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Assessing grazing animal production systems on large Greek islands: A case study on the island of Crete

I. Hadjigeorgiou* and G. Zervas

Department of Nutrition Physiology and Feeding, Agricultural University of Athens,
75 Iera Odos, GR 118 55, Athens (Greece)
*E-mail: ihadjig@aua.gr

Abstract. Greece has a long history of breeding sheep and goats utilizing the indigenous vegetation, under a system of free ranging or shepherded grazing, which in combination to some shepherds' practices formed the present land cover and biodiversity. Islands present an interesting model for animal farming activity. The study area was the island of Crete in the South Aegean Sea. The land area covers some 825,000 ha and officialy holds a population of 600,000 inhabitants, while considerable numbers of sheep and goats (1,270,000 and 580,000 respectively) are raised. These animals produce 88,000 tonnes of sheep milk and 52,000 tonnes of goat milk, together with 14,300 tones of sheep and 6,600 tonnes of goat meat. Production systems applied in this island, were investigated and flocks were divided in semi-intensive and extensive. However, since pedoclimatic conditions vary widely, in order to advise grazing management rules in the different areas, a combination of National Statistics, CORINE and field data was used to define system dependence on local grazing resources. Subsequently grazing capacities were determined and advised to the local authorities together with management guidelines with the aim of maintaining the preserved areas under moderate grazing activity.

Key words. Production systems – Rangeland management – Biodiversity – Islands – Greece.

L'évaluation des systèmes de production animale sur les grandes îles grecques : Une étude de cas sur l'île de Crète

Résumé. *La Grèce a une longue histoire d'élevage des ovins et des caprins en utilisant la végétation indigène, en vertu d'un système de pâturage libre ou avec des bergers, qui, en combinaison à des pratiques des bergers a conformé de la couverture du sol et la biodiversité présentes. Les îles sont un modèle intéressant de l'activité élevage. La zone d'étude était l'île de Crète dans la mer Égée du Sud. La superficie couvre quelque 825.000 ha et occupe officiellement une population de 600.000 habitants, tandis que le nombre d'ovins et de chèvres (1.270.000 et 580.000 respectivement) est élevé. Ces animaux produisent 88.000 tonnes de lait de brebis et 52.000 tonnes de lait de chèvre, avec 14.300 tonnes de viande de moutons et 6.600 tonnes de viande de chèvre. Les systèmes de production suivis dans cette île, ont été étudiées et les troupeaux ont été divisés en semi-intensives et extensives. Cependant, les conditions pédo-climatiques sont très variables, et afin de conseiller les règles de gestion des pâturages dans les différents zones, une combinaison de statistiques nationales, données CORINE et données de terrain a été utilisé pour définir la dépendance des systèmes sur les ressources pâturables locales. Par la suite les capacités de pâturage ont été déterminées et conseillés aux autorités locales ainsi que des directives de gestion dans le but de maintenir les zones préservées sous une activité de pâturage modéré.*

Mots-clés. *Systèmes de production – Gestion des pâturages – Biodiversité – Îles – Grèce.*

I – Introduction

Greece has a long history of breeding sheep and goats utilizing the indigenous vegetation, under a system of free ranging or shepherded grazing, which in combination to some shepherds' practices, formed the present land cover and biodiversity (Hadjigeorgiou *et al.*,

2005). Written evidence, testifying to the existence of pastoral stockfarming, is to be met with from as early as the Mycenean era (XVI-XIII c. B.C.). In the surviving corpus of Linear B inscriptions found in palaces of Knossos (Crete) and Pylos (Peloponesse), records relating to sheep farming form the largest single component (Halstead, 1990). The great majority of these sheep records were concerned with the administration of flocks, which in some sense belonged to the palaces (Halstead, 1990). Islands present an interesting model for land biodiversity evaluation studies, since transfering of terrestrial organisms is minimal and management effects on biota more prominent.

The multifunctional role of grazing systems is widely recognized today, since not only production and economic objectives can be met, but cultural, social and environmental dimensions are also covered. In this sense, pastoral livestock systems are thought as cost-effective instruments to modulate the strong inclination of Mediterranean vegetation development towards shrub invasion (Sternberg *et al*., 2000) and the accumulation of plant biomass. If adequately implemented, grazing management can be a suitable tool to maintain traditional complex landscapes and sustain biodiversity (Flamant *et al*., 1999; Rook *et al*., 2004).

II – Materials and methods

The objective of this study was to depict the systems of grazing animal farming in the study area of Crete island and define management rules aiming to maintain current situation in vegetation cover. Sheep and goat farming systems were investigated at the farm scale and farms were classified according to structure and management, with special focus on the utilization of grazing areas, but also considering socio-economic factors. Subsequently, an appropriate structured questionnaire was completed by 96 animal farmers interested in collaborating, always with the assistance of an expert. The survey principally recorded basic farm data i.e. number of animals per category, production output, available grazing areas, available arable areas, as well as fencing, housing and machinery infrastructure. Moreover, the survey included questions designed to collect information on farm management practices, feeding programmes for the different classes of animals, rations used, rangeland management (calendars, animal types, areas and location), stock hygiene, preventive treatments, farm economics (values of inputs and outputs), commercialization of products, social characteristics of farmers etc.

At the regional scale, existing data (CORINE land cover, on farm statistics and animal census, etc) were combined with vegetation sampling to determine the areas available for grazing and their potential. Exclusion cages were erected in autumn to study vegetation dynamics, where for herbaceous vegetation available biomass at the start of summer, species composition and chemical composition were recorded. Shrub vegetation was clipped at the same time to estimate the biomass available for grazing and chemical composition was analyzed. Finally nutritional value of the vegetation was defined according to existing equations (Van Es, 1978). The above data were co-investigated in order to facilitate management decisions. The study area was divided on a Prefecture territory level and boundaries of the study area were described on the map at the same level.

III – Results and discussion

The study area of the Crete island (35^{o} N, 25^{o} E) as part of the Southern Aegean complex of islands is covering a significant area of 831,290 ha. The island shows a large variety of ground relief and ecological niches and hosts 34 “Natura 2000” sites, with a total surface area of 277,850 ha (33.4% of the island). These sites are hosting many important plant, mammal, reptile, fish and invertebrate species which are declared “endangered” and put under many protection statuses, through E.U. Directives 79/409 and 92/43. Furthermore, a wealth of endemic and rare species, have been identified on the island.

The island holds a population of 600,000 people, who by majority (49.6%) are employed in the "services" sector, which is mainly tourism. However, a total of about 94,000 agricultural holdings are officially registered on this island utilizing an area of 396,673.8 ha (NSSG, 2004). Moreover, a total of 1,270,000 sheep, 580,000 goats, 2,200 cattle, 61,000 pigs and 2,300 equines are farmed on the island, at an average flock size of 79 sheep, 27 goats, 9,7 cattle, 19,7 pigs and 1,1 equines per farm (NSSG, 2004). On average, annual productivity of livestock in this area according to official census is 69 kg milk and 12.5 kg meat per ewe; 89 kg milk and 11.8 kg meat per goat; 1,100 kg milk and 165 kg meat per cow (NSSG, 2004). However, field data produced in this study demonstrated these figures might be even lower (Tables 1 and 2).

Table 1. Basic characteristics of the sheep and goat farms investigated in Crete island (n=96)

System	Farms N°	Ewes in total	Purchased forages (kg/head/year)	Purchased concentrates (kg/head/year)	Cultivated land for forages (ha/head)	Utilized grazing land (ha/head)
Extensive	48	15,392	56.1	204.5	0.005	0.48
Semi-intensive	48	10,950	125.0	266.2	0.100	0.26

Table 2. Basic production characteristics of the sheep and goat farms investigated in Crete island (n=96) and the respective gross income

System	Farms N°	Milk per ewe (kg/head/ year)	Lambs per ewe/year	Energy requirements through feeds	Energy requirements through grazing	Gross income (€ ewe/year)
Extensive	48	89.4	1.26	53.5%	46.5%	37.6
Semi-intensive	48	143.7	1.43	78.5%	21.5%	43.6

According to CORINE land cover data, the study area had a total of 28 different land cover classes. Assuming that areas under CORINE codes 211, 212, 221, 223, 242 and 243 correspond to cultivated land, areas under codes 231, 321, 322, 323 and 324 correspond to the potential grazing land and areas under codes 311, 312 and 313 include all forestry land, it was estimated that cultivated land of the island amounted 273,280.8 ha (33.2%), rough grazing land 444,140.8 ha (53.9%) and forestry land 59,507.6 ha (7.2%).

The representative samples collected, according to geographical location and the land cover types provided data on vegetation productivity. Therefore, by combining the vegetation biomass available for grazing, its nutritional value and the nutritional requirements of the breeding animals in the study area, the grazing capacity of the rough grazing lands was assessed and defined at 0.25 LU/ha. Although this figure was comparable to the calculated grazing load of the area, an appreciable deviation from the mean was observed among the different municipalities, indicating the uneven distribution of the animals within the island, which should be rectified. However, abandonement of agricultural activity and in particular animal farming in the island poses a threat in these marginal areas and risks the stability of the whole ecosystem (de Rancourt *et al.*, 2006). Therefore, efforts should be made to secure the continuation of these activities possibly through correct marketing of local products.

IV – Conclusions

This study dealt with the important interrelationship of small ruminants with the islands vegetation. It was concluded that current grazing load would maintain land cover at its present

form, therefore supporting biodiversity. Proper management directions should be applied and farmers should be actively encouraged to follow them, towards a wider societal benefit.

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