

The future of grazing

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The Future of Grazing

Proceedings, Third Meeting of the EGF Working Group "Grazing"

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This report presents the main results of the third meeting of the EGF Working Group "Grazing" which was held in Aberystwyth, UK on 7 September 2014. The aim of the Working Group "Grazing" is to exchange knowledge on all aspects of grazing research and to provide a forum for networking. The theme of the meeting in Aberystwyth was "The Future of Grazing".

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The ISO 9001 certification by DNV underscores our quality level. All our research commissions are in line with the Terms and Conditions of the Animal Sciences Group. These are filed with the District Court of Zwolle.

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Foreword

The third meeting of the Working Group "Grazing" of the European Grassland Federation (EGF) was held in Aberystwyth, UK in September 2014 prior to the 25th General Meeting of the European Grassland Federation. This meeting, the 50th anniversary of EGF, had the theme "EGF at 50, the Future of Grasslands". The Working Group "Grazing" followed suit by choosing the theme "The Future of Grazing". We worked with subthemes that were introduced by plenary speakers followed by discussion sessions in small groups of around 10 persons. Short summaries of the presentations and the discussion sessions can be found in this report. This report and PDFs of the presentations are available at www.europeangrassland.org/working-groups/grazing.

The coordination team of the Working Group would like to thank all the participants with special thanks to the speakers and the chairs and reporters of the discussion sessions for their active participation in the meeting and the lively discussions during and after the meeting. The aim of this Working Group, to exchange knowledge on all aspects of grazing and networking, was certainly achieved in 2014.

Coordination team of the EGF Working Group "Grazing":

Dr. Agnes van den Pol-van Dasselaar, the Netherlands (Chair)
Dr. Alex de Vliegher, Belgium
Dr. Deirdre Hennessy, Ireland
Prof. Johannes Isselstein, Germany
Dr. Jean-Louis Peyraud, France

Summary

This report presents the main results of the third meeting of the EGF Working Group "Grazing", held in Aberystwyth, UK on 7 September 2014. The aim of the Working Group "Grazing" is to exchange knowledge on all aspects of grazing research and to provide a forum for networking.

The theme of the meeting in Aberystwyth was "The Future of Grazing". There were five sessions:

- Welcome session / introduction
- Several forward looking views on the future of grazing in Europe
- Developments in forage production
- Current and future economics of grazing
- Closing session

The participants concluded that there certainly is a future for grazing! However, threats to grazing were also identified which need to be addressed. The EGF Working Group "Grazing" is a valuable platform for addressing these issues and exchanging knowledge on corresponding solutions.

1 Introduction



Grazing is an important theme for the European Grassland Federation (EGF). In Europe, forage is the main feed for dairy cattle and grasslands are predominantly grazed. Grazing systems are important components of the landscape in almost all European countries. A Working Group on grazing will ensure detailed knowledge exchange and discussion. The EGF Working Group "Grazing" was therefore established in Uppsala, Sweden at the General Meeting of the EGF in 2008. The aim of this Working Group is to exchange knowledge about all aspects of grazing and to support networking. The first meeting was held in Kiel, Germany in 2010 (Research methodology of grazing; Van den Pol-van Dasselaar *et al*., 2011) and the second in Lublin, Poland in 2012 (Innovations in grazing; Van den Pol-van Dasselaar *et al*., 2012).

The third meeting of the Working Group was held in Aberystwyth, UK in 2014, prior to the 25th General Meeting of the European Grassland Federation. Forty participants from 16 countries Figure 1) represented mainly research interests, with others from the fields of advice, education, policy, industry and the press. The theme of the meeting was "The Future of Grazing".

The meeting was split into five sessions. First (welcome session / introduction), grazing in Europe was presented. A huge area of grassland in Europe is mainly grazed. The percentage of grazing is country specific, however; in general there is less grazing in the eastern and southern parts of Europe and more in northern and western Europe. One clear trend is the general decline in the popularity of grazing. Fewer cows graze, and if they do, it is for fewer days per year and fewer hours per day than previously. So the question arises: Is there a future for grazing? And, if so, what do we need to shape that future? This was discussed in three subsequent sessions (forward looking views on the future of grazing in Europe, developments in forage production, current and future economics of grazing) followed by a closing session. The main sessions consisted of plenary presentations followed by a short plenary discussion. Then the theme was thoroughly discussed in group discussions in four groups of about 10 persons each in a varying composition (Figure 2).

Both the plenary presentations and the group discussions are summarised in this report. The welcome/ introductory session is described in this first chapter. Chapter 2 reports on several forward looking views on the future of grazing in Europe. Chapter 3 reports on developments in forage production. Chapter 4 reports on current and future economics of grazing, followed by some concluding remarks in Chapter 5. Both this report and PDF files of the presentations of the meeting can be found at the EGF website under the pages of the Working Group "Grazing" (www.europeangrassland.org/working-groups/grazing). The program of the meeting can be found in Appendix 1 of this report.



Figure 1. Participants of the EGF Working Group "Grazing" meeting in 2014.









Figure 2. Group discussions.

2 Forward looking views on the future of grazing in Europe

2.1 Grazing in France and its future

Jean Louis Peyraud – INRA, France

Grazing is still an important part of the annual diet of French cattle. More than 90% of the dairy cows are grazed. Conditions for the use of the grassland are highly variable (e.g. grazing by dairy cows, suckler cows, sheep; intensive grazing and extensive grazing; grazing in the plains and grazing in the mountains). Dairy systems using grasslands in the plains are competitive. However, many farmers are not convinced and think that "the more I produce the more I earn". Society thinks that grazing is an important issue for animal welfare and environment and that grazing gives a good image of the production system. For farmers, this depends on the area where they farm. In mountains and less fertile areas, grazing is important. In the plains, however, some farmers are confident and pro-grazing, while others perceive grazing as a constraint. The future of grazing in France depends on the geography as well. In the mountains and difficult-to-farm areas, the grazed area is expected to remain stable, while in the more intensive regions a decline is expected. This is related to intensification of dairy production, discontinuation of dairy production at the expense of crop production, and the Nitrate Directive. The biggest challenge for grazing and forage production research in the next decade is to explore some technical improvements, namely to increase the DM yield by 1 to 3 t DM ha^{-1} through better grassland and herd management (avoid wastage), and to increase the DM yield through multi-species swards and quality of silage. Other actions necessary will be: communication towards farmers and policy makers, revisiting the evaluation criteria of grassland performances to better communicate with different stakeholders, and training and consulting (to provide tools and adapted repositories).

2.2 Future trends in grazing with Hungarian extensive beef farming

Andras Halasz, Hungary

Hungary has about 1 million hectares of grasslands. About three-quarters are used for farming (both meadows and pastures) and one-quarter is fallow land, i.e. abandoned fields. The grasslands are used by cattle, sheep and horses. The majority of these animals (70-100%) are grass-fed. The number of grazing animals has slightly increased during the last number of years due to changes in family farm legislation. The biggest challenge for Hungary is to protect the domestic market with an increased amount of local food, with more added value and food processors in Hungary. Precision farming could be important as well, but the trend is showing a different approach. In Hungary, young farmers need more options to manage the farm. If an expensive milking robot could encourage the young generation to continue with dairy farming, it would be a good investment. From an economic point of view, labor is a key issue and will be even more important in the near future. Hungary will stay in green farming. In the last decade, N fertiliser application has still not reached 100 kg N ha^{-1} $year^{-1}$. Tillage farming will slightly decrease. The ratio of livestock to crop farming should be 50:50. Grazing still has potential as 300,000 hectares of grassland is currently not being farmed at all. In essence, the importance of Hungarian grasslands is growing and grasslands are a very good base for small and mid-sized farms.

2.3 Status and future of grazing in Germany

Johannes Isselstein, Germany

Some 30 years ago, i.e. before loose-house systems for dairy cows had been widely introduced in German farming practice, almost every cow had access to pasture during the summer months. This was particularly true for northern Germany. The percentage of cows allowed access to pasture has decreased ever since. Census data from a representative sampling in 2009 (The Federal Statistical Office, 2011) show that 58% of dairy cows in Germany are kept indoors throughout the year. In larger herds (>200 cows) this value is markedly higher (84%). Regional variation is marked: in northern Germany (Schleswig Holstein, Lower Saxony) some 70% of cows graze on pasture while in southern parts of the country (Bavaria, Baden Württemberg) this drops to around 20%. The census did not take into account to what extent grazed grass contributes to the dairy cows' energy supply. In Germany, a structural change in dairy farming is ongoing. Because these census data were already five years old, a non-representative telephone questioning of grassland experts from different states in Germany was undertaken. According to this, 70–80% of the dairy cows are kept indoors with no grazing and 10–15% of the cows that graze on pasture are allowed only short time grazing (called "jogging"). Approximately 80-90% of heifers are raised on pasture, with a variation of 30% (Bavaria) to 100%. Fattening steers are mainly kept indoors (<10% grazing) while cattle from specialised beef production (beef cattle, suckler cows) are dominantly grazed (>90%). Recent economic analyses of grazing systems for dairy cows have demonstrated the potential of grazing to support dairy production (Kiefer *et al.*, 2014). Some important prerequisites for successful milk production from grazed grass have been reported, however, including sufficient pasture area round the farm, efficient grazing management, and high grass intake. Compared to confined systems, the relative advantage of grazing systems will increase as the cost of concentrates increases (Kiefer *et al*., 2013). In addition to these factors, farmers' perception of the benefits of grazing dairy cows is likely to greatly influence grazing practices. A survey was therefore performed among dairy farmers in Germany. Farmers were clustered according to their farming practice, i.e. (I) Summer grazing with a considerable contribution of grazed grass to the energy supply of the cows, (II) 'Jogging' grazing, where cows are allowed to go outside without a considerable offer of herbage at pasture, (III) An indoor, confined dairy system with no grazing (Becker *et al.*, 2014). Preliminary results are as follows: Farmers value the benefits and drawbacks of grazing dairy quite differently, depending on the practice on their own farm. Farmers who adopt grazing consider grazing as advantageous with regard to labor costs, animal health and milk performance. Production and management risks and challenges related to grazing are seen much less as a general problem as compared to farmers who use the confined dairy system.

2.4 Management and benefits of grazing large herds

Emer Kennedy, Teagasc, Animal and Grassland Research & Innovation Centre, Moorepark, Fermoy, Co. Cork, Ireland

The herd size is increasing in many European countries in anticipation of quota removal. In Ireland (average herd size 61 cows) there has been a 19% increase in the number of calves born to a dairy sire since 2009.

<u>Requirements for grazing large herds</u>

- Paddock shape
    - Square paddocks work best, ideally 2:1, not over 4:1
    - Square paddocks allow for a few entrances
    - Less walking to water troughs
    - Long narrow paddocks can result in a lot of damage in wet weather, especially near entrances
- Distance from roadway to furthest point in paddock
    - Within 100m on heavy land
    - Within 200m on free draining land

- Paddock entrances
    - Have multiple access points from roadway
    - Where possible put entrances at rear of paddock also
    - Wide entrance for cow flow
    - Set entrance posts back into paddock for cow and slurry/silage access
- Water troughs
    - Minimum flow rate of 0.15 litres/minute/cow
    - Water intake
        - 10 L on cold wet days
        - Up to 90 L on hot sunny days
        - Drink up to 14 L per min, 30-50% within one hour of milking
    - Locate centrally to minimise walking distance and facilitate strip grazing (do not locate near paddock entrances)
    - Trough size
        - Allow 7 L trough capacity per cow
        - Use large troughs, give plenty of drinking space
        - Rough guideline: ensure that 5% of the herd can drink at once
- Roadways
    - Considerations when designing/locating new roadways
        - Future herd size
        - Location of future grazing platform – locate centrally
        - Well-constructed roadway will use 1-2% of land area
    - Width of road
        - Widest section near the milking parlour
        - Herd size <80 cows – 4-5m road width
        - Herd size <250 cows – 6m road width
        - Roads too narrow – lameness
    - Cow flow
        - Cows will walk at 2-3 km/hour on good road structure
        - Narrow roads, bends, poor surface will slow down movement
        - Cows walk <1.5 km/hour on poorly designed roads
        - Avoid water troughs on road
        - Wide entry exit points to prevent blockages
        - Avoid road slopes over 3:1 for stock

Grazing management tools

- Spring Rotation Planner
    - Divides the area of farm into weekly portions (ensures there is sufficient area to finish the first grazing rotation)
- Grazing Wedge
    - Visual representation of the grass on the farm
    - Line drawn from the ideal pre-grazing yield to the desired post-grazing residual
    - Completed weekly during main grazing season

2.5 Future of grazing in the Netherlands and in Europe

Agnes van den Pol-van Dasselaar, Wageningen UR Livestock Research, the Netherlands

Future of grazing in the Netherlands

The number of grazing animals is slowly declining in the Netherlands; current percentages are at about 70% (Figure 3). Regional differences are observed, with the highest numbers for grazing on the peaty soils in the west. There is a strong relationship between herd size and percentage of grazing, with 92% grazing for herds of less than 40 animals and 42% grazing for herds with 160 animals and more. Since the average herd size in the Netherlands is increasing, this could lead to less and less

grazing. However, society may provide counterbalance to the trend. Grazing is highly valued for reasons of cultural heritage and the association with animal welfare. Therefore, in 2012 the 'Convenant Weidegang' ('Treaty Grazing') was initiated. At the end of 2013 almost 60 parties in the Netherlands have signed this Treaty, including dairy farmers, dairy industry, feed industry, banks, accountants, semen industry, veterinarians, cheese sellers, retail, NGO's, nature conservation, government, education and science. The aim of the Treaty is to stabilize the percentage of farms that practice grazing.

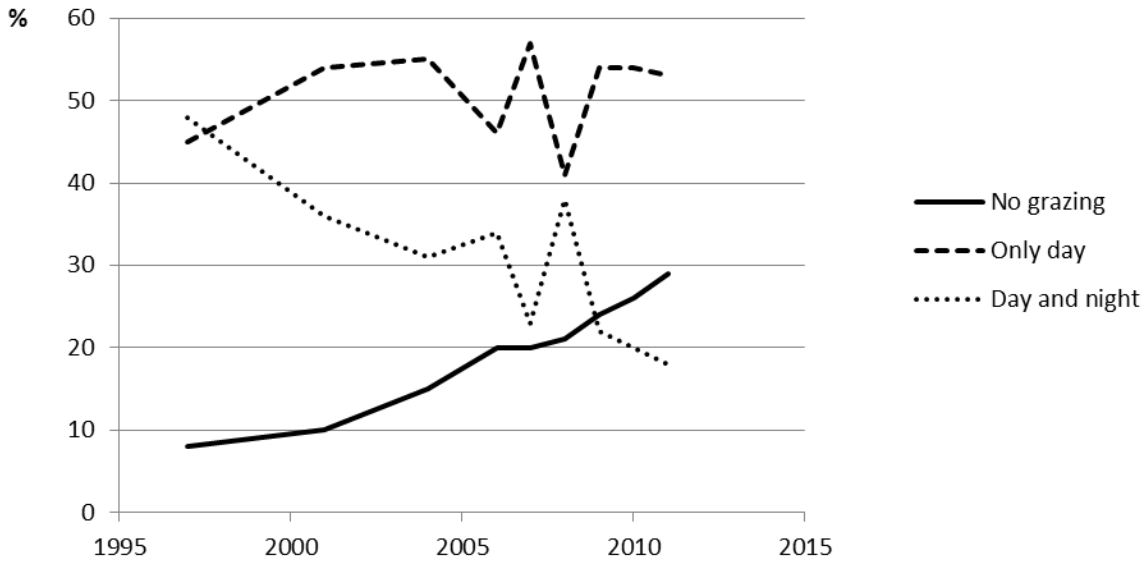


Figure 3. Grazing in the Netherlands (% of dairy cows with no grazing, grazing only during the day, and day and night grazing).

Future of grazing in Europe

Data on grazing in Europe are not easily available. Since the first meeting of the EGF Working Group "Grazing" in 2010 surveys have been conducted among members of this Working Group. Results have been variable and there is no complete overview, but at least these results provide an image of grazing in Europe. Sometimes statistical data are available, but usually the numbers are only an educated guess. Furthermore, the amount of grazing is not defined. It can range from full grazing to very limited grazing. *These observations should be kept in mind when reading the figures on grazing below; the data presented will be different from reality.*

- Norway, Sweden, Finland: welfare legislation, six weeks to four months outside; the number of hours that cattle spent outside is decreasing
- Denmark: 84% in 2001, 70% in 2003, 40-50% in 2008, 35-45% in 2010, 30-35% in 2011, 25-30% in 2014
- Ireland: 99% in 2010 and 2011, 98% in 2014, grass based seasonal systems dominate, grazing season of 230-240 days
- UK: 92% in 2013
- the Netherlands: see Figure 3
- Belgium: 85-95% in 2010, 75-80% in 2014
- Luxembourg: 90% in 2008, 75-85% free access in 2010, 73% in 2014
- Germany: 40-50% of the milking cows were grazing to some extent in 2009, 20-30% in 2014
- France: 90-95% in 2011, 90% in 2014
- Switzerland: 85-100% in 2011, 75-90% in 2014
- Austria: 25% in 2011
- Poland: decreasing
- Estonia: 35% in 2011

- Lithuania: 50-70% in 2014
- Czech Republic: 20% in 2010
- Bosnia and Herzegovina: 5% in 2011
- Slovenia: 25% in 2010, stable or decreasing
- Portugal: 50% in 2010, increasing
- NW Spain: 20% in 2010, 18.5% in 2014; 78% farm feeding budget from grass in 1996, 37% in 2006
- Greece: 15% in 2010, less than 10% in 2011
- Hungary: 70% of all LSU (cows, sheep, horses, goats) were grazing in 2010
- Bulgaria: sheep and goat always graze, for dairy no grazing on big farms, on smaller farms grazing

It is interesting to see what is happening in grass-based systems outside Europe. Currently, in New Zealand almost all farms have some grazing in their system, but the extent of grazing is decreasing there as well.

Members of the EGF Working Group "Grazing" were also asked to provide their opinion on the future of grazing. Although opinions differed on some things, all members agreed:
- Grazing is complicated
- Larger herds lead to less grazing
- Farming systems that fit with grazing are smaller, have more land available close to the barn and are usually more low-input
- Farm development complicates grazing
- In many areas grazing is valued more and more by society, but consumers buy milk and meat from non-grazing animals anyway

2.6 Summary of group discussions

Discussion items

Four groups of about 10 persons discussed the following questions:
- Why is grazing of dairy cows in some countries mainstream while in others it is almost a niche system?
- Possibilities and constraints of producing milk on grasslands
- Grazing of large herds
- Is there a future for grazing?

Highlights of discussion group 1

Why do farmers choose grazing or zero grazing systems?

Tradition/heritage: Some countries have no tradition of grazing or have lost it, such as Hungary which lost the tradition of grazing during the time of the USSR.

Grass silage and maize provide a good ration for dairy cows
- This ration leads to high and stable production
- Easy system – grazing can complicate the system, particularly managing supplements/maize and grazing

Environment
- Some regions have a *climate* suitable for growing large quantities of grass, e.g. Ireland and NW France. In other regions the climate is less suited to growing grass, e.g. low rainfall areas
- The *soil type* in some regions prevents extended grazing, e.g. peat soils
- *Topography* in some regions is not suitable for maize/arable crops and grazing is the only option

Farm structure – fragmented farms are not suited to grazing

Labor
- kg milk per labor hour can be reduced in confinement systems
- Hybrid systems have higher labor requirements compared with confinement systems, thus farmers choose increasingly for non-grazing management

Cow genotype: Many farmers in Europe have high production cows (e.g. North American Holstein), which are unsuitable for grazing systems.
Herd Size – perception is that large herds are not suitable for grazing, but in New Zealand average herd size is 400 cows and grazing is the norm.
Attitude of farmers

- Feeding is simpler in confinement systems
- Automatic Milk Systems (AMS, milk robots) are increasing in Europe. Farmers use AMS for a better lifestyle but the use of AMS leads to more indoor milk production systems.
- Grazing is perceived as 'old–fashioned'
- Farmers are reluctant to invest in grazing infrastructure, e.g. tracks and fencing. Yet it appears that farmers are willing to invest in new tractors and machinery.
- Education/knowledge transfer is important for the uptake of grazing. Knowledge transfer must not only focus on the hard facts but must improve the perception of grazing among farmers.

Conclusions of discussion group 1
Farmer decision making around the use of grazing in the diet is based on both hard facts and soft facts (Figure 4). Hard facts include economics, climate, soil type, topography and farm infrastructure. Soft facts include the personal motivation of the farmer, social pressures and the image or perception of grazing, which is sometimes perceived as 'old-fashioned'.

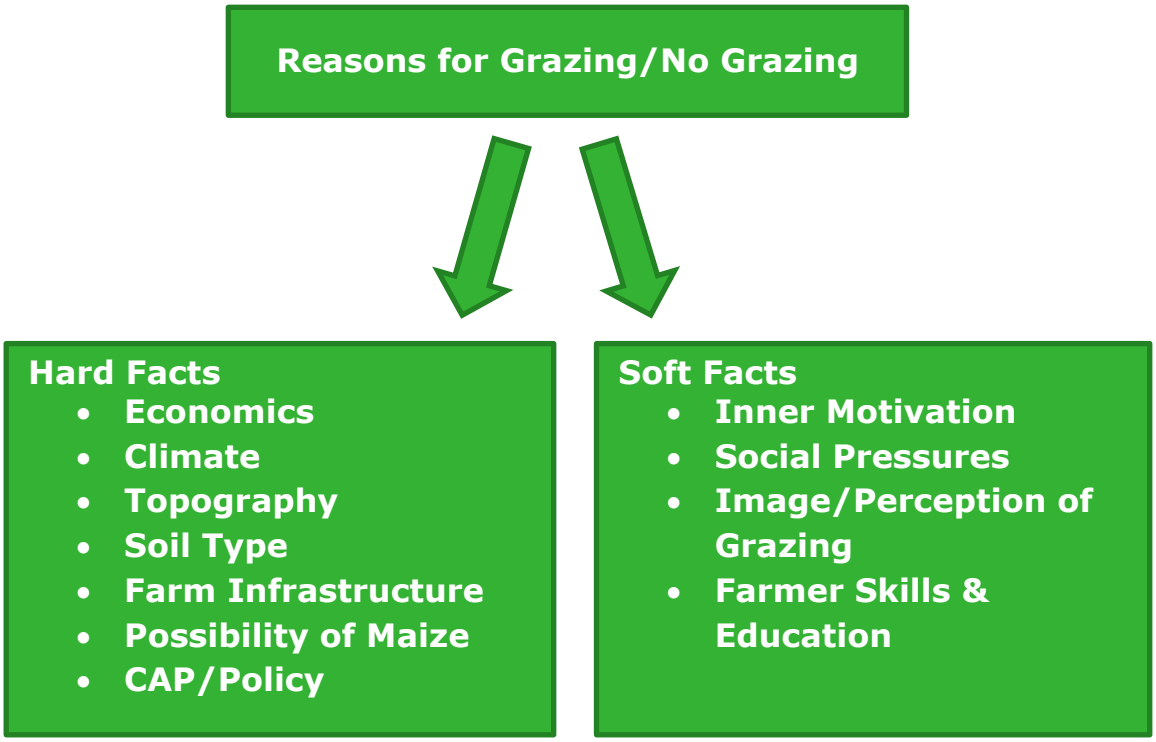


Figure 4. Reasons for grazing / no grazing.

Highlights of discussion group 2
Grazing or no grazing, the future? The answer is difficult as it depends on the context (e.g. country, regional specificities, etc.). In some areas, grazing is the only way to valorise grasslands (e.g. mountainous areas). Amount/significance of grazing can differ depending on the context: there are several kinds of grazing: "siesta grazing" or effective grazing.
Several factors were considered regarding their potential effects on grazing:

- *Extension of herd:* development of larger herds was considered a barrier to grazing.

Definition of large herds was debated and the following was concluded: A large herd is a herd whose size is twice the average herd size of a country or a region. The management of larger herds requires more technical skills, and grazing in this scenario seems more complicated.

- *Consumers* value grazing.
- *Welfare issue:* in general, grazing is considered as beneficial for health of cattle but with improvements in buildings and investment in research on cattle housing, keeping cows indoors may be less detrimental than it was in the past.
- *Development of new technologies* such as AMS could decrease grazing. But combining grazing with AMS is possible.
- *Fragmentation* of land and price of land in some regions is detrimental to grazing.
- *Environmental problems* linked to grazing (like nitrate leaching) could devaluate grazing. The environment has to be considered as a whole. Use of maize silage induces the importation of soybeans and has a negative impact on the environment. Cutting grass is energy demanding.
- *Labor:* perception of labor linked to grazing depends on the farmer. A farmer who is used to grazing his cows does not consider it as labor-intensive. The general decrease in grazing induces the perception of difficulty in managing grazing. It seems that in some areas there is a loss of skills that are necessary for good grazing practice.

Conclusions of discussion group 2

- There is a future for grazing.
- It needs some investment to inform and motivate the farmers.
- It is important to learn from each other and to avoid the loss of grazing skills.
- It is important to increase research on this topic and to adapt new technologies to grazing.

Highlights of discussion group 3

Grazing or no grazing, what does the future hold? To graze or not to graze depends on several factors and on livestock systems used. Here are some barriers to grazing:

- (1) Larger herds (probably increasing after quota removal); the meaning of "large" herd depends on the country
- (2) Fragmentation of land or lack of land in some regions (although agricultural lands may also be abandoned in certain areas, e.g. Hungary)
- (3) Development of AMS
- (4) New information on grazing techniques: grazing is complicated
- (5) General development of "easy management" systems based on conserved/ensiled forages (i.e. maize)
- (6) environmental problems (nitrate leaching) in grazed pastures

These barriers could be solved:

- Grazing is possible with large herds as demonstrated in New Zealand (1)
- Solutions with mobile milking exist, even with automatic systems (2 and 3)
- Development of training and extension services around grazing for farmers (4 and 5)

Some arguments are also in favor of grazing:

- It has been largely proven that grazing reduces feed costs.
- In some Nordic countries or on organic farms, grazing is compulsory in order to improve animal welfare.
- The opinion of citizens can be important in maintaining cows in fields: grazing allows farmers to get a price premium for milk production in the Netherlands. Germany and Luxembourg are developing the same systems to encourage grazing.
- In some countries, young farmers are motivated to graze and are convinced that grazing is good for their cows and for their way of live.
- Labor inputs are generally less with grazing.
- Milk quality is improved with grazing.

Conclusions of discussion group 3

- Grazing is possible in all livestock systems. Grazing or not is heavily determined by the *farmers mindset,* which is related to the personal perception of life comfort, management capacities, personal motivation and preferences and the way farmers are locked into their current system.
- Eventually the *farming system* determines whether grazing will or will not be practiced.
- It is important to learn from each other and to take care that new information reaches young farmers, advisors and teachers.

Highlights of discussion group 4

1) There are big differences in grazing possibilities in different regions; e.g. in very hot conditions the cows just stop grazing, in colder climates you need buildings, meaning there will be two different systems for the farmer and the employers if they rely on grazing for only part of the year. It is also important to shift systems successful to get the rumen accustomed to different feed. Some countries can grow large amounts of grass so the cows can graze during most of the year.

2) There are big differences in grazing infrastructure. For big herds the land area available per cow close to the barn is restricted. Herd size differs between regions, e.g. in former Eastern Germany the herds are much bigger than in former Western Germany for historical reasons. A fast increase in herd size usually creates lots of problems. The grazing system must fit to the region and the farm.

3) There are big differences in grazing culture in different regions. Ireland is more or less outstanding in Europe with its grazing culture, in the Netherlands there is no big need for home-grown feed due to the big harbour in Rotterdam, in the Nordic countries the knowledge about good grazing practices for production (and not siesta grazing) is restricted to a few enthusiastic farmers and advisors. There is a large potential for increasing farmers' and advisors' knowledge and motivation for good grazing management. In the Mediterranean countries the silvo-pastoral system is common, in Sweden there are also cultural and historical reasons for having quite a lot of trees (e.g. old oaks) in the semi-natural grasslands.

4) There are big differences due to policies and to the market in different regions, e.g. if the milk is produced for direct consumption or for milk powder. The challenge to achieve steady grass growth is larger in regions with directly consumed milk because of the need for year round supply.

5) How to stimulate interest in grazing? There are many good examples:

a) Inspiring discussion groups where farmers teach farmers using positive and negative examples. Examples were given of a financial incentive of €1000 (Department of Agriculture) when joining such a group. The group, led by an advisor, meets once a month at different farms in the grazing season for farm walks and to discuss topics and management strategies appropriate at that time of the season.

b) A premium price for "grazing milk" is practised by dairy companies in the Netherlands. In France, milk based on 100% grazing is premium marketed and Luxembourg has tested a subsidised system with no cutting before 1 August.

c) Perhaps there will be some possibilities for operational groups in the EIP framework (European Innovation Partnership) which is now being implemented in several countries?

d) The subsidies for semi-natural grassland are of great importance for the farmer. There is a more open definition of grasslands in the new or actual direct payments regulation. It is important that the member states that use this possibility include grasslands with trees and shrubs as well.

e) Finally, the Netherlands show examples of the power in having many parties signing a petition in favour of grazing.

Conclusions of discussion group 4

- There is a future for region-specific grazing in Europe.
- The main driving force is finances (economy), and the main constraint is the grazing infrastructure.
- There is a need for motivation and changing attitudes to grazing by farmers, advisors and researchers.

3 Developments in forage production

3.1 Does early spring grazing stimulate spring grass production?

Nick van Eekeren[1], Petra Rietberg[1], Goaitske Iepema[2], Jan de Wit[1]
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For dairy farmers the key question in spring is how to get the grass growing as soon as possible. The easiest method is to add N fertiliser, but due to stricter fertiliser regulations farmers have to depend more and more on soil nutrient mineralization. This process starts when the soil warms up in spring, and can be stimulated by mechanical soil aeration and the addition of lime. Furthermore, according to the experience of various dairy farmers, grass growth may also be stimulated by 'early spring grazing', a method in which grasslands are grazed in early spring for a short period of time. A possible explanation for this effect is that grazing leads to increased root exudation, which in turn triggers mineralization (Hamilton *et al.,* 2008). However, it is not known whether this mechanism also works in spring when soil temperatures are still low. Furthermore, it is unclear whether the positive effects of grazing on mineralization could outweigh the negative effect of (early) grazing on photosynthetic leaf area and thus growth rate. Therefore, the objective of this study was to investigate the net effect of early spring grazing on spring grass production.

In 2013 we conducted two field experiments on production grasslands: one on a shallow sandy soil in the south of the Netherlands, and one on a clay soil in the north. All plots in both experiments were fertilised with 25 m^3 ha^{-1} cattle slurry in mid-March. The experiment on sandy soil consisted of four treatments with six replicate plots: early spring grazing with, and without the addition of artificial fertiliser; artificial fertiliser only; and a control. To this end, on April 19 half of the plots were mowed to ±4cm with a lawn mower to simulate early spring grazing. On the same day, half of the mowed and unmowed plots received 50 kg N ha^{-1} of calcium ammonium nitrate (CAN). The experiment on clay soil consisted of three treatments with five replicate plots: early spring grazing on April 19 (lawn mower treatment, see above); artificial fertiliser (50 kg N ha^{-1} of CAN); and a control. The effect of early spring grazing was measured in the first two cuts. The plots on sandy soil were cut on May 19 and July 8; and on clay soil on May 24 and July 2. Grass production of each plot was determined by mowing a strip of 0.84m x 5m (sandy soil) or 1.50m x 10m (clay soil). Half of the yield from mowing the plots at t=0 to simulate early grazing was added to the yield of the first cut. After weighing the fresh biomass, a sub-sample was analyzed for dry matter and crude protein (CP) content. Results were analyzed for significance by ANOVA and Tuckey's test.

Simulated early spring grazing negatively affected the yield of the first cut compared to ungrazed plots on sandy soil and a tendency on clay soil. The DM yield of early-grazed plots was reduced by 20% (sand, $p=0.009$) and 12% (clay, $p=0.062$), respectively. These differences were partly compensated for in later cuts. Despite the negative effect on grass yield of the first cut, early grazing positively affected the crude protein (CP) content of the grass in the first cut on sandy soil, but only in the plots that had not been fertilised with CAN. The stimulating effect of early spring grazing on soil nutrient mineralization appears to be too small to compensate the negative effects of early grazing on grass leaf area and photosynthesis capacity.

3.2 The impact of automation: two examples (grazing time, mobile milking)

Valérie Brocard, Institut de l'Elevage, France

Use of the "Lifecorder+" activity meter to estimate grazing time of dairy cows

Assessing grass DM intake (DMI) is a difficult task when cows are grazing, in contrast to indoor feeding. In research centers it is possible to use methods such as the n-alkane technique, but these methods are too complicated and labor intensive to be implemented on commercial farms. However, many farmers would like to know if cows are really eating grass when grazing outside, and they want a more precise idea of the amount of grass used. A first step to reassure farmers is to assess the time spent grazing by cows, though it remains difficult to establish a relation between grazing time and grass DMI.

A few years ago a Japanese team of researchers showed that a human activity meter named "Lifecorder+" could be used to assess cows grazing time. It was also demonstrated by R. Delagarde (INRA, France) who created an Excel tool to valorise the data. Lifecorder+ is a uniaxial neck mounted activity meter. Its signal is converted into a yes/no information over a certain threshold (0.3 or 0.5). Within the Autograssmilk program, this sensor was tested in an applied research situation in 2014. The sensor was tested at two experimental AMS farms (25 cows equipped in Derval farm, 14 cows equipped in Trévarez farm). The data from the sensor were compared with human observations as reference: trained researchers recorded activity with a scan performed every 10 min in the pastures. The recorded activities were the following: grazing / ruminating and standing / lying / walking. One observation session was performed in Derval (10h) and 12 observation sessions (1 to 3h) on 7 days were performed in Trévarez. The results showed a very high correlation between the human observations of activity and the signal of the sensor ($R^2 = 0.95$) with a bias of 1.1 min (0.9%) in Derval and 6 min (4%) in Trévarez related to the recording of walking in the pathways (Figure 5). Lifecorder+ appears to be a possible cheap and easy tool to record grazing time at pasture. The data collection and processing is easy. It gives information on variations among days that could be used to improve grass management and cow traffic organization, but also among cows, which could be further investigated. Further research is needed to link this information to the amount of grazed grass used by cows, as they can adapt their grazing speed, the weight of their bites, and their intake behavior.

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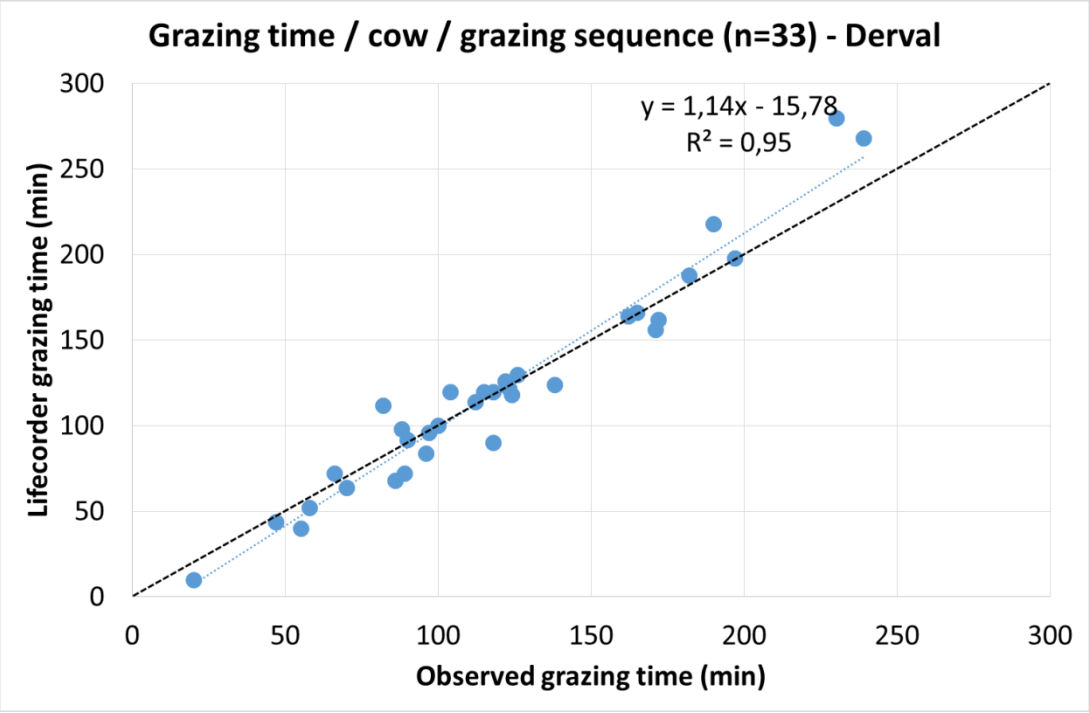


Figure 5. Correlation between grazing time recorded by observers and signal from Lifecorder+ ; source: Raynal, 2014.

Trévarez mobile AMS experiment

Trévarez experimental farm belongs to the regional Chamber of Agriculture of Brittany, France, and is located in an area with an oceanic climate and good grass growth. Similar to many dairy farms in western France, it is facing a fragmented land with little pasture around the main cowshed. The choice was made a few years ago to invest in an AMS to decrease working time. To increase the milk price, the conversion of the system to organic farming was also chosen. But how is it possible to maximise the use of grazed grass, necessary in an organic dairy farming system, and to efficiently use an AMS, in particular when you lack access to pasture? The choice was made to purchase one AMS and to move it from a new winter barn to a block of 23 ha of grass located 4.5 km away. The new barn was built in 2012, the robot was purchased the same year together with two trailers, one for the robot and one for the milk tank. During the winter, the trailer with the robot is located inside the shed; the trailer with the tank remains outside. Cows have access to grazing on the winter site during spring and autumn. From May to October, the trailers, the drafting gate and the cows are moved to the summer site; the 54 Holstein cows stay on a 100% grazed grass based system, with 0.5 kg of concentrate per milking. On the summer site (Figure 6), a platform was built for the trailers. The drafting gate directs cows either towards night or day paddocks, or towards an isolation box. A concentrate silo, a small technical room, a survey camera and a waiting area with slatted floor above a slurry pit were added. The first transfer was performed on the 13th of May 2014. Good preparation prevented technical problems. The total working time required for all participants reached 30 hours (including the transfer of the drafting gate the day before) including 10 h from the retailer's team. It took less than 4 hours between the stopping of the robot on the winter site, and the first milking on the summer site. Since the arrival of the cows on the summer site, the production level reached 19.5 kg per day per cow with a milking frequency of 1.8 milkings per cow per day.

The system must now be evaluated technically and economically over a longer period. The extra costs of mobility reaches almost €100,000 and will hardly be covered by a decrease in the feeding costs, because the system was implemented on an area where all the servicing had to be done (no water, no power, no internet, no tracks, no fences, no access road). In many situations, the extra costs of mobility can be reduced when reusing existing plants. This experiment shows that it is possible to combine robotic milking with a 100% grazed grass based system.

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Figure 6. View of the platform with cows on the summer site, June 2014.

3.3 Grazing of *Festuca arundinacea*

Martin Elsaesser, D-LAZBW Aulendorf, Germany

In a 3 year experiment 18 plots of different grass mixtures and grass varieties were tested under grazing with 10 heifers in a rotational grazing system in Aulendorf (Baden-Württemberg, South Germany). The objective of this study was to investigate the grazing behavior of the heifers and their intake of two varieties of *Festuca arundinacea* (a soft leaved variety), *Dactylis glomerata* (late and early) and *Lolium perenne* (early and late) in comparison with typical grazing grass mixtures. *F. arundinacea* and *D. glomerata* were the best suited grasses for dry periods, which may happen more often caused by climate change. Sward heights were measured at the beginning and the end of grazing, grazing residuals were measured and estimated in a scoring system after grazing. The results showed best intake of parcels with late *Lolium perenne*, whereas *Festuca arundinacea* and *Dactylis glomerata* showed lowest intake in all rotations. Soft leafed *Festuca arundinacea* had a slightly better intake than the other varieties. The experiment is ongoing.

3.4 Effect of grassland management in autumn on the mineral N content in the soil

De Vliegher A., Vandecasteele B. (ILVO), 9820 Merelbeke, Belgium

In Flanders the level of nitrate-N residue in the soil (0-90cm) at the end of the growing season is used as an indicator for the risk of nitrate-N leaching. The aim of the experiment was to study the effect of cutting in autumn in comparison with grazing to evaluate the effect on mineral N content (nitrate-N and ammonium-N) in the soil profile. The intention was to evaluate whether this may reduce the risk of N leaching. Twenty-seven parcels with an intensive, mixed management were selected in 2010-2012. Two cutting frequencies were applied: a single cut in October (n=27) or a cut in September and in October (n=15). Grazing cows excrete N on the pasture in a very heterogeneous way in space and time. The N use efficiency is very low, especially during grazing in autumn. This makes it difficult to sample adequately and can help to explain the high variability in NO_3-N and NH_4-N concentrations in the soil between the three measurements per treatment and per sampling period within a pasture. As a result, a pairwise t-test was used on the average of the three measurements per pasture in each sampling period to compare cutting without a pre-cut with grazing (n=27) or to compare cutting with and without a pre-cut (n=15). Cutting in October instead of grazing resulted in a significant decrease in NH_4-N content in the 0-30 cm soil layer in October and November, and a significant decrease in total mineral N content in the 0-30 cm soil layer in November. NO_3-N, which is sensitive to leaching, was not significantly influenced in this period, which is in contrast with literature. Cutting twice versus once had no significant effects on NO_3-N, NH_4-N, or mineral N content in the soil (De Vliegher and Vandecasteele, 2014).

A short video of this experiment can be found at http://www.ilvo.vlaanderen.be/NL/Pers-en-media/Videos/Multisward.

3.5 10 years management of on-farm dairy pasture projects: review of methodology and results

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Introduction

On-farm projects are an effective method to implement innovative ideas and so are an appropriate help to strengthen grazing as a competitive dairy production system in regions where high yielding indoor dairy systems are predominant. Pilot farms provide grazing data (available pasture, pasture

intake, milk yield, economic aspects, etc.), and furthermore improvements can be implemented on these farms. The on-farm network is an exchange platform for researchers, advisors, policy makers and farmers.

Materials and methods

A) Supervised networks

Since 2003, the grassland section of the Lycée Technique Agricole (LTA) managed three different on-farm networks:

a) FILL Grazing Project (national, 2003-2005, 2006-2008) initiated by FILL (Promotion of Sustainable Farming Luxembourg) in collaboration with LTA, CONVIS (herd book), SER (Rural economy service) and University of Bonn (Institute of Crop sciences and resource protection) with four pilot farms (2006-2007: 6 farms). The main objectives of the project were (1) to analyze problems, and (2) to elaborate innovative methods (=> Pasture ruler).
b) Dairyman (2010- 2013, EU Interreg IV B) a collaboration of 10 regions from 7 countries in North-West Europe (Baden-Württemberg, Brittany, Pays de la Loire, Nord-Pas de Calais, Flanders, Wallonia, Ireland, Northern Ireland, the Netherlands, Luxembourg) with the main objectives to analyze and strengthen the sustainability of milk production in these regions. A network of 130 dairy farms: (Luxembourg: 6 farms, 4 grazing farms) allowed data analyses and implementation of a farm specific development plan on each farm.
c) AutoGrassMilk (2014-2015; FP7 EU project): Collaboration of research institutes from 7 countries (Ireland, France, Belgium, the Netherlands, Denmark and Sweden, Luxembourg co-opted since 2014) with the aim to combine automatic milking systems (AMS) and grazing. Data from 37 dairy farms equipped with AMS (Luxembourg: 4 farms).

B) Methodology for estimating available pasture grass intake: four different methods were applied.

a) Device: Grass Master II ® (GrazeTech Grazing Management Technology, New Zealand; Grass Master Pro ® on Novel Ways Ltd., New Zealand); Measurement of the variation of the electrical capacitance of the sward
b) Device: Herbomètre ® (AGRO-Systèmes, France); Compressed sward height
c) Device: Rising Plate Meter (Farm Works Precision Farming Systems, New Zealand); Compressed sward height
d) Device: Feed Reader (Farm Works Precision Farming System, New Zealand); Ultrasonic sensor permanently installed in the front of a quad; sward height

Methods a), b) and c) require a weekly farm walk of all paddocks, whereas method d) requires a weekly farm drive by the quad, which speeds up the assessment of all paddocks. The Feed wedge allows an interpretation of collected data.

C) Estimating pasture feed intake by grazing and feeding calendar:

At farm level pasture feed intake can never be measured, but only estimated. The total feed intake can be estimated relatively accurately (+/- 1 kg DM cow $^{-1}$ day^{-1}) based on live weight and daily milk yield. The subtraction of the amount of supplementation predicts the daily pasture feed intake. Knowing the grazed areas, paddock yields can be estimated:

$$IT_P = IT - IT_S \quad (1)$$

$$IT = 0.0186\ BW + 0.305\ FPCM \quad (2)$$

(IT_P daily pasture feed intake, IT total daily feed intake, IT_S supplementation, [kg DM.cow^{-1}.day^{-1}]; BW: live weight [kg]; FPCM: fat and protein corrected milk [kg.cow^{-1}.day^{-1}])

A feeding and grazing calendar on a daily basis (bulk milk; number milked cows, supplementation feeding and grazed paddocks) allows a daily estimation of pasture intake. All required data are easy to acquire. However a recording discipline is required, otherwise important information gets lost (time needed 5 minutes per day).

D) Farm Improvement plan / Operational optimization:

The aim of each pilot farm network should be an improvement in the current situation. Improvement must be farm specific and documented. Three steps are necessary: (1) Farm analysis based on the recorded data, (2) Outlining the objectives and indicators, and (3) Developing a strategy with concrete actions and systematic monitoring of progress (figure 7).

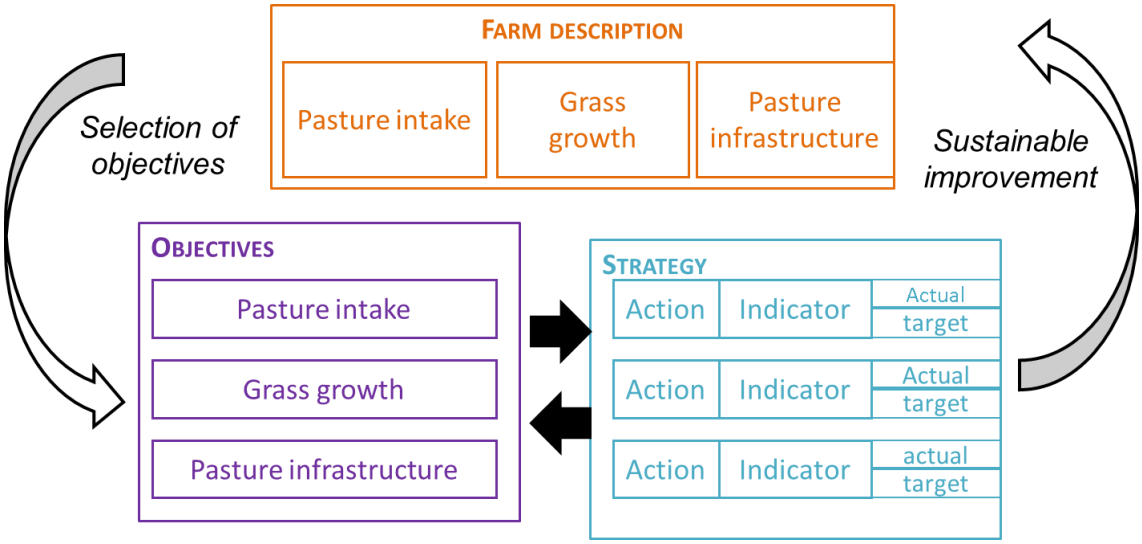


Figure 7. Farm improvement plan.

Results and discussion

The pasture and feeding calendar, used in all three projects is likely to be a guarantee of success for on-farm projects. A computer based data assessment allows four graphs to be generated which provide an intuitive understanding of grazing and instinctively motivate to improve (two examples below: Figure 8 and Figure 9).

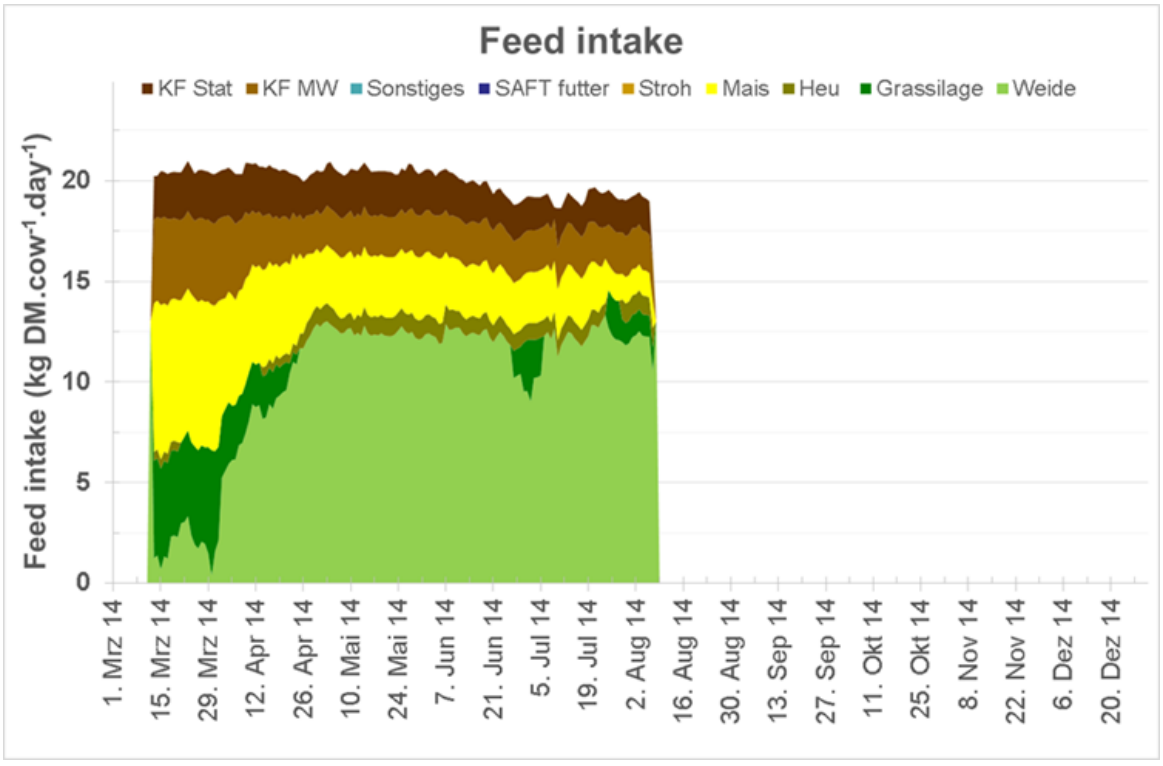


Figure 8. Feeding calendar showing daily feed intake.

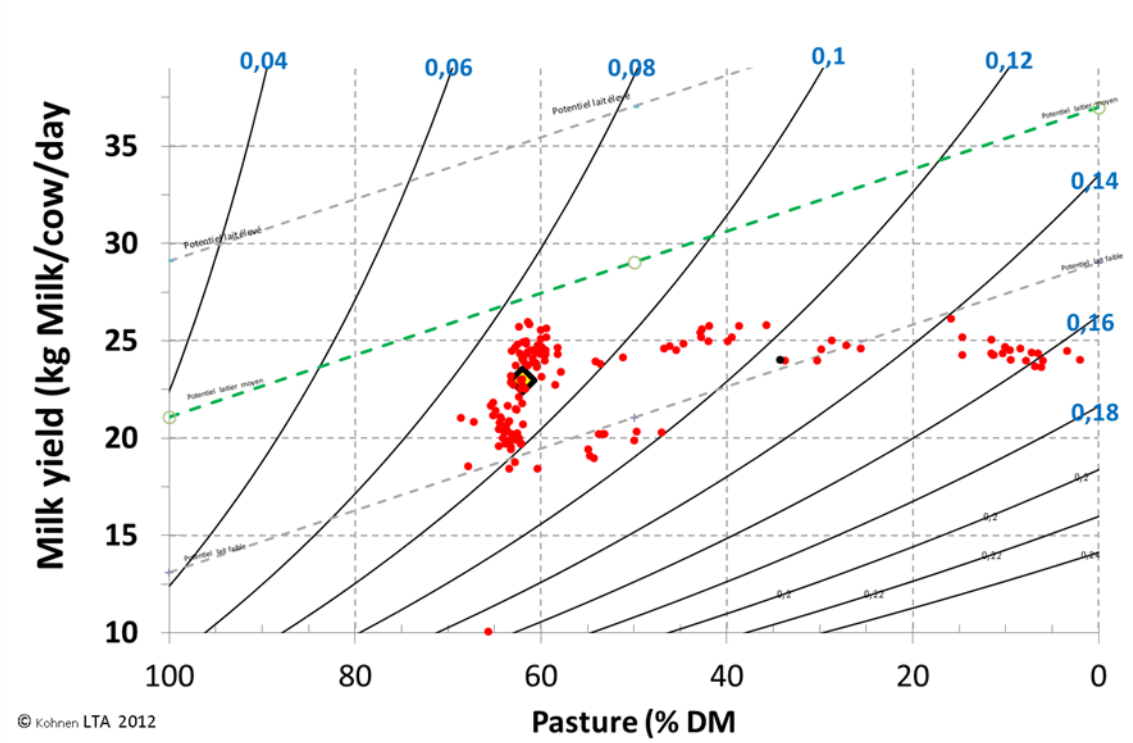


Figure 9. Daily estimated feed costs in relation to milk yield and % pasture in the diet (red dots: daily pasture situation; ascending curved lines: estimated feed costs)

Discussion and conclusions

The pasture and feeding calendar guaranteed the success in managing on-farm dairy projects. Table 1 gives a global appreciation of all methods used and shows the different levels of implementation of new farm practices: "assisted during the network period" and "applied autonomously after the project". Even if most of the tools implemented during the project were abandoned at the end of the projects, a positive attitude for grazing could however be strengthened and all farmers continued to graze at a high level.

Table 1.

Global appreciation of all methods used

	F&P	GM	HM	RPM	FR	FW	FDP
Time consuming	++	--	--	--	-	+	-
Spec. knowledge (technical realisation)	++	+	+	+	++	--	---
Spec. knowledge (data interpretation)	-	--	--	--	--	--	---
Accuracy	++	+	+	+	-	++	++
Acceptance (with technical assistance)	++	**+**	**+**	**+**	++	++	++
Acceptance (autonomous)	-	---	---	---	---	---	---

(F&P = Grazing and feeding calendar, GM = Grassmaster, HM = Herbomètre, RPM = Rising plate meter, FR = Feed reader, FW = Feed wedge, FDP = Farm development plan)

3.6 The Dairyman Sustainability Index (DSI) as a possibility for a complete data validation

Martin Elsaesser, Germany

Sustainability of dairy farms is determined by a multiplicity of single indicators. A combination of these single factors established useful sustainability indicator systems, but Von Wiren-Lehr (2001) reported the truth of sustainability is not possible even if complex models or time consuming measurements are used. Therefore the team of the Interreg IVb NWV project Dairyman chose a pragmatic way to install an indicator system for comparisons of so-called sustainability of dairy farm systems. The number of indicators for the calculation of the DSI was substantially reduced on 17 indicators. The DSI is not yet a fixed system, but it can be a proposal for an evaluation of sustainability (Elsaesser *et al.,* 2013, Elsaesser *et al.*, 2014). In conclusion:

- The DSI gives a better view on the farm situation than each single factor
- The DSI allows to look deeper into the farm specific situation if using the single factors
- The DSI gives the possibility to compare farms in and between regions easily
- The DSI gives the possibility to compare dairy production systems

3.7 Summary of group discussions

Introduction (by Jean-Louis Peyraud)

Sustainability has three pillars: economy, environmental and social. Scientific papers claim they work for sustainability, but most of them tackle only one pillar and most of them often only a specific aspect of this pillar (e.g. GHG emissions ignoring nitrate leaching in the environment pillar). Furthermore, the sustainability of the production systems has seldom been studied. In the group discussions, we will try to consider the performances of practices related to "forage production and utilisation" considering a holistic approach. The concept of multi performance includes:

- Competitiveness
- Productivity (per unit area) (and product quality)
- Parsimonious use of natural resources: P, energy, water
- Low emissions to air (ammonia, GHG) and water (nitrate)
- Acceptability for farmers (workload, simplification)
- Acceptability for society (animal welfare)

Four practices will be discussed in the following context:

- What are the effects of these practices on the panel of performances?
- Is it possible to counteract negative effects without adverse effect on the positive ones?
- What are the needs for innovation in forage production and utilisation?

Discussion items

Four groups of about 10 persons discussed the following items:

- What impact has diversification of grassland on performance, i.e. on competitiveness, productivity, natural resources, ammonia emission, nitrate loss, GHG emission, and animal welfare?
- What is the effect of extension of the grazing season (spring and autumn) on different aspects of sustainability?
- The strategic role of cutting vs. grazing
- The potential of new technologies for effective grazing management

Highlights of discussion group 1

Topic: What impact has diversification of grassland on performance, i.e. on competitiveness, productivity, natural resources, ammonia emission, nitrate loss, GHG emission, and animal welfare?

Competitiveness and productivity

Competitiveness and productivity are closely interlinked and therefore were considered together. The impact of diversification on competitiveness and productivity differs between ley and permanent grassland systems. For ley farming, a positive effect is assumed for both aspects. For permanent pasture, however, the effect is less clear. This is also due to methodological difficulties in quantifying

the impact of biodiversity on productivity in permanent systems. There seems potential in many regions to improve and/or stabilise production by diversification and thus increase competitiveness of farms, which is not fully exploited at the moment. Under specific conditions, however, a negative impact may not be excluded. It is generally accepted that diverse pastures result in better milk quality (fatty acid composition), which may generate a higher milk price. In addition, managing permanent pastures with high biodiversity may provide an alternative source of income if society is willing to pay for this environmental service.
Evaluation competitiveness: + (for permanent pastures)
Evaluation productivity: + (leys), +/- (permanent pastures)
Natural resources
Permanent pastures may benefit from biodiversity by improved water use efficiency under drought conditions. Orchard grass, chicory and lucerne, for instance, are known to have a higher water use efficiency through deeper rooting systems. This may reduce the need for irrigation. With respect to energy use, pastures with high legume content require less mineral N input due to N fixation. Furthermore, diverse pastures may make better use of phosphorus in soil.
Evaluation water use: +
Evaluation energy use: +
Ammonia emission
For a sound evaluation, all ammonia emissions occurring at the farm level have to be taken into account (slurry spreading, urine and feces excretion in the field, emissions in barn and at bunker silo), which seems not to have been quantified so far.
Evaluation ammonia emission: ?
Nitrate leaching and GHG emission
Given the same productivity, diverse pastures are assumed to require less N input and thus cause less nitrate loss and GHG emissions.
Evaluation nitrate leaching and GHG emission: +
Conclusions of discussion group 1

- A differentiation between ley and permanent grassland systems is required for evaluating the impact of biodiversity on productivity and competitiveness.
- Biodiversity is assumed to have a beneficial effect on the environmental impact of pasture systems.

Highlights of discussion group 2
Topic: What is the effect of extension of the grazing season (spring and autumn) on different aspects of sustainability?

1. *Competitiveness*

Lower costs are clearly a positive effect on competitiveness but the lower income is a negative effect. If extension of the grazing season is done accurately under good weather conditions and allowed by the farming system, it is a competitive option in comparison to feeding the animals inside.

2. *Productivity*

Similar to the competitiveness, the conditions of sward and weather greatly influence productivity. One way to extend the grazing season without destroying the sward is to restrict the access time to pastures. However, in general the extension of the grazing season does not directly translate into higher yields. Costs will increase and productivity decreases in particular when drainage or watering is required. More important for a sustainable productive system is a low sward height before the winter season and starting the grazing season on the correct date, as this stimulates the mineralisation due to root exudates most efficiently.

3. *Use of natural resources, e.g. water and energy*

We agreed on a decrease in energy costs due to an extension of the grazing season, because the energy used for production of fodder and to clean the stable is not required. However, this situation would be different in arid climates where energy would be required for irrigation. However, the water amount would be lower due to extension of the grazing season, because the animals need lower amounts of drinking water while fed by pasture than silage (e.g. maize silage). However, the amount of water used could also be higher if irrigation is necessary for plant growth.

4. *Ammonia (NH_3) losses*

NH_3 losses are lower due to an extension of the grazing season, because the faeces and urine are separated by the animal over the area, whereas inside the barn, the faeces and urine are mixed and

brought out on the sites in mixture. The urea causes an alkaline surrounding at the surface of the soil, which benefits the reaction of ammonium (NH_4^+) from the faeces to gaseous NH_3, which is then emitted to the atmosphere. Additionally, the storage of manure also causes losses of NH_3.

5. *Nitrate (NO_3^-) leaching*

NO_3^- leaching is higher due to an extension of the grazing season, especially in autumn. The input of NO_3^- due to the animal is partially (spatial heterogeneity of grazing) higher than the amount which is relocated due to plant growth. Subsequent rainfalls then cause leaching of NO_3^-.

6. *Greenhouse gas emissions (GHG)*

GHG emissions will be lower due to an extension of the grazing season if the grazed plants are high in protein and low in indigestible parts. Otherwise, the GHG emissions are higher, because a higher quality of fodder e.g. maize silage causes lower methane emissions due to rumination and digestion.

7. *Workload*

The workload depends on the farm system and on the farmer. In general, the workload should be lower due to an extension of the grazing season because the daily work of cleaning the barn and feeding the animals is not required. Otherwise, the daily work load is unpredictable when the animals are on pasture because damaged fences or water troughs must be repaired immediately. Also, the health care is more complicated when the animals are pastured. However, working outside on the pastures with the animals increases the work quality according to some farmers.

8. *Welfare*

The welfare for the animal is higher on the pasture, because of the more similar conditions to the natural conditions, but decreases when the amount and the quality of fodder decrease and depends on the weather conditions.

Conclusions of discussion group 2

The conclusions of discussion group 2 are summarized in Table 2.

Table 2.

Effects of an extension of the grazing season on sustainability aspects (+ = positive; - = negative).

Competiveness	Productivity	Natural resources		NO_3	GHG	NH_3^+	Workload	Animal welfare
		Water	Energy					
+	+	+ (-)	+ (-)	+	+ (-)	-	+	+

Highlights of discussion group 3

Topic: The strategic role of cutting vs. grazing.

The issue addressed was whether cutting and subsequent feeding herbage indoors, fresh or conserved, is better than grazing in relation to productivity per ha, water and energy use, emissions (ammonia, greenhouse gases (GHG)), nitrate leaching, work load and animal welfare. Dairy cows fed fresh or conserved grass indoors are often supplemented with maize silage and protein concentrates, etc. This leads to the question: Where should the limits of the cutting production systems be put for the discussion?

Consensus was found quite easily that cutting systems consume more fossil fuels. It was assumed that nitrate leaching was complementary with ammonia emissions. Concretely, in cutting systems more ammonia was emitted, but due to the better distribution of the slurry, less nitrate leaching happens compared to grazing. In general, animal welfare is better outdoors on pastures, although housing conditions are becoming better in terms of welfare aspects. Welfare concerns in grazing systems could be heat stress, disturbance from insects and parasites, strong energy deficiency in non-adapted dairy cows etc. Perception of welfare can differ in relation to tradition and culture of the different stakeholders. The assessment of GHG emissions depends on the definition of the system limits (plot, farm, region or planetary scale) and which criteria are considered. The water consumption would be similar in both production systems. Concerning the work load, competitiveness and the productivity per ha, no uniform and clear statement could be given by the group, because conditions for efficient grazing systems like long vegetation periods, sufficient grassland with good grass growth,

suitable climate etc. do not exist everywhere in Europe or in the world. Just as an example, in the group the conditions from Sweden, Ireland, Netherlands, Germany, Belgium, France, Switzerland, Hungary and New Zealand were discussed. The economic aspects and therefore the way to produce are also strongly linked to prices of milk, concentrates, land, labor etc. in the different regions. Finally, to compare production systems the assessment criteria should be clear, complete and accepted.

Conclusions of discussion group 3

It was concluded that the superiority of the cutting vs. grazing depends strongly on the situation (country, region).

Highlights of discussion group 4

Topic: The potential of new technologies for effective grazing management.

In the past, the problem of unused opportunities to enhance the efficiency of grazing management could not be addressed by developing, introducing, and using new technologies. But recently, different new technologies were developed and are available to improve grazing, for example due to progress in breeding technologies, spectrometer development, or broadly available GPS mapping. New technologies that have the potential to be applied in practice cover the different fields of breeding, labor facilitations, and precision farming. Namely we identified the following: plant genetics, animal genetics, automatic milking systems (AMS), mobile AMS, automatic fencing for strip grazing, drones, grazing sensors (for animals), grass sensors (for plants), precision fertilizing, precision grazing, and precision cropping. Further on, automatic fencing, mobile AMS, and precision farming were discussed in more detail. In general, all three technologies have the potential to improve grazing management mainly by increasing productivity, reducing environmental emissions, and reducing work load, whereas the use of environmental resources is considered to be not touched by automatic fencing and mobile AMS, whereas these resources can be reduced under precision farming (Table 3). Especially the possibility to reduce environmental emissions may become even more important in the future. In some cases it is not possible to predict if the impact will be positive or negative because it either strongly depends on the present grazing management system or environmental conditions, or more research is necessary to make more precise predictions. The acceptance of new technologies by farmers because of the low competitiveness of new technologies compared to established technologies was recognised as the biggest obstacle for introducing new technologies. Especially as long as new technologies are still in the introduction phase, they are not competitive with well-established technologies. Moreover, there is a certain risk that new technologies may even lead to reduced grazing (e.g. AMS).

Table 3.

Predicted positive (+), negative (-) and neutral (0) qualitative impacts of new technologies for effective grazing management on different economic aspects, environmental resources, emissions, farmers, and animal welfare.

	Competitiveness	Productivity	Use of water	Use of energy	Ammonia emissions	GHG emissions	Nitrate leaching	Work load	Animal welfare
Automatic fencing	-	+	0	0	0 +	0 +	0 +	+	+
Mobile AMS	-	0	0	0	+	+	+	+	+
Precision farming	+ (-)	+	+	+	+	+	+	+ (-)	0

Conclusions of discussion group 4

We conclude that there is a generally high potential for new technologies as effective grazing management, but (I) it differs among technologies and grazing systems, (II) there is the need to transfer this knowledge to farmers so that they know how to use new technologies, (III) for a successful implementation, farmers intrinsic motivation to apply a new technology is one of the basic prerequisites, and (IV) competitiveness remains the main limiting factor for introducing new technologies.

4 Current and future economics of grazing

4.1 Profitable grazing

Bert Philipsen, Wageningen UR Livestock Research, the Netherlands

The majority of Dutch farmers graze their dairy cattle. The percentage is declining, however. More and more farmers are asking themselves whether grazing is profitable now, and in the future. Therefore a study was carried out to improve the financial benefits from grazing on Dutch farms. It consisted of three parts.
In the first part of the study, economics of grazing were modelled for modern Dutch dairy farms in the years 2015-2020. These farms will be more intensive than they are nowadays and the number of farms with AMS will increase. The whole farm model DairyWise (Schils *et al.*, 2007) was used to calculate gross margins. Results showed that grazing is financially more attractive than summer feeding if the cows eat sufficient amounts of fresh pasture grass (>600 kg DM cow^{-1} yr^{-1}). In this figure the grazing premium of €0.5 for each 100 kg milk supplied, that Dutch farmers currently receive, was not taken into account so in practice the effect should be even more positive. Fresh grass intake is a crucial factor determining the economic result of grazing.
In the second part of the study, data envelopment analysis (Steeneveld *et al.*, 2012) was used for statistical analysis of farm data collected by accounting firms and advisors. The results illustrate the actual financial results of approximately 10% of all Dutch commercial dairy farms in 2011. On average, grazing was profitable in 2011. However, these positive results declined in relation to increasing farm size. The transition point was, on average, a farm size of about 90 dairy cows. In 2011, the majority of dairy farms did not yet have the option of receiving a grazing premium. Today, however, most dairy companies have implemented the grazing premium. The current grazing premium would have made the transition point go up to a farm size of approximately 130-140 cows. Unfortunately, the actual grass intake on the commercial dairy farms was not known. Therefore, it was not possible to relate the grass intake to the farm income. The category 'grazing farms' included both farms with very low grass intake and farms with full grazing.
Finally a group of advisors discussed and calculated success factors for increasing the profit of grazing. Most important management options that were identified were increasing the grass intake, lower supplementation of roughage and enlarging the grazing platform around the farm. For a farm of 120 milking cows the benefits of changing management could mount up to €9000 yr^{-1}.

Since most farmers do not know the fresh grass intake of their dairy cows, a Dry Matter Intake (DMI) dashboard was developed. Farmers have to register the milk production and milk solids and the supplementary feeding and the DMI dashboard calculates the fresh grass intake and the feeding costs on a day-to-day basis. The tool was tested by farmers of the Network Group '*Dynamisch Weiden'*. Farmers considered the tool very useful. Furthermore, a "FarmWalk concept NL" was developed to improve the grazing skills of dairy farmers. First, 60 "grazing coaches" have been trained. Each grazing coach has thereafter been coaching a group of 10 farmers five times a year. Currently, around 550 farmers are part of the programme and carry out a FarmWalk each week. Finally, there is a lot of communication on grazing, for example weekly columns of the "*Weideman*" ("Grazing man") with practical tips for grazing.

This all leads to more profitable grazing. A lower roughage supplementation and a higher fresh grass intake are the most important factors affecting the profit of grazing. For this, grazing skills of farmers are very important. Overall, the approach for more profitable grazing is considered rather successful in the Netherlands.

4.2 Economical evaluation of feeding costs in pilot farms applying grazing

Françoise Lessire, Isabelle Dufrasne, University of Liège, Liège

Development of Automatic Milking Systems (AMS) is often associated with a decrease in grazing. However, grazing is beneficial from several points of view including economics. This study aimed to develop a method to assess the impact of grazing on feeding costs in pilot farms.
Feeding costs of grazing cows are difficult to appreciate since the amount of ingested grass is hardly predictable. However, several methods based on 'on-field' evaluations and on feed supply could allow this estimation.

- Evaluation of grass available in pastures could be made
    - By measuring grass height when cows enter and leave the parcel. The difference corresponds to the amount of grass eaten by the animals.
    - By calculating the grass density (kg DM/ha). This figure divided by the stocking rate and by the number of days the cows stay on the paddock estimates the amount of grass (kg DM) available.
- Evaluation of feed supply at stable

The maximum ingestion was estimated at 22 kg DM on basis of intake recorded during the winter. The DM provided by the distribution of the total mixed ration (TMR) was assessed during the grazing period. The difference between the maximum ingestion and TMR (kg DM) + concentrates (kg DM) gave the amount of grass the cows were able to eat.
Once the grass intake was assessed, feeding costs could be calculated. Two methods were tested:

- Method 1: Evaluation of feeding costs related to the TMR and the concentrates using data from accountancy for purchased feeds and for forages, the compensation received in case of damage to the crops by wildlife.
- Method 2: Method 1 + Evaluation of costs related to grass production.

The grass production costs were obtained by calculating the percentage of grass valorised by grazing and by applying this correction factor to the costs related to grass production (sum of grazed grass plus grass forages).
To conclude, these methods allowed to calculate the economic benefit related with grazing with some uncertainties linked to the grass evaluation, TMR evaluation and to the individual behaviour.
Comparing the feeding costs estimated on this basis with the feeding costs from wintertime gave the financial advantage provided by grazing. The financial advantage was estimated to be €0.03 kg^{-1} for farms incorporating on average 30% grass in summer diet while it was €0.09 kg^{-1} for the farm with 90% grass.

4.3 Stimulation of grazing in Europe

Agnes van den Pol-van Dasselaar, Wageningen UR Livestock Research, the Netherlands

To gain insight about whether grazing is being stimulated in Europe, a survey was conducted among members of the EGF Working Group "Grazing" in 2014. Members were asked: "Are there any laws/regulations/subsidies in your country that are promoting/stimulating either grazing or no-grazing?" The answers show several legislation initiatives, subsidy initiatives and other initiatives.

<u>Legislation</u>

- New EU policy concerning CAP2014-2020 promotes grazing
- EU: area permanent grassland should remain stable (prevents conversion to arable land)
- Agri-environmental programmes, cross compliance
- Organic agriculture needs grazing
- Grassland preservation precept in certain areas of Germany
- Animal welfare laws in Scandinavia
- Manure legislation

- Derogation, Manure Action Plan: no grazing leads to less administration and makes an acceptable N balance easier
- Limits for nitrogen leaching (complicated for grazed lands)

Subsidies
- Luxembourg: after 2015 special subsidy for grazing cows
- Parts of Germany: subsidies for renewable energy promoting land use other than grazing
- Parts of Germany: subsidies when cows have access to pastures >3 months/yr (€30 per cow or €60-80 per ha)
- Switzerland: farmers can obtain higher subsidies it they graze a certain percentage of their farmland. Outdoor-programme: May-Oct at least 26 days per month access to pasture, other months 13 days to an outdoor place with solid ground
- The Netherlands: initiatives of dairies to pay more for pasture milk; dairy industry provides grazing premium: 0.5 ct/kg in 2014; 1.000.000 kg milk equals €5000; definition of grazing for this premium: minimum 120 days minimum 6 hours per day
- Sweden: subsidies on grasslands and organic production

Other
- Retail: Special grazing labels of milk and meat, cheese exclusively based on milk from grazing cows
- Courses
- Advice
- FarmWalk
- Issuance of permits
- The Netherlands: "Treaty Grazing" (almost 60 parties have signed this Treaty with the aim of stabilising the percentage of farms that practice grazing)
- Tailor made solutions for different farm systems / grazing systems

In conclusion, there are some laws/regulations/subsidies. Some are applicable for a country or even Europe and some are special cases for specific regions. The minority of these laws/regulations/subsidies stimulate no grazing, the majority stimulates grazing.

4.4 Summary of group discussions

Discussion items
Four groups of about 10 persons discussed the following items:
1. Can grazing remain a cheap and efficient way of grassland utilisation in the future?
2. Fertilisation regulations stimulate no-grazing.
3. Should grazing be stimulated by (inter)national bodies?
4. Does legislation (e.g. fertilisation) stimulate or complicate grazing?
5. How to calculate production costs of grazing?
6. The end of the milk quota will lead to less grazing.
7. Is there a future for grazing?

(not all topics were discussed by all groups)

1. Can grazing remain a cheap and efficient way of grassland utilisation in the future?

Group 1: In general grazing is a cheap and efficient way of using grassland. But other developments influence what is happening. For example in Germany, pigs, fruit and bioenergy production have superseded dairy farming in the race for land. The group believes that grazing is the only way for dairy farming to go out of the competition. However, this is not recognised by all farmers. In conclusion, in general there is no other way for cheap and efficient utilisation of grasslands than by grazing. Prices and opportunities decide if grazing will happen.
Group 2: Whether grazing will remain cheap will depend on the development of farms in terms of herd size versus grazing area. The end of the milk quota will affect that. A problem is that the (economic)

benefits of grazing compared to indoor feeding get smaller and smaller due to faster technical innovations in the cutting/indoor feeding systems than in the grazing systems. More investment in research is needed (management innovation, system innovation).
Group 3: In general grazing is a low cost system. Sometimes with lower fresh grass intake farmers have double work (feeding in the barn and work with grazing) which makes it difficult. Concentrates have high prices and grazing is cheap which means that grazing reduces feedings costs. In Germany the cost of fresh grass is €13-14.6 per 10 MJ NEL and silage is €26 per 10 MJ NEL. So grazing is cheaper than stall feeding. However in the east of Germany with dry conditions in summer (<500 mm rainfall) grazing is not easy to practice; more farmers therefore choose for stall feeding. In France it depends on how the grass is produced. Grass with legumes is less expensive. Feeding costs of grass/white clover versus maize have a ratio of 1:3 or 1:4. In Luxemburg the rule of the thumb is that grazing is half the price. In conclusion: grazing is generally cheaper than stall feeding but harmonising the way of calculating the costs of grazing and cutting (with or without labor, etc.) is needed. Future unpredictability makes it more difficult to graze, take for example drier conditions in the future due to climate change.
Group 4: The group was divided (yes and no). No: probably there are other crops that are more efficient then grass and have less utilisation losses. When there is a bonus or extra milk price, it will be helpful. Yes: it is a cheap way of utilisation, but there are some aspects that make it more difficult and those aspects are depending on the country and the region: farmer, farm size, legislation, land price, land community, development of energy and feed prices. By competitive yields (New Zealand, Ireland), grazing is and will be cheaper. In conclusion, grazing may be a cheap and efficient method of grassland utilisation in the future, depending on: stocking rate, regional characteristics, animal species, grassland yield and volatility of input and output prices.

2. <u>Fertilisation regulations stimulate no-grazing</u>

Group 1: No is our unanimous answer. Fertilisation regulations reduce losses.
Group 2: Among farmers, research and policy there are different perceptions of the benefits of grazing. In DK and NL for example, the mainstream opinion is that the manure use efficiency is higher when cows are inside. We discussed that this is probably true when the cows are outside without real grazing, but not when the grass is well eaten and the grass grows well. So, grazing can become an environmental problem when legislation (e.g. the Scandinavian animal welfare legislation) stimulates 'siesta' grazing instead of real grazing.
Group 3: In most countries there is no limitation. E.g. in France the 170 kg N ha^{-1} from organic fertilisation but no limits on extra artificial fertiliser. So it depends on the country.
Group 4: This is probably true for the Netherlands, Belgium and Denmark; on the other hand: more grazing means less manure storing so lower building costs. In France, Ireland and New Zealand no effect is expected.

3. <u>Should grazing be stimulated by (inter)national bodies?</u>

Group 1: We were all convinced that to graze or not to graze is because of the interests of the farmer. If he is not interested, he is not going to graze. (Inter)national bodies can help to increase the interest of farmers in grazing. This can be done for instance by education and/or by financial stimulation. It is certainly desirable that grazing should be stimulated depending on the situation where it is desirable for whatever reason. For example, in Bulgaria huge areas of grassland are abandoned. Grazing these areas could be stimulated by (inter)national bodies. In conclusion: (inter)national bodies should stimulate grazing by increasing the interest of farmers in grazing.
Group 3: When everybody earns from grazing except the farmers, it should be stimulated by an (inter)national body. In Luxemburg a subsidy is coming and is hidden in an environmental regulation. It is a premium of €300 per ha, and the only condition is that grassland is not cut until August. It is available for three years and you can change per paddock. In Germany there are environmental subsidies in some states which could stimulate grazing (€80 per cow for example in Bavaria).
Group 4: Unanimously "no". It is and should be an economic or even a marketing issue. Consumers should be willing to pay extra if they think it's important. If stimulation is required than it should be through conservation of grasslands (by grazing) or Ecosystem services (thus in a broader way). It

must be done as part of a long term strategy, in order to offer reliable perspectives to farmers. One of these strategies may be: "stimulate grazing in order to safeguard ecosystem services".

4. Does legislation (e.g. fertilisation) stimulate or complicate grazing?

Group 1: This can go both ways. For example: In Poland the amount of milk is stimulated. In some cases, depending on farm structure and preference of the farmer, this might complicate grazing.
Group 4: If there are special components in it, it can work as a stimulus (more NH_3 rights for grazing systems). In Sweden and Norway grazing is already obligatory. This indirectly stimulates organic farming. Stimulating organic farming indirectly stimulates grazing. Whatever stimuli are created, they must be controllable.

5. How to calculate production costs of grazing?

Group 1: We agreed that this is a complex issue. Important is to know the yield from each paddock. You have to take into account all costs related to grazing (labor, yield, etc.). Another idea: grazing is part of a certain grassland management that is practised on a farm. If you want to know the costs of grazing you should compare two identical farms, one with grazing and one without grazing to know the costs of grazing.
Group 4: It should be possible to calculate the costs in the same way they are calculated for organic farms (Belgium), or in the way the premium for a delayed first cut is calculated (the Netherlands). It should be done by the 'normal' way of fixed costs and variable costs. Problem is: which part is related to grazing? Backward calculations underestimate by about 20%. In general you should know more about yields and grass intake. We must get rid of the backward calculation or at least adapt it since backward calculations underestimate grassland yield by approximately 15-20%. Weighing facilities (on large farms) may improve the knowledge of grassland productivity.

6. The end of the milk quota will lead to less grazing

Group 1: Farmers already anticipate/prepare for the end of the milk quota by building barns and keeping more heifers. It is expected that farmers will have to buy more feed because the level of self-sufficiency will decrease because of the fact that they will keep more animals to produce more milk. We think that at a certain point this will be counterbalanced by the fact that prices of feed and other inputs will increase and milk prices will decline. We conclude that initially the end of the milk quota will lead to less grazing. Prices and opportunities will decide the future.
Group 2. The end of the milk quota will influence the development of farms in terms of herd size versus grazing area and this will affect whether grazing will remain cheap. The situation will be very different in different European regions/countries, e.g.:

- Sweden: for large areas, there is no alternative to grazing. But without stimulation from the government, grazing will decrease and large semi natural grasslands will become forest in the near future. Because Sweden never fully milked the quota, the end of the quota will not influence grazing directly.
- Lithuania: expect more grazing.
- the Netherlands: less grazing expected with the end of the quota, but market forces will stimulate grazing.
- Switzerland: good conditions for grazing (mountains, tourism).
- Spain: north-west good grazing conditions but the mentality and awareness of the benefits is lacking.

Group 3: The end of the quota is a great risk for less grazing but there will be strong regional differences. In general farmers will intensify their production but probably less in places like Ireland. What ultimately will happen depends on the price of the milk. If the price collapses in 2016 possibly more farmers will seek to reduce production costs via grazing.
Group 4: Not in Ireland: 60% of the farmers can improve their management without changing the grassland system. In other countries more problems are foreseen: land is more and more divided and not near the farm. There is a chance that world market prices (lower) combined with high fuel and feed costs will stimulate grazing. The absolute grazed area is expected to remain stable. Since the

number of cows is expected to rise, the relative importance of grazing may decline. At the end of the day, price volatilities may or may not stimulate grazing.

7. Is there a future for grazing?

Group 1: Yes, there is a future for grazing. Economics don't change this conclusion.
Group 2: There is a future for grazing. Surely in the long term due to advantages in terms of sustainability, e.g. energy prices will probably increase in the future, making feeding on the basis of mechanization and concentrate import more expensive. On the other hand, in the short term, the new market situation after the end of the quota will probably discourage grazing and stimulation will be needed through legislation, research and innovation, and initiatives in the market.
Group 3: The future of grazing is depending on the market/milk prices and environmental regulations.
Group 4: Yes, there is a future for grazing, but as mentioned in the discussion of earlier topics, the importance of grazing may decline.

5 Concluding remarks

Evaluation of the day

The meeting was evaluated positively. The discussion sessions were greatly appreciated. It is good to meet people and to know what they are working on. Further exchange between researchers was encouraged. The EGF Working Group "Grazing" is a valuable platform for this. The next meeting of the Working Group is scheduled at 14 June 2015 in Wageningen, the Netherlands, prior to the 18th Symposium of EGF.

Reporting

The highlights of the meeting were briefly reported in the Business Meeting of the European Grassland Federation on 11 September 2014. The proceedings (this report) and the PDFs of the presentations are available on the website of EGF (www.europeangrassland.org/working-groups/grazing).

The future of grazing

The participants of the meeting concluded that there is a future for grazing and furthermore, even though the importance of grazing may decline in some regions, that it is a positive future. Grazing will remain an important aspect of future animal production systems. Therefore the EGF Working Group "Grazing" should continue to exchange knowledge, methods and innovations and should continue to network.

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Appendix 1: Agenda 3rd Meeting of the EGF Working Group "Grazing"

Aberystwyth, 7 September 2014

Session I (chaired by Agnes van den Pol-van Dasselaar)
9.00-9.15 Welcome, introduction of participants, introduction of the day

Session II (chaired by Alex de Vliegher)
9.15 – 11.30 including coffee/tea
Several forward looking views on the future of grazing in Europe (short introductions)

- Grazing in France and its future (Jean Louis Peyraud, France)
- Future trends in grazing with Hungarian extensive beef farming (Andras Halasz, Hungary)
- Future of grazing in Germany (Johannes Isselstein, Germany)
- Management and benefits of grazing large herds (Emer Kennedy, Ireland)
- Future of grazing in the Netherlands and in Europe (Agnes van den Pol-van Dasselaar, the Netherlands)

Group discussions
Plenary discussion / feedback

Session III (chaired by Jean-Louis Peyraud)
11.30 – 14.30 including lunch
Developments in forage production (e.g. optimising forage production; biological developments, technological developments: e.g. in grass growth, progress in plant genetics for production, forage growth under grazing and cutting, grass use efficiency, new insights in plant eco-physiology, effects of mixed swards, management strategies to optimise grass quality, soil-grass-animal interactions, innovations to better cope with constraints of grazing) (short introductions)

- Does early spring grazing stimulate spring grass production? (Nick van Eekeren, the Netherlands)
- The impact of automation (sensors, grazing time, mobile milking) (Valérie Brocard, France)
- Grazing of *Festuca arundinacea* and *Dactylis glomerata* with heifers (Martin Elsaesser, Germany)
- Cutting vs. grazing in autumn (Alex de Vliegher, Belgium)
- 10 years management of on farm dairy pasture projects: review of methodology and results (Henri Kohnen, Luxembourg)
- The Dairyman Sustainability Index (DSI) as a possibility for a complete data validation (Martin Elsaesser, Germany)

Group discussions
Plenary discussion / feedback

Session IV (chaired by Johannes Isselstein)
14.30 – 16.45 including coffee/tea
Current and future economics of grazing (short introductions)

- Economics of grazing (Bert Philipsen, the Netherlands)
- Economical evaluation of feeding costs in pilot farms at grazing (Françoise Lessire, Belgium)
- Stimulation of grazing in Europe (Agnes van den Pol-van Dasselaar, the Netherlands)

Group discussions
Plenary discussion / feedback

Session V (chaired by Agnes van den Pol-van Dasselaar)
16.45-17.00
Closing of the meeting

To explore the potential of nature to improve the quality of life



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