Grazing, innovation, animal welfare

Proceedings 7th Meeting EGF Working Group ''Grazing'' in Caen

A. van den Pol-van Dasselaar[1], D. Hennessy[2], J. Isselstein[3]

[1]Aeres University of Applied Sciences, the Netherlands
[2]Teagasc, Ireland
[3]University Göttingen, German

14 augustus 2023

Preface

The seventh meeting of the Working Group “Grazing” of the European Grassland Federation (EGF) was held in Caen, France, in June 2022 prior to the 29th General Meeting of the European Grassland Federation. Approximately sixty persons worked on the themes grazing, animal welfare and innovation. The sub-themes 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. It is available, together with pdf’s of the presentations, on the internet at www.europeangrassland.org/en/working-groups/grazing.

The coordination team of the Working Group (editors of this report) would like to thank all the participants, and especially the speakers, 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 objective of this Working Group, i.e. to exchange knowledge on all aspects of grazing and networking, has, as in previous meetings, been fully achieved.

On behalf of the coordination team of the EGF Working Group “Grazing”,
Dr. Agnes van den Pol-van Dasselaar, the Netherlands (Chair)

Summary

This report presents the main outcomes of the seventh meeting of the EGF Working Group “Grazing” which was held in Caen, France, on 26 June 2022. The aim of this Working Group is to exchange knowledge on all aspects of grazing research and to provide a forum for networking.

There were three sessions:
- State-of-the-art with respect to grazing
- Grazing and animal welfare
- Grassland innovation

The state-of-the-art session provided insight into the extent of grazing from 2010 to 2022 based on a survey among members of the Working Group “Grazing”. Furthermore, the importance of grazing in European agriculture was discussed. In the session on grazing and animal welfare, both the technical and ethical/socio-economic aspects of grazing in relation to animal welfare and animal health in a European setting were discussed. Finally, in the session on grassland innovation, best-practices and methodologies to co-create implementation of innovative systems on grasslands and grazing were discussed.

Table of contents

1 Introduction

The aim of the Working Group "Grazing" of the European Grassland Federation (EGF) is to exchange knowledge on all aspects of grazing research and to provide a forum for networking. The group was established in Uppsala, Sweden at the General Meeting of the EGF in 2008. The Working Group ensures detailed knowledge exchange and discussion on grazing by organizing meetings and surveys. Meetings were held in:

1. Kiel, Germany, 2010: Research methodology of grazing
2. Lublin, Poland, 2012: Innovations in grazing
3. Aberystwyth, UK, 2014: The future of grazing
4. Wageningen, the Netherlands, 2015: Grazing and automation
5. Trondheim, Norway, 2016: Grazing in a high-tech world
6. Cork, Ireland, 2018: Maximising grazing in ruminant production systems

Proceedings of all these meetings can be found at www.europeangrassland.org/en/working-groups/grazing. The 7th meeting of the EGF Working Group "Grazing" was held in 2022.

The 7th meeting was held in Caen, France on the 26 June 2022 prior to the 29th General Meeting of EGF. The meeting facilitated learning from the experiences in projects and related activities, and to use these experiences to improve future collaborations. There were approximately 60 participants from 16 nationalities present during the meeting. The majority of the participants were from research, but there were also other stakeholders present, e.g. from industry.

There were three sessions during the meeting:

- State-of-the-art with respect to grazing
- Grazing and animal welfare
- Grassland innovation

The state-of-the-art session provided insight into the extent of grazing from 2010 to 2022 based on a survey among members of the Working Group "Grazing". Furthermore, the importance of grazing in

European agriculture was discussed. The session on grazing and animal welfare covered both the technical and ethical/socioeconomic aspects of grazing in relation to animal welfare and animal health in a European setting. Finally, in the session on grassland innovation, best-practices and methodologies to co-create implementation of innovative systems on grasslands and grazing were discussed.

All three sessions consisted of plenary presentations followed by a short discussion. Thereafter, the theme was thoroughly discussed in alternating groups of about ten persons each. The program of the meeting can be found in Appendix 1 of this report. Both the plenary presentations and the group discussions are summarized in this report. Plenary presentations are summarized by the presenters. Groups were led by an alternating chair and an alternating reporter. This method ensured that many participants contributed to the meeting itself. The reports of the individual group reporters were summarized by the authors of this report.

State-of-the-art is described in Chapter 2. Chapter 3 reports on grazing and animal welfare and chapter 4 reports on grassland innovation. Finally, some concluding remarks can be found 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/en/working-groups/grazing).

2 State-of-the-art

2.1. Grazing in Europe from 2010 to 2022

Deirdre Hennessy[1], Johannes Isselstein[2], Agnes van den Pol-van Dasselaar[3]
[1]Teagasc, Ireland
[2]University of Göttingen, Germany
[3]Aeres University of Applied Sciences, the Netherlands

Grazing is not monitored explicitly at a European level. However, since the first meeting of the EGF Working Group "Grazing" in 2010, surveys on the extent of grazing in different countries have been conducted among members of this Working Group. Results have been variable and there is no complete overview, but these results do provide some insight in to the state of the art with respect to grazing in Europe. Sometimes statistical data are available, but usually the numbers provided are only an educated guess. Furthermore, in these surveys 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 are mainly educated guesses.

In 2022, the annual survey on opinions, thoughts and facts with respect to grazing was carried out among the members of the Working Group using the on-line survey program SurveyMonkey. The total number of respondents was 95, of which 91 respondents completed the full questionnaire. About two-thirds of the respondents said that their estimate of the percentage grazing in their country was an educated guess. The other one-third based their answer on data, e.g. statistical surveys, projects, subsidies, etc.

The respondents considered grazing important for different stakeholders: farmers, government, scientists, teachers, students, advisers. On a scale of 1 to 10 (where 1 is unimportant and 10 is important), the respondents rated the importance of grazing between 6.13 and 7.29 for these different stakeholder groups. The importance of grazing for the members of the Working Group themselves was rated at 8.65 (this number has been gradually increasing from 2016 onwards when it was 8.33). The members thought that the importance of grazing for the general public was 7.88 (which is also higher than in 2016 when it was 7.46).

Europe can be divided into six distinctive regions with respect to the extent of grazing (Table 1).

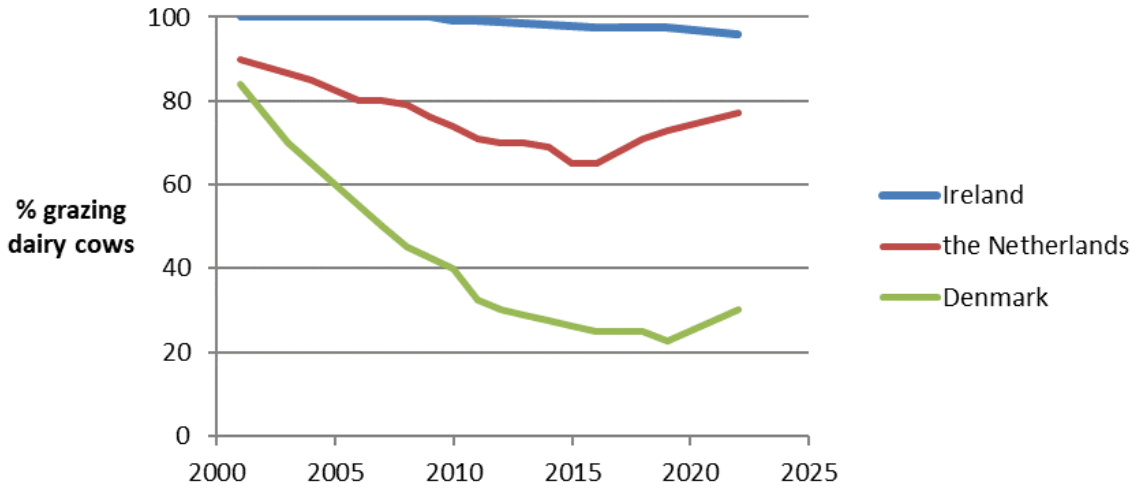
Table 1. Grazing in Europe (% of dairy cows) in six distinctive regions of Europe. Data come from members of the EGF Working Group "Grazing" and are mainly educated guesses.

		2010	2014	2016	2019	2022
North	Norway			90	80	80 (75-95)
	Sweden	100	100	100	100	100 (100-100)
	Finland			70	80	70 (60-80)
West	Ireland	99	98	95-100	95-100	96 (90-100)
	UK		92	80-90	70-80	82,5 (70-90)

Central; Grazing > 50%	The Netherlands		70	65	73	75-80
	Belgium Huge differences between Flanders (low) – Wallonia (high)	85-95	75-80	60-85	30-95	40-90
	Luxembourg	75-85	73	75		30-50
	France	90-95	90	75-95	90	50-90
	Switzerland	85-100	75-90	80-97	70-90	94 (88-96)
Central; Grazing < 50%	Denmark	35-45	25-30	25	20-25	30
	Germany	42		10-50	15-40	30 (20-50)
	Austria	25		40	44	45
East	Poland			20	30	30
	Czech Republic	20		3		4
	Slovenia	25		20	20-40	20
	Hungary			2-3	3-5	5-10
South	Spain	20		10-30	20-30	10-50
	Greece	15		10	10	5
	Italy			10-20		2-70

Table 1 shows that the extent of grazing is country specific and that there is less grazing in the East and the South than in the North and the West of Europe. Even though the data are often only an educated guess, it can be concluded that in general the popularity of grazing in Europe is declining, with less cows grazing less days per year and less hours per day. However, a few exceptions can be seen. They are illustrated in Figure 1.

Figure 1. Grazing (% dairy cows) in Ireland (educated guesses), the Netherlands (statistical data in 2001–2020 and educated guesses in 2022) and Denmark (educated guesses), based on Van den Pol-van Dasselaar et al., 2020 and data of the EGF Working Group "Grazing" survey in 2022.



Finally, respondents were asked for the biggest challenges for grazing in the next decade. They mentioned:

- Climate change, weather
- Costs, economy
- Policy, judgement of people with no connection to agriculture
- Balancing/managing different ecosystem services
- Farmers understanding the benefits of grazing

Climate change / weather was by far the most frequently mentioned.

References:

Van den Pol-van Dasselaar, A., D. Hennessy, J. Isselstein (2020) Grazing of Dairy Cows in Europe—An In-Depth Analysis Based on the Perception of Grassland Experts. Sustainability 12, 1098.

2.2. SustAinimal Grazing Living Lab – a quantitative analysis of grazing management among dairy farms in Northern Sweden

Anna-Karin Karlsson[1], Nilla Nilsdotter-Linde[2]
[1]RISE Research Institutes of Sweden
[2]SLU – Swedish University of Agricultural Sciences

A survey was carried out in Northern Sweden to study grazing management among dairy farms. Three hundred and two farms with a total of approximately 21,000 milking cows were questioned in winter 2021/2022. Leys (1-4 years) are the main land use of these farms (60% of total agricultural land). The Swedish grazing policy framework requires 60 days of grazing in Northern Sweden. The majority of the farms in the survey grazes more: 2-2.5 months (30%), 3-3.5 months (39%) or 4-5 months (31%). The average amount of grazing hours per day is 13.5 hours and the average distance from barn to paddock is 0.5 km. Different grazing strategies are used: continuous grazing (59%), rotational grazing with on average 6 days in a paddock (45%) and compartmented continuous grazing with on average 22 days in a paddock (30%). Some dairy farms use a combination of grazing strategies. Almost 2/3 of the farms uses forage mixtures with red clover and 1/3 used grazing mixtures with white clover. The average age of temporary grasslands before ploughing is 4.6 years. Almost 25% of the farms apply re-sowing and more than 80% apply mowing. The average number of mowings per season is 1.8. Main challenges in using temporary grasslands for grazing are: too wet – trampling damage (30% of the dairy farms), lack of land (17%), drought and lack of shadow/shade (12%), weeds, e.g. docks (10%) and fencing – time and labour consuming (10%).

2.3. Summary of group discussions

The state-of-the-art shows the importance of grazing in European agriculture. How should developments in Europe regarding grazing be positioned? Six groups of about 10 persons each discussed three related items.

What is and what should be the role of politics/government with respect to grazing? (political framework / political innovations)

- Government/politics should support grazing in a way that it is ‘reasonable’ or ‘balanced’ in view of nutrient flows and animal welfare, and the framework should be based on scientific results and allow profitability for the farmer.
- It was questioned by some whether policy makers should play a role in grazing. Dairy companies can take a leading position. Politics/government could provide rules or advice.
- It is necessary to have a consistent national x EU policy
- It is necessary to justify economic reason in relation to other ecosystem services.

- Communication with the public is another main role of politics.
- The role of the politics/government should be to represent wishes of society and promote grazing because grazing
    - is more natural than indoor feeding
    - provides other ecosystem services like biodiversity, pollinators, water protection, soil erosion, recreation, aesthetics value, etc.
    - provides food from plants directly to animals, not indirectly through silage or hay and therefore reduces additional costs and lowers gaseous emissions
    - in some countries, grass is the only possible crop and it is the only way to manage the landscape
- Government should stimulate. There should not be too many regulations. The farmer should have a mission and not only check the "rules" to get money or be "a good farmer".
- Main objective of current politics in view of dairy production is manifold, e.g. encouragement of plant-based diets in human nutrition, and down-scaling of meat consumption (e.g. Denmark); plan to buy and close down farms (e.g. the Netherlands); reduction of imported protein (e.g. Norway). Often, politicians see an increase in the share of organic production as a solution too. In the public opinion, animal welfare is high on the agenda, but there are different views when this links to higher prices for beef and dairy products – in some countries, higher prices would be accepted, in others not.
- More rules or regulations are needed with respect to milk and meat for special markets like grass fed products. Grass fed does not always mean grazing. Consumers should know for sure that when they are buying a product that this product is produced according to how it is positioned (the example of France was given where more product control would be needed).
- Grazing should be real grazing, not only outdoor-cows. There should be more attention for health instead of only for milk and feed. Grazing can be a way to control other issues like environmental and animal health.
- Organic production is not always seen as an option in grassland.
- Methane emissions from grazing are sometimes overestimated.
- Check whether lower productivity per area from grassland vs. TMR compensates for improved environmental balance.
- Country-specific examples were provided:
    - National Parcs in France: Dairy farmers are forced to produce to a high extent from grass and regulations on pasture management exist.
    - In Ireland, consideration of livestock nitrogen increases over years.
    - Ireland: Farmers own the land. Grazing is only possible, if you have the land around the farm and good infrastructure.
    - Germany: Grazing is considered difficult because of high stocking rates, big herds (300, 600, 1000 cows). Farmers do not know how to do grazing with larger herds. Grazing could lead to lower stocking rates. Labelling of products is increasing (type of housing, grazing, organic). Or reach specific levels of dairy production like no tie-stall and grazing is level 2.
    - How important is farm economy in relation to grazing? In Ireland, big farms make more money, so it's not important to get money from the government. Government could set rules like "how many cows could be on one farm". It is important to distinguish between livestock being outside grazing or being outside but fed with conserved forage/concentrates.
    - The framework of Switzerland is heavily shaped by schemes and subsidies, however, there is no support of grazing-based farming. The goal of grazing-based farms is to change the scheme to achieve 70% DM intake from pasture and reduce the crude protein content in supplementary feeds. About 90% of dairy cows are already on pasture, but their diet is not only grass-based. Animals usually spend 6-12 h per day on pastures. There are not yet any established, reliable measures to monitor the goal of 70 % DM intake.
    - Sweden has a "100% grazing" policy, but still "not many cows graze". They spend time outside on the pasture but are fed inside with silage and concentrates. General contestation of the subsidy-system: Is it sustainable? Does it make sense at all in its current form?

    - In Northern Italy, farmers reject subsidies and would prefer if consumers had a higher appreciation of grazing-based products instead.
    - In the words of a Dutch farmer, ”subsidies are the most unsustainable development in my farm”.
    - In Germany, bureaucracy and regulations hamper the development of grazing-based systems.
    - On the contrary, in Uruguay, there are no subsidies and farming systems are financially assessed based on the end product. Accordingly, the focus of Uruguayan research is to work closely with and for real-world farming systems. From there, recommendations for policy makers are derived.
    - Luxemburg also has a highly subsidized system. Farmers lack knowledge in grazing management. Herds increase and now have 70-150 or more cows per herd. Grasslands are not prepared to maintain such numbers of animals. Therefore, farmers switch to penned systems or jogging pastures.
    - In France, subsidies should be given to consultants which could facilitate improvement of grazing management and support farmers with know-how. Change, however, needs to go beyond the issue of subsidies.
    - In the USA you don't have grass farmers. You are dairy farmer or you are beef farmer, you are the type of farmer according to what you produce. This is also the way the government promotes it: there is no backup for the resources you need to initiate change. It only looks at the end goal. In the USA, the economics of large crops are better than those of roughage, which makes most farmers lean toward crops and not roughage.
    - In the Netherlands, the amount of grazing previously decreased. The full dairy chain has since then provided support through knowledge, premiums, grazing coaches, etc. and at the moment the percentage of grazing dairy cows has increased again.
- It was questioned whether grazing should be mandatory as in Sweden. Important here is to look at the underlying motivation. Why is it the way it is in Sweden? Answer: the legislation around grazing in Sweden was a birthday present from the ministers to Astrid Lindgren, a famous Swedish author. She thought this aspect was important and this law was given to her. A question that arises here is whether grazing in this case is tradition or whether it is done for the animals.
- The political role regarding grazing must be considered in terms of complexity. Food shortage, milk production and animal welfare are all aspects to consider. In addition, we need to look at the definition of grazing. How much fresh grass is in the ration? There can be a lot of variation.
- Politics need to understand the complexity; it is best when the farmer can grow the grass himself and is in charge. Being a politician is a very hard job.

In areas where there are low levels of grazing or declining levels of grazing, how to make farmers aware of the potential of grazing?
Several options were discussed:

- Set up knowledge exchange platforms. This already exists in several countries. Farmers have to trust the advisor (and his advice). Scientists have to learn from practice. Knowledge exchange should already begin in agricultural schools. Or, even better, in elementary school. Include politics as well. In the last decades, a lot of knowledge has been lost. We have gone from diversity to specialization, which has led to a loss of facilities.
- Have research/training projects together with farmers for better management of grassland. Organize working groups, visiting other groups. Grassland is very different between regions (locally different), so peer-to-peer knowledge exchange and demonstrations on regional and local scale is important.
- Provide information. Measure grass growth and show the farmer the potential (productivity of grassland). Show the potential of grazed land to milk yield. Show the importance of grass / feed quality on milk products. Use economic arguments.
- Change farm management, e.g. reduce maize and concentrates or adapt the breed (use a different breed of cattle with adaptation to lower production, but with better fertility).
- Subsidize grazing (this can be justified, e.g. by decrease in NH_3 emissions). Free (founded) advice will also help.

Furthermore, some country-specific examples were provided:

- Uruguay: A farm data collection system (once a month) provides a good picture on what happens on the farms and gives the opportunity for benchmarking, e.g. within a region. It also shows the differences between systems. Once a month the advisors/researchers are on the farm. The farmer gives the data and gets information/knowledge, e.g. about grazing planning. Consultants or advisers are from the milk industry.
- The Netherlands: Grazing Coaches are introduced that support farmers in grazing. Subsidies are available for designing grazing plans for farmers that did not graze before and intend to start grazing.

Finally, other related items were addressed:

- Problems of farmers vary, farm-specific solutions are needed. For example, weather conditions can give problems. Now farmers often have one strategy, they are used to it and it is difficult to get rid of it. For many people grazing doesn't play a role. There is also the financial aspect. Cows in the barn give higher feed costs, but also more stability which is often considered as more important.
- Grazing is not possible in all areas. Northern Italy, for example, has high levels of grazing in mountainous areas. Terrain and altitude, however, is difficult. Thus, an increase in grazing is not likely. Other areas struggle with increasing drought and other dominating forms of land use.
- There is no industry/market/money for grazing (and grassland in general).
- The image of grazing is different for consumers and for farmers.
- Grazing is more than feeding. Labor is a problem for a lot of farmers; in Italy for example there are a lot of part-time farmers; they spent less time on the farm. Extra attention for control is needed so farmers have less control fear.
- In some countries other (wild) animals compete in terms of grass allowance (deer, goose); probably a too low grazing pressure?
- There should be more attention to combine products on one farm (beef+milk).
- Climate effects, we may need different animals/species to adapt. Policy makers should pay more attention to this subject.
- Change is a long-term process, change can take a generation, because money for building infrastructure was already spent.

Based on recent discussions on non-human edible resources as the sole basis of livestock feeding, what is the potential contribution of grazing?

- A first question is how to define “human edible resources”? There are different indicators like human-edible protein per kg concentrates, or human-edible protein per ha land (quality of the land to produce direct human-edible food in a good crop rotation).
- First, grass cannot be utilised by monogastrics. Second, agricultural crops for livestock are in competition with areas for human food. Thus, grass holds tremendous potential for the production of food without entering in competition with food crops.
- There is a no simple answer to this question. With this issue, there are a number of points to consider:
    - Reintegration of animals into the cropping system
    - Potentially human edible feed sources are not as valuable as animal protein. Not every protein is a protein for the human body. The amino acids vary. Sometimes wrong methods are used that do not recognise the right value of different types of proteins
- There is the potential for meat and milk production based on low productive grassland for supporting biodiversity and reducing gas emission.
- Grass is often produced in areas where arable crop production is not an option, so often there is no competition between feed and food production. Improve grass quality to reduce protein input from other sources into the feed ration.
- Intensive dairying (high inputs, concentrates, confinement, high yielding) should be used on arable land on the grass that is a part of the crop rotation. The focus of arable land should be to produce food directly for humans. By-products, second quality of wheat and grass should be used for the dairy cows. Extensive dairying (low input, circular, low concentrates, grazing, grassland based) should be used on non-arable land like alpine region, bad soil quality, this land can thus be used to convert grassland into human food (milk and meat) with the help of ruminants and to increase biodiversity.

- Mixed farming/ co-operation: good land for crops (human) and bad land (which cannot be used for other crops due to e.g. steepness) for grassland and ruminants. Or dairy farmers exchange good land with crop farmers and use the grasslands in the rotation (circular thinking). So both are specialized and use the land as efficient as possible (example from Switzerland where a vegetable farmer gives a dairy farmer twice the area of grassland).
- Grazing is the only way of land management in some areas where factors do not allow any other utilization, e.g. at steep slope, and where grazing is required for maintenance of biodiversity (example Norway). In spring at periods of intensive growth, cattle cannot keep up with grazing, and alternative use is required. Biorefinery of production of conserved feed (silage, hay) could be an option.
- In Sweden, a lot of mediocre land is currently under utilised. 50% of that farmland was grazed historically, but is now abandoned despite its potential for production. Reasons are timber production and high labour costs for fencing. Farming has been concentrating now on the highly fertile land, abandoning the poorer land. With good know-how and management this land would have promising productivity. Here, the discussion of herding was raised. Should there be a revival of herders? What is the potential of virtual fences as ”modern herdsmen”? Also, fuel costs increase massively, therefore prices for fertilizers increase too.
- The manure of the grazing animals contain a lot of nutrients. This manure should be given higher value to produce human food.
- Grazing can reduce a lot of N emissions if it is done in a proper way.
- Grazing can be done anywhere where no other forage crops can be grown. Then you create food, otherwise nothing at all. If the animals are removed from agriculture (outgrazing, only plant based agriculture) then there is no longer a sustainable food system.

3 Grazing and animal welfare

3.1. Grazing and animal welfare: what do we know?

Agnes van den Pol-van Dasselaar, Aeres University of Applied Sciences, Dronten, the Netherlands

Grazing affects animal welfare. Welfare includes aspects that are relatively easy to measure, such as health, as well as intangible aspects such as emotions and feelings. An important aspect of animal welfare is natural behaviour. Grazing literally provides the space for natural behaviour. However, in terms of health, there are both positive effects of grazing and negative effects of grazing. Results of a literature review and a survey among members of the EGF Working Group "Grazing" in 2022 led to the following main positive effects of grazing on animal welfare and animal health:

1. Grazing gives much more scope for natural behaviour
2. Grazing may reduce risk of udder health problems
3. Grazing may benefit claw health

Furthermore, supply of vitamins and carotinoids through fresh pasture, clean air, more positive interactions, low rank cows can eat undisturbed / less competition were mentioned as positive effects of grazing.

Main negative effects of grazing on animal welfare and animal health were:

1. In the field cows are exposed to weather conditions, especially sun
2. Lack of balanced ration / grazing results in large fluctuations in diet composition

Furthermore, other weather conditions (freezing/snow, wet and rainy, not enough grass), poisonous plants, insects (ticks and mosquitoes), ruminal imbalance and resulting (subacute) metabolic disorders, risk of disease introduction due to infection with specific pathogens (e.g. worms, liver fluke), attack of predators and bloat if grazing high clover swards were mentioned as negative effects of grazing on animal welfare and animal health. Remarkably, there were also group members that could not think of any disadvantages of grazing.

The Working Group members concluded that grazing in general has a positive effect on animal welfare, but there are exceptions:

- A high merit dairy cow will unlikely satisfy welfare at 24-h grazing without supplementation
- Depending on how it is managed / only if executed well
- Except if temperatures become too high
- Except if walkways are bad or distance to the pastures is too long

3.2. Summary of group discussions

Six groups of about 10 persons discussed technical and ethical/socio-economic aspects of grazing in relation to animal welfare and animal health in a European setting. Results are summarized below.

Impact of innovations in grazing systems on health and welfare (e.g. virtual fencing, animal tracking technologies, remote sensing, drones)

- If innovations result in an increase in animals outside, it means an improvement in animal welfare.
- Remote sensing could monitor allocation of dry matter, plant stress, presence of poisonous plants and could increase customers' trust due to more data / transparency. Important health data could be monitored / collected to improve animal health.
- Transponders / GPS sensors are a great possibility to track movements and can be beneficial for controlling grazing cows and link data to grazed vegetation. The collected data can be used for monitoring health, heat, etcetera and provide knowledge of welfare of cows to farmers. In

mountains, the connection can sometimes be difficult. Furthermore, batteries with year-round grazing need recharging. For cattle this is not a problem, since they graze seasonal and their solar panels are larger than with sheep and goats. There is no negative impact on health or welfare.

- Virtual fencing can be very useful for grazing management. For virtual fencing, changes in infrastructure are needed and training for animals to adapt to such technology. The virtual fence is like a modern shepherd. Virtual fencing is, however, not allowed in all countries. In general, cows first get an acoustic signal and later on a little electric shock as they approach a virtual fence. Health and welfare for the cow have in some cases been the trigger for regulations. An example was provided from Germany where a project was set on hold from the local authorities because cows can break out, it can be painful, there can be stress from electric impulses etc. It was also noted in one group that use of new technologies (like virtual fencing) is more closely examined / regulated / criticized than existing technologies (like electric fencing). "Shock" is perceived by some as "electrocution". Something new is perceived skeptically (by farmers and by the public). According to another group, for the evaluation of the animal welfare of virtual fencing technologies, a comparison should be made with normal electric fencing.
- Farmers prefer technology that's directly related to profit. The cost-benefit-analysis is important. Will the customer pay for the adoption? New technology won't be adopted if the farmer is expected to carry the cost.
- Farmers feel controlled by technology. How much visibility do farmers want to the public? Does it increase their vulnerability?
- Law and regulations may be important, not only for virtual fencing but also for drones.

Does grazing affect stress levels of the animal? If so, in what way, how do you know and how can this be managed?

- Most groups provided examples of grazing affecting stress levels of cows, although some group members did not see grazing affecting stress levels of the animal at all. Examples of stress factors were mosquitoes, worms, and flies when wind speed is low. The grassland itself also was considered to be a potential stress source. Grazing (being outside) is natural behavior. Cows can select grass and plants. However, there must be something to choose in the field. Sown fields are not always diverse enough. Furthermore, animals can be under stress when the topography does not suit the breed of cows (e.g. HF in mountainous area).
- Animals can also be stressed due to humans, for example tourists. The farmer himself can also be a stress factor. Cows give signals if a farmer is stressed. Stressless farmers go along with stressless cows.
- Stressed animals can in some cases be dangerous to humans, an example was given where people have been killed by suckler cows, they can become aggressive/stressed.
- In general, cows should be used to grazing. Within species, genetic traits could be selected for animals better adapted to grazing systems. Grazing experience is also important. And finally, the conditions shouldn't change too much, changes give stress.

Heat stress is often mentioned as a negative for grazing. As a result of climate change, more regions cope with this problem. What can we learn from each other?

- When temperatures are above 23- 25°C, heat stress can be problematic. A decline in milk production can be an indicator. Water and shadow should be available.
- Climate change can result in additional heat stress. Furthermore, climate change also provides additional problems, like changes in insect pests and in a need to look for different forage species. More research is needed as discussions often lack a science base.
- Most farmers are not aware of heat stress and not prepared. Inform them.
- Improve indicators to tell farmers when animals are experiencing heat stress, e.g. via the use of technologies such as activity monitors or accelerometers to measure animal activity with some devices now measuring animal's body temperature as a tool to indicate heat stress.
- The assumption that grazing is better (less stress) than stables/confinement depends on the stable. Options / technologies are available in both grazing and housing systems to reduce heat stress.
- Tips and tricks for the animals:
    - Providing fresh pasture at noon makes cows forget heat. In the heat cows are together lying down. Giving them access to fresh grass make them stand up.

    - Siesta grazing takes cows indoors at midday so avoiding exposure to sun and heat.
    - Some breeds are more adapted to the heat (e.g. cows with a lower weight).
    - Grazing during night time in warm periods. Graze outdoors at night and feed the animals indoors during the day until it cools down.
    - Planting trees for cooling down or introduction of agroforestry systems. Using agroforestry to provide shelter for animals during high temperatures aids in reducing heat stress. Additional benefits of agroforestry systems are biodiversity, beneficial for grass as well, additional yield of trees like apples.
- Tips and tricks for the grassland:
    - Look at different forage species. Other species in the sward like chicory and plantain are more drought/heat tolerant.

Predators are more and more a problem. What can we learn from each other?

- Wolves are seen as the biggest problem, and bears were also mentioned. The number of wolves is increasing in most European countries. In some countries, it is a political issue, e.g. Sweden and Switzerland. Sweden now has a regulated population.
- Wolves eat sheep, which is a problem. Also, suckler cows can run far if their calves are in danger making it hard to find them in the forest afterwards.
- It is not clear who will pay for prevention and loss. Protection costs a lot of money.
- The balance must be found. There is a need to examine human-predator interactions.
- Countries can learn a lot from each other. Methods to control dangers of predators to grazing livestock:
    - Hunting (not allowed in many areas)
    - Collars on wolves?
    - Fencing can help. Improve fencing in areas that suffer from large predators like wolfs and bears
    - Dogs; some livestock farmers have begun to use dogs to prevent wolves from attacking livestock, however many dogs have also been attacked
    - Donkeys
    - Aggressive cows
- Irish group members did not experience any issues with predators. They noted another problem, namely the issue of wildlife acting as vectors of disease, particularly tuberculosis.

Solving negative aspects of grazing. What can we learn from each other?

- If a farmer wants to graze, the farmer can graze. There are systems that help. What is possible on your farm? A farmer has to find his balance.
- There are negative aspects of grazing, e.g. variability in the field and during the year, parasites
- There are also options to solve negative aspects. Some examples:
    - multispecies swards can be better
    - winter active crops to have a longer grazing period
    - short grazing under wet conditions, send them out hungry for 3 hours; they run faster and eat quick
    - not too big herds (in Ireland max 300)
- Knowledge is essential: research, sharing experiences, information collection and sharing, problem identification
- Avoid solving problems that don't exist
- Challenge of dealing with bureaucrats / administrators / agency personnel

Why do some people see no negative aspects of grazing at all?

When people are too much into grazing, they may not want to see the negative aspects or they find them minor problems. Grazing is also a solution for certain problems like NH_3 and CH_4. Maybe grazing is too important for the people that do not see negative aspects. Or they don't have knowledge of practice.

4 Grassland innovation

4.1. Methodology for knowledge transfer and co-creation / developing innovation networks

4.1.1. Analysis of grassland innovations – a method for leading discussion groups

Franziska Mairhofer[1,2], Philipp Höllrigl[1], Claudia Florian[1], Astrid Weiss[3], Anna Pfeifer[3], Christian Plitzner[2], Agnes van den Pol-van Dasselaar[4], Giovanni Peratoner[1]
[1] CENTRO DI SPERIMENTAZIONE LAIMBURG – Bolzano, Italy
[2]BRING Beratungsring für Berglandwirtschaft – Bolzano, Italy
[3]SÜDTIROLER BAUERNBUND – Bolzano, Italy
[4]Aeres University of Applied Sciences – Dronten, the Netherlands

Inno4Grass, a thematic network (2017 – 2019) within the Horizon 2020 network, had the aim to close the gap between practice and science in order to identify grassland innovations, to analyse them and to spread the results into practice. Capturing innovations in grassland from innovative farmers requires the interaction of practitioners and scientists in discussion groups (practice and science meetings). Within the project, 145 discussion groups were held and a framework for innovation analysis in participatory, multi-stakeholder discussion groups has been provided. A method comprising five elements was developed: (1) briefing, ensuring that all participants have a common baseline knowledge about the innovation in order to be able to discuss it. For this purpose, information material is prepared and sent to the participants prior to the meeting. Then, in a 1-2 hour on-farm visit, the innovation is presented in more detail. In this phase, each participant can ask questions for a better understanding of the operational procedures. (2) Short (about 15 minutes), simplified, brainstorm-like SWOT-analysis, collecting strengths and weaknesses. (3) PESTLE-analysis (Political, Economic, Social, Technological, Legal and Environmental factors), looking at the results of the SWOT-analysis more deeply including also (4) the exploration of predefined sub-topics, and (5) standard questions to the innovator concerning (a) the willingness of the innovator to implement the innovation again, if given this possibility; (b) things that the innovator would do differently with today's knowledge; (c) an evaluation of the demand on the local market for the innovation. The method was made available to the project partners, along with more general suggestions, in form of non-compulsory guidelines. The use of the guidelines was recommended, but each project partner was free to decide whether to adopt them, and to which extent, as some partners were already applying other previously established methods. The feedback of the moderators of the discussion groups was obtained by a structured survey. The survey revealed that the briefing phase was very frequently used during the whole project. With the progress of the project, the guidelines in general and the simplified SWOT-analysis were used more frequently. The use of the single elements of the method decreased with their increasing complexity (from element 2 to 4). So, the PESTLE-analysis and the predefined subtopics of the PESTLE-analysis, the most complex and structured elements, got only a low percentage of use and reached about 30% in the last project phase. Looking on the self-evaluation of the success of the discussion group (5-grade score system from 1 = poor to 5 = excellent), the meetings were evaluated more successful if the more complex and structured elements of the method were used regarding the three sections "comfort of the innovator with the discussion group", "communication between moderator and participants", and "communication between participants".

References:

- Mairhofer F., Florian C., Weiss A., Pfeifer A., Plitzner C., Prünster T., van den Pol-van Dasselaar A., Peratoner G. (2019). A method to lead discussion groups for the analysis of grassland innovations. Grassland Science in Europe 24, 500-502.

- Peratoner G., Florian C., Mairhofer F., Baste-Sauvaire F., Bogue F., Carlsson A., Czerwińska A., Delaby L., Delaite B., de Kort H., Fradin J., Jacquet D., Kaemena F., Krause A., Melis R., Nilsdotter-Linde N., Pascarella L., Paszkowski A., Peeters A., van den Pol-van Dasselaar A. (2019). Effect of training and methodology development on the effectiveness of discussion groups on grassland innovation. Grassland Science in Europe 24, 509-511.
- Peratoner G., Mairhofer F., Höllrigl P., Florian C., Weiss A., Pfeifer A., Plitzner C., van den Pol-van Dasselaar A. (2020). Un metodo per l'analisi dell'innovazione nella prassi foraggero-zootecnica. In: Bovolenta S., Sturaro E. (eds.). I servizi ecosistemici: opportunità di crescita per l'allevamento in montagna?. Società per lo Studio e la Valorizzazione dei Sistemi Zootecnici Alpini, San Michele all'Adige, Italien, pp. 183-190.

4.1.2. Developing innovation networks at the national level: the Uruguayan recent experience

Pablo Chilibroste, Universidad de la República, Facultad de Agronomía, Departamento de Producción Animal y Pasturas, Paysandú, Uruguay

The Uruguayan dairy industry has enjoyed dynamic growth during the past 35 years, with a mean growth rate of about 4% per year. The Uruguayan dairy system can be defined as a 'Pasture-Based Dairy System' that has the flexibility to reduce or increase external inputs, mainly feed concentrates and pasture fertilizers, appropriate for changing agronomic conditions in order to minimize the cost of milk production. The dairy industry has faced, and still does, challenges, but it has the opportunity for further growth within a social, environmental and economical balance (Chilibroste, 2021). Experiences from Uruguay provided insight in how to learn from dairy production systems and how to align the research agenda with the dairy production system requirements. More than 800 dairies and 110 professionals participate in a web based information system developed by CONAPROLE and the dairy group at EEMAC (Agronomy Faculty, Uruguay) for economical and physical monitoring of dairy production systems on a monthly basis (farm + industry + adviser information). This was a common effort to build a database suitable to support either tactical or strategic decision making, system analysis and system re-design. A private-public agreement (Dairy Technological Network) was created to work on the competitiveness of dairy chain value. A vertical integration of research within long-term research platforms was developed between 2015-2021. A second phase of the Technological Network 2022-2027 continues these long-term research platforms. It encompasses sustainability of the whole chain (with a link between production system and dairy products development), focus on monitoring, control and integration of main processes and special emphasis on the social dimension.

References:

Chilibroste, P. (2021). A major challenge for the Uruguayan dairy industry: sustainable growth (Editorial). Agrociencia Uruguay 25 (2), https://doi.org/10.31285/AGRO.25.970

.

4.2. Best-practice' innovations: examples of co-created innovations or new approaches that consider the adoption in grassland practice right from the start of the R&D process

4.2.1. The digital grass chain

Marcia Stienezen, Wageningen Livestock Research, the Netherlands

Within Wageningen University and Research (WUR) various models are available generally focusing on a specific topic. Combining model outcomes, real time data and techniques, e.g. machine learning and data assimilation, might gain new knowledge and serve new purposes. This idea resulted in the development of the digital twin The Digital Future Farm (DFF) (Digital Future Farm, 2022) in which the

nitrogen cycle of a land based farm with crops, grasslands and a dairy herd, is simulated for use in research and on farm management.

In the DFF, daily grass yield and grass quality are simulated using “GrasSignaal” (Hoving et al., 2018). By feeding “GrasSignaal” automatically with real time GEO based data, e.g. satellite data, sward height, soil moisture and actual weather data, the model is not only site specific for each field of a farm, but also easy to use. In the DFF data assimilation is used to improve the simulation of soil N availability for plant uptake in GrasSignaal.
The Digital Grassland Use Calendar is set up to register grassland use during the grazing season on parts of a field by creating new polygons. By combining GrasSignaal with the Digital Grassland Use Calendar (Precision Farming 4.0, 2022) grass yield and grass quality can be simulated using real time grassland management data. Daily grass yield and grass quality data from GrasSignaal are input for the Cow model (Zom, 2014). Based upon the ration fed to the animals in the Cow model milk yield for the available herd is simulated.
Using the facilities of data service platform Farmmaps (Farmmaps, 2022) is not only giving the opportunity to exchange real time data from several sources and parties (satellite, laboratories, …) but also offering the opportunity to present model output in widgets for on farm use.

References:

- Digital Future Farm (2022) https://www.wur.nl/en/Research-Results/Research-funded-by-the-Ministry-of-LNV/Expertisegebieden/kennisonline/Digital-Future-Farm-DFF-1.htm
- Hoving, I.E.; Starmans, D.A.J.; Booij, J.A.; Kuiper, I.; Holshof, G. (2018). Amazing Grazing; Grass growth measurements with remote sensing techniques. Grassland Science in Europe 23, 860-862. https://www.wur.nl/nl/Publicatie-details.htm?publicationId=publication-way-353734363837
- Precision Farming 4.0 (2022) https://www.wur.nl/nl/Onderzoek-Resultaten/Onderzoeksprojecten-LNV/Expertisegebieden/kennisonline/Precisielandbouw-4.0.htm
- Zom, R.L.G. (2014) The development of a model for the prediction of feed intake and energy partitioning in dairy cows, Dissertation. https://www.wur.nl/en/Publication-details.htm?publicationId=publication-way-343536333032
- Farmmaps (2022) Data service platform Farmmaps, https://www.farmmaps.net/en

4.2.2. Modelling grass growth to optimize grazing in Luxembourg

Gérard Conter, Lycée Technique Agricole, Luxembourg

Grazing has a long tradition in Luxembourg. However, in the past years the proportion of grazing dairy cows is decreasing continuously. The reasons to this are multiple: increasing herd sizes, automatic milking systems, missing know how, etc. Since many years, the FILL “grazing group” includes national grazing experts from different backgrounds: advisors, teachers, scientists… Innovative grazing tools helping farmers to optimize grazing have been developed: grazing calendar, grass-measuring techniques and tools, … In order to stop the trend of less grazing with dairy cows however, the prediction of grass growth seems to be an important variable. The goal of the FILL-EIP Project “Méi Weed” (2020-2024) consists thus in adapting existing grass growth models to the Luxembourgish situation.

Grass growth modelling needs specific and precise input data (meteorological, management) and grass growth parameters (vegetation, soil, seasonal influences). In order to collect these, the “Méi Weed” project collaborates with 5 pilot farms, representing the different “grassland-regions” in Luxembourg. Weather stations have been installed on the farms and grass growth is measured according to the method of Corral and Fenlon. The scientific data analysis and validation is assured by the specialists of Bern University of Applied Sciences, the scientific partner in the “Méi Weed” project.

First results are based on the data of the year 2021. These are showing an existing relation between the functional groups as well as an underestimation of the yields in the beginning and an over estimation of the yields at the end of the season. In order to further optimize the results, adjustments of different

parameters (water storage capacity, functional groups) are necessary. Also, the quality of meteorological data has to be further improved.

The goal of the project is the creation of an additional "grass-growth" layer in collaboration with the national cadastral office (www.geoportail.lu), serving in future as an additional management tool in grassland and more specifically for grazing farmers in Luxembourg.

4.2.3. Challenging pastures to support high-producing heavy dairy cows under grazing

Gabriel Menegazzi
Wageningen University & Research, the Netherlands
University of Uruguay, Uruguay

Sward height is strongly related to the daily dry matter intake of grazing dairy cows, which consequently determines animal performance. Despite that, few studies have explored the potential to increase milk production managing the post-grazing sward height. An experiment was carried out to evaluate the effect of three defoliation intensities on a *Lolium arundinaceum* based pasture on frequency and length of grazing meals and ruminating bouts, daily grazing and ruminating time, feeding stations and patches exploration and dry matter intake and milk production of dairy cows. The treatments imposed were three different post-grazing sward heights: control (TC), medium (TM) and lax (TL), that were managed with 6, 9 and 12 cm of post-grazing sward heights during autumn and winter, and 9, 12 and 15 cm of post-grazing sward heights during spring, respectively. Thirty-six autumn-calving Holstein cows were grouped by parity (2.6 ± 0.8), body weight (618 ± 48) kg and body condition score (2.8 ± 0.2) and randomized to the treatments. The pasture was accessed from 08:00 to 14:00 h and 17:00 to 03:00 h during spring and not supplement was involved during the evaluation period. Daily grazing time averaged 508 ± 15 min and was not affected by treatment. The reduction of post-grazing sward height increased the length of the first grazing session in the morning and the afternoon. The number of grazing sessions was greater on TL than on TM, with no difference in TC. The number of feeding stations (the hypothetical semi-circle in front of an animal from which the bites were taken without moving the front forefeet) visited was less on TC than on TL, and neither of them differed from TM. Dry matter (DM) intake was lesser on TC than on TM and TL (14.7 vs. 17.8 kg DM). Milk production during the evaluation period was 13.1, 16.2 and 18.7 kg/day for TC, TM and TL, respectively. The milk fat, protein and lactose content did not differ between treatments. The cows on TC exhibited a lower intake rate, although they were less selective, probably as a consequence of the sward structure of TC treatment. The cows on TM adopted a compensation mechanism which allowed them to achieve the same dry matter intake as cows on TL, but lower milk production. The cows on TL were more selective than TC and TM resulting in higher digestible dry matter intake and consequently higher milk production. The intensity of defoliation impacts on the animal-plant interaction, and constitute a valuable management tool that can be used to booster forage intake and milk production. The new developments on information technology would allow to link behavioral data with responses variable (e.g. milk production, health, welfare, etc.) at different spatio-temporal scales and support short and long-term management decisions.
So, the next step of our research will be to study the impact of the defoliation intensity on the productive performance of high-production dairy cows, the animal behaviour strategies adopted to achieve the daily herbage dry matter intake and their relationship with pasture characteristics, and pasture productivity. Also, to quantify and study the environmental impact (methane emissions and N balance) of the grazing management.

4.2.4. Three things to know about LIFE project "PTD" and Herby grazing management

Joséphine Cliquet and Alice Poilane, CAVEB, France

From 2014 to 2020, the French co-coop "CAVEB" handled a LIFE funded project called "PTD" (for dynamic rotational grazing). The co-cop is based in western France, and works with 900 breeders (beef, sheep and goat). Next to the usual "sell and buy" business, they are active in farm consulting, research

and innovation. During the “PTD” project, 150 farmers worked with advisers and scientists. The aim was to test the sustainability of the so-called “Herby” grazing management that worked with four principles:

- Never leave the animals for more than three days on the same paddock
- Wait until the grasses have had time to grow back three leaves
- Take the animals out before they graze the stem of grasses
- Adapt the time of return of the animals in a paddock to the time of grass regrowth.

Measurements were done on the farm network and concerned different aspects such as animal performance, grassland composition, grassland production and environmental, soil and economic parameters. The presentation focused on 3 take-home messages:

- Working together! Farmers, advisers and researchers working together is powerful
- Take the best, leave the rest! Using grass physiology knowledge can help farmers with managing grassland and increase performance of both grassland and animal
- Look deeper for C! In the experiment, there was no significant increase in soil C content in the top soil (0-25 cm), but there was a significant increase of C in deeper layers (25-50 cm and 50-75 cm)

More information on www.life-ptd.com or by e-mail (jcliquet@caveb.net or apoilane@caveb.net)

4.3. Summary of group discussions

Practice and science should work together to ensure the implementation of innovative systems in grasslands and to increase the profitability of European grassland farms and preserve environmental values. Six groups of about 10 persons each discussed three related items.

Are there in the group other examples of ‘Best-practice’ innovations? (co-created innovations or new approaches that consider the adoption in grassland practice right from the start of the R&D process)

- Several examples were provided from different countries:
    - Luxemburg: “Light houses”. Cooperation with pilot farmers that act like “Light houses”. These “Light houses” show the direction to other farmers.
    - Uruguay: The Tech Network starts discussions with a group of farmers, scientists etc. directly after a certain project design. This group comes together every 2 months and follows the process of the project. So, the practice is aware of the project progress and is involved – therefore the distribution in the practice is faster and the recognition of the results from famer’s side is better.
    - Ireland: Certain projects have a monitoring group coming together one or two times a year and having the possibility to bring in possible concerns directly. This direct feedback gives hints whether or not a method, etc. is practical for use on farm.
    - France: A change in grazing management was possible due to the interaction between farmers and researchers. Knowledge transfer was important so that people can understand the importance of grasslands.
    - Sweden: Rotational grazing on dairy farms
    - Ireland: PastureBase Ireland (good tool for farmers)
    - Uruguay: If farmers in Uruguay deliver data for science, they directly get a report and don’t have to wait for years.
    - Ireland: In Ireland, decision support tools are helping scientists and farmers. Farmers can use computer-based decisions systems for grassland management and scientists get a lot of data for their work. A little bias might exist though because every farm is acting and working a bit differently.
    - The Netherlands: Funds for societal wishes, a fund has for example been set up for multi-species grasslands. Companies, governments and private persons can pay to the fund and then farmers, interested in sowing multi-species grasslands, can get financial support (in the example of multi-species grasslands: financial support (discount) for up to 3 hectares per farmer).
- Other examples were not country-specific:
    - Using red/white clover as protein sources on farms

- Artificial intelligence for grazing/agricultural production
- Sensors, GPS fertiliser spreading (precise application of nitrogen and pesticides)
- Real time measurements (advanced optimisation of measurement techniques)
- Digital solutions for grassland (drone/satellite measurements)
- Reactive environmental flows
- Pasture remote sensing in general to answer what is on the pasture, how long can you use it, the forage quality, when can you graze it again? With the drone, a "potential" easy access technology. Could be a tool in the near future, either used directly by farmers to collect data and feed a model to extract information for better management or through service done by advisers if it is too complicated, training intensive or time-consuming for the farmers. Not here to replace farmers/adviser expertise but to complement it and help them in the decision-making (e.g. pasture projection (10-14 days ahead), linked with weather forecast to make precision estimates etc…)
- Digitalization and easy to use tech: e.g. plate meter, data direct on the smart phone, with live estimation of the yield and possible to make decision on pasture, estimate + expert eye (from the farmer).
- On a low-tech innovation, encourage meeting between famers, where they choose a topic to discuss, propose solutions or seek for solutions in each other's experience/knowledge. Try to generate a snowball effect in case of good practices that spray within the farmers community through farmers ideas and their own implementation. Encourage discussion groups at any level.

Some challenges were also discussed:

- There seems to be a challenge in all countries: What's the yield? How to make the farmer to measure the grass-yield?
- It is hard to find money to finance the contribution of the farmer in collecting data.
- A challenge is that grassland is abandoned, especially areas in the mountains. The new generation doesn't want to run these areas longer.

How do we improve the methodology for knowledge transfer and co-creation in the grassland research and practice communities?

- Before defining the best way to transfer knowledge, you first have to learn what the farmers of the grassland know and see. Based on that, organize attractive practices to transfer knowledge.
- Some farmers do not trust the knowledge disseminated through their country's advisory services. Advisory services need to use best practice when communicating messages. Only go to the best farmers when trying to set an example. Always remember that profit is very important to farmers.
- Improve knowledge transfer via field days, field demonstrations, open days on research farms that do not have to be paid for and farm walks where practice and science can meet, where farmers among each other can exchange their knowledge, and where strong relationships between farmers, scientists and consultants can be build. Trust is important and farmers usually believe farmers more than for example a scientist.
- Adopt the communication with the farmer to the workflow they use, for example smartphones. The challenge is to develop associated apps with the limited budget in projects.
- Give the data back to the farmers, connect farmers with scientists sand give them more feedback, and maybe more feedback that they want.
- Integrate innovation in methodologies for knowledge transfer with environmental practices.
- Use platforms and big communities to connect people such as Workplace, where questions and knowledge can easily be exchanged. Find the right platform to connect/communicate with different communities of people. And create platforms that connect different communities that would normally not exchange.
- It is important to involve the farmers from the very beginning of a project. Sometimes the project has been planned without the participation of the farmer. A network needs to be created with communication from two sides.
- Early involvement and cooperation of all stakeholders is important; farmers, professionals (such as grazing coaches) and scientists have to be brought together as early as possible. Co-creation means also to involve the sector of machinery because you can't introduce for example new seed mixtures if there is no suitable technique for sowing them. And often there is not yet scientific evidence but

methods evolve good in practice and therefore it's important to have consultants involved. They can motivate farmers in trying out techniques from the practice which could work good on their farms.
- Both creatives/visionary people are needed to create things and others to facilitate the exchange through periodical meetings, taking care of the process to ensure the working of the "new" techniques.
- It is necessary to consider the "profile" of the farm and the farmer in the decision of what way to go in knowledge transfer and to include the economic consequences as well. "Sometimes the solutions found in an experimental setting do not work in real situations, so how to improve the knowledge transfer?"
- Co-creation is not always easy. Farmers often say: As scientists you can afford mistakes, we farmers can't – so try it out and if it is working well, we will implement it. And policy is often very slow compared to the technologies available.

What is the best way to develop innovation networks at local/regional/national/international level?
Several topics were addressed:
- One of the best ways to develop innovations is, first, to identify or find what motivates, understand how this is interesting and, in this way, use the tools to motivate and stimulate. Social networks are important as a tool to publish and share information.
- Early involvement of stakeholders is important; farmers, professionals and scientists have to be brought together as early as possible. Co-creation means to involve the sector of machinery as well because you cannot introduce for example new seed mixtures if there is no suitable technique for sowing them. And often there is no existing scientific evidence, but the methods used have been evolving good in practice. Therefore, consultants should also be involved. They can motivate farmers to try techniques from practice which could work good on their farms. Work together.
- Ensure that the farmer needs the innovation, so listen to the farmer and understand the farmer.
- Make the innovation attractive to engage the people in the process.
- More science in the commercial barn, science done by everyone, everywhere. Ensure a stronger connection between science and farmers.
- Use living labs (with regional stakeholders, council members, veterinarians, farmers etc.). Hold regular meetings with all stakeholders to develop innovations that are helpful for everyone involved.
- Conferences/group meetings.
- In some countries, projects are only financed if they have a partner from the industry. Innovations can be implemented at project management level and the industry partners can keep their distance.
- Every level is important. You get different information by discussing in a conference at international level than by discussing with farmers, but both are equally important. The multi-level is most important rather than one particular level. Each level should be taken into consideration and information should move between levels.
- Comparison of innovation networks between regions with a similar environment is more interesting than comparison between countries. Ensure knowledge sharing and comparison within regions regardless the country/language.
- Supervised research is important, especially when it occurs on the farms, as well as following the experiments across time to know what occurs in the long-term. Also take into account the circumstances because innovations usually do not work everywhere. It is necessary to step back to understand the system and how to best apply the innovation. It might be better to use a system that produces less but is easier for the farmers, thus highlighting the importance to keep it simple.
- Public funding for tools, e.g. for registration. The public funding ensures that all can use these tools.
- Develop science dissemination with specialists (journalists specialized in science) understanding scientific information and being accurate in understanding the dissemination's challenges. Create a bridge between public/farmers etc. and science. Take inspiration from good structures for dissemination, e.g. at Teagasc, Ireland.
- Educational services also have a network to improve farmer adoption of scientific research.

Some limiting factors were also mentioned. To develop networks, these should be solved.

- A limiting factor in developing innovation networks at all levels is the trade-off between agricultural production from grasslands and environmental concerns.
- Networks need to collect data, but who owns the data? It is hard to get raw data without paying.
- Developing innovation networks is more difficult at an international level.
- There is a big gap between R&D departments in companies and Universities.
- In the last 10 years the link between practice and research has decreased because the academic evaluation system presses publication of papers and the researchers do not go to the farm. Publishing is necessary and important in the process of creating innovations, but the weak point has been the transfer of the innovations to the field, aggravated by the lack of resources to spread the findings to practice and the "devaluation" of that process in the academic evaluation of the researchers.
- Co-creation is not always easy because farmers often say: As scientists you can afford mistakes, we farmers can't – so try it out and if its's working good for you, we will implement it.

5 Concluding remarks

Theme of the meeting
The meeting focused on the state-of-the art with respect to grazing, on grazing and animal welfare and on grassland innovation. It was inspiring to exchange different viewpoints and experiences within the EGF Working Group “Grazing”. Clearly, different researchers have expressed different opinions and ideas, based on their cultural background and on personal values, preferences and experiences. This is valuable and will lead to new ideas and research.
The state-of-the-art session provided insight into the extent of grazing from 2010 to 2022 based on a survey among members of the Working Group “Grazing”. Furthermore, the importance of grazing in European agriculture was discussed. In the session on grazing and animal welfare, both the technical and ethical/socio-economic aspects of grazing in relation to animal welfare and animal health in a European setting were discussed. Finally, in the session on grassland innovation, best-practices and methodologies to co-create implementation of innovative systems on grasslands and grazing were discussed.

Reporting
The proceedings (this report) and the pdf’s of the presentations are available on the EGF website (www.europeangrassland.org/en/working-groups/grazing).

Appendix 1: Agenda 7th Meeting of the EGF Working Group "Grazing"

Caen, 26 June 2022
Location: Caen University, Campus 1, Esplanade de la Paix

9.30-10.00 Registration, coffee/tea

10.00 Welcome, introduction of the day and the themes, ice-breaker (Agnes van den Pol)

10.15-10.45: Plenary session "State-of-the-art" (chaired by Agnes van den Pol)
- Deirdre Hennessy: Grazing in Europe from 2010 to 2022
- Anna-Karin Karlsson and Nilla Nilsdotter-Linde: SustAinimal Grazing Living Lab – a quantitative analysis of grazing management among dairy farms in Northern Sweden

10.45-11.45: Discussion in small groups (challenges and developments with respect to grazing) and plenary feedback

11.45-12.30: Plenary session on two topics "Grassland innovation: Methodology for knowledge transfer and co-creation / developing innovation networks" and "Grazing and animal health" (chaired by Deirdre Hennessy)
- Franziska Mairhofer: Analysis of grassland innovations – a method for leading discussion groups
- Pablo Chilibroste: Developing innovation networks at the national level: the Uruguayan recent experience
- Agnes van den Pol: Grazing and animal welfare: what do we know?

12.30-13.30 Lunch
Group picture

13.30-14.30 Discussion in small groups (Grazing and animal health/grassland innovation) and plenary feedback

14.30-15.00 Plenary session on "Grassland Innovation: 'Best-practice' innovations: examples of co-created innovations or new approaches that consider the adoption in grassland practice right from the start of the R&D process" (chaired by Johannes Isselstein)
- Marcia Stienezen: The digital grass chain
- Gérard Conter: Modelling grass growth to optimize grazing in Luxembourg (EIP-project)

15.00-15.30 Coffee/tea break

15.30-16.00 Plenary session on "Grassland innovation: 'Best-practice' innovations" (chaired by Johannes Isselstein)
- Gabriel Menegazzi: Best practices: Challenging pastures to support high-producing heavy dairy cows under grazing
- Joséphine Cliquet and Alice Poilane (Fr): Three things to know about LIFE project "PTD" and Herby grazing management

16.00-17.00 Discussion in small groups (Grassland innovation) and plenary feedback

Plenary closure of the meeting

Postbus 374, 8250 AJ Dronten
De Drieslag 4, 8251 JZ Dronten
088 020 6000
www.aereshogeschool.nl/dronten
info.hogeschool.dronten@aeres.nl