Grassland Farming in Austria - status quo and future prospective

Buchgraber K., Schaumberger A. and Pötsch E.M.
Agricultural Research and Education Centre Raumberg-Gumpenstein, 8952 Irdning , Austria
Corresponding author: karl.buchgraber@raumberg-gumpenstein.at

Abstract

Austrian grassland farming is marked by very differing climatic and topographical conditions and, compared with many European countries, it is also distinctively small in structure. While in the favourable areas a definite intensification can be observed, grassland farming in the mountain regions follows traditional methods which are ecologically orientated and sustainably maintain the utilisation of the land. This is also seen in the high acceptance of the Austrian agri-environmental programme, which offers numerous specific measures for the maintenance of grassland. Austria has chosen the path of widespread agricultural utilisation of the land by farming families, who also ensure a high degree of care and product quality.
Due to the low prices paid for products, and high energy and operational costs, state compensation for production is also necessary to ensure the future survival of grassland farmers, and thus the multi-functionality of grassland. Most grassland farming is undertaken in disadvantaged alpine regions and there is only a limited number of alternatives for agricultural production. Many grassland regions today are already affected by the increasing abandonment of farms, which also leads to widespread negative consequences in the cultivated landscape, infrastructure, and the entire development of rural areas. Therefore, alternative forms of agriculture are also required in the future through simple cooperation under civil law between several farms. In this way costs can be saved and at the same time sustainable utilisation of entire valleys and regions can be assured. But appropriate general conditions are also required, as well as rethinking among the farmers who, as before, remain very ownership-orientated and conscious of tradition.
In addition, there will be a future requirement for sound agricultural research, that offers not only the solution-approaches to problems in techniques of production, but also an important interface between agriculture, teaching, consultation, practice and consumers.

Keywords: alpine farming, ecology, circuit farming, cultivated landscape, modern land management

Structure data of Austrian agriculture

Austria offers interesting and varied living spaces on a total area of 84,000 km² with all of its diverse geological and topographical forms, which extend about 500 km from the Pannonian lowlands in the east to the high mountains in the west. In this way the climatic conditions change from the Continental-Pannonian influences in the east to the Atlantic-Continental conditions in the southeast, and on to the harsh alpine conditions in the north and west. A notable altitude gradient from 200 to 2,500 metres and the often extreme, inclined locations have an additional effect on the cultivation and utilisation of varied farming and forestry cultures.

Utilisation of the agricultural land

The entire area of farming and forestry utilisation in Austria is 6.53 million hectares today. The area used for farming amounts to 3.19 million hectares, of which 1.39 million hectares are arable land and 1.73 million hectares are permanent grassland. The area used for farming

in Austria has decreased in the last 50 years by 860,000 hectares. In the alpine locations in this period 566,000 hectares of grassland have become forest areas or built upon. The forested share stands at an average of 51% throughout the country, but in some regions this share has already increased to more than 90% and leads to negative developments in the landscape. Agriculture, fruit and wine production prevail in the climatically favoured east and southeast of Austria. The level of self-sufficiency is 103% for grain, 63% for fruit, 60% for vegetables, 52% for oilseeds and 118% for wine. In 2009 Austria showed a total agrarian trade deficit of € 912 million, within which the milk and dairy products sectors, and meat and meat products sectors showed a positive balance with export surpluses of € 300 million and € 182 million, respectively. The strongest import surplus was seen in vegetables, fruit, nuts, oilseeds and vegetable and animal fats (BMLFUW, 2010).

Grassland and dairy farming takes place predominantly in Austria's alpine regions, which with 2.05 million hectares comprise about 82% of the entire disadvantaged regions of 2.5 million hectares. More than a third of the Austrian population live in the mountain regions and work on about 70% of the 40,600 dairy farms, some under very difficult and extreme conditions. While for grassland farming in the favourable valley and basin locations there is the option to cultivate silage maize, field forage and grain to provide their domestic animals, most of the grassland farms in the mountain regions depend exclusively on the utilisation of permanent grassland (Graphic 1). In the western provinces of Vorarlberg, Tyrol and Salzburg, the share of grassland within the total agriculturally used area is in each case 97%. In Carinthia the grassland share is 78%, in Styria it is 64% and in Upper Austria there is still about 45% of the farming area utilised in the form of meadows and pastures (INVEKOS, 2008; BMLFUW, 2010).

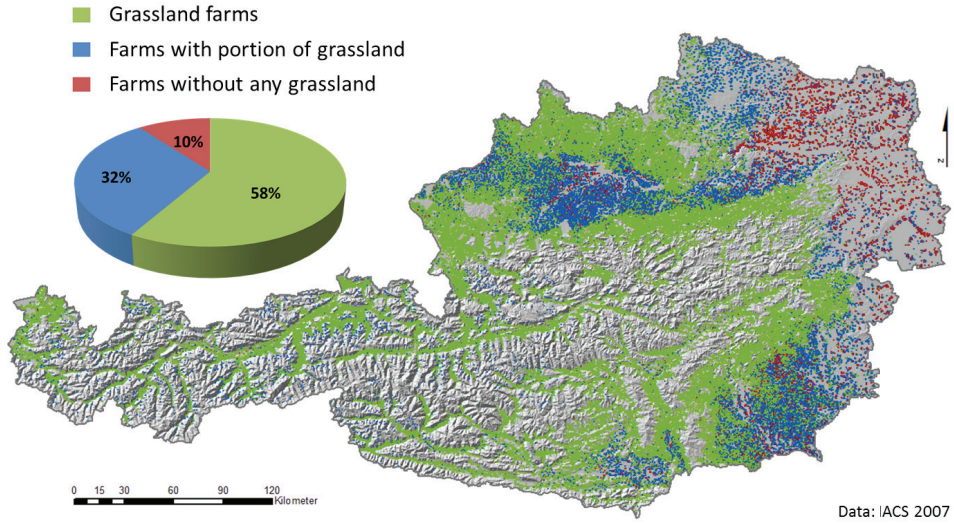

Figure 1. Spatial distribution of Austria's farms and their classification in respect of the share of grassland farmed

Two-thirds of farmed units of grassland are smaller than 0.5 hectares and in total they comprise only 12.6% of the permanent grassland area. Only 1.6% of the units are larger than five hectares, the largest mowed meadow in Austria has an area of 33 hectares (Table 1). In terms of altitude distribution, 34% of all grassland areas are at altitudes of up to 600 metres, 17% are between 600 and 800 metres and almost 50% are above 800 metres (INVEKOS, 2009). In terms of slopes: more than a third of the meadows and pastures have an inclination of more

than 35% and farming them requires the use of special machines that are significantly more expensive than standard machinery (Greimel *et al*., 2003).

Table 1. Distribution in size of Austrian grassland units (ley farming, intensively and extensively used grassland) according to INVEKOS 2009

Unit area in hectares	Number	Number in %	Area in hectares	Area in %
< 0.5	1,127,854	64.74	195,479	12.60
≥ 0.5 and < 1.0	287,666	16.51	202,631	13.06
≥ 1.0 and < 2.0	196,399	11.27	271,065	17.47
≥ 2.0 and < 5.0	102,456	5.88	300,679	19.38
≥ 5.0	27,761	1.59	581,656	37.49
Total	1,742,136	100.00	1,551,510	100.00

About 60% of Austria's permanent grasslands are regarded as extensively utilised, and within this are the alpine meadows and mowed mountain meadows, extensive pastures, litter meadows and meadows that are mowed once and/or twice annually. A critical view of area development within the last five decades, however, clearly shows the dramatic decrease of extensive grassland, which is primarily caused by abandonment of utilisation and reforesting of the borderline areas, and also but to a relatively slight degree, by intensification of use (Groier, 2007). Especially affected by this decrease were the extensive pastures (-72%) and once-mown meadows (-85%), both categories of which play important roles in respect to species diversity and function as a habitat. Current statistics on alpine-meadow areas show a further intensification of this situation because the degree of alpine-meadow forage areas has also greatly decreased due to the natural increase of shrubs and bushes.

Farm and income structures

Austrian farms, compared with the EU-27, are still structured in a small way and an average area of 19.3 hectares of farming land is utilised with 27 head of cattle, including 13 dairy cows. The livestock density in 2005-2009 was at an average of 0.81 LU/ha of agricultural used area. In 2009 about two million head of cattle were kept by 73,466 cattle farmers, but in the last 30 years the number of cattle has decreased by 19.5% and the number of cattle farmers by 58.8%. The greatest structural change is to be seen in the numbers of dairy cattle: within 50 years a reduction from 1.13 million to 0.53 million dairy cows has taken place. Although the number of dairy cattle farms has decreased in the last 15 years by 48%, the remaining 40,600 farms continue to deliver the annual reference amounts for Austria of 2.7 million tons of milk to 92 processing plants with an average milk quota of 70,000 kg (Kirner, 2009). A high proportion of the milk (65%) comes from the mountain regions, within which the extreme alpine farmers have an average milk quota of only 29.3 tons per farm and year. The share of delivered organic milk in 2009 was 13.2% (9,235 dairy farmers with a total of 91,000 dairy cows), for which the price per kilogram of organic milk was, on average, 6.33 cents higher than for conventionally produced milk.

Of those employed in Austria, there are still 4.7% today in farming and forestry. Nevertheless, there are rural regions that still barely show an agrarian quota of 0.5%. The increasing abandonment of farms is of much concern in this respect in alpine regions, where in recent decades many farmers have stopped working and closed down their farms. This also leads to a loss of infrastructure, to the increased desertion of rural areas and weakening of economic power (Dax, 2007). The attractiveness of a beautiful and cared-for cultivated landscape with an intact rural life is greatly endangered in some regions of Europe's mountain areas (Tasser *et al*., 2011).

Austrian farms are run 40.1% as full-time and 59.9% as part-time operations. The share of part-time farming is up to 70% in the mountain regions, which is significantly higher than in the favourable locations. In all, individual farmers form the majority but there is a tendency shown towards an increased forming of personal associations, which in the future could play a stronger role in comprehensive farming. Agriculture in Austria is still a 'man's domain' and only 3.5% of farmers are women (+1.5% compared with 2005). The age structure of Austrian farmers can be seen as favourable because 70% are younger than 55, while the EU-27 average is only 43% below this age. Nevertheless, it is evident that farming successors are in many cases not assured and it will be increasingly more difficult to enthuse young people for a profession in farming. The basis of the small structure of farming in Austria is still family businesses, and 94% of the workers - 1.39 workers per farm - are family members, whereas only 6% of the workers are paid employees from outside.
An assessment of book-keeping farms (n = 2,250) shows that the incomes from farming and forestry (many farmers also undertake forestry in addition) from 2005 to 2009 was at an average of € 22,655 per farm. Together with the production of milk and meat, incomes were also given through holidays on farms, direct marketing, services within machinery rings and agricultural sideline jobs. To this is added about € 18,800 in incomes outside of agriculture, including social remuneration. The civil remunerations for services given during the same period are an average of € 17,183 per farm.

Rural development - agrarian environmental programme

The Austrian programme for the promotion of an environmentally compatible, extensive and natural habitat-preserving farming (ÖPUL) placed high value on the entirety of Austrian farming in its first programme period in 1995. A total of 89.2% of all the agriculturally utilised area today is farmed according to the ÖPUL criteria. The high acceptance (73.1% of all farms currently take part in ÖPUL) is proof of the great willingness of Austrian farmers to integrate environmentally-friendly and resource-sparing measures into their farming systems.
There are 28 differing measures offered in the current ÖPUL 07 programme, of which very many also have influence on the quantity and quality of forage production from grassland. Table 2 shows the connection between the current grassland-relevant ÖPUL-measures and the yield factors or quality-defining factors of grassland. The strongest of the depicted measures relate to the sphere of fertilisers, through which in many cases an additional effect on the soil is given as the most important location factor. Most of the given measures show stronger limitations in respect of the fertiliser level, which are anyway to be kept within the sphere of cross compliance (EU nitrate guideline, 1991; EU-VO 796, 2004; BGBl. II No. 457, 2005; AKTIONSPROGRAMM, 2008).

Organic farming

11.9% of all Austrian farms are run according to the criteria of organic farming (Steinwidder *et al*., 2011) and 20,800 organic farms thus work 13% of the entire area used for farming, of which about 60% are meadows and pastures with an overwhelming share that can be classified as permanent grassland. Together with organic farms, however, there are a further 38,400 farmers who voluntarily relinquish the use of yield-increasing farming measures and thus concentrate on the optimum use of their own resources. These farms also present a significant potential for the expansion of organic farming. In ÖPUL, which in 2010 was endowed with € 554 million, grassland plays a central role, which above all is also shown by relevant measures for biodiversity.

Table 2. Grassland-relevant ÖPUL-measures and their influence on yield factors and the quality-defining factors of forage production (BMLFUW, 2011)

				fertilisation			utilisation				plant stand		
ÖPUL-measures	number of farms (2010)	total area in ha (2010)	grassland therefrom in ha (2010)	intensity level	date[5]	type of fertiliser	date	frequency	type of utilisation	forage conservation	ploughing up	renewing	weed control
organic farming	20,789	414,148	231,881	×		×	×[1]	×[1]		×	×	×	×
environmental friendly use of arable land and grassland	67,305	1.286,793	468,802	×			×[1]	×[1]			×		
abdication of yield increasing	38,400	408,965	371,895[2]	×		×	×[1]	×[1]			×		×
substances on grassland abdication of silage production	9,999	113,993	111,057[3]	×		×	×[4]	×[4]		×			
mowing of steep slopes	41,703	149,731	149,702				×[1]	×[1]	×		×	×	
maintenance of field orchards	16,904	10,106	10,102								×		
use of mountain meadows	1,215	1,787	1,787			×		×	×				×
Herding on alpine pastures	7,770	409,793	409,793	×		×			×				×
nature conservation measures	23,858	84,776	60,662	×	×	×	×	×	×	×	×	×	×
ecopoint-system[6]	6,571	133,603	80,885	×		×	×	×			×		×
water protection and maintenance of grassland[7]	2,029	28,339	28,331	×		(×)[8]	×[1]	×[1]		(×)[8]	×	×	(×)[8]

[1] on at least 5 % of total grassland
[2] including 37,067 ha temporary grassland
[3] including 2,937 ha temporary grassland
[4] indirectly by hay production
[5] timely limits (ban periods) for fertilisation have to be fulfilled for all ÖPUL measures according the national „action programme nitrate“
[6] only offered in lower Austria
[7] only offered in Salzburg
[8] only available in combination with organic farming

Nature conservation

390,000 hectares of agricultural land (14% of the entire agricultural utilisation area) are within the Nature 2000 network and are thus subject to additional, specific management stipulations. At 66%, grassland represents the largest part of the 218 designated Nature 2000 regions in Austria (16% of the entire federal area). Nature conservation in Austria is the responsibility of the provinces; for this reason there exist nine, partly very differing nature conservation laws. The relationship between farming and nature conservation is unfortunately not always free from conflict, but also there are very many positive examples in which the synergies and common interests are in the foreground.

Austrian grassland farming in the area of conflict between becoming ecological or increased intensification

Around 50 years ago, all grassland- and cattle farmers in Austria still carried out a very extensive form of grassland farming. Meadows in mountain regions were mowed once or twice annually and those in the favourable locations two or three times, and together with the pasture areas they were the main providers of ruminant forage. The nutritional provision of the meadows and pastures took place as circuit farming and was based almost exclusively on the site-related use of the farm’s own manure.

In the 1970s and 1980s, together with enhanced mechanisation (particularly in the techniques of mowing, harvesting and conservation) there was also increased intensification of the utilisation and fertilisation of grassland. In accordance with the practices in Germany, Netherlands and Denmark, the frequency of utilisation was increased, especially in the more favourable areas (utilisation to as many as six times annually), and the use of concentrates from outside of the farms and mineral fertilisers was clearly increased. In the highly favourable areas of Austrian grassland farming (Rhine Valley, Inn Valley, foothills of the Alps), the yield potential of the meadows and pastures could be better utilised and, initially, the quality of forage significantly raised. Higher frequency of cutting, however, often led to the loss of utilisation-sensitive species of grass and many open-patch areas were created, which according to the demands of today in respect of yield and quality could no longer be sufficiently fulfilled. The open patches were colonised more and more by broad-leaved dock (*Rumex obtusifolius*), common dandelion (*Taraxacum officinale*) and rough-stalked meadow-grass (*Poa trivialis*), which are of less feed value and no longer fulfil the ration demands of dairy cows in the middle- and higher performance spheres.
In the mountain locations, on the other hand, traditional farming has only been changed slightly so that the meadows there today are mowed twice or a maximum of three times annually. According to ÖPUL-stipulations, mineral nitrogen is hardly used in the mountain locations and, moreover, with two to four kilograms per dairy cow the daily amounts of concentrates are at a comparatively low level. This site-adapted farming system takes ecological contexts into account to a high degree and guarantees sustainable, resource-sparing farming of the land. An essential contribution for making farming ecologically viable in Austria is also undoubtedly the numerous existing general legal conditions in respect of the utilisation of water, soil, nature- and animal conservation. Among other things clearly defined limits are fixed within the legal framework, the maintenance of which is also severely controlled in the course of cross compliance.

How ecologically do Austrian farmers utilise grassland?

The proof of ecologically orientated, sustainable farming of the land can take place by different ways and means. At a European and national level, the evaluation of the programme for rural development makes an essential contribution (Pötsch and Schwaiger, 2009). The Austrian agri-environmental programme is very critically controlled within the sphere of this evaluation in respect of its effect on the protected resources of soil, water, climate and biodiversity and, based on the results achieved, is improved and further developed. The current evaluation results offer an excellent testimony as a whole to Austrian grassland farming, but also shows a certain potential for improvement (BMLFUW, 2010; Pötsch and Schwaiger, 2011).
Recommendations were laid down as early as 1991 in the "Guidelines for Appropriate Fertilisation" for the fertilisation of grassland with nitrogen, phosphorous and potassium. In addition, together with the yield situation and the type of utilisation and frequency, the subsequent delivery of the nutrients from soil was also taken into account. These recommendations are not targeted on the maximisation of yield but on sustainable utilisation of grassland as a circuit farming system (BMLFUW, 2006). The farm's own fertiliser and its appropriate use plays an increasingly important role for grassland farms, not least due to the high energy and fertiliser prices. Nutrition balances are an important means for the depiction and assessment of material flows and enable concrete statements from various points of view (international, national, regional, and for individual farms and areas). What is decisive, however, is that the method of nutrient balancing is clearly defined and thus also open to comparison (Taube and

Pötsch, 2001). Farm gate balances for differing grassland regions in Austria showed average nitrogen balances of -7 kg to +10 kg per hectare and year, although significant deviation appears (Pötsch, 2000). With an average of +17 kg N per hectare and year, farms in the valley regions show a higher surplus than farms in mountain locations, which are almost equally balanced. A tendentious difference was also seen in the farming method with an average of +9 kg N per hectare and year among conventional farms and +2 kg N per hectare and year among organic farms. Balance results from Steinwender *et al*. (2001) show a strongly marked difference between mountain farmers using organic farming methods and the most intensive conventional grassland farmers in the favourable locations, with nitrogen balances of -1.2 kg N per hectare and 115.6 kg N per hectare and year. According to Guggenberger (2006), Austrian grassland areas show an average nitrogen balance of +11.4 kg N per hectare. If a balance surplus of 50 kg N per hectare and year is accepted as a tolerable upper limit, according to Guggenberger (2006) 93% of Austrian grassland areas can be considered to be sustainably farmed.
Site-adapted utilisation and fertilisation of grassland guarantees a high floristic diversity on both levels of species and plant associations. According to Bohner (2007), on average, between 36 and 70 species of vascular plants are to be found among the permanent-meadow and permanent-pasture plant communities in Austria. The intensively utilised meadows and pastures in the favourable locations still show at least 20 to 30 species. In the alpine-valley meadows and mountain meadows, according to Buchgraber and Sobotik (1995) up to 72 species can be assessed in regional transects. According to Bohner *et al*. (2010), 910 species of vascular plants were found in a single quadrant of 35 km². By far the most species-rich grassland types identified were alpine-meadows, extensive pastures (with up to 115 species) and mountain meadows, followed by once- and twice-cut areas and cultivated pastures (Pötsch *et al*., 2005). Together with floristic diversity, the diversity of the types of grassland utilisation and their significance for the habitat- and landscape structure were recorded by Pötsch and Blaschka (2003). Austrian grassland farming thus makes an indispensable contribution to a positive image of a cultivated landscape that, year after year, attracts many tourists and holidaymakers to the mountain regions of Austria.

Protecting and maintaining an open cultivated landscape

In the past 60 years the number of farms in Austria has decreased from 400,000 to about 180,000. The loss of many small farms has meant that particularly in areas in the mountains, and steep locations that are difficult to work, farming has been given up. This also means the ecologically valuable but very sensitive alpine-meadow areas that are increasingly threatened by the growth of shrubs and forests are becoming fully overgrown. Of the currently existing alpine-meadow areas (about 720,000 hectares), for example, only 63% are now designated as forage areas. Many grassland areas become overgrown within a few years after no longer being utilised, and thus no longer fulfil their original function for production.
The problem of giving up utilisation and the loss of function can be seen over the entire region of the European Alpine Bow and, together with farming, also affects numerous other sectors and stakeholders (Tasser *et al*., 2011). In Austria this development also increasingly affects those regions in which tourism plays a significant economic role. Tourists come mainly because of the cared-for and open cultivated landscape that still shows a high agricultural identity (Buchgraber, 1995). To keep open the regions with an agrarian quota of less than 3%, and which are endangered from being overgrown, new forms of organisation and production alternatives must also be implemented for comprehensive farming in the future together with full- and part-time farmers. Under the title of "Modern Land Management", models for cross-

farm cooperation in endangered regions were considered and their practical realisation capacity discussed. In a specific living area (e.g. side valley, region) all of the resources that are still available (land areas, buildings, animals, machines, workers) should be voluntarily bundled on the basis of private legal cooperation, and the cared-for cultivated landscape maintained in its diversity (Buchgraber, 2004; Buchgraber, 2007). With the preservation of the cultivated landscapes in the mountain regions, according to Pötsch (2010) their multi-functionality can be guaranteed, so that together with production, such aspects as protection, wellbeing and recuperation can also be contained. Giving up the utilisation of these often steep grassland areas can trigger extensive natural dangers in mountain locations, above all due to extreme precipitation. Sustainable farming, on the other hand, fosters the turf and root penetration of the soil and thus protects the steep locations against erosion and mudflows. If these mountain meadows and mountain pastures become overgrown with forest, much of the biodiversity and the popular image of this delightful living area will be lost (Ahrens and Kantelhardt, 2007). The mountain regions of Europe must therefore assume an important role in the future as a living-and-recuperation area, as well as for the production of foodstuffs.

Specialised theme focuses in theory and practice

The number of experts responsible in Austria for grassland and animal farming may be limited but their efficiency is very high. Science, consultation, training and further education work together effectively in practice. In recent years the following focal themes have been dealt with and put forward.

Soil - fertilizer - plant stands

Protection of the soil and maintenance of the soil fertility must also be given increasing attention (Starz, 2007). The use of increasingly larger and heavier machines also leads in the mountain regions to heavy loads and compaction of grassland soil, as well damage to the swards. The environmentally friendly use of farm manure is given the highest regard. The national guidelines for appropriate fertilisation (BMLFUW, 2006) take into account the differing site characteristics and in practice they are very well implemented. Together with liquid manure, slurry and farmyard manure, organic compost (Buchgraber, 2000) is also used on Austrian grassland and controlled in respect of effects on yield, forage quality and soil. The carrying out of soil sampling and soil analysis is recommended at intervals of 5-6 years and their results taken into account in the planning of fertilisation.
Great attention is given to research, consultation as well as teaching of the composition and improvement of plant stands. Knowledge of the most important plant species in grassland and knowledge of their feed value must be further improved, above all by the farmers to ensure that problems are recognised on time and appropriate regulating measures can be undertaken. This is all the more important because, due to the raising of the cutting frequency in recent years, especially so in the favourable regions, a certain loosening of the swards has been shown. This open patchiness often leads to unfavourable development of the plant stands and thus to a reduction of forage quality. Together with the classic dock problem (*Rumex obtusifolius*, *Rumex crispus*, *Rumex alpinus*), the current increased appearance of rough-stalked meadow-grass (*Poa trivialis*) presents great challenges in practice. Mechanical weed control moves into the foreground due to the increasing renunciation of chemical-synthetic farming methods (Pötsch and Griesebner, 2007). A majority of the Austrian grassland is old and permanent, the improvement and renewal of which, due to climatic and topographical conditions, presents a special challenge. While in many European regions that are favourable for grassland farming a

regular ploughing up of grassland swards takes place, often combined with the use of herbicides such as glyphosate, in Austria grassland renewal without ploughing is increasingly implemented as a modern grassland standard procedure. In this respect site-specific seed mixtures of very high quality are used (ÖAG quality), which in their spectrum of species and varieties differ very greatly from the mixtures containing a predominance of ryegrass and white clover that are used in the favourable locations (Krautzer *et al*., 2010). The ÖAG seed mixtures, which compared with the general European norms clearly fulfil stricter quality criteria, have been checked for more than 15 years in field trials, and further developed and utilised in practice with the greatest success.

Forage quality and feed conservation

Grassland in the mountain regions presents other plant stands than those in the favourable locations and due to the difficult conditions (climate, area size, steepness, etc.) it also presents great challenges to the farmers in respect of forage conservation. Forage quality is at the centre of attention of numerous, specific research projects, as well as field studies, which offer an excellent insight into the situation in-practice on farms and, at the same time, indicate the unrealized potential (Pötsch, 2009). A specific forage-value table for the forage from alpine regions was created at LFZ Raumberg-Gumpenstein (Resch *et al*., 2006). This is complementary to the additional sensory assessment of silage and hay on farms (Buchgraber, 1998) that is increasingly being used. In forage conservation in recent decades the production of silage has increased significantly, while traditional hay making has decreased, especially in the favourable locations. The production of haylage is increasingly more popular in several areas. In respect of silage systems, high silos are also being increasingly replaced in the mountain regions by baled silage and bunker silo systems. But in recent years the production of hay again acquired importance after "hay milk" and "hay cheese" were exceedingly well accepted by consumers. Within the sphere of the Austrian agri-environmental programme, hay is produced exclusively and the production of silage voluntarily renounced on about 10,000 farms on about 115,000 hectares in selected areas.

Alpine-meadow farming

28,600 Austrian farms utilise a total of 8,855 alpine meadows. However, in recent decades many alpine meadows have no longer been farmed and have already become overgrown. There are many initiatives today for the re-cultivation of these ecologically valuable but also very sensitive areas (Aigner *et al*., 2003), which, due to especially difficult farming conditions, require financial support. The re-cultivation of extreme mountain locations, within the sphere of farming as well as following diverse construction measures (ski runs) or occurrences of damage (avalanches, mudflows) were intensively processed and successfully realised with the use of site-specific seed and special techniques (Krautzer *et al*., 2006).

Transfer of expertise in practice

The research applied at the AREC Raumberg-Gumpenstein is used in its projects to deal with numerous practice-relevant and future-orientated themes. The results are communicated in professional and scientific journals, and through lectures, professional events, seminars and on field days, to pupils, students, teachers, consultants and above all to farmers. The close cooperation between all participants enables the necessary efficiency in the individual regions. The Austrian Grassland Association (ÖAG) also offers an ideal platform for all participating stakeholders, and by means of practically edited brochures and leaflets it informs continuously on current problem areas and approaches to solutions.

Perspectives of Austrian grassland farming

With the predicted expiry of the European milk quota system and the advancing liberalisation of the markets, the pressure on small farms in the disadvantaged regions will be further increased. The giving up of farms will lead to a noticeable change in the cultivated landscape and its appearance. In the more favourable regions, on the other hand, an intensification of farming and enlargement of farms will take place, and also at the same time there will be increasing competition for utilisation of the available areas for the production of energy and for infrastructure use.

These extremely contrasting developments in the mountain regions, and especially in the regions of the Alps, will take place parallel in time with each other, and within locations of close proximity. But a minimum of farming in the mountain regions, as well as an upper limit of cattle stock in the favourable locations, is also required for the maintenance of the diverse economic and ecological functions of the grassland. On the one hand there is the danger of giving up utilisation, and of excessive intensification on the other; and both developments finally lead to a further reduction of the agrarian quota. New, cooperative forms of land utilisation could counteract this, and, together with maintaining the preparedness to produce, should also continue to guarantee the qualitatively high-value production of healthy and nutritious foodstuffs.

An indirect contribution to maintaining the farming of meadows and pastures could be provided by the rising costs for energy and concentrates (above all protein components), which brings the farm's own forage more into the foreground. Grassland and dairy farming can take place to a medium level of performance based on the farm's own resources - forage and farm manure - and thus show a high degree of self-sufficiency. But this also demands an improvement in the future of plant stands, further development of the quality of silage, hay and aftermath, optimisation of grazing and the efficient use of environmentally compatible farm's manure.

The attractive but difficult-to-farm living space in the mountains requires coordinated farming in unison with nature. But the mountain farmers must be offered the appropriate incentive in the rural development programmes to ensure that they are also able to undertake their valuable tasks in the future for the benefit of all of society!

References

Ahrens H. and Kantelhardt J. (2007) Integrating ecological and economic aspects in land use concepts for agricultural landscapes. *Agrarwirtschaft* 56 (3), 166-174.

Aigner S., Egger G., Gindl G. und Buchgraber K. (2003) Almen bewirtschaften. Pflege und Management von Almweiden. Leopold Stocker Verlag, Graz, 126 S.

Aktionsprogramm (2008) Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über das Aktionsprogramm 2008 zum Schutz der Gewässer vor Verunreinigung durch Nitrat aus landwirtschaftlichen Quellen, CELEX-Nr. 391L0676.

BGBl. II Nr. 457/2005: 474 (2005) Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Einhaltung der anderweitigen Verpflichtungen und über das integrierte Verwaltungs- und Kontrollsystem im Bereich der Direktzahlungen. Zuletzt geändert im Dezember 2006 (2. Änderung der INVEKOS-Umsetzungs-Verordnung 2005).

BMLFUW (2006) Richtlinien für die sachgerechte Düngung. Fachbeirat für Bodenfruchtbarkeit und Bodenschutz. 6. Auflage, Bundesministerium für Land- und Forstwirtschaft, Wien, 79 S.

BMLFUW (2010) Grüner Bericht 2010 - Bericht über die Situation der österreichischen Land- und Forstwirtschaft. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien, 336 S.

BMLFUW (2011) Grüner Bericht 2011 - Bericht über die Situation der österreichischen Land- und Forstwirtschaft. Bundesministerium für Land- and Forstwirtschaft, Umwelt and Wasserwirtschaft, Wien, in Vorbereitung.

Bohner A. (2007) Phytodiversität im Wirtschafts- and Extensivgrünland der Tallagen. Biodiversität in Austria, Bericht HBLFA Raumberg-Gumpenstein, 29-36.

Bohner A., H. Kerschbaumsteiner and F. Starlinger (2010) Bemerkenswerte Pflanzenvorkommen am Putterersee (Bezirk Liezen, Steiermark), *Joannea Botanik* 8, Graz, 19-41.
Buchgraber K. (1998) Nutzung and Konservierung des Grünlandfutters im österreichischen Alpenraum. Habilitationsschrift, Universität für Bodenkultur Wien, Mai 1998, 113 S.
Buchgraber K. (2000) Ertragspotentiale and Artenvielfalt auf Grünlandstandorten im Berggebiet. MAB-Forschungsbericht: Landschaft and Landwirtschaft im Wandel, Wien, Akademie der Wissenschaften, 22.-23. September 2000, 181-189 S.
Buchgraber K. (2004) The Kulturlandschaft ist ein Produkt der Nutzung. In: Proceedings of the AlpWeek 2004, The Alps of the next generation. Kranjska Gora/Slovenia, S 13.
Buchgraber K. (2007) Modernes Landmanagement - eine Chance für das Berggebiet. Ländlicher Raum, Online-Fachzeitschrift des BMLFUW, Jg. 2007.
Buchgraber K. und Sobotik U.M. (1995) Einfluss der Grünlandwirtschaft auf die Artenvielfalt in verschiedenen Pflanzengesellschaften. In: Bericht Expertentagung zum Thema Landwirtschaft und Naturschutz - Gemeinsam erhalten für die Zukunft. 9-23, BAL Gumpenstein.
Dax T. (2007) Szenarien der Entwicklung der Berggebiete in Europa. In Oedl-Wieser (Red.): Zeitreisen(de) im ländlichen Raum, Forschungsbericht Nr. 57, Bundesanstalt für Bergbauernfragen, Wien, 11-24 S.
EU-Nitratrichtlinie (1991) Richtlinie 91/676/EWG des Rates vom 12. Dezember 1991 zum Schutz der Gewässer vor Verunreinigung durch Nitrat aus landwirtschaftlichen Quellen, Amtsblatt Nr. L 375 vom 31/12/1991.
EU-VO 796/2004 (2004) Verordnung der Kommission vom 21. April 2004 mit Durchführungsbestimmungen zur Einhaltung anderweitiger Verpflichtungen, zur Modulation and zum Integrierten Verwaltungs- and Kontrollsystem nach der Verordnung (EG) Nr. 1782/2003 des Rates mit gemeinsamen Regeln für Direktzahlungen im Rahmen der Gemeinsamen Agrarpolitik and mit bestimmten Stützungsregelungen für Inhaber landwirtschaftlicher Betriebe. Celex Nr.: 02004R0796.
Greimel M., Handler F., Stadler M. and Blumauer E. (2003) Methode zur Ermittlung des einzelbetrieblichen and gesamtösterreichischen Arbeitszeitbedarfes in der Landwirtschaft. *Die Bodenkultur* 54 (2), 143-152.
Groier M. (2007) Permanent grassland in change: Aspects of grassland farming in Austria, Mountain Forum Online Library, Vienna, 6 S., http://mtnforum.org/rs/ol/browse.cfm?tp=vd&docid=876, (15.02.2011).
Guggenberger T. (2006) Befunde zur österreichischen Grünlandwirtschaft: Gutes ökologisches Verhalten bei hoher Energieabhängigkeit der Tierproduktion. Landkalender 2007, 98-103.
Krautzer B., Buchgraber K., Egger H., Frank P., Frühwirth P., Hietz M., Humer J., Leonhardt C., Luftensteiner H., Mechtler K., Meusburger C., Peratoner G., Pötsch E.M. and Starz W. (2010) Handbuch für ÖAG-Empfehlungen von ÖAG-kontrollierten Qualitätssaatgutmischungen für das Dauergrünland and den Feldfutterbau 2011-2013. Österreichische Arbeitsgemeinschaft für grassland and Futterbau, c/o LFZ Raumberg-Gumpenstein, Irdning.
Krautzer B. Wittmann H., Peratoner G., Graiss W., Partl C., Parente G.Venerus S., Rixen C. and Streit M. (2006) Site-specific high zone restoration in the Alpine region, The current technological development, Federal Research and Education Centre (HBLFA) Raumberg-Gumpenstein Irdning, no.46, Wallig Ennstaler Druckerei and Verlag GmbH, Gröbming, 135 p.
Krautzer B., Peratoner G., Frühwirt P., Pötsch E.M. Buchgraber K. and Galler J. (2011) ÖAG-Saatgutmischungen: Spitzenqualität setzt sich durch. *Der Fortschrittliche Landwirt* 6, 71-82.
Pötsch E., Buchgraber K., Resch R., Häusler J., Ringdorfer F., Pöllinger A., Rathbauer J. and Amon T. (2009) Extensively used grassland as a basis of low input livestock systems and as a resource of energy and raw materials. In: Alternative functions of grassland, Proceedings 15th Symposium EGF 2009, Grassland Science in Europe, 14, 428-431.
Pötsch E.M. (2009) Einflussfaktoren auf Ertrag and Qualität von Grünlandfutter. Fortbildungsveranstaltung "Tierärztliche Bestandsbetreuung von Milchviehbetrieben in Austria", LFZ Raumberg-Gumpenstein, 4-6 June 2009, 5-13 S.
Pötsch E.M. (2010) Multifunktionalität and Bewirtschaftungsvielfalt im grassland. Bericht zum 16. Alpenländischen Expertenforum zum Thema "Biodiversität im grassland", LFZ Raumberg-Gumpenstein, 1-10.
Pötsch E.M. and Griesebner C. (2007) Control of broad-leaved dock on organic grassland farms. In: Permanent and temporary grassland - plant, environment and economy, Proceedings14th Symposium EGF 2007. *Grassland Science in Europe* 12, 138-141.
Pötsch E.M. and Schwaiger E. (2009) Evaluation of the Austrian agri-environmental program ÖPUL in terms of biodiversity. *Proceedings of the 15th Meeting of the FAO CIHEAM Mountain Pasture Network, Les Diablerets*, 57-58.
Pötsch E.M. and Blaschka A. (2003) Abschlussbericht über die Auswertung von MAB-Daten zur Evaluierung des ÖPUL hinsichtlich Kapitel VI.2.A Artenvielfalt. Gumpenstein, December 2003, 37 S.
Pötsch, E.M., Blaschka A. and Resch R. (2005) Impact of different management systems and location parameters on floristic diversity of mountainous grassland. In: Integrating Efficient Grassland Farming and Biodiversity, Proceedings 13th Symposium of EGF 2005. *Grassland Science in Europe* 10, 315-318.

Pötsch E.M., Resch R. and Buchgraber K. (2010) Forage conservation in mountainous regions - results of the Austrian silage monitoring project. In: Proceedings 14th International Symposium Forage Conservation, Brno, Czech Republic, 17-19 March 2010, pp. 4-11.
Resch R., Guggenberger T., Wiedner G., Kasal A., Wurm K., Gruber L., Ringdorfer F. and Buchgraber K. (2006) Futterwerttabellen für das Grundfutter im Alpenraum. *Der Fortschrittliche Landwirt* 24, Sonderbeilage 8/2006, 20 S.
Schwaiger E. and Pötsch E. (2011) Halbzeitbewertung des Österreichischen Programms für die Entwicklung des Ländlichen Raums 2007-2013, Teil B. Evaluierung des ÖPUL- Bereich Biodiversität, BMLFUW, 261-289.
Starz W. (2007) The Boden als Grundlage des biologisch bewirtschafteten Grünlandes. *Der Fortschrittliche Landwirt*, ÖAG-Sonderbeilage 8, 1-8.
Steinwidder A., Schneider M., Wachendorf M., Starz W. and Pötsch E.M. (2011) The future of organic grassland farming in mountainous regions of Central Europe. In: Grassland farming and land use management systems in mountainous regions. In: Proceedings 16th Symposium EGF 2011. *Grassland Science in Europe* 16, 286-296.
Tasser E., Leitinger G., Pecher C. and Tappeiner U. (2011) Agricultural changes in the European Alpine Bow and their impact on other policies. In: Proceedings 16th Symposium EGF 2011. *Grassland Science in Europe* 16, 40-51.
Taube F. and Pötsch E.M. (2001) On-farm nutrient balance assessment to improve nutrient management on organic dairy farms. In: Organic grassland farming, Proceedings of the 11th Symposium EGF 2001. *Grassland Science in Europe* 6, 225-234.