JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

A cross-sectional study on animal nutrition and management evaluation of selected small ruminant enterprises in Sakarya and Balıkesir.

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Research article

Volume: 8, Issue: 3
December, 2024
Pages: 321-334

ABSTRACT

This study was conducted to determine the deficiencies or improvable aspects in this area in order to carry out sustainable and more efficient small ruminant farming in Balıkesir and Sakarya provinces, to reveal the demographic and structural status of small ruminant farming, animal health conditions, production techniques applied by enterprises with existing opportunities, biosecurity, health-protection, care-feeding and other elements. For this purpose, the results obtained from a face-to-face survey conducted on a total of 200 enterprises, 150 in Balıkesir and 50 in Sakarya, were evaluated. It has been observed that while most small ruminant enterprises in Balıkesir do not have cattle, cattle farming is more prominent in Sakarya. In both provinces, a significant proportion of owners were over 46 years old, and only a small percentage were university graduates. When the enterprises in the two provinces are compared, the rates obtained regarding the types of small ruminant enterprises in Balıkesir such as fattening (84%), the dominance of extensive and semi-extensive enterprises in terms of enterprise structure (33%), the presence of poultry in the enterprise (43%), environmental spraying (45%), the use of factory feed in feeding the animals (98.7%), vitamin-mineral supplements (41.3%), the use of pasture (93.3%), the use of vetch hay (16%), the use of automatic water dispensers (15.6%), buckets (70.9%), water tanks (25.2%) in water supply to the animals, the presence of a maternity area in the enterprise (75.3%) and umbilical cord care and hygiene in neonates (67.1%) were found to be higher than the enterprises in Sakarya ($p<0.05$). On the other hand, the proportions obtained regarding the enterprise type of small ruminant enterprises in Sakarya being combined (meat-milk) (94%), the dominance of closed farms in terms of farm structure (94%), quarantine application for new animals entering the farm (26%), the use of barley (98%), oats (24%), alfalfa (66%), oat straw (76%), the use of licking stones (98%), the use of troughs for water supply (100%), keeping rams separate from the herd (46%), the ability of the farm owner to help during difficult births (100%) and postpartum cleaning (87%) were found to be significantly higher than the rates obtained from the farms in Balıkesir. Therefore, in order enhance the efficiency of small livestock enterprises in both provinces and to eradicate the shortcomings, negative aspects, and faults found in these businesses, educational activities and practices are required.

Keywords: sheep, goat, survey, small ruminant, farm, nutrition

Article History

Received: 21.12.2024
Accepted: 30.12.2024
Available online: 30.12.2024

DOI: https://doi.org/10.30704/http-www-jivs-net.1605281

To cite this article: Altinöz, T., Danyer, E., Gündoğan, T. T., Keser, O., Öklen, S. B., Bilal, T. (2024). A cross-sectional study on animal nutrition and management evaluation of selected small ruminant enterprises in Sakarya and Balıkesir. ***Journal of Istanbul Veterinary Sciences, 8*(3), 321-334. Abbreviated Title*: J. İstanbul vet. sci.**

Introduction

As in every country, the livestock sector has a great importance in meeting the need for animal protein in Türkiye. The contributions of animal husbandry on a national basis include national nutrition and development, increase in exports, provision of raw materials, employment and consequently prevention of hidden unemployment in rural areas, balanced development between sectors and ensuring stability (Aydemir and Pıçak, 2007). While pork and beef have a large share in red meat production in the world, in

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Türkiye this demand is mainly met by beef and sheep meat. Considering the geographical, climatic and agricultural structure, sheep breeding, which provides significant advantages in terms of cost and quality, has continued in our country until recently as both an economic animal production activity and a part of cultural and family life (Çiçek et al., 2022).

It is noteworthy that the sheep population in Türkiye fluctuates from year to year. As a matter of fact, the number of sheep, which was approximately 40 million heads in 1975, increased to 45-50 million between 1980-1985, decreased to approximately 33.7, 28.5, 25.2 and 21.7 million in 1995, 2000, 2004 and 2009, respectively, and increased again in 2019 and 2021 to 37.3 and 45.2 million, respectively (Aydemir and Pıçak, 2007; Çiçek et al., 2022). According to a recent report by the Turkish Statistical Institute, the number of sheep was recorded as 42,060,470 in 2023, showing a 5.9% decrease compared to the previous year, and this number increased by 3.2% in 2024, totaling 43,393,709 heads in June (TÜİK, 2024). In the same report, it was also reported that the number of goats, which was 10,302,940 in 2023, increased by 2.6% to 10,571,297 in 2024.

Today, although animal production and the amount of consumption of the products obtained from this production are used as an indicator of development, the consumption of animal products in Türkiye, which is a country with a significant potential in terms of animal population and suitable climatic conditions for animal breeding, has remained at a low level compared to other countries, and the reason behind this is the effort of producers to meet the need for animal products within a closed system production model that adopts self-sufficiency due to their long-standing habits (Aydemir and Pıçak, 2007).

In Türkiye, small ruminant breeding is generally carried out extensively based on pasture with domestic breeds with low combined productivity, and the number of enterprises engaged in intensive breeding with improved breeds imported from abroad is quite small. Especially since sheep breeding is carried out in the form of extensive production, flock management practices differ in the same or different regions. For example, while some livestock breeders do not separate the ram from the flock at all, some livestock breeders add rams in different seasons according to their own preferences, while some farms do milking, some farms do not milk and make the lambs suckle during lactation, and the suckling period of the lambs also varies from farm to farm (Ülsü and Çilek, 2024).

As in all other sectors, increasing productivity, maintaining stability, ensuring progress and minimizing or preventing the adversities encountered in the livestock industry depend on scientific studies in this field. Considering that the increase in capacity and efficiency especially in the field of small ruminant breeding depends on factors such as pasture characteristics, pasture grazing capacity, climate, roughage source, market security and stability, breeding animal supply, disease and pest risk, labor force and similar factors, it is obvious how important scientific researches on this sector are. In this regard, survey studies that provide data revealing the current situation of enterprises on a general or regional basis are as essential as experimental researches carried out on animals in order to search for alternative ways to increase yield performance. As a matter of fact, surveys are the best known and most frequently used method for obtaining original data and primary data in agricultural researches are mostly obtained through surveys as a time-saving and less costly technique (Oruç and Gürler, 1994).

In this context, in this study, it was aimed to carry out a comprehensive cross-sectional study to reveal the deficiencies of the livestock farmers in Balıkesir and Sakarya provinces, which provide a large part of the demand for small ruminant products of the surrounding provinces, especially Istanbul, in order to carry out sustainable and more efficient animal husbandry, to determine the deficiencies of the breeders or to determine the aspects that can be improved, to obtain data on issues such as the structural status of small ruminant farming, animal health conditions, production techniques applied with the existing facilities, basic problems such as health-protection, care-feeding and socio-economic status.

Materials and Methods

This study was designed in cross-sectional descriptive study. The main material of the study consisted of original data obtained from small ruminant farming enterprises through face-to-face questionnaires. The prepared questionnaire was planned to take approximately 10 minutes and this time was proved to be sufficient in the preliminary test on people who were not related to the subject. The data collection process involved the period between 01 October and 30 December 2023. Balıkesir and Sakarya provinces, which are considered to be representative of the region, were preferred as the study area since they provide a large part of the small ruminant demand of the surrounding provinces, especially Istanbul, in the Marmara Region. In this context, data on the number of enterprises and the number of small ruminants in the enterprises were obtained from the Provincial and District Directorates of Agriculture and Forestry and Animal Information System, and a face-to-face survey

was conducted in a total of 200 enterprises, 126 and 24 in Bigadiç and Sındırgı districts of Balıkesir province, respectively, and 50 in Taraklı district of Sakarya province, and the structure of the relevant enterprises, protection control methods against diseases, feeding methods of animals, habits of the enterprises on issues such as hygiene, vaccination and disinfection were discussed. The number of enterprises to be surveyed was calculated by simple random sampling method.

It was estimated that there were approximately 1,000 small ruminant enterprises in Balıkesir and Sakarya. The sample size was calculated using the following formula and OpenEpi, Version 3, Open Source Calculator-SSPropor software. A sample size of 186 was needed for a population size of 1000, a prevalence of 50% ± 5%, 95% confidence level, 6.5% margin of error (precision) and 1 design effect.

$$n = deff \times \frac{N\hat{p}\hat{q}}{\frac{d^2}{1.96^2}(N-1) + \hat{p}\hat{q}}$$

n = number of samples, $deff$ = design effect, N = population size,

$\hat{p}$ = estimated proportion, $\hat{q} = 1 - \hat{p}$, d = desired absolute precision

The data obtained from the standard and study-specific questionnaires were analysed using SPSS v.20 package programme. Number and percentage distributions of categorical variables were used in the analyses. Chi-square and Fisher's exact Chi-square tests were used in the comparisons to reveal the differences between the two provinces.

Results

The number of animals of the enterprises included in the study is presented in Figure 1. When the percentages of the groups of animal numbers were evaluated, it was observed that the herds in Sakarya were smaller and Balıkesir had more small ruminant population. While most of the small ruminant farms in Balıkesir do not have cattle, it was determined that cattle are more prominent in Sakarya.

The evaluation of the demographic and structural status of small ruminant farming enterprises was presented in Table 1. There was no difference in the age distribution of enterprise owners in both provinces, and it was determined that a significant portion of enterprise owners in both provinces were over 46 years of age. According to the data obtained regarding the educational status of the enterprise owners, it was found that 8% of the owners of the enterprises included in the study from Balıkesir province were university graduates, but none of the owners of the enterprises in Sakarya were university graduates. It was observed that 61% and 80% of the enterprise owners in Balıkesir and Sakarya provinces, respectively, were at secondary school and before, and 31% and 20% were at high school level. While 84% of the enterprises in Balıkesir were of fattening type, only 6% in Sakarya were of fattening type; 33% of the enterprises in Balıkesir were of extensive and semi-extensive type, but only 6% in Sakarya were of the same type (p=0.001).

The evaluation of the enterprises in terms of precautions taken to minimize possible disease risks and general biosecurity practices was presented in Table 2. According to the data on the presence of different animal species in the related enterprises, it was found that 43% of the enterprises in Balıkesir had poultry while this rate was 18% in Sakarya. In addition, 90% of the enterprises in Balıkesir and 43% of the enterprises in Sakarya contained cats and dogs, but there was no significant difference between the two

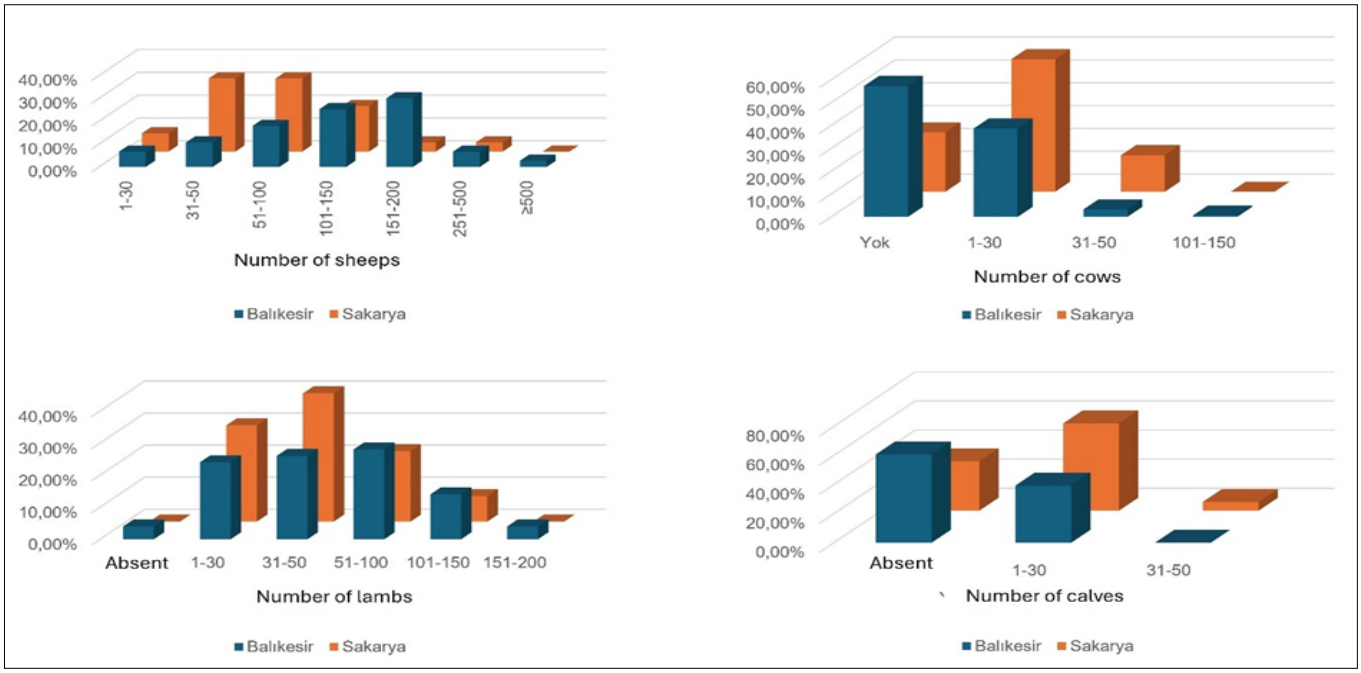

Figure 1. Distribution of the number of animals in the enterprises

Table 1. Demographic and structural characteristics of the enterprises.

	Balıkesir	Sakarya	Overall	*p-value*
Age distribution of enterprise owners				
≤24	4 (2.7 %)	2 (4 %)	6 (3 %)	
25-35	18 (12 %)	8 (16 %)	26 (13 %)	
36-45	38 (25 %)	8 (16 %)	46 (23 %)	0.70
46-55	43 (28 %)	16 (32 %)	59 (29 %)	
>=56	47 (31 %)	16 (32 %)	63 (31 %)	
Education status of the enterprise owner				
Secondary school and before	92 (61 %)	40 (80 %)	132 (66 %)	
High school	46 (31 %)	10 (20 %)	56 (28 %)	0.06
University	12 (8 %)	0 (0 %)	12 (6 %)	
Type of enterprise				
Fattening	126 (84 %)	3 (6 %)	129 (64 %)	0.001
Dual-purpose	24 (16 %)	47 (94 %)	71 (36 %)	
Structure of enterprise				
Intensive system	100 (66 %)	47 (94 %)	147 (73 %)	0.001
Extensive and semi-extensive system	50 (33 %)	3 (6 %)	53 (26 %)	

provinces (p=0.44). The use of parasite medicines in cats and dogs in Balıkesir and Sakarya provinces was 57% and no significant difference was found (p=0.55). It was determined that 45% of the enterprises in Balıkesir applied environmental disinfestation while this rate was approximately 14% in Sakarya (p=0.003). Depending on environmental spraying, the rates of fly presence were 59% and 94% for Balıkesir and Sakarya, respectively. It was also observed that 62% of the enterprises in Sakarya and 71% in Balıkesir did not perform fly control. In both provinces, the proportion of enterprises with new animal entries in the last one year was determined as 26% and 14% in Balıkesir and Sakarya, respectively, and no significant difference was found (p=0.14). It was determined that the participants were quite insufficient in terms of quarantine application for new animals and disinfection of vehicles entering the enterprise from outside.

The data on the feed and feed ingredients used in the enterprises, excluding the flushing period, was presented in Table 3. In the small ruminant farming enterprises participated from Balıkesir and Sakarya provinces, the proportions of enterprises using concentrate feed were determined as 64% and 78% for wheat, 28% and 98% for barley, 10% and 24% for oat and 99% and 62% for factory feed (pellet), respectively. Although there was a significant difference between the two provinces in terms of the proportions of enterprises using oat (p=0.02), pellet feed (p=0.001) and barley (p=0.001), no significant difference was found for wheat. Vitamin and mineral supplements were not used in any of the enterprises from Sakarya,

Table 2. Data on selected biosecurity practices in the enterprises.

	Balıkesir		Sakarya		Overall		*p-value*
	Yes	No	Yes	No	Yes	No	
Presence of different animal species							
Poultry	65 (43 %)	85 (57 %)	9 (18 %)	41 (82 %)	74 (37 %)	126 (63 %)	0.001
Cat, dog	135 (90 %)	15 (10 %)	43 (86 %)	7 (14 %)	178 (89 %)	22 (11 %)	0.44
Administration of antiparasitic to cats and dogs							
	85 (57 %)	63 (42 %)	28 (57.1 %)	21 (42.9 %)	113 (57 %)	84 (42 %)	0.55
Application of environmental disinfestation							
	39 (45 %)	48 (55 %)	4 (13.8 %)	25 (86.2 %)	43 (37 %)	73 (63 %)	0.003
Presence of flies							
	88 (59 %)	62 (41 %)	47 (94 %)	3 (6 %)	135 (67 %)	65 (32 %)	0.99
Applications to rid flies							
	43 (28 %)	107 (71 %)	19 (38 %)	31 (62 %)	62 (31 %)	138 (69 %)	0.22
New animal entry (last year)							
	111 (74 %)	39 (26 %)	43 (86 %)	7 (14 %)	154 (77 %)	46 (23 %)	0.14
Quarantine for new animals							
	17 (11 %)	133 (88 %)	13 (26 %)	37 (74 %)	30 (15 %)	170 (85 %)	0.02
Application of vehicle disinfection							
	12 (8 %)	138 (92 %)	8 (16 %)	42 (84 %)	20 (10 %)	180 (90 %)	0.11

whereas 41% of the enterprises from Balıkesir used them (p=0.001). In order to meet the mineral requirements of animals, 86% of the enterprises in Balıkesir and 98% of the enterprises in Sakarya preferred to use licking stones. In Balıkesir and Sakarya, it was determined that 93% and 76% of the enterprises participating in the survey preferred to graze their animals on pasture, respectively, and a significant difference was found in pasture preference between the two provinces (p=0.03). For Balıkesir and Sakarya provinces, the proportions of enterprises using roughage were 44% and 66% for alfalfa, 8% and 76% for oat straw, 97% and 90% for wheat straw, 12% and 10% for grass hay, 16% and 2% for vetch hay, 3% and 8% for beet pulp, 1% and 2% for forage pea, respectively. However, preference for sainfoin was found only in Sakarya with 4% of enterprises. There was a significant difference between the two provinces only in terms of preference for pasture (p=0.03), alfalfa (p=0.01), oat straw (p=0.001) and vetch hay (p=0.006), and it was also noteworthy that the use of valuable and alternative forages such as beet pulp, forage pea and sainfoin was very rare.

The data on the methods of water provision to animals in the enterprises were presented in Table 4. It was determined that the rate of enterprises using automatic water dispensers was 16% in Balıkesir and 2% in Sakarya (p=0.03). The proportions of the enterprises using buckets, water troughs and water tanks to supply water to animals were determined as 71% and 37%, 70% and 100%, 25% and 0% for Balıkesir and Sakarya, respectively, and a significant difference was found between the two provinces in terms of these water supply methods (p=0.001).

The data on parturition management and practices in small ruminant enterprises were presented in Table 5. It was observed that the proportion of enterprises separating rams from the flock was 18% in Balıkesir province and 46% in Sakarya province, and the proportion of enterprises not preferring to separate rams from the flock in Balıkesir province was significantly higher than those of in Sakarya province

Table 3. Data on feeds and feedstuffs used outside the flushing period in the enterprises.

	Balıkesir		**Sakarya**		**Overall**		***p-value***
	Yes	No	Yes	No	Yes	No	
Concentrate feeds and feedstuffs							
Wheat	96 (64 %)	54 (36 %)	39 (78 %)	11 (22 %)	135 (67.5%)	65 (32.5 %)	0.07
Barley	42 (28 %)	108 (72 %)	49 (98 %)	1 (2 %)	91 (45.5%)	109 (54.5 %)	0.001
Oat	15 (10 %)	135 (90 %)	12 (24 %)	38 (76 %)	27 (13.5 %)	173 (86.5 %)	0.02
Factory feed	148 (98.7 %)	2 (1.3 %)	31 (62 %)	19 (38 %)	179 (89.5 %)	21 (10.5 %)	0.001
Vitamin-mineral supplements							
	62 (41.3 %)	88 (58.7 %)	0 (0 %)	50 (100 %)	62 (31 %)	138 (69 %)	0.001
Licking stone							
	129 (86 %)	21 (14 %)	49 (98 %)	1 (2 %)	178 (89 %)	22 (11 %)	0.04
Forages							
Pasture	140 (93.3 %)	10 (6.7 %)	38 (76 %)	12 (24 %)	178 (89 %)	22 (11 %)	0.03
Alfalfa	66 (44 %)	84 (56 %)	33 (66 %)	17 (34 %)	99 (49.5 %)	101 (50.5 %)	0.01
Oat straw	12 (8 %)	138 (92 %)	38 (76 %)	12 (24 %)	50 (25 %)	150 (75 %)	0.001
Wheat straw	145 (96.7 %)	5 (3.3 %)	45 (90 %)	5 (10 %)	190 (95 %)	10 (5 %)	0.12
Grass hay	18 (12 %)	132 (88 %)	5 (10 %)	45 (90 %)	23 (11.5 %)	177 (88.5 %)	0.08
Vetch hay	24 (16 %)	126 (84 %)	1 (2 %)	49 (98 %)	25 (12.5 %)	175 (87.5 %)	0.006
Beet pulp	4 (2.7 %)	146 (97.3 %)	4 (8 %)	46 (92 %)	8 (4 %)	192 (96 %)	0.1
Forage pea	2 (1.3 %)	148 (98.7 %)	1 (2 %)	49 (98 %)	3 (1.5 %)	197 (98.5 %)	0.99
Sainfoin hay	0 (0 %)	150 (100 %)	2 (4 %)	48 (96 %)	2 (1 %)	198 (99 %)	0.06

Table 4. Data on the methods of water provision to animals in enterprises.

	Balıkesir		**Sakarya**		**Overall**		***p-value***
	Yes	No	Yes	No	Yes	No	
Automatic	23 (15.6 %)	124 (84.4 %)	1 (2.4 %)	49 (98 %)	24 (12.8 %)	164 (87.2 %)	0.03
Bucket	105 (70.9 %)	43 (29.1 %)	16 (37.2 %)	27 (62.8 %)	121 (63.4 %)	70 (36.6 %)	0.001
Water trough	103 (70.1 %)	44 (29.9 %)	50 (100 %)	0 (0 %)	153 (77.7 %)	44 (22.3 %)	0.001
Water tank	37 (25.2 %)	110 (74.8 %)	0 (0 %)	40 (100 %)	37 (19.8 %)	150 (80.2 %)	0.001
From pasture	129 (87.8 %)	18 (12.2 %)	44 (91.7 %)	4 (8.3 %)	173 (88.7 %)	22 (11.3 %)	0.6

Table 5. The data on parturition management and practices in the enterprises.

Balıkesir		Sakarya		Overall		*p-value*
Yes	No	Yes	No	Yes	No	
Separation of rams from the flock						
28 (18.7%)	122 (81.3%)	23 (46%)	27 (54%)	51 (25.5%)	149 (14.5%)	0.001
Vaccination of pregnant animals						
127 (84.7%)	23 (15.3%)	39 (78%)	11 (22%)	166 (83%)	34 (17%)	0.28
The presence of a maternity area						
113 (75.3%)	37 (24.7%)	18 (36%)	32 (64%)	131 (65.5%)	69 (34.5%)	0.001
The presence of birthing pen						
5 (3.3%)	145 (96.7%)	3 (6%)	47 (94%)	8 (4%)	192 (96%)	0.41
Enterprise owner knows the signs of parturition						
147 (98%)	3 (2%)	50 (100%)	0 (0%)	197 (98.5%)	3 (1.5%)	0.57
Enterprise owner can assist during case of dystocia						
132 (88%)	18 (12%)	48 (100%)	0 (0%)	180 (90.9%)	18 (9.1%)	0.008
Postpartum cleaning of the parturition area						
49 (32.7%)	101 (67.3%)	42 (87.5%)	6 (12.5%)	91 (46%)	107 (54%)	0.001
Administration of the colostrum to neonates within first two hours						
140 (93.3%)	10 (6.7%)	44 (88%)	6 (12%)	184 (92%)	16 (8%)	0.23
Forced administration of colostrum when necessary						
113 (75.3%)	37 (24.7%)	40 (80%)	10 (20%)	153 (76.5%)	47 (23.5%)	0.56
Umbilical cord care and disinfection						
100 (67.1%)	49 (32.9%)	17 (34%)	33 (66%)	117 (58.8%)	82 (41.2%)	0.001

(p=0.001). The rate of enterprises not vaccinating pregnant animals was determined as 15% and 22% for Balıkesir and Sakarya provinces, respectively, and no significant difference was found between the two provinces. In Balıkesir and Sakarya provinces, the proportion of enterprises with a maternity area was determined as 75% and 36%, respectively, and this difference between the two provinces was statistically significant (p=0.001). Although there was no statistically significant difference, it was found that there was no owner who did not know the signs of parturition in Sakarya, whereas 2% of the owners in Balıkesir did not know the signs of parturition (p=0.57). While 88% of the owners of small ruminant enterprises in Balıkesir provided assistance in the case of dystocia, it was determined that all of the owners in Sakarya provided assistance (p=0.008). While 33% of the enterprise owners perform postpartum cleaning in Balıkesir, this rate was 87% in Sakarya, and in Balıkesir, 67% of enterprises did not perform postpartum cleaning, compared to 13% in Sakarya (p<0.001). Data on colostrum management and umbilical cord care and disinfection in neonates were also presented in Table 5. While the proportion of enterprises administered colostrum to neonates within 2 hours after birth was 93% in Balıkesir, this proportion was determined as 88% in Sakarya. Although there was no statistically significant difference, it was understood that there were a considerable number of enterprises that did not administer colostrum to neonates in both provinces (p<0.23). It was also determined that 75% and 80% of enterprises participated from Balıkesir and Sakarya provinces, respectively, performed forced administration of colostrum when necessary (p=0.56). The proportion of the enterprises applied tincture of iodine and antibiotic spray etc. for umbilical cord of neonates after parturition was 67% in Balıkesir and 34% in Sakarya. In Balıkesir, 33% did not implement umbilical cord care and disinfection initiatives, whereas in Sakarya, the number was 66%, which was significant. (p=0.001).

Discussion

In this survey study, it was observed that Balıkesir province has a higher number of small ruminants than Sakarya province. According to the 2021 report published by Balıkesir Provincial Directorate Animal Health and Breeding Department in 2023, the total number of cattle and small ruminants in Balıkesir was 550,054 and 1,685,029, respectively, and the total number of cattle and small ruminants in Bigadiç and Sındırgı districts were 104,419 and 225,089, respectively (Ercan, 2023). According to this report, it is understood that these two districts have a share of

approximately 32% and 68% in terms of cattle and small ruminants, respectively. According to the Sakarya Agricultural Investment Guide published by the Ministry of Agriculture and Forestry, Strategy Development Directorate, Agricultural Investor Advisory Office in 2022, the total number of cattle and small ruminants in Sakarya province in 2021 was 195,829 and 94,493, respectively. It is clear that small ruminant farming is more prominent in Balıkesir than in Sakarya, and this situation is in accordance with the comparison of small ruminants and cattle in the present study. In addition, in the 2023 Situation and Forecast Report on red meat by the Institute of Agricultural Economics and Policy Development, it is observed that the number of small ruminants in Balıkesir in 2021 (1,685,029) is considerably higher than the number of small ruminants in Sakarya (94,493), and when compared to other provinces, small ruminant population in Balıkesir is higher than other provinces except Ankara, Diyarbakır, Konya, Van and Şanlıurfa.

Although there was no significant difference in the age distribution of the enterprise owners in both provinces, it was observed that the majority of them were between the ages of 46-55 and 56 or older, and there were very few young owners. In general, it can be said that middle and older age is dominant. In a survey conducted on sheep farming enterprises in the Selçuklu district of Konya province, it was determined that 45.2% of the enterprise owners were between the ages of 26-44 and 6.5% were between the ages of 18-25 (Mohamud et al., 2023), and the low proportion of young enterprise owners is similar to the situation in the current study. Also, in a recent survey study conducted on small ruminant enterprises, it was determined that the owners between the ages of 41-60 constituted the most important age range with a rate of 52.1% (Demir and Tuncer, 2023) and it was noteworthy that the owners were mostly in the middle age group as in the present study. This situation shows that the interest of the young population in this sector is low and that small ruminant farming should be made more attractive for the young generation. When the educational status of the enterprise owners participating in the study was considered, it was understood that all of them were literate. It was determined that 66% of the total participants had primary and secondary school education, 56% had high school education and 6% had university education. On a provincial basis, although the rate of secondary school and high school graduates of the small ruminant enterprise owners in Balıkesir was partially lower than that of the enterprise owners in Sakarya, it was determined that Balıkesir had a high rate of high school and university graduates, whereas no university graduate was found among the small ruminant enterprise owners from Sakarya. The fact that the proportion of those with secondary and primary education is considerably higher than the proportion of those with high school and university education is expected as a result of the fact that primary education is compulsory. When the educational status of the enterprise owners who participated in the survey in this study was compared with the recent studies, it was found that the rate was lower than the rate determined by Mohamud et al. (2023) and Tavalı and Çak (2023), higher than the rate determined by Demir and Tuncer (2023), Göncü (2023), Yıldız (2023) in terms of primary and secondary school educational attainment rate. In terms of high school educational attainment, the rate determined in this study was lower than the rate determined by Çetinkaya et al. (2023) and Göncü (2023), higher than the rate determined by Demir and Tuncer (2023), Mohamud et al. (2023), Tavalı and Çak (2023), and almost similar to the rate determined by Yıldız (2023). In terms of university education, the rate obtained in this study was lower than the rate reported by Çetinkaya et al. (2023) and Yıldız (2023), higher than the rate reported by Demir and Tuncer (2023), Tavalı and Çak (2023) and Göncü (2023), and close to the rate determined by Mohamud et al. (2023). When both age and education status were taken into consideration, the data obtained showed that young and educated people stayed away from the related sector. Since the livestock sector requires large areas of land, enterprises are generally concentrated in towns and villages, so the limited infrastructure and social facilities in rural areas cause young and highly educated people to prefer urban life with a wider choice in terms of relevant opportunities (Güven and Yavuz, 2020). As a matter of fact, the possible reflections of this situation were also observed in the data on age and education level obtained in the present study.

When the results of this survey were evaluated in terms of enterprise type, it was observed that small ruminant fattening enterprise type was more prominent in Balıkesir province compared to Sakarya province, whereas dual-purpose small ruminant enterprise type was more preferred in Sakarya. Balıkesir Provincial Directorate of Agriculture and Forestry reported that Balıkesir ranks third in Türkiye in terms of red meat production with 4%, 10th in terms of sheep milk production with 2.5%, and 17th in terms of goat milk production with 1.9% (Republic of Türkiye Ministry of Agriculture and Forestry Balıkesir Provincial Directorate of Agriculture and Forestry, 2024). This situation explains why fattening enterprise type is

preferred more in small ruminant farming in Balıkesir. In addition, it is also possible that Balıkesir has a climate where fodder crops required for fattening can be grown more easily and small ruminant enterprises aiming to obtain faster results in terms of production in this province may find the fattening enterprise type more attractive. As a matter of fact, in the same report prepared by Balıkesir Provincial Directorate of Agriculture and Forestry, it was stated that this province ranked 1st for wheat, rye, broad bean, 2nd for maize, oat, 3rd for forage pea, maize for silage, fodder turnip, 4th for Italian ryegrass, 6th for vetch, green grass and sorghum in Türkiye in terms of fodder crops and green grass production. In terms of enterprise structure, it was determined that the majority of the enterprises (73%) participating in the survey were in closed enterprise structure, whereas 26% were in extensive and semi-extensive enterprise structure. On a provincial basis, it was determined that the enterprises in Sakarya had a significantly higher proportion of closed enterprise structure compared to the enterprises in Balıkesir, whereas extensive and semi -extensive enterprise structure was dominant with a significantly higher proportion in Balıkesir. It can be said that regional climate structure is an effective factor in the preference of the enterprise structure. Balıkesir province has a transitional climate type between the Mediterranean and the Black Sea (Aliağaoğlu and Miroğlu, 2020), while Sakarya has humid weather conditions due to the influence of the Black Sea in the north and the Marmara Sea in the west, and continental climate conditions due to the land masses originating from the Saman Mountains in the south and east (Ustaoğlu, 2018). Şişman et al. (2009) reported that 66.6% of small ruminant enterprises in Bolu region had closed housing type and 33.4% had open housing type, Elmaz et al. (2014) reported that 84.4% of the enterprises in Burdur province had semi-open, 6.3% had open and 9.3% had closed housing type, Bakır et al. (2017) reported that 95.8% of enterprises had closed housing type, 4.2% had open housing type in Siirt province due to the harsh climate conditions, and Aydın and Keskin (2018) reported that the majority of small ruminant enterprises in Muğla province had semi-open (54% for sheep and 36% for goats, respectively) or open housing type (36% for sheep and 56% for goats, respectively).

Biosecurity, which is a set of proactive routine precautions to protect the health of the herd by limiting the risk of transmission of agents that can cause herd disease in an animal enterprise, is also an important issue in terms of minimizing the risk of exposure of farmers, their families and workers to zoonotic diseases and reducing food safety risks (Erzurum et al., 2021). In order to carry out livestock farming activities in a sustainable and efficient manner, it is of great importance to act in a herd-oriented manner beyond individual animal treatments and to create a enterprise structure away from infectious diseases (Kristiensen and Jakobsen, 2011). In the current study, when the biosecurity data obtained from the enterprises were examined, it was determined that some of the small ruminant enterprises participating in the survey harboured different types of animals in addition to the relevant animal species. In terms of different animal species, it was observed that the proportion of enterprises keeping poultry was significantly higher in Balıkesir province compared to Sakarya province (43% vs. 18%). Although there is no significant difference between these two provinces in terms of cat-dog harbouring rates, it was observed that 89% of all participant enterprises harbour cats-dogs, in addition to this, 42% of all participant enterprises do did not carry out routine antiparasitic treatment of cats -dogs. Considering that parasites such as neosporosis, sarcocytosis and tapeworms can be transmitted from dogs to livestock (Atton, 2021), this can be considered a biosecurity weakness. In a study conducted in Malatya by Şeker et al. (2017), who reported that keeping animals of different species together in farms caused significant disadvantages, the rate of farms kept animals of different species together was 37.2% and this was a high rate. Another issue addressed under the biosecurity framework is combat against flies. Since manure waste in livestock farms is a suitable spawning environment for flies, the fly problem related to livestock farming is an important problem that both negatively affects animal productivity and interrupts livestock activities in areas close to settlements (Kaya and Uzmay, 1995). In the present study, although there was no significant difference between the two provinces in terms of fly problem and fly control, it was determined that there was a high rate (67%) of fly problem, whereas the rate of enterprises that did not fight against flies was high (69%). In this study, the low proportion of enterprises that combated flies, which can cause serious risks such as sheep-goat pox, Rift Valley fever, Wasselbron disease, Cache Valley virus (Sevinç and İder, 2021), myiasis (Uslu, 2021), bluetongue infection and Schmallenberg disease (Bulut, 2021), demonstrated that the fly control was not at the desired level.

The quarantine programme to be applied to new animals joining the herd in an enterprise is an important biosecurity issue for herd health. Rams and bucks selected as strong in terms of genotype and

phenotype should also be free from diseases, all vaccinations and controls should be carried out at least 8 weeks before the breeding season, and rams or bucks newly purchased during the breeding season should not join the herd before completing the quarantine process as much as possible (Güler and Satılmış, 2021). It is also essential to adopt an effective quarantine program of at least 15 days for new additions to the flock against foot diseases of sheep and goats (Alkan et al., 2021). In the current study, it was determined that the quarantine process was not applied to new animals entered the enterprises at a high rate of 85%, and the disinfection of new vehicles entered the enterprise was not carried out at a rate of 90%, which revealed the inadequacy in this regard.

Balanced and adequate feeding is of great importance for a successful herd performance and sustainability in small ruminant farming. In the present study, although there were differences in the preference rates of cereal grain feeds between the two provinces, the preference rates of barley and oat, except wheat, were statistically higher in the enterprises in Sakarya than in Balıkesir; however, it was determined that wheat preference was the first with a rate of 68%, barley preference was the second with a rate of 46% and oat preference was the third with a rate of 14% in terms of all participated enterprises. It was thought that these differences in cereal grain feed preferences for both the provinces and all participants were probably related to factors such as local agricultural production, feedstuff prices, feeding habits of the owners, regional conditions, feedstuff supply chain and economic reasons. The proportion of enterprises preferring to use factory feed was found to be as high as 90% for all participants and it was observed that this proportion was significantly higher in Balıkesir province than Sakarya province (99% vs. 62%). Considering the fact that factory feed, which is expensive, has a large share in feed costs, this high proportion of enterprises preferring to use factory feed both in the enterprises in Balıkesir on a provincial basis and among all participating enterprises can be interpreted as the fact that most of the enterprise owners are able to tolerate this cost. However, it was determined that there were also enterprises that did not use factory feed at all, this rate was 38% especially in enterprises participated from Sakarya province and 10% for all participated enterprises. This situation may probably be due to economic reasons. As a matter of fact, in the studies conducted by Demir et al. (2015), Karadaş (2018) and Ünal and Dellal (2023), it was reported that feed prices ranked first among the problems experienced in enterprises.

In this survey study, differences were found between the enterprises participating from Balıkesir and Sakarya provinces in terms of forage preferences. According to the results obtained from all participants, it was observed that wheat straw was preferred the most, followed by alfalfa. According to the results obtained on provincial basis, it was understood that the enterprises in Sakarya preferred alfalfa and oat straw at a significantly higher proportion than the enterprises in Balıkesir, whereas the enterprises in Balıkesir preferred grass hay and vetch hay at a significantly higher proportion than the enterprises in Sakarya. The fact that the enterprises in Balıkesir have lower preference rates for oat and oat straw and higher preference rates for wheat and wheat straw is probably related to the production potential of Balıkesir. As a matter of fact, according to TÜİK (2022), Balıkesir ranks 16th in oat grain production in Türkiye, while it ranks 2nd in wheat hay production. However, alternative roughages such as beet pulp, forage peas and sainfoin were preferred at very low rates in both provinces and in all participated enterprises. It is highly probable that factors such as local vegetation, feeding habits and availability of forage supply play a role in the formation of these differences. In a study conducted by Gökmener (2023) on sheep farms in Uzundere district of Erzurum province, the usage rates of straw, dry clover, sainfoin and hay were found to be 39.9%, 24.4%, 11.1% and 24.4%, respectively.

In this study, it was determined that pasture was utilized at high rates on the basis of provinces and all participating enterprises. In particular, this proportion was 93% for the enterprises in Balıkesir, 72% for Sakarya and 89% for all enterprises participated in the survey. This is an expected situation since small ruminant farming is based on pasture in our country. However, pasture grazing preference proportion of the enterprises in Balıkesir was significantly higher than the enterprises in Sakarya. It was thought that this situation was related to the geographical structure and the area of meadow-pasture. According to the Balıkesir Provincial Directorate of Agriculture and Forestry of the Ministry of Agriculture and Forestry, Balıkesir meadow-pasture area in 2022 is 82,715 hectares and constitutes 5.67% of its surface area, and in the Provincial Briefing made by the Governorship of Sakarya in 2024, Sakarya meadow-pasture area is 7080.5 hectares and constitutes 1.47% of its surface area.

One of the important issues in terms of nutrition in animal farming is to meet the vitamin and mineral requirements of animals. In this study, it was determined that 41% of the small ruminant enterprises from Balıkesir supplemented their animals with

vitamins and minerals, whereas 59% of the enterprises from Balıkesir and none of the enterprises from Sakarya did not do this supplementation. It was noteworthy that the majority of the enterprises (89%) used licking stones, and this rate was higher in Sakarya than in Balıkesir. Considering the finding that none of the participating enterprises from Sakarya used vitamin-mineral mix, it is estimated that they tried to cover this gap by using licking stones. The use of licking stone alone without mineral supplementation to the ration is not sufficient especially for meeting mineral requirements (Pump et al., 1976; Burghardi et al., 1982; Zervas et al., 2001).

Provision of water, which is one of the most basic needs for growth, reproduction and milk yield in livestock, is an important issue. In this study, most of the enterprises (89%) provided water from pasture water sources, followed by the use of troughs (78%) and buckets (63%). On the other hand, the use of water tank and automatic drinker remained at a low level with 20% and 16% respectively. When compared on the basis of provinces, no significant difference was found between Balıkesir and Sakarya provinces in terms of the use of pasture water sources, however, it was found that the use of automatic drinker, bucket and water tank was significantly higher in enterprises from Balıkesir than enterprises from Sakarya province, except the use of trough. It is recommended to use automatic water dispensers in animal farms so that the herd can constantly access clean water and not get sick by drinking contaminated water (Şeker et al., 2017). The finding that automatic water dispensers, which provide advantages in terms of labor, water saving and hygiene, were preferred less than equipment such as buckets and troughs in this study demonstrated that those enterprises had not sufficiently adopted mechanization and modernization in the provision of water to animals. Nevertheless, in this study, the trough and automatic drinker preference proportion determined for water supply of total enterprises were lower and higher, respectively, than the trough preference proportion (95.5%) and automatic drinker preference proportion (5.5%) determined in the recent study conducted by Şeker et al. (2022) on sheep farms.

In the present study, variables such as whether rams are separated from the herd, whether pregnant animals are vaccinated, whether there is a maternity area or birthing pen for parturition, whether the owners know the signs of birth, whether they help in case of dystocia and whether disinfection and hygiene procedures are carried out after birth were also evaluated in the context of herd management related to birth. It was found that 74.5% of the enterprises in the survey did not separate the rams from the flock and this rate was significantly higher in the enterprises from Balıkesir compared to the enterprises from Sakarya (81% vs. 54%). This situation can be considered as a problem related to flock management. Because keeping rams together with ewes in the flock throughout the year may cause negative effects on the ram effect, which is known to have a direct effect on the mating season, synchronization of estrus and fertility, delaying the seasonal estrus of ewes by about 6 weeks, decreasing the mating desire of rams, and keeping rams among lactating ewes may cause resistance to rams in ewes (Ungerfeld et al., 2004; Sunderland et al., 1990; Yılmaz et al., 2009). In sheep farming with different flock management in the same region or in different regions, some farms do not separate the ram from the flock at all, while some farms introduce rams in different seasons (Ülsü and Çilek, 2024). In this study, the proportion of the enterprises separating rams from the flock among all enterprises was close to the proportions determined by Dönmez (2008) for Bursa and Gökmener (2023) for Edirne Uzundere (29.8% and 24. 4%), higher than the proportion determined by Bilginturan and Ayhan (2009) for enterprises in Burdur (3%), lower than the proportions determined by Ceyhan et al. (2015) for enterprises in Niğde and Mohamud et al. (2023) for enterprises in Konya-Selçuklu (69.8% and 69.4%, respectively). When compared on the basis of provinces, the proportions of enterprises keeping rams separate from the flock in the participating enterprises from Balıkesir and Sakarya were lower and higher respectively, than the proportions reported by Gökmener (2023), higher than the proportions reported by Bilginturan and Ayhan (2009), and lower than the proportions reported by Ceyhan et al. (2015) and Mohamud et al. (2023).

In small ruminant farming, both the sheep and the offspring can be immunized against possible diseases by vaccinating pregnant animals, and in this context, it is recommended to vaccinate pregnant animals against clostridial infections, contagious ecthyma caused by Orf virus, contagious agalactia caused by mycoplasma, and agents such as B. melitensis, C. abortus, T. gondii that cause abortions (Fthenakis et al., 2012). Especially during pregnancy, Clostridial vaccines are important in preventing lamb and kid losses due to enterotoxaemia, lamb dysentery and tetanus, and the application of Mannheimia haemolytica and Bibersteinia trehalosi vaccines can prevent lamb losses due to pneumonia (İder and Ertürk, 2023). In the present study, although 83% of the enterprises applied mixed vaccination to pregnant animals, 17% did not vaccinate, which was

considered as a risk in terms of herd health and this situation necessitated the requirement to inform the owners about possible risks. In the evaluation on whether there was a maternity area in the enterprises, it was found that there was a statistically significant difference on the basis of provinces and it was observed that the enterprises from Balıkesir had a maternity area at a significantly higher proportion than the enterprises from Sakarya (75.3% vs. 36%). Among all participant enterprises, this rate was 65.5% and it was noteworthy that 34.5% of enterprises used common barns for parturition. It has been reported that, in general, individual maternity areas should account for approximately 10% of the total sheep and goat population on the farm, and if parturition is synchronized, the number of maternity area may need to be increased up to three times that amount (Ünal et al., 2018). The reason why maternity areas were rarely found in enterprises in the current study was probably due to insufficient space. It was determined that most of the enterprises participating in the study both on the basis of province and in general did not have a birthing pen. This situation indicated that the enterprises in the region preferred to use the existing barns and other areas rather than investing in a separate structure for parturition. Postpartum cleaning in the place of birth within the framework of hygiene rules is an important safety precaution against the risk of disease transmission of surfaces contaminated with birth fluids and residues. In the present study, significant differences were found between the enterprises handled on a provincial basis regarding postpartum cleaning, and this proportion was 46% for all enterprises. This situation drew attention as a weak point in postnatal biosecurity in terms of hygiene.

In the present study, it was determined that the owners knew the signs of birth at a high proportion (98.5%) both on the basis of the province and on the basis of all participant enterprises, and it was understood that almost all owners were aware of the signs of birth in the herd. Considering that the experience and knowledge of the owners to recognise signs such as loss of appetite, restlessness, swelling and discharge in the vulva, swelling of the milk glands, vocal changes in the form of silence or shouting in the animal is critical for the protection of both maternal and offspring health and rapid intervention in possible complications that may occur during the birth process, the finding that the owners in the current study had this knowledge and competence can be considered as a positive development. One of the most common difficulties encountered in ruminant farming is to ensure the continuity of the survival of newborn offspring and the main objective is to increase the number of offspring born and to reduce offspring losses during the period in these enterprises (Koyuncu and Duymaz, 2017). In small ruminant farming, umbilical cord care and colostrum are of vital importance in increasing the survival chances of neonatal lambs and kids (Fesseha et al., 2023). In order to cut and disinfect the umbilical cord properly following birth in lambs and kids, the cord is cut 3-4 cm below the abdominal region and immersed in 7% iodine solution or alcohol-based 2.5% iodine solution to dry the umbilicus and to reduce the risk of disease transmission through the umbilical cord (Tepeli, 2021; Menzies and Bailey 1997). In this study, significant differences were found between the participant enterprises from Balıkesir and Sakarya in terms of the proportions of disinfection and initial care of the umbilical cords in neonates immediately after birth (67% and 34%, respectively). This rate was 58.8% in terms of all enterprises evaluated in the study and it was noteworthy that the proportion of enterprises that did not perform umbilical cord disinfection and care both on a provincial basis and on a general basis was at a considerable level. This situation revealed that there were still small ruminant farms in these provinces that need to be raised awareness in terms of umbilical cord care and hygiene, which is of vital importance. In a study conducted by Kandemir et al. (2015) in Izmir region, it was reported that umbilical cord disinfection of neonates was not performed in 91.3% and 76.5% of enterprises in mountainous and plain regions, respectively, and 83.3% of all enterprises. When these proportions were compared with the results of the present study, the proportions of enterprises performing umbilical cord disinfection both on the basis of provinces (Balıkesir and Sakarya) and on the basis of all enterprises were higher than the proportions in the study conducted by Kandemir et al. (2015). Similarly, the umbilical cord disinfection proportion (40.4%) obtained in the study conducted by Şahin (2019) in Tokat province was lower than the proportion determined for Balıkesir and all enterprises in the present study. Since newborn lambs and kids are susceptible to hypothermia due to their low energy reserves and large body surface areas compared to their body weights, they should receive sufficient colostrum in the first 30-60 minutes after birth, and the survival of these animals can be increased by consuming sufficient colostrum in the first 2-3 hours (Tepeli, 2021). Since small ruminants have epitheliochorial placenta structure, immunoglobulins cannot pass the placental barrier and therefore, neonates should receive the maternal immunoglobulins through the colostrum (Koyuncu and Duymaz, 2017). In

the present study, it was determined that the majority of the enterprises in the survey both on provincial and general basis paid attention to the colostrum intake of neonates within the first two hours and these proportions were 93.3% and 88% in the enterprises participated from Balıkesir and Sakarya provinces, respectively, and 92% on the basis of all enterprises. However, the presence of 6.7% and 12% of the enterprises that did not use colostrum in the related provinces clearly showed that there were still enterprises that did not comprehend the importance of colostrum, which is vital for newborn animals, and that there were still enterprises with poor colostrum management. In the present study, the proportion of colostrum usage in the enterprises participated from Balıkesir province and on the basis of all enterprises was similar to the proportion (93.4%) reported in the study conducted by Kandemir et al. (2015) in Izmir. In cases when newborn lambs and kids could not benefit from colostrum due to reasons such as weakness, hypothermia, lack of sucking reflex or rejection by their mothers, colostrum should be given by bottle or gastric catheter (Tepeli, 2021; Ermetin, 2021). In the present study, it was determined that 76.5% of the enterprises performed forced administration of colostrum to neonates, when necessary, whereas 23.5% did not do so. It was thought that this situation may probably be due to the inadequacy of the enterprises in terms of technical knowledge, equipment and experience related to colostrum administration.

Conclusion

The fact that the owners of most of the small ruminant farms included in this survey study from Balıkesir and Sakarya provinces are older than 46 years of age and the fact that there are very few young owners shows that the interest of young generation in this sector should be increased, and small ruminant farming should be made more attractive. In terms of the educational status of the owners of small ruminant enterprises, the majority of them have primary and secondary school education, but the number of those with university education is generally low, especially in the enterprises included in the study from Sakarya province, no university graduates were found, which shows that this sector should be informed and encouraged for higher education graduates that this sector can be an attractive option. It is noteworthy that there are considerable deficiencies and mistakes in biosecurity in small ruminant enterprises from both provinces. Informing the owners and employees about the correction of this situation and strengthening the weak points will contribute to minimizing both the economic losses of the enterprise and the factors that will adversely affect human and animal health. The feed and feedstuff preferences for feeding animals in the enterprises in the two provinces differed, and although it is considered normal that these preferences include differences due to regional differences, soil structure, budget, and product supply chain variability, deficiencies and errors in feeding were noted, and especially the failure to use vitamin-mineral mixture and the attempt to meet this need from licking stones were evaluated as a wrong and negative situation. Owners and personnel should be informed about appropriate, balanced and rational feeding strategies for animals and deficiencies in this regard should be eliminated. In the enterprises examined in the study, different equipment is used to meet the water requirements of the herd. It has been observed that the use of automatic water dispensers in water supply is preferred at low rates, and it is thought that this is probably due to the inability to provide the necessary mechanization for economic reasons. There is a need for initiatives to encourage the use of automatic water dispensers in these enterprises, and to inform those who use equipment such as buckets, troughs and barrels about the importance of frequent cleaning and disinfection of these equipment. In the small ruminant sector, deficiencies and errors have also been identified at some critical points regarding the management of pregnant animals, animals approaching birth, animals giving birth, and the postpartum period, which are of particular importance in maintaining the herd and increasing the number of animals. In the majority of the enterprises examined in the study, it was evaluated as a positive finding that the enterprise owners knew the signs of the beginning of parturition in animals and had the ability to help in cases of dystocia. However, the existence of enterprises that made incorrect and incomplete applications in vital points such as vaccination of pregnant animals, postpartum cleaning, colostrum management and umbilical cord care, disinfection and hygiene in neonates has led to the necessity of teaching informative practical applications to the relevant responsible persons in these matters.

Acknowledgment

We would like to thank all the participants who completed the questionnaire. Erdem Danyer was supported by the 2219 Fellowship Program of The Scientific and Technological Research Council of Türkiye Project No: 1059B192300618.

Authors' contributions

All authors have read and agreed to the published version of the manuscript. E.D., T.A., T.T.G., and T.B.

were responsible for the creation of the questionnaire. T.A., T.T.G. shared the questionnaire and collected the responses. E.D. and T.A. performed the statistical analysis and interpreted the data O.K. and S.B.Ö. drafted the manuscript. T.B. revised the first versions of the manuscript.

Disclaimer

No potential conflict of interest was reported by the authors.

Ethical statement

This study was conducted with the approval of the ethics committee for feasibility in accordance with the decision of Istanbul University Cerrahpaşa Social and Human Sciences Research Ethics Committee dated 09.10.2023 and numbered 2023/344.

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