

Hewa Karrem FATTAH¹ , Ayşe Özge DEMİR² *

¹ Collage of Agricultural Engineering Sciences, Salahaddin University, 44002, Erbil, Iraq

² Department of Animal Science, Faculty of Agriculture, Yüzüncü Yıl University, 65080, Van, Türkiye

Farm Management Strategies and Structural Characteristics of Small Ruminants in IRAQ: A Case Study

ABSTRACT

Objective: This study aimed to investigate the population structure and diversity of small ruminants, assess the effects of farm management strategies, evaluate reproductive performance, particularly the parturition and analyze the socio-economic context of agro pastoral systems in relation to income and feeding practices.

Material and Methods: The study was carried out in three districts of Iraq's Erbil Province between March 15, 2020 and March 15, 2021. A standardized questionnaire consisting of 69 items was used to gather data from 160 small ruminant farms. SPSS version 24 was used for data analysis and a descriptive research design were used.

Results: All breeders were male (100 %) and 67.5 % were over 40 years old. Primary education predominated (70 %). Most holdings operated under extensive systems (60.6 %), while 10.6 % practiced intensive management. Concrete waterers (56.3 %) and soil-based barns (93.1 %) were common, but only 50 % performed daily cleaning. Housing was built mainly of reinforced concrete (89.4 %) and just 54.4 % of farms registered animals with the Ministry. During summer, 72.5 % of farmers grazed flocks for 15 hours per day and 46.9 % practiced transhumance. Roughage was mostly sourced externally (63.1 %), with barley (88.8 %) as the primary concentrate feed. Rams were kept year-round (90 %) and 69.4 % of breeders produced one lamb per year. Periodic dipping was common (84.4 %), but veterinary support remained limited.

Conclusion: Despite current limitations, improved and strategic farm management practices show potential to improve productivity and overall reproductive and economic outcomes on small ruminant farms in the region.

Keywords: Erbil region, farm management strategy, small ruminant husbandry, structural characteristics

Irak'ta Küçükbaş Hayvanların Çiftlik Yönetim Stratejileri ve Yapısal Özellikleri: Bir Vaka Çalışması

ÖZ

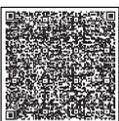
Amaç: Bu çalışma, küçükbaş hayvan popülasyon yapısı ve çeşitliliğini incelemek, işletme yönetim stratejilerinin etkilerini değerlendirmek, özellikle doğum üzerinde durarak üreme performansını analiz etmek ve tarım-hayvancılık sistemlerinin gelir ve besleme pratikleriyle ilişkili sosyo ekonomik bağlamını değerlendirmek amacıyla gerçekleştirilmiştir.

Materyal ve Yöntem: Çalışma, 15 Mart 2020 ile 15 Mart 2021 tarihleri arasında Irak'ın Erbil ilindeki üç ilçede yürütülmüştür. 160 küçükbaş hayvan çiftliğinden veri toplamak için 69 sorudan oluşan standart bir anket kullanılmıştır. Veri analizi için SPSS 24 sürümü kullanılmış ve tanımlayıcı bir araştırma tasarımı kullanılmıştır.

Bulgular: Tüm yetiştiriciler erkekti (%100) ve %67,5'i 40 yaşın üzerindedir. İlköğretim düzeyi baskındır (%70). İşletmelerin çoğu ekstansif sistemle çalışmaktaydı (%60,6), yalnızca %10,6'sı entansif yönetim uygulamaktaydı. Beton suluklar (%56,3) ve toprak tabanlı ağır zeminleri (%93,1) yaygındı, ancak yalnızca %50'si günlük temizlik yapmaktaydı. Barınakların çoğu betonarme olarak inşa edilmişti (%89,4) ve işletmelerin sadece %54,4'ü hayvanlarını Bakanlığa kayıt ettirmişti. Yaz aylarında yetiştiricilerin %72,5'i sürülerini günde 15 saat otlatmakta, %46,9'u ise göçer hayvancılık yapmaktaydı. Kaba yem çoğunlukla dışarıdan temin edilmekteydi (%63,1) ve arpa (%88,8) başlıca kesif yem kaynağıydı. Koçlar yıl boyunca sürüde bulundurulmaktaydı (%90) ve yetiştiricilerin %69,4'ü yılda bir doğum elde etmekteydi. Periyodik ilaçlı banyo uygulaması yaygındı (%84,4), ancak veterinerlik desteği sınırlıydı.

Sonuç: Mevcut sınırlamalara rağmen, iyileştirilmiş ve stratejik çiftlik yönetimi uygulamaları, bölgedeki küçükbaş hayvan çiftliklerinde verimlilik ile genel üreme ve ekonomik sonuçları iyileştirme potansiyeline sahip olduğu görülmüştür.

Anahtar Kelime: Erbil bölgesi; çiftlik yönetim stratejisi; küçükbaş hayvancılık; yapısal özellikler



How to cite:

Fattah, H.K. & Demir A.Ö. (2025) Farm Management Strategies and Structural Characteristics of Small Ruminants in IRAQ: A Case Study. *Journal of Animal Production*, Vol: 66 (2): 161-177, <https://doi.org/10.29185/hayuretim.1701861>

*This article is summarized from the first author's master thesis.

* Correspondence: aodemir@yyu.edu.tr



INTRODUCTION

Erbil is 405 meters above sea level and is surrounded by wide plains. It is located in northern Iraq at coordinates 36.19°N and 44.00°E. With 1,243 villages and 30 districts, the governorate is home to more than 18,000 sheep farmers (Qadir et al., 2020; Abbas and Akbay, 2017).

Small ruminants are raised in Iraq under a variety of administrative and environmental circumstances. These animals have developed resilience through adaptation to harsh ecological settings and the forces of natural selection. Despite their relatively low production, they continue to be vital to rural residents' livelihoods and are well suited to Iraq's dry and semi-arid regions (Alkass and Juma, 2005). However, compared to crop agriculture, small ruminant production systems progress more slowly in terms of technological advancement and management efficiency. Furthermore, research on farm-level management practices remains limited (Majid et al., 2003).

Iraq's small ruminant population includes approximately 7–8 million sheep and 1.5–2 million goats, highlighting the sector's importance for national food security and the economic resilience of rural households (Alhamada et al., 2017). In this context, a field survey was conducted to collect comprehensive data on farm infrastructure, feeding practices and the socio-economic conditions of small ruminant production in Erbil. The primary goal of the study was to evaluate existing management practices and offer evidence-based recommendations for improving productivity and sustainability.

Among the various elements of small ruminant production, feeding is a central and resource intensive component. Sustainable grazing strategies, based on the effective use of natural pastures, aim to maintain both animal performance and soil structure. The success of these systems depends heavily on structured technical guidance and support from agricultural institutions. In rural Erbil, small ruminant farming continues to grow due to its profitability and its role in fulfilling local nutritional needs.

This study was conducted in three ecologically and topographically distinct districts of Erbil Governorate—Debaga, Degala and Shaqlawa. The aim was to examine the structural and functional characteristics of small ruminant farms, evaluate management systems, identify key production constraints and propose region-specific sustainable solutions to enhance productivity and bridge the gap between traditional and modern livestock practices. Field data collected through surveys provided valuable insights into existing farm conditions and informed the development of practical, locally adapted improvement strategies.

MATERIAL and METHODS

Study area

This study was conducted in three districts of Erbil Province in Iraq Debaga (348 m), Degala (580 m) and Shaqlawa (990 m) (Figure 1). which differ in elevation, climate and vegetation, factors that influence small ruminant production systems (Anonymous, 2020).

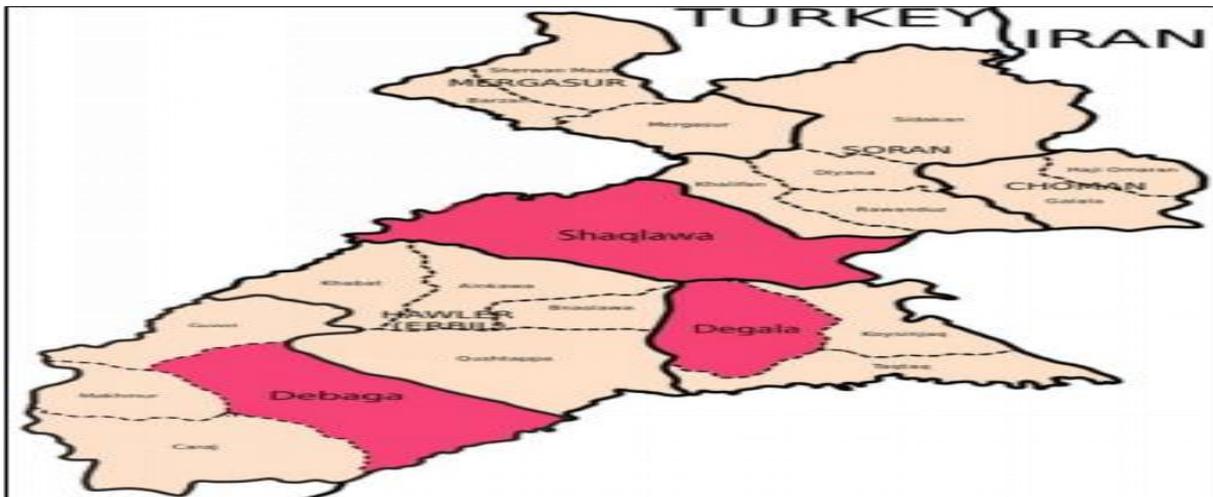


Figure 1. Map of Erbil province with the three districts (Anonymous, 2020).

Şekil 1. Erbil ilinin üç ilçesiyle haritası (Anonim, 2020).



Questionnaire design and content

Data were collected from small ruminant farms between March 2020 and March 2021 using a structured 69 item questionnaire adapted from previous studies (Karakus and Akkol, 2013; Yilmaz and Kor, 2016; Demir and Tuncer, 2023). The questionnaire comprised four main sections: (1) breeder demographics, (2) farm management practices, (3) livestock population and productivity traits and (4) data on birth rates, disease incidence, mortality and veterinary access.

Statistical analysis

The study sample included 160 farms, determined through stratified sampling based on official population data from the Erbil Directorate of Animal Husbandry. The sample size was calculated using the following formula (Yildirim et al., 2009):

$$n = \frac{NZ_{\alpha}^2 P(1-P)}{(N-1)d^2 + P(1-P)Z_{\alpha}^2}$$

In equality,

n: Sample size (Number of individuals to be sampled)

N: Population size

P: Frequency of the event under investigation

Z_α: Z table value at a given error level α

d: standard deviation desired to be made according to the incidence of the event

Accordingly, the sample size was calculated as n=160 for α=0.01 (Z_α=2.5728) and d=0.05. After determining the ratios within the population, the sample sizes were calculated based on these ratios and the stratified sampling process was completed. The number of samples to be taken from each region is provided in the table below. Thus, the 160 samples to be studied were distributed as follows: 51 from Debaga, 46 from Shaqlawa and 63 from Degala (farmers, etc.). Prior to conducting the farm survey, we performed stratified sampling analysis for farm numbers representing Debaga, Degala and Shaqlawa (Erkan et al., 1991; Yildirim et al., 2009). Ethical principles including informed consent, confidentiality and voluntary participation were strictly followed.

Data were analyzed using SPSS v24. Descriptive statistics (means, standard errors, frequencies, percentages) were used to summarize the data. Relationships between categorical variables were evaluated using Chi-square tests, while one way ANOVA was applied for normally distributed continuous variables. A significance level of p < 0.05 was adopted. Furthermore, regression models and factor analysis were utilized to explore associations between management practices and production parameters. Results were presented through tables, charts and graphs.

RESULTS

Socio-demographic profile of breeders

The associations between the structural characteristics of farms and prevailing environmental conditions were detailed in the following section (Figure 2).

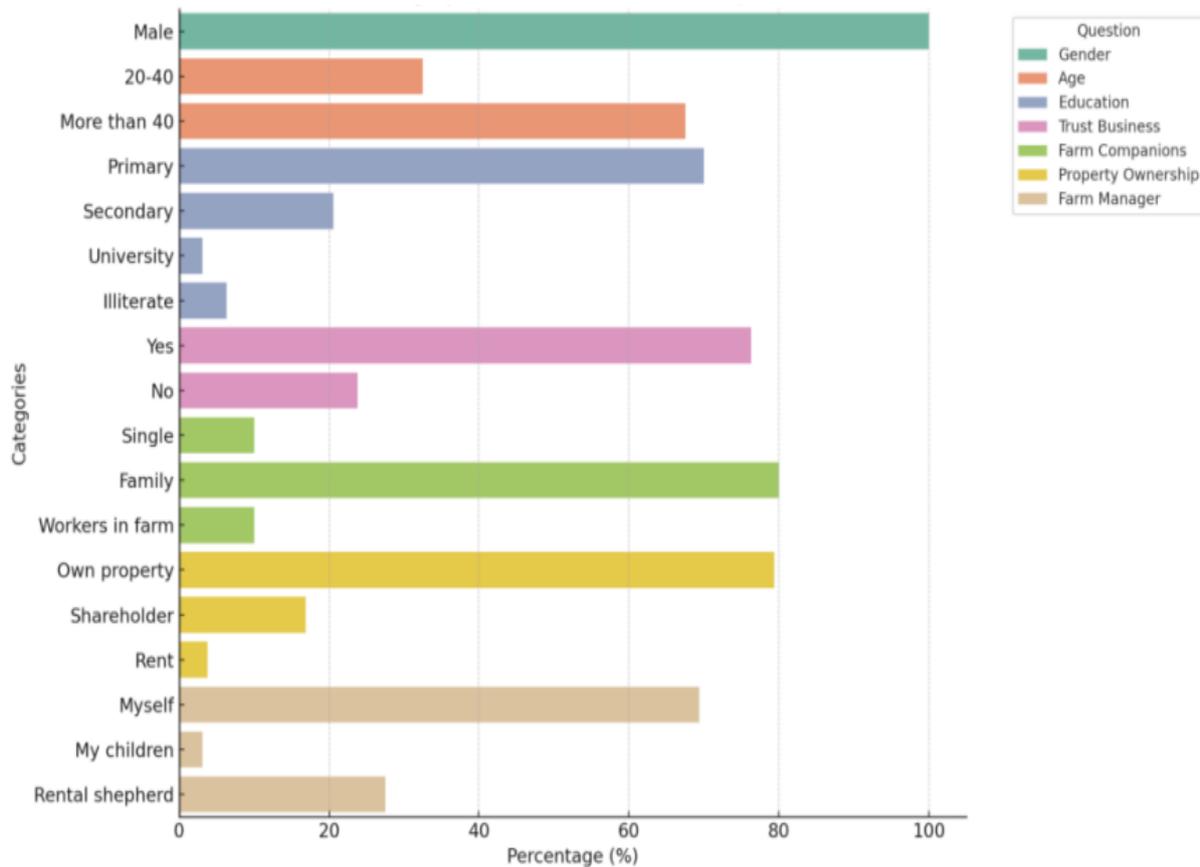


Figure 2. Demographic characteristics of participants.

Şekil 2. Katılımcıların demografik özellikleri.

Gender: The overwhelming majority of breeders were male, constituting 100% of the sample. Age: Regarding age distribution, most participants were over the age of 40 (67.5%), while a smaller proportion fell within the 20–40 age (32.5%) range. Education: In terms of educational background, primary education (70%) was the most common level attained, followed by secondary (20.6%) and university (3.1%) education, whereas a minor segment of the sample was illiterate (6.3%). Trust farms: While some of the participants in the survey did not trust the livestock sector (23.8%); a significant portion of them (76.3%) stated that they trusted it and believed in the sustainability and profitability of the sector. Farm companions: The majority of participants operated their farms with family support (80%), while fewer breeders worked alone (10%) or employed external workers (10%). Property ownership: Most of the land used was privately owned (79.4%), though a portion operated on rental (3.8%) or shareholder based (16.9%) systems. Farm manager: When it came to farm management, a large share of breeders stated they managed the farms themselves (69.4%), whereas only a small number relied on rental shepherds (27.5%) or received assistance from their children (3.1%) responsibilities (Figure 2).

Housing and environmental conditions

The relationships between farm management strategies and housing conditions were presented below (Figure 3).

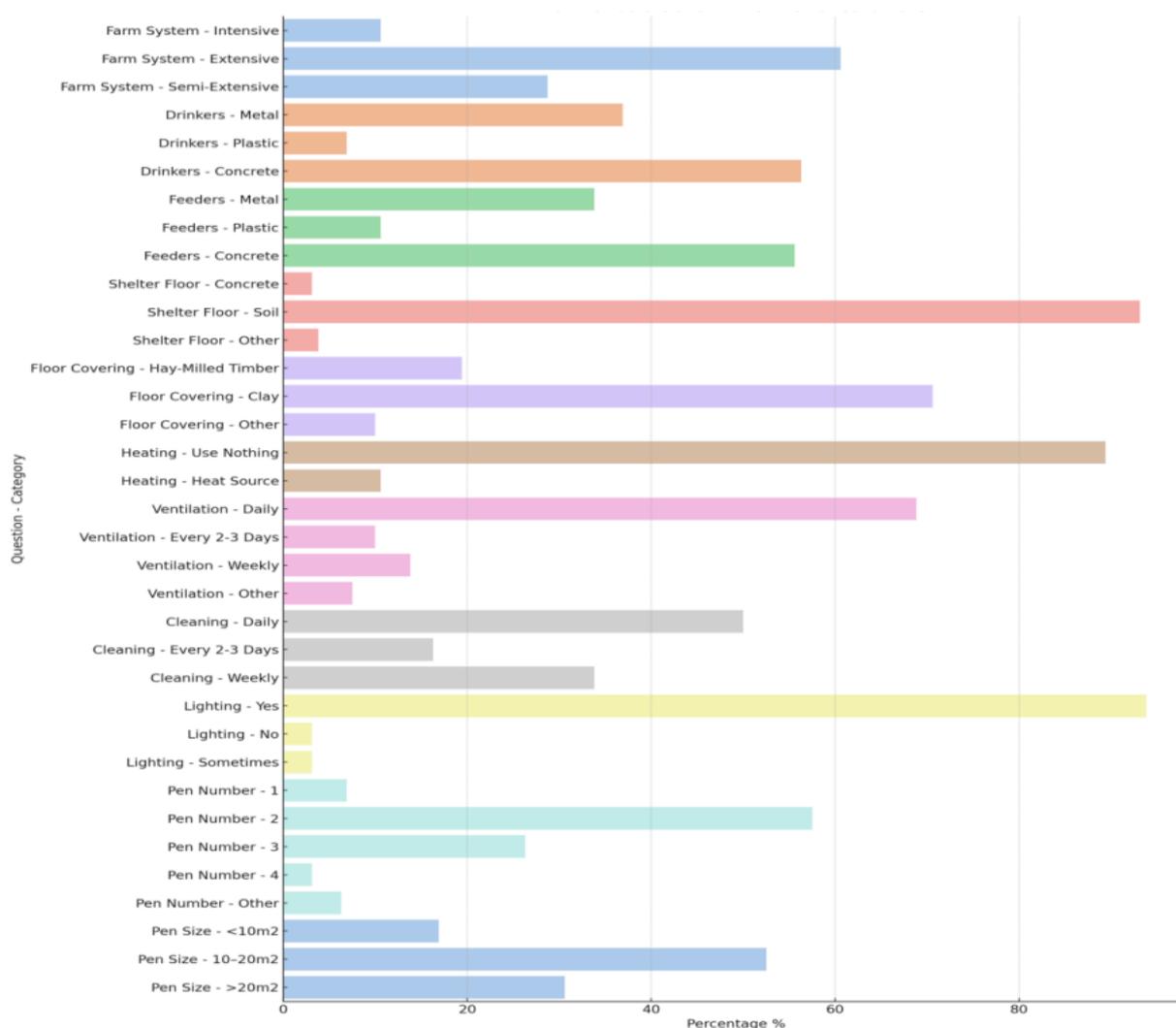


Figure 3. Farm structure and environmental conditions.

Şekil 3. Çiftlik yapısı ve çevre koşulları.

The structural and environmental conditions of the surveyed farms were characterized by predominantly traditional and low-input livestock production systems. Farm system: While some of the farms apply intensive (10.6%) and semi-extensive (28.7%) training methods, an extensive production model was adopted by the majority of farms (60.6%), indicating that grazing based management was widely relied upon, with limited use of controlled housing systems. Waterers: While the proportion of metal (36.9%) and plastic (6.9%) was low, concrete was most commonly utilized for both waterers (56.3%). Feeders: The proportion of metal (33.8%) and plastic (10.6%) was lower than concentrate (55.6%). Barn: Barn floors were predominantly constructed from soil (93.1%) while concentrate (3.1%) and other (3.8%) was low. Floor covering: Clay (70.6%) was most frequently employed as the material for pen floor coverings while hay milled timber (19.4%) and other (10%) were at a low rate. Heating: The fact that heating systems were largely absent (10.6%) in winter conditions and that the majority of participants (89.4%) stated that they did not use a heating source raised concerns in terms of animal welfare. Cleaning: Ventilation was reported to be carried out daily in the majority of farms (68.8%), whereas daily cleaning practices were followed in only half of the establishments (50.0%), with others reporting weekly (13.8%), every 2–3 days (10.0%), or other (7.5%) cleaning routines, pointing to inconsistencies in sanitation practices. Lighting: Lighting during nighttime was provided in the majority of farms (93.8%), indicating a basic level of environmental control, while some reported no lighting (3.1%) or only occasional use (3.1%). Pen number: The number of animal pens varied among farms, with most having 2 pens (57.5%), followed by those with 3 pens (26.3%), 1 pen (6.9%), 4 pens (3.1%) and other configurations (6.3%). Pen size: The most commonly observed pen size ranged between 10–20 m² (52.5%), followed by pens larger than 20 m² (30.6%) and those smaller than

10 m² (16.9%), indicating modest but generally functional housing capacities. In conclusion, although traditional practices were still predominantly followed, it was suggested that improvements in barn quality and environmental management could contribute significantly to the enhancement of animal welfare and overall farm productivity (Figure 3).

Grazing and pasture management

The pasture and grazing management practices adopted by small ruminant farms were detailed in the following section (Figure 4).

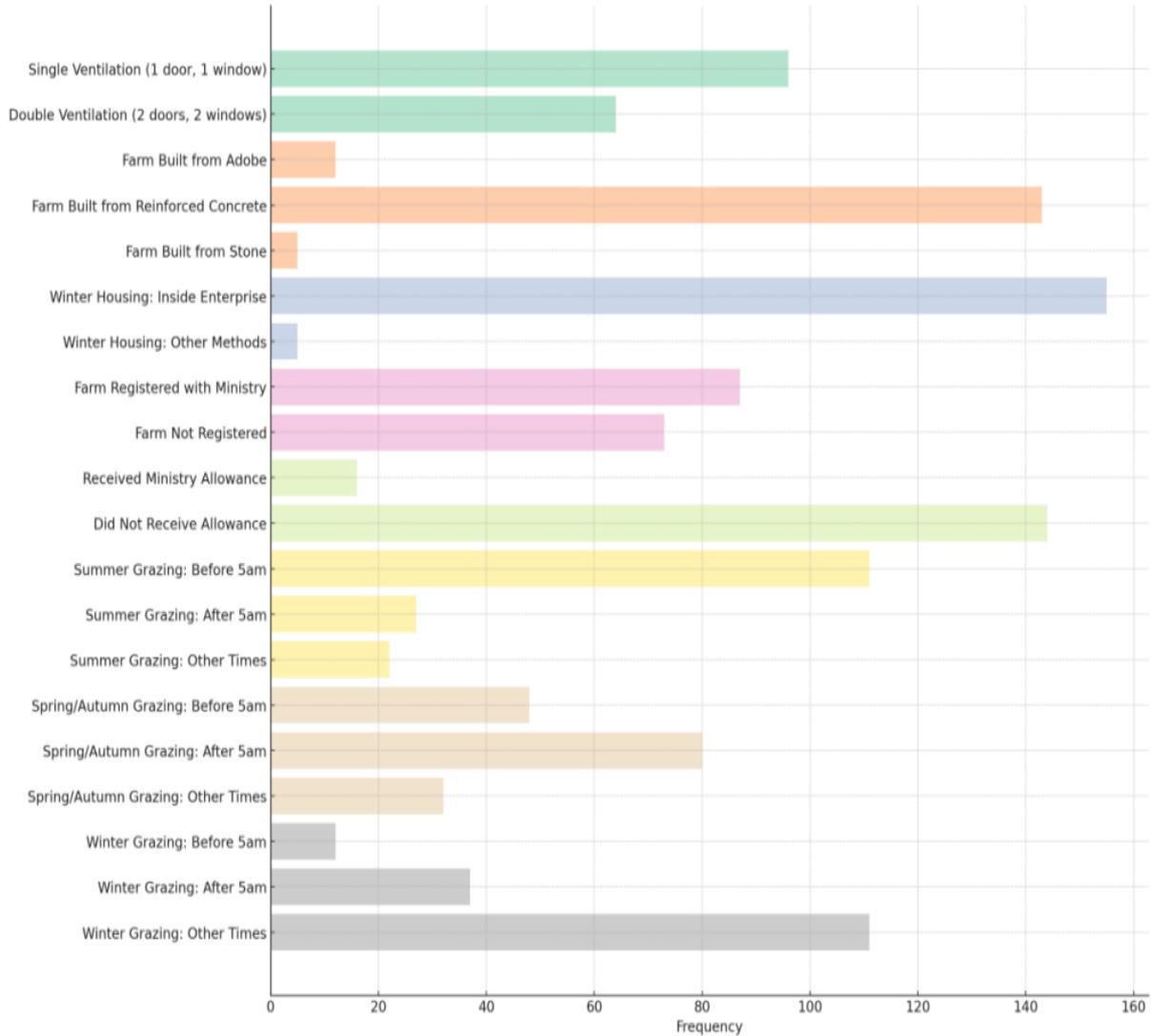


Figure 4. Farm management strategy and housing conditions.

Şekil 4. Çiftlik yönetim stratejisi ve barınma koşulları.

Ventilation: Ventilation was primarily facilitated through basic architectural features, with most farms having one door and one window (60.0%), while others had two doors and two windows (40.0%). **Farm built:** The assessment of farm management strategies and housing conditions revealed that the majority of the farms were constructed using reinforced concrete (89.4%), indicating a clear preference for structurally durable materials. In contrast, the use of stone (3.1) and adobe (7.5%) for construction was found to be minimal. **Winter housing:** In winter, animals were predominantly housed within the enterprise (96.9%), while a small proportion were kept in other locations (3.1%). **Animal registered:** A slight majority of breeders indicated that their animals were registered by the Ministry (54.4%), while the remaining farms reported no official registration (45.6%). **Receiving:** Only a small percentage of breeders reported receiving an allowance from the Ministry for their animals (10.0%), whereas the vast majority did not receive any financial support (90.0%). **Summer grazing:** During the summer,



most breeders took their animals out of the pen for 15 hours per day (72.5%), followed by 12 hours (23.8%) and 10 hours (3.8%). Spring / Autumn grazing: During autumn and spring, most breeders took their animals out of the pen for 10 hours per day (67.5%), followed by 8 hours (19.4%) and 14 hours (13.1%). Winter grazing: During winter, most breeders took their animals out of the pen for 8 hours per day (74.4%), while the remainder reported 10 hours (25.6%) (Figure 4).

Feeding and feed sources

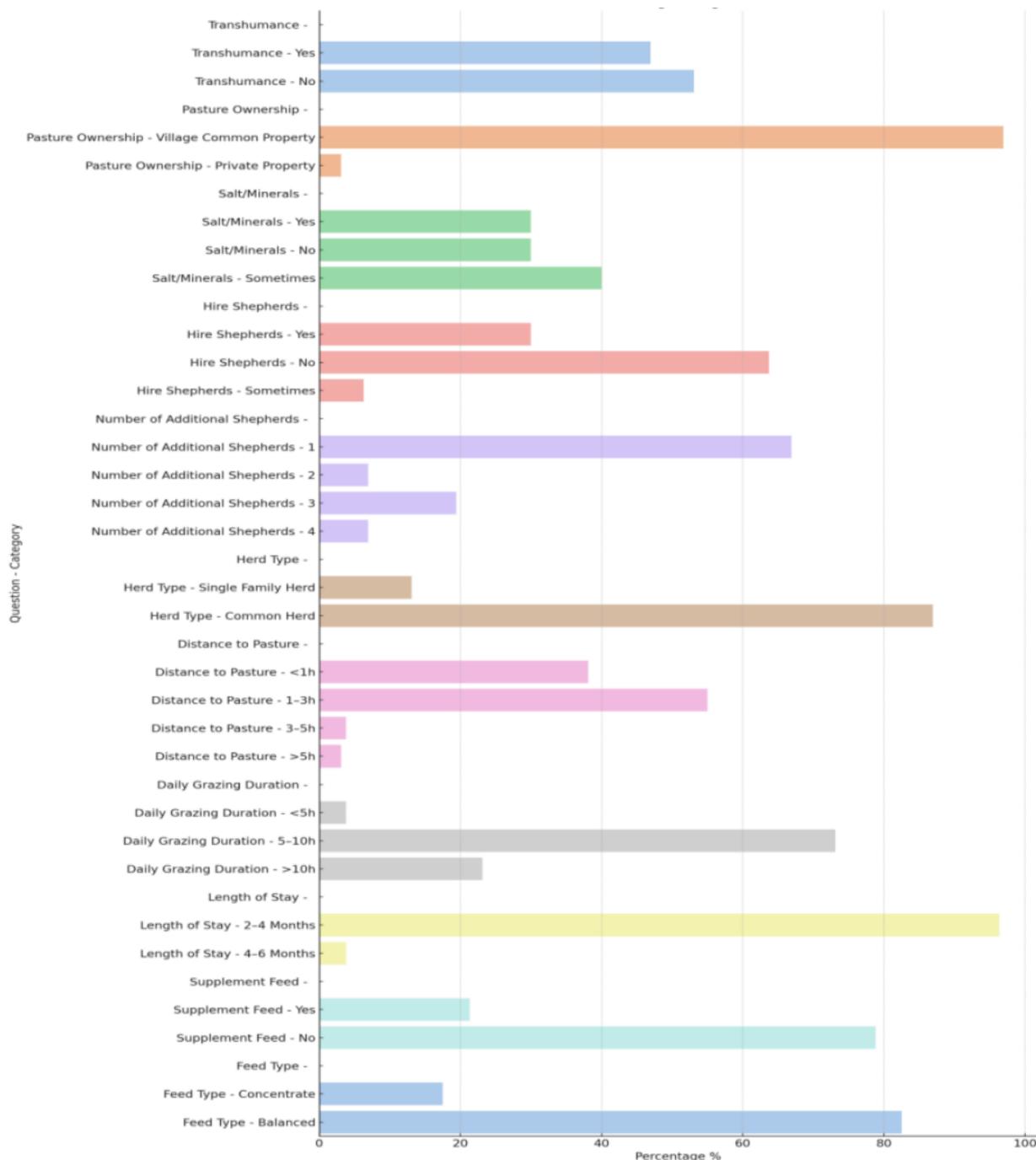


Figure 5. Pasture and grazing management practices.

Şekil 5. Mera ve otlatma yönetimi uygulamaları

Transhumance: The majority of the farms practiced transhumance (46.9%), while a slightly lower portion did not engage in seasonal migration (53.1%). Pasture ownership: In terms of land ownership, almost all grazing lands were reported as village common property (96.9%), with private ownership being extremely rare (3.1%).



Salt / minerals: Regarding mineral supplementation, the responses were distributed relatively evenly among providing salt and minerals regularly (30.0%), not providing them (30.0%) and doing so occasionally (40.0%). Hire sepherd: When it comes to labor practices, most farms did not employ additional shepherds (63.7%), while a smaller group reported hiring them either regularly (30.0%) or occasionally (6.3%). Additional sepherd: The additional number of shepherds on farms was most commonly one (66.9%), followed by three (19.4%) and both two and four shepherds were reported equally (6.9% each). Herd type: In terms of herd structure, the majority of animals were managed as part of a common herd (86.9%) rather than a single family unit (13.1%). Distance to pasture: Farms were located mostly within 1 to 3 hours from the pasture (55.0%), with others less than an hour away (38.1%) and a small number situated 3 to 5 hours (3.8%) or more than 5 hours (3.1%) away. Daily grazing periods ranged mostly between 5 to 10 hours (73.1%), though a smaller group reported exceeding 10 hours (23.1%) or staying below 5 hours (3.8%). Daily grazing duration: Sheep were typically taken to pasture for grazing between 5 and 10 hours daily (73.1%), with fewer farms grazing less than 5 hours (3.8%) or more than 10 hours (23.1%). Lenght of stay: The length of stay in the pasture was mostly between 2 and 4 months (96.3%), with only a small portion staying 4 to 6 months (3.8%). Supplement feed: Only a minority of breeders reported giving supplements to their animals (21.3%), while the majority did not provide any supplementation (78.8%). While in the pen, most breeders provided a balanced feed or ration to their animals (82.5%), whereas a smaller proportion offered concentrate feed (17.5%) (Figure 5).

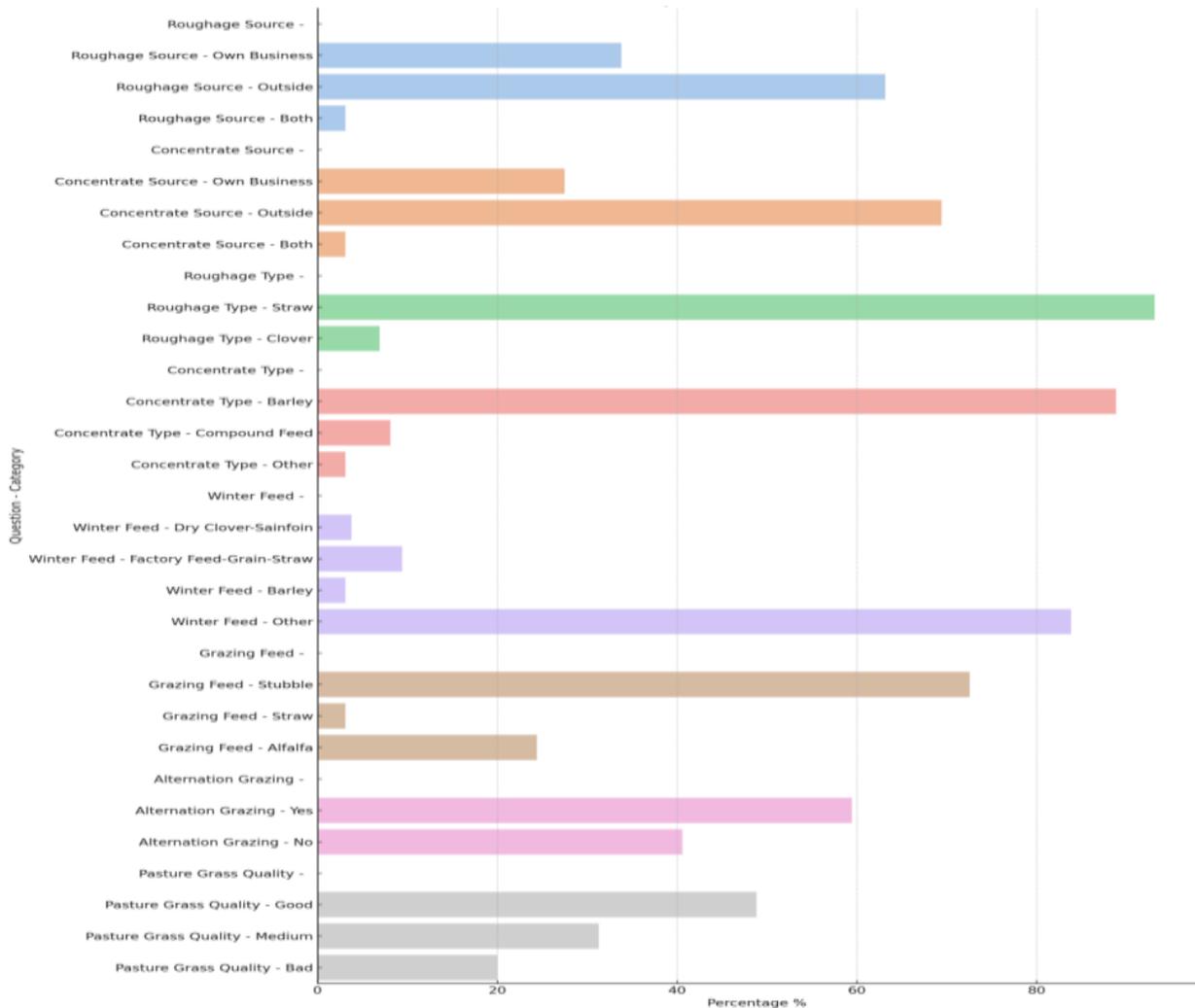


Figure 6. Feeding practices and feed sources

Şekil 6. Beslenme uygulamaları ve yem kaynakları

Roughage source: Most farms obtained their roughage from outside sources (63.1%), while some relied on their own production (33.8%) or both (3.1%). Concentrate source: Concentrate feed was predominantly sourced externally (69.4%), with fewer farms using their own supply (27.5%) or both (3.1%). Roughage type:



Straw (93.1%) was the most common roughage type, followed by clover (6.9%). Concentrate type: Barley (88.8%) was the primary concentrate feed, whereas compound feed (8.1%) and others (3.1%) were less used. Winter feed: During winter feeding, the majority of breeders relied on other feed sources (83.8%), while smaller proportions used factory feed, grain and forage straw (9.4%), dry clover sainfoin (3.8%), or barley (3.1%). Grazing feed: The primary grazing feed source reported was stubble (72.5%), followed by alfalfa (24.4%) and straw (3.1%). Alternation grazing: Alternation grazing in pastures was practiced by a majority of breeders (59.4%), while the remaining farms did not implement this method (40.6%). Pasture grass quality: Pasture grass quality was rated as good by nearly half of the breeders (48.8%), while others assessed it as medium (31.3%) or bad (20.0%) (Figure 6).

Breeding and reproductive management

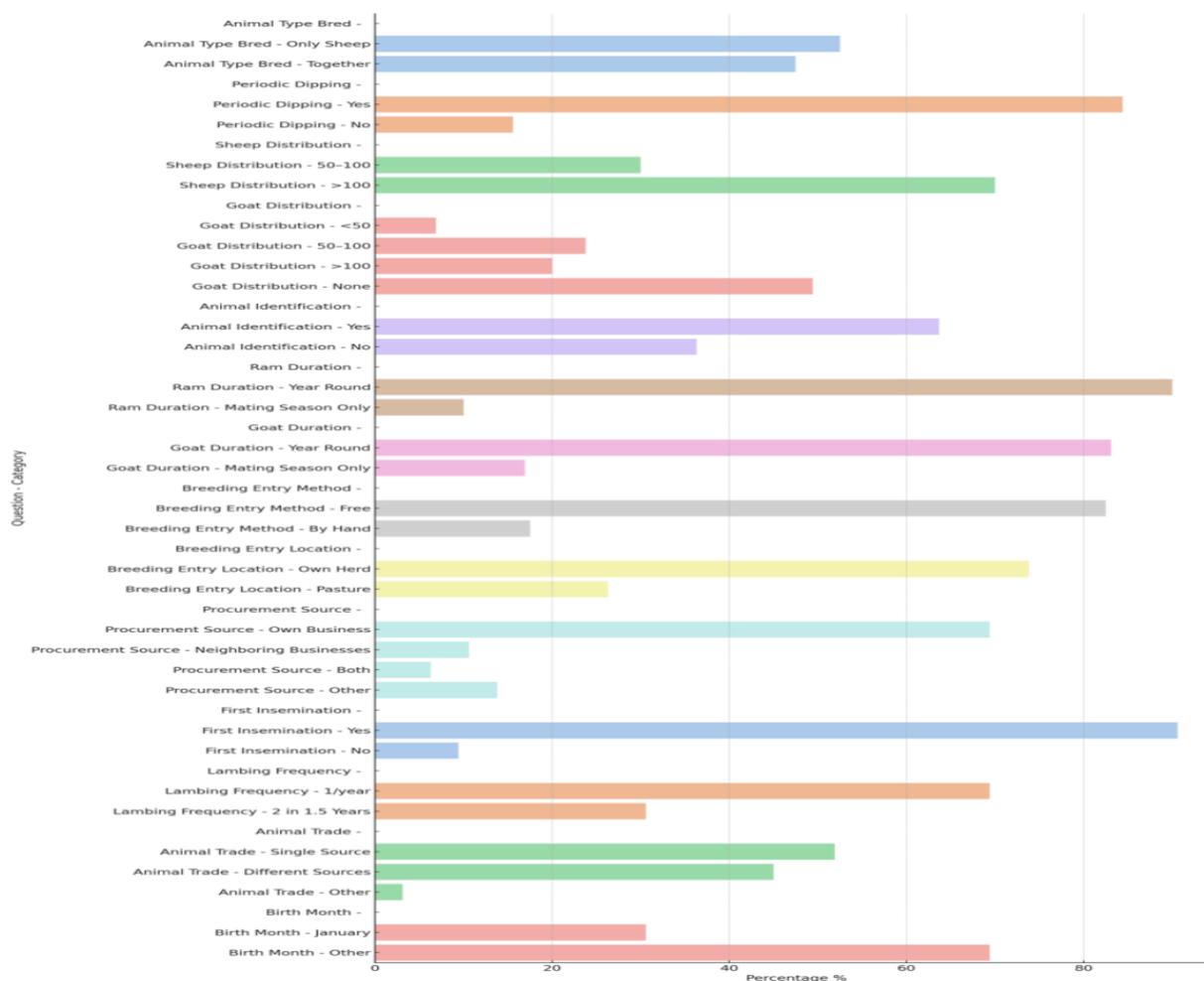


Figure 7. Breeding and reproductive practices

Şekil 7. Yetiştirme ve üreme uygulamaları.

Breed: On most farms, only sheep were bred (52.5%), while the remainder reported breeding sheep together with other species (47.5%). Periodic dipping: Periodic dipping was practiced widely (84.4%), though it was not applied in a few farms (15.6%). Sheep distribution: In terms of animal distribution, most farms had more than 100 sheep (70.0%), while a smaller portion maintained flocks of 50 to 100 sheep (30.0%). Goat distribution: Regarding goat distribution in the farms, nearly half reported having no goats (49.4%), while others had flocks of 50–100 goats (23.8%), more than 100 goats (20.0%), or less than 50 goats (6.9%). Animal identification: The majority of breeders had identified their animals (63.7%), while a notable portion had not implemented any identification system (36.3%). Ram duration: The breeding ram was kept in the herd year round on most farms (90.0%), while a smaller percentage of breeders used rams only during the mating season (10.0%). Buck duration: Breeding goats were kept in the herd year round on the majority of farms (83.1%), while a smaller portion retained them only during the mating season (16.9%). Breeding method: Rams and bucks were mostly added to the farms freely (82.5%), while a smaller proportion were introduced manually (17.5%). Breeding location: Rams



and bucks were primarily added within the farms in their own herd (73.8%), while the rest were introduced in the pasture within their own flock (26.3%). Procurement source: Rams and goats were mostly procured from the farm's own farms (69.4%), while others obtained them from neighboring farms (10.6%), both sources combined (6.3%), or through other means (13.8%). First insemination: The vast majority of breeders reported inseminating females at their first age (90.6%), while a small portion did not practice early insemination (9.4%). Lambing frequency: Most breeders reported getting 1 lamb per year (69.4%), while the rest obtained 2 lambs within 1.5 years (30.6%). Animal trade: Animals were bought and sold mostly through a single source (51.9%), while others used different sources (45.0%) or other methods (3.1%). Birth month: The busiest month of birth was reported as January by 30.6% of breeders, while the majority indicated other months (69.4%) (Figure 7).

Health and daily farm practices

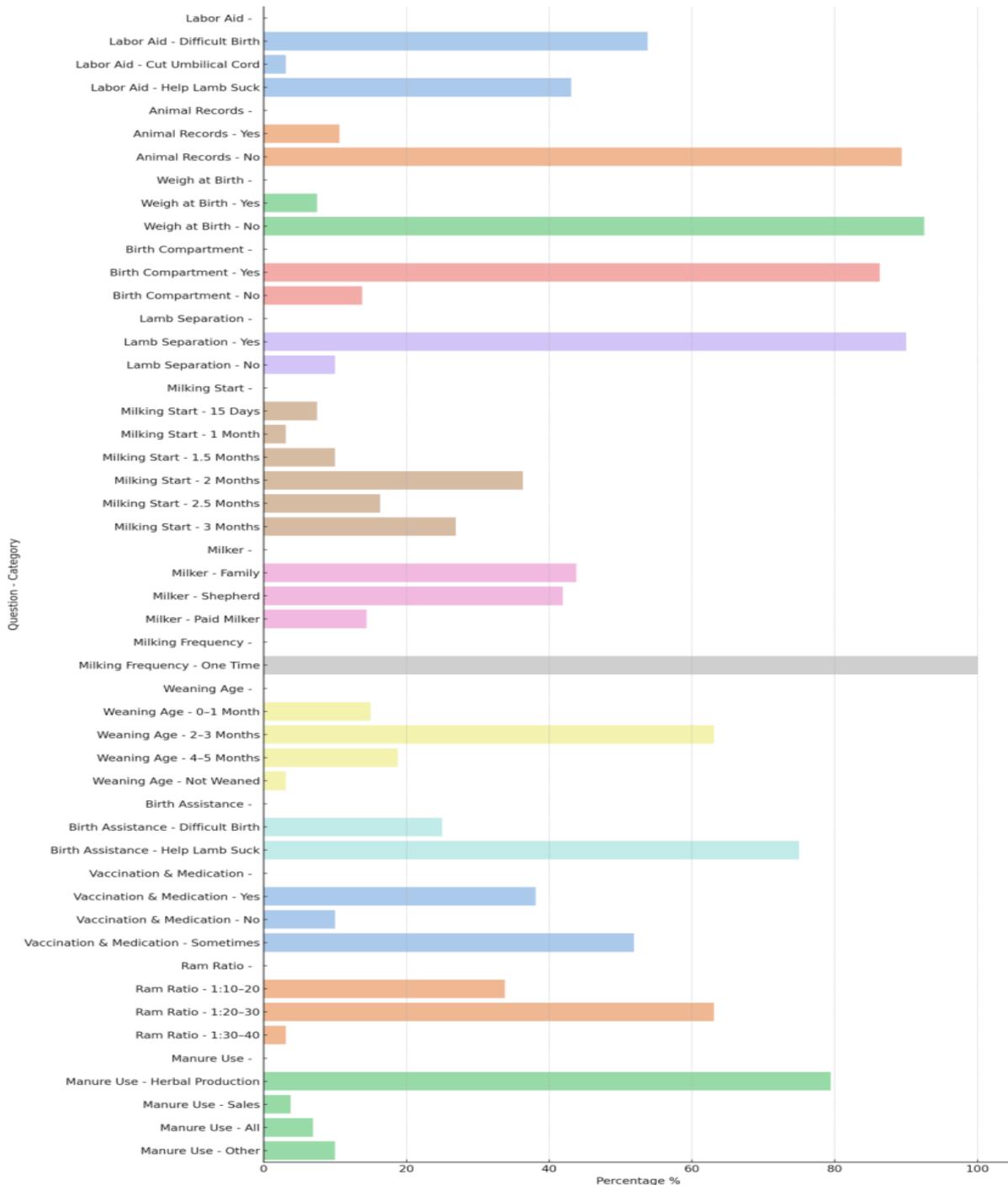


Figure 8. Animal care and daily management practices
Şekil 8. Hayvan bakımı ve günlük yönetim uygulamaları



The routine practices related to animal health, hygiene, milking and general management activities carried out by farmers on a daily basis were presented below. Labor aid: As labor aid, most breeders reported intervening in difficult births (53.8%), followed by helping lambs suckle their mothers (43.1%) and cutting the umbilical cord (3.1%). Animal records: Regular records of animals were kept by only a small proportion of breeders (10.6%), whereas such records were not maintained by the vast majority (89.4%). Birth weight: Weighing of lambs at birth was practiced by a small number of breeders (7.5%), while the vast majority did not weigh newborn lambs (92.5%). Birth pen: Animals expected to give birth were separated into a dedicated pen by most breeders (86.3%), while a smaller portion did not implement this practice (13.8%). Lamb separation: Sheep were separated from lambs for grazing by the majority of breeders (90.0%), whereas a smaller percentage did not follow this practice (10.0%). Milking start: Milking of sheep after birth was most commonly started at 2 months (36.3%), followed by 3 months (26.9%), 2.5 months (16.3%), 1.5 months (10.0%), 15 days (7.5%) and 1 month (3.1%). Milker: Milking was primarily carried out by family members (43.8%) and shepherds (41.9%), while a smaller proportion of farms employed paid milkers (14.4%). Milking frequency: All breeders reported milking once a day (100.0%). Weaning age: The weaning age for lambs and kids was most commonly between 2 and 3 months (63.1%), followed by 4 to 5 months (18.8%), 0 to 1 month (15.0%), while a small percentage were not weaned (3.1%). Birth assistance: To assist birth, most breeders helped the lamb suck its mother (75.0%), while a smaller portion intervened in difficult births (25.0%). Vaccination and medication: Regular administration of vaccinations and medicines to animals was reported by breeders (38.1%), whereas such treatments were not provided by others (10.0%). Ram: sheep ratio: The number of sheep calculated per ram was reported as 1 ram for 20–30 sheep by most breeders (63.1%), followed by 1 ram for 10–20 sheep (33.8%) and 1 ram for 30–40 sheep by a small percentage (3.1%). Manure use: Manure was mostly used for herbal production (79.4%), sold by a small proportion (3.8%), used for multiple purposes (6.9%), or applied in other ways (10.0%) (Figure 8).

Statistical relationships among variables

The responses to the survey questions were analyzed using the Chi-square Test of Independence to examine the relationships between categorical variables. Figures 9, 10 and 11 present only the statistically significant associations ($p < 0.05$), which are shown through heatmaps.

Chi-square analysis showed that several socio-demographic characteristics of farmers, particularly age and education, were significantly associated with structural, feeding and reproductive management practices across farms ($p < 0.05$). Farmers with higher education levels were more likely to use concrete barn floors, apply regular winter ventilation and cleaning routines and maintain a greater number of pens and ventilation openings. Age was also related to the types of waterers and feeders used on farms.

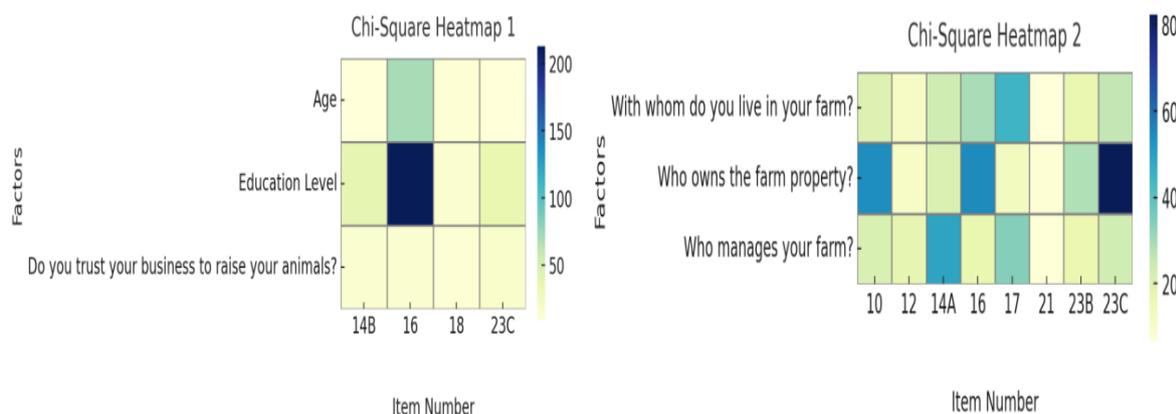


Figure 9. Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q14B, Q16, Q18, Q23C) in the second section (a), Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q10, Q12, Q14A, Q16, Q17, Q21, Q23B, Q23C) in the second section (b).

Şekil 9. İkinci bölümde (a) x koordinatının tüm değişkenleri (Q14B, Q16, Q18, Q23C) için arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir. İkinci bölümde (b) x koordinatının tüm değişkenleri (Q10, Q12, Q14A, Q16, Q17, Q21, Q23B, Q23C) için arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir.

Q10: What types of feeders are used in the enterprise?

Q12: What do you use to cover the floor of the pen?

Q14A: In which periods is the ventilation and cleaning of the folders done in the winter months?

Q14B: In which periods is the ventilation and cleaning of the folders done in the winter months?

Q16: What is the number of pens?

Q17: What is the size of the pen?

Q18: How many windows and doors do you use for ventilation?

Q21: Are your animals registered by the Ministry?

Q23B: What time do you take your animals outside the pen in the morning? spring and autumn

Q23C: What time do you take your animals outside the pen in the morning? Winter

Nutrition-related decisions such as grazing behaviour, mineral supplementation and the choice of winter feed sources showed significant associations with both age and education. In addition, breeding and marketing practices including animal identification, the source of breeding stock, buyer–seller interactions and herd size distribution varied according to education level. The weaning age of lambs and kids was also influenced by the educational status of the farmers ($p < 0.05$).

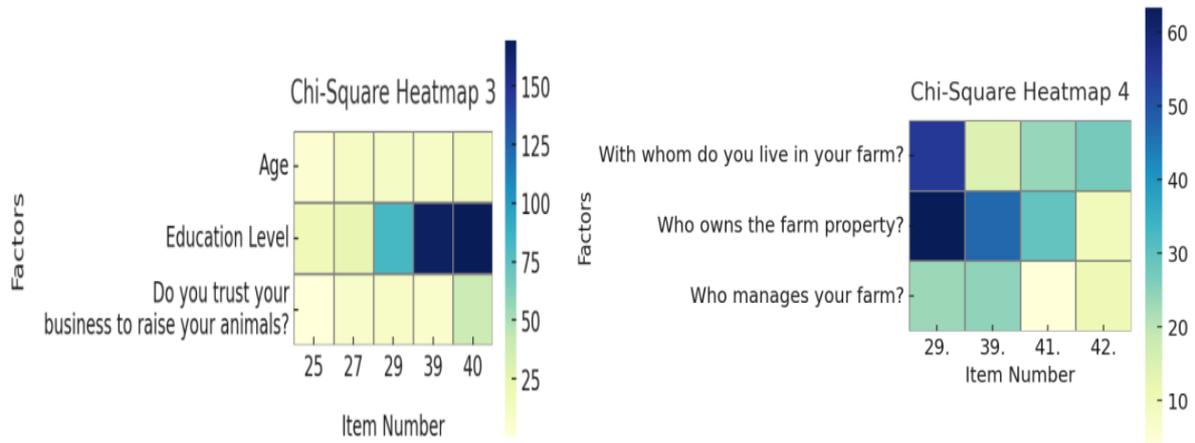


Figure 10. Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q25, Q27, Q29, Q39, Q40) in the third section (a), Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q29, Q39, Q41, Q42) in the third section (b).

Şekil 10. Üçüncü bölümde (a) x koordinatının tüm değişkenleri (Q25, Q27, Q29, Q39, Q40) için arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir. Üçüncü bölümde (b) x koordinatının tüm değişkenleri (Q29, Q39, Q41, Q42) için arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir.

Q25: Do you do transhumance?

Q27: Do you mix with your animal's ration supplementary salt and/or minerals?

Q29: What is your additional number of shepherds?

Q39: What is the type of concentrate used?

Q40: Which feed sources do you use in winter feeding?

Q41: What are the grazing animal feed sources?

Q42: Is alternation grazing in pasture?

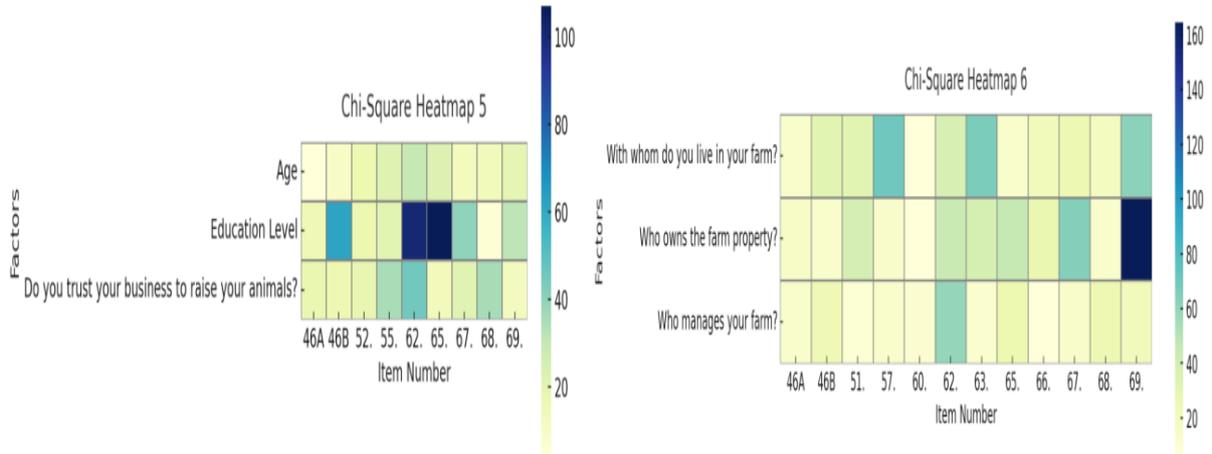


Figure 11. Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q46A, Q46B, Q52, Q55, Q62, Q65, Q67, Q68, Q69) in the third section (a), Illustrates chi-square tests of y coordinate in background information for all the variables of x coordinate (Q46A, Q46B, Q51, Q57, Q60, Q62, Q63, Q65, Q66, Q67, Q68, Q69) in the third section (b).

Şekil 11. Üçüncü bölümde (a) x koordinatının tüm değişkenleri için (Q46A, Q46B, Q52, Q55, Q62, Q65, Q67, Q68, Q69) arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir. Üçüncü bölümde (b) x koordinatının tüm değişkenleri için (Q46A, Q46B, Q51, Q57, Q60, Q62, Q63, Q65, Q66, Q67, Q68, Q69) arka plan bilgilerinde y koordinatının ki-kare testlerini göstermektedir.

Q46A: How is the distribution of animals in your farms? Sheep

Q46B: How is the distribution of animals in your farms? Goat

Q51: Where do you add rams / goat in your farms?

Q52: How do you procure ram / goat in your farms?

Q55: Who do you buy and sell animals with?

Q57: What kind of operations do you carry out as a labor aid?

Q60: Do you divide the animals that will give birth to a separate pen?

Q62: When do you start milking sheep after birth?

Q63: Who is doing the milking?

Q65: What is the weaning age for lambs / kids?

Q66: What kind of operations do you take to assist the birth?

Q67: Do you regularly administer vaccinations and medicines to your animals?

Q68: How many sheep are calculated for each ram (male / female ratio)?

Q69: How do you use the manure?

DISCUSSION

Education levels among breeders were generally low, reflecting the limited access to formal schooling in rural areas. In the present study, 70% of participants had only primary education, indicating a modest educational background among small ruminant farmers. Similar trends were reported by Gul and Ornek (2018), who found that among 92 sheep breeders, 61 had primary education, 13 secondary, 8 high school, 5 higher educations and 5 did not respond. Likewise, Acar and Ayhan (2012) observed that in Isparta province, 75.76% of goat breeders had basic schooling, 14.55% had secondary and 7.27% had high school education. These parallel findings confirm that the majority of small ruminant farmers in both Türkiye and Iraq possess only elementary education. Such limited formal education likely constrains the adoption of modern management practices, record-keeping and



data-based decision-making, emphasizing the importance of continuous training and extension services to improve production efficiency and herd management in traditional farming systems.

Regarding farm dipping practices, Demirhan (2019) reported that only 8.4% of farms had dipping baths, though 18.6% dipped sheep at least once annually and 5.4% more than once. Our study contrasts this, with 84.4% of farmers having dipping baths and 15.6% without. Small ruminants remain vital to rural livelihoods, especially among marginalized farmers in Iraq's Erbil Governorate, where they provide meat, milk, wool, leather and manure, adapted to harsh climatic conditions.

All farmers in our study were male, consistent with cultural norms and supported by Shenkute (2009), who found 94.4% of small ruminant farms headed by men. Increasing numbers of landless youth engage in small ruminant farming due to market demand and profitability. Shenkute (2009) also identified challenges including feed shortages, disease and marketing issues, emphasizing the need for alternative feed options, disease control and improved marketing policies. Our findings similarly indicate obstacles such as poor breeds, inefficient feeding, challenging geography and lack of management strategies, all affecting productivity. These challenges can be mitigated by adopting strategic management practices.

Age distribution showed 67.5% of farmers were over 40 years old, consistent with Tufekçi and Oflaz (2015) who reported average sheep and goat farmer ages of 42 and 50.8 years, respectively, in Turkey. Contrastingly, Dellal (2000) reported very high illiteracy rates (82-86%) among breeders, differing from our study's low illiteracy rate (6.3%).

Iraqi small ruminant breeds are generally not specialized, producing wool, meat and milk in small quantities, a challenge echoed by Walugembe (2017), who highlighted poor nutrition, harsh environments and limited production knowledge as constraints. Farmers expressed the need for continuous government support, especially in fodder provision, consistent with findings from Ogel and Gul (2018), who noted high operational costs and the negative effects of pasture rental fees on production. Farmers requested supportive policies to encourage feed crop cultivation to reduce costs.

Family structure analysis showed 80% of farmers lived with their families, corroborating Karagol and Keskin (2018) who found most enterprises had families of 5-7 members. Pasture ownership conflicts remain problematic, with farmers requesting government policies to clarify pasture geography, a concern also raised by Lombardi (2005) emphasizing the need for political support to promote extensive small ruminant breeding and environmental conservation.

Regarding housing, 89.4% of farmers used cement for animal barns, supporting Chah et al., (2013), who reported 63% concrete housing, with fewer using traditional materials. Ventilation and illumination are important for animal welfare; Gul and Ornek (2018) found ventilation in 85.16% of pens and adequate lighting in 87.5%. Our study found all farms had ventilation and 93.8% adequate illumination.

Shearing and dipping significantly reduce endemic diseases and parasites. Farmers cited limited veterinary services and lack of training as major issues. This finding is consistent with Fenton et al. (1998) and Chedid et al. (2018), who emphasized the impact of herd size on management challenges and market costs. Bohan et al. (2017) reported that flock size and ewe breed influence management practices and performance, supporting our findings.

Marital status analysis showed 90% of farmers were married, similar to Wasihun et al. (2013), who reported 96.8% married farmers, linking family labor availability to farm management capacity.

Kenfo et al. (2018) noted that extensive production systems predominate sheep farming, highlighting the need for improved feeding, disease control, breeding and marketing findings aligned with our observation that 60% of farmers practice extensive systems. Unlike Færevik et al. (2005), most farmers in our study did not use insulation materials like hay or wood for flooring. Demirhan (2019) found that 46.3% of farms used metal waterers, 42% plastic, with various manger types, which broadly aligns with our data where metal waterers (36.9%) and metal mangers (33.8%) were common.

Social structure and feeding strategies influence production efficiency. Ozella et al. (2020) emphasized social behavior's role in management, while Papadopoulou et al. (2021) cautioned that grazing does not always



improve financial outcomes and may increase labor costs. This supports our finding that most farmers prefer feeding animals inside farms and avoid hiring shepherds during grazing season (63.7%).

Corner-Thomas et al. (2016) found that most farmers used limited management strategies, with only a few increasing their use significantly over time. Koluman and Daskiran (2011) emphasized the importance of ventilation in lamb welfare during hot seasons, supporting our finding that 68.8% of pens have daily ventilation.

Farm management practices such as parturition intervention and lamb weaning varied; Demirhan (2019) reported lamb births primarily in December, while our study found only 30.6% born in January with intervention rates of 53.8%. Weaning mostly occurred at 2-3 months (63.1%), with some variation.

Lurette et al. (2018) showed that once-a-day milking balances workload and productivity, aligned with our finding that 100% of farmer's milk once daily.

Mating practices in Iraq reported by Alkass and Mayi (2011) found mating mostly began in June, with most farmers using own rams and concentrate feeding during winter. Our study similarly found 69.4% used own rams, supporting these regional patterns.

CONCLUSION

The findings of this study reveal that small ruminant farming in Erbil Province is characterized by low formal education levels, limited access to veterinary and extension services and predominantly traditional management practices. Although basic housing and animal care are generally adequate, significant improvements are required in veterinary support, feeding systems and pasture management to increase efficiency and sustainability.

Technical recommendations

Housing and hygiene: Replace soil floors with concrete and ensure daily cleaning to reduce disease incidence; improve ventilation, lighting and drainage in barns.

Feeding management: Promote the use of locally available feed resources, balanced rations and feed conservation techniques (silage and hay) to reduce dependency on purchased feed.

Reproductive management: Train farmers on controlled breeding, appropriate ram-to-ewe ratios and proper lambing supervision to improve birth and survival rates.

Health and record-keeping: Encourage regular dipping, vaccination and the adoption of simple digital or notebook-based farm records to monitor productivity and costs.

Economic and policy recommendations

Microcredit and cooperative purchasing schemes should be developed to reduce feed and veterinary input costs.

Subsidized training programs through agricultural extension units and universities can strengthen farmer knowledge in nutrition, breeding and disease control.

Government incentives for herd registration and the adoption of improved housing and biosecurity practices will accelerate modernization.

Strengthening local cooperatives and farmer organizations can enhance marketing efficiency, collective bargaining power and knowledge exchange.

By translating these recommendations into field practice, the productivity and profitability of small ruminant farms in Erbil can be markedly improved. Better housing, feeding and reproductive management are expected to enhance flock performance, reduce disease losses and strengthen the resilience of farm systems. Implementing such evidence-based measures will contribute to higher household incomes, improved animal welfare and greater food security, while supporting the sustainable modernization of Iraq's small ruminant sector.

**Acknowledgements:** -

Data availability: Data will be made available upon reasonable request.

Author contributions*: All authors contributed equally to the preparation of the article.

Competing interests.: There is no conflict of interest between the authors in this study

Ethical statement: All researchers declared it that "all animal procedures were conducted in accordance with EU Directive for animal experiments (European Union, 2010), ARRIVE guidelines (Kilkenny et al., 2010) and national regulation on the protection of experimental animals used for experimental "

Financial support.: -

Article description: This article was edited by Editor Çağrı KANDEMİR.

REFERENCES

- Acar M, Ayhan V. 2012. Isparta ili damızlık koyun keçi yetiştiricileri birliği üyesi keçicilik işletmelerinin mevcut durumu ve teknik sorunları üzerine bir araştırma. *Tarım Bilimleri Araştırma Dergisi*, 5 (2): 98-101.
- Alhamada A, Habib I, Barnes A, Robertson I. 2017. Risk factors associated with brucella seropositivity in sheep and goats in Duhok Province, Iraq. *Veterinary Sciences*, 4 (4): p.65.
- Alkass JE, Juma KH. 2005. Chapter 3. Small Ruminant breeds of Iraq. In: Iniguez L (ed), *Characterization of small ruminant breeds in West Asia and North Africa*. vol. West Asia. International Center for Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria: 63-101.
- Alkass JE, Mayi VJN. 2011. Sheep and goats of Iraq are raised under different climatic, topographic. University of Duhok, Department of Animal Production, Duhok, Iraq.
- Bohan A, Shalloo L, Creighton P, Boland TM, McHugh N. 2017. A survey of management practices and flock performance and their association with flock size and ewe breed type on Irish sheep farms. *The Journal of Agricultural Science*, 155 (8): 1332.
- Chah JM, Obi UP, Ndofo-Foleng, H. M., 2013. Management practices and perceived training needs of small ruminant farmers in Anambra State, Nigeria. *African Journal of Agricultural Research*, 8 (22): 2713-2721.
- Chedid M, Tourrand JF, Jaber LS, Hamadeh SK. 2018. Farmers' perception to change and adaptation strategies of small ruminant systems in the West Bekaa of Lebanon. *Small Ruminant Research*, 167: 16-21.
- Corner-Thomas RA, Kenyon PR, Morris ST, Ridler AL, Hickson RE, Greer AW, Logan CM, Blair HT. 2016. The use of farm-management tools by New Zealand sheep farmers: changes with time. *New Zealand Society of Animal Production*.
- Dellal G. 2000. Some structural features of hair goat breeding in Antalya province I: workforce situation, production systems, roughage source, shelter features. *Ankara University Journal of Agricultural Sciences*, 6 (3): 153-158.
- Demir Y, Tuncer SS. 2023. Hakkâri ili küçükbaş hayvancılık işletmelerinin yapısal özellikleri. *Hayvansal Üretim / Journal of Animal Production*, 64(1), 27–35. <https://doi.org/10.29185/hayuretim.1277515>
- Demirhan SA. 2019. Sheep farming business in Uşak city of Turkey: Economic structure, problems and solutions. *Saudi Journal of Biological Sciences*, 26 (2): 352-356.
- Erkan O, Orhan O, Budak F, Sengul H. 1991. Economic analysis of farms in the region of lower Mardin-Ceylanpınar plains and their planning, *Doğa Turkish Journal of Forestry*, 15:58-67.
- Færevik G, Andersen IL, Bøe KE. 2005. Preferences of sheep for different types of pen flooring. *Applied Animal Behaviour Science*, 90 (3-4): 265-276.
- Fenton A, Wall R, French NP, 1998. The effect of farm management strategies on the incidence of sheep strike in Britain: a simulation analysis. *Veterinary Parasitology*, 79 (4): 341-357.



- Gul S, Ornek H. 2018. Structural characteristics of small ruminant breeding in Gaziantep I. Sheep breeding. Mustafa Kemal Üniversitesi Ziraat Fakültesi Dergisi, 23 (2): 306-314.
- Karagöl E, Keskin M. 2018. Problems of nomadic goat breeders and their effects on forest. Mugla Journal of Science and Technology, 4 (1): 11-15.
- Karakus F, Akkol S. 2013. Van ili küçükbaş hayvancılık işletmelerinin mevcut durumu ve verimliliği etkileyen sorunların tespiti üzerine bir araştırma. Van Yüzüncü Yıl Üniversitesi Fen Bilimleri Enstitüsü Dergisi/ Journal of the Institute of Natural & Applied Sciences, 18 (1-2): 09-16.
- Kenfo H, Mekasha Y, Tadesse Y. 2018. A study on sheep farming practices in relation to future production strategies in Bensa district of Southern Ethiopia. Tropical Animal Health and Production, 50 (4): 865-874.
- Koluman N, Daskiran I. 2011. Effects of ventilation of the sheep house on heat stress, growth and thyroid hormones of lambs. Tropical Animal Health and Production, 43 (6): 1123-1127.
- Lombardi G. 2005. Optimum management and quality pastures for sheep and goat in mountain areas. Options méditerranéennes, 67: 19-29.
- Lurette A, De Boissieu C, Morin E, Hassoun P, Moulin CH. 2018. Improved management to limit milk production losses resulting from the transition to once-a-day milking in dairy sheep. Small Ruminant Research, 165: 8-16.
- Majid Sawsan A, Al-Murani WK, Alkass JE, Al-Rawl AA. 2003. Iraqi country report to the FAO, for the state of the world's Animal Genetic Resources, FAO, Rome, 2003.
- Oğel H, Gul M, 2018. Analysis of technical structure of small ruminant farms: Sirnak Province Sample.
- Ozella L, Langford J, Gauvin L, Price E, Cattuto C, Croft DP. 2020. The effect of age, environment and management on social contact patterns in sheep. Applied Animal Behaviour Science, 225: 104964.
- Qadir RW, Asaad N, Qadir KW, Ahmad ST, Abdullah HY. 2020. Relationship between radon concentration and physicochemical parameters in groundwater of Erbil city, Iraq. Journal of Radiation Research and Applied Sciences, 1-9.
- Papadopoulou A, Ragkos A, Theodoridis A, Skordos D, Parissi Z, Abraham E. 2021. Evaluation of the contribution of pastures on the economic sustainability of small ruminant farms in a typical Greek area. Agronomy, 11 (1): 63.
- Shenkute BG. 2009. Production and marketing systems of small ruminants in Goma district of Jimma zone, Western Ethiopia. Ph.D. Dissertation, Hawassa University.
- Tufekci H, Olfaz M. 2015 Problems and solution proposals of ovine breeding in Kastamonu. Turkish Journal of Agriculture, Food, Science and Technology, 3 (7): 577-582.
- Yıldırım İ, Çiftçi K, Ceylan M. 2009. Comparison of profitability of cross and native breed cattle fattening farms in Turkey. Journal of Applied Animal Research, 35: 17-20.
- Yılmaz C, Kor A. 2016. Hakkari İli Yüksekova İlçesi küçükbaş hayvan yetiştiriciliğinin yapısal durumu (yüksek lisans tezi, basılmamış). Van Yüzüncü Yıl Üniversitesi, Fen Bilimleri Enstitüsü, Van.
- Walugembe M. 2017. Evaluation of pig and cattle performance under small scale farmers' management conditions. Iowa State University ProQuest Dissertations & Theses, 10218582.
- Wasihun BN, Kwarteng JA, Okorley EL. 2013. Farmer's perception of their level of participation in extension in Ethiopia: Policy implications. Journal of Agricultural Extension and Rural Development, 6 (2): 80-86.