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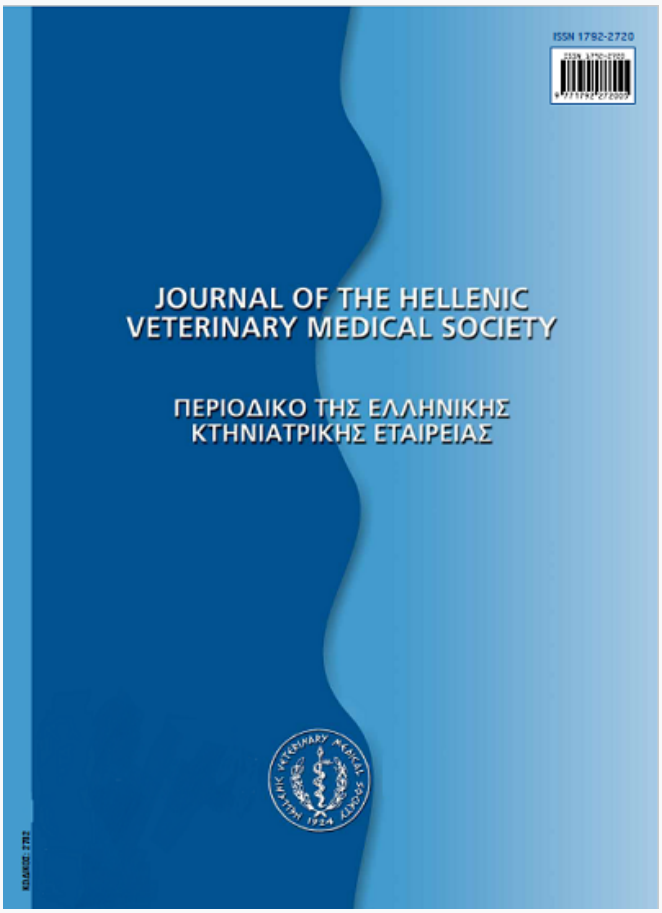

Farm conditions and production methods in Chios sheep flocks

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Farm conditions and production methods in Chios sheep flocks

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Οι συνθήκες εκτροφής και οι μέθοδοι παραγωγής σε ποίμνια προβάτων της φυλής Χίου

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ABSTRACT. The objective was to describe farm conditions and production methods in intensively reared flocks of Chios sheep in Greece. The total of 66 farms of the Chios sheep Breeders Cooperative "Macedonia" were included in the study that was carried out using a purpose-built questionnaire and farm visits for onsite assessment by an experienced veterinarian. A detailed database was constructed using the information obtained from individual farms. Thereafter, four parameters concerning structural and management components were selected (flock size, sheep breeding experience, pasture use and application of three milkings daily) and their effect on milk production was estimated using one-way ANOVA. The results showed that the average flock comprised of 314 sheep (16 rams, 210 ewes and 88 lamb ewes), whereas flock size was positively correlated to milk production ($P<0.05$). In addition, large flocks had more personnel and practiced three milkings per day ($P<0.05$). The majority of farms (83.3%) had milking parlours and the average milk yield per ewe was 276.6±55.6. The majority of farmers were relatively young (41.2±8.9 years old) with limited experience in sheep production. However, they had a good level of education and showed increased interest in intensification and specialization of production methods. The acreage of private land was generally small (7.6 hectares) and was used mainly for production of feedstuffs; grazing was a secondary objective. In most farms, the feeding management was inappropriate; overfeeding of concentrates and unbalanced rations was the dominant practice. Preventive measures included vaccinations (100% of farms vaccinated for clostridial diseases) and anthelminthic treatments (at least once a year in all flocks). In conclusion, farm conditions and production methods in studied flocks were considered satisfactory and revealed the potential for further improvements that are discussed here.

Keywords: farm conditions, production methods, Chios sheep

ΠΕΡΙΛΗΨΗ. Στόχος της εργασίας ήταν να περιγραφούν τα χαρακτηριστικά των εκτροφών και οι μέθοδοι εκτροφής εντατικά εκτρεφόμενων προβάτων της φυλής Χίου στην Ελλάδα. Για την έρευνα χρησιμοποιήθηκε το σύνολο των 66 εκτροφών του αγροτικού συνεταιρισμού προβατοτρόφων φυλής Χίου «Μακεδονία». Η συλλογή των στοιχείων έγινε με τη χρήση ερωτηματολογίου, το οποίο συμπληρώθηκε κατά την επίσκεψη του ίδιου κτηνίατρου σε κάθε εκτροφή. Από τα στοιχεία που προέκυψαν δημιουργήθηκε μια εκτενής βάση δεδομένων, από την οποία επιλέχθηκαν τέσσερις ανεξάρτητες μεταβλητές: μέγεθος ποιμνίου, εμπειρία του κτηνοτρόφου, διαθεσιμότητα βόσκησης και αριθμός ημερήσιων αρμεγμάτων. Στη συνέχεια, έγινε ανάλυση διακύμανσης κατά έναν παράγοντα, προκειμένου να διαπιστωθεί η επίδρασή τους στη γαλακτοπαραγωγή. Τα αποτελέσματα έδειξαν ότι ο μέσος όρος των ζώων στα ποίμνια ήταν 314 πρόβατα (16 κριάρια, 210 προβατίνες και 88 ζυγούρια). Διαπιστώθηκε

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υψηλή θετική συσχέτιση μεταξύ του μεγέθους του ποιμνίου και του ύψους της γαλακτοπαραγωγής (P<0.05). Επιπλέον, στα μεγάλα ποίμνια απασχολούνταν περισσότεροι εργάτες και εφαρμόζονταν τρία αρμέγματα την ημέρα (P<0,05). Οι εκτροφές στην πλειονότητά τους διέθεταν αρμεκτήρια (83,3%) και η μέση γαλακτοπαραγωγή ανά προβατίνα ήταν 276,6±55,6 λίτρα. Οι κτηνοτρόφοι ήταν σχετικά νέοι (41,2±8,9 ετών), με σχετικά μικρή εμπειρία στην εκτροφή προβάτων. Ωστόσο, το μορφωτικό τους επίπεδο ήταν υψηλό και έδειχναν ιδιαίτερο ενδιαφέρον για την εντατικοποίηση και την εξειδίκευση των μεθόδων παραγωγής. Η ιδιόκτητη γη ήταν γενικά περιορισμένη (κατά μέσο όρο 7,6 εκτάρια) και χρησιμοποιείτο κυρίως για την ιδιοπαραγωγή ζωοτροφών, ενώ η χρήση της ως βοσκότοπος ήταν δευτερεύουσας σημασίας. Στις περισσότερες εκτροφές τα χορηγούμενα σιτηρέσια δεν ήταν ισορροπημένα και επικρατούσε η υπερκατανάλωση συμπυκνωμένων ζωοτροφών. Σε επίπεδο πρόληψης ασθενειών γίνονταν εμβολιασμοί (για κλωστηριδιάσεις στο 100% των ποιμνίων) και χορήγηση αντιπαρασιτικών φαρμάκων (τουλάχιστον μία φορά το χρόνο). Συμπερασματικά, οι εφαρμοζόμενες μέθοδοι εκτροφής στα ποίμνια που μελετήθηκαν ήταν ικανοποιητικές, ενώ από την έρευνα αναδείχθηκαν οι δυνατότητες για περαιτέρω βελτιώσεις οι οποίες συζητούνται διεξοδικά.

Λέξεις ευρετηρίασης: συνθήκες εκτροφής, προβατοτροφία, φυλή Χίου

Introduction

Sheep production is considered as a very important industry for Mediterranean countries due to economic, environmental and sociological reasons (Haenlein and Fahmy 1999, Haenlein 2001, De Rancourt et al. 2006). However, the description of farming systems in these countries has been rather difficult because of the existing diversity in land use and implementation of management systems; varying from zero grazing intensive systems to extensive pastoral systems (Caballero 2001).

In Greece, dairy sheep production is the core industry of livestock production. Milk production is the main objective, whereas meat production is considered as secondary (Zygoyiannis 2006a). With about 6.7 million dairy ewes in 2007 (Greek Ministry of Rural Development and Food 2007), the Greek national flock is ranked as the second largest dairy flock in the E.U. Annual milk production ranges from 650,000 to 700,000 tons (De Rancourt et al. 2006, Zygoyiannis 2006a, Greek Ministry of Rural Development and Food 2007, Institut de l'élevage 2008), representing about 35% of the milk production in Greece. Sheep milk is used for the production of traditional types of cheese (i.e. feta) and yoghurt. About 83.5% of the country's sheep population is reared under a system described as 'semi–intensive', which is characterized by grazing in communal lands all year round, whereas during winter supplementing feeding is provided with purchased feedstuffs (Zygoyiannis 2006b). Over the last few years, high-producing ewes of various indigenous (Chios, Frizarta, Karagouniko) and foreign dairy breeds (Lacaune, Assaf, East Friesian), as well as their crosses, have been introduced. The Chios breed is the most productive of the indigenous Greek breeds and it is the dominant breed at the 'semi-intensive' and intensive systems applied (Basdagianni 2006).

Intensive and semi-intensive systems tend to capitalize on the full potential of the ewe and facilitate the production of quality products. These systems are characterized by the greatest labour input per ewe (Neimann-Sorensen and Tribe 1982) and enjoy the benefit of the most advanced information and technology (Lebbie and Irungu 1994, Morand-Fehr and Boyazoglu 1999). However, such systems in Greece are still in a transitional stage and more work is needed towards the development of new management strategies to achieve higher and better productivity.

The main objective of this study was to assess farm conditions and production methods in intensively and semi-intensively reared flocks of Chios sheep. A further objective was to identify any farm components that needed change or improvement in order to achieve a profitable management.

Materials and Methods

The total of 66 flocks of the Chios Sheep Breeders Cooperative "Macedonia", located in northern and central Greece, were included in the study. Data were collected between June and September 2007 by the same veterinarian during pre-scheduled on-farm visits. Initially, during the visit to each farm, a general evaluation concerning livestock and facilities was performed. Thereafter, a detailed interview of the farmer took place using a case-specific questionnaire, comprised of questions about livestock, facilities, equipment, nutrition, management practices, preventive medicine and major health problems of reared sheep.

Table 1. Family status and education level of farmers.

		Group 1 (20-29 years)	Group 2 (30-39 years)	Group 3 (40-49 years)	Group 4 (>50 years)
Marital status	Married	2	15	27	9
	Not Married	4	6	3	0
Education	Primary school	0	4	8	5
	Basic education	5	15	17	2
	University level	1	2	5	2

Table 2. Allocation of farms according to available farming land and farmers' responses.

	Farming area (Mean ± S.D.)	Farmers' responses about farming
Group A n=10	0.0±0.0	Farming disrupts sheep breeding. All feed (only of higher-quality) is purchased. Economies of scale are used to reduce costs.
Group B n=23	5.4±2.6	Exercise area/pasture were available. At least part of the feed must be home-grown in order to reduce costs.
Group C n=22	20.0±7.3	Provide pasture to sheep. Most of the feed must be home-grown (either in owned or rented land) in order to reduce costs.
Group D n=11	65.6±25.7	Feed must be home-grown to reduce costs. Large scale farming (feed and market crops) does not disrupt sheep breeding.

Interviews lasted for 3-5 hours and, generally, farmers' cooperation was excellent.

While most of the information was provided by the farmers, housing conditions were subjectively evaluated by the researcher. The use of bedding in sheep sheds was scored in a 2-point scale (adequate/inadequate), whereas ventilation was assessed using a 3-point scale (adequate/intermediate/inadequate). Adequacy of total surface area and total building volume (according to Capedeville and Tillie 1995) were evaluated with a 2-point scale (adequate/inadequate) over three periods: dry period, lactation and lamb rearing, when the demands are 'low', 'average' and 'high', respectively. Surface area demand was estimated to be 90%, 100% and 110% and building volume demand was estimated to be 85%, 100% and 105%, for the three periods, respectively.

Data analysis was performed using SPSS 17.0. Initially, descriptive statistics, such as means and standard deviation, for continuous variables and frequencies for categorical variables were calculated. Thereafter, from the plethora of information obtained from the questionnaires, four (4) major structural and management components were selected (flock size, sheep breeding experience, pasture use and application of three milkings daily) and were used as independent variables; afterwards, one way ANOVA was used to estimate their effect on milk production per ewe per 210 days lactation (depended variable).

Results

1. Farmer and farm characteristics

The average age of interviewed farmers was 41.2±8.9 years. Table 1 presents information regarding the family status and education level of farmers by age group. Farmer education level and age were not correlated. About 70% of the farmers had less than 10 years (4.5±2.7) of experience in sheep production. Most of the older farmers (>40 years old) were married (92.3%) with children (77.2%).

The average farm size was 7.6±10.7 hectares; an additional land of about 11.9±22.6 hectares per farm

was rented. Irrigated land accounted for 36.2% of the total available arable land. Table 2 shows the four groups that have been identified according to availability of farming land, as well as farmers' responses concerning sheep farming. Farms of Group A kept significantly more sheep ($P<0.05$) than those of the other three groups (310 vs 194 ewes). Farmers with high education were more likely ($P<0.05$) to be in groups C and D. Alfalfa hay and cereals were the main crops of the cultivated land. Grazing areas were available in 42 farms (63.6%), but in many farms with low acreage, the available land was used as exercise area for the flock.

The mean flock size comprised of 314 sheep (median 242 sheep), but it varied considerably. Mean number of rams, ewes and ewe lambs were 16.0±12.4, 210.3±138.5 and 87.7±69.9 per farm, respectively. Flock size was positively correlated with milk production ($P<0.05$).

2. Personnel

All farm owners were actively involved in the daily activities of farms. Other family members were employed on 51 farms (77.3%), being mainly the wives of the farmers, offering part-time assistance. Hired personnel was used in 36 (54.5%) of the farms; they were immigrants from neighbour Balkan countries and only in two farms they were full-time employees. The number of ewes per total working units (WU) varied considerably (91.0±42.6). Overall, mean WU were 2.3±0.9 per farm; 1.4 and 0.9 WU from family members and hired personnel, respectively. Farms with a high number of family WU had significantly higher ($P<0.05$) milk production per ewe. Milk production per ewe was positively correlated ($P<0.05$) with the number of hired personnel.

3. Facilities and equipment

On-site storage for forages and concentrates, as well as concentrate mixing facilities, were available in 63 (95.5%), 43 (65.2%) and 35 (53.0%) farms, respectively. Hammer mills, vertical concentrate mixers and chopper-mixer wagons were available in 31 (47.0%), 35 (53.0%) and 7 (10.6%) farms, respectively. Farms with high milk production per ewe and farmers with long experience in sheep breeding were more likely to have an emergency power-generator (29 farms, 43.9%; $P<0.05$ and $P<0.01$, respectively). Fourteen farms (21.2%) with large flocks ($P<0.01$) were also equipped with machines for artificial suckling of lambs; only three were actually using them.

4. Livestock

Sheep of all farms were pure-bred animals of the Chios breed. Mean bodyweight (BW) of adult rams and ewes was 83.4±12.3 and 57.6±5.5 kg, respectively. Rearing of lambs for 6-8 weeks was the common practice in all flocks, followed by a 7-month ewe's milking period. Mean prolificacy and mean milk production per ewe were 2.1±0.3 and 276.6±55.6 kg, respectively. Mean BW of lambs at birth, according to farmers, was 4.6, 3.9 and 3.5 kg for single, twins and triplets, respectively. Male lambs, not kept for breeding, were slaughtered as milk-fed lambs at a mean age of 52.0±11.4 days, providing a mean carcass weight of 9.9±1.2 kg. Male lambs kept for breeding purposes were usually sold immediately after weaning (20 kg BW at 2 months of age). The BW of replacement ewe lambs was estimated at 37.4±4.3 kg at the time of breeding (8-9 months old) and at 44.8±5.5 kg at lambing (13-14 months). Given that, at the time of the study, most farms were increasing the number of ewes in their flocks, it was very difficult to estimate the actual ewe replacement rate; according to farmers, it was around 20-25% per year. Ewe lambs sold for breeding purposes were between 1.5 and 7 months old (mean 87.0±33.5 days) and weighed between 14 and 40 kg (mean 21.5±5.7 kg). Over the last decade, ewe lambs of the Chios breed are in high demand in Greece; during the period the study was undertaken, they were sold around 250,00 € per head.

5. Livestock Management

a. Housing

All farms had a main sheep shed with the building of the milking parlour usually (83.3%) attached to it. Moreover, in 27 farms (40.9%) there was, also, a secondary shed, while in 11 farms (16.7%) there was a simple 'shed' attached to the main one and 10 farms (15.2%) had both of the latter buildings. Milking ewes were always housed in the 'main shed'; the other sheds, if available, were used for the housing of rams and ewe lambs. With the exception of 6 farms, all the others had exercise paddocks located next to the main sheep shed. The different housing types and conditions for ewes, ewe-lambs, rams and suckling lambs are shown in Table 3. Both open-front and closed buildings were used. Earthen floor was clearly the predominant type.

Table 3. Housing types and conditions by age and sex class (% of farms).

		Ewes	Ewe-lambs	Rams	Lambs
Building type	**Open-front**	63.6	53.0	54.5	59.1
	Closed	36.4	47.0	45.5	40.9
Floor type	**Earthen**	84.8	86.4	89.4	86.4
	Concrete	15.2	13.6	10.6	13.6
Bedding	**Adequate**	59.1	65.2	66.7	60.6
	Inadequate	40.9	34.8	33.3	39.4
Ventilation	**Adequate**	24.2	28.8	22.8	25.8
	Intermediate	36.4	34.8	42.4	31.8
	Inadequate	39.4	36.4	34.8	42.4

Bedding (wheat straw >90%) was considered adequate on 60-67% of the farms. Generally, natural ventilation of sheep buildings was the norm (93.9%); fans (auxiliary to natural ventilation) were used on 4 farms, only. Overall, ventilation was rather inappropriate; on average, it was considered adequate in about 25% of the farms. Surface area available to different categories of raised sheep was inadequate at 33.3%, 27.3% and 42.4% of farms, at the 'average', 'low' and 'high' demand periods, respectively. Farms with high milk production per ewe were providing significantly more surface area ($P<0.05$) at the 'high' demand period. Building volume available was inadequate on 34.8%, 22.7% and 36.4% of farms, at the 'average', 'low' and 'high' demand periods, respectively. The results showed that farms with high building volume per ewe at 'average' and 'high' demand periods had significantly high milk production ($P<0.05$).

During the suckling period, small groups of ewes/lambs were formed on 40 farms (60.6%). Group size ranged from 10 to 100 ewes (38.1±27.9). On 45 farms (68.2%), milking ewes were kept in a single group, regardless of lambing date and milk yield. Lambing date was the predominant grouping factor of milking ewes on 18 farms (27.3%), whereas milk yield was used as grouping factor only in 3 farms (4.5%). Ewe lambs were grouped according to the time of birth (early or late in the lambing season) in 10 farms (15.2%). Rams were usually kept in a single group; grouping rams according to age (younger and older rams) was not a common practice (6.1% of farms).

b. Feeding

The most commonly used feeds were alfalfa hay, wheat straw, cereal grains (corn, barley and wheat), wheat bran, soybean meal (solvent), sunflower meal (solvent) and cottonseed meal (expeller). Eighteen farms (27.2%) produced enough alfalfa hay to be self-sufficient; these were farms with considerable acreage ($P<0.05$). Corn silage was produced and used in 4 farms. Commercial compound feeds were used in 28 farms (42.4%). Farm-mixed concentrates were formulated using self-produced (only 10 farms, 15.2%, were self-sufficient) or purchased cereal grains and purchased oilseed meals. Mineral and vitamin supplements were widely used (95.6%), whereas yeast and fat supplements were less commonly used (19.7% and 9.1%, respectively).

A typical 'winter' ration for lactating ewes consisted of different amounts of alfalfa hay, wheat straw and concentrates. On 42 farms (63.6%), there was grazing availability for lactating ewes during spring and summer months, which substituted mainly the use of alfalfa hay. Total amounts of alfalfa hay and concentrates fed during the 9-month lactating period were 301.4±64.1 kg and 344.0±39.6 kg per ewe, respectively. In farms with milking parlours (53 out of 66), concentrates were offered during milking. In 40 of them, the total amount was offered, whereas, in 13 of them, only part of the concentrates was offered. Wheat straw was provided on all farms, either *ad libidum* (81.8%) or in restricted amounts (0.1-0.4 kg per ewe per day).

A typical ration for dry ewes included alfalfa hay (0.64±0.44 kg), wheat straw (0.29±0.18 kg) and concentrates (0.39±0.24 kg). In 30.3% of the cases (20 farms), dry ewe rations provided less nutrients than those required (NRC 2007). Moreover, the variability

of quantities offered was considerable. Farmers based their rations either to forages (alfalfa/wheat straw and very small amounts of concentrates) or to concentrates (concentrates plus pasture/wheat straw); there was not a common feeding strategy. Steaming-up was practiced by all farmers and, in general (about 90% of farms), ewe nutrient requirements were adequately met. On the other hand, the step-up process and protein allowances (largely exceeding requirements) needed adjustment on most farms.

Artificial rearing of lambs was practiced in 3 farms only; two of them had more than 600 ewes. In many cases, lambs were not separated from their dams until weaning. Creep feeding was practiced in 34 flocks (51.5%); lambs were provided with water and dry feed from the 2nd and 3rd week of age, respectively. On 32 farms (48.5%), suckling lambs had access to the same feed and water troughs as their dams. After weaning and up to the age of 12-13 months, ewe lambs consumed 0.68±0.16 kg of alfalfa hay and 0.57±0.11 kg of concentrates per day. Wheat straw was mostly offered for *ad libidum* consumption (estimated at about 0.3 kg per day).

Alfalfa hay, wheat straw and concentrates were the main components of ram rations, as well. The rations for rams exceeded published requirements for energy (125-150%) and digestible protein (190-250%), year-round (maintenance, pre-breeding and breeding periods) (NRC 2007). However, during the maintenance period, mineral and vitamin requirements were not adequately met on 41 farms (62.1%). This was largely corrected in pre-breeding and breeding rations.

c. Reproduction

Ewes of the Chios breed have a long breeding season. However, due to long milking period which provides the main income, accelerated lambing systems were applied in two flocks, only. Table 4 presents the start of the mating period by age group. Ewes were all bred by natural service. Hand-mating was practiced only in 12.7% of farms and single-sire mating groups were formed on 39.7% of them; the rest (47.6%) applied both methods, starting by hand-mating for two or three estrus cycles (1.5-2 months) and, then, leaving one ram per ewe group. 'Ram effect' and estrus synchronization, using progestegional inpregnated intravaginal sponges followed by an injection of eCG,

Table 4. Start of mating period (% of flocks) by age class.

	Age class		
Month	**Adult ewes**	**2-year old ewes**	**Ewe lambs**
April-May	36.4	21.2	} 19.7
June	21.2	27.3	
July	33.3	34.8	
August	9.1	} 16.7	24.2
September			34.9
October-November			21.2

were practiced on 62.1% and 21.2% of flocks, respectively. Flushing was not routinely applied (21.2% of flocks); however, due to high milk production, all ewes were in a high plane of nutrition during most of the mating period. Problems of delayed conception in ewe lambs were reported by 36.4% of farmers; young age (8-10 months old) at the start of mating period was presumed to be the cause. On most farms (71.2%), young rams were hand mated for the first time at a comparable age (8-9 months old) with lamb ewes. Farms belonging to Group A (Table 2) kept a significantly ($P<0.05$) lower ewe:ram ratio. Teaser rams were widely used (89.5%). The rams used were either home-bred, purchased or both, on 21.2%, 24.3% and 54.5% of the farms, respectively. Rams were kept for two, three or four consecutive years on 33.3%, 39.4% and 27.3% of the farms, respectively. After that period, most adult rams were sold for breeding purposes to other pure-bred or commercial flocks.

d. Milking

The majority of farms (53 of 66) had milking parlours. On 45 farms (68.2%), herringbone milking parlours (most of the 'Case' type) were used, while 10 farms (15.2%) had portable milking machines. Almost all farmers using portable equipment or hand-milking scheduled to install a herringbone parlour, when their flocks had more than 250 ewes. Milking three times per day for 2-4 months after lamb weaning was a common practice (77.3%) and it was positively correlated with milk production per ewe ($P<0.05$). Depending on flock size, 1 to 3 milkers were used. Mean performance was 70.1±43.2 and 38.4±14.4 ewes per milker per hour for ewes milked in parlours or with portable milking machines, respectively. Milking machines were disinfected at the end of each milking on all farms, but

34.8% of their users did not perform an annual service and only 7.6% of them used total milking hours as a criterion to change milk liners. Parlour automations included concentrate feeding (55.5%), cluster removal (6.7%) and daily milk recording (4.4%).

e. Health

Vaccination against clostridial diseases, contagious agalactia and enzootic abortion was rather widespread (66, 53 and 50 farms, respectively). Vaccination against pasteurellosis, gangrenous mastitis and paratuberculosis was less common (32, 14 and 3 farms, respectively). Injections with vitamin E and Selenium were routinely given to all newborn lambs on all 66 farms. Parasite control, using benzimidazoles and ivermectin, was practiced once or twice a year on 12 and 33 farms, respectively. On the remaining 21 farms, these preventive treatments were applied three times a year. Diarrhoea (≥10%) and pneumonia (≥5%) in lambs were reported to be serious health problems in 33 (50.0%) and 9 (13.6%) flocks, respectively. Mastitis was reported to be a serious problem in milking ewes; its incidence in 14 of flocks was ≥10%. On 34 farms (50.7%), the use of intramammary dry treatment was commonly practiced. Method of lameness prevention included foot trimming, foot bathing and dietary supplements (zinc oxide or biotin) in 18, 5 and 7 farms, respectively.

Discussion

Sheep production advanced significantly over the last 30 years, as a result of improved feeding techniques, acceleration of reproduction, genetic improvement and prevention of principal diseases. Moreover, the intensification of rearing systems nearly doubled productivity levels (Morand-Fehr and Boyazoglu 1999).

Over the last decade, in Greece, flocks of the Chios breed, kept under intensive and semi-intensive systems, showed an important structural and managerial development compared with the more traditional systems that are still dominant. The results of the present study showed that the average farm acreage is small and its use is dominated by different perceptions regarding home-grown feed; half of the farmers want to focus on sheep breeding only. However, there is not any available information whether the latter option is the most profitable one or not. None of the farms included in the present study had a vertical integration of production, but some farmers expressed interest to adopt such practice, which is common in other countries (Thomas and Rowe 1998).

Mean number of ewes per WU in Chios flocks was in accordance with the estimation of the Farm Accountancy Data Network, reported by Tsiboukas et al. (1998) (91.0 vs. 88.0 ewes/WU, respectively), despite the fact that milk production of Chios ewes is almost 3 times higher than that of the average ewe in Greece. The latter is most likely the result of the wide use of milking machines in Chios flocks. On the other hand, the positive correlation between milk production per ewe and the number of WU available emphasizes the importance of labour in intensive management systems. However, the lack of a farmer training programme is a major obstacle and the temporary employment of immigrant workers aggravates the situation.

We found that the facilities and equipment used in Chios sheep farms are more advanced compared to those of an average sheep farm in Greece. This is the result of considerable investments, aiming at better working conditions, higher productivity per ewe and higher milk quality. However, the minimum flock size and minimum milk production per ewe, to justify such investments, is not known and merits further investigation. Improvement of old and implementation of new management practices (Gelasakis et al. 2009), together with the application of a comprehensive genetic improvement programme, will reveal the true productive potential of the breed. Currently, the main objective is to increase milk production. Milk composition and udder conformation should, also, become objectives in the programme. The results showed that a shorter lamb rearing period or artificial lamb rearing can significantly increase the amount of milk sold. Artificial rearing had, also, beneficial effect on the quality of produced carcasses from slaughtered lambs. Moreover, the fact that larger flocks have a statistically significant higher milk production per ewe indicates that flock size is not an obstacle, as far as management adjusts to increased demands.

As asserted in the Introduction, housing conditions are very important for sheep health and productivity. The results showed that, in the majority of farms, the ventilation of sheep buildings was very poor and the use of bedding was inadequate. Natural ventilation was usually "obstructed" in an effort to protect sheep from cold weather; on the other hand, although bedding has

a similar effect, its use was limited because it was not considered necessary in sheep housing. In our view, the way forward is proper training of farmers to reverse these false perceptions. The fact that about one third of the farms had inadequate surface area and building volume per ewe was critical, because the trend in all farms was to increase their size. The latter will be an issue of major concern in the future, since a positive correlation between milk production and housing conditions was confirmed from the findings of the present study. The evidence in the literature suggests that grouping of various sheep classes (especially lactating ewes) can also be improved with beneficial effects on productivity and profitability (Valergakis et al. 2008).

Concerning the nutrition of sheep in the studied flocks, it was found that farmers were reluctant to seek professional advice in ration formulation. Generally, in an effort to increase milk production, the common practice was overfeeding of concentrates. Concentrate to roughage ratio was almost 1:1 in the rations of milking ewes. Protein level in rations was, also, high having negative impact on profitability. Recently, Valergakis et al. (2008) proposed a system of lead factors in the nutrition of milking ewes; the adoption of a Chios-specific lead factor system for lactating ewes is under development.

The data presented in Table 4 suggest that there is ground for substantial improvement in reproduction management of Chios ewes. Milk recording data suggest that early lambing ewes (October/November) have longer lactations and produce more milk (Chios Sheep Breeders Cooperative "Macedonia" 2004). Given that this is a management issue, most farmers deliberately delay breeding, in order to avoid the start of milking during the colder winter months (January/February). The data from different farms showed that housing conditions is the key to overcome this problem. The common practice of hand-mating in the majority of farms was proved very labour-intensive. In our view, the step forward is the use of artificial insemination, especially in flocks with pedigree Chios sheep. It was found that machine milking was widely applied in the studied farms and, in most of them, milking three times per day was common. Labour productivity during milking appeared low on many farms; currently, farmers do not seem to consider this as a major issue, but the continuous increase in flock size will undoubtedly change their attitude. Considering the importance of the sheep industry in Greece and the lack of bibliographic evidence and actual farm data from dairy flocks, the next aim is to use the results of our research to develop specific recommendations for all classes of Chios sheep in the form of a technical manuscript, addressing issues such as feeding practices and reproduction management.

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