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Transhumant Sheep and Goat Farming Sector in Greece

Research Article

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ABSTRACT

Transhumance is an extensive farming system developed by livestock farmers, that moved their herds between lowlands and uplands, in order to cope with the seasonality of the available forage. The purpose of this study was to examine the transhumant sheep and goat system in Greece highlighting differences in management aspects among the country's regions. Non-parametric statistical methods in a sample of 551 herders were applied to depict management practices while the regions were separated into four groups according to climate and geographical features. Results revealed differences between the groups, adoption of crossbreeding and limitation of grazing in pastures mainly by sheep breeders. The breeding of goats and on average larger herds were met mainly in southern Greece while sheep and mixed type of herds, as well as smaller on average herds were more common in the northern regions of the country. Evidently, transhumance in Greece nowadays preserves its traditional character being accustomed to the demand of the market for larger production however the introduction of the cross or improved dairy breeders should be controlled in order to protect diversity of indigenous mountain breeds.

KEY WORDS crossbreed, extensive farming system, sheep and goat.

INTRODUCTION

Pasture-based livestock farming systems (LFS) are well incorporated with the environment and include management practices that do not over-exploit natural resources (Bignal and McCracken, 2000; Bernués *et al.* 2011). Pasture-based LFS play also an important role in management and conservation of high natural value (HNV) areas that are commonly located in the less productive areas of Europe (Southern Europe) and mountainous areas (Pardini and Nori, 2011; Mitsopoulos *et al.* 2015). Several authors (Bignal and McCracken, 2000; Gibon, 2005; Rancourt *et al.* 2006), point out that the general trend of modernization and intensification of agriculture in general and of livestock production in particular initiated after world war II was the main factor leading to the replacement of permanent grasslands with more productive forage crops (Rancourt *et al.* 2006). Intensive production systems gradually substituted pasture-based systems; consequently, a 12% decrease of the permanent pastures in the European countries was recorded during 1975-1995 (Rancourt *et al.* 2006). However pastures are still maintained in regions with adverse natural conditions, such as those with high altitude, steep slopes and poor soil quality, which generally characterize Southern European and Mediterranean countries (Laga *et al.* 2003).

Transhumance constitutes a traditional extensive system mainly of sheep and goat farming, classified as a particular type of pastoralism. The system is based on human and animal mobility and flocks graze in mountainous and lowland rangelands in order to obtain their nutritional requirements; mobility occurs towards mountainous and semi-mountainous areas and flocks remain there for 4 to 6

months (May to October) according to climate conditions and plant's productivity (Ruiz and Ruiz, 1986; Koocheri and Gliessman, 2008).

The seasonal movement of flocks and their use of rangelands has several positive effects on the environment as it favors the renewal of natural vegetation and the diversity of species, the conservation of heterogeneous pseudo-alpine landscapes (Ispikoudis *et al*. 2002) and the provision of agri-environmental services such as the prevention of afforestation and desertification (Rook *et al.* 2004; Casasus *et al.* 2007; Weber and Horst, 2011).

The multifunctional character of transhumance also includes other social functions such as the prevention of depopulation of Less Favored Areas (LFAs as defined in Dir.75/268/EEC) and the maintenance of traditions in less favored areas (Cabarello, 2001; Hadjigeorgiou, 2011; Siasiou *et al*. 2017).

Indeed, the system is endowed with traditional know-how, as a result of its resilience through time; nonetheless, this does not imply it remains stagnant and unchanged. Transhumant farmers nowadays tend to adopt innovation and try to modernize their farms in order to ameliorate their productivity and economic performance. Such examples include the general mechanization of production grain stores, milking machines or usually the genetic improvement of the animals often of higher nutritional requirements that eventually lead to the limitation or even abandonment of grazing (Mitsopoulos *et al*. 2015).

Transhumance in Greece, during the last forty years has been characterized by a significant fluctuation in the number of transhumant herds and reared animals alike, a trend directly comparable to the changes noticed in the rest of Europe namely the agricultural reform and the rural depopulation.

More specifically, a decrease of as much as 30% of the number of transhumant herds has been recorded during 1970-1990, reciprocal to the intensification of small ruminant farming systems.

However, during the last decade according to Karatassiou *et al.* (2015) and Ispikoudis *et al.* (2002), there is a roughly 12% increase of the total population of transhumant sheep and goats, possibly because of the favorable form of EU subsidies (i.e. per head) and the volatile economic conditions of the last few years as a result, the number of transhumant sheep and goat from a little more than 900000 in 2002 exceeded one million in 2011.

Within this perspective, the purpose of this paper is to study the current state of transhumant sheep and goat farming sector in Greece by investigating the herders' management practices and ultimately highlighting influential variations in management practices among different regions.

MATERIALS AND METHODS

The studied area was separated into four groups based on geographical and climate characteristics of the different regions. Group A was comprised of the Macedonia and Thrace regions, i.e. the northern part of the country, characterized by a mountainous climate with cold winters, cool summers, and rainfalls throughout the year. Group B was the region of Thessaly that is more traditional linked with transhumance in Greece and a climate typical characterized by milder winter and warm and dry summers. Group C consisted of the regions of Epirus and Central Greece, the Central-West area of the country, characterized by wet winters and summers that vary from cool to dry and finally group D included the regions of Peloponnese and Crete, (Southern Greece), typical characterized by higher temperatures throughout the year (Figure 1).

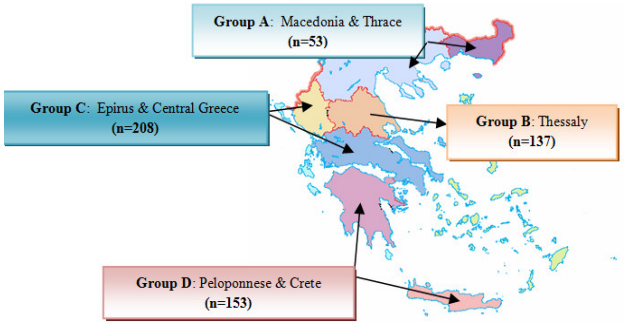

Figure 1 Presentation of the studied groups

Data collection and sampling

The survey covered a random stratified (division of the population of transhumant herders in seven groups according to the placement of their winter domiciles) sample of 551 transhumant sheep and goat farmers. Data were obtained in 2014 through individual interviews conducted by trained enumerators by means of an appropriate structured survey that included questions about the performed managerial practices of the herders as well as the performance characteristics of the reared animals. The section of the managerial practices of the herders included questions such as:

-General features of the herd: Size, species of the reared animals (sheep and goats), animal breeds, distance of and the periods of mobility.

-Nutritional management: Daily hours of grazing through the year.

Surveys were administrated to herders located at the seven regions of Greece under study (six inland regions and Crete) and enumerators visited the farmers in their place of residence (either summer or winter domiciles).

Because of the complexity of the survey, each interview lasted for 60 minutes on average.

Data analysis

Seven variables were used in total to describe the transhumant farming system (Table 1) in Greece, including certain qualitative/non-consecutive variables approximated through dummy variables. More specifically the species (SPE) of the reared animals included three categories being sheep herds, goat herds or mixed herds of sheep and goats. The breeds (BRE) of the reared animals were separated in three major categories according to the genetic background of animals. The first category included purebred sheep and goats of indigenous mountainous breeds, the second was comprised of crossbreeds and the third category included improved dairy sheep and goat breeds. The method of transportation (TRANS) included three categories, where the first category included movement by foot, the second movement by trucks and the third category movement by foot and trucks together.

Descriptive data were summarized using frequency classes, means and cross-tabulations while non-parametric tests were used to perform further analysis as the data violated the normal assumption. More specifically X^2 and Kruskal-Wallis tests were conducted to detect differences among means across the farmers in the four studied groups while differences between means of specific groups were estimated using the Mann-Whitney U test (Mundry and Fisher, 1998). Also, Kruskal-Wallis and Mann Whitney U test (post hoc) were used to compare the performance of sheep, goat and mixed herds for herd size (HDS) and method of transportation (TRANS). For the parameters reared species (SPE), grazing hours in winter domiciles (GRW) and grazing hours in summer domiciles (GRS) Mann Whitney U test was performed as the management practices for the majority of the mixed herds differed between the two species and were recorded separately (SPSS 17.0).

RESULTS AND DISCUSSION

The management practices between the four groups were compared in an attempt to reveal potential differences that characterize the studied areas, while comparisons between the performances of different types of farms were conducted in order to reveal differences among the two reared species. The comparison of the groups revealed important differences for all included parameters (Tables 2 to 6) that point out that the farming system is adjusted to the peculiarities of the different groups as the climate conditions or the geomorphologic configuration of the landscapes as well as the adaption of different practices between the studied species.

Reared species (SPE) - herd size (HDS)

The majority of the samples consisted of purely sheep herds (252), 81 herds bred only goats, while 218 herds consisted of both sheep and goats (mixed type of herds), the 78.15% of which were primarily sheep accompanied with a relatively small number of goats (Table 2). Between groups, statistical differences have been detected (Pearson X^2=49.9, P<0.001).

Group C was typically comprised of mainly sheep herds, whereas in all other groups, the prevailing type was the mixed herd. In group A, the proportion of pure goat herds was significantly higher than in other groups. The average HDS was 486 animals (Table 3) the biggest HDS located in groups B and A (622 and 596 animals, respectively), while the smallest HDS were found in groups C and D (Kruskal Wallis X^2=80.9, P<0.001). The average HDS differed among the different type of herds as well (Kruskal Wallis X^2=61.7 and P<0.001) as shown in Table 3. Interestingly, goat herds (Z=-5.09, P<0.001) and mixed herds tend to be importantly larger (approximately+60%) than sheep herds (Z=-7.29, P<0.001) implying a more extensive character than pure sheep herds. However, in group C the average size of goat and mixed herds did not differ importantly from the average size of the sheep herds as came up to approximately 300 animals. It should be mentioned that in group C the average herd size was generally smaller than in other groups.

Method of transportation (TRANS)-distance of movement (DIST)

The most common method of movement was by trucks (accounting for roughly 65% of the herders), while 27% moved their herds by foot and the remaining 8% performed movements by foot and by trucks as well. Statistical differences among the four groups were detected (Pearson X^2=154, P<0.001).

Specifically, in group A farmers moved more frequently their herds on foot on contrast to the other groups, where movements by trucks were preferred, a result directly linked to the shorter distances traveled in group A.

Conversely, in group B the majority of the producers used trucks, corresponding to longer movement distances. Comparing the preferred method of transportation and distance traversed between different types of herds, no statistical difference has been detected (Kruskal Wallis X^2=0.750, P=0.576 and X^2=2.17, P=0.337) however, more than 50% of goat herds were moved on foot and covered longer distances compared to the other two types of herds.

Table 1 Description of the parameters used in statistical analysis

Parameters	Abbreviation	Definition
Reared species	SPE	Herds rearing sheep, goat and mixed type of herds
Herd size	HDS	The total number of breeding males, females and young replacement ewes/does or bucks/rams
Breed	BRE	Breed of the reared animals: Genetically improved or not, indigenous sheep and goat breeds and purely genetically improved breeds
Method of transportation	TRANS	Movement by feet or use of truck
Distance of movement	DIST	Measured in km
Grazing hours in summer domiciles	GRS	The sum of total grazing hours during the persistence on summer domiciles
Grazing hours in winter domiciles	GRW	The sum of total grazing hours during the persistence on winter domiciles

Table 2 Reared species in the four groups (n and % for the different types of herds)

Groups	Species (SPE)			Total
	Sheep herds	Goat herds	Mixed herds	
A[a]	n=16 30.19	n=16 30.19	n=21 39.62	n=53
B[b]	n=48 35.04	n=26 18.97	n=63 45.99	n=137
C[b, c]	n=127 61.06	n=22 10.57	n=59 28.37	n=208
D[c]	n=61 39.87	n=17 11.11	n=75 49.02	n=153
Total	n=252 45.73	n=81 14.70	n=218 39.57	n=551
Significance of difference between groups				0.000

[a, b, c] Groups without common superscript differ significantly (P<0.005).
A: Macedonia and Thrace; B: Thessaly; C: Epirus and Central Greece and D: Peloponnese and Crete.

Table 3 Herd size (HDS) in the four groups, average ± SE (min-max)

Groups	HDS			Average HDS
	Sheep herds	Goat herds	Mixed herds	
A[a]	673±458 (70-1900)	654±356 (126-1150)	495±273 (179-1158)	596±364
B[b]	505±306 (52-1910)	777±269 (275-1540)	650±350 (146-1585)	622±334
C[c]	300±139 (18-772)	259±185 (126-800)	257±208 (89-1089)	359±174
D[d]	300±411 (67-3060)	293±175 (125-716)	708±374 (125-1640)	499±395
Total	359	581	597	486
Significance of difference between groups (p)				P < 0.001
Significance of different between sheep, goat and mixed herds				P < 0.001
Significance of different between sheep and mixed herds (post-hoc)				P < 0.001
Significance of different between goat and mixed herds (post-hoc)				0.907
Significance of different between sheep and goat herds (post-hoc)				P < 0.001

[a, b, c, d] Groups without common superscript differ significantly (P<0.005).
A: Macedonia and Thrace; B: Thessaly; C: Epirus and Central Greece and D: Peloponnese and Crete.

Breed (BRE)

As presented in Table 5, the majority of transhumant sheep were crossbreds (59%) a fact that reflects the producers' efforts to improve the genetic background of their herds. Indigenous herds were ranked second (28%), while the remaining (13%) farms reared sheep of improved dairy breeds. Crossbreeds were relatively more abundant (Pearson X^2=38, P<0.001) in groups B and D, whereas in group C the number of flocks of indigenous mountainous breeds was almost equal to the number of flocks of crossbreed.

Generally, reared animals are mostly genetically improved in group B and to a lesser extent in group C. However, it should be noted that in group A improved dairy sheep breeds accounted for almost 30%, relatively higher than in any other part of the country. On the other hand, the situation is quite different in goat, as indigenous breeds prevailed (Z=-5.5, P<0.001) in the whole country and less than 4% of farmers replaced indigenous breeds with improved dairy ones. Crossbreeds were relatively more abundant in groups A and B.

Table 4 Method of transportation (TRANS) and distance (DIST) of movements (km) in each group

Groups	TRANS			DIST
	By feet	Truck	Both	
A[a]	46	4	3	36.5±45.5 (8-195)
B[b]	7	109	21	174±67.8 (15-370)
C[c]	69	138	1	111±85.8 (3-400)
D[d]	72	76	5	52.6±36.8 (6-270)
Total	194	327	30	104±82.3 (3-400)
Significance of difference between groups		P < 0.001		P < 0.001
Type of herds				
Sheep herds	101	140	11	104 ± 82 (10-370)
Goat herds	47	25	9	117 ± 93 (50-400)
Mixed type of herds	69	139	10	95 ± 78 (3-350)
Significance of difference between sheep, goat and mixed type of herds		0.576		0.337

[a, b, c, d] Groups without common superscript differ significantly (P<0.005).
A: Macedonia and Thrace; B: Thessaly; C: Epirus and Central Greece and D: Peloponnese and Crete.

Table 5 Sheep and goat breeds (BRE) of the transhumant sampled farms (n and % for different types of breeds)

Groups	BRE					
	Sheep			Goats		Improved dairy
	Indigenous Mountainous	Cross breeders	Improved dairy	Indigenous Mountainous	Cross breeders	
A[a]	n=7	n=19	n=11	n=22	n=12	n=3
	18.9	51.4	29.7	59.4	32.4	8.2
B[a,b]	n=17	n=84	n=10	n=58	n=31	n=0
	15.3	75.7	9.0	65.2	34.8	-
C[c]	n=75	n=80	n=31	n=54	18	n=9
	40.3	43.0	16.7	66.7	22.2	11.1
D[b,c]	n=33	n=93	n=10	n=66	n=26	n=0
	24.3	68.4	7.3	71.7	28.3	-
Total	n=132	n=276	n=62	n=200	n=87	n=12
	28.1	58.9	13	66.7	29.6	3.7
Significance of difference between groups (p)						P < 0.001
Significance of difference between species (sheep and goat)						P < 0.001

[a, b, c] Groups without common superscript differ significantly (P<0.005).
A: Macedonia and Thrace; B: Thessaly; C: Epirus and Central Greece and D: Peloponnese and Crete.

Grazing during summer (GRS)–grazing during winter (GRW)

Table 6 shows the average grazing hours on summer and winter domiciles of transhumant sheep and goat. Sheep and goat herds in group B were grazing for a longer time during summer (2.206 hours). Still, they spent less time grazing during winter, especially during the productive stage of lactation (719 hours). Intuitively it can be argued that this is due to the fact that herds in group B containing breeds that are genetically improved to a higher extent compared to the other groups.

Thus, the farmers tried to cover the nutritional requirements through supplementation. Flocks during winter graze more in the western and southern parts of the country (groups C and D), where winter is milder than in the northern areas (groups A and B), while a significant differences were detected among all groups except group C and D. Finally, transhumant goats grazed approximately 12 % more than sheep during winter (Z=-4.34, P<0.001) while no difference was recorded for the time spent grazing during summer (Z=-0.65, P=0.516). Based on an extensive country–wide survey, the management practices performed by the average transhumant herd in Greece have been analyzed. The results revealed the adaption of different management practices among the different regions. More specifically goats' breeding was met proportionally more in northern Greece, where winter is colder (group A) and steep slopes, brush-lands and "evergreen oak" domains (vegetation that goats are much more adapted to utilize). On the rest groups (*chalepian-chaparral zone*) pure sheep and mixed type of herds prevailed as plains and grasslands, among other kinds of vegetation (brushland, forest plants or oak forests), do-main while the winter is milder allowing the growth of vegetation and grazing even during early winter. Analogous results have been reported by other authors as Ispikoudis *et al*. (2002) highlighting that goats can more effectively ex-ploit pastures of lower nutritive value even under harsh conditions, climate and geomorphologic.

Table 6 Average grazing hours during persistence to winter (GRW) and summer (GRS) domiciles

Groups	GRW	GRS
	Mean±Sd (min-max)	Mean±Sd (min-max)
A[a]	918±220 (420-1440)	1794±380 (960-2520)
B[b]	719±331 (110-1700)	2.206±288 (1200-3360)
C[c]	892±211 (75-1860)	1828±288 (1040-3450)
D[a]	790±180 (150-1440)	1982±338 (840-2880)
Significance of difference between groups	P < 0.001	0.558
Species		
Sheep	771±252	1913±397
Goat	861±240	1944±385
Significance of difference between species (sheep and goat)	P < 0.001	0.516

[a, b, c] Groups without common superscript differ significantly (P<0.005).
A: Macedonia and Thrace; B: Thessaly; C: Epirus and Central Greece and D: Peloponnese and Crete.

The comparison between the four groups also revealed the extent to which the character of the transhumance has been altered, as the farms tried to be more competitive, mainly through the adaption of crossbreeding. This finding coincides with Laga *et al.* (2003) who showed that a significant number of transhumant herders in West Macedonia had genetically improved their animals through crossbreeding.

The practice of crossbreeding has been overwhelmingly adopted by the transhumant producers, despite the fact that indigenous breeds are evidently more suitable for the harsh conditions of mountainous rangelands and despite their lower milk production they contribute positively to farm incomes because of savings from reduced feeding and veterinarian costs.

However genetic improvement was largely met to sheep through crossbreeding or replacement by dairy breeders and to a lesser degree to goats. This finding coincides with analogous results reporting (FAO, 2008) that crossbreed's types consist the 92% of the sheep population in Greece overall, while the 90% of the goat population belong to various types of indigenous Greek breed.

The negative impacts of the uncontrolled genetic improvement of indigenous mountainous breeds have been mentioned by several researchers, e.g. Wallis De Vries (2007); Rook *et al.* (2004) and Metera and Sakowski (2010). This type of management intensification besides the genetic loss, also impacts biodiversity of pastures in two additional manners, the first one is that 'genetically improved animals' or animals of dairy breeds are not well adapted to grazing, the climatic and geomorphologic conditions of Greece particularly the mountainous areas (Siasiou *et al.* 2015). The latter is that farmers in order to adjust the higher nutritional needs of the genetically superior animals are obliged to increase the housing periods than the grazing periods depicted to the results of the survey as the "more genetically improved" sheep grazed less than indigenous goats of the sample (approximately 10% lesser), especially during persistence on winter domiciles.

Increasingly, large number of herders has been replaced movement on foot by trucks, thus ceasing the use of the old traditional routes. Movement on foot is limited and occurs mainly when the transportation of the animals is conducted in the borders of the same region and more rarely between different regions. Laga *et al.* (2003) and Mitsopoulos *et al.* (2015) also reported replacement of movement by foot with mechanized transportation. Mechanization of transportation is obviously attributed to a tendency for alleviating burdensome tasks.

This tendency can be negatively associated with the configuration of the landscapes and biodiversity with limitation of grazing that allows scrub invasion and accumulation of plant biomass on pastures. Another collateral damage of the abandonment of the traditional roots are wild animal species, as the limitation of carcasses are the main source of feed for eagles, the grey wolf, the red fox, as reported by several studies such as Ruiz and Ruiz (1986); Chang (1992); Ispikoudis *et al.* (2002); Constantin (2003); Nardone *et al.* (2004); Molina *et al.* (2013); Peco *et al.* (2006); Olea and Mateo-Tomás (2009) and Weber and Horst (2011).

Lastly comparing the practices performed in sheep herds to goat herds turned out that goat herds preserved mostly the traditional character of transhumance as were larger, belong mainly to indigenous mountainous breeds, covered longer distances and grazed more during winter contributing to the biodiversity of the lowland grasslands as well. This result coincides with analogous findings of Laga *et al.* (2003) and Siasiou *et al.* (2017) reported that transhumant goat farming sustained the traditional character of the system whereas the management of transhumant sheep herds tends to be to more intensive naming, smaller herds, limitation of grazing on pasture, increase of housing periods and genetic improvement oriented to higher milk production.

CONCLUSION

This study revealed the dynamic presence of transhumance

in Greece in all mainland regions. It has been also shown that crossbreeding resulted to a gradual loss of the genetic diversity of indigenous mountainous breeds as well as gradually domination of smaller on average herds (mainly to northern Greece) and the increase of housing periods. In order to protect extensive systems as transhumance from the deterioration (e.g. limitation or substitution of grazing) but not their evolution, policy options are required to support them. Specifically, recognizing the value of the system on nature conservation, cultural and other societal functions (e.g. scenery for tourism), promoting the reproduction of local, traditional breeds or labeling of transhumance product could improve effectively the decision making and management and the economic performance of the transhumant herds.

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