Grassland Farming and Land Management Systems in Mountainous Regions

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Erich M. Pötsch
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Alan Hopkins

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W. Kessler, Federation Secretary
c/o Agroscope Reckenholz-Tänikon Research Station ART
Reckenholzstraße 191
CH-8046 Zürich, Switzerland
E-Mail: fedsecretary@europeangrassland.org

The relationship between farming systems and grassland diversity in dairy farms in Valle d'Aosta, Italy

Bassignana M., Curtaz A., Journot F., Poggio L. and Bovio M.
Institut Agricole Régional, Rég. La Rochère 1/A, 11100 Aosta, Italy
Corresponding author: m.bassignana@iaraosta.it

Abstract

Dairy farming is the main agricultural activity in Valle d'Aosta, a mountain region in NW Italy. Traditional breeding is based on permanent grassland mown for hay or grazed by cows of local breeds. Since dairy farmers are the main users of these semi-natural grasslands, their management decisions play a key role in the preservation of these resources. In 2009 a two-year project was started, aimed at investigating the diversity of permanent meadows in the region and analysing how it was related to the management decisions made by farmers. Twenty-seven dairy farmers were interviewed and vegetation surveys carried out to gather comprehensive information. The data collected were used to determine the diversity of environment, vegetation and farming techniques adopted on grasslands and to profile the organization of farming systems. This information resulted in the classification of five different farming systems and their relationship with grassland diversity was established. Even in a small region, we found farming practices within the same production system to be quite diverse and grasslands with different functions (hay production and pasture variously combined during the year) to have a higher number of species than those whose utilization was not as complex.

Keywords: dairy farming, grasslands, pastures, farming system, biodiversity

Introduction

The relationship between agriculture, biodiversity and landscape represents a key issue in the management of territories, especially in tourist regions and in high nature value areas. Dairy farming is the main agricultural activity in Valle d'Aosta (NW Italy), a mountain region with an average elevation of more than 2000 m a.s.l. Foraging is based on permanent grasslands, in the lowland (300-1300 m a.s.l.), in middle elevation areas (the May pastures, also called ‚mayen', at 1300-1800 m a.s.l.) and in alpine summer pastures (1800-2500 m a.s.l.). These are mown for hay or grazed by cows of local breeds (mainly Aosta Red Pied and Aosta Chestnut); their milk is used to produce Fontina PDO (Protected Designation of Origin) cheese. Long winters and a relatively short vegetation period have a strong impact on grassland utilization and farming system. Since dairy farmers are the main managers of these semi-natural meadows and pastures, it is necessary to understand how their farming techniques (type and intensity of utilization, fertilization, irrigation etc.) can influence species diversity and landscape characteristics. Past surveys assessed species composition and functional diversity of permanent meadows, resulting in a classification of the main meadow types (Roumet *et al*., 1999; Tarello *et al*., 2000). In 2009, an Interreg-Alcotra project (NAPEA) began to analyse the relationship between farming systems and grassland diversity.

Materials and methods

Twenty-seven dairy farmers, cultivating at least 3 ha of grassland, were selected to represent farms in the different areas in the region. They were interviewed to collect comprehensive information about their farming systems: farm structure (livestock, grassland area, work force,

equipment and buildings, manure handling), grassland and animal management (mowing and grazing schedule, allotment, feeding, calving and summering periods).
To overcome any problems caused by the fragmentation of land property, on each farm the lowland meadows were subdivided into homogeneous lots, gathering all the parcels subjected to the same agricultural management together. The main meadow type of each lot was determined using the typology defined by Roumet *et al*. (1999). Floristic surveys were carried out on representative plots using the De Vries and De Boer method (1959). The 27 farms were classified, using the SPSS® software, through a cluster analysis based on variables describing the main features of grasslands and animal management, presented in Table 1. Data were standardised using the Z-scores and we used Ward's method for the clustering and the squared Euclidean distance as a measure of similarity. The variables were then submitted to analysis of variance and Spearman's correlation was calculated on the data set.

Results and discussion

The cluster analysis divided farms into five groups (Table1). Cluster A groups the 4 biggest farms, with an average of about 70 LSU and 35 ha of lowland grassland. The entire herd is kept on lowland grasslands all year long and the calving period is distributed over 10 months. Cluster B, grouping only 2 farms, is characterized by relatively big herds (> 65 LSU) and nearly 40 ha of ‚mayen'. These are predominantly grazed in spring and autumn, while lowland grasslands are mown for hay. In summer, dairy cows are entrusted to other farmers to graze alpine pastures for about 2 months. The calving period takes some 3 months, as in cluster C which includes 6 small farms (LSU = 25.2) without ‚mayen'. Only a quarter of their grassland is both mown and grazed during the year, while the rest, depending on seasonal weather conditions and herd needs, is either cut or grazed. Cluster D consists of 6 medium size farms (14 ha of lowland grassland and 38 LSU) that keep their dairy cows in lowland areas even during summer; calves are delivered over a period of more than 6 months, hence, as in cluster A, and unlike the other types, milk production is more constant throughout the year. Cluster E includes 9 farms with an average of 30.6 LSU and only 10.7 ha of lowland grasslands. Therefore, dairy cows are handed over to other farmers in summer, to graze upper mountain pastures for about four months, and most lowland meadows are mown in spring and summer and grazed in autumn.

Table 1. Main features of the five groups of 27 farms classified through cluster analysis.

	Cluster					
	A	B	C	D	E	*P*-values
No. of farms	4	2	6	6	9	of effects
Lowland grasslands (ha)	35.0	16.0	15.7	14.3	10.7	< 0.001
Double use (cut and grazed) grasslands (%)	58.7	71.2	23.8	65.6	89.5	< 0.001
‚Mayen' grasslands (ha)	1.5	39.5	0.0	3.2	2.3	< 0.001
Livestock Units (LSU)	69.9	65.3	25.2	38.0	30.6	0.001
Calving period (d)	293.8	105.0	92.5	205.8	90.0	< 0.001
Dairy cows summering period (d)	0.0	54.0	60.2	0.0	116.3	< 0.001

The floristic survey confirmed the consistency of the typology put forward by Roumet *et al*. (1999). All farming systems had at least 5 meadow types, except small farms with little dual-use grassland from cluster C, which showed only 3 types (Table 2). According to Tarello *et al*. (2000), vegetation types were divided into species-poor (fewer than 25 species per 200 m²), medium (25 to 30 species) and species-rich (more than 30 species). Meadows from farming

types A and D, gathering farms whose lowland grasslands are grazed during summer, presented a medium-to-high number of species, whereas those from farms sending their animals to the alpine summer pastures were relatively poorer.

Table 2. Number of meadow types, number of lots and percentage distribution of lots in relation to their species richness in the five farm types classified through cluster analysis.

Farm types	Total No. of meadow types	Average No. of lots per farm	Distribution of lots in relation to species richness (%) Low	Medium	High
Cluster A	6	3.5	7.1	42.9	50.0
Cluster B	5	4.5	22.2	55.6	22.2
Cluster C	3	2.7	-	50.0	50.0
Cluster D	5	4.2	12.0	40.0	48.0
Cluster E	6	2.9	11.5	61.5	26.9

No correlation was found between the total area of lots and the number of vegetation types determined in the surveys. We observed more species-rich meadows at lower altitude, near the central axis of Valle d'Aosta, and less in the lateral upper valleys (*P*-value = 0.047). Species-poorer grasslands were found in farms with a higher concentration of animals (*P*-value = 0.049) or which spread liquid instead of farmyard manure (*P*-value = 0.020). Grasslands both cut and grazed showed a higher number of species than those that were only grazed or, even more, than those that were only mown (*P*-value = 0.029). We noticed, however, that management decisions made by farmers rarely take the floristic richness of their meadows into account. It was confirmed, as Roumet *et al*. (1999) and Andrieu *et al*. (2007) have already demonstrated, that floristic diversity is more a result of farming techniques rather than one of the factors which influence them.

Conclusions

Even in a relatively small region, farming techniques within the same production system can be quite diverse. More data about the influence of agricultural techniques on species richness will be available from vegetation surveys that are still ongoing. The first results, however, have confirmed that farming techniques influence the species richness of permanent semi-natural grasslands and that meadows with different functions (hay production and pasture variously combined during the year) present a higher number of species than those whose utilization is not as complex.

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