

PRODUCERS' PERSPECTIVES OF MODERN SHEEP BREEDS IN SAUDI ARABIA

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ABSTRACT

Sheep (*Ovis aries* L.) farming significantly contributes to food security and is a source of revenue for small-scale breeders in Saudi Arabia. The present study aims to investigate breeders' practices and perceptions on rearing of modern sheep breeds along with their preferences regarding modern farm management. For this purpose, 360 breeders were selected at random, and their responses were collected on a pretested paper-based questionnaire, with 154 breeders agreeing to share information. It was found that most breeders received veterinary extension services and seemed very satisfied. Moreover, the majority of breeders did not receive financial support from the government. Independent *t*-test analysis revealed that the education level significantly influenced breeders' perceptions of modern sheep breeds. Furthermore, age, veterinary extension services, and financial support from the government significantly influenced their preferences regarding modern farm management. The study suggests that veterinary extension programs, through the active involvement of the livestock department and other stakeholders, should be implemented to promote modern sheep breeds and farm management. In addition, the government should facilitate the adoption of these modern sheep farm technologies by enhancing their availability on the market and affordability to breeders.

Keywords: farm management, *Ovis aries* L., perceptions.

INTRODUCTION

The rapid increase in global population has incited food insecurity for future generations. Livestock contributes significantly food security and the incomes of small-scale breeders in many nations, including Saudi Arabia (SA), which holds approximately 26 million individuals of camels, cattle, sheep, and goats, out of which 92 % are sheep and goats. More than 60 % of the sheep and goats are managed by small- and medium-scale breeders for meat and milk production. SA has implemented commercial-scale modes of production for dairy and poultry farms. However, sheep

Citation: Alotaibi BA, Muddassir M, Alharbi M, S-Aljohani E, Ahmad-Shah A. 2025. Producers' perspectives of modern sheep breeds in Saudi Arabia. *Agrociencia*. <https://doi.org/10.47163/agrociencia.v59i2.3316>

Editor in Chief:
Dr. Fernando C. Gómez Merino

Received: October 04, 2024.
Approved: January 30, 2025.
Published in Agrociencia:
March 12, 2025.

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are generally produced by traditional methods due to adverse agro-climatic conditions (FAO, 2023b).

The International Fund for Agriculture and Development (IFAD) loan and grant projects have proven that livestock can play a key role in poverty reduction in rural areas (Rota and Sidahmed, 2010). Rearing sheep and agriculture together assures availability, access, and quality of food (Seifman and Katz, 2016; Aldosari, 2018). SA fulfills 30 % of its food demands through livestock. Rearing of animals, including sheep, provides direct employment to 250 million people and has been a great source of sustaining Saudi sociocultural heritage (MEWA, 2021).

The Awassi sheep are conventionally shepherded by desert nomads and villagers. Sheep are primarily raised for milk and meat production, and Awassi sheep are sold at high prices due to their fat tail. Moreover, rural residents traditionally make several crafts with their wool (Aldosari, 2018). As of 2021, 12 million individuals of sheep and goats were raised in SA under organic projects. It dropped from the total of 16.07 million individuals of sheep and goats that were raised in 2017 (Puri-Mirza, 2024). The identified causes of low production included limited pasture access, high animal feed costs, traditional farm practices, and climate change. With a huge potential to increase livestock production with the existing inventory of livestock individuals, climate change has been a major challenge, leading to constrained growth of this sector within the country. The use of modern sheep breeds in farming may compensate for the production deficit.

The Sustainable Rural Agricultural Development (SRAD) program (2019–2025) was jointly started by the Ministry of the Environment, Water, and Agriculture (MEWA) and the Food and Agriculture Organization (FAO) within the context of Vision 2030. The program aimed to achieve Sustainable Development Goals (SDGs) by the transformation of animal husbandry (MEWA, 2021). Modern breeding systems and management were introduced in the country to improve technical skills and output. MEWA provided advanced energy and water supply, electric ID, weighing and drafting, head lockers, handling units, feeding technologies, trough and watering, facilities and fences, surveillance, cooling technologies, information technologies, 3D images, and automatic farm cleaning systems. In terms of breeding systems, they acquired photoperiods and hormonal oestrous synchronization, which are widely used in seasonal sheep breeds. These methods are associated with artificial insemination and embryo transfer techniques, in addition to improving meat quality (MEWA, 2021).

Notably, sheep meat is among the top preferred foods among Saudi citizens, followed by camel meat. Because of the low production of sheep meat, SA imports mutton from other countries. According to Business Monitor International (BMI), in 2013, 7584 Mg of mutton were imported from Australia, projecting an increase of 65 % for the same year (BMI, 2016). Moreover, the Observatory of Economic Complexity (OEC) reported that SA imported \$2.88 million USD in sheep and goats, ranking as the second largest importer (OEC, 2022). SA imports primarily from Jordan (\$118 million), Romania

(\$80.7 million), Kuwait (\$46.1 million), Spain (\$32.9 million), and Georgia (\$5.62 million) to meet domestic demand.

Mutton imports from other countries increase the economic burden on SA. The only way to increase sheep production is to raise modern sheep breeds and implement modern sheep farm management that allows for the long-term sustainability of sheep populations well-suited for the challenging climate of SA. Sheep breeders raise sheep on traditional farms, but large-scale production of modern sheep breeds has not been achieved. Before raising modern sheep breeds in modern sheep farms, it is critical to understand breeders' perceptions of modern sheep breeds and their preferences for modern sheep farm management. Therefore, the current study aims to assess breeders' perceptions of modern sheep breeds, as well as their preferences for modern sheep farm management. Surprisingly, no studies have been conducted to measure these variables. Based on the findings, long-term strategic plans can be developed. Differences in sheep breeders' perceptions of modern sheep breeds and their preferences for modern sheep farm management were measured in Dawadmi Governorate, SA, based on socioeconomic characteristics. Thus, the hypothesis was proposed as follows: H1: Age, education, breeders' experiences, veterinary extension services, and financial support affect sheep breeders' perceptions of modern sheep breeds; H2: Age, education, breeders' experiences, veterinary extension services, and financial support influence sheep breeders' preferences for modern sheep farm management.

MATERIALS AND METHODS

Study area

This study was conducted in the Dawadmi Governorate, which is located to the northwest of the Riyadh region. This governorate shares its borders with Shaqra and Murat Governorates to the east, Afif Governorate to the west, and Al-Rass Governorate (administratively affiliated with Al-Qassim region) to the north. To the south, it is bordered by Unaizah Governorate, Al-Mithnab Governorate, and Al-Bukayriyah Governorate, all of which are administratively part of the Qassim region. It covers approximately 28 000 km² and is ranked fifth among the governorates in the region in terms of area (Gomaa *et al.*, 2023).

Research sample

Out of 5690 sheep breeders who received health cards from the Ministry of Environment, Water, and Agriculture (MEWA) in Dawadmi Governorate (FAO, 2024), 360 were selected using a simple random sampling technique. The sample size calculator was used to determine the sample size (confidence interval, 95 %; margin of error, 5 %; population proportion, 50 %; and population size, 5690). A questionnaire was distributed among sheep breeders, in their local language, at various centers of

the Dawadmi Governorate. They were informed about the objectives of the study and assured that the data would be utilized for research purposes. Out of 360 questionnaires sent, 154 (around 43 %) were returned by the respondents in complete. After the completion of the pilot test, the final survey was conducted in Dawadmi governorate. The data were collected over a 12-week period from February until the end of April 2022.

Research instrument

The questionnaire was reviewed by a group of researchers of the College of Food and Agriculture Sciences at King Saud University. The questionnaire contained five sections. Demographic details were included in the first section. Questions about age, education, sheep farming experiences, sheep breeds, and financial support from the government and the veterinary extension services were measured using a nominal scale (0 = no; 1 = yes). The breeders' age (1 = young; 2 = older), education (1 = school education; 2 = higher education), and experience (1 = low; 2 = high) were computed as new nominal variables using their raw scores. Respondents aged 18 to 38 years were classified as young, while those aged 38.1 to 89 years were classified as older. Respondents with primary, secondary, and intermediate education were classified as having a low level of education, whereas those with college and university education were classified as having a high level of education. Respondents with 2–15 years of sheep farming experience were classified as having a low level of experience, whereas those with 16 or more years of sheep farming experience were classified as having a high level of experience.

The second section measured the sheep farming methods (1 = traditional method; 2 = semi-traditional method; 3 = modern method) and how breeders managed sheep breeds (1 = managed by workers; 2 = managed by specialized technicians; 3 = managed by the owner). The third section included questions on breeders' perceptions of modern sheep breeds using a five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). The fourth section contained questions about breeders' satisfaction with veterinary extension services, which were also measured using a five-point Likert scale (1 = very dissatisfied; 2 = dissatisfied; 3 = slightly satisfied; 4 = satisfied; 5 = very satisfied). The last section of the questionnaire covered questions about the breeders' preferences regarding modern farm management. This variable was also measured using a five-point Likert scale (1 = strongly unpreferred; 2 = unpreferred; 3 = neutral; 4 = preferred; 5 = strongly preferred) (Joshi *et al.*, 2015).

Data analysis

Both descriptive and inferential statistics were used for summarizing and analyzing the collected data. The demographic characteristics of the respondents, sheep farming methods, and sheep farming management were summarized using frequencies and percentages. To determine differences in the breeders' perceptions of modern sheep breeds and their preferences regarding modern farm management due to their

personal demographics, parametric statistics were used. For the nominal variables with two categories (age, education level, farming experience, veterinary extension services, and financial support from the government), the independent *t*-test was used. The statistical package for social sciences (IBM SPSS, version 28.0) was used for running the data analysis.

RESULTS AND DISCUSSION

More than three-fifths of the breeders were old, while less than two-fifths of them were young (in the age bracket of 18–38 years). Around three-fifths of the breeders had higher education. More than two-fifths of them had school-level qualifications. More than three-fourths of the respondents earned less than 10 000 SR per month, while less than one-fourth earned more than 10 000 SR to less than 15 000 SR. A large number of breeders had low experience in sheep farming (2–15 years), and more than one-fourth had high experience. The majority of breeders were employed in the government sector, whereas less than 10 % were employed in the private sector, students, or employed in other sectors. More than one-tenth of the breeders were retired and jobless.

Regarding sheep breeds, more than one-fourth of the breeders raised Najdi, and around two-fifths raised Naimi, whereas more than three-fifths of the breeders raised Awassi. Less than 10 % of the breeders raised other breeds. Around three-fifths of the breeders received veterinary extension services. Around one-fourth of the breeders received financial support from the government (Table 1).

Less than three-fourths of the breeders adopted traditional and semi-traditional methods for sheep breeding methods, while more than one-fourth adopted modern sheep breeding methods. A large number of the farms were managed by owners. One-fourth of the farms were managed by workers. A smaller number of the farms were managed by specialized technicians. The findings of the study revealed that most of the breeders operated their farms themselves and followed traditional farm practices (Table 2).

Breeders' responses were arranged in descending order according to the average score for each statement. The average score ranged from a maximum of 4.28 to a minimum of 3.94. More than 80 % of breeders believed that using modern breeds is part of agriculture, that herds of modern breeds are easy to manage, that modern breeds improved production efficacy, and that modern breeding improved herd health. More than three-fourths were convinced that modern breeding helps to the preservation of feed safety, that modern breeds are better than traditional technologies, and that modern breeds are adapted to climate change. More than 70 % of breeders believe that modern breeds are more efficient, increase income, have lower mortality rates, and reduce feed costs. Around 67 % of breeders were convinced that the percentage of twins increased with modern breeding (Table 3).

Table 1. Frequency and percentage of socioeconomic characteristics of sheep breeders, sheep breeds, veterinary extension services, and financial support evaluated in the Dawadmi Governorate, Saudi Arabia (n = 154).

Variables	n	Percentage
Age		
18 to 38 years	54	35.1
39 to 89 years	100	64.9
Education		
School education	64	41.6
Higher education	90	58.4
Monthly income		
Less than 5000 SR	63	40.9
5000 to less than 10 000 SR	55	35.7
10 000 to less than 15 000 SR	30	19.5
15 000 SR or more	6	3.9
Farming experience		
Low experience	110	71.4
High experience	44	28.6
Profession		
Government	99	64.3
Private	12	7.8
Retired	19	12.3
Student	3	1.9
No job	18	11.7
Others	3	1.9
Breeds of sheep		
Najdi		
No	106	68.8
Yes	48	31.2
Naimi		
No	95	61.7
Yes	59	38.3
Awassi		
No	51	33.1
Yes	103	66.9
Others		
No	140	90.9
Yes	14	9.1
Received veterinary extension services		
No	64	41.6
Yes	90	58.4
Financial support from the government		
No	108	70.1
Yes	46	29.9

n: sample size.

Table 2. Frequency and adoption percentage of sheep breeding methods and farm management among sheep breeders evaluated in the Dawadmi Governorate, Saudi Arabia (n = 154).

Variables	n	Percentage
Methods of sheep breeding		
Traditional methods	68	44.2
Semi-traditional methods	44	28.6
Modern methods	42	27.3
Management of sheep farming		
Managed by workers	39	25.3
Managed by specialized technician	8	5.2
Managed by the owner	107	69.5

n: sample size.

Table 3. Percentage, mean, and standard deviation (SD) of sheep breeders' perceptions on modern breeds in the Dawadmi Governorate, Saudi Arabia (n = 154).

Items	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %	Mean	SD
Using modern breeds is part of agriculture	0.6	3.9	14.3	29.2	51.9	4.28	0.89
The herds of modern breeds are easy to manage	2.6	4.5	11.0	28.6	53.2	4.25	1.00
Modern breeds improve production efficacy	1.3	3.9	13.6	32.5	48.7	4.23	0.92
Modern breeding improves herd health	3.9	3.2	12.3	32.5	48.1	4.18	1.03
Modern breeding helps to maintain feed safety	3.9	3.2	15.6	29.2	48.1	4.14	1.05
Modern breeds are better than traditional technologies	2.6	4.5	16.9	27.9	48.1	4.14	1.02
Modern breeds are more efficient	0.6	7.1	19.5	24.0	48.7	4.13	1.00
Modern breeds are adapted to climate change	1.9	7.1	13.6	31.2	46.1	4.12	1.02
Modern breeding improves income	1.3	7.8	16.9	35.7	38.3	4.02	0.99
Mortality rate is lower with modern breeding	3.9	4.5	18.8	32.5	40.3	4.01	1.06
Modern breeding reduces feed cost	3.9	3.9	20.8	30.5	40.9	4.01	1.06
Percentage of twins is increased with modern breeding	2.6	4.5	26.0	29.9	37.0	3.94	1.02

More than three-fifths of breeders agreed with the statement that modern sheep breeding is more profitable and desirable. More than one fourth of the breeders were neutral, and less than 5 % of the breeders disagreed with modern sheep and goat breeding (Table 4).

For successful sheep breeding, a vibrant linkage with veterinary services is mandatory. In this regard, more than one-fourth of the breeders were very satisfied with the veterinary extension services (Table 5). These findings differ from those of Jain *et al.* (2016), who found that the majority of the breeders were not highly satisfied with the veterinary extension services delivered by the State Department of Animal Husbandry

Table 4. Percentage of overall breeders' perceptions of modern sheep breeds in the Dawadmi Governorate, Saudi Arabia.

Perception level	%
Negative	4.5
Neutral	29.2
Positive	66.2

Table 5. Percentage of breeders' satisfaction level regarding veterinary extension services in the Dawadmi Governorate, Saudi Arabia.

Satisfaction level	%
Very dissatisfied	15.6
Dissatisfied	14.3
Slightly satisfied	18.8
Satisfied	16.9
Very satisfied	34.4

(SDAH) in Rajasthan, India. The high satisfaction level of the breeders in the study area might be the consequence of regular contact with extension offices. Kassem *et al.* (2021) reported that regular contact with extension offices improved satisfaction. Apart from personal attributes, economic advantages gained from the veterinary extension services could be a major determinant for satisfaction (Elias *et al.*, 2016). Sheep farming gives direct financial profits and social protection during poor harvest years (Getachew *et al.*, 2010).

There are various attributes of modern farm management, starting from fodder selection to market selection, which significantly affect the choice of a breed, its rearing, and market targeting. In this research, the average score ranged from a maximum of 4.24 to a minimum of 3.82. More than four-fifths of breeders preferred to work with veterinarians to manage a herd and preferred modern breeding methods, whereas less than four-fifths preferred balanced diets and implementing instructions provided by the National Livestock Improvement Program. More than three-fifths of the breeders preferred modern technologies to manage their farms (Table 6).

Around half of the respondents preferred modern sheep farm management, whereas more than two-fifths were neutral and less than 10 % did not prefer modern sheep farm management (Table 7). The high preference for modern sheep breeds might be due to the high education among breeders. It is understandable that higher education improves understanding of complex information. Educated breeders might have received innovative information through training, workshops, and extension

Table 6. Percentage, mean, and standard deviation (SD) of breeders' preferences regarding modern sheep farm management in the Dawadmi Governorate, Saudi Arabia.

Items	Strongly unpreferred %	Unpreferred %	Neutral %	Preferred %	Strongly preferred %	Mean	SD
I work with veterinarians to manage the herds	0.6	3.9	13.6	34.4	47.4	4.24	0.87
I prefer modern breeding methods	0.00	4.5	13.6	36.4	45.5	4.23	0.85
I prefer balanced diets	0.00	4.5	16.2	36.4	42.9	4.18	0.86
I implement instructions provided by the National Livestock Improvement Program	0.00	6.5	19.5	28.6	45.5	4.13	0.94
I prefer modern technologies to manage my farm	3.2	9.1	26.6	24.7	36.4	3.82	1.12

Table 7. Overall breeders' preferences towards modern sheep farm management in the Dawadmi Governorate, Saudi Arabia.

Preference level	%
Unpreferred	9.1
Neutral	44.8
Preferred	46.1

programs that probably improved their perception of modern sheep breeds (Noor and Dola, 2011; Thakur *et al.*, 2019).

There were significant differences in the breeders' perception of sheep breeds based on their level of education ($t = -3.11; p < 0.05$). Highly educated breeders had a more positive perception of modern sheep breeds than less educated breeders; the difference in the means represented a medium effect (Cohen's $d = 0.5$). Regarding breeders' preference towards modern sheep farm management, there were significant differences based on their age ($t = 2.05; p < 0.05$), veterinary extension services ($t = -3.30; p < 0.05$), and financial support from the government ($t = -2.37; p < 0.05$). Older breeders preferred modern sheep farm management practices more than young breeders; the difference in the means represented a small effect (Cohen's $d = 0.35$). The breeders who received veterinary extension services showed a higher preference towards modern sheep farm management than those who did not; however, the effect was medium (Cohen's $d = 0.52$). The breeders who received financial support from the government showed a high preference towards modern sheep farm management as compared to those who did not receive any financial support. The computed effect was also small (Cohen's $d = 0.45$) (Table 8).

Table 8. Differences in sheep breeders’ perceptions of modern sheep breeds and their preferences regarding modern sheep farm management according to age, education, breeders’ experiences, veterinary extension services, and financial support in the Dawadmi Governorate, Saudi Arabia.

Variables	Breeders’ perceptions of modern sheep breeds				Breeders’ preference for modern sheep farm management			
	Mean	SD	<i>t</i>	Sig(2-tailed)	Mean	SD	<i>t</i>	Sig(2-tailed)
Age								
18–38 years (n = 54)	4.25	0.74	1.51	0.13	4.28	0.62	2.05	0.04
39–89 years (n = 100)	4.05	0.80			Cohen’s d = 0.35			
Education								
School education (n = 64)	3.89	0.85	-3.11	0.00	4.05	0.76	-0.88	0.37
Higher education (n = 90)	4.28	0.69			Cohen’s d = 0.50			
Breeders’ experience								
Low experience (n = 110)	4.16	0.72	1.21	0.22	4.15	0.69	0.87	0.38
High experience (n = 44)	4.00	0.93						
Veterinary extension services								
No (n = 64)	3.99	0.80	-1.69	0.09	3.89	0.79	-3.30	0.00
Yes (n = 90)	4.21	0.76			Cohen’s d = 0.52			
Financial support								
No (n = 108)	4.08	0.81	-0.76	0.44	4.02	0.76	-2.37	0.01
Yes (n = 46)	4.19	0.70			Cohen’s d = 0.45			

SD: standard deviation; *t*: *t* student test.

The findings of this study revealed that the socio-economic characteristics have a significant relationship with breeders’ perceptions of modern sheep breeds and their preference towards modern farm management. Inferential analysis revealed significant differences in the perceptions of modern sheep breeds. Education levels also showed significant differences, as highly educated breeders had positive perceptions, likely demonstrating dedication and preference for learning about modern sheep breeds to achieve sustainable production (Martín-Collado *et al.*, 2021). Previous findings revealed that educated breeders in SA improved the survival rate of sheep flocks by adopting modern breeds (Ali *et al.*, 2020). Haile *et al.* (2020) reported that the breeders’ perceptions can be improved through repeated training and awareness programs. For instance, MEWA and FAO cooperation formulated the Sustainable Rural Agricultural Development (SRAD) program (2019–2025), focusing on improving incomes in the livestock sector. The challenge of low productivity was addressed by

promoting modern breeding technologies and advanced farm management practices among small-scale livestock herders. Farm demonstrations were arranged to educate participants in terms of sustainable farm productivity, safe and low-cost animal feed, organized milk and wool processing infrastructures, enhanced marketing networks, farm management, and management of local breed resources (FAO, 2023a). MEWA has organized a visit of international experts to SA and signed an agreement in order to promote modern livestock breeds, modern farm management, productivity, and food security (FAO, 2022).

Positive perceptions of modern sheep breeds might be a consequence of the breeders' participation in the training and farm demonstrations. Toma *et al.* (2018) argued that the provision of appropriate educational or relevant information transfer could influence breeders' perceptions and intent to adopt. According to researchers' observations, educated breeders hold deep understandings of the advantages of modern breeds. Breeders stated that modern breeds contained genetic diversity, which improved disease resistance and allowed for the sustainability of sheep populations well suited to the challenging climate conditions of the study area. Caihong (2023) reported similar advantages of modern breeds. Furthermore, educated farmers in the study area believed that the higher perception of modern breeding is an output of modern knowledge gained from various educational programs arranged by the veterinary extension department.

Results revealed that older breeders preferred modern sheep farm management. It is understandable that they may have extensive experience, and it is reasonable to assume that they will achieve good results with modern farm management. Holmøy *et al.* (2012) reported that experienced breeders hold a high understanding of the socio-economic advantages of modern sheep farm management. Lianou and Fthenakis (2021) found an association between experience and farm management. Moreover, Martín-Collado *et al.* (2021) confirmed that experience is one of the major factors that increase preferences for modern sheep farm practices. Older farmers have more experience and may be better able to learn advanced information about modern farm management. It is reasonable to expect older breeders to be responsible for their own livelihoods and income.

Sheep farming provides direct cash profits and social security during bad crop years (Getachew *et al.*, 2010). According to researchers' observations, older sheep breeders seemed interested in modern sheep farm management because of its socio-economic and cultural values. They stated that modern sheep farm management improved their annual incomes and enabled them to meet their socio-economic needs, whereas young breeders seemed less interested in sheep farming and preferred to get jobs away from rural areas. Similar observations were recorded by Papadopoulos (2006), who found that modern sheep farm management increased farm productivity and incomes. Breeders' agreement with the advantages of modern farm management also was validated by Simões *et al.* (2021), who found that the understanding of modern farm management is the key to achieving sustainable sheep production in the future,

allowing breeders to understand and implement high-yielding techniques, nutrition, reproductive patterns, genetic improvements, and modern reproductive techniques (Simões *et al.*, 2021).

The findings of this study also point out that breeders who received veterinary extension services preferred modern sheep farm management, implying that they are aware of its advantages. This is consistent with Asaduzzaman *et al.* (2021), who reported that veterinary extension services provide information about disease and causes of mortality. Poor veterinary extension services discourage modern sheep breeding, farm management, and production. MEWA and other stakeholders are working together to strengthen the capacity of small-scale livestock breeders through learning processes (FAO, 2023a).

The veterinary extension services in SA established farm demonstrations and presented the advantages of modern farm management in terms of sustainable productivity. Moreover, these services benefit breeders in terms of safe animal food, reduced feeding costs, feed imports, organized milk and wool processing infrastructure, enhanced marketing networks, a functional digital livestock information management system, conservation and utilization of local animal genetic resources, attainment of animal food self-sufficiency, and movement towards one-health. The unique animal genetic resources, socio-cultural dimensions, and increasing demand offer investment opportunities and can be the keystone of resilient and sustainable livestock development in SA (FAO, 2023b).

Previous research also indicates that veterinary extension services can shift breeders' preferences from traditional to modern sheep farm management (Aman *et al.*, 2019; Martín-Collado *et al.*, 2021; Dabiah *et al.*, 2023; Muddassir and Alotaibi, 2023). The veterinary extension department educates breeders on scientific animal husbandry practices, modern breeds, and farm management (Jena *et al.*, 2019). Veterinary extension services in SA consolidated modern farm management and improved farm production. MEWA and FAO jointly provide required materials, medicines, vaccines, and small equipment to achieve sustainable modern sheep breeds (UNSA, 2022). In response to the underuse of modern sheep farm management practices, the SRAD program established farm demonstrations to enhance productivity through natural resource management and promote diversification and incomes for smallholders, including sheep breeders, with a focus on rural youth and women (FAO, 2024).

Results also explain the significance of external financial support in the success of modern sheep breeding. It is clear from the findings that breeders who received financial support from the government preferred modern farm management. Financial support enables them to purchase modern farm tools to accomplish sustainable productivity. In turn, it might change breeders' preferences regarding modern sheep farm management, such as the adoption of modern breeds and management techniques to achieve desirable outcomes. According to the researchers' observations, breeders sought financial support to gain more benefits. Moreover, breeders in the study area stated that they could establish modern sheep farms and improve production if they

received financial support from the government. Similar findings were reported by Aldosari (2018).

There are increasing concerns of the Saudi government towards modern sheep farm management. In previous decades, the government has formulated several policies to support sheep breeders. The modern sheep farming system was among the supported sectors, in which breeders received financial support to increase farm production, upgrade traditional farm management, and subsidize feed prices (Ameen *et al.*, 2019). These findings are consistent with those of Vaintrub *et al.* (2021), who revealed that financial support for sheep breeding and modern farm management is crucial. The lack of support hinders extensive breeding and reduces preference for modern sheep farm management. Similarly, Bartolini and Viaggi (2012) found that financial support for sheep breeders increased farmers' interest in modern farm management. As a result, financial support for sheep breeders in the study area is expected to increase breeders' preference for modern sheep farm management.

CONCLUSIONS

Modern sheep breeds and farm management have significant value for breeders, especially those whose income partially or totally depends on livestock rearing and marketing. The education level of breeders showed a significant relationship with their perceptions of modern sheep breeds. Moreover, age, veterinary extension services, and financial support had a significant impact on their attitudes toward modern sheep farm management. It is critical that the government create a framework to inform breeders about modern sheep breeds and farm management and that the veterinary extension department develop a capacity-building program to strengthen modern sheep breeds in remote areas where sheep farming is the primary source of income for breeders.

Breeders' participation in raising modern sheep breeds can be encouraged by providing improved veterinary extension services that help breeders develop their skills. Moreover, the extension department should arrange programs, workshops, and training sessions to improve commercial sheep farming. Commercial benefits may encourage breeders to learn and implement modern breeding systems and farm management. The findings of this study may not be relevant for breeders in other geographical regions; therefore, a similar study should be conducted in other sheep and goat farming regions in Saudi Arabia.

ACKNOWLEDGEMENTS

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was funded by the Researchers Supporting Project (number RSP2025R443), King Saud University, Riyadh, Saudi Arabia.

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