Grazing land management and sheep farm viability in semi-arid areas: evidence from Western Lesvos, Greece

Psyllos G., Kizos T., Hadjigeorgiou I., Dimitrakopoulos P.G.

in

Kyriazopoulos A.P. (ed.), López-Francos A. (ed.), Porqueddu C. (ed.), Sklavou P. (ed.). Ecosystem services and socio-economic benefits of Mediterranean grasslands

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 114

2016
pages 369-372

Grazing land management and sheep farm viability in semi-arid areas: evidence from Western Lesvos, Greece

G. Psyllos[1], T. Kizos[1], I. Hadjigeorgiou[2]* and P.G. Dimitrakopoulos[1]

[1] University of the Aegean, University Hill, 81100 Mytilene (Greece)
email: g.psyllos@geo.aegean.gr
[2] Agricultural University of Athens, Iera Odos 75, Athens 11855 (Greece)
*email: ihadjig@aua.gr

Abstract. In semi-arid areas of the Mediterranean basin, sheep and goat herding has been a land management activity for millennia. In the last decades, intensification of grazing has resulted in grazing land degradation. Today, many sheep farms face growing dependence from feed to cover the dietary needs of animals, as grazing land productivity covers only a fraction of these needs and decreasing economic outputs. In this paper, we present a conceptual framework for linking grazing lands management practices and economic viability of sheep farms in Agra, a village in Western Lesvos. The framework required data from grazing lands (biomass production in four periods of the year, plant diversity and plant composition), production and quality of milk and economic viability of four sheep farms. Some insights and initial results of the first year of the research are presented and discussed.

Keywords. Grazing land – Sheep farming – Grazing pressure – Lesvos.

Gestion des pâturages et viabilité des exploitations agricoles ovines dans les zones semi-arides: constats dans l'ouest de Lesbos, Grèce

***Résumé**. Dans les zones semi-arides du bassin de la Méditerranée, l'élevage ovin-caprin contribue à la gestion des terres depuis toujours. Dans les dernières décennies l'intensification de l'utilisation des pâturages a entraîné leur dégradation : actuellement de nombreuses exploitations ovines affrontent une dépendance croissante pour couvrir les besoins alimentaires des animaux du fait que la productivité des pâturages ne couvre qu'une proportion de ces besoins, ce qui contribue à la diminution de leurs résultats économiques. Dans cet article, nous présentons un cadre conceptuel pour relier les pratiques de gestion des pâturages et la viabilité économique des exploitations ovines à Agra, un village dans l'ouest de Lesbos. Ce cadre était alimenté par les données nécessaires provenant de pâturages (production de biomasse dans quatre périodes de l'année, diversité végétale et composition de la flore), de la production et de la qualité du lait, et de la viabilité économique de quatre exploitations ovines. Certaines idées ainsi que les résultats de la première année de la recherche sont présentés et discutés.*

***Mots-clés.** Pâturages – Élevage de moutons – Pression de pâturage – Lesbos.*

I – Introduction

Grazing of small ruminants (sheep and goats) has always been an integral part of the ecology of many areas of the Mediterranean, especially in semi-arid regions (Kıfi *et al*., 2007). In the past, these systems were integrated with agriculture, involving practices such as mixed farming, fallow and rotational grazing. Intensification of agriculture, the gradual stop of many of the mixed practices and the widespread rural exodus, separated animal husbandry from other agriculture sectors (Kizos *et al*., 2013). For sheep farming, these developments were expressed by the decrease of the number of sheep farms and the increase of sheep per farm, while supplementary feeding was made dominant practice. The recent increase of input costs (especially feeding costs) was not coupled by an equivalent increase of milk prices and this has squeezed profit margins for most sheep farms in semi-arid and/or marginal regions. Moreover, intensification is associated with high grazing pressure, caused by either high densities and/or

continuous grazing, which result in the reduction of grazable species in vegetation. In areas of unfavorable pedo-climatic conditions, this leads to severe soil degradation (Kıfi, *et al*., 2007; Papanastasis *et al*., 2015; Symeonakis *et al*., 2014; Kizos *et al*., 2013). Any effort to overcome this dead-end that sheep farmers in such areas seem to face should be based on research on environmental, economic and social aspects of sheep farming systems and their operation, such as the viability of farms, the quantity and quality of its outputs, the volume and cost of inputs, the grazing practices, the productivity and use of grazing lands. So far, the relevant bodies of literature tend to focus on some of these aspects only (e.g. Kıfi, *et al*., 2007; Thornes, 2007; Noguıs-Bravo, 2006).

In this paper, we explore social, economic and environmental impacts of sheep farms in a semi-arid location, on Lesvos Island, Greece. Lesvos Island has a long tradition in sheep farming, but in recent decades farmed sheep increased sharply and pasture lands became insufficient (Hadjigeorgiou *et al*., 2010). The main objectives of the study were to combine grazing lands management, with the actual feeding patterns of the farm, its economic results, the quality of its products and its future. They also call for a combination of research approaches at the farm and the grazing land level. The farm level is vital for understanding and recording grazing and feeding practices, but also for estimating the viability of farms, while the grazing land level is necessary for measuring grazing related attributes of plant communities.

II – Materials and methods

The objectives of our approach were: (a) To measure primary productivity of grazing lands throughout the grazing period; (b) To estimate plant cover throughout the grazing period; (c) To estimate plant diversity in grazing lands; (d) To record supplementary feed provided throughout the grazing period; (e) To record prices and volumes of inputs (feeds) and outputs (milk, meat, etc.) of the sheep farms; (f) To collect data on quality of produced milk produced; (g) To record opinions and attitudes of sheep farmers towards the viability of their farms and their future. These objectives combine grazing lands management, with the actual feeding patterns of the farm, its economic results, the quality of its products and its future. They also call for a combination of research approaches at the farm and the grazing land level. The farm level is vital for understanding and recording grazing and feeding practices, but also for estimating the viability of farms, while the grazing land level is necessary for measuring grazing related attributes of plant communities.

The area selected was Western Lesvos (Agra). Western Lesvos is a typical semi-arid Mediterranean area with very high grazing densities, high dependence on sheep farming for livelihoods and incomes and soil degradation (Kizos *et al*., 2013). Agra is a settlement of approximately 1000 people, located in the southwestern part of Lesvos (Table 1). It has lost a significant part of its population in the last decades and sheep farming is an important part of local livelihoods. It has been intensified recently with a fourfold increase of the number of sheep between 1961 and 2010 (Table 1).

Table 1. Data from the livestock census of the study area (Agra)

Date	Pasture area (ha)	Sheep farms	Sheep heads	Sheep / farm	Permanent residents
1961	2750.3	224	7733	34.5	1572
2010	4958.2	213	30741	144.3	1013
1961-2010 %	80.2%	-2.3%	297.5%	418.2%	-35.5%

The selection of the four farms with 16 grazing parcels was made considering sizes and locations. We chose to select closely located farms to eliminate differences attributed to soil and

micro climate, but care was also taken to include lowland and more uphill grazing lands. Size of farms (assessed by the number of sheep and not the area of land) was selected to be medium to high for both Agra and Lesvos standards, as we aimed to avoid small and part-time farmers and the few very big farms with animals housed indoors. Another important aspect for the selection of farms was the availability of their owners to participate. Their cooperation was also of significant importance for recording grazing and feeding practices, including aspects such as the number of days and the season they graze each particular parcel, inputs and outputs, etc. Finally, we preferred farms with Lesvos sheep.

Measurements of biomass production were conducted in all grazing lands with the use of 0.25 m^2 cylinder shaped metal cages (made of galvanized grid of 1x1.2 cm openings) and 0.7 m height anchored on the ground. We used four cages in each sampling location for each grazing parcel: two were placed at the beginning of the grazing season (September), one of them left unharvested for the entire season, the second one harvested in the 1st sampling period (December) when a third cage was added. In March (2nd sampling period) the third cage was harvested and a fourth added, which was harvested in May (3rd sampling period). Finally in June all the four cages were harvested. In each sampling we also collected above ground biomass of a grazed space area of equal size with the cage and were able to monitor the impact of grazing throughout the year against the productivity of the grazing land (Singh *et al.,* 1975).

Measurements of land cover were conducted by recording the cover of 50 continuous steps along a line, representative of the grazing parcel and repeated the recordings for each parcel several times to cover habitat heterogeneity. Land cover categories used were: herbaceous vegetation, bare soil, rocks, thorny burnet (*Sarcopoterium spinosum*), branched asphodel (*Asphodelus ramosus*) and other shrubs. We repeated these measurements in each sampling period. This provided us with a very good image of the cover and its changes throughout the season. Plant diversity assessment was made at the end of the grazing period. We collected and dried samples of all cages during the last sampling and classified plants at the family, genuses and species levels when this was feasible. Data on feeding and grazing practices were recorded from farmers in a number of personal interviews, along with prices and volumes of inputs and outputs. Finally, quality parameters of the milk produced by these farms, were obtained through analyses conducted by the Greek National Milk and Meat Organization.

III – Results and discussion

The four selected farmers are young (the older 43 year old, the younger 33), all of them of secondary education at the most. Their farms are 50 ha of grazing lands (three also use common pasturage for small periods of time) and 335 sheep on average and are quite large compared to local averages. Only one farm is smaller in size or 210 sheep and 5.6 ha of grazing lands. The larger three farms own automatic milking machines. They all report moderately satisfied with sheep farming incomes (including subsidies: all receive the Single Farm Payment and the compensatory payment from the Less Favored Areas scheme), but stress rising costs, including feed.

Although the second year of the experiment is on the way, some preliminary results demonstrate the relevance of the approach. We were able to monitor seasonal changes of biomass production, with more important differences in autumn and winter when plant growth is slow and less differences between grazed and ungrazed areas in the spring. This is also reflected in the differences between biomass production of grazed areas (Fig. 2B, the differences of means are statistically significant, ANOVA $F = 7{,}045$, $P < 0{,}001$).

All farms provided supplementary feed at least to the producing (high dietary requirements) animals (milking females and replacement lambs) during the recording periods, which indicates that the grazable biomass production was either not sufficient for covering dietary needs or farmers considered that it was not sufficient. Land cover is dominated by herbaceous (56.3% of

total cover, while rock covered 19.2% of total, *S. spinosum* 12.3%, *Aspodelus spp.* 9.2% and bare soil 3.1%), with 12.7 / 0.25m^2 annual species on average for ungrazed areas for the whole season, compared to 7.4 / 0.25m^2 species for grazed areas in June (these differences of means are statistically significant, ANOVA F=20,43, p<0.001), which are comparable with those reported in similar semi-arid locations (e.g. Noor Alhamad, 2006).

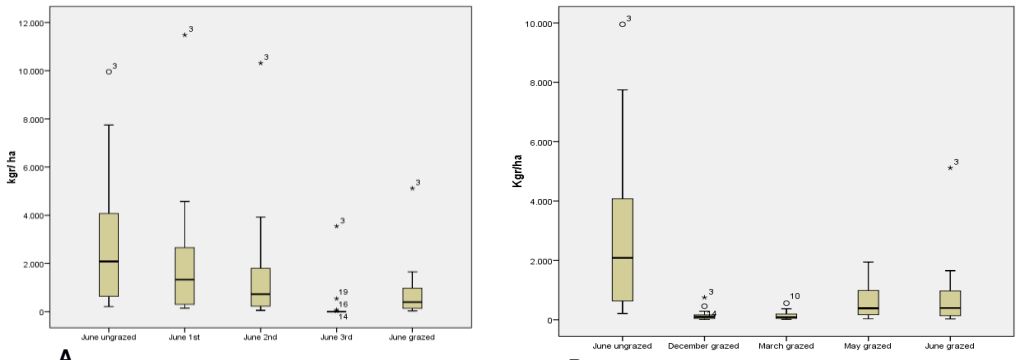

Fig. 1. Boxplots of biomass production (kgr/ha) for: (A) control cage, all cages and grazed area in June; (B) control cages and grazed areas in all sampling periods.

IV – Conclusions

These first results demonstrate the high dependence of sheep farming on imported feeds, but also the strong connection with available land although it can only highlight some aspects of the research objectives. The second year of sampling, the analysis of the data with the use of grazing densities as well, is expected to provide more insights.

References

Hadjigeorgiou I., Vaitsis T., Laskaridis G. and Tzanni Ch., 2010. Restoring semi-arid rangelands on a Greek Aegean island. In: *Options Mediterranéennes*, Series A 79, p. 33-36.

Kıfi S., Rietkerk M., Alados C.L., Pueyo Y., Papanastasis V.P., El Aich A., De Ruiter P.C., 2007. Spatial vegetation patterns and imminent desertification in Mediterranean arid ecosystems. In: *Nature* 449 (7159), p. 213-217.

Kizos T., Plieninger T., Schaich H., 2013. "Instead of 40 Sheep there are 400": Traditional Grazing Practices and Landscape Change in Western Lesvos, Greece. In: *Landscape Research* 38(4), 476-498.

Noguıs-Bravo D., 2006. Assessing the effect of environmental and anthropogenic factors on land-cover diversity in a Mediterranean mountain environment. In: *Area* 38 (4), p. 432-444.

Noor Alhamad M., 2006. Ecological and species diversity of arid Mediterranean grazing land vegetation. In: *Journal of Arid Environments* 66 (4), p. 698-715, DOI http://dx.doi.org/10.1016/j.jaridenv.2006.01.001.

Papanastasis V.P., Bautista S., Chouvardas D., Mantzanas K., Papadimitriou M., Mayor A.G., Koukioumi P., Papaioannou A., Vallejo R.V., 2015. Comparative Assessment of Goods and Services Provided by Grazing Regulation and Reforestation in Degraded Mediterranean Rangelands. In: *Land Degradation and Development*, Article in Press, DOI: 10.1002/ldr.2368

Singh J.S., Lauenroth W.K. and Steinhorst R.K., 1975. Review and assessment of various techniques for estimating net aerial primary production in grasslands from harvest data. In: *Botanical Review* 41, p. 181-232.

Symeonakis E., Karathanasis N., Koukoulas S., Panagopoulos G., 2014. Monitoring sensitivity to land degradation and desertification with the environmentally sensitive area index: The case of Lesvos island. In: *Land Degradation and Development*, Article in Press, DOI: 10.1002/ldr.2285.

Thornes J.B., 2007. Modelling soil erosion by grazing: Recent developments and new approaches. In: *Geographical Research* 45 (1), p. 13-26.