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Dairy Sheep and Goat Farmers: Socio-Demographic Characteristics and Their Associations with Health Management and Performance on Farms

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Abstract: The objectives were to determine the socio-demographic profiles of small ruminant dairy farmers and to study associations with management practices, production outcomes and health parameters on their farms. In total, 325 sheep flocks and 119 goat herds across Greece were included in the study and visited for collection of information. Socio-demographic characteristics of the dairy farmers and details of management practices, production outcomes and health parameters on their farms were recorded. For the analysis of results, multivariable models were created using mixed-effects logistic regression, with farms as the random effect. Most dairy farmers were male (93.2%), most were full-time professionals in farming (89.4%) and most had a farming family tradition (86.9%). The mean age was 47.0 years and the mean farming experience was 24.3 years. For 17.3% of the farmers, the highest level of education received was primary education, for 54.3% it was secondary education, for 16.4% it was post-secondary vocational training and for 12.0% it was tertiary education. In 35.4% of dairy farms, external farm workers were employed. Of the socio-demographic characteristics, farming experience was associated with geographical location of farms, management system, breed of animals, application of quarantine measures, laboratory evaluation of feedstuffs, ultrasonographic examination for pregnancy diagnosis, application of vaccination against clostridial infections, means of calculation of bodyweight for drug administration to animals, maintenance of colostrum bank, number of annual veterinary visits, annual milk production per animal, number of newborns and somatic cell counts and total bacterial counts in milk. Further, the employment of external farm workers on the farm was associated with management system, machine-milking, number and breed of animals, application of quarantine measures, laboratory evaluation of feedstuffs, ultrasonographic examination for pregnancy diagnosis, number of annual veterinary visits, annual milk production per animal, protein content in milk and number of newborns. The findings indicate that dairy sheep/goat farming is still a family-driven business, but, nevertheless, there are now younger people among these farmers, many of them with post-secondary education. Socio-demographic characteristics may influence the management practices applied, which in turn can have consequences for production and health results of the farms.

Keywords: farmer; goat; health management; sheep

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1. Introduction

Dairy sheep and goat farming is an important sector of the agricultural industry in Greece, with significant annual milk production. Recent data of the Hellenic Milk Board registers a total of 51,750 farms (38,717 sheep flocks and 13,031 goat herds) that produced and delivered milk during 2019 [1]. In 2019, total deliveries of sheep and goat milk from these farms to dairy factories were approximately 645,000 and 143,000 m^3, respectively [1]. These quantities amount to approximately 15% of the total European milk production from small ruminants [2] and confirm Greece as a significant producer of milk of small ruminants in Europe. Of those quantities, 90% are used for cheese production.

Despite the importance of small ruminant farming for the agricultural sector in Greece, the socio-demographics of its farmers have not been widely investigated. Internationally, there is also little knowledge about possible associations between farmer characteristics with production outcomes and health parameters in small ruminant farms [3]. Indeed, farmers are the ones taking the decisions about management practices and are important determinants of the overall functioning of the farms. In addition, knowledge of farmer characteristics can lead to predictions about the future of an industry in the longer term. In Europe, for example, there are concerns about the involvement of younger people in agriculture and its impact upon the viability of the sector in the longer term [4]. Past investigations have tended to focus on the effects of animal-related variables, management practices or veterinary care provided on production outcomes (e.g., [5–9]), but the possible effects of farmer profiles have been largely ignored or under-reported. Among the few relevant studies, Corner-Thomas et al. [3] reported that with increasing age, farmers were using fewer health management tools (e.g., vaccinations). Nevertheless, there is value in obtaining information regarding socio-demographic profiles of farmers, as such data could be useful to identify possible reasons that constrain efficient small ruminant farming. Further, possible threats for the sector could also be identified (e.g., increased age of farmers, low level of education).

The present study reports an extensive countrywide investigation performed in 444 dairy small ruminant farms (325 sheep flocks and 119 goat herds) throughout Greece. The objectives of the study were (a) to determine the socio-demographic profiles of the small ruminant farmers in Greece and (b) to study associations with management practices, production outcomes and health parameters on their farms.

2. Materials and Methods

2.1. Small Ruminant Farms

In total, 325 sheep flocks and 119 goat herds in the 13 administrative regions of Greece (Figure 1) were included in the study and visited for collection of information. The field work was performed from April 2019 to July 2020.

Veterinarians active in small ruminant health management around Greece were contacted by telephone and asked if they wished to collaborate in the investigation [10]; in total, 48 veterinarians were contacted and of these, 47 (97.9%) agreed to collaborate. Farms were selected by the collaborating veterinarians on an accessibility basis and the willingness of the farmers to accept a visit by university personnel for an interview. Visits had been scheduled to 446 farms, but on two occasions, whilst the investigators and the accompanying veterinarians had already arrived at these farms, the respective farmers refused to collaborate (both mentioned that they did not have enough time available to receive a visit). The two investigators (authors D.T.L. and G.C.F.) visited all the farms.

Figure 1. Location of 444 small ruminant farms around Greece, which were visited and the socio-demographic characteristics of farmers were recorded (drawn by use of GPS Visualizer (Adam Schneider; Portland, OR, USA)).

2.2. Interviews of Farmers

At the start of each visit to a farm, the investigators were introduced to the farmer by the veterinarian accompanying them to the respective farm. Then, the senior investigator (author G.C.F.) informed the farmer about the objectives and the details of the study. He also presented the interviewer (author D.T.L.) to the farmer, explaining that the work was part of her doctoral thesis. All the interviews were conducted by the same investigator (author D.T.L.). No relationship had been established between the interviewer and any of the farmers prior to commencement of the study.

The interview was performed by using a standardized questionnaire (Table S1) [10]. The interview served to record socio-demographic characteristics of the farmers, as well as details regarding management practices, production outcomes and health parameters on the farm.

If farmers asked for clarifications of the questions during the interview, these were provided immediately by the interviewer. The mean (±standard error of the mean) duration of the interview was 63.6 ± 0.3 min [10]. After completing the interview, no repeat visits were made to the farms.

2.3. Sample Collection

Bulk-tank milk samples were collected aseptically from each farm for somatic cell counting, total bacterial counting and milk composition measurement. The samples were collected directly from the milk cooling tank on each farm. Milk samples were collected by sterile plastic single-use pipettes, which were immersed into the tank to withdraw the samples.

A total of four samples were collected from the milk tank of each farm, and a new pipette was used for each sample. Immediately after collection, samples were transferred into sterile plastic Universal vials.

Samples were stored at 0.0 to 4.0 °C using ice packs in portable refrigerators. Somatic cell counting and milk composition measurement were performed on each of the samples within 4 h after sample collection. Transportation of samples to the laboratory was made by the investigators and by car; samples collected from farms in the islands were also transported as ice-packed accompanying luggage by airplane (Crete, Lesvos and Rhodes) or by boat (Cephalonia).

2.4. Body Condition Scoring of Animals

On each farm, 25 females were selected at random and evaluated for body condition scoring (1–5, including half scores). In order to ensure uniformity of measurements and adherence to published standards [11], this was always carried out by the senior investigator (author G.C.F.), a certified European Veterinary Specialist in Small Ruminant Health Management.

2.5. Laboratory Examinations

Two of the four milk samples collected from each bulk tank were used for somatic cell counting and milk composition measurement, and the remaining two were used for the bacteriological examinations. Two sub-samples were created and processed from each of the four samples, so that each separate test was performed four times (each one in different sub-samples).

Somatic cell counting (Lactoscan SCC; Milkotronic Ltd., Nova Zagora, Bulgaria) and milk composition measurement (Lactoscan Farm Eco; Milkotronic Ltd.) were performed on each of the four relevant sub-samples.

Total bacterial counts (TBC) were performed within 24 h after collection of samples. TBC in the milk samples were performed on each of the four relevant sub-samples. The procedures detailed by Laird et al. [12] were followed. In brief, serial 10-fold dilutions of the milk samples were made under aseptic conditions by pipetting the sample into sterile phosphate buffer saline; of each dilution, three 1 mL-drops were deposited on a Petri dish containing plate count agar (or standard methods agar); plates were incubated at 37 °C for 48 h; colony counts were performed within 2 h; and based on the findings and the dilution in which growth occurred, the total bacterial count in the initial sample was calculated. After completion of sample aliquot withdrawal for microbiological examination, the temperature of the respective samples was measured and in no case was found to exceed 3.8 °C.

2.6. Data Management and Analysis

2.6.1. Characteristics of Farmers That Were Studied

The following socio-demographic characteristics of farmers were studied: gender (male/female), age (years), farming experience (years), professional farming (full-time/part-time), daily time spent at the farm (hours), highest level of education (primary/secondary/post-secondary vocational/tertiary), primary language (description), farming tradition family (yes/no), members in farmer's family (no. of persons), members in farmer's family working at the farm (no. of persons), employment of external farm workers (yes/no), citizenship of the external farm workers (description). Answers of the farmers were marked by the interviewer directly on the printed questionnaires; no audio

or video recordings were made; no subsequent comments were made on the answers by the respondents. The age at which respondents were first involved with farming (years) was then calculated by subtracting the experience of the farmers from their age.

2.6.2. Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS v. 21 (IBM Analytics, Armonk, NY, USA). Basic descriptive analysis was performed. Exact binomial confidence intervals (CIs) were obtained.

Subsequently, the socio-demographic characteristics were evaluated, in order to study their potential association with a set of 26 variables (related to management practices [n = 17], production outcomes [n = 4] or health parameters [n = 5] on the farms) (Table A1).

In order to evaluate the role of the location of farmers, the 13 administrative regions of the country were clustered in four main areas: North, Central, South and Islands of the country. For the evaluation of the management system applied in the farms (intensive, semi-intensive, semi-extensive, extensive), the classification of the European Food Safety Authority [13] was used. The total workforce on a farm was calculated as the sum of the number of family members involved on the farm and the number of external farm workers.

For all statistical analyses, somatic cell counts (SCC) were transformed to somatic cell scores (SCS) as described by Wiggans and Shook [14] and Franzoi et al. [15]: $SCS = \log_2(SCC/100) + 3$, whilst total bacterial counts were transformed to $\log_{10}$ and the transformed data were used in the analyses. The findings were back-transformed into $100 \times 2^{(SCS-3)}$ and 10^{log} data, respectively.

The potential associations of the socio-demographic characteristics with the management practices, production outcomes or health parameters were evaluated by using cross-tabulation with Pearson's chi-square test, one-way analysis of variance or analysis of correlation, depending on each occasion on the nature of the data.

Finally, multivariable models were created using mixed-effects logistic regression, with farms as the random effect and initially offering to the model all variables, which achieved a significance of $p < 0.2$ in the univariable analysis. Variables were removed from the initial model by backwards elimination. The p value of removal of a variable was assessed by the likelihood ratio test, and for those with a p value of >0.2, the variable with the largest probability was removed. This process was repeated until no variable could be removed with a p value of >0.2.

In all analyses, statistical significance was defined at $p < 0.05$.

3. Results

3.1. Description of the Characteristics of Farmers

3.1.1. Gender and Age of Farmers

Most farmers were male (93.2%); significantly fewer farmers were female (6.8%). The mean (± standard error of the mean) age of farmers was 47.0 ± 0.6 years.

There was no significant difference in the mean age of farmers between genders (46.9 ± 0.6 years for males versus 47.8 ± 2.6 years for females; $p = 0.68$). Of the farmers, 16.2% were younger than 35 years and 5.2% older than 65 years.

The mean age at which the respondents started their involvement with farming was 22.6 ± 0.6 years. This age was significantly smaller for males than females: 22.0 ± 0.6 versus 31.3 ± 2.9 years ($p < 0.001$).

3.1.2. Farming Experience and Farming Work by Farmers

The mean farming experience of farmers was 24.3 ± 0.8 years. Mean experience of male farmers was longer than that of females: 24.9 ± 0.8 versus 16.5 ± 2.9 years, respectively ($p = 0.006$).

Most farmers (89.4%) were working full-time in farming (89.6%, among males—86.7%, among females; $p = 0.35$); fewer farmers (10.6%) had farming as secondary activity. On average, professional farmers were older than those with farming as a secondary activity: 47.6 ± 0.2 years versus 43.6 ± 1.9 years ($p = 0.047$); however, there was no significant difference in the average experience between these two groups of farmers ($p = 0.11$).

Full-time farmers spent on average 12.0 ± 1.9 h daily at the farm, a period which was significantly longer than the average time spent by those with farming as secondary activity: 9.1 ± 0.7 h daily ($p < 0.001$). Among professional farmers, males spent significantly longer periods at the farm than females: 12.3 ± 0.2 versus 9.8 ± 0.9 h daily, respectively ($p = 0.004$).

3.1.3. Highest Level of Education Received by Farmers

The highest level of education received by most farmers was secondary education (54.3%), primary education (17.3%) or post-secondary vocational training (16.4%). For fewer farmers, the highest level of education received was tertiary education (12.0%), at polytechnic (20.7%) or university (79.3%) level (Figure 2).

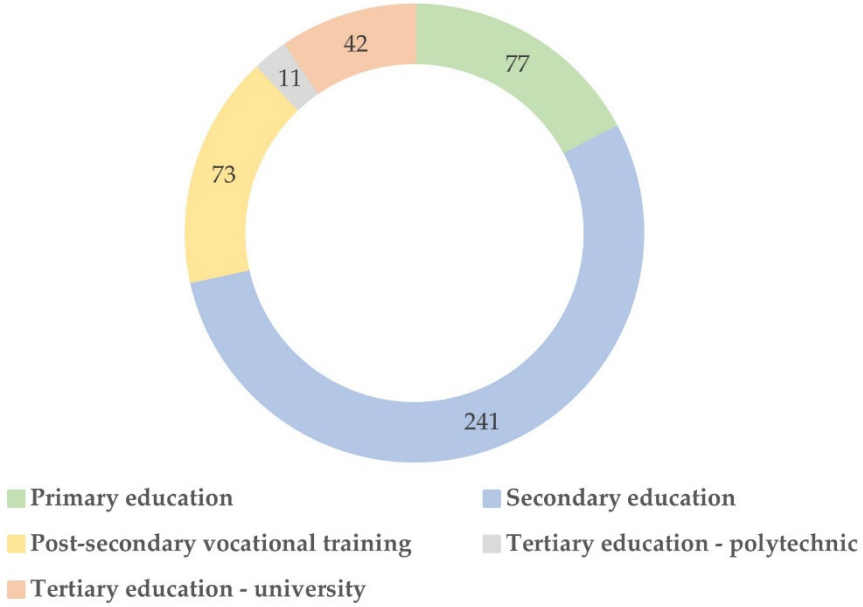

Figure 2. Ring pie chart of the frequency of highest education level received by 444 small ruminant farmers throughout Greece.

A significantly greater percentage of females had a tertiary education degree than males: 23.3% versus 11.1% ($p = 0.046$), but no associations were evident between farmers' ages and their education levels ($p > 0.45$ for all comparisons). No farmer aged over 65 years (0.0%) had a tertiary education degree, whilst 12.6% of those younger than 66 years had such a degree, although this difference was not significant ($p = 0.073$).

Some type of professional training (e.g., seminars or short-term educational programs) had been received by 15.1% of farmers. Such training had been undertaken more often by professional farmers than by those working part-time: 16.4% versus 4.3% ($p = 0.028$). Farmers who had received such training were less likely to have a tertiary education degree: 85.1% versus 14.9% ($p = 0.002$).

3.1.4. Main Language Spoken by Farmers

For most farmers (94.1%), Greek was the primary language. For fewer farmers, it was Turkish (4.7%), Albanian (0.7%), Bulgarian (0.2%) or Indian (0.2%).

3.1.5. Family

Most farmers had a farming family tradition: 86.9%, with a significantly higher proportion among males (87.9%) than females (73.3%) ($p < 0.001$), and among professional farmers (87.4%) than non-professional (70.9%) farmers ($p = 0.001$). The mean number of family members of farmers was 4.3 ± 0.7 persons. Of these, 2.2 ± 0.02 persons worked at the farm. These numbers did not differ in relation to gender, age, professional involvement or highest level of education of the farmers ($p > 0.06$ for all comparisons).

3.2. External Farm Workers

In 35.4% of the farms, external farm workers were employed. Within these farms, the mean number of external farm workers was 1.6 ± 0.1 persons. There were external farm workers of Greek nationality on 15.3% of these farms and of non-Greek nationality on 90.4%.

Farmers who employed external farm workers had, on average, shorter experience than ones who did not employ external farm workers: 20.9 ± 1.3 versus 26.2 ± 0.9 years ($p = 0.001$). Also, on farms where external farm workers were employed, more family members worked there than on farms where no external farm workers were employed: 2.3 ± 0.04 versus 2.2 ± 0.02 persons ($p < 0.001$). Cumulatively, mean total workforce on farms was 2.8 ± 0.1 persons.

3.3. Associations with Management Practices, Production Outcomes or Health Parameters on the Farms

All the details and the full results of the various univariable associations performed initially are provided in Tables S2–S27.

The details of the associations that emerged as significant after applying the multivariable models are summarized in Table 1. The table presents a cross-tabulation of the various socio-demographic characteristics recorded versus the variables studied on the farms (management practices, production outcomes, health parameters); only significant associations are indicated therein.

The results showed that farming experience was the socio-demographic characteristic mostly associated with the variables studied ($n = 14$, of which eight were management practices, two were production outcomes and two were health parameters). Also, the employment of external farm workers on the farm was associated with 11 of the variables studied (of which eight were management practices and three were production outcomes).

No socio-demographic characteristics were found to be associated with the animal species farmed (Table S3), the maintenance of withdrawal period after drug administration (Table S15) or the annual incidence risk of clinical mastitis (Table S24).

Table 1. Significance (p) [a] of associations of the socio-demographic characteristics of 444 small ruminant farmers throughout Greece with variables related to management practices, production outcomes or health parameters on their farms.

Variables Related to Management Practices, Production Outcomes or Health Parameters [b]	Socio-Demographic Characteristics of Farmers									
	Gender	**Age**	**Farming Experience**	**Farming Work**	**Daily Period at the Farm**	**Highest Level of Education Received**	**Farming-Family Tradition**	**Family Members**	**Family Member at the Farm**	**Employment of Farm Workers**
Location of farm (area of the country)			<0.001					0.002		
Animal species farmed										
Management system followed in farm			<0.001						0.026	<0.001
Application of machine- or hand-milking		0.046			0.013	0.010				<0.001
No. of animals in farm	0.009				0.037			0.027		<0.001
Animal breed			0.033							0.002
Application of quarantine for new animals into a farm			0.013							<0.001
Annual occasions of cleaning and disinfection							0.004			
Laboratory evaluation of feedstuffs and water			0.004							<0.001
Ultrasonographic examination for pregnancy diagnosis			0.024				<0.001			0.008
Vaccination against clostridial infections			<0.001		0.042		<0.001			
Administration of 'dry-ewe' treatment						<0.001	0.001			
Method of calculation of bodyweight			<0.001			0.016		0.008		
Maintenance of withdrawal periods after drug administration										
Care to the newborns		0.027								
Maintenance of colostrum bank			0.009							
Annual veterinary visits			0.021			0.037				0.006
Annual milk production per animal			0.002							<0.001
Fat content in bulk-tank milk									0.018	
Protein content in bulk-tank milk										0.027
Newborns per animal			0.025	<0.001						0.024
Body condition score		<0.001								
Annual incidence risk of clinical mastitis										
Bulk-tank milk somatic cell counts			0.027		0.002	0.003				
Bulk-tank milk total bacterial counts			0.008		0.12					
Annual incidence risk of deaths of adult animals		0.018								

[a] Significance after applying multivariable models, using mixed-effects logistic regression with farms as the random effect. [b] Full details in Tables S1–S27.

3.3.1. Importance of Farming Experience by Farmers

Table 2 presents the details of the associations of the farming experience with the 14 variables for which a statistical significance was found.

Table 2. The importance of farming experience among 444 small ruminant farmers throughout Greece for variables related to management practices, production outcomes or health parameters on their farms, for which significance was seen in multivariable analysis of socio-demographic characteristics.

Variables				*p*
Farmers in Central Greece (n = 169) 20.0 ± 1.2 years	Farmers in the Islands of Greece (n = 59) 33.5 ± 2.2 years	Farmers in Northern Greece (n = 123) 24.9 ± 1.4 years	Farmers in Southern Greece (n = 93) 25.5 ± 1.5 years	<0.001
Farmers following intensive management system (n = 53) 15.3 ± 2.2 years	Farmers following semi-intensive management system (n = 169) 22.3 ± 1.1 years	Farmers following semi-extensive management system (n = 177) 26.1 ± 1.2 years	Farmers following extensive management system (n = 45) 35.6 ± 2.2 years	<0.001
Farmers with imported animal breeds (n = 184) 20.2 ± 1.1 years		Farmers with indigenous animal breeds (n = 260) 27.2 ± 1.0 years		<0.001
Farmers applying quarantine measures (n = 374) 23.3 ± 0.8 years		Farmers not applying quarantine measures (n = 70) 29.7 ± 2.0 years		0.002
Farmers performing laboratory evaluation of feedstuffs and water provided to animals (n = 134) 23.0 ± 1.4 years		Farmers not performing laboratory evaluation of feedstuffs and water provided to animals (n = 310) 26.0 ± 0.9 years		0.002
Farmers using ultrasonographic examination for pregnancy diagnosis in the farm (n = 139) 17.9 ± 1.3 years		Farmers not using ultrasonographic examination for pregnancy diagnosis in the farm (n = 305) 27.6 ± 0.9 years		<0.001
Farmers performing anti-clostridial vaccination to the animals (n = 434) 24.0 ± 0.8 years		Farmers not performing anti-clostridial vaccination to the animals (n = 10) 37.5 ± 6.1 years		0.009
Farmers estimating bodyweight of animals before drug administration (n = 344) 22.6 ± 0.8 years		Farmers weighing animals before drug administration (n = 100) 30.3 ± 1.8 years		<0.001
Farmers maintaining a colostrum bank in the farm (n = 58) 18.5 ± 2.0 years		Farmers not maintaining a colostrum bank in the farm (n = 386) 25.2 ± 0.8 years		0.003
Annual veterinary visits r = −0.1268				0.004
Annual milk production per animal r = −0.1725				<0.001
Newborns per animal r = −0.1291				0.003
Somatic cell counts r = 0.0511				0.14
Total bacterial counts r = 0.0887				0.031

In relation to management practices, farming experience was significantly associated with the area of the country where farms were located (farmers located in the islands with the longest experience; Table S2), the management system applied on farms (farmers following extensive management system with the longest experience; Table S4), the breed of animals (farmers with indigenous animal breeds with the longest experience; Table S7),

the application of quarantine for animals newly entering into the farm (negative association; Table S8), the laboratory evaluation of feedstuffs and water (negative association; Table S10), the ultrasonographic examination for pregnancy diagnosis (negative association; Table S11), the application of vaccination against clostridial infections (negative association; Table S12), the calculation of bodyweight for administration of drugs to animals on the farms (positive association; Table S14), the maintenance of a colostrum bank (negative association; Table S17), and the number of annual veterinary visits to the farm (negative correlation; Table S18).

In relation to production outcomes, farming experience was associated with the annual milk production per animal (negative correlation; Table S19) (Figure 3) and the mean number of lambs or kids born per ewe or doe (negative correlation; Table S22).

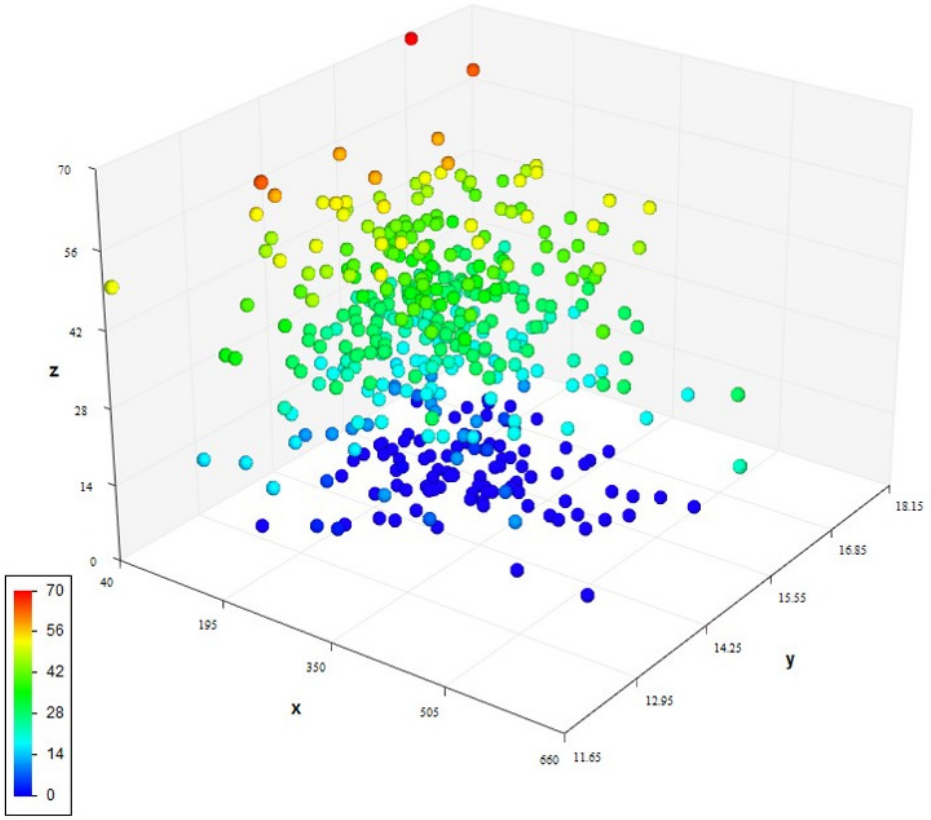

Figure 3. Three-dimensional scatter plot of results of annual milk production per animal (L) (x axis) and somatic cell scores in bulk-tank milk (y axis) against farming experience of respective farmers (years) (z axis) in 444 small ruminant farmers throughout Greece (each sphere represents a farm; the color of the sphere indicates the years of farming experience of respective farmers, according to the color legend at the bottom left corner of the diagram).

In relation to health parameters, farming experience was associated with the number of somatic-cell counts in bulk-tank milk (negative association; Table S25) (Figure 3) and the total bacterial counts in bulk-tank milk (negative association; Table S26).

3.3.2. Importance of External Farm Workers

Table 3 presents the details of the associations of the employment of external farm workers with the 11 variables for which a significance was found.

Table 3. The importance of employment of external farm workers among 444 small ruminant farmers throughout Greece for variables related to management practices, production outcomes or health parameters on their farms, for which significance was seen in multivariable analysis of socio-demographic characteristics.

Ext. Farm Worker Employ. [a]	**No Ext. Farm Worker Employ.** [a]	**Ext. Farm Worker Employ.** [a]	**No Ext. Farm Worker Employ.**	**Ext. Farm Worker Employ.**	**No Ext. Farm Worker Employ.**	**Ext. Farm Worker Employ.**	**No Ext. Farm Worker Employ.**	***p***
Farmers following intensive management system (n = 53)		Farmers following semi-intensive management system (n = 169)		Farmers following semi-extensive management system (n = 177)		Farmers following extensive management system (n = 45)		
(75.5%)	(24.5%)	(40.2%)	(59.8%)	(24.3%	(75.7%)	(13.3%)	(86.7%)	<0.001
Ext. Farm Worker Employ.		**No Ext. Farm Worker Employ.**		**Ext. Farm Worker Employ.**		**No Ext. Farm Worker Employ.**		***p***
Farmers applying machine-milking (n = 321)				Farmers applying hand-milking (n = 119)				
44.2%		55.8%		12.2%		87.8%		<0.001
Farmers with imported animal breeds (n = 184)				Farmers with indigenous animal breeds (n = 260)				
44.6%		55.4%		28.8%		71.2%		<0.001
Farmers applying quarantine measures (n = 374)				Farmers not applying quarantine measures (n = 70)				
39.3%		60.7%		14.3%		85.7%		<0.001
Farmers performing laboratory evaluation of feedstuffs and water provided to animals (n = 134)				Farmers not performing laboratory evaluation of feedstuffs and water provided to animals (n = 310)				
50.8%		49.2%		42.4%		57.6%		<0.001
Farmers using ultrasonographic examination for pregnancy diagnosis in the farm (n = 139)				Farmers not using ultrasonographic examination for pregnancy diagnosis in the farm (n = 305)				
47.5%		52.5%		29.8%		70.2%		<0.001
External Farm Worker Employment				**No External Farm Worker Employment**				***p***
Number of animals								
414.5 ± 22.4 animals				239.4 ± 10.8 animals				<0.001
Annual veterinary visits								
8.6 ± 0.6 visits				6.6 ± 0.4 visits				0.003
Annual milk production per animal								
234.4 ± 7.5 L				189.9 ± 5.7 L				<0.001
Protein content in bulk-tank milk								
4.2% ± 0.04%				4.1% ± 0.04%				0.021
Newborns per animal								
1.4 ± 0.02 newborns				1.3 ± 0.01 newborns				0.005

[a] ext.: external, employ: employment.

In relation to management practices, employment of external farm workers was significantly associated with the management system applied on farms (farmers following intensive management system mostly employing external farm workers; Table S4), the use of machine-milking (most farmers using machine-milking employed external farm workers; Table S5) (Figure 4), the number of animals on the farm (positive association; Table S6); the breed of animals (most farmers with imported animal breeds employed external farm workers; Table S7), the application of quarantine for animals newly entering into the farm (positive association; Table S8), the laboratory evaluation of feedstuffs and water (positive association; Table S10), the ultrasonographic examination for pregnancy diagnosis (positive association; Table S11), and the number of annual veterinary visits to the farm (positive association; Table S18).

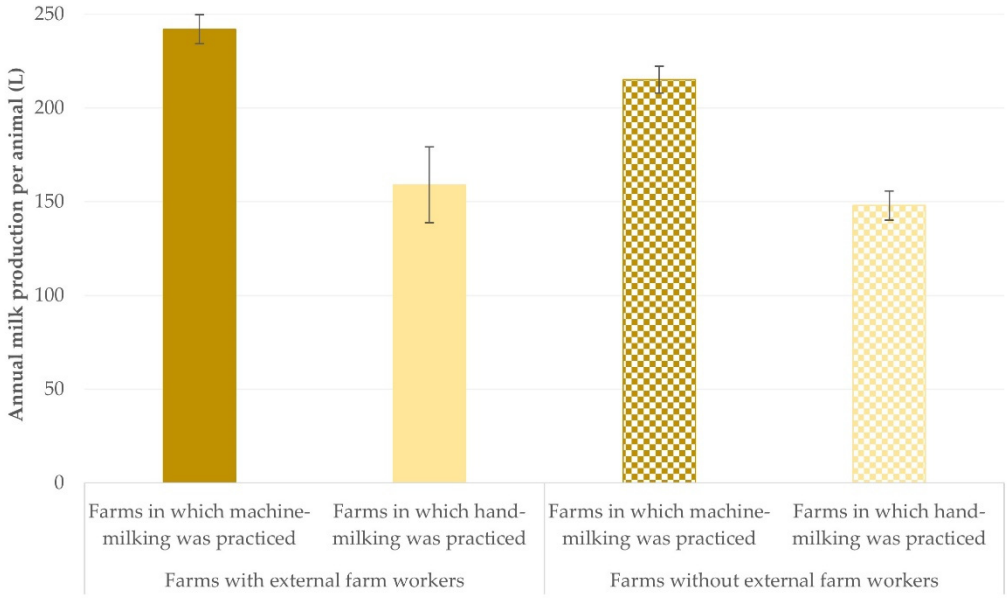

Figure 4. Mean annual milk production per animal (L) on 444 small ruminant farms throughout Greece, in accord with the use of machine- or hand-milking and employment of external farm workers.

In relation to production outcomes, employment of external farm workers was associated with the annual milk production per animal (positive association; Table S19) (Figure 4), the protein content in bulk-tank milk (positive association; Table S21), and the mean number of lambs or kids born per ewe or doe (positive association; Table S22).

The total number of people in the workforce on the farm was not associated with the management system ($p = 0.07$) or the use of machine- or hand-milking ($p = 0.15$) in the farms, but was correlated with the number of animals in the farms ($r = 0.3601$, $p < 0.001$).

4. Discussion

4.1. Preamble

The farming of small ruminants in Greece has been present since antiquity [16]. The practice has continued to modern times, despite significant disruptions, due to war-related events in the 20th century. Traditional farming communities, e.g., the '*tseliggato*', which included many families (often related) and their animals and provided vertically integrated production and processing of animal products [17], have played an important role during the post-1700s history of the country [18].

Small ruminant farming is currently the most important animal farming business in Greece, generating 18% of the total primary sector income [19]. Small ruminant farming in Greece is characterized overwhelmingly by dairy production. In this system, lambs/kids are weaned at the age of 5 to 90 days and then sent for slaughter at the age of 40 to 120 days. Animals are thereafter milked from 3 to 8 months and milk is sold to dairy factories for preparation of cheese or yoghurt. The importance of small ruminant farming for the Greek agriculture is illustrated by the fact that national annual milk production from small ruminants exceeds that from cattle [16].

The present study has investigated the socio-demographic profiles of small ruminant farmers in an extensive countrywide investigation on 444 farms. Moreover, the study evaluated potential associations of the socio-demographic characteristics with some management practices in the farms and explored effects on production and health of the animals. Farmers from all regions of Greece were included in the study; that way, situations and conditions present in all the parts of the country were taken into account and factors of regional importance weighed less. As far as we are aware, this has been the largest sample size used to investigate such issues in Greece; the authors believe, to the best of their knowledge, that it is also possibly a very large study internationally as well.

The best estimate of the number of small ruminant farms in the country is provided by the data of the Hellenic Milk Board, which records milk deliveries from farms, i.e., indicates that these farms are active and operating [1]. The farms studied in this work represent 0.84% and 0.91% of the total sheep and goat farms, respectively [1]. Although farms were enrolled in the study on a convenience basis, this approach nevertheless guaranteed acceptance of the visit by the farmers and lack of suspiciousness and distrust for the investigators, resulting in a relaxed interview. In order to minimize possible bias, the study used consistent methodologies and ensured that specific tasks were always performed by the same investigators.

The finding of 2.8 ± 0.1 persons, on average, working on a farm, allows us to estimate an average of approximately 145,000 people working in this sector in Greece, taking into account the 51,500 farms countrywide [1]. This may account for approximately 4% of the total workforce in the country (3,730,000 people [20]). Even taking into account approximations due to possible bias in the dataset, this figure further underlines the importance of the industry for the agricultural sector and the country in general.

4.2. Socio-Demographic Characteristics of Farmers

The results clearly indicate that small ruminant farming in Greece is a family business: 87% of farmers have followed a family tradition, whilst, on average, 2.2 family members work at the farms. It is also interesting that family tradition appeared to influence management practices followed at the farm, despite some practices being integral components of the health management on farms (e.g., anti-clostridial vaccination, ultrasonographic examination for pregnancy diagnosis) [21]. However, family tradition did not have any effect in the production outcomes on the farms, nor did it contribute to improved health-related parameters on the farms. In a previous study performed over 25 years ago, it was found that, on average, 1.95 family members were working at small ruminant farms at the time [22]. Although a direct comparison of those findings with the results of the present study is impossible as they derive from different datasets, a tendency appears for an increase of family members working at farms. This can be explained as a consequence of the recent significant economic crisis in Greece, as well as the need for an 'alternative' lifestyle that has probably supported this trend. However, it is possible this trend often hides under-employment and social deprivation [23].

It thus comes as no surprise that most farmers were found to be male (>90%). This could be a leftover from the '*tseliggato*' approach, in which men were involved in the animal work of the business and women in the preparation of the dairy products. The present study provided different results from the recent study by Tsiaousi and Partalidou [24], who reported that almost 30% of farmers were women and the majority of these were over 65 years of age. It is possible that the difference could be the consequence of the limited geographical extent of that study, which was performed in only one administrative region of the country, and its limited sample size. This discrepancy further underlines the importance of a countrywide investigation for a clearer picture of the socio-demographics of farmers. In any case, gender was associated only with the number of animals on the farms and was not found to have any influence in the production outcomes and health parameters on the farms.

The average age of farmers (in the mid-40s) is in line with the increased number of people that have entered work in the agricultural sector since 2010, i.e., after the emergence of economic problems in the country and the consequent recession. This is in contrast with the general trend for the age of farmers in across Europe, where only 11% of farmers are younger than 40 years of age [4]. The new entrants into agriculture are considered to have a younger age and a better educational background [25], which agrees with the finding that for almost 30% of the farmers in the study, post-secondary education was the highest level received. This pattern can also be associated with the trend for counter-urbanization and 'return to the countryside' prevalent in developed countries [26], which has also been described as occurring in Greece [27,28]. However, at the other end of the spectrum, a high

proportion of farmers are aged over 65 years, which could be the outcome of two issues: first, the traditional bond of the farmers with their land and animals and second, the low pensions to which farmers are entitled, both of which might result in a preference to be active until as late as possible.

The largest proportion of farmers were working full-time in the activity, with only a small proportion having small ruminant farming as a secondary activity. Part-time small ruminant farming can have two facets. In the first, people with a full-time job unrelated to agriculture may also own sheep or goats for an additional income or as a transitional step into full-time farming, within the frame of the local economies; for example, olive tree cultivation or small ruminant farming in the island of Crete are often combined with work in the local tourism hospitality industry. In the second, people have a multi-faceted approach of involvement in agriculture, with a variety of activities that often interact with each other, e.g., small ruminant farming and large-scale hay production. All of these can be viewed within the changes that farming households have introduced in their efforts to use the available resources flexibly, with a view to increasing their income.

Many foreign workers were employed on the dairy farms, as found by this study. The arrival of a foreign workforce in Greece during the last decade of the 20th century was an opportunity for the agricultural sector of the country; at that period, the restructure of the country, particularly of rural areas and populations, had resulted in pressure for agricultural labor, which was not eagerly provided by Greeks [25,29]. At the end of the previous century, the social restructuring in the country, coupled with the increase of education opportunities, resulted in the younger generation searching for employment outside of agriculture and away from rural areas [30,31]. There is consensus that the influx of foreign workers has benefited Greek agriculture; in 1995, foreign nationals were approximately 50% of the external farm workers in agriculture [32], and in the current study, they accounted for >85% of the external farm workers. The present findings are in line with the national situation in the primary sector, where foreign citizens are employed mainly on farms with intensive production (in the current study: on >75% of farms following intensive management systems) and increased labor requirements (in the current study: on >40% of farms applying machine-milking). Nevertheless, it seems that the number of foreign workers has decreased in recent years, mainly due to the requirements for their regularization in the early 2010s [25], which has led to increasing labor costs. Consequently, labor needs have again been filled by family members, and this is in line with the increase in family members involved in farming work compared to 1995, as discussed above.

4.3. Association with Management-, Production- and Health-Related Variables

The two socio-demographic characteristics found to be particularly associated with the management-, production- and health-related outcomes were the length of farming experience and the employment of external farm workers. The results have provided evidence that an increased length of farming experience was negatively associated with the adoption and use of some health management practices, which are nevertheless considered to be important on farms [8,21]; these included well-established practices, e.g., quarantining animals at their arrival at the farm or performing essential vaccinations. In a study performed in Scotland, it was found that around 60% of farmers would not adopt and apply new management tools on their farms [33]; it was also found that increased age (which is associated with experience) was a good predictor of that typology.

Moreover, farm productivity has been found to decrease progressively with farmers over 45 years of age [34]. In New Zealand, Corner-Thomas et al. [3] found that farmers aged over 50 years were using fewer health management tools and also used them less frequently than younger farmers, and this was the case even for procedures as basic as anti-clostridial vaccinations in sheep flocks [3]. This is consistent with the present study, in which we found that overlooking some management practices on the farms (e.g., anti-clostridial vaccination, pregnancy diagnosis) was associated with both age and experience of farmers. This neglect of standard health management practices would have contributed

to lower annual milk production per animal, fewer newborns per female animal and higher somatic cell counts and total bacterial counts in bulk-tank milk.

There were obviously direct links between the management factors that were omitted or overlooked and the production outcomes. An example of a neglected management factor is the lack of applying a pregnancy diagnosis in ewes or does; animals not found pregnant during a routine ultrasonographic examination can be put with male animals or culled, thus increasing lambing rates [21]. There is also a potential for consequences on product quality, as high somatic cell counts or total bacterial counts (i.e., over defined thresholds [6]) can lead to penalties in the price of milk collected by dairy factories.

Workload on the farm seemed to be the main determinant for the employment of external farm workers. Machine-milking of animals, high numbers of animals on the farm, performing various management tasks (e.g., collecting samples for laboratory evaluation, gathering and holding animals for ultrasonographic examination, following visiting veterinarians in their rounds, feeding large number of animals), i.e., variables found to be associated with the employment of external farm workers, require time and labor, hence the need for extra workforce becomes obvious. Employment of external farm workers was also found to be associated with higher production outcomes: higher annual milk production per animal, higher protein content in bulk-tank milk and more newborn lambs or kids per ewe or doe. These improved production outcomes result in increased income on the farm, through which the employment of workforce could be justified.

Employment of external farm workers can allow allocation of roles and subsequent development of expertise in specific tasks by people, e.g., feeding the animals, working at the milking parlor or performing basic health-related tasks. This way, proactivity and efficiency can be increased on the farm, as shown by the improved production outcomes. The consensus regarding the positive role of workforce in the operation and financial returns of agricultural business in Greece has been highlighted by Kasimis et al. [22]. Although many farmers would complain regarding the quality of work of those farm workers, they fully understand the significance of farm workers in performing various tasks [22]. Possibly, in the future, Greek dairy farmers would move towards the employment of more specialized and better-trained personnel for farm labor.

5. Conclusions

We investigated the socio-demographic characteristics of the people involved in small ruminant farming in Greece.

The findings indicate that sheep/goat farming is still a family-driven business (87% of farmers have a family tradition, 2.2 family members work at the farms), but, nevertheless, there are now younger people among small ruminant farmers (average age: 47.0 years), of whom several (28.4%) had received post-secondary education. The involvement of younger people in the industry bodes well for the future of the sector and its future direction. In several farms (35.4%), external farm workers were employed.

The socio-demographic characteristics may influence the management practices applied, which in turn can have consequences for production and health outcomes at the farms. Farming experience was the socio-demographic characteristic mostly associated with the above. Specifically, it was associated with location of farms (farmers in the islands with longest experience), management system (farmers following extensive management system with longest experience), breed of animals (farmers with indigenous breeds with longest experience), application of quarantine procedures, use of laboratory evaluation of feedstuffs, ultrasonographic examination for pregnancy diagnosis, anti-clostridial vaccination, maintenance of a colostrum bank, number of veterinary visits, milk production, number of newborns, milk somatic cell counts and total bacterial counts (negative association) and calculation of bodyweight for administration of drugs (positive association).

Employment of external farm workers was also often associated with management practices. Specifically, it was associated with management system (most often on farms following intensive management), machine-milking, number of animals, imported animal breeds, application of quarantine procedures, use of laboratory evaluation of feeds, ultrasonographic examination for pregnancy diagnosis, number of veterinary visits, milk production, milk protein content and number of newborns (positive association).

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/land10121358/s1, Table S1: The questionnaire used in the interview of farmers on 444 small ruminant farms in Greece. Table S2: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the area of the country (Central Greece, Islands of Greece, Northern Greece, Southern Greece), where farms were located. Table S3: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the animal species (sheep, goats) on the farms. Table S4: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with management system (intensive, semi-intensive, semi-extensive, extensive1) applied on the farms. Table S5: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with application of machine- or hand-milking on the farms. Table S6: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the number of animals on the farms. Table S7: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the breed of animals on the farms. Table S8: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the application of quarantine measures for animals newly entering into the farms. Table S9: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the number of occasions in which cleaning and disinfection procedures were performed at the farms annually. Table S10: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with performing laboratory evaluation of feedstuffs and water provided to the animals on the farms. Table S11: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the use of ultrasonographic examination for pregnancy diagnosis on the farms. Table S12: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with application of anti-clostridial vaccination on the farms. Table S13: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with administration of 'dry-ewe' treatment at the end of the lactation period on the farms. Table S14: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the method of calculation of bodyweight for administration of drugs to animals on the farms. Table S15: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with keeping prescribed withdrawal periods after drug administration on the farms. Table S16: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with provision of care to the newborns on the farms. Table S17: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the maintenance of a colostrum bank on the farms. Table S18: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the number of veterinary visits to the farms annually. Table S19: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the mean milk production per ewe or doe during the preceding season on the farms. Table S20: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the fat content of the bulk-tank milk on the farms. Table S21: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the protein content of the bulk-tank milk on the farms. Table S22: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the mean number of lambs or kids born per ewe or doe during the preceding season on the farms. Table S23: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the mean body condition score of animals examined on the farms. Table S24: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the incidence risk of clinical mastitis during the preceding period on the farms. Table S25: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the somatic cell counts in the bulk-tank milk on the farms. Table S26: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the total bacterial counts in the bulk-tank milk on the farms. Table S27: Socio-demographic characteristics of small ruminant farmers in Greece (n = 444), in accord with the incidence risk of deaths of adult animals during the preceding season on the farms.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Variables evaluated for potential association with socio-demographic characteristics of farmers on 444 small ruminant farms in Greece.

Part of the country (central part, islands, north part, south part)
Animal species farmed
Management system applied in the farm (description according to EFSA classification) [8]
Machine- or hand-milking
Number of animals in the farm (no.)
Breed of animals (description)
Application of quarantine measures for animals newly entering into a farm (yes/no)
Occasions in which cleaning and disinfections procedures are performed at the farms annually (no.)
Laboratory evaluation of feedstuffs and water provided to the animals (yes/no)
Use of ultrasonographic examination for pregnancy diagnosis (yes/no)
Vaccination against clostridial infections (yes/no)
Administration of 'dry-ewe' treatment at the end of the lactation period (yes/no)
Method of calculation of bodyweight for administration of drugs to animals (estimation/weighing)
Keeping prescribed withdrawal periods after drug administration (yes/no)
Provision of care to the newborns (yes/no)
Maintenance of a colostrum bank in the farm (yes/no)
Number of veterinary visits to farm annually (no.)
Mean milk production per ewe or doe during the preceding season (litres)
Fat content of the bulk-tank milk (%)
Protein content of the bulk-tank milk (%)
Mean number of lambs or kids born per ewe or doe during the preceding season (no.)
Body condition score (1–5)
Incidence risk of clinical mastitis during the preceding season (%)
Somatic cell counts in the bulk-tank milk (cells mL^{-1})
Total bacterial counts in the bulk-tank milk (cfu mL^{-1})
Incidence risk of deaths of deaths of adult animals during the preceding season (%)

References

1. Hellenic Agricultural Organisation—Demeter. Deliveries of Ovine and Caprine Milk by Region and Regional Authority and Average Milk Price—Calendar Year 2019. Cumulative Data Updated. Available online: https://www.elgo.gr/images/ELOGAK_files/Statistics/2020/AIGO_%CE%A0%CE%B1%CF%81%CE%B1%CE%B4%CF%8C%CF%83%CE%B5%CE%B9%CF%82_%CE%A0%CF%81%CF%8C%CE%B2%CE%B5%CE%B9%CE%BF%CF%85_%CE%BA%CE%B1%CE%B9_%CE%93%CE%AF%CE%B4%CE%B9%CE%BD%CE%BF%CF%85_%CE%93%CE%AC%CE%BB%CE%B1%CE%BA%CF%84%CE%BF%CF%82_2019.pdf (accessed on 20 December 2020).
2. Pulina, G.; Milan, M.J.; Lavin, M.P.; Theodoridis, A.; Morin, E.; Capote, J.; Thomas, D.L.; Francesconi, A.H.D.; Caja, G. Current production trends, farm structures, and economics of the dairy sheep and goat sector. *J. Dairy Sci.* **2018**, *101*, 6715–6729. [CrossRef] [PubMed]
3. Corner-Thomas, R.A.; Kenyon, S.P.R.; Morris, T.; Ridler, A.I.; Hickson, R.E.; Greer, A.W.; Logan, C.M.; Blair, H.T. Influence of demographic factors on the use of farm management tools by New Zealand farmers. *N. Z. J. Agric. Res.* **2015**, *58*, 412–422. [CrossRef]
4. European Commission. Common Agricultural Policy: Young farmers. Available online: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/income-support/young-farmers_en (accessed on 20 July 2021).
5. DePeters, E.J.; Cant, J.P. Nutritional factors influencing the nitrogen composition of bovine milk: A review. *J. Dairy Sci.* **1992**, *75*, 2043–2070. [CrossRef]
6. Bencini, R.; Pulina, B. The quality of sheep milk: A review. *Aus. J. Exp. Agric.* **1997**, *37*, 485–504. [CrossRef]
7. Paape, M.J.; Wiggans, G.R.; Bannerman, D.D.; Thomas, D.L.; Sanders, A.H.; Contreras, A.; Moroni, P.; Miller, R.H. Monitoring goat and sheep milk somatic cell counts. *Small Rumin. Res.* **2007**, *68*, 114–125. [CrossRef]
8. Sargison, N. *Sheep Flock Health a Planned Health Approach*; Blackwell Science: Oxford, UK, 2008; p. 465.
9. Adjou, K.; Autef, P. *Practical Guide of Ovine Medicine and Surgery*; Wolters-Kluwer France: Ruell-Malmaison, France, 2013; p. 192.
10. Lianou, D.T.; Chatziprodromidou, I.P.; Vasileiou, N.G.C.; Michael, C.K.; Mavrogianni, V.S.; Politis, A.P.; Kordalis, N.G.; Billinis, C.; Giannakopoulos, A.; Papadopoulos, E.; et al. A detailed questionnaire for the evaluation of health management in dairy sheep and goats. *Animals* **2020**, *10*, 1489. [CrossRef] [PubMed]
11. Martin, W.B.; Aitken, A.I. Appendix C. In *Diseases of Sheep*, 3rd ed.; Martin, W.B., Aitken, I.A., Eds.; Blackwell Science: Oxford, UK, 2000; p. 502.
12. Laird, D.T.; Gambrel-Lenarz, S.A.; Scher, F.M.; Graham, T.E.; Reddy, R. Microbiological Count Methods. In *Standard Methods for the Examination of Dairy Products*, 17th ed.; Wehr, H.M., Frank, J.F., Eds.; APHA Press: Washington, DC, USA, 2004; pp. 153–186.
13. European Food Safety Authority. Scientific opinion on the welfare risks related to the farming of sheep for wool, meat and milk production. *EFSA J.* **2014**, *12*, 3933–4060.
14. Wiggans, G.R.; Shook, G.E. A lactation measure of somatic cell count. *J. Dairy Sci.* **1987**, *70*, 2666–2672. [CrossRef]
15. Franzoi, M.; Manuelian, C.L.; Penasa, M.; De Marchi, M. Effects of somatic cell score on milk yield and mid-infrared predicted composition and technological traits of Brown Swiss, Holstein Friesian, and Simmental cattle breeds. *J. Dairy Sci.* **2020**, *103*, 791–804. [CrossRef] [PubMed]
16. Hadjigeorgiou, I.; Vallerand, F.; Tsimpoukas, K.; Zervas, G. The socio-economics of sheep and goat farming in Greece and the implications for future rural development. *Opt. Méditerran. B Etud. Recherch.* **2002**, *39*, 83–93.
17. Thanopoulos, G. Agricultural and Shepherding Life. In *Public and Private Life in Greece II: The Recent Years*; Ekaterinidis, G., Alexakis, E., Giatrakou, M.E., Thanopoulos, G., Spathari-Begliti, E., Tzakis, D., Eds.; Greek Open University: Patras, Greece, 2002; pp. 80–87.
18. Arseniou, L.A. *The Tseliggata*, 2nd ed.; Private Edition: Larissa, Greece, 1972; p. 68.
19. Ministry of Agricultural Development & Food. *Greek Agriculture—Animal Production*; Ministry of Agricultural Development & Food, General Directorate for Animal Production: Athens, Greece, 2018; p. 16.
20. Hellenic Statistical Authority. *Greece in Numbers*; Hellenic Statistical Authority: Athens, Greece, 2021; p. 83.
21. Fthenakis, G.C.; Arsenos, G.; Brozos, C.; Fragkou, I.A.; Giadinis, N.D.; Giannenas, I.; Mavrogianni, V.S.; Papadopoulos, E.; Valasi, I. Health management of ewes during pregnancy. *Anim. Reprod. Sci.* **2012**, *130*, 198–212. [CrossRef] [PubMed]
22. Kasimis, C.; Papadopoulos, A.G.; Zacopoulou, E. Migrants in rural Greece. *Sociol. Rural.* **2003**, *43*, 167–184. [CrossRef]
23. Anthopoulou, A.; Kaberis, N.; Petrou, M. Aspects and experiences of crisis in rural Greece. Narratives of rural resilience. *J. Rural Stud.* **2017**, *52*, 1–11. [CrossRef]
24. Tsiaousi, A.; Partalidou, M. Female farmers in Greece: Looking beyond the statistics and into cultural-social characteristics. *Outl. Agric.* **2020**, *50*, 55–63. [CrossRef]
25. Kasimis, C.; Papadopoulos, A.G. Rural Transformations and Family Farming in Contemporary Greece. In *Research in Rural Sociology and Development*; Marsden, T., Ed.; Emerald Publishing: Bingley, UK, 2013; pp. 263–293.
26. Halfacree, K.H. Rurality and post-rurality. *Int. Encycl. Hum. Geogr.* **2009**, *9*, 449–456.
27. Anastasiou, E.; Duquenne, M.N. Return to the Rural in Greece During the Last Decade: A Methodological Approach of the Potential Spatial Patterns. In Proceedings of the 5th International Conference of the Balkans Demography: The Population of the Balkans at the Dawn of the 21st Century, Ohrid, North Macedonia, 21–24 October 2017; pp. 331–354.
28. Anastasiou, E.; Duquenne, M.N. Determinants and spatial patterns of counterurbanisation in times of crisis: Evidence from Greece. *Popul. Rev.* **2020**, *59*, 85–110.

29. Kasimis, C.; Papadopoulos, A.G. The de-agriculturalisation of the Greek countryside: The changing characteristics of an ongoing socio-economic transformation. In *Europe's Green Ring*; Granberg, L., Kovacs, I., Tovey, H., Eds.; Routledge: Aldershot, UK, 2001; pp. 179–218.
30. Lazaridis, G.; Psimmenos, I. Migrant flows from Albania to Greece: Economic, social, and spatial exclusion. In *Eldorado or Fortress? Migration in Southern Europe*; King, R., Lazaridis, G., Tsardanidis, C., Eds.; Macmillan: London, UK, 2000; pp. 170–185.
31. Papadopoulos, A.G. Rural immigrations and female employment. In *Rural Gender Relations: Issues and Case Studies*; Bock, B.B., Shortall, S., Eds.; CABI: London, UK, 2006; pp. 196–213.
32. Lianos, T.P.; Sarris, A.H.; Katseli, L. Illegal migration and local labour markets: The case of Northern Greece. *Int. Migr.* **1996**, *34*, 449–484. [CrossRef] [PubMed]
33. Liu, J.; Toma, L.; Barnes, A.P.; Stott, A. Farmers' uptake of animal health and welfare technological innovations. Implications for animal health policies. *Fr. Vet. Sci.* **2019**, *6*, 410. [CrossRef] [PubMed]
34. Tauer, L. Age and farmer productivity. *Rev. Agric. Econ.* **1995**, *17*, 63–69. [CrossRef]