LIFS & livestock production – grassland and dairy farming in Austria

Erich M. Poetsch
Research and education centre for agriculture, Raumberg-Gumpenstein, A-8952 Irdning, Austria
Erich.poetsch@raumberg-gumpenstein.at

Abstract In some countries, especially in disadvantaged areas, a stronger tendency for low input farming systems (LIFS) can be noticed nowadays aiming at aspects of sustainability. Sustainable agriculture refers to the ability of a farm to produce food indefinitely without causing irreversible damage to the health of the ecosystem. There is a set of different LIFS-elements available, which have to be chosen and combined according to the specific situation on farm. Most of the LIFS-elements directly aim at the reduction of production costs, which are rather high in alpine and mountainous regions compared with favourable lowland areas.
Several studies have been carried out by the Federal research and education centre for agriculture (HBLFA) Raumberg-Gumpenstein during the last years to identify different effects of low input farming systems on ecology, economy and socio-economy. The results clearly indicate beneficially effects of LIFS on nutrient fluxes, floristic biodiversity and economy. LIFS not automatically means organic farming but also can be realized on integrated and conventional farms. In Austria the majority of grassland and arable farms follow the principles of LIFS, which are also included in the Austrian agri-environmental program ÖPUL that is highly accepted by the farmers.

Keywords: low input farming, low cost farming, sustainability, organic farming, bio-diversity

Introduction In many European countries agriculture has developed from traditional and natural farming to highly productive and industrial farming systems during the last decades. High loads of farm external inputs have increased environmental problems like nutrient leaching, contamination with pesticides, soil degradation and erosion. Such intensive systems mainly focus on an increase of output, which very often does not reflect in a rising economic efficiency.
In some countries, especially in disadvantaged areas, a stronger tendency for low input farming systems can be noticed nowadays aiming at aspects of sustainability (Brundtland, 1983). Sustainable agriculture refers to the ability of a farm to produce food indefinitely without causing irreversible damage to the health of the ecosystem (Ikerd, 1990). Furthermore such systems must be resource-conserving, socially supportive, commercially competitive and environmentally sound.

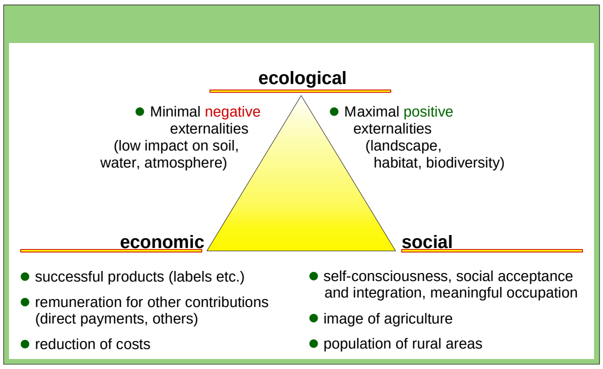

Figure 1 Conception and main criteria of low input farming systems

What could be the elements and strategies of low input farming systems (LIFS) and what are the resulting consequences of implementing these elements and strategies in practice? In Table 1 possible elements of LIFS are listed, which affect different parts of agricultural production. Due to the manifold farm structures (size, focal point of production, location, production conditions, financial situation …) there is no general and fixed set of LIFS-elements, which covers all different aspects and conditions. Therefore farm specific LIFS have to be implemented, using a selected combination of existing LIFS-elements, which consider natural and structural conditions, interest and capability of the farmers and also agri-political conditions including subsidies.

Most of the mentioned LIFS-elements directly aim at the reduction of production costs, which are rather high in alpine and mountainous regions compared with favourable lowland areas. There are e.g. much higher costs for special machinery but also higher costs for buildings. Considering the full costs of dairy farming in Austria the highest proportion of costs is caused by labour, which additionally has a strong impact on the personal and social situation of farmers (Kirner, 2004).

Table 1 Basic elements of low input farming systems

elements	necessities/consequences/advantages
Reduction of external resources (concentrates, mineral fertilisers especially mineral nitrogen, pesticides, fossil energy)	improve forage quality, legume based forage systems, enhance manure efficiency, mechanical and biological weed control, use of renewable energy
Maximisation of grazing	full grazing systems, harmonisation of lactation time with vegetation period, improve forage conversion efficiency, synchronisation of calving, animal welfare and health reduce forage conservation costs, natural hay drying systems, no or little maize
Optimized animal husbandry	low replacement rate of dairy cows, high life-performance, site adapted local breeds – lightweight animals to avoid sward damage
Cheap and labour extensive animal housing systems	free-range husbandry, wooden stable houses and farm buildings, stable co-operations
Reduction of costs for farm machinery and other farm equipment	Use of machinery rings, inter-farm co-operations, management co-operations for larger areas (valleys)

Basically it has to be taken into account, that:

- LIFS not automatically means low cost in any case (e.g. abdication of chemical weed control may increase the work load, grazing in wet regions may result in sward damage and regeneration costs …)

- LIFS is not a simple extensification but is a strategy which is closer to nature and more sustainable than high input farming systems (even LIFS can - depending on the existing production conditions - be high yielding systems)

- LIFS can be but have not necessarily to be organic farming (organic farming compulsory include many elements of LIFS, but also in integrated and conventional farming some LIFS-components are considered)

Material and methods Several studies have been carried out by the Federal research and education centre for agriculture (HBLFA) Raumberg-Gumpenstein during the last years to identify different effects of low input farming systems on ecology, economy and socio-economy. The main focus was given on grassland and dairy farming systems which are of great importance in the disadvantaged area that amounts to nearly 70% of the total Austrian agricultural area. Within the Man and Biosphere (MAB) project “Mountainous grassland in Austria” a comprehensive field study was carried out in the test region of Ennstal in the province of Styria. The project region includes different geological and topographical conditions and ranges from the valley bottom with about 650 m to an altitude of more than 1100 m. On about 200 farms, which manage more than 3,700 ha of farm land investigations on nutrient fluxes, yield productivity, forage quality, soil properties, floristic diversity and economy have been made (Poetsch et al., 1999).

Results and discussion Nutrient and energy balances are generally considered as practicable tools for the documentation of long term ecological impacts and as indicators for the evaluation of environmental measures. Due to the environmental relevance of nitrogen farm gate balances for this central and important nutrient have been set up within the MAB Project. The main input components of the farm gate balances were mineral fertiliser, feedstuff, livestock, external farm manure, N-deposition and biological N-fixation by legumes. The used output components were animal and plant products, organic fertiliser and unavoidable N-losses.

The total set of dairy farms was grouped into organic farms, integrated farms and conventional farms. Table 2 contains the most important structural data about the investigated dairy farms which clearly indicate that the use of farm external resources (mineral nitrogen and concentrates) is on a very low level. Even on conventional dairy farms the average use of mineral nitrogen is just at 20 kg ha^{-1} $year^{-1}$ and the yearly input of concentrates per cow was at 800 kg, which is about 2.5 kg cow^{-1} and day^{-1} during the lactation period.

Table 2 Structural data about the dairy farms in the MAB project region (Taube and Poetsch, 2001)

	Organic farms	Integrated farms[1]	Conventional farms
kg milk ha^{-1} forage grassland	5,801	5,583	8,883
Ø milk production in kg dairy cow^{-1} $year^{-1}$	4,710	4,650	6,095
Input of mineral nitrogen, kg ha^{-1} $year^{-1}$	0	0	20
Input of concentrates, kg cow^{-1} $year^{-1}$	276	437	806
LU[2] (livestock units) ha^{-1}	1.14	1.12	1.73

[1] farms with renunciation of the use of mineral nitrogen, herbicides
[2] based on 500 kg liveweight

The relative importance and size of the different input and output components varied between the investigated farming systems. On organic and on integrated farms, biological N-fixation was the main N-input component, whereas on conventional farms concentrate and mineral fertiliser were the main N-input sources. Independent of the farming system, milk-N and unavoidable N-losses were the most important output components.

There was no significant difference between organic and integrated dairy farms concerning N-input, N-output and the N-surplus, which was around 280 kg $farm^{-1}$ $year^{-1}$ (Figure 2). On the conventional dairy farms both a much higher input and a higher output of nitrogen was observed, which resulted in a significant N-surplus of around 400 kg $farm^{-1}$ $year^{-1}$. If the average farm size of the different farm types is taken into account there is no more significant difference in the N-surplus per ha AA (+ 14 kg to +16 kg N).
These well balanced results could be reached either by the combination of low input + low output or high input (of concentrates) + high output, when unavoidable losses were taken into account. Even at the highest intensity level of about 1.7 LU ha^{-1} on conventional farms only a minor surplus was found. It is evident, that the main reason for these minor differences in N surplus are due to the small differences in fertiliser application rates.

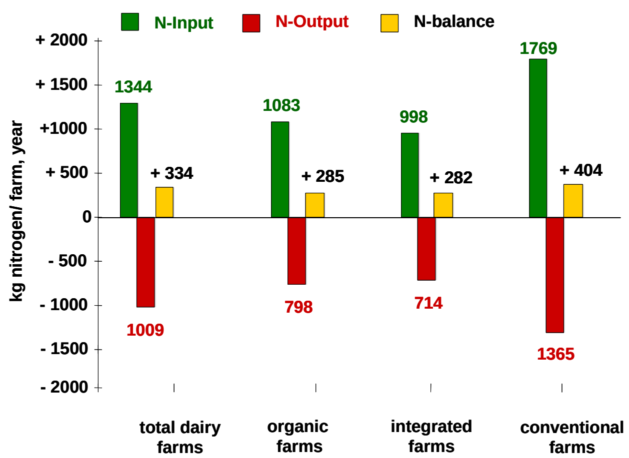

Figure 2 Farm gate nitrogen-balance for dairy farms in the Austrian test region “Ennsvalley”

Concerning the results of the farm gate balance, the tolerable range of surplus/deficit has to be discussed as well as the term of "unavoidable losses". Due to the limited nitrogen efficiency in the process of milk production, it is evident, that also the nitrogen balance of a specialised dairy farm results in a considerable surplus even in organic farming systems, especially if unavoidable losses are not taken into account. Therefore, comparisons between organic and conventional farming systems in terms of nitrogen surplus are only appropriate when data of stocking rates per hectare are taken into consideration.

The comparison of some international studies (Table 3) shows remarkable differences in efficiency indices of dairy production systems in Europe. Compared with very intensive dairy production systems, significant lower nitrogen surpluses and a therefore much higher N-efficiency could be observed in the Austrian study. It can not be concluded that specialised organic dairy farms are generally superior in relation to conventional ones as long as LU ha^{-1} are rather low in both systems. This conclusion is also confirmed by recent results from Scheringer and Isselstein (2001).

Table 3 N inputs and outputs (kg N ha^{-1} year^{-1}) on dairy farms in Europe (Taube and Poetsch, 2002)

	A	NL 1	NL 2	CH	DK 1	DK* 2	G 1	G 2
Nitrogen inputs	64	486	226	152	287	156	252	144
Nitrogen outputs**	24	78	74	43	47	32	53	34
Nitrogen surplus	40	407	153	109	240	124	199	110
N-surplus (g kg-1 milk)	6	34	13	15	-	-	25	22
N output/N input (%)	38	16	32	28	16	21	21	24

* without mineral fertiliser ** not regarding unavoidable losses

A	:	Austria, commercial farms MAB-project (Pötsch, 2000)
NL1	:	Netherlands, commercial conventional farm (Aarts et al., 1999)
NL2	:	Netherlands, De Marke experimental farm (Aarts et al., 1999)
CH	:	Switzerland, commercial conventional farms (Thomet and Koller, 1996)
DK1	:	Denmark, commercial conventional farms (Halberg et al., 1995)
DK2	:	Denmark, commercial organic farms (Halberg et al., 1995)
G1	:	Northern Germany, „modelled conventional farms„ (Taube et al., 1997)
G2	:	Northern Germany, "modelled organic farms" (Taube et al., 1997)

Additional benefits of LIFS The reduction of external nutrient and energy resources not only influence the result of farm gate balances but also beneficially effects water quality, soil fertility and biodiversity. In Austria a strong decrease in the use of mineral nitrogen and of pesticides in agriculture can be noticed (BMLFUW, 2007). The Austrian agri-environmental program "ÖPUL", which is offered nationwide, has stimulated many grassland and dairy farmers to participate in organic and integrated farming as well as in special measures aiming at environmental friendly land use. The Austrian "Aktionsprogramm Nitrat" which is the national implementation of the European Nitrate Directive has in general a very positive effect on the quality of groundwater resources in Austria. This program includes some restrictions in the use of farm manure concerning e.g. time of application, apportioning, minimum distances to waters and upper limits of nitrogen load. Nevertheless there are some small scaled vulnerable areas in the eastern and south-eastern part of Austria with higher nitrate concentration in the groundwater under arable land.

Maintenance and improvement of biodiversity can be seen as an international objective. The results of the above mentioned MAB-study clearly show that LIFS provide both a various number of grassland types and an impressively high floristic diversity (Figure 3).

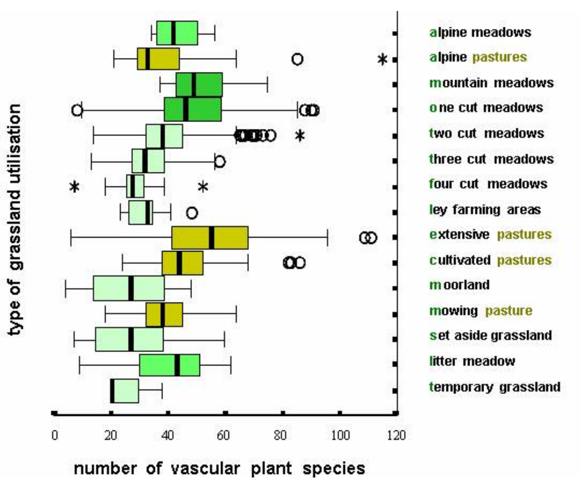

Figure 3 Floristic biodiversity on different grassland types in the Austrian test region "Ennsvalley"

Austria still leads the organic farming in Europe both with respect to the proportion of total AA (13.5%) and the proportion of all farms (11.5%). In 2006 the number of subsidized organic farms raised to 20,104 which means an increase of 2.7% compared to the previous year. The majority of organic farms in Austria are grassland and dairy farms, but a significant increase of organic farming in other land use systems is to be noticed.

In addition to organic farming around 65,000 grassland farms take part in special measures, which require an abolition or reduction of resources leading to yield increase such as mineral nitrogen, easily soluble fertilizer and pesticides. These farms represent a huge potential for the increase of organic farming in the near future.

Conclusions LIFS can be seen as resource-conserving, socially supportive, commercially competitive and environmentally sound production systems in agriculture. There is a set of different LIFS-elements available, which have to be chosen and combined according to the specific situation on farm. On-farm nutrient balance assessment is a valuable tool for identifying efficiency of nutrient use in the soil-plant-animal system as well as detecting the potential for pollution of the environment. Farm gate balances can be used as an indicator for Codes of Good Agricultural Practice in Europe, but input/output parameters have to be standardised and acceptable surpluses need to be regionally validated.

It takes strong efforts to maintain grassland and dairy farming in less favoured areas and to keep the landscape open. Different strategies have to be considered and adapted to the special conditions and requirements. In Austria there will be productive agricultural land use systems, both intensive dairy farming (around 5,000 farms each with 40-50 dairy cows and 300-400 t milk quota) and more traditional dairy farming (around 35,000 farms each with 10 cows and 40-50 t milk quota). Another 30,000 farms will focus on extensive livestock production including sheep and goats, suckler cows, heifer and beef fattening. The already existing system of income combinations has to be enhanced and different types of farm co-operations have to be forced to reduce costs and work load.

In some regions there will also be productive but non-agricultural land management systems with an alternative use of grassland biomass. Grassland could be the basis of a green refinery providing energy, isolation and insulation material, lactic and amino acids, enzymes or even secondary metabolites for special usage. Another strategy to keep the landscape open will be non-productive and non-agricultural land management via cutting or mulching without any use of the biomass.

In future strong efforts have to be made to inform the public about the multifunctional role of agriculture for the whole society. The awareness and sensibility of consumers should be increased to improve sympathy for this endangered economic sector and to raise the acceptance for support. The farmers themselves must improve their efforts for a sustainable management at least by following all relevant laws, guidelines and regulations for production to advance their image.

References

Aarts H F M, Habekotte B, Hilhorst G J, Koskamp G J, van der Schanks S F C and de Vries C K (1999). Efficient resource management in dairy farming on sandy soils. Netherlands Journal of Agricultural Science, 47, 153-167.

BMLFUW 2006. 47. Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes. BMLFUW, Wien

Brundtland-Report (1987). World Commission on Environment and Development. Our common future. Oxford University Press, N.Y.

Halberg N, Steen Christensen E and Sillabak Kristensen I (1995). Nitrogen turnover on organic and conventional mixed farms. Journal of Agricultural and Environmental Ethics, 8 , 30-51.

Ikerd J. (1990). quoted by Richard Duesterhaus in "Sustainability's Promise," Journal of Soil and Water Conservation (Jan.-Feb. 1990) 45(1): p.4. NAL Call # 56.8 J822

Kirner L. (2004). Internationale Wettbewerbsfähigkeit der österreichischen Milchproduktion – Ergebnisse aus dem IFCN-Netzwerk. Die Bodenkultur 54, 221-229

Poetsch E.M. (2000). Auswirkung der biologischen Wirtschaftsweise auf pflanzenbauliche Kennwerte im Dauergrünland. 27. Viehwirtschaftliche Fachtagung „Managment von Hochleistungskühen, Grünlandwirtschaft und Milchproduktion, Biologische Wirtschaftsweise“, HBLFA Raumberg-Gumpenstein, 147-153

Poetsch E. M, Buchgraber K, Bohner A, Greimel M and Sobotik M (1999). Utilisation and cultivation of grassland in the Upper Enns Valley; Vegetation and ecological classification, aspects of plant production, internal resource flows, socio-economics and case-studies of utilisation. EUROMAB-Symposium, Vienna.

Scheringer J and Isselstein J (2001). Nutrient budgets in organic dairy farms in north-west Germany. Grassland Science in Europe, 6 (this volume).

Taube, F. and E.M. Poetsch (2002). On-farm nutrient balance assessment to improve nutrient management on organic dairy farms. Proceedings of the international occasional Symposium of the European Grassland Federation “Organic Grassland Farming”, Witzenhausen, Germany, 225-234

Taube F, Wachendorf M, Greef J M and Wulfes R (1997). Perspektiven semi-intensiver Produktionssysteme in Milchvieh-/Futterbauregionen Norddeutschlands. Berichte über Landwirtschaft, 75, 586-603 (German with english summary).

Thomet P and Koller P (1996). Gute N-Effizienz auf Luzerner Milchwirtschaftsbetrieben. Agrarforschung 3 (2), 77-80.