

A Short Communication on Exploring the Rearing, Breeding, and Future Outlook of Damani Sheep in Pakistan

Muhammad Jamil

PARC Arid Zone Research Centre, Dera Ismail Khan-29050-Pakistan, jamilmatrah@gmail.com

Ashiq Saleem

PARC Arid Zone Research Centre, Dera Ismail Khan-29050-Pakistan, agro_ashiqsaleem@yahoo.com

Abdul Razzaq

Department of Animal Health, Pakistan Agricultural Research Council, Islamabad, Pakistan, abdulrazzaqazrc@gmail.com

Naveed Ahmed

Department of Theriogenology, University of Agriculture Faisalabad, Pakistan, drnaveedahmed828@gmail.com

Muhammad Faraz Ahsan

Faculty of Veterinary Sciences, Bahauddin Zakariya University (FVS-BZU), Multan, Pakistan, farazahsan829@gmail.com

See next page for additional authors

Follow this and additional works at: <https://corescholar.libraries.wright.edu/jbm>



Part of the [Animal Sciences Commons](#)

Recommended Citation

Jamil, M., Saleem, A., Razzaq, A., Ahmed, N., Ahsan, M. F., Ur Rehman, M., Anwar, I., Ramzan, F., Ahmad, Z., & Ameen, A. (2023). A Short Communication on Exploring the Rearing, Breeding, and Future Outlook of Damani Sheep in Pakistan, *Journal of Bioresource Management*, 10 (3).

ISSN: 2309-3854 online

(Received: Mar 19, 2023; Accepted: May 30, 2023; Published: Sep 30, 2023)

This Article is brought to you for free and open access by CORE Scholar. It has been accepted for inclusion in Journal of Bioresource Management by an authorized editor of CORE Scholar. For more information, please contact library-corescholar@wright.edu.

A Short Communication on Exploring the Rearing, Breeding, and Future Outlook of Damani Sheep in Pakistan

Authors

Muhammad Jamil, Ashiq Saleem, Abdul Razzaq, Naveed Ahmed, Muhammad Faraz Ahsan, Mujeeb Ur Rehman, Irem Anwar, Faiqah Ramzan, Zaheer Ahmad, and Abdurehman Ameen

© Copyrights of all the papers published in Journal of Bioresource Management are with its publisher, Center for Bioresource Research (CBR) Islamabad, Pakistan. Users have the right to read, download, copy, distribute, print, search, or link to the full texts of articles in the Journal. We operate under International Version 4 (CC BY 4.0) of Creative Commons Attribution License which allows the reproduction of articles free of charge with the appropriate citation of the information.

A SHORT COMMUNICATION ON EXPLORING THE REARING, BREEDING, AND FUTURE OUTLOOK OF DAMANI SHEEP IN PAKISTAN

MUHAMMAD JAMIL¹, ASHIQ SALEEM¹, ABDUL RAZZAQ², NAVEED AHMED³, MUHAMMAD FARAZ AHSAN⁴, MUJEEB UR REHMAN⁵, IREM ANWAR⁶, FAIQAH RAMZAN⁷, ZAHEER AHMAD⁷, ABDUREHMAN AMEEN⁸

¹PARC Arid Zone Research Centre, Dera Ismail Khan-29050-Pakistan

²Department of Animal Health, Pakistan Agricultural Research Council, Islamabad, Pakistan

³Department of Theriogenology, University of Agriculture Faisalabad, Pakistan

⁴Faculty of Veterinary Sciences, Bahauddin Zakariya University (FVS-BZU), Multan, Pakistan

⁵Faculty of Veterinary Sciences, The University Of Agriculture Peshawar, Pakistan

⁶Livestock Production Research Institute Bahadurnagar Okara, Pakistan

⁷Department of Animal and Poultry Production, Faculty of Veterinary and Animal Sciences, Gomal University, Dera Ismail Khan 29050, Pakistan

⁸Faculty of Veterinary & Animal Sciences, The Islamia University (IUB) of Bahawalpur, Pakistan

Corresponding author's email: jamilmatrah@parc.gov.pk

ABSTRACT

The intentional production of animals is predicated on their genetic proficiency, which is dependent on optimal resource utilization and manipulation of biotic and abiotic environmental components to increase production for societal sustenance. The annual global consumption of sheep meat is approximately 2.5 kilograms per individual, out of a total of 41.6 kilograms. Three management systems are used to rear sheep: extensive wool and meat production, intensive milk production, and traditional pastoralism. Possessing adequate resources for sheep husbandry contributes to positive welfare outcomes. This review examined the rearing, breeding, and future potential of Damani sheep in Pakistan. Damani sheep are a composite, meat-specialized breed with thin tails, tiny to medium bodies, white heads, and camel-colored legs. They are native to the Khyber Pakhtunkhwa districts of Dera Ismail Khan and Bannu and are predominantly raised for their meat and wool. Damani sheep have well-developed teats and udders, small ears, and a mature body height and weight of 53-61 cm and 27-28 kg, respectively. They are robust, well-adapted, and successful in their native environment. Damani ewes produce high-quality milk with an average fat content of 5.8 % and average lactation period of 120 days. Despite their potential, the breed's per-unit meat and wool production has decreased due to cross-breeding, disease, malnutrition, improper management, and a lack of agricultural knowledge. Pakistan recognizes between 28 and 33 categories of sheep, but sheep continue to be an undervalued species with low productivity per animal unit.

Keywords: Animal husbandry, breed development, damani sheep, genetic proficiency, indigenous breeds.

INTRODUCTION

The district of Dera Ismail Khan consists of a predominantly dry area commonly referred to as "Daman". Millions of people of Daman have small farms of sheep and other ruminants and the indigenous sheep breed of the area is known as Damani sheep. Damani sheep is one of the best sheep breeds in Pakistan. Pakistan is blessed with 25 breeds of goats and 28 well-defined (thin and fat-tailed) sheep breeds (Hussain et al., 2018). According to the most recent data from the Pakistan Bureau of Statistics, the livestock sector accounted for

approximately 14.04 % of the country's GDP and 61.89 % in Agriculture economy, in the 2021-22 (Economic Survey of Pakistan). For smallholders in rural areas, livestock has historically been the most important sector in Pakistan. Small farmers and the landless poor rely greatly on their livestock for their livelihoods (Ziad et al., 2019).

Since the sheep and goats produce 400,000 tons of meat on annual basis, they play a crucial role in the economy of our country (Molina et al., 2020). They contribute 43 percent of the country's total meat production (Baloch et al., 2006). Sheep and goats are often referred to as "poor man's cow". They are important farm animals, and their contributions to human nutrition are well documented, globally. Flocks of small ruminants with random breeding are the characteristic feature of the small ruminant industry (Ojango et al., 2016). A substantial share of livestock production in Pakistan goes for improvement of the socio-economic conditions of small ruminant producers and pastoralists who are resource-poor (Gadahi et al., 2009).

Importance of Sheep in Pakistan

Almost all sheep breed provides coarse-type wool and can also be used for meat. They are often kept in mixed flocks with goats, but independent sheep farms are also raised. Kachhi and Damani are the most important in milk production, producing nearly 1 litre daily and having a lactate period ranging from 4 to 6 months (Khan et al., 2022). Similarly, the Kari and Kaghani breeds are well-known for producing finer wool than any other breeds, but their fineness is still inadequate to meet the domestic need for finer wool and long fibre. Consequently, wool imports may amount to a few million rupees. Sheep populations have not grown at a rate similar to that of goat populations, which have grown at the quickest rate among all animal kingdom's species. Drought in sheep-raising areas such as Baluchistan and the demand for meat from those people are the two major factors contributing to the slow expansion of the sheep population in the country. However, the shift from wool to synthetic fibre may be even more critical in the country's slow development of the sheep population (Khan et al., 2007). Despite this, sheep are an essential sacrifice animal and are highly significant to many cultures since they are more suited to their local environmental and socio-economic conditions (Khan et al., 2004).

A majority of sheep and goat production in Pakistan is carried out by smallholder families, and small ruminants are very important to the country's economy, both as consumers and as producers of animal feed. Goats and sheep are essential to the livelihood of farmers and their families. They may be readily sold to provide revenue in times of need and provide nutrition and food security for the family. Because of their low initial cost and low ongoing maintenance needs, they are also an affordable option for poor parts of society, notably women (Miller and Lu, 2019).

Pakistan's livestock producers rely on sheep and goats for their livelihoods, making them a critical national breeding resource. Sheep and goats also generate a significant percentage of the country's revenue (Saeed et al., 2022). The capacity to save water is particularly important in arid areas where agriculture and dairy production is carried out on small landholdings. In addition, sheep and goats are crucial aspects of a diversified farming system in an extensive farming context, practised by around 4 million farmers globally in irrigated agricultural backgrounds (Ahmad and Ma, 2020). Small ruminants are also influential users of Pakistan's rangelands, as shown by the high number of them on the country's rangelands (Hashmi et al., 2021). The anticipated rise in the sheep population of 41 % over the previous 20 years has not been accompanied by an increase in productivity in the same proportion. The absence of genetic manipulation for improvement, management, nutrition, and disease management are the most significant issues (Thakur et al., 2020).

In Pakistan's arid and semi-arid climates, sheep and goat husbandry is one of the most significant sources of income for the country's rural population. There are 26.5 million sheep and 53.8 million goats are currently present in the country and rising of these little ruminants in the country is mostly for the purpose of producing meat (Aziz et al., 2020). When it comes to red meat production, these ruminants account for around 40 % of the total. It has been noticed that the general per capita consumption of animal food items has grown over the previous many years, particularly in developing countries. Goats grow at a rate of 4 % per year on average in Pakistan, making it the fastest growing animal in Asia. Pakistan has the third-largest small ruminant population in Asia, behind China and India (Ghafar et al., 2020). Farming tiny ruminants, which need less capital investment, may be a source of income for rural populations. The rearing of animals, especially goats and sheep, for the goal of making a livelihood is a popular pastime among the people of Pakistan (Liang and Paengkoum, 2019).

According to a recent study, the production of sheep and goats in low-input smallholder systems in developing countries supports the livelihoods, economic prosperity, and social welfare of a substantial portion of the world's population. Increasing global population, urbanisation, and shifting consumer preferences all contribute to an increase in demand for these animals and their products, resulting in higher prices (Milford et al., 2019).

There are 28 sheep breeds in the country, generally kept by smallholders. Out of these, eight (Buchhi, Cholistani, Kajli, Latti, Lohi, Sipli, Thalli and Kacchi) are maintained in different tracts of Punjab (Saeed and Kamran, 2022). The Kacchi is thin tailed breed in southern Punjab. The head and legs are black and the animal's coat is white with rough wool. Small-scale farmers may benefit from the decreased feed and capital needs of these animals. Smaller size and shorter generation intervals allow them to use a wider variety of feedstock than larger animals, including crop residues that would otherwise be thrown away. Because of their contributions, tiny ruminants are essential to the welfare of rural residents and the growth of the nation, particularly in dry areas where agricultural production is constrained (Awasthi et al., 2021).

Types of Sheep in Pakistan

There are a lot of sheep genetic resources in Pakistan with an estimated value of 26.5 million sheep. Among them, at least two dozen different varieties of sheep present in Pakistan that are increasing in number. There are conflicting statistics on the number of breeds in the country. According to Hasnain (1985), there are a total of 28 different sheep breeds, whereas Isani and Baloch (1996) provide basic information on 31 different sheep breeds (Hasnain et al., 1985).

Table 1: Sheep breeds in Pakistan (n=28)

Area	Breed number	Breed names
Sindh	3	Kooka, Dumbi and Kachhi,
Baluchistan	4	Rakhshani, Bibrik, Balochi and Harnai
Khyber Pakhtunkhwa	7	Balkhi, Damani, Kaghani, Hashtnagri, Michni, Tirahi, Waziri
Azad Jammu Kashmir and Northern areas	7	Poonchi, Baltistani, Pahari, Kali, Gojal, Koh-i-Ghizer and Kail,
Punjab	7	Sipli, Buchi, Salt Range, Lohi, Kajli, Cholistani and Thalli

The most important sheep breeds in Pakistan include Salt Range, Lohi, Bucchi and Thalli in Punjab; Harnai, Baluchi, Rakhsani, and Bibrik in Balochistan; Kooka, Kachhi and Bambi in Sindh; Kaghani, Damani and Balkhi and in Khyber Pakhtunkhwa (Table 1), while, the distribution of different sheep breeds in Pakistan is given in Table 2.

Table 2: Sheep breeds distribution in Pakistan

S. No.	Breed	Utility	Geographic distribution	Population. Size (000)*	Population. trend
1.	Baghdale	Mutton, wool	Punjab	<1	NA
2.	Balkhi	Mutton, wool, fat	Kpk	444	+ve
3.	Baltistani	Mutton, wool	Northern Areas	235**	NA
4.	Balochi	Mutton, wool, fat	Balochistan	4130	+ve
5.	Bibrik	Mutton, wool, fat	Balochistan	1687	-ve
6.	Buchi		Punjab	466	-ve
7.	Cholistani	Mutton, wool	Punjab	39	+ve
8.	Damani	Mutton, wool, milk	Kpk	624	+ve
9.	Dumbi	Mutton, wool, fat	Sindh	38**	NA
10.	Gojal	Mutton, wool, fat	Northern Areas	93**	NA
11.	Harnai Dumari	Mutton, wool, fat	Balochistan	572	+ve
12.	Hashtnagri	Mutton, wool, fat	Kpk	156	+ve
13.	Hissardale	Mutton, wool	Punjab	<2	NA
14.	Kachhi Kutchhi	Mutton, wool	Sindh	708	+ve
15.	Kaghani	Mutton, wool	Kpk	183	-ve
16.	Kail	Mutton, wool	AJK	40	+ve
17.	Kajli	Mutton, wool	Punjab	1379	-ve
18.	Kali	Mutton, wool	AJK	6**	NA
19.	Khijloo Haleenjoo	Mutton, wool, fat	Punjab	NA	NA
20.	Kohai Ghizer	Mutton, wool, fat	Northern Areas	139**	NA
21.	Kooka	Mutton, wool	Sindh	1096	+ve
22.	Latti Salt Range	Mutton, wool	Punjab	125**	NA
23.	Lohi Parkanni, Lamochar	Mutton, wool	Punjab	969	-ve
24.	Michni	Mutton, wool, fat	Kpk	36**	NA
25.	Pahari	Mutton, wool	AJK	15**	NA
26.	Pak-Awasssi	Mutton, wool, fat	Punjab, Sindh	<1	NA
27.	Pak-Karakul	Mutton, wool	Punjab, Balochistan	<1	+ve
28.	Poonchi	Mutton, wool	AJK	57**	NA
29.	Rakhshani	Mutton, wool, fat	Punjab		NA
30.	Sipli	Mutton, wool	Punjab	52**	NA
31.	Thalli	Mutton, wool	Punjab	818	+ve
32.	Tirahi Afridi	Mutton, wool, fat	Kpk	40**	NA
33.	Waziri	Mutton, wool, fat	Kpk	575	+ve

Numbers as in 2006 livestock census but if not available, estimates are given, **1986 estimates from www.fao.org/DAD-IS/.

Damani Sheep Breed Characteristics

Damani sheep is a small to medium-sized breed that tends to have a white body. Their legs are camel-coloured and have a black or tan-coloured head. Ewes have small ears and well-developed udders and teats. A mature ram's height at the withers is approximately 61 cm, and that of a mature ewe is approximately 53 cm. Damani rams are generally 32 kg in weight on average when mature. The weight of fully grown ewes is about 27 kg.

A Damani sheep is a strong animal. Their adaptation to their local environments is excellent and they thrive within them. The breed is raised both for meat production and wool production as a dual-purpose animal. Wool yield is approximately 1.5kg with coarse fiber. At birth, the approximate weight is 2.5-2.7 kg. Damani sheep are also pretty good in milk production with 5.8 % milk fats with average milk production is about 80kg during lactation periods of 120 days. Despite potential, the per-unit production of meat and wool from the Damani sheep breed has been very low because of cross breeding, diseases, feeding shortage, mismanagement, and lack of knowledge of the scientific farming (Naqvi et al., 2017, Khan et al., 2020). The reproductive performance and production traits of Damani sheep in Pakistan are given by Table 3 and 4 respectively.

Table 3: Reproductive performance of Damani sheep

Parameters	Units
Birth weight	3-3.5 Kg
Weaning weight	8.5-11.5 Kg
Average body weight	37-42 Kg
Flock pregnancy percentage	80 %
Conception rate	86-96 %
Length of oestrous cycle	17 days
Oestrous period	24-36 hours
Puberty age	6-9 months (Din et al., 2019)

Table 4: Production traits of Damani sheep in Pakistan (Din et al., 2019)

Breeds	Province	Birth Weight (kg)	Weaning weight (kg)	Growth rate (g/day)	Adult weight (kg)	Dressing percentage (%)
Damani Sheep	Khyber Pakhtunkhwa	2.5-2.7	8.5-11.5 Kg	104	37-42	40

Damani Sheep Rearing and Breeding

a) Rearing

Pakistan is a developing country with an ever-increasing population and an unstable economy. There is still huge untapped potential in the livestock sector that can boost the economy. Sheep farming is one of the most neglected parts of the livestock sector, even though Pakistan has a 30.5 million sheep population. Most of the sheep population is owned by small-scale farmers; most of the time, landless flocks either separate or combine with goats. Sheep are reared in one of the following systems.

b) Nomadic Production System

This production system is primarily practised in parts of Khyber Pakhtunkhwa, Baluchistan and Sindh. Flock is usually greater than 100 animals and is on the move throughout the year. Grazing on rangeland pasture and banks of the river is common, which also minimizes the input cost.

c) *Transhumant Production System*

This system needs a fixed base from which the flock is moved to other areas for grazing most of the year. This is the more prevalent system in Pakistan. Flock is about 100 animals and grazes in rangelands and crop residues.

d) *Sedentary Production System*

This flock remains at the sheds throughout the year but is taken out to grazing during the day and brought back at night. The flock is small, usually 10-20 animals. In this way, sheep are a significant livelihood for millions of farmers in arid and semiarid areas where cattle farming cannot be practised. Sheep provide about 22 % of meat produced along 5000 tons with carpet grade. But sheep productivity is lower in Pakistan compared to Western countries due to nutritional stress in the dry season, poor management, and the lack of breeding strategy, vaccination and medical assistance.

Damani sheep are maintained by landless farmers who are socially and economically less developed, most of whom are not literate. Some farmers prefer to keep their animals in a shed at night, while others prefer to leave them out in the open during the day. Most sheep are reared on pasture, with just a small amount of supplementation to keep them healthy. Most farmers let their animals out in the open for security. Cattle and goats are often kept in the same house but separated by a fence. Sheep and other livestock are often kept in a section of the farmer's residence. Mud, bricks, or other locally available materials are used to build the boundary walls. The roof is thatched. The sheds' low-lying roofs and poor hygienic conditions make them more vulnerable to ecto- and endo-parasitic infestations than other structures. Sheep in this area are bred by natural mating, according to research. In most flocks, just one breeding male is kept.

Some big flocks have more than one male for breeding purposes (one ram for 40 ewes). Most farmers began breeding their animals in October and continued through November, with lambing in February and March. During these months, most births were recorded. Mostly, farmers are unaware of the need to vaccinate their flocks against common illnesses. Diseases such as parasitic infestation, enterotoxaemia, and pneumonia were detected in the herds. Lamb mortality, which varied from 8 to 15 per cent, was found to be the most severe health issue. In the winter, pneumonia was the leading cause of lamb death, whereas, in other seasons, dysentery was the leading cause of lamb mortality. Between 2 % to 4 % of cases were recorded in November and December as abortions.

It is common practise to raise Damani sheep for the purpose of producing mutton, milk, and wool. As a source of revenue, a source of livelihood, and an opportunity for profit, sheep are a vital part of the community. On Eid-ul-Azha, sheep are sacrificed at a far higher rate than any other time of year. Damani sheep as a native breed is best suited for the local environment (Figure 1). It is raised in low input - low-output system, which is the main reason for most of the problems associated with its productivity and quality. There are also issues with breeding policy, as there are no incentives for breeders to keep the breed pure. Thus, farmers are breeding their flock with other breeds haphazardly. This has resulted in unique crossbreeds in regions with areas having two or more breeds. This should be tackled immediately and handsome incentives should be introduced to develop the Damani breed as a distinct breed. Organized Vaccination campaigns for enterotoxaemia should also be launched regularly to reduce losses.

Record Keeping of Damani Sheep

It is important to keep track of the performance of individual ewes over the course of many years on fertility, prolificacy, raising or mothering capacity, and milk output. As a result of variances in farm circumstances or other environmental factors, comparisons across animals in same flock should be done to prevent misunderstanding. It becomes more reliable to utilise animal records as a reference for the breeding value of particular animals when there are more records available. The ability to track and analyse sheep performance in the agricultural system is critical, and this is where record keeping comes into play. Farmers should keep track of everything in a record book



Figure 1: Damani sheep (female)



Figure 2: Home flock (a) and adult male (b) of Damani Sheep

A simple and clear structure is needed for farmers to read and comprehend. Farmers in the area should be able to read and understand this record book, which must include any regionally relevant records or information.

The registers for record-keeping have different formats and well-defined information collected through these records would be a source of selection program to improve performance traits after their assessment. Any genetic selection program needs solid and accurate information on the performance as well as the pedigree of the animals. Different parameters are estimated by analysing performance records to estimate the breeding values that indicate the genetic worth of the animals.

Nucleus Flock and Breeding Centres

Genetic improvement is a permanent sort of improvement and is essentially based on the genetic worth of animals. Among many uses, tracking the performance of animals through generations is only possible through record keeping. Identification of elite animals and their involvement in selective breeding programs is possible when there is availability of performance records. The selection and culling decisions would become impossible without the provision of performance records.

According to FAO, 2007, approximately 995 sheep breeds have been documented at the global level, where Asia is native to 265 sheep breeds. Among these 180 breeds no longer exist in this world and were lost due to cross breeding. Approximately 417 breeds are yet to be characterized for their morphological and performance traits. Sheep populations of 45 breeds are critical and if no proper attention is paid, then these may also get extinct (Jalil et al., 2009).

Only a few districts of Khyber Pakhtunkhwa province are habitat to Damani sheep. Despite its relatively low genetic and economic value, it is routinely kept by rural farmers who are unaware of its true worth. Sheep farming is only a method of supplementing the family's financial situation for them. Because they don't care about pure and crossbreeding tactics, vital national genetic assets are being lost. Nucleus flocks and breeding facilities are essential for the preservation and conservation of our national genetic resources. Efforts must be made to enhance the selective mating of pure breeds with desired features. Public and private farms should be set up to breed better animals that may be reintroduced into private farms to increase the quality of the animals and the goods they generate.

Research Status and Future of Damani Sheep

A variety of sheep breeds have been studied for their genetic potential in Pakistan, but less is known about the Damani breed's reproductive qualities in comparison (Islam et al., 2019, Saif et al., 2020). Scientific and livestock management specialists would benefit from further information about Damani sheep's production, reproduction, and performance characteristics. Genetics, breeding, management, and disease control must be studied in order to reduce the mortality and morbidity of sheep in the area, especially infectious illnesses.

Genetics improvement, gene transplanted, crossbreeding and lethal genetic defects, selected phenotypes and nutritional requirements, and changes in puberty due to nutrition, behaviour, production of vaccines against local strains, or improvements in techniques for disease diagnosis should be the focus of additional research in the future. In Pakistan, there have been some publications on the genetics of sheep, however in order to improve sheep production in the future, more attention must be paid to the scientific community. The usage of animal by-products to improve the nutritional range for humans

would need more research as well. In many parts of Pakistan, the Damani sheep is a unique specimen of this kind of sheep.

The following are some strategies for preserving genetic resources in the region:

- Purebred nucleus centres should be established to preserve breeds such as the Damani goat.
- Training, awareness and advice are needed for farmers on the farm.
- The use of both natural and artificial insemination should only be done with purebred males breeding.
- Avoid putting rams and ewes together at random during the breeding season.
- Pakistani Damani sheep farming and breeding

CONCLUSIONS AND SUGGESTIONS

Pakistan's rural areas, in particular, place a substantial economic value on sheep. Unless breeding centres and nucleus flocks are effectively maintained, Damani sheep, which are widely distributed throughout the nation with a stronghold in the Khyber Pakhtunkhwa province, are at risk of extinction. Therefore, it is essential to provide ample time for livestock breeders and farmers in Pakistan to devise a comprehensive plan for enhancing the economic traits of Damani sheep, thereby maximizing the utilization of this valuable indigenous genetic resource. To fully realise the potential of Damani sheep, numerous scientific aspects must be investigated. Improved health control measures and production practises can increase the health and productivity of Damani sheep. Increasing lamb survival rates through the adoption of improved production practises can yield long-term benefits.

AUTHORS' CONTRIBUTION

All authors equally contribute to carry out the present study; review and write the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

REFERENCES

- Ahmad MI, Ma H (2020). Climate change and livelihood vulnerability in mixed crop–livestock areas: The case of Province Punjab, Pakistan. *Sustainability*. 12(2):586.
- Aziz MA, Khan AH, Pieroni A (2020). Ethnoveterinary plants of Pakistan: a review. *J Ethnobiol Ethnomed.*, 16(1):1-18.
- Awasthi MK, Sarsaiya S, Wainaina S, Rajendran K, Awasthi SK, Liu T, Duan Y, Jain A, Sindhu R, Binod P (2021). Techno-economics and life-cycle assessment of biological and thermochemical treatment of bio-waste. *Renewable Sustainable Energy Rev.*, 144:110837.
- Baloch KH (2006). Some Common Aliments And Areawise Distribution of Small Ruminants In District Bolan Balochistan. *J Appl Sci.*,1(2):197-9.
- Din I, Khan A, Rizwan M, Haq R, Wazir MA (2019). Study of Birth Weight and Post Weaning Growth Rate in Lambs and Kids of Damani Sheep and Damani Goat for Fattening Purpose. *Open Academic J Advanced Sci Tech.*, 3(1):1-5.
- Economic Survey of Pakistan, 2021-22, Finance Division, Government of Pakistan.

- Gadahi J, Arshed M, Ali Q, Javaid S, Shah S (2009). Prevalence of gastrointestinal parasites of sheep and goat in and around Rawalpindi and Islamabad, Pakistan. *Vet World.*, 2(2):51.
- Ghafar A, Abbas T, Rehman A, Sandhu Z-u-D, Cabezas-Cruz A, Jabbar A (2020). Systematic review of ticks and tick-borne pathogens of small ruminants in Pakistan. *Pathogens.*, 9(11):937.
- Hashmi HA, Belgacem AO, Behnassi M, Javed K, Baig MB (2021). Impacts of Climate Change on Livestock and Related Food Security Implications—Overview of the Situation in Pakistan and Policy Recommendations. *Emerging Challenges to Food Production and Security in Asia, Middle East, and Africa*:197-239.
- Hasnain H (1985). Sheep and goats in Pakistan. *FAO Animal Production and Health.*, 56:81-101
- Naqvi A, Mahmood S, Vahidi S, Abbas S, Utsunomiya Y, Garcia J, Periasamy K (2017). Assessment of genetic diversity and structure of major sheep breeds from Pakistan. *Small Rumin Res.*, 148:72-9.
- Hussain T, Shaheen M, Babar M, Musthafa M, Nadeem A, Nawaz A, Javed M, Marikar F (2018). Molecular diversity analysis of Jattal and Dera Din Panah goat breeds of Pakistan using microsatellite markers. *J Hell Vet Medical Soc.*, 69(1):791-6.
- Islam R, Li Y, Liu X, Berihulay H, Abied A, Gebreselassie G, Ma Q, Ma Y (2019). Genome-wide runs of homozygosity, effective population size, and detection of positive selection signatures in six Chinese goat breeds. *Genes.*, 10(11):938.
- Khan MS (2022). Cattle breeding in Pakistan-some policy options. *J Plants Anim Sci.*, 32(4):1168-1174.
- Jalil A, Ahmad S, Habib G, Akmal M (2009). Kutta Sheep-An endangered bred in Northern Pakistan. *Sarhad J Agric.*, 25(2):273-7.
- Khan MS, Khan M, Ahmad S, Mahmood S (2007). Continuing education article genetic resources and diversity in Pakistani sheep. *Int J Agric Biol.*, 6:941-4.
- Khan M (2004). Technical report on the status, trends, utilization and performance of FAnGR and their wild relatives in Pakistan. Univ Agri, Faisalabad.
- Khan S, Khan IU, Khan AZ, Zaman S, Majid A, Rehman AU, Khan MA, Maris H, Ullah R, Qureshi S (2020). Evaluating fertility and growth rate potential of indigenous sheep breeds submitted to heat stress under different management systems. *J Adv Vet Anim Res.*, 7(1):170.
- Liang JB, Paengkoum P (2019). Current status, challenges and the way forward for dairy goat production in Asia—conference summary of dairy goats in Asia. *Asian-Australasian J Anim Sci.*, 32(8):1233-43.
- Milford AB, Le Mouël C, Bodirsky BL, Rolinski S (2019). Drivers of meat consumption. *Appetite.*141:104313.
- Miller BA, Lu CD (2019). Current status of global dairy goat production: An overview. *Asian-Australasian J Anim Sci.*, 32(8):1219.
- Molina CN, Herrera CAM, Machuca MAH, Cruz UM, Deras FGV (2020). Not all ruminants were created equal: Environmental and socio-economic sustainability of goats under a marginal-extensive production system. *J Cleaner Prod.*, 255:120237.
- Ojango JM, Audho J, Oyieng E, Recha J, Okeyo A, Kinyangi J, Muigai AW (2016). System characteristics and management practices for small ruminant production in “Climate Smart Villages” of Kenya. *Animal Genetic Resources/Resources génétiques animaux Recursos genéticos animales.*, 58:101-10.
- Saeed R, Kamran MA, Qasim M, Naheed S, Mahmood I (2022). Determinants of Livestock Herd Size in Mixed Cropping Zone of Punjab-Pakistan. *J Econ Impact.*, 4(1):150-7.

- Saif R, Henkel J, Jagannathan V, Drögemüller C, Flury C, Leeb T (2020). The LCORL locus is under selection in large-sized Pakistani goat breeds. *Genes.*, 11(2):168.
- Ziad KT, Hayat U, Bacha MS (2019). An Economic Assessment of Problems Associated with Small-Scale Farmers in the Dairy Sector of Pakistan (A Case Study of Punjab Province). *Sarhad J Agri.*, 35(1).
- Thakur AK, Parmar N, Singh K, Nanjundan J (2020). Current achievements and future prospects of genetic engineering in Indian mustard (*Brassica juncea* L. Czern & Coss.). *Planta.*, 252(4):1-20.