

The future of organic grassland farming in mountainous regions of Central Europe

Steinwider A.¹, Schneider M.K.², Wachendorf M.³, Starz W.¹ and Pötsch E.M.¹

¹ *Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein, 8952 Irdning, Austria*

² *Forschungsanstalt Agroscope Reckenholz-Tänikon ART, 8046 Zürich, Switzerland*

³ *University Kassel, Organic agricultural Science, Department of Grassland Science and Renewable Plant Resource, 37213 Witzenhausen, Germany*

Corresponding author: andreas.steinwider@raumberg-gumpenstein.at

Abstract

8 % of the total EU population lives in mountainous areas which represent a particularly important eco-region in Central Europe. Because of ecological, climatic and economic reasons an increasing pressure is imposed upon agriculture. Hence in large parts of European mountainous areas drastic changes in agricultural structure and land use systems can be observed in terms of emigration and land abandonment. Due to disadvantaged production conditions, and the high ecological sensitivity, organic farming is an important option for a sound regional development. In alpine regions organic farming does not proceed in a homogeneous way. One essential reason for that could be seen in the differences of national and regional “traditions and orientations” and supporting tools. For a positive development it is necessary to work on further integration of organic farming in regional development concepts (e.g. organic regions) and on the development of the “quality leadership” through cross-regional production, marketing and merchandising concepts. Undisputedly, further positive development of organic farming in mountainous regions depends on ongoing financial, research and advisory support.

Keywords: organic farming, alpine regions, agriculture, regional development, quality leadership

1. Introduction

Mountainous regions play an important role in terms of biological and cultural diversity. They provide valuable habitats, opportunities for recreation and tourism and they supply a substantial part of the European Union’s drinking water. Their ecosystems are, in most cases, fragile and highly sensitive to environmental alteration.

Various definitions of mountain areas on regional, national and international level exist. Article 18 Regulation (EC) No 1257/99 defines mountainous less-favoured areas as “those that are characterized by considerable limitation of the possibilities for using the land and an appreciable increase in the cost of working it due:

- 1) to the existence, because of altitude, of very difficult climatic conditions, the effect of which is substantially to shorten the growing season;
- 2) at a lower altitude, to the presence over the greater part of the area in question of slopes too steep for the use of machinery or requiring the use of very expensive special equipment, or;
- 3) to a combination of these two factors, where the handicap resulting from each taken separately is less acute but the combination of the two gives rise to an equivalent handicap”.

Areas north of 62 degrees of latitude in Finland and Sweden are assimilated into mountain areas since, even in the absence of high altitude, low temperatures limit crop growth and development and therefore severely affect the agricultural activity (EC, 2009).

In 2006, around 39.5 million people representing 8% of the total EU population lived in mountainous regions. Economic development in mountainous regions is significantly below the EU-27 average. In 2006, the level of GDP (Gross Domestic Product) per head in mountainous regions corresponded to 77% of the Union's average. This gap tends to widen slightly over time, increasing by 1.3 percentage points from 2000 to 2006 (Monfort, 2009). The relative importance of mountainous areas at the national level varies strongly in the EU, from dominant (more than 50% of farms and utilised agricultural area (UAA) in Finland, Slovenia and Austria) to marginal (less than 5% of farms and UAA in Germany and Poland) (EC, 2009). The land cover and the topography of the European mountains distinctively differ from the high mountains (Alps, Pyrenees, Carpathians, southern Norway) to the lower middle mountains, which are far larger in their extent. Land-use systems and farm management methods have developed through a long-term process, and thus have shaped and modified the natural and cultural landscapes according to the specific climatic, historical and socio-economic conditions. There is a close link between the natural environment and the cultural and lifestyle patterns of the population in mountainous regions (Dax and Wiesinger, 1998).

Today permanent grassland and meadows with low stocking density dominate the agricultural land use in mountainous regions. The most important agricultural sectors are dairy farming and beef production. Mountainous areas are not isolated from the development of the modern urban societies. Hence, in large parts of European mountainous areas, drastic changes in the agricultural structure and land use systems can be observed in terms of emigration and land abandonment, agricultural intensification in valleys, changing livestock densities, decrease of traditional farming methods etc. These changes are frequently accompanied by a decline of biodiversity, loss of natural and cultural landscapes, an increase of natural hazards, forest degradation, negative ecosystem processes, eutrophication problems, water pollution and soil degradation (Dax and Wiesinger, 1998; Zervas, 1998; Olsson *et al.*, 2000; Cozzi and Bizzotto, 2004; Marriott *et al.*, 2004; Nordregio Report, 2004; Tasser *et al.*, 2005; Marini *et al.*, 2009; Marini *et al.*, 2011 ;). Permanent handicaps (altitude and temperature, slope, soils, low productivity, limited agricultural and business sectors, long distances, loss of infrastructure and agricultural services), natural hazards, climate change, the competition for the use of land by different users (urbanisation in valleys, tourism) and long distances to the market are weak points and threats to agriculture in mountainous regions. On the other hand, traditions and know-how in specialist food production, the positive image of agricultural products, the importance of tourism, the high proportion of many valuable habitats and wild species, the specific and not transferable values of the landscape, the combination of income sources from different sectors (agriculture, tourism) are strengths and potentials.

To support socio-economic development, infrastructure and environment both on national and European level, different funding tools exist (Pillar 1, rural development, quality policy). Whereas worldwide, the situation in most mountain ranges is dramatic (few economic dynamic, weak ecological development) the situation in Europe especially in the Alps is more differentiated (Dax and Hovorka, 2004). Figure 1 shows the strong variability of total public support per AWU (Annual Working Unit) and the farm net values added per AWU of mountain farms as well as the mountainous area percentage in selected EU countries and Switzerland. Due to various agro-political, economic, cultural and operational factors the development of mountainous regions strongly differs between countries and regions. Therefore, one example is the development of agriculture in the Alps.

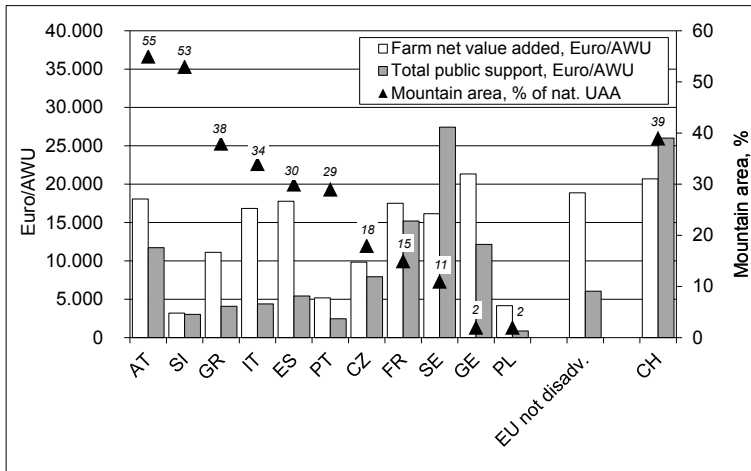


Figure 1. Farm net value added, total public support and mountainous area of farms in mountainous less favoured areas in the EU (FADN average 2004-2005) and of mountain farms in Switzerland (2009) (adapted EC, 2009; BLW, 2010)

2. Agriculture in the Alps

From 1980 to 2000 the farm abandonment rate in the Alpine Convention area accounted for approximately 36% (Streifeneder and Ruffini, 2007). Relatively stable situations were found in the Alps of Austria and Switzerland, whereas high farm abandonment rates appeared in Italy and Slovenia (Table 1). In Austria and Germany the farm abandonment rate proved to be lower than the respective national average. In comparison with the Alpine-wide average, the Alpine areas in Austria, Germany and Switzerland underwent moderate changes, whereas in Italy and Slovenia it was dynamic, and in France divergent changes regarding the number of farms and the utilized agricultural area occurred (Streifeneder and Ruffini, 2007). Nevertheless, between 2000 and 2007 the farm abandonment rate also increased in those regions that had been only moderately affected before, and regional differences within countries increased. Between 2000 and 2007 the farm abandonment rate resulting from the agro-structural change rose once more, even exceeding the 1980-2000 trend line (Streifeneder, 2009; Hoffmann *et al.*, 2010). In Austria, France and Slovenia the proportion of part-time managed farms is still traditionally high, but in all Alpine areas the share of full-time farms decreases whereas the agricultural area per farm increases (Streifeneder, 2009).

Table 1. Characteristics of mountain farms in the Alpine convention area (Streifeneder, 2009)

Country	Farm abandonment from 1980-2000, %		average AA, ha	Changes in agricultural area farm ⁻¹ from 1980-2000, %				Full-time farms, %	
	Alpine area	Country		< 5 ha	5-10 ha	10-20 ha	> 20 ha	Alpine area	total country
AT	-12	-32	18	-39	-20	-19	+18	35	41
CH	-34	-31	12	-62	-39	-10	+90	59	70
GE	-24	-45 ¹⁾	20	-30	-39	-42	+17	59	44
FR	-47	-47	39	-50	-70	-65	+10	43	62
IT	-44	-24	8	-34	-42	-15	+5	62	44
SI	-56	-28	6	n.a.	n.a.	n.a.	n.a.	46	48
LI	n.a.	-47	18	-75	-70	-57	19	n.a.	n.a.

¹⁾ old federal states

3. Organic farming in Alpine Regions

As already mentioned in the introduction, mountain regions are disadvantaged because of the harsh climatic conditions, higher altitude and of other geomorphological conditions. Therefore in these regions productivity and intensity of land use is naturally limited, with the farming system playing a minor role. This is also based on economic reasons, as the management is much more expensive concerning specialized machinery and higher workload. Additionally, comparisons between organic and conventional farms are difficult from a methodological point of view, as different farms have different preconditions and the variance between organic and conventional farms in mountain regions is, in general, smaller than in favoured areas.

Due to the high sensitivity of mountainous regions in terms of changes in agricultural systems, well-balanced and site-specific management practices are of great importance. In this context organic farming can play a key role to support agriculture in mountainous regions so that it can be maintained. Organic farming plays a dual societal role. On the one hand it provides products for a specific market responding to consumers' demand for organic products and regionality, and on the other hand, it delivers public goods contributing to the protection of the environment and animal welfare, as well as to rural development. Organic farming can be seen as an integrated holistic agricultural approach aiming at the provision of high quality products that nurture consumer health, by respecting high animal welfare standards, by establishing sustainable management systems for agriculture which support and enhance the health of soil, water, plants and animals and the balance between them and by contributing to high levels of biodiversity and guarantying the responsible use of natural resources (EC 834/2007). Important positive effects of organic farming on the nominated protection targets of water, soil, climate and biodiversity could be proven in the current evaluation of the Austrian programme of rural development, but there is still some room for improvement (BMLFUW, 2010). Concerning structural changes in agriculture, alpine farms are increasingly faced with difficulties to remain economically viable. Organic farming presents a promising alternative for alpine farmers on the market (positive image, diversification etc.) and receives considerable financial support to compensate for disadvantages due to environmental constraints. In 2009, approximately 17% of the total remuneration of the Austrian agri-environmental programme ÖPUL (€ 548 billion) was spent for the measure of organic farming.

In the EU the growth of the organic sector was influenced by common regulation for organic farming in 1991 (EC, 1991), the inclusion of organic farming in the agro-environmental programme of the common agricultural policy in 1993, and by the growth of the consumers' demand for organic food (Padel, 2008). In 2007, the area under organic farming accounted 4.1% of the total utilized agricultural area and the proportion of organic producers in total agricultural holdings was 1.3% in the EU-27 (Eurostat, 2010). The organic area is still increasing in the EU-27 and in Norway. Denmark, Austria, and Switzerland have the highest market share of organic food with around 5-7% of the total national food market. The largest market for organic food exists in Germany (€ 5.8 billion), followed by France (€ 3.0 billion), the UK (€ 2.1 billion) and Italy (€ 1.5 billion). While organic land has expanded rapidly in many new EU Member States as well as in candidate and potential EU candidate countries, consumption levels have remained at a very low level (< 1%). With the economic crisis, market growth in 2009 has slowed down in some countries; in the UK there was even a decrease of 12.9 percent and in Germany the market stagnated. On the other hand, an increase of half a billion Euros (or +17 percent) was noted for France. For 2010, many companies have reported growth and it is expected that the overall growth rate was higher than in 2009 (Padel, 2010).

On average, organic farms receive higher subsidies in absolute terms and per hectare than conventional farms (€ 324 against € 225 per hectare in the EU-10 and € 438 against € 355 in the EU-15 in 2007). This is partly due to higher agri-environment payments (€ 127 per hectare in the organic sector in the EU-15 against € 24 in the conventional sector in 2007). Organic farms benefit from higher lessfavoured area (LFA) payments (more than twice as high as the conventional sector in the EU-10 in 2007) because they are more likely to be located in disadvantaged rural areas where extensive production systems are more predominant (EC, 2010). The size of organic area and the share in organic area as well as the number of producers differ considerably from country to country also within the Alpine countries (see Table 2). In the German-speaking Alpine regions (including Switzerland) organic farming is traditionally of great importance and shows a high proportion in all farms and land areas.

Table 2. Alpine areas and organic farming in selected Alpine States (Streifeneder and Ruffini, 2007; Streifeneder, 2009; Willer and Kilcher, 2009; BLW, 2010; BMLFUW, 2010)

	AT	CH	GE	FR	IT	SI
Alpine areas (year 2000) ¹⁾						
Alpine area, km ²	54,620	24,862	11,103	40,802	51,466	7,864
Alpine area, % of total area country ⁻¹	65.1	60.2	3.1	7.4	17.1	39.3
Farms, N	96,205	19,968	22,017	28,128	93,046	23,149
Farms, % of total farms country ⁻¹	33.5	28.3	7.7	9.8	32.4	8.1
Organic farming (year 2008, 2010 ²⁾)						
Organic area, ha×1000	518.2 ²⁾	120	907.8	583.8	1002.4	29.8
Organic area, % of UAA country ⁻¹	14.7 ²⁾	11.1	5.1	1.9	9.0	6.0
Organic producers, farms	20,870 ²⁾	5,935	18,703	11,978	45,231	2,000
Organic producers, % of farms country ⁻¹	18.5 ²⁾	11.1	5.7	2.4	2.6	2.5

¹⁾ Note: alpine area < mountainous area

²⁾ Year 2010

Austria has always played a leading role in the field of organic farming and was the first country in the world to set official guidelines for organic farming in 1983. Since the end of the 1980s, the number of organic farms has increased from 1,200 in 1989 to 20,900 in 2009 (BMLFUW, 2010). The number of organic farms grew considerably after Austria entered the European Union (EU) in 1995. In total 390,000 ha AA are nowadays managed organically in Austria of which 230,000 ha are grassland. The EU still subsidizes agriculture to a high extent, and one way for small-scale farmers to obtain higher subsidies is to convert to organic farming. Other reasons for the increase in the number of organic farms in Austria are the political support, high consumer demand for organic products, consumers' interest and trust in organic production, marketing and the high availability of organic products in supermarkets (Milestad and Hadatsch, 2003). In mountainous regions of Austria organic farming is well accepted by farmers and the proportion of organic farms on the total of farms is higher than the Austrian average (see Table 3). In mountainous regions climatic and geo-morphological restrictions are the limiting factors to production, and high-output strategies are not economically common. Therefore, high-input farming systems are rare in disadvantaged regions and a lot of farms take part in the Austrian agro-environmental programme ÖPUL. In addition to organic farming, around 65,000 grassland farms contribute in special measures, which require an abdication or reduction of yield-increasing substances such as mineral nitrogen, easily soluble fertilizer and pesticides (Pötsch, 2007). These listed reasons were and are even beneficial in conversion to organic farming, which also can be an explanation that differences between organic and conventional farms cannot always be found.

Table 3. Number of mountain farms and organic mountain farms in Austria (BMLFUW, 2010)

	2002	2005	2009	Change in % 2002-2009
Number of mountain farms (with MFC ¹⁾ points)	75,066	72,340	67,485	-10.1
Number of organic mountain farms (with MFC points)	14,408	15,183	15,214	+5.6
Organic mountain farms, % of total mountain farms	19.2	21.0	22.5	

¹⁾ Mountain Farm Cadastre; Increasing handicaps of management and public support in mountainous areas from MFC group 1-4

The growth of organic farming in Switzerland has been considerably slower than in Austria despite the fact that the origins of organic and biodynamic farming can be traced back to Switzerland. Since the economic and bioclimatic conditions in the two countries are also similar, the differences are likely to be caused by agricultural policy. During the years of guaranteed prices in the 1980s, there were little incentives for farmers to opt for higher returns from organic products. In 1990, the conversion of the Swiss agricultural system to direct payments with regulations for nutrient balance and ecological compensation areas boosted the share of organic agriculture. Between 1994 and 2006 the area under organic farming increased each year, but stagnated thereafter. Between 2004 and 2009 the number of organic farms in mountain regions decreased by about 12%, in line with the general decrease of farm numbers (Table 4).

Table 4. Number of mountain farms and organic mountain farms in Switzerland (BFS, 2010)

	1997	2004	2009	Change in %	
				1997-2009	2004-2009
Number of mountain farms (Zone 1-4)	29,812	26,473	24,801	-16.8	-6.3
Number of organic mountain farms (Zone 1-4)	3,350	4,505	3,982	+18.9	-11.6
Organic mountain farms, % of total mountain farms	11.2	17.0	16.1		

Comparable to Austria and Switzerland, in Germany a high proportion of the country's total of organic farms can be found in mountainous regions. More than 55% of all organic farms are located in South Germany (Baden-Württemberg and Bavaria).

4. Organic farming in mountainous regions - opportunities, risks and constraints

Due to disadvantaged production conditions and the high ecological sensitivity, organic agriculture is an important option in terms of reducing the risks of farm abandonment or intensification in mountainous regions. It can support agriculture to maintain or become more environmentally and economically sustainable. What is the future of organic farming in alpine regions and how can it be developed further? Although outcomes cannot be predicted, there are trends that influence the development of organic farming.

4.1. Opportunities

Regional organic mountain quality products: There is an increasing market for quality products which are typical for different regions. The organic sector will be able to profit from this trend if it is possible to link high-quality production with tradition and innovative marketing strategies. There is a trend towards further diversification in marketing of organic products within a product group. But there is still some uncertainty for consumers by confusing labels and indications (close to nature, environmentally friendly, controlled-integrated, alternative, not containing chemicals etc.) which pretend to be organic but are definitely not! In the eyes of consumers, mountain areas and the mountain image are associated with goods of certain added

value that opens up chances. On the other hand, there is still a remarkable discrepancy between declaration of intent and real purchase behaviour of consumers, and this has to be overcome. Specific promotion of ecological services by organic agriculture: So far, the existing regulations in organic agriculture only indirectly promote grassland biodiversity or other services (e.g. by limiting animal numbers on the farm, by banning mineral fertilisers and by prescribing organically produced concentrates). These constraints act at the farm level and only diffusely at the local level of ecological processes (e.g. competition between plants). More target-oriented action of organic farmers for biodiversity (such as the Swiss programme “Scoring with biodiversity”) may considerably increase the willingness of the public to support this mode of production. In general more specific information is needed, which highlights the benefits of organic farming without bashing conventional farming.

4.2. Risks and constraints

Less money for rural development and agri-environmental programmes

The Common Agricultural Policy is due to be reformed by 2013. Mountain support schemes (part of the rural development programme) and organic farming support (part of agri-environmental programme) have great implications on mountain organic farms. For example, the Austria agricultural-policy aid to the mountain areas has succeeded, in part, in compensating for the production disadvantages of mountain farms (Dax and Hovorka, 2004). The dynamic development of organic farming in Europe is a positive outcome of the CAP.

Higher returns may not always be realised

A recent review among 484 farms (Ferjani *et al.*, 2010) reveals that financial aspects are the main driver for abandoning organic farming. The lack of higher returns under organic agriculture was the main reason for reconversion, but also changing regulations, difficulties to obtain concentrates and weed problems were often mentioned. There is also a considerable influence of the farming type on the choice of farming system. Dairy producers were more frequently abandoning organic farming than herders of suckler cows or sheep.

Restrictions and regulations for organic farmers

It is evident that organic farming has to fulfill numerous requirements and rules, which are adopted occasionally. Beyond controversy the renunciation of yield-increasing substances (e.g. mineral nitrogen, pesticides) will always be an essential part of organic farming. Restrictions and rules are necessary for a clear and traceable differentiation but should be developed in cooperation with the organic stakeholders. For example, a challenge in organic grassland management is the availability of organic reseeding mixtures. In this special case, site-specific seeds are necessary for alpine grassland, which are often not available in organic quality.

Sometimes evidence for ecological benefits in mountain grassland is missing

A recent investigation by Lüscher *et al.* (2011) on 19 farms in a Swiss mountain region found no difference in plant species diversity in grasslands. They found that plant diversity at the farm level depended significantly on habitat diversity and farm size. The results are understandable by considering that the local management intensity is one of the primary driving forces of grassland biodiversity, and this intensity can be high or low in both organic and conventional systems. Other constraints of organic agriculture such as the ban of herbicides, mineral fertilizer or antibiotics were of little relevance to farmers in the investigated region.

As shown by the presented results the development of agriculture and organic farming in alpine regions does not proceed in a homogeneous way. One essential reason for that could be seen in the differences of national and regional “traditions and orientations”. Therefore, different tools to support organic mountainous farming are required. Undisputedly, further positive development depends on future financial support. Beside this it is necessary to work on further integration of organic farming in regional development concepts (e.g. organic regions). In this context, efforts in relation to processing and marketing of organic products are necessary as well, in spite of (or right because of) the dynamically developing organic market. A further development of the “quality leadership” needs a cross-regional marketing and merchandising concept beside the regional concept for expansion. Principally, both the term ‘mountainous agriculture’ as well as ‘organic agriculture’ have a positive image for consumers. The combination of them can essentially contribute to the hedging of mountainous agriculture. However, special support is especially needed by those regions, where the organic proportion is still low and the rate of abandoned farms is high.

5. Tasks for research

Development of organic farming in mountainous regions requires the integration of different sources of knowledge (research, policymakers, advisory services, politics, farmers, processors, marketing experts, consumers etc.). The most successful innovations arise from approaches that engage all main actors as well as the end users in the research (Padel *et al.*, 2010). There are many aspects of agriculture and organic farming in mountainous regions which require special research work and innovation. In this regard it has to be considered that mountainous agricultural area is not only a resource of fodder for animal production but also a complex agro-ecosystem. This requires a system approach in scientific work and cooperations between different sciences. Due to more standardized production systems, even in mountainous regions traditional agricultural management systems become less important. This development endangers mountainous ecosystems, the highly specific and not transferable values of the landscape and the products and therewith the sustainability of the regional production. For a sound development the research focus has to be set on qualitative issues rather than quantitative expansion. Furthermore a “one size fits all” approach is not a good recipe. Organic farming is based on traditional methods but innovations are an important complementation of this system. Therefore, organic farming research is especially necessary for a sustainable rural development in the Alpine area. The following research topics are of great interest:

- Site-adapted sustainable agriculture: There is a need to identify and develop improved management measures which are better able to integrate biodiversity and agronomy targets of species-rich farming. To improve functional biodiversity, further investigations are needed. Climate change, world population growth and uncertainties concerning supplies of fossil energy and water are research challenges. On the farm and regional level, innovations are needed to increase the efficiency of use of resources and to minimize negative impacts on the environment. Innovative nutrient recycling systems have to be developed, especially for the limited resource of phosphorus. The increasing gap between requirements of intensive livestock production (and breeding) and fodder resources available in mountain farms requires alternative low-input livestock systems. In general, the need for external feed is expected to increase with an increase in the performance level, as the demands for high forage quality also increase, especially with respect to the protein quality, and often can be covered to a lower degree by home-grown feedstuffs (Sundrum *et al.*, 2008). Therefore, it is often necessary to use some external feed materials, even though this conflicts with the

principle of closed nutrient cycles. On the other hand, field studies clearly show that there is still an unused potential to improve the quality of home-grown forage, which very often could be realized without any extra costs (Pötsch *et al.*, 2010). To improve this situation both specific research and concerted advice is necessary.

Taking these different and partly conflicting objectives of organic farming into account, the principle in relation to the use of external and non-organic inputs should be: to use as few external inputs as possible and as many as necessary (Sundrum and Padel, 2006). Due to the renunciation of conventionally produced feedstuffs in the long run, the limited availability of nutrient resources is a characteristic of organic farming, and it is an on-going challenge for organic farmers to maintain a balance between nutrient demands for livestock and the organic resources available. One option may be to improve animal breeds adapted to grazing and low levels of external input. The development of herd management guidelines in which the requirements of the animals are better synchronized with the availability of the local feed sources and their introduction into farming practice will be an on-going challenge. Due to decreasing ruminant stocking rates on mountain pastures, research activities to reactivate these grassland areas are necessary. Because housing and indoor feeding of livestock are costly, innovations are necessary (co-operations, concerted production strategies etc.). Animal welfare is important both on the farm and on the market level (consumer demand) - the special production situations in mountain regions require practical and individual solutions. Through documentation of traditional management systems it will be possible to enhance modern and site-adapted agricultural systems and to design new support-instruments (economic, social etc.). There is also a need on socio-economic research to support decision makers and politicians by means of models to simulate and evaluate founding and support tools. Additionally, results of these investigations can assist farmers in their decision-making process and farm orientation (diversification, marketing of their products etc.).

- Meeting consumer's and public demands: The advantages of organic farming in mountainous areas will only be maintained if organic farms are viable. Therefore a higher (premium) price for the products is important, but at the same time the consumers' willingness to pay must be stimulated. Trans-disciplinary research and innovations must help the food sector to meet consumer's demand and acceptance, including the aspects of "terroir" food products that add a cultural experience beyond food as a provision (Hopkins, 2009). There is a need to document traditions and know-how in special food production, which could be the basis for cross-regional marketing and merchandising concepts. There is also a need for further research to quantify and value non-market "public benefits and goods". Not in all cases consumer's, public and ecological demands are optimally fulfilled by organic regulations and farming methods - therefore a further development of the "quality leadership" of organic farming is necessary.

Conclusions

Mountainous regions play an important role in terms of biodiversity, valuable habitats, water, energy and fresh air supply, recreation sites, tourism areas and cultural heritage. Agriculture and its related activities are key components of the mountain rural economy and of land use. Although the development of economy and agriculture in mountain regions is heterogeneous, it can be concluded that farm abandonment or intensification of agriculture lead to substantial ecological and rural problems. In this regard organic farming can undertake a key role in the task to support agriculture in mountainous regions to maintain or become more environmentally and economically sustainable. A further development of the "quality leadership" needs

targeted actions to promote ecological services as well as regional and cross-regional concepts in research, dissemination, marketing and further financial support.

References

- BfS (2010) Bundesamt für Statistik: Biologischer Landbau: Betriebe, Betriebsgröße, Landwirtschaftliche Betriebsstrukturerhebung, Neuchâtel, <http://www.bfs.admin.ch/bfs/portal/de/index/themen/07/22/lexi.html>; 06.04.2011.
- BLW (2010) Agrarbericht 2010. Bundesamt für Landwirtschaft (BLW) CH-3003 Bern, 204 p.
- BMLFUW (2010) Grüner Bericht 2010 gemäß § 9 des Landwirtschaftsgesetzes, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien, 336 p.
- BMLFUW (2010) Evaluierungsbericht 2010 - Halbzeitbewertung des Österreichischen Programms für die Entwicklung des ländlichen Raums. Wien, 125 p.
- Cozzi G. and Bizzotto M. (2004) Sustainability and environmental impact of the dairy production systems in mountain areas. *Acta agriculturae slovenica, supplement 1*, 21-28.
- Dax T. and Hovorka G. (2004) Integrated rural development in mountain areas. In: Brouwer F. (ed.) *Sustaining Agriculture and the Rural Environment - Governance, Policy and Multifunctionality*, Edward Elgar, Cheltenham, UK, p. 124-143.
- Dax T. and Wiesinger G. (1998) Mountain farming and the environment: Towards integration. Perspectives for mountain policies in Central and Eastern Alps. Research Report No. 44. Bundesanstalt für Bergbauernfragen, Wien, 175 p.
- EC (European Commission) (1991) 'Council Regulation (EEC) No 2092/91 of 24 June 1991 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs', *Official Journal of the European Communities* L198, 1-15.
- EC (European Commission) (2009) Peak performance. New insights into mountain farming in the European Union. Commission staff working document. SEC(2009) 1724 final. Draft 16.12.2009, pp. 1-31, (http://ec.europa.eu/agriculture/publi/rurdev/mountain-farming/working-paper-2009-text_en.pdf; 07.02.2010).
- EC (European Commission Directorate-General for Agriculture and Rural Development) (2010) An analysis of the EU organic sector. June 2010, 80 p.
- Eurostat (2010) Area under organic farming increased by 7.4% between 2007 and 2008 in the EU-27. *Statistics in focus* 10/2010, 1-12.
- Ferjani A., Reissig L. and Mann S. (2010) Biolandbau in der Schweiz - wer steigt aus, wer steigt ein? *Agrarforschung Schweiz* 1 (4), 142-147.
- Hofmann C., Stiefenhofer A. and Streifeneder T. (2010) The agro-structural change in the Alps and its outlook until 2020 - a model based on key determinants. 118th EAAE Seminar "Rural development: governance, policy design and delivery" Ljubljana, 25-27 August 2010, 699-712.
- Hopkins, A. (2009) Relevance and functionality of semi-natural grassland in Europe - status quo and future prospective. Report of the International Workshop of the SALVERE-Project 2009 at the Agricultural Research and Education Centre Raumberg-Gumpenstein, 9-14.
- Lüscher G., Bailey D., Schneider M.K. and Jeanneret P. (2011) Farming intensity, habitat and plant diversity in a Swiss grassland region. EGF 2011, Raumberg-Gumpenstein, *Grassland Science in Europe* 16, 586-588.
- Marini L., Fontana P., Klimek S., Battisti A. and Gaston K.J. (2009) Impact of farm size and topography on plant and insect diversity of managed grassland in the Alps. *Biological Conservation* 142, 394-403.
- Marini L., Klimek S. and Battisti A. (2011) Mitigating the impacts of the decline of traditional farming on mountain landscapes and biodiversity: A case study in the European Alps. *Environmental Science and Policy* 14, 258-267.
- Marriott C.A., Fothergill M., Jeangros B., Scotton M. and Louault F. (2004) Long-term impacts of extensification of grassland management on biodiversity and productivity in upland areas. A review. *Agronomie* 24, 447-462.
- Milestad R. and Hadatsch S. (2003) Organic farming and social-ecological resilience: The alpine valleys of Sölktalet, Austria. *Conservation Ecology* 8 (1), 3. <http://www.consecol.org/vol8/iss1/art3> (09.02.2011)
- Monfort P. (2009) Territories with specific geographical features. Working papers. A series of short papers on regional research and indicators produced by the Directorate-General for Regional Policy. European Union, Regional Policy, n° 02/2009, 1-23.
- Olsson E.G.A., Austrheim G. and Grenne S.N. (2000) Landscape change patterns in mountains, land use and environmental diversity, Mid-Norway 1960-1993. *Landscape Ecology* 15, 155-170.
- Padel S. (2008) Values of organic producers converting at different times: results of a focus group study in five European countries. *Int. J. Agricultural Resources, Governance and Ecology* 7, 63-77.
- Padel S., Niggli U., Pearce B., Schlüter M., Schmid O., Cuoco E., Willer E., Huber M., Halberg N. and Micheloni C. (2010) Implementation Action Plan for organic food and farming research. TP Organics. Published by: TP Organics c/o IFOAM EU Group, Rue du Commerce 124, 1000 Brussels, Belgium, 96 p.

- Pötsch E.M. (2007) LIFS & livestock production - grassland and dairy farming in Austria. In: Low Input Farming Systems: an Opportunity to Develop Sustainable Agriculture. (Ed. K. Biala, J.-M. Terres P. Pointereau, M.L. Paracchini) Proceedings of the JRC Summer University Ranco, 2-5 July 2007, 33-38.
- Pötsch E.M., Resch R. and Buchgraber K. (2010) Forage conservation in mountainous regions - results of the Austrian silage monitoring project In: Proceedings of the 14th International Symposium „Forage Conservation“, Brno, Czech Republic, 17.-19th March, 4-11.
- Sundrum A., Nicholas P. and Padel S. (2008) Organic farming: challenges for farmers and feed suppliers. Recent Advance in Animal Nutrition. Nottingham University Press, CONF 41, 239-260.
- Sundrum, A. and Padel, S. (2006) Evaluation criteria for including feed materials in Annex II C and dietary supplements in Annex II D of the Regulation (EEC) 2092/91. D 4.2 EEC 2092/91 (Organic) Revision. SSPE-CT-2004-502397. University of Kassel.
- Nordregio Report (2004) Mountain areas in Europe: Analysis of mountain areas in EU Member States, acceding and other European countries. *Nordregio Report* 2004/1, 271 pp.
- Streifeneder T. and Ruffini F.V. (2007) Ausgewählte Aspekte des Agrarstrukturwandels in den Alpen - in Vergleich harmonisierter Agrarstrukturindikatoren auf Gemeindeebene im Alpenkonventionsgebiet. Bericht über Landwirtschaft, *Zeitschrift für Agrarpolitik und Landwirtschaft* 85, 406-440.
- Streifeneder T. (2009) Die Agrarstrukturen in den Alpen und ihre Entwicklung unter Berücksichtigung ihrer Bestimmungsgründe - Eine alpenweite Untersuchung anhand von Gemeindedaten. Dissertation der Fakultät für Geowissenschaften der Ludwig-Maximilians-Universität München, 230 p.
- Tasser E., Tappeiner U. and Cernusca A. (2005) Ecological effects of land-use changes in the European Alps. U.M. Huber *et al.* (eds.), *Global Change and Mountain Regions*, 409-420.
- Willer H. and Kilcher L. (Eds.) (2009) *The World of Organic Agriculture. Statistics and Emerging Trends 2009*. FIBL-IFOAM Report. IFOAM, Bonn; FiBL, Frick; ITC, Geneva 299 p.
- Zervas G. (1998) Quantifying and optimizing grazing regimes in Greek mountain systems. *Journal of Applied Ecology* 35, 983-986.