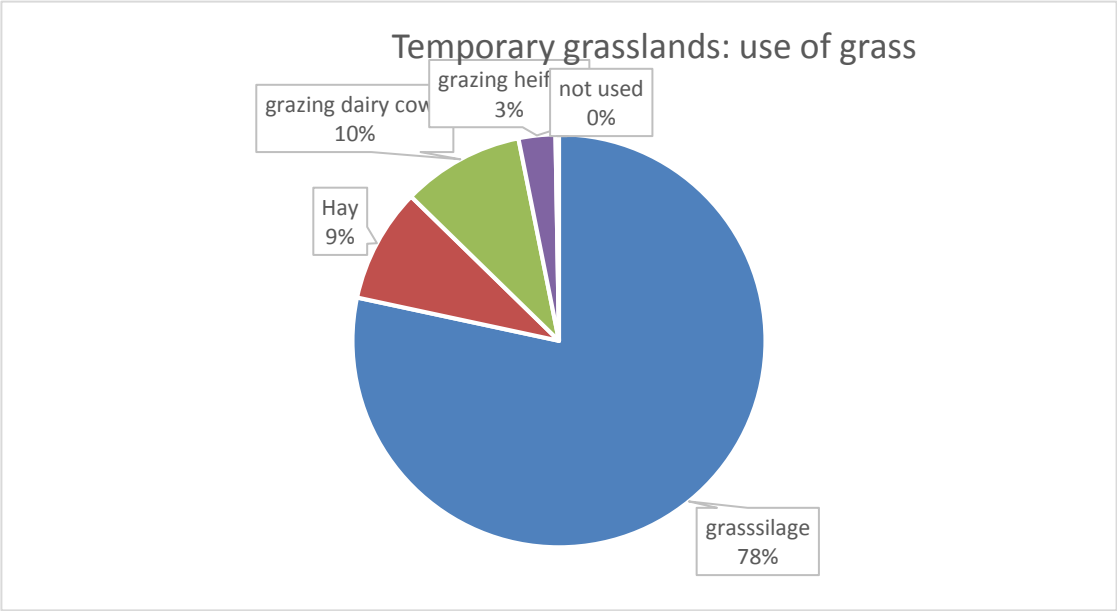

Figure 9. : Percentage of grass production and their allocation in temporary grasslands.

Grass of temporary grasslands was mostly used as a silage (78%), followed by grazing for lactating cows and hay.

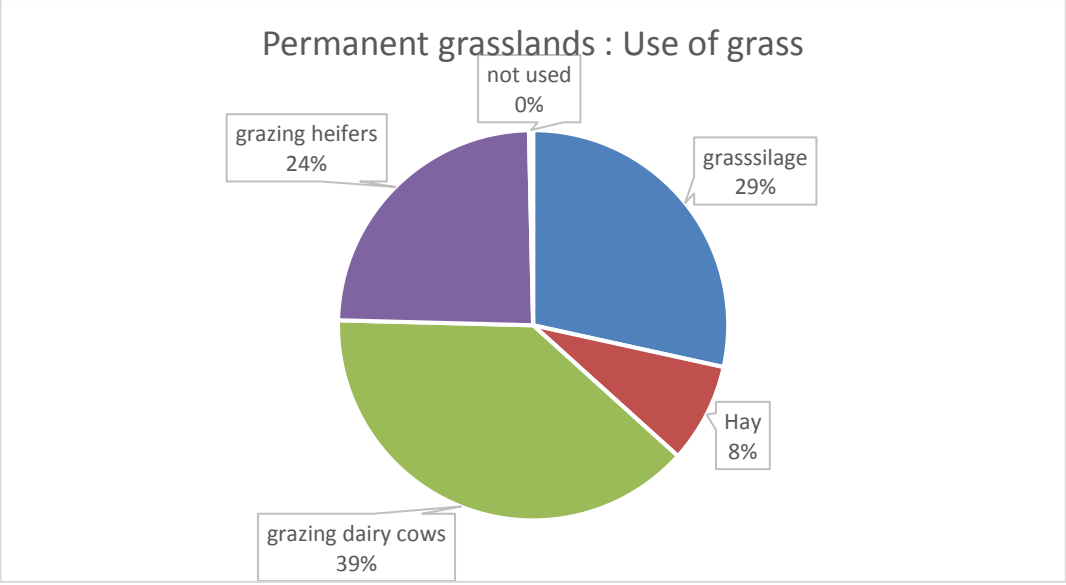

Figure 10.: Use of grass in permanent grasslands.

On the contrary, permanent grasslands were mostly used for grazing of lactating cows (39%) and heifers (24%). The part of grass silage represented only 29% of the allocation.

1.5 Discussion

1.5.1. Comparison with official figures

The high answer rate (32,3%) obtained for this survey should allow a good reflectance of the Walloon grazing practices. However, some figures differed in this survey from the official sources. The mean surface of Walloon farms was following the report "Evolution of the agricultural and horticultural economy 2011-2012" was 53,4 ha and 56 ha in 2015. Around 64% have more than 30 ha (Anonymous$_b$, 2015). Following the results of our study, 46,6% of the farmers reported an agricultural surface of more than 75 ha, letting suggest a higher size of the farms.

Following the official reports (Anonymous$_b$, 2015) in 2013, 1,78 labour units was present by farm. This figure seems lower in our survey with less than 1,25 labour unit. The result of the survey could be reduced as the questionnaire did not offer the opportunity to give a different answer for more than one helper. Thus, if two or three helpers were working on the farm but within the same age range, only one data was taken into consideration. The majority of farmers were over 50-year old. The distribution key of farmers 'age is different following the survey and figures from "L'Agriculture wallonne en chiffres", 2015 (Figure 11. Chi-square test: $p<0,05$). A greater proportion of farmers of 50-60 y old was noted while the class over 60 y was less represented.

The diversification of production is often proposed as a way for increasing the revenues of farmers and decreasing their vulnerability to the volatility of prices. It seems that this advice is more commonly followed in conventional systems with only 36% of farms specialised in dairy production than in organic farms where specialisation in dairy products rises up to 50%.

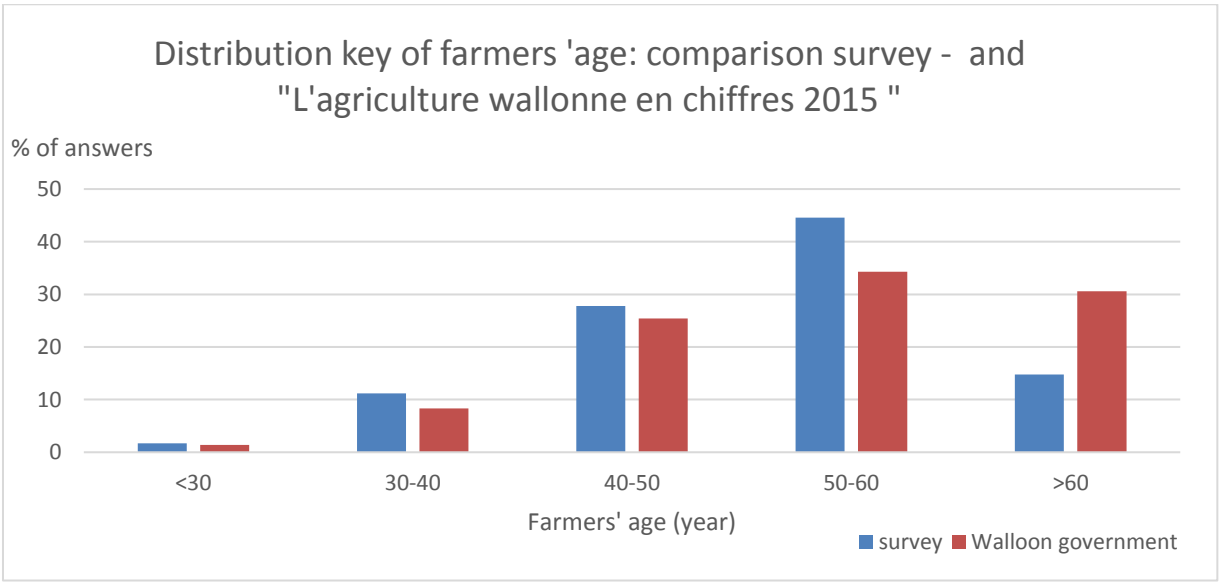

Figure 11 Comparison of farmers'age following "L'agriculture wallonne en chiffres 2015" and the results of the survey.

The average number of dairy cows following the report of the Walloon government was estimated at around 45 dairy cows per farm. Following the results of this survey, this number seems to be higher as 86,2% of farms reporting less than 100 cows/farms: 38% less than 50 and 48% between 50 and 100 cows. The mean milk yield per cow and per year was 6.819 kg per cow per year following official sources.

The same indication was provided by the survey with 47,6% of the farmers producing between 6.000 and 8.000 litres per cow per year.

These discrepancies between official sources and the survey could be due to several factors. The survey was completed on a volunteer basis, with the possibility to induce bias, e.g. in the age of farmers. It was sent to dairy farms only, which maybe have more surface and more animals. The official sources provided figures from 2013 and the dairy sector was deeply modified during the last years because of the milk crisis. However, other reports confirmed the increasing size of farms in Wallonia.

1.5.2. Comparison of conventional systems with organic ones.

Relative proportion of answers from conventional and organic systems comply with existing data from the Walloon and Belgian authorities (Anonymous a b, 2013-2015). Organic farms are mostly specialised in dairy production. This complies with the geographical distribution of organic systems which are more numerous in the Ardennes, the Famenne and the herbaceous region of Liège where the dairy production predominates. The surface of the farms is not significantly different from conventional systems while the herds usually smaller are composed for 50% of Holstein cows and 50% of mixed breeds. The average milk yield per year is lower than in conventional system. Almost all the animals graze. The surface devoted to cows' grazing is more important than in conventional systems and composed of 2 times more permanent than temporary grasslands. In other words, a large proportion of the surface of the farm is used as grassland. This is confirmed by other sources (Le Bio en chiffres, 2012). The estimated production of grasslands does not differ from these reported in conventional grasslands and the management is very similar (number of cuts and organic fertiliser used). The mineral fertiliser used is lower in temporary as in permanent grasslands of organic farms compared with conventional ones. The estimated % of leguminous is not different between conventional and organic farms in temporary grasslands while it tends to be in permanent grasslands (p=0,06), organic permanent grasslands having a greater proportion of 40% leguminous. Even if supplement feed is provided to the cows during the grazing time, its proportion in cows' diet is more limited and its nature is different with a higher dependence to herbal products (Hay and grass silage) than in conventional farms. In half of the farms, compound feed is allocated during summer despite the high cost of this kind of feed in organic systems. During the winter, grass remains a major component of the cows' ration. All the organic farmers are convinced about all the advantages of grazing (influence on production costs, cows' health and landscape preservation) and more than 90% of them will keep grazing at the same level or even increase this practice.

1.5.3. Comparison of grazing and no-grazing systems

Grazing is very common in Wallonia. A large majority of animals graze in all the surveyed farms with a more limited access to pastures for young animals. Only 35 farms on 1004 declared that their lactating cows do not graze. Dairy production is the main activity in these farms while a lower proportion of them producing milk and meat. These farms are also involved in cereal production in combination with milk or with milk and meat. The size of no-grazing farms is more important in terms of number of cows but also because of larger surface. The p-value (Exact test of Fisher) is just above the significant level (p =0,07) with a distribution pattern of surfaces with higher values than expected for surfaces of 125-150 ha and of 150-200 ha. The low number of this kind of farms reached by the survey was probably the cause for not reaching the significance level.

The predominance of the Holstein breed in zero grazing herds gives also an indication of specialisation of these farms with in parallel a higher milk yield than in other systems.

The opinion about grazing is diametrically opposed to those of other groups. A large proportion of them does not recognize the decrease in production costs allowed by grazing and they are less convinced about other advantages (cows' health, environmental and landscape preservation) with more neutral opinions compared with the other farmers.

The reasons for no grazing are mainly funded on management that seems more problematic e.g the difficulty to manage grazing cows, the limited grazeable area and the distance between pastures and farms which are frequently cited. The increased size of the farms requires more grazeable areas nearby the farm and thus becomes a limiting factor to grazing. On the other hand, the diversification in several productions requires more time and work units. Time spent to manage grazing becomes thus too important. Economic reasons are evoked in 40% of answers and include mainly the decrease in milk yield at grazing.

In conclusion, the aim of these zero-grazing exploitations seems to reach a high milk yield and grazing is perceived as a brake on production. Following their opinion, grazing offers too few advantages to compensate time expenditure and difficulties in management.

1.5.4. Comparison permanent and temporary grasslands

Data about permanent grasslands are provided by 916 farms/1004, while the temporary grasslands are cited in less than half of the farms (449) demonstrating the importance of permanent pastures in Belgium. The average surface is also larger in permanent grasslands with a lower reported productivity. This smaller figure could be due to the difficulty to assess the productivity because grazed grass is the main output of these pastures. The estimated productivity of permanent and temporary grasslands comply with values from literature (Deprez et al., 2007; Knoden et al., 2007). The amount of N-mineral fertilizer is on average between the ranges of recommendations (Knoden et al., 2007). Some extreme figures impact the value of the respective means but they are sporadic as it was demonstrated by the analysis by range of fertilisation. The percentage of leguminous is different in temporary and permanent grasslands with an observed lower % in permanent pastures, likely due to the inclusion of higher percentage of leguminous seeds at sowing and so the impact on the productivity. The use of organic fertiliser is correlated to the % of leguminous and in accordance with the fixation capacity of the pastures. The age of temporary grasslands is higher than 2 years, in accordance with recommendations.

1.6 Conclusion

More than 30 % of the dairy farmers answered the questionnaire. Although farmers were very positive about grazing and expected to continue with the practice, the proportion of grass in cows' feed was moderate, even during the grazing period, and a high level of supplementation of grazing cows was reported. This may suggest low confidence in grass quality and quantity. Despite a limited economic benefit due to the high supplementation level, the reasons given for retaining grazing were the reduced feeding costs and improved cows' welfare. Organic farmers were more convinced of these advantages including the positive effect on the environment and preservation of landscape. Zero-grazing farms stop grazing mainly because of difficulty in management. These could be due to the size of the farms and to other activities like crops. Economic reasons were also reported and in particular the decrease in milk production at grazing.

2 Luxembourg

2.1 Introduction

After the first consultations with the Belgian and Danish partners, the DairyClim committee had finally decided at the beginning of winter 2015 to develop an internet based survey tool in cooperation with the marketing department of the University of Liège. The basic ideas behind this approach were allowing to contact in a short time period a high number of potential farmers by e-mail and allowing so the data collection directly with the implemented Internet software by ULG communication department. But it turned out, that this was not a good approach. Many farmers were arguing, that it was not easy to answer correctly to the survey questionnaire and expressed often the desire to be accompanied by an advisor for the filling out of the form. So in a short term period, the decision for changing the approach for the Luxemburgish farms was made end of January 2016. The internet approach was replaced by a paper approach. These questionnaires had been allotted to the CONVIS advisors from the milk control service and they became awarded a 6 weeks period whereas they could ask the farmers personally to participate at the survey. With this approach, finally 62 completed forms had come back until the specified time at End of March 2016.

In a general way, it was relatively complicated to motivate farmers in the middle of the actual bad price crises spending time on a subject where they don't see the direct importance and consequently judge often as not directly useful for their farms.

2.2 Results

The presented results are based on 62 data sets. Ninety-five % are conventional farms and only a small number of 3 organic farms had participated at this survey. Due to this low number of organic farms, it did not make sense to provide separate figures for these three organic farms. Thus, the presented results include the whole dataset (organic and conventional farms).

2.2.1. Statistics about structure of farms in Luxemburg

A first part of the questions are especially points about the structure of the farms in Luxembourg. One of the most important outcome was, that the great diversity of farming systems in Luxemburg was clearly demonstrated and this diversity is maybe the most important difference compared to the two other countries. It is an important factor explaining many patterns of behavior of farmers.

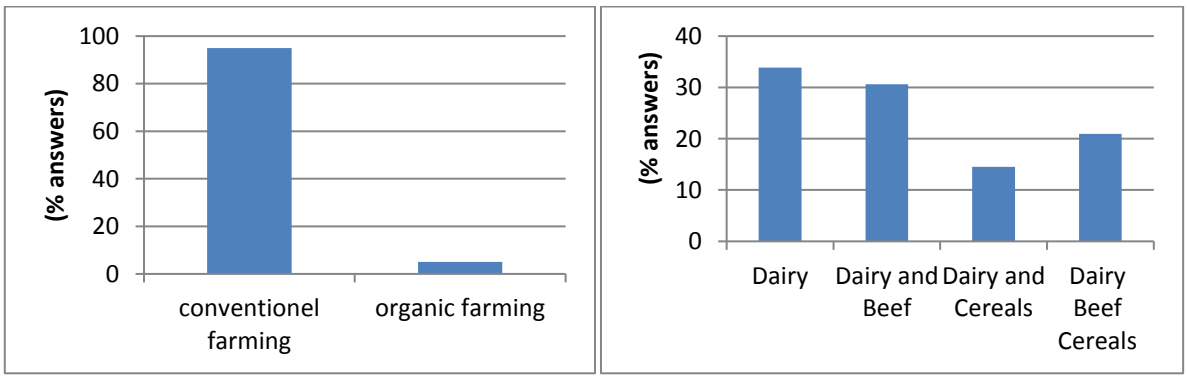

Fig 1.: Distribution between the different farming systems.

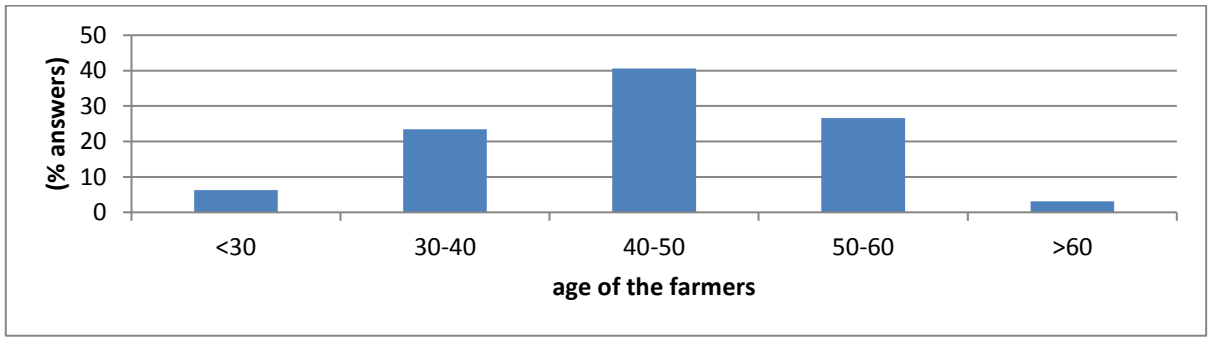

Fig 2.: Distribution of the age of the survey participants.

Concerning the farm size, we evaluate it as important to set those results in relation to the global situation in Luxemburg. The datas about the national situation are coming from the Statec Institution and the annual report of the Luxembourg Agriculture Ministry. The farms of the survey participants are much larger than the average of Luxemburg which is strongly influenced by the small farms of the wine producers. Another interesting point is that the DairyClim Farm Pool contains much more farms over 100 ha than the national distribution.

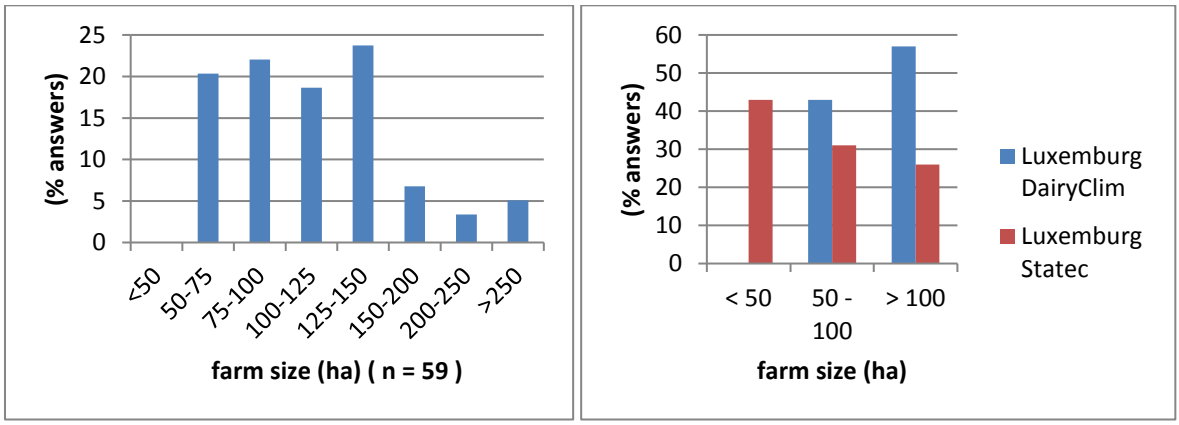

Fig 3.: Distribution of the farm size. (DairyClim in comparison with the whole Luxembourg Farm)

Concerning the herd size, the survey data pool expressed an atypical left summit distribution. This reflected the typical situation of the Dairy farm structure in Luxemburg where we see a small part of maybe 10 % of the farms which have more than 100 cows/herd and sometimes much more. This 10 % represents more than 20 % of the Luxemburgish dairy herd. The biggest farm in Luxembourg has a herd size of more than 450 dairy cows.

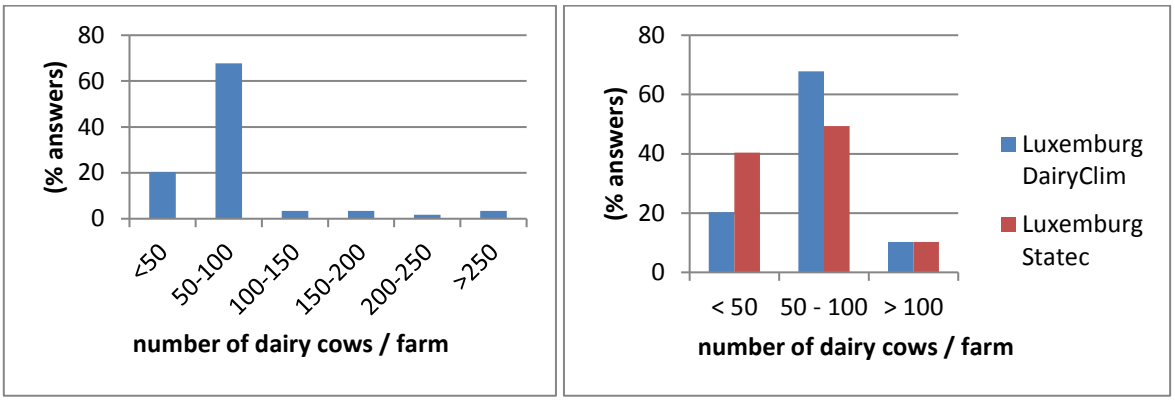

Fig 4.: Distribution of the herd size. (DairyClim in comparison with the whole Luxembourg Farm)

Concerning the milk yield per cow, it seems that the category of 8.000–10.000 liters is the most represented. It can be mentioned, that the average in the official Luxembourgish milk control figures between 7.500 to 8.000 liter/cow average for the last three years. Assuming that, we can conclude that the participants of this survey are rather best performed farms with above average results.

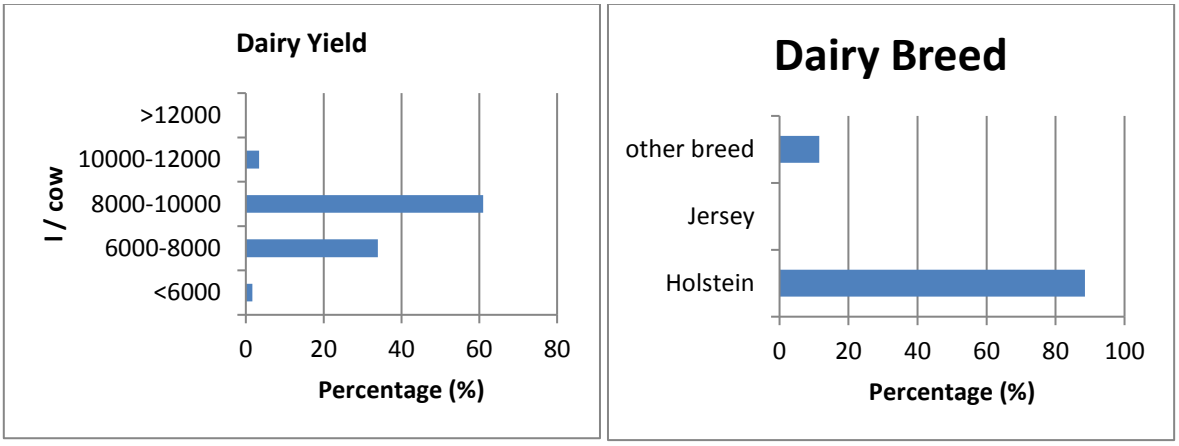

Fig 6.: The annual milk yield par cow and distribution of the three different breeds.

Important in relation to the results about the breeding is, that the advisory service from CONVIS checked constantly an increase of cross breads (Holstein X more robust breeds like “Fleckvieh”) or an integral change to Simmental/Montbeliard.

2.2.2. Statistics about grassland and grazing methods

As we can see on figure 7, farmers put much value on the improvement of animal welfare and they are hoping for positive effects from pasturing what is logical. Amazing is, that the environment impact of grazing were judged from a selection of 4 possible parameters as the least important. That is maybe a mirror of non-existent knowledge about relations of influencing factors of these complex evaluation systems.

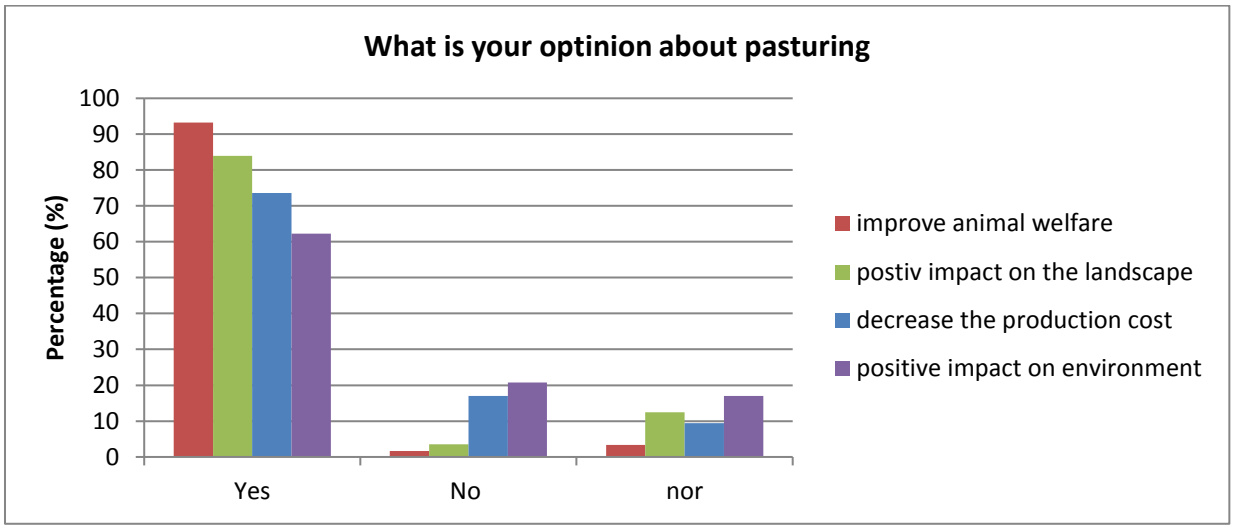

Fig 7.: Farmers opinion about pasturing.

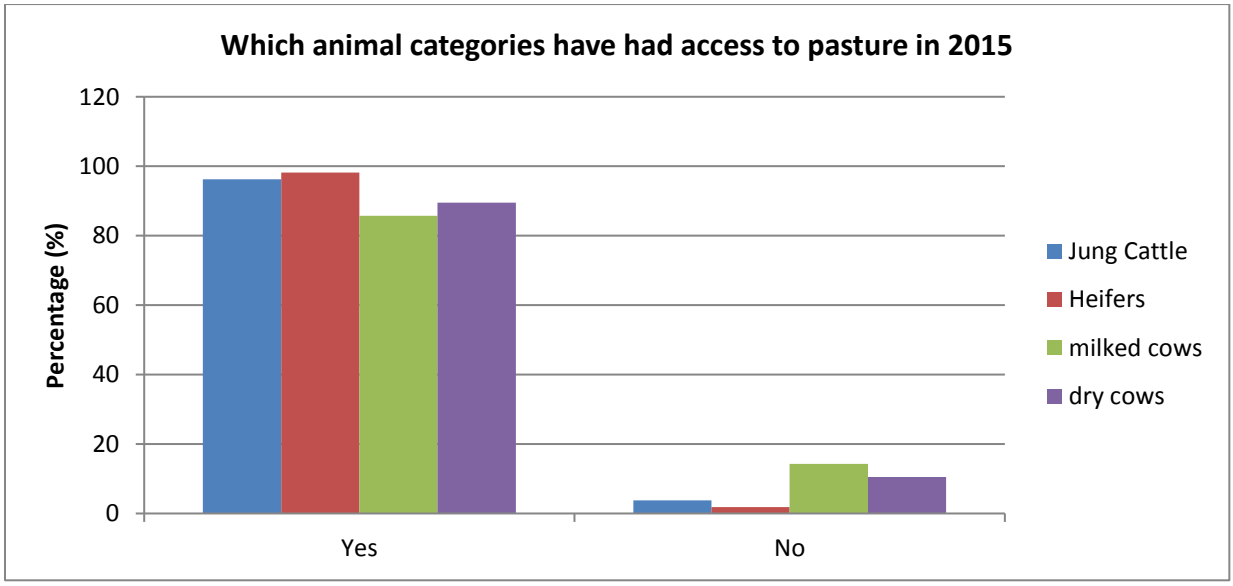

Fig 8.: Situation about access to pasture.

Over 80 % of the farms have grazing activities with all of their cattle categories. The intensity about grazing is expressed by the time passed on the pastures. And in this matter we have detected significant differences for the daily period going from a few hours per day up to 24 hours per day.

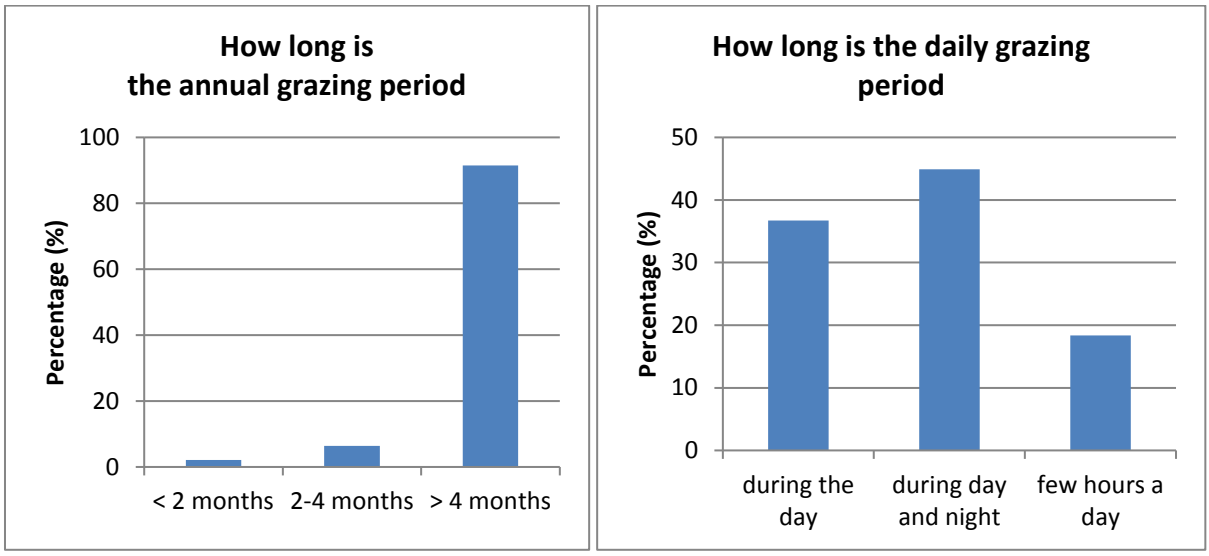

Fig 9.: Time levels of grazing activities.

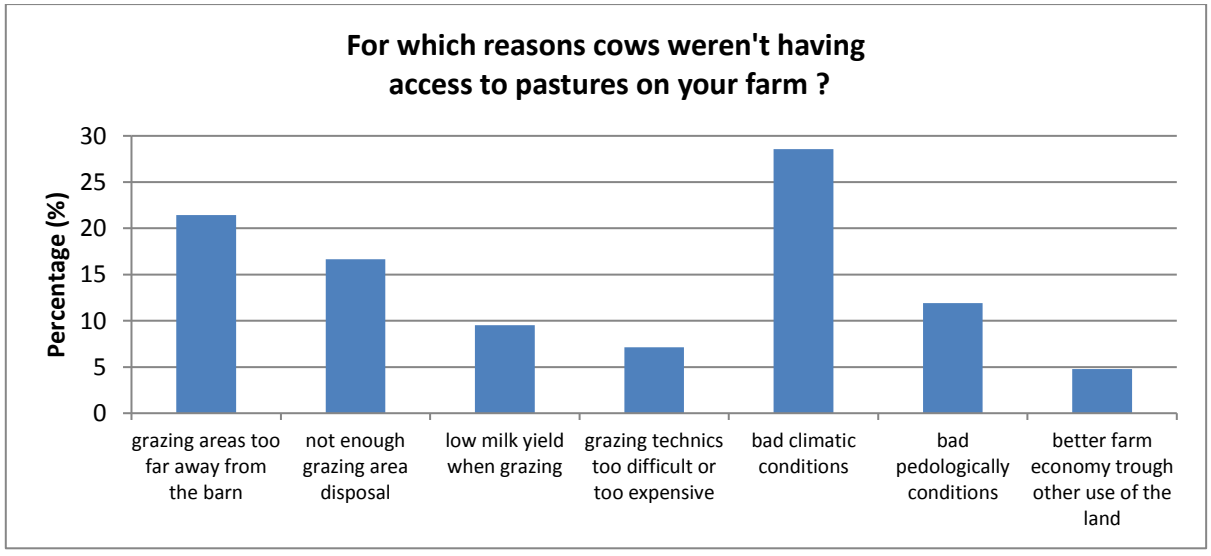

Fig10.: Reasons why cows weren't having access to pastures on your farm.

In this matter, the farmers were asked for which reason there cows had no access to pastures. Bad climatic conditions were the most frequently cited reason. This answer could maybe be influenced by the extreme drought conditions in the summer 2015 and so when farmers speak about climatic conditions, they are thinking primarily on their feeding stuff situation. During the last years, we see in Luxemburg very strong meteorological differences from one to the next year and that combined with sometimes extreme variation in forage yield. When the feeding is primarily based on an additional administered diet in the barn, for instance that mostly means for farmers a much easier risk management in relation with prediction of the forage situation for one harvest to harvest period.

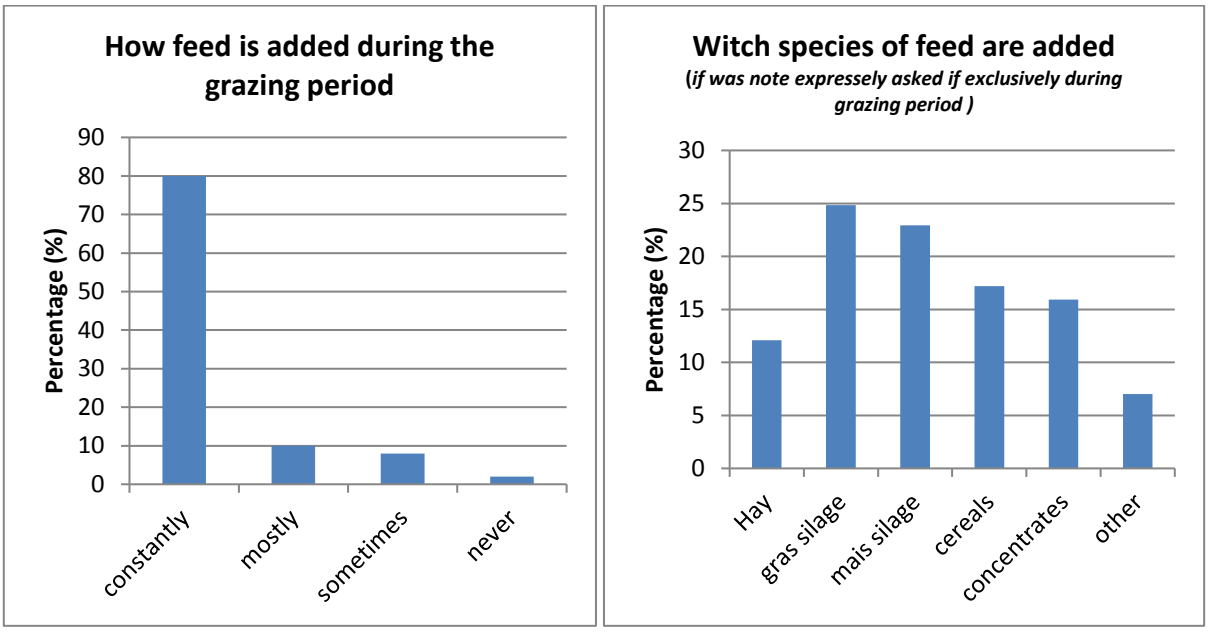

Fig 11.: Information about added feed during the grazing period.

It is not surprising that over 80 % of the farmers are adding constantly feed during the grazing period. A common argument for that coming from practice is in the end to catch a better persistence of the milk yield and milk ingredients. Something amazing is the answer, that grass silage is apparently the most important added feed. Therefore we had to conclude, that farmers were thinking that this question was not exclusively designated to the grazing period because for the case of a normal trend, during summer time, much more maize is added to the diets.

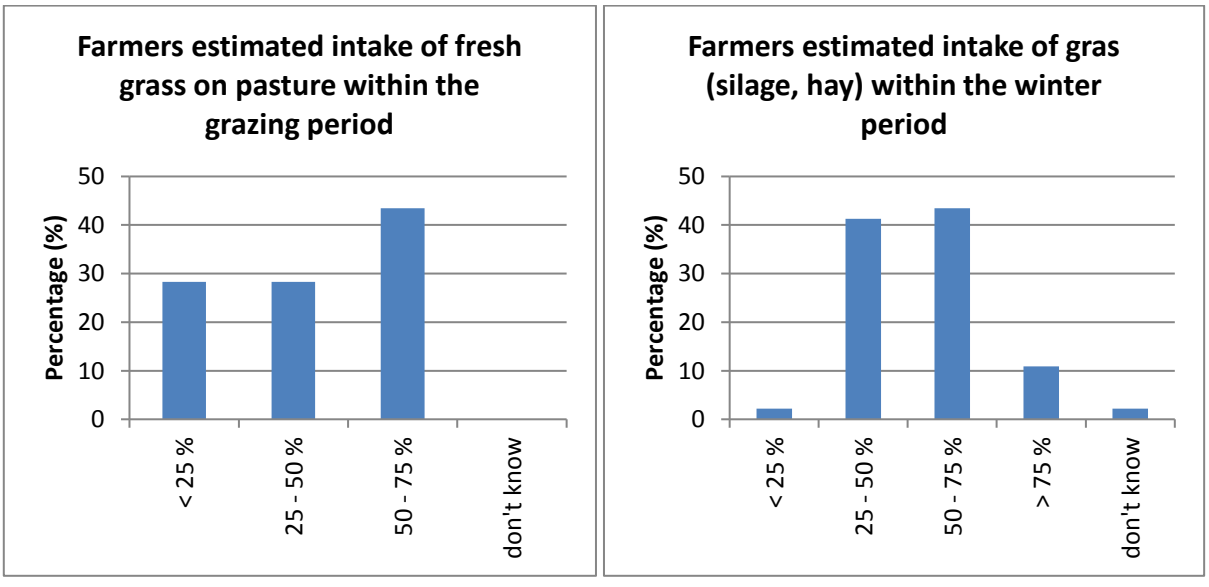

Fig 12.: Information about estimated feed intake.

In figure 12 are represented information about the percentage of grass intake for different year periods. Something amazing in this matter is the fact, that the part of farms with less than 25 % of grass in the diet is higher in the summer season than in the winter season.

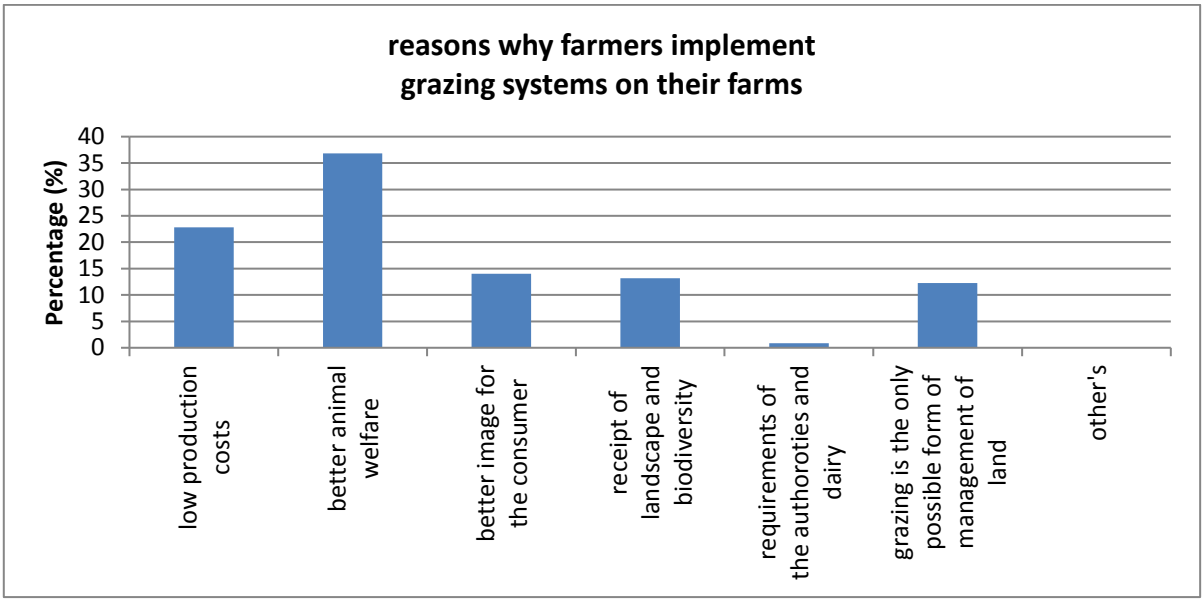

Fig 13.: Analysis about different motivations from farmer why implementing grazing systems on their farms.

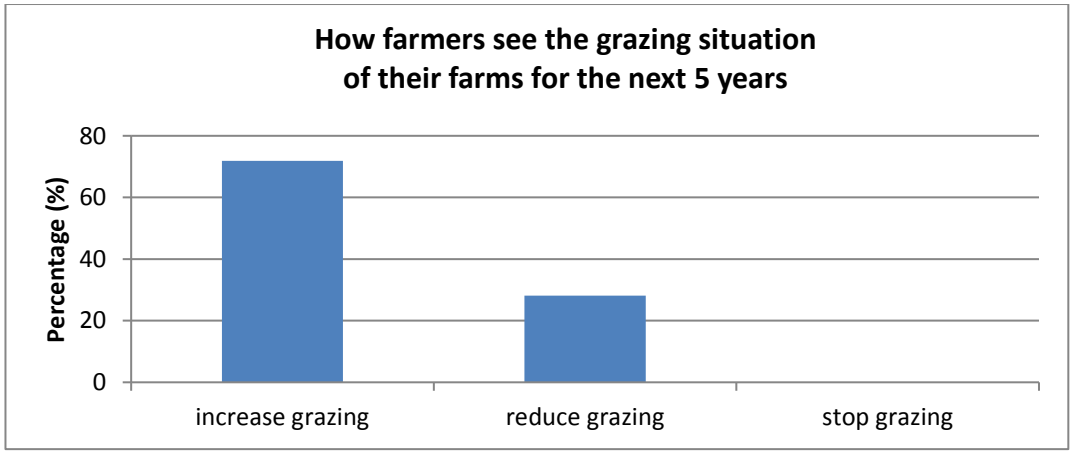

Fig 14.: How see farmers the future of the grazing situation on their farms.

Over 70 % of the farmers foresee an increase of the grazing activities on the next years. This result could be merged to the bad milk price, because it looks like that the factor input concentrate feed is less interesting and that the optimum specific intensity for concentrates strongly decrease.

3 Denmark

3.2 Introduction

How is forage production at dairy farms with special focus on grassland? This area has always been of interest as part of understanding productivity of dairy farming, and in the resent years also from an environmental perspective as grassland plays an important role in nutrient cycling, emission of greenhouse gasses and as carbon sink. In addition, has the decreased utilization of grassland by grazing been raised as an area of concern in relation to animal welfare and as part of nature preservation and value creation in the landscape.

The purpose of this investigation was therefor to get updated figures from dairy farming in Denmark and to compare these figures with the status in other part of EU through the EU Life project "DairyClim". In this report is a short presentation the status in Denmark based on a questioner made by the EU project.

3.2 Material and Method

Mail with a short introduction and link to questioner was send – by ARLA Denmark - to 2550 dairy farmers delivering milk to ARLA Denmark. In total 386 responded (15%) and 11 of these were deleted due to obvious mistakes and only answers to a very limited part of the questions.

In the questioner some important areas were grouped. In order to calculate and estimated average an average within each group was made based on the distribution of the answer in the groups. For farm land a new grouping was made by merging some groups due to a low number of farms in some groups (Table 1).

Table 1. Grouping, regrouping and assumed quanta within group.

Milk		Farmland (ha)			Herd size (no)	
Grouping	***Averageassumed***	***Grouping***	***New grouping***	***Averageassumed***	***Grouping***	***Averageassumed***
< 6.000	5500	<50	<50	40	<50	40
6.000-8.000	7000	50-75	50-100	75	50-100	75
8.000-10.000	9000	75-100			100-150	125
10.000-12.000	11000	100-125	100-150	125	150-200	175
>12.000	12500	125-150			200-250	225
		150-200	150-200	175	>250	325
		200-250	200-250	225		
		>250	>250	350		

3.3 Results

3.3.1 General results

The results presented are based on 375 farms, of which 334 where conventional and 41 organics. Average farms size was estimated to 170 ha for conventional and 235 ha for organic dairy farms (Table

2), and as seen in Figure 1 45% of the organic producer had more than 250 ha, while this was the case for 18 % the conventional farms.

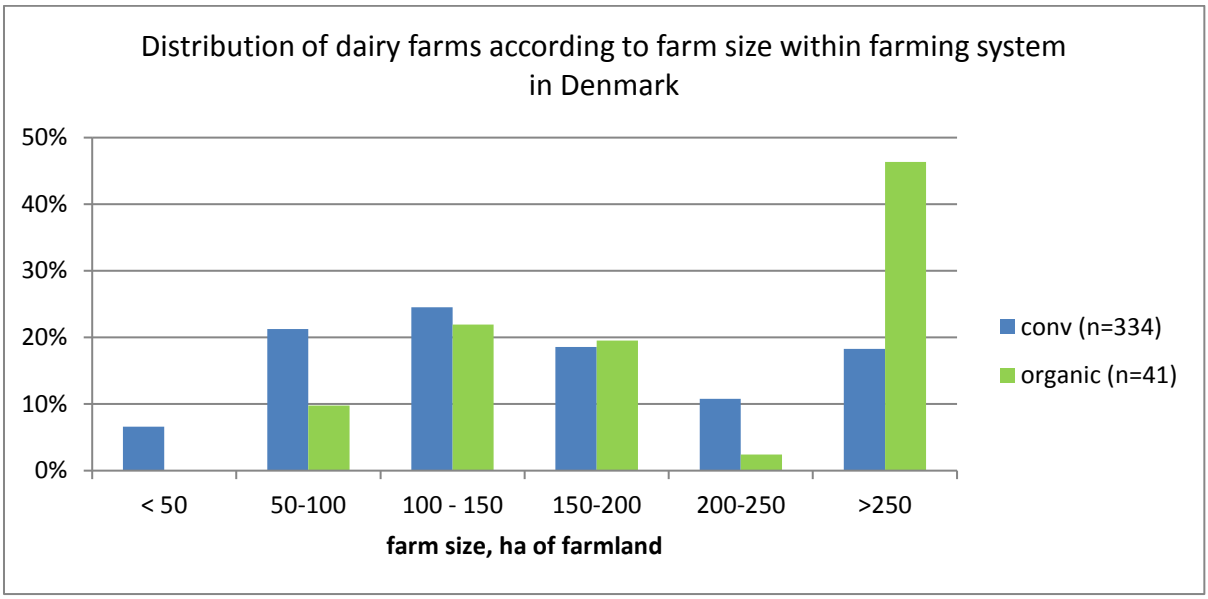

Figure 1.: Distribution of dairy farms according to farm size within farming system in Denmark.

Average herd size was close to 170 cows irrespectively of farming system, 16% of the farms had Jersey cows, 6% crosses or mixed breed and the majority, 78% has Holstein or similar type of breeds. Average annually milk production was estimated to 9250 kg EKM in organic and 10100 kg EKM for conventional. The most common herd size in organic was 100-150 cows, while 150 to 200 cows was most common among conventional dairy farms. From Figure 2 it appears that nearly 20% of both organic and conventional farmers had more than 250 cows.

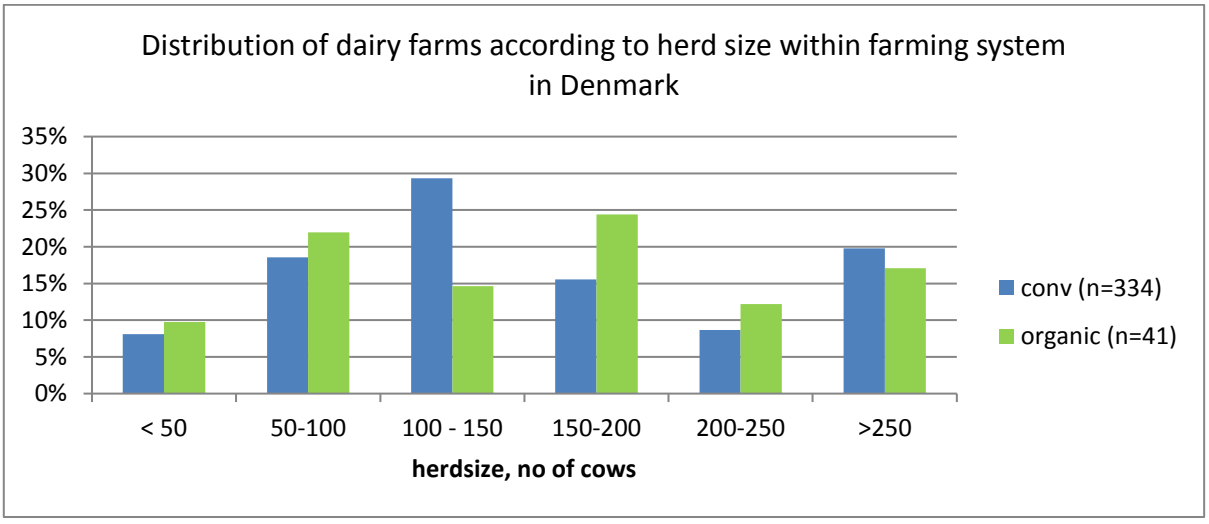

Figure 2. Distribution of dairy farms according to herd size within farming system in Denmark

Information about land use is more detailed in Table 2 with focus on grassland, either as part of the arable land or as permanent pasture (defined as area with more than five years of grassland in a row) and maize. These three type of land use accounts for 70 % of the total agricultural area across farming system. Other crops were not specified, but will be a combination of other type of roughage (whole crop silage based on grain or peas), grain for fodder or sale as well as a minor area with other type of cash crops.

In conventional farming was grass and maize on the arable area grown at 52 ha each, or 0,6 ha roughage per cow. Productivity was estimated to be highest, 10250 SFU (around 12.000 kg DM) per ha from maize used as silage, while the grass produced 83% of this both in term of energy and dry matter. The majority of the estimated production was utilized as silage, 65%, while the remaining was primarily utilized as pasture. The productivity from the permanent grass areas was lower, 28% of that from grass in rotation, and most of this was used for pasture. Input was also lower both as fertilizer and slurry. For maize was 69% of the area established with grass under sown in the maize which is expected to reducing the leaching of nitrogen.

In organic farming was the use of maize less common with only in average 8 ha of the arable land, while grass is more pronounced with 136 ha of grass, in total 0,85 ha roughage per cow. The estimated productivity of organic grass was 80% of conventional and for maize lower, 72%. The input slurry was lower at the organic forage area and due to the legislation the is no input of fertilizer, which might be the reason for the higher content of legumes 34% in organic compared to 21% of the herbage mass in conventional farming.

All these figures are simple means without correction for farm size, so at national level the figures might be different as there could be some bias to farm and herd size, illustrated by the difference in proportion of herbage utilized for silage.

Table 2. General descriptive figures for DK dairy farming within conventional and organic farming system

		unit	**conv**	**organic**	**conv**	**organic**
Herd size	*cows*	*no*	168	169	Figures after weight by ha of grassland	
Farm size	*agricultural area*	*ha*	170	235		
Grassland						
Arable	*Area*	*ha*	52	136		
	Production	*SFU per ha*	8550	6850		
	fertilizer	*kg N per ha*	141	0		
	Slurry	*ton per ha*	49	34		
	legumes	*% of herbage*	21	34		
	Silage	*% of production*	65	57	76	58
		no of cuts	4,0	4,2		
	Hay		7	2	3	2
	Grazing	*% of production*	28	41	18	40
Permanent	*Area*	*ha*	11	21		
	Production	*SFU per ha*	2389	2263		

	Fertilizer	*kg N per ha*	59	0		
	Slurry	*ton per ha*	6	7		
	legumes	*% of herbage*	8	14		
	Silage	*% of production*	30	10	15	11
	Hay	*% of production*	20	6	20	7
	Grazing	*% of production*	42	80	56	75
Maize	*Area*	*ha*	52	8		
	Production	*SFU per ha*	10250	7330		
	fertilizer	*kg N per ha*	60	0		
	Slurry	*ton per ha*	43	40		
	grassundersown	*% of area*	69	28		
Othercrops	*Area*	*ha*	55	70		
Forest	*Area*	*ha*	6	6		
Hedgerows	*Length*	*m*	3186	5885		

For conventional production there is a clear effect of farms size on the proportion of the production utilized as silage, due to a reduced number of animals on pasture. The area weighted proportion of production harvested as silage is 76% against 65% as simple average of the conventional farms, while there is no effect in the organic system. Also for permanent grassland the weighted average differs fron the simple, but in the other direction with a reduction in proportion utilized as silage when corrected for area of permant grasland. This might be due to that area of permant grassland is not higherly correlated to farmsize.

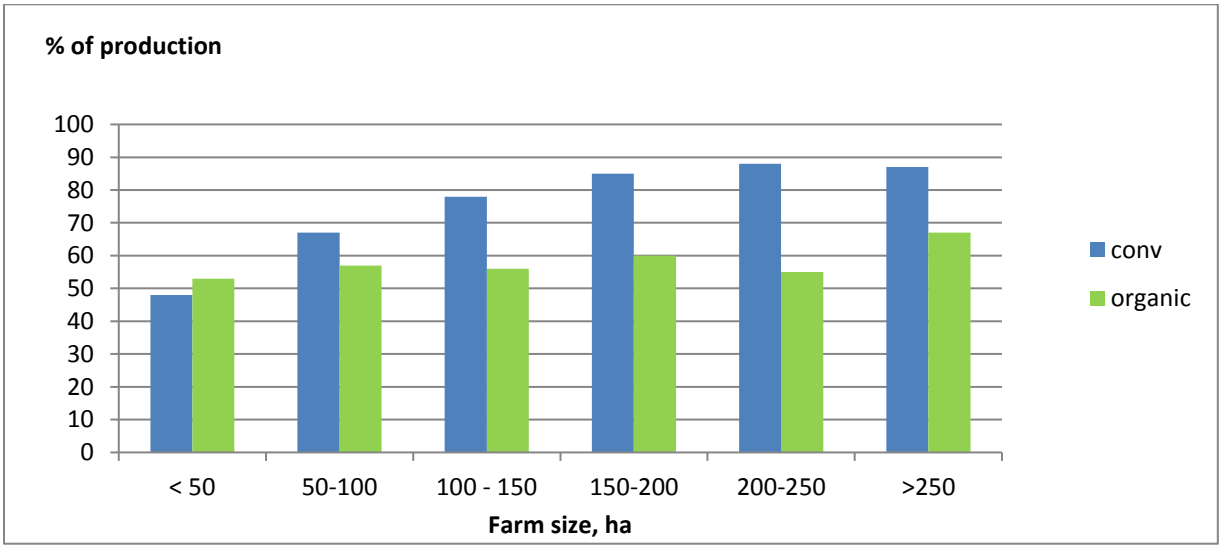

Figure 3. Proportion of annually production from grass in rotation harvested as silage in relation to farmsize within conventional and organic.

3.3.2. Grazing situation - proportion of farms and animals

Grazing is part of the legislation for organic farmers, which count for 41 of the 375 farmers. Among the conventional farmers decreased the proportion of herds with animals grazing by herd size (figure 1). Only at farms with less than 100 cows were grazing with cows and young stock the most common, while grazing only young stock was used at half of the farms with more than 100 cows. This does not mean that all young stock was at pasture, as this group is a combination of several possibilities for having all or part of the young stock at pasture. At 25 % of the farms no animals was grazing, and this type of management increased by herds size with 40% of the farms with more than 250 cows having all animals indoor all year round.

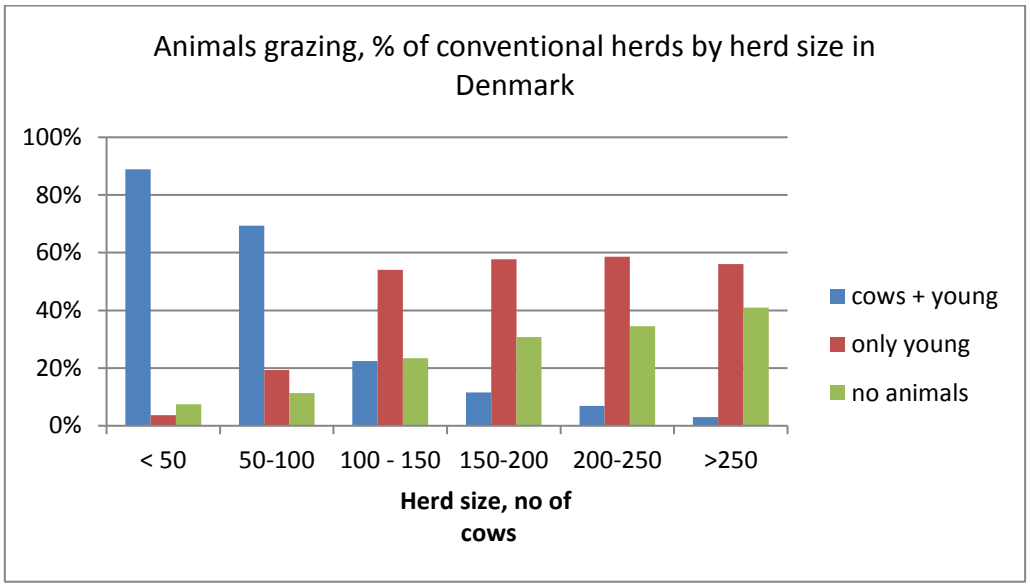

Figure 4. Proportion of conventional farms with animals grazing within herd size.

Looking more at the cows, 30% of the conventional farms did graze lactating cows, while approximately 16 % the conventional cows was grazing as grazing the cows was most common at the smallest farms (figure 2).

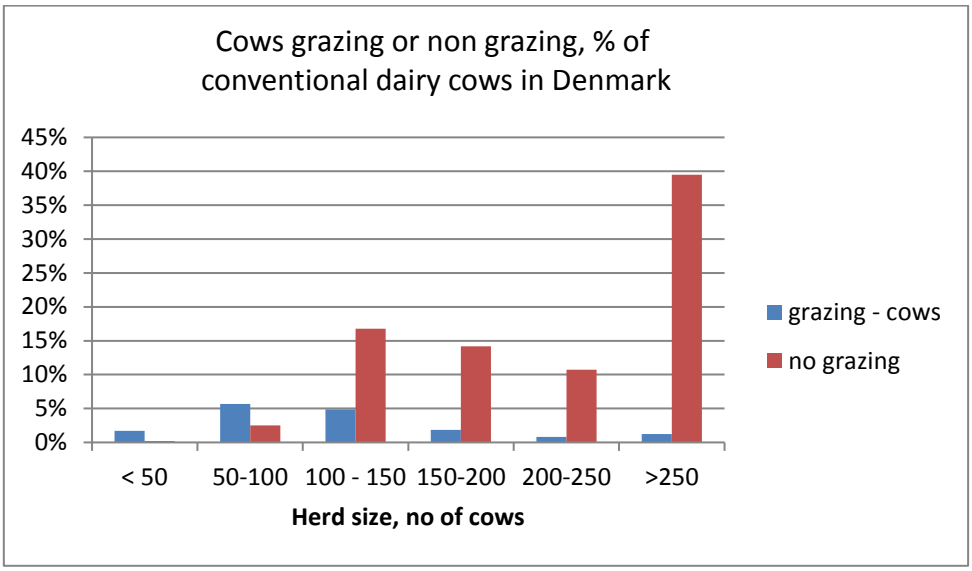

Figure 5. Proportion of conventional cows grazing or not group by herd size.

In total for Denmark this means that around 25% of the cows were grazing during 2015, as 11% of the cows was organic.

Grazing dairy cows – intake and time

Farmers were asked to give an estimate of the proportion of the total dry matter intake that was from pasture. The proportion of pasture was lower in conventional herds than organic, with almost 40% of the conventional estimating an intake of pasture below 25% of total dry matter intake, while only 10% of the organic was at this level. These data is rather uncertain which might be one of the reasons for that 30% the organic farmers did not make any estimate. All farms indicated that they used supplement and 94% that it was used during the entire grazing period. From figure 4 it can be seen that day grazing was the most common, while day & night grazing was used at 25-30% of the farms for some part of the season.

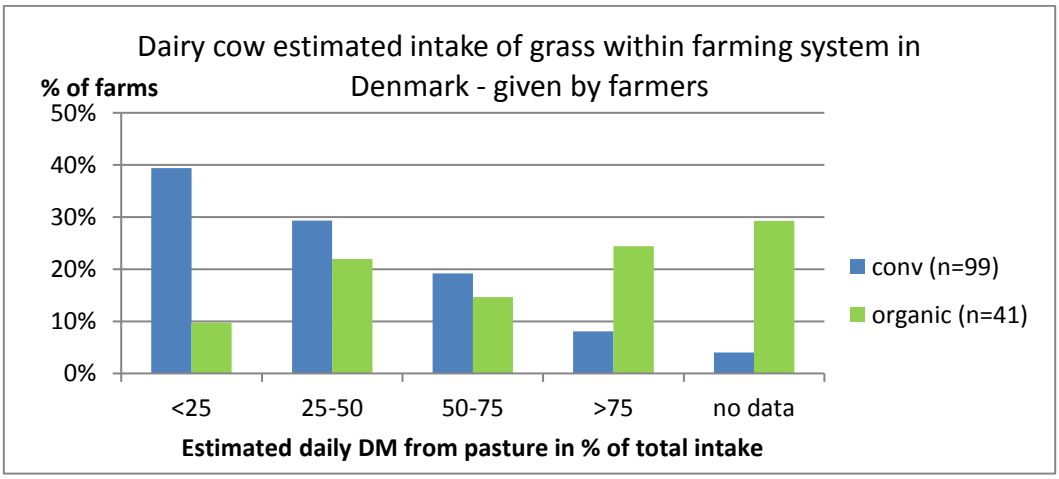

Figure 6. Estimated proportion of dry matter intake from pasture.

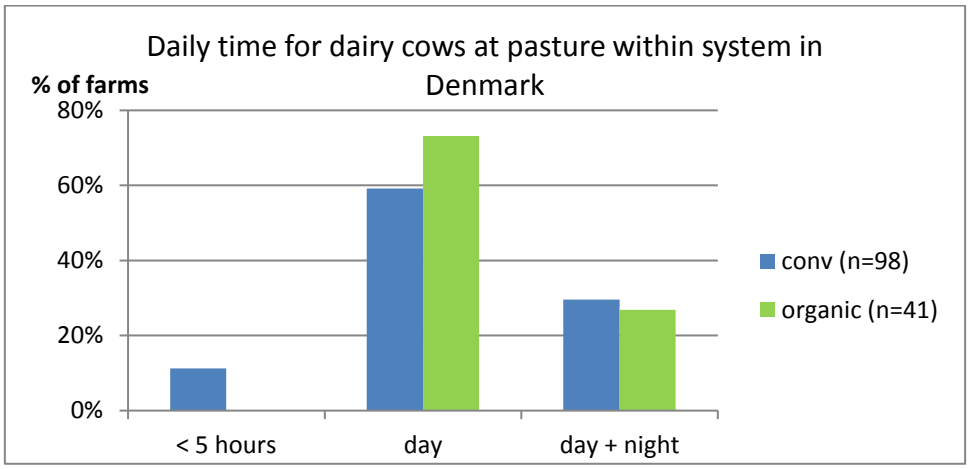

Figure 7. Time at pasture for cows during the summer within organic and conventional dairy

Grazing dairy cows – why not

A majority, 70 % the conventional farmer, did not graze the cows. In figure 5 is the proportion of answers between 7 different reasons for not using grazing shown within herd size. Each farm could give more than one reason so the total number of reasons was 611 from the 234 farmers not grazing cows in 2015.

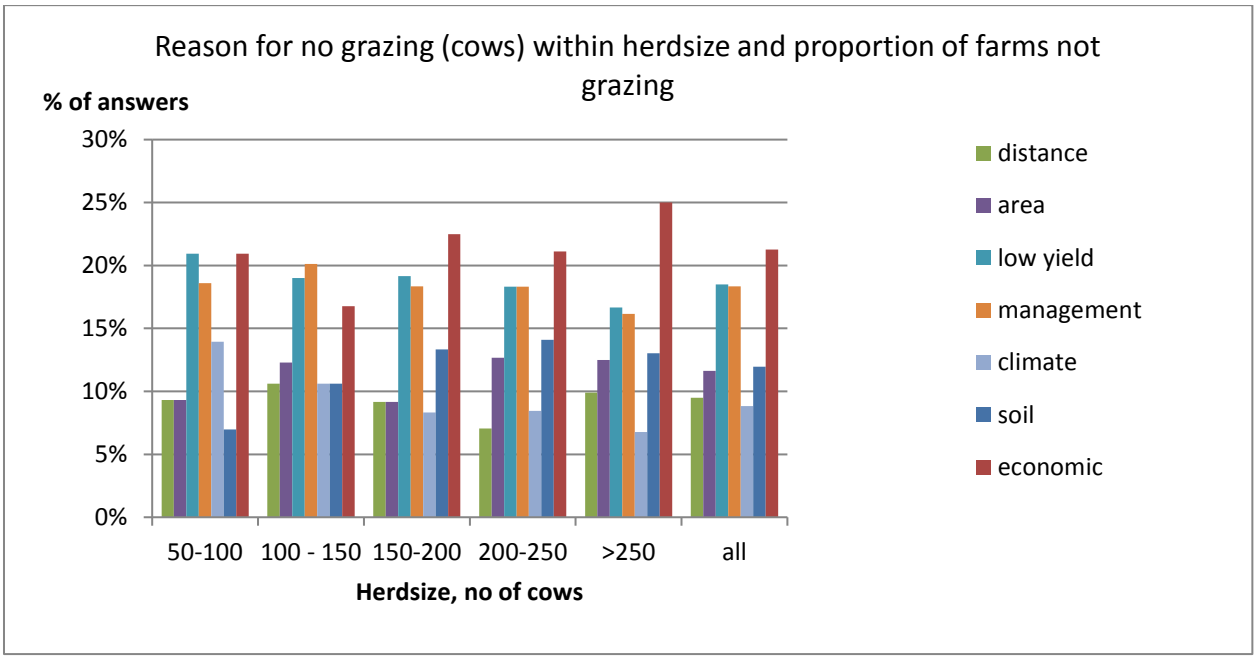

Figure 8. Reasons for not grazing dairy cows

The three most frequent reasons, across all herd size groups, were “expected lower milk yield”, “difficulties with grassland management” and “reduced economic return”. Distance from barn to potential grazing area and too less.

3.3.3. Other matters

Together with the agricultural land use, nature areas play a role in carbon emission. Besides the permanent grassland, forest and hedgerows contribute to carbon turn over. In average of all farms within the system there was an area of 6 ha with forest and hedgerows was most widespread in organic farming also after adjusting for total area, with 25 m per ha against 19 m per ha agricultural land in conventional

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