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Utilization of grazing in different small ruminant management systems on Crete Island, Greece

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Abstract. Two major small ruminant management systems exist on Crete, the semi-intensive (SI) and the extensive (EX). For the establishment of these systems the availability of pasture has a major impact. A project lasted from 2009 until 2012 aimed to study the characteristics of these systems and the impact on productivity, product quality and animal health. Twenty farms were selected, based on criteria established by an earlier survey, and were monitored for two milking seasons. At the extensive systems, located at the slope of the mountains, the animals graze almost exclusively on marginal communal pastures, where transhumant practices are still in place. The farmers use concentrate feeds and hay to increase productivity, mainly during milking period and during critical time-periods when grazing is scarce. The semi-intensive systems, are located at lower altitudes, where the animals graze mainly on fenced cultivated pastures and rotational grazing is applied. The use of concentrate feeds and hay is significant throughout the year. Between the two systems, the semi-intensive achieve higher production rates, but significant differences were also found for product quality, where extensive systems had in general a more preferable fatty acid profile.

Keywords. Small ruminant – Grazing – Management system – Crete.

Utilisation du pâturage dans les différents systèmes de production de petits ruminants en Crète

Résumé. *Deux systèmes de production de petits ruminants existent en Crète, le système semi-intensif et l'extensif. Pour la mise en place de ces systèmes, la disponibilité des pâturages a eu un impact majeur. Un projet qui s'est déroulé de 2009 jusqu'en 2012 a étudié les caractéristiques de ces systèmes et l'impact sur la productivité, la qualité des produits et la santé animale. 20 fermes ont été choisies, selon les critères établis par une enquête antérieure, et ont été suivies pendant deux saisons. Dans les systèmes extensifs, situés sur le versant des montagnes, les animaux se nourrissent presque exclusivement sur des pâturages marginaux et les pratiques transhumantes sont encore en place. Les agriculteurs utilisent des aliments concentrés et du foin, pour augmenter la productivité, principalement durant la période de traite et les périodes critiques où le pâturage est rare. Comme pour les systèmes semi-intensifs, qui sont situés à des altitudes plus basses, les animaux paissent sur des pâturages clôturés cultivés et le pâturage en rotation est appliqué. L'utilisation d'aliments concentrés et de foin est importante tout au long de l'année. Entre les deux systèmes, le système semi-intensif atteint des taux plus élevés de production, mais il y a des différences significatives sur la qualité des produits, et les systèmes extensifs ont généralement un profil d'acides gras préférable.*

Mots-clés. *Petits ruminants – Pâturage – Système de production – Crète.*

I – Introduction

Grazing is a practice closely related to most ruminant rearing systems. Especially, the ability of small ruminants to utilise low quality forage on marginal areas, gave the population of such areas a suitable economic activity and a source of high quality protein. Although this capacity is exploited by most small ruminant rearing systems there is a high variation among regions, associated with different management systems.

In Greece grazing practices have been studied to some extent (Zervas, 1998), but there is a large variation between regions (e.g. continental areas and the islands), due to differences in landscape, socioeconomics and climatic conditions. However, it has been noted that poor grazing practices have a significant impact on landscape, desertification, and on farms sustainability (Kosmas, 2015). A deeper understanding of the use of grazing by the different management systems is essential in order to indentify mistakes and provide viable solutions.

II – Management systems in Crete

Two are the predominant small ruminant management systems on Crete, the **semi-intensive (SI)** and the **extensive (EX)** (de Rancourt *et al*., 2006). The specific characteristics of these systems as found on Crete have been previously studied. In the SI management systems the overall invested capital on housing, machinery and land is high. There is a considerable use of supplementary concentrate and conserved forage especially during critical time-periods (by "critical" we refer either to climate i.e. winter or to production cycle phase i.e. mating, lambing, suckling, early lactation). The animals graze on pastures for some hours on a daily basis, with the exception of winter when animals are kept mostly indoors (Stefanakis *et al*., 2007). In the EX management systems animals are kept outdoors most of the year and grazing is a primary source of energy and nutrients. The overall invested capital in infrastructures is limited and the use of supplementary concentrate and conserved forage is low and targeted at critical time-periods (Volanis and Tzerakis, 1997). The grazed pastures are mainly marginal lands, private or communal where the area grazed by individual flocks is not clearly defined (Fig. 1). Transhumance practices are still present with flocks switching to highland pastures from early summer until late autumn. Productivity is lower in the extensive systems (Volanis *et al*., 2007). The natural pastures in the area consist mostly of phryganic and orophryganic vegetation and a high variety of endemic taxa. Between the shrubs several herbaceous species, of the *Leguminosae*, *Compositae* and *Gramineae* families, grow. Pure grasslands are limited and found mostly on high altitudes, where several annual herbaceous species and dwarf shrubs grow (Caballero *et al*., 2009).

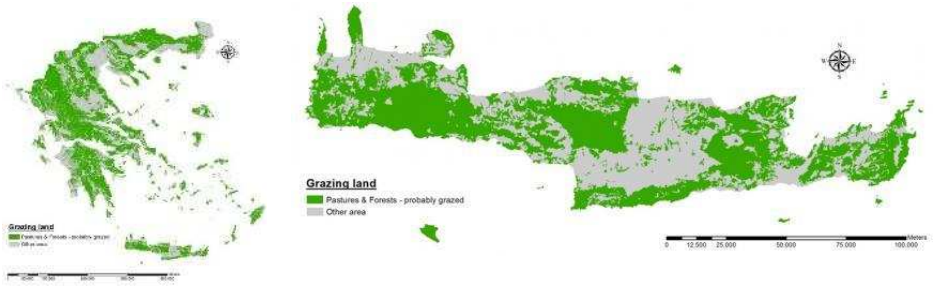

Fig.1. Geographical distribution of natural pastures in Greece and Crete. (CORINE 2000 data).

In both systems lambing takes place mainly in late autumn, with a second lambing period existing in late winter involving mainly the yearlings (around ~30% of the flock). At the EX systems lambs are kept with their mothers for around 60-70 days and slaughtered at 13 to 16 kg live weight. Milking starts after weaning and ewes are milked twice a day until June. At the SI systems lambs suckle their mothers for around 30-55 days and slaughtered at 13 to 16 kg live weight or fattened on concentrates until 30 kg. Milking starts 30-50 days after lambing, depending on the farm, and lasts until the end of summer. The main sheep breed reared is the local "Sfakiano", because it has good production traits (average body weight ~40 kg, lambs per ewe per birth: 1.2 -1.5, average annual milk production: 180 kg) but also is well adapted to the harsh Mediterranean environment (Volanis and Tzerakis, 1997).

III – Grazing practices and feeding regimes

In general the extensively managed flocks spend more time grazing (Fig. 2), compared to the semi-intensively managed flocks, especially on natural pastures. On the other hand the SI farms invest on crop growing and rotational grazing of cultivated fenced pastures is applied during winter and spring. Therefore, the SI farms own more land suitable for cultivation than the EX farms, who mainly use private or communal unimproved pastures for grazing. The average grazing land in the extensive systems has been reported to be 0.477±0.012 ha×animal^{-1}, with only 0.020 ha×animal^{-1} being cultivated grains or forages (Volanis *et al*., 2007). Contrary, the SI farms were reported to have an average of 0.206 ±0.005 ha×animal^{-1} grazing land, with 0.095 ha×animal^{-1} being cultivated with grains or forages (Stefanakis *et al*., 2007). When we investigated these characteristics in areas of Crete where ruminant rearing is the main agricultural activity similar differences were found. The EX farms had an average of 0.743 ±0.033 ha×animal^{-1} of natural pastures available for grazing and the SI farms an average of 0.096±0.001 ha×animal^{-1} (p-value<0.001). The cultivated pastures were 0.008±0.001 ha×animal^{-1} and 0.062±0.009 ha×animal^{-1} respectively (p-value<0.001). The dominant cultivated fodder plant is oat and though grazing starts primarily in December, it is not systematic due to weather conditions and the availability of forage. It is introduced as a daily practice in February and lasts until early summer with a peak for both systems in March.

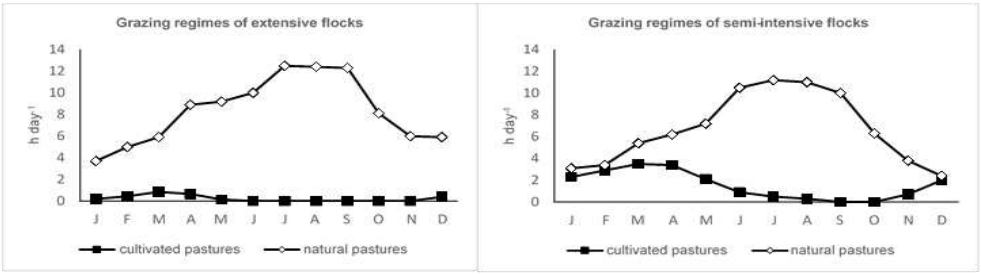

Fig. 2. Grazing regimes of the two management systems within a year (Stefanakis *et al*., 2007, Volanis *et al*., 2007, Voutzourakis *et al*., unpublished data).

While both systems exploited mainly natural pastures during summer, in June the extensive flocks are moved to new pastures at higher elevations, where animals are not always shepherded and graze unattended until September. On the contrary, the semi-intensive flocks are sedentary and grazing time (around 11 h×day^{-1}) remains stable until September. When lambing starts, animals are kept indoors especially in the semi-intensive systems.

Since grazing is closely linked to the climatic conditions the daily grazing time may vary between lactation periods, but these changes are limited. The farmers make use of supplementary feeds (mainly pelleted compound feeds or raw grains) in order to compensate for the shortage of high quality fresh forage. The EX farmers feed on average lower amounts of supplementary feeds, compared to the SI farmers. According to this survey the average amount used annually is 596±31 in the EX flocks and 831±45 g×head^{-1}×day^{-1} in the SI flocks (p-value<0.001); similar amounts have been reported in other studies (Stefanakis *et al.,* 2007; Volanis *et al.,* 2007). During winter the quantities fed are similar between the two systems when grazing is impractical due to weather conditions and lack of good quality fodder. Afterwards, the amount decreases more rapidly in the extensive farms and small amounts of concentrate feed are provided during dry season in the SI farms and in some EX farms. The portion of concentrates in the rations increases again during lambing at similar rates. In cases when the portion of concentrate is high (>70%) or replaced by cereal grains in similar amounts, overgrazing of pasture is observed (Stefanakis A., 2006).

Conserved forage is provided at the beginning September until spring and the amounts are similar between the two systems. This study recorded the amount of 191±5 g×head^{-1}×day^{-1} for the EX farms and 184±5 g×head^{-1}×day^{-1} for the SI farms. Nonetheless, there are seasonal differentiations. During lambing and till winter, higher amounts of hay are used by the SI farms. In contrast, more hay is fed by the EX farmers during milking, in order to compensate for the need of high value forage. As for the hay fed, the farmers used mostly alfalfa hay and secondly self-produced wholecrop oat.

The higher amounts of compound feeds and high quality forage fed, is most likely the reason for the higher milk yield observed in the SI farms. As it has been reported the introduction of supplementary concentrates in a grazing based farming system will increase productivity and may later affect milk composition of small ruminants (Marques and Belo, 2001; Min *et al.,* 2005), thus the most common difference found in milk composition is a higher fat content in the milk of EX ewes, possible due to the dilution effect (Morand-Fehr *et al*., 2007). Moreover, differences that have been found in milk fat fatty acids concentrations between these two systems (Voutzourakis, unpublished data), with milk from the extensive system exhibiting in general a more preferable fatty acid profile, may be attributed to the aforementioned differences in feeding regimes, as it has been found from previous studies on other ruminants (Chilliard *et a*l., 2007).

IV – Conclusions

Both systems centre their feeding regimes on grazing. However, the semi-intensive managed farms exploit cultivated pastures of annual forages and feed supplementary concentrate and hay to increase productivity. On the other hand the extensive farmers exploit mainly natural pastures. Because of the seasonal availability of these pastures the extensive farmers are forced to apply transhumance practices and use supplementary feed as a mean to meet the nutritional needs of the ewes and boost productivity. If these practices are rationally applied, farmers may be provided with high quality end products, of added value, while utilizing cost-free natural resources and protecting the local environment.

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