

# **Synthesis and perspectives on EGF2004: Land Use Systems in Grassland Dominated Regions**

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## **Abstract**

Grassland research in Europe is active and responding to rapidly changing political, economic, social and environmental circumstances. It is widely accepted in the research community that grassland must be increasingly multi-functional. As well as producing food it must protect soil, water and air, and it must conserve and restore biodiversity and the landscape. In producing food for which there will in future be little or no market support, it must be used efficiently and at low cost, and/or grassland products must command a price which reflects high quality in terms of taste, health, animal welfare and the value of the landscape from which they come. And new knowledge must be discussed between researchers, farmers, other stakeholders and the public. This paper summarises a conference at which all these aspects have been discussed.

## **1 Introduction**

We give here our personal views of this large conference as gained from reading and listening, between us, to all 13 invited papers, virtually all of the further 60 oral presentations, and viewing most of the 289 poster presentations published in the proceedings. We have structured this short paper into the five themes identified by Steffen in his Foreword, and have attempted to pick out key messages, particularly where thinking has progressed substantially in recent years, and where gaps in understanding remain. We refer to papers by their first author and their page number.

## **2 Policy context**

Burtscher (3) opened the conference by highlighting that agricultural activity is of paramount importance for the identity of the EU.... but it must meet the expectations of society as a whole, and respond to international challenges. This means respect for the environment, food safety, health and welfare. It also means decoupling support payments from production. These drivers resulted, in 2003, in fundamental changes to the Common Agricultural Policy (CAP). And the CAP will apply in the same way across the EU, including all the new member states which increase the number of farmers by over 60%.

In Switzerland, our host country, the same drivers have resulted in similar policy developments (Bötsch, 5), with a great reduction in production-related subsidies. Here multifunctional land use, with support for public benefits of landscape and conservation, has received even greater emphasis in recent years (Jeangros, 11; Durgiai, 49; Gotsch, 52).

We felt that critical comments on the resulting restraints on grassland productivity were expressed with less emphasis than in the recent past, and overall there was little dissent at

the meeting from this multifunctional vision. The majority of papers, including those from new EU member and non-member states, referred to environmental or socio-economic aspects of land use.

### **3 Balancing economy and ecology**

Hodge (27) addressed the delivery of public goods at least cost. Scheringer (61) in Germany and Rosef (88) in Norway, demonstrated that simple prescriptive schemes may not deliver the desired outcomes (eg due to conflict with farmer's business aims, lack of buy-in from farmers and other stakeholders) and hence, though having low transaction costs, may represent poor value-for-money. Hodge concluded that policies need to be sharply targeted at what society wants, highlighted alternative approaches, and suggested that grassland research should encompass social science and focus on the whole range of land use outputs.

Dabbert (38) suggested that in the dairy sector only those farms with high yields and low labour/ kg milk will survive. We think this is doubtful, but we do agree with his conclusion that there is potential for farmers to combine agri-environment schemes with marketing products at a higher price. Shaw (91) described one such initiative – ‘White and Wild’ milk.

One of the underlying drivers of research, particularly in hill and mountain areas, is the ecological and landscape consequences of land abandonment. Posdissek (82) from the Czech Republic described the decline of cattle and sheep numbers by over 50% since 1990 and the likelihood of decimation of botanical diversity of grassland. Hejcman (213) also from CR, showed that, where livestock were available, grazing could be an acceptable alternative to mowing for maintenance of species-rich meadows. Fatyga (76) from the Sudeten region of Poland described the abandonment of over 30% of grasslands and their designation for biomass production. In the alps reduction or cessation of grazing is also recognised as threatening biodiversity (Erschbamer, 284), and runoff for hydroelectric power (Körner, 278).

### **4 Benefits and Risks for Society**

Lehmann (105) identified the multiple benefits that grasslands provide for society, and considered how these could be valued economically. He identified non-use values, including those that result from the knowledge of continued existence of grassland, and use values including biodiversity and resource protection. Valuation methods based on assessing the preference of consumers are often used by economists but tend to neglect functional benefits and therefore miscalculate the total economic benefits of grassland. The imperative of evaluating all outputs echoed Hodge's conclusions.

#### **4.1 Biodiversity**

Biodiversity in grassland is a major functional benefit and was a strong thread woven through several sessions. Progress has been made in:

- how to conserve (Santa-Maria, 207; Cop, 222) and restore (Hald, 174; Kazoglou, 225; Hofmann, 243; Korevaar, 246;) biodiversity

- the consequences of this for herbage production (Palmborg, 183; Zarovali, 201; Pacurar, 216; Paoletti, 258) and grazing value (Tonioli, 204).
- landscape ecology (Amiaud, 198).
- ecosystem functioning in alpine and sub-alpine zones (Muller, 281; Lavorel, 287).

Greater understanding of the functioning of ecosystems has been generated by the pan-European BIODEPTH project (Spehn, 177; Scherer-Lorenzen, 180). This showed that plant communities with higher diversity were more productive and utilised resources (light and N) more effectively. They are most effective at N uptake if additional N input through fixation occurs.

There is also welcome interest in soil biodiversity, and Breure (195) showed a negative correlation between above-ground farming intensity and below-ground functional diversity. He described the development of a Biological Indicator for Soil Quality.

Questions still remain :

- The importance of intraspecific biodiversity
- Local reserves versus widespread preserved areas, eg Swiss Ecological Compensation Areas.
- A better definition of the aims of increasing grassland biodiversity – for farmers, citizens and grassland researchers.
- More precise evaluation of benefits and costs.

#### ***4.2 Environmental impacts were also a significant topic.***

Benoit (117) reviewed the impact of grassland on water. If soil is compacted by heavy grazing, high runoff can occur. There are also problems with N leaching, particularly under intensive grazing, and contamination of water by bacteria, viruses and parasites from livestock. Nevertheless he concluded that appropriately-managed grassland has a positive effect on water quality. In much of W Europe, though not in UK, the area of grassland has declined in the last decade. He advocated a halt to this, and recreation of grassland particularly along river corridors. This could also be positive for wildlife.

Much research has addressed the better evaluation of management impacts on environment quality: the effect on NO<sub>3</sub> leaching of irrigation (Burs, 343) and rotations (Bobe, 346); the effect of N fertiliser and slurry on gaseous emissions (Ammann, 130; Lampe, 334); effect of grazing with cattle or sheep on CO<sub>2</sub> fluxes and C sequestration (Casals, 136).

An emerging impact was identified by Burkhardt (322) – veterinary antibiotics (VA) in animal slurries. In Switzerland about 50% of all antibiotics administered are used in animal production, and approx 80% is excreted. Input of VA into soils may be substantial, especially in grassland areas, and high levels have been found in watercourses.

The impact of land and animal management on the environment is large-scale and long-term, but most research is short-term and local. Future research must address this. Huguenin-Elie (772) described the Swiss Agricultural Life Cycle Assessment which attempts to comprehensively assess forage systems. Preliminary findings suggest that at farm level a co-existence of areas with high and low intensity management might be better than medium intensity over the whole farm area.

## **5 Efficient use of natural resources**

### **5.1 Dairy systems**

Jarvis (361) reviewed best practice in nitrogen management, focusing on dairy farms. Building on much research, many improvements are possible at farm level, particularly in manure management. This requires farmers to recognise, and have confidence in, the N value of manures, and the soil's ability to mineralise N. Farm studies show that, often, they do not. Bleken (672), looking at dairy farms across Europe, also found low N efficiency and advocated more extensive, forage-based, systems.

Peyraud (373) reviewed dairy cow grazing management. This is also a mature subject and, like manures, placing greater reliance on grazing requires higher farmer confidence. A large pan-european project – Grazemore – has enabled knowledge to be synthesised and decision-support packages to be developed (Mayne, 584 ; Delagarde, 650). It was also encouraging to hear that an EGF dairy group is being established.

But the question remains - how to balance profit and environment in dairy systems? The consensus here was that, overall, grazing is an important component of sustainable systems, *but*

- Grazing limits milk yields, so need more cows = more methane (Oldham, 867).
- Grass is high in N, which is poorly used by ruminants, leading to high risk of loss via NO<sub>3</sub>, NH<sub>3</sub> and N<sub>2</sub>O (eg Saarijarvi, 337).
- Reducing nutrient leaks via one pathway may result in higher losses via another – ‘Pollution swapping’ (Jarvis)

We are still waiting for whole system evaluations and demonstrations relevant in most of Europe.

### **5.2 Can plant breeding provide solutions ?**

Grassland scientists often expect plant breeding to provide solutions where management options are limited. We observed at the conference that this expectation tends to turn away from a general increase in forage productivity to more specific requirements related to the production system of interest.

For intensive grazing systems, Peyraud (373) identified the following:

- Extend growing season of perennial ryegrass
- Improve forage intake
- Make alternative species like red clover adapted to intensive grazing; there is considerable genetic resource available (Boller, 386), and useful genetic variation for tolerance to defoliation was detected (Collins, 389).

Opportunities for plant breeding were also suggested for tolerance to ozone (Lötscher, 139) and for adaptability to grass-clover mixtures (Collins, 486). However, the requirement for new varieties do pass national list trials before having a chance to enter the European market might hinder the rapid availability of breeding progress to farmers (Caradus, 392). In addition, the long time required and the limited funding available for developing varieties with the desired specific traits make it rather unlikely that these will become available soon.

In order to speed up progress, there is a need to better integrate grassland science, genetic resource conservation and plant breeding.

### **5.3 Use of legumes and mixed swards**

The role of legumes in sustainable grassland systems is widely acknowledged and a topic of important research efforts. There is increasing interest in legumes other than white clover:

- Red clover is being studied particularly in NW Europe (Bakken, 442; Deprez, 469, 498; Nykanen-Kurki, 513). It's productive potential on a range of soil types is high, and breeding and management for persistence under grazing is progressing (Marshall, 389).
- Lucerne (alfalfa) is also of great interest particularly in E Europe on calcareous and other well-drained soils because of it's high production and drought resistance. Problems. Including seed production, are being addressed (Slepetys, 445; Vasileva, 448; Stevovic, 454)
- Peas and vetches, as high-protein forages, are also of interest in SE (Mihailovic, 457; Kertikov, 460) and NW (Nesheim, 942) Europe.
- Birdsfoot trefoil has lower production, but is adapted to poorer soils and has condensed tannins, offering protein protection and freedom from bloat (Hopkins, 504; Nilsson-Linde, 1062)
- In a new and very large series of experiments across Europe, Canada and Australia (Sebastia, 483) mixtures of legumes and grasses from different functional types are being evaluated. These seek to increase stability and reliability.

### **5.4 Ley-arable rotations re-discovered**

An EGF Working group on grassland resowing and grass-arable rotations had been launched at the previous EGF general meeting at La Rochelle (vol 7 in this series) and a progress report was given by Taube (520). While the benefit of grassland resowing as measured by long term dry matter productivity compared to well-kept permanent grassland remains debatable, and breeding progress did not change this view (Soegaard, 523), ley-arable rotations appear to have the potential of combining the high productivity of a newly established sward with a reduction in necessary N-fertilizer inputs (Nevens 532). This is particularly true when grass-legume mixtures are sown (Kryszak, 535). Several contributions dealt with the benefits of grass-legume leys for the succeeding arable crop (Nevens, 532; Vertes, 526; Conijn, 541).

## **6 From forage to food quality**

### **6.1 Forage quality**

Oldham (867) reviewed forage quality for dairy cows in the context of continued increase in genetic potential for milk yield. He foresaw a polarisation of systems: large intensive farms producing commodity milk and small extensive farms adding value. Both could be accommodated with acceptable welfare, provided genotypes and management were balanced.

The focus in research on forage quality is changing from general nutritive value

to individual compounds, such as vitamins (Nadeau, 891), carotenoids (Muntean, 1049), minerals (Grzegornczyk, 921; Ignatovic, 960) and fatty acids (Chow, 981), accepting that the consumer wants ruminant products to originate from an appropriate diet.

We note some research and development opportunities:

- Turn cows into new paddock in the evening to benefit from diurnal change in WSC (Smit, 951)
- Mycotoxins from *Fusarium* may cause feed safety problem in late autumn/winter grazing of *Lolium* and *Festuca* (Laser, 1014)
- High levels of phytoestrogens in clover silage could pass to milk and have beneficial health effects for humans – need to re-assess potential fertility problems in cattle? (Sakakibara, 984).

## **6.2 Quality of products**

The impact of livestock feeding and management on quality of milk and meat is an expanding area. And at this conference human health aspects predominated rather than organoleptic quality.

Martin (876) reviewed the effect of feed on milk components of interest to consumers – fatty acids, carotenoids, vitamins A and E and global antioxidant status. He concluded that varying diet composition can change milk composition rapidly and efficiently. Milk from fresh grass-based diets, compared with concentrates, maize silage or hay, was higher in all these components. Leiber (1139) confirmed this for CLAs and Elgersma (1136) found that content of beneficial omega-7 FAs decreased rapidly with decreasing herbage allowance. She also noted that, in the Netherlands, milk from cows grazing for more than 5 hrs/day can achieve a higher price.

Gebbing (1130) confirmed the possibility of tracing food provenance; he found that meat from maize-fed cattle had a different C-isotope signature from grass-fed stock.

## **7 Transdisciplinary research and knowledge exchange**

This was an excellent theme and it was a pity that people had started to leave the conference by the final morning.

Fry (1157) reviewed integrated research. He noted that this was seen as more likely than disciplinary studies to solve management problems in multifunctional grassland landscapes. There had been a rapid expansion over the last 20 years of large-scale integrative projects, but given the challenge of working across disciplines expectations from funders were unrealistically high. He saw stakeholder participation as the critical factor. Despite being largely driven by funders, integrated research is popular with researchers. But they worry about publication, and recognition. Journal editors claim to welcome such work, though reviewers may differ. Academic merit systems are currently tailored for disciplinary approaches and require revision.

Wielinga (1168) addressed the question of how scientific knowledge impacts upon farmers and decision-makers. He traced the changing concepts of knowledge from the prevailing 'expert oriented' view of 1950-1970, through the 'market-oriented' view of the

1980s when extension services in W Europe were privatised, to the current 'network-oriented' concept. He proposed that for knowledge to make an appropriate impact healthy networks are needed. And these require people working to bridge science and practice who have the time, space and recognition to not only network, but to take ownership and lead the process.

Other papers provided examples of involving the users of research, at the beginning of projects (Mayne, 584), and even better throughout (Baars, 1181). There was also a forward-looking example of involving the community, and schools, in the research and knowledge exchange process (Bele, 1184).

## **8 Acknowledgments**

EGF2004 was a large, high quality conference, superbly organised and wonderfully friendly. We thank the organising committee for inviting us to give this concluding paper. We found it to be very demanding, but very rewarding.