

A QUICK LOOK AT GOAT PRODUCTION AND HUSBANDRY PRACTICES IN PAKISTAN

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ABSTRACT

Goat production has a great impact on socio-economic factors, especially in less-favored regions of the globe. From a sociological view, goat farming provides security and diversification of assets. Pakistan has about 80 million goat heads, while most of the goat production is carried out at a household level. However, research concerning the goat industry in this country is scarce. This review investigated goat production systems and husbandry practices in Pakistan. There are 36 indigenous breeds in Pakistan, predominantly Beetal, Kamori, Nachi, and Sindh Desi. However, it is not clear if these breeds are distinct genetic units. Nearly all goats are reared under smallholder production conditions in extensive production systems. It seems that the identification of alternative feed resources and strategic feeding management might be options for development since there is neither nutrition management nor cost-effective feeding in Pakistan. Therefore, an integrated effort may be desirable in terms of management, health, genetic improvement, and product technology

to enhance production by focusing on small-scale farming. Current practices and concerns within Pakistan's goat industry must be more acknowledged if research is to possess an optimal value. Lack of industrial breeding systems, inattention to genetic improvement of native goats, incompleteness of the value chain as well as the creation of added value to products are issues that warrant further attention.

Keywords: Goat farming, dairy, mutton, Pakistan, smallholders, social.

INTRODUCTION

Globally, goat farming has been performed in less-favored regions as this livestock type can easily adapt to different environments and transform feed into high-quality protein found in milk and meat (Miller and Lu, 2019; Utaaker et al., 2021). The worldwide goat population is about one billion heads, which has doubled during the last four decades, with more than 90 percent of goats being reared in developing countries, and with Asia and Africa accounting for the largest share of the world's goat population (Utaaker et al., 2021). Additionally, about 64% of these are reared mainly by smallholder farmers located in arid and semi-arid regions (Darcan and Silanikove, 2018; Miller and Lu, 2019; Utaaker et al., 2021). In Pakistan, the livestock sector contributes to almost 60% of agriculture and 11.5% of the national gross domestic product (GDP), which had a growth rate of 3.06% during 2021 versus 2.01% during 2020 (GOP, 2021; Sikandar and Nasir, 2023). Pakistan has huge livestock genetics and possesses many goat breeds since it is the 3rd largest goat producer in the world after China and India (Miller and Lu, 2019; GOP, 2021). The province of Punjab has the largest number of goats, followed by Sindh,

Baluchistan, and Khyber Pakhtunkhwa (Fig. 1).

Of all livestock population, goats contribute to 60.4% in Pakistan, and they are mainly raised for meat purposes, but milk, hair, and skin are also considered. Goat meat is an important component of local food and dishes, and its price is quite high compared to cow, buffalo, or poultry meat, mainly due to less intensive production and lack of competitive markets against high demand (Sikandar and Nasir, 2023; Lund and Ahmad, 2021; Nagy et al., 1991). Pakistan is the 3rd largest world goat meat producer (Rischkowsky et al., 2007). During EidulAdha celebrations, goats are sold at good prices as sacrificial animals (Sikandar and Nasir, 2023). Shorter growth duration, fewer space requirements for raising, and quick return are the main drivers of goat production among farmers. In addition, a short gestation period, twinning, early maturity, disease resistance, less forage requirement, adaptability, and particularly their small size give goats advantages over other livestock. In Pakistan, however, goats are mainly raised under small-scale conditions that are characterized by minimal resources in terms of land and capital, low income, poor food security, diversified agriculture, and informal labor arrangements derived from family members

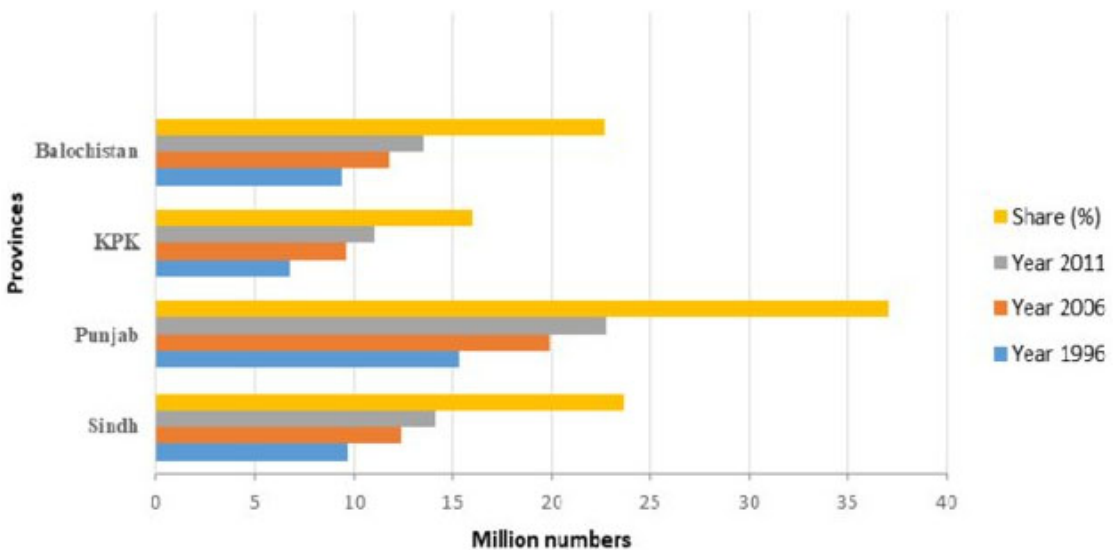


Fig. 1. The provinces with the largest populations of goats in Pakistan (GOP, 2021).

(Khan et al., 2013; Teufel et al., 1998). Hence, goats play great economic and social roles for the poor and landless people living in the rural areas of the country. Goat farming is justifiable for small farmers because the costs of a goat are much cheaper than those of a cow or buffalo and is easily replaceable. Goat production is a monetarily attractive economic endeavor as the amount of manpower and micromanagement required is relatively low. Furthermore, goats can be easily integrated with other livestock (Miller and Lu, 2019; GOP, 2021). In Pakistan, goats are acknowledged as the poor man's cow; they are not only easily adaptable and have low raising costs farming, being regarded as an important nutrition source that can help prevent human malnutrition, especially in rural and less developed regions (Lund and Ahmad, 2021). A few studies have dealt with various aspects of goat husbandry and production in Pakistan (Sikandar and Nasir, 2023; Muhammad et al., 2015; Khan and Ashfaq, 2010; Khan et al., 2013; Sarwar et al., 2010; Teufel et al., 1998; Nagy et al., 1991). However, until now, there is still a lack of comprehensive research regarding goat production, health, and welfare. In this sense, providing a comprehensive insight into goat breeding in Pakistan, depicts the existing challenges and provides practical ways to improve this sector.

Except for household consumption, in Pakistan, goats are usually not milked due to low production, lack of milk collection centers, difficulty in access, or production costs of dairy products at small-scale farms (Miller and Lu, 2019). Therefore, there are no retail goat dairy products. Despite such a huge goat population, its industrial production is not widely used in Pakistan, and farmers are only limited to meat supply at local markets. Moreover, strategies to respond to the potential growth for domestic use and export of goats and their products are non-existent. In Pakistan, documenting goat husbandry issues and prospects could be valuable, not only for small-scale producers, but also for farms, industry, and research institutes. This review aims to describe different aspects of goat production in Pakistan, focusing on the current practices and identifying challenges to address in future studies. The following sections provide insights into the current goat husbandry and production in the country. The main production systems will be described, along with details on the indigenous goat breeds as well as the main concerns regarding health, welfare, and market. Finally, current and future issues will be discussed.

Goat population and distribution in Pakistan

Goat has the highest growth rate of 3.98% per year among all the domestic livestock in Pakistan

(Khan and Ashfaq, 2010). Currently, the goat population is around 80 million heads (GOP, 2021), mainly concentrated in Punjab, which is also the most human-populated province. This represents 37% of the country's goat population (Sarwar et al., 2010). A study conducted Khan and Ashfaq (2010) reported that the highest goat population (around 37% of the total population) was found in Punjab followed by Sindh and Baluchistan. Additionally, it has been documented that goat distribution is highly dependent on altitude. In lowland regions, goats graze on rangelands with poor supplementation in the stable. As elevation rises, goats become integral to nomadic herding. In mid-altitude areas, semi-nomadic practices prevail, blending crop cultivation with pastoralism. In high-altitude zones, such as Gilgit-Baltistan and Azad Jammu & Kashmir, goats are predominantly nomadic, enduring extreme climates (Sarwar et al., 2010). A higher population compared to other livestock species reflects the economic importance of goat raising and adaptation to the different agroecological zones of the country (Sarwar et al., 2010).

Indigenous goat breeds

Pakistan has 36 indigenous breeds of goats (Isan and Baloch, 1996; Siddiky, 2017). These breeds are distributed in different regions, namely Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan, Azad Jammu Kashmir, and Gilgit Baltistan (AJK/GB) (Afzal and Naqvi, 2004). Indigenous breeds in Pakistan differ in growth, reproduction, and milk production. Goats are primarily raised for meat, but some breeds (Beetal, Dera Din Panah, Nachi, and Kamori) excel in milk production, while some are renowned for dual-purpose (both their milk and meat, especially Beetal and Kamori). In contrast, the Teddy breed is small and has gained popularity in the last 30 years due to its high fertility rate and rapid growth. The adaptation of indigenous breeds raised in local production conditions, often encounter challenges arising from inadequate management practices (Khan and Ashfaq, 2010). Research has demonstrated that indigenous breeds outperform imported breeds in rangeland environments when assessed through a productivity index that incorporates fertility, survival, and yield traits (Khan et al., 2008). The presence of goat breeds varies between provinces or states where Sindh Azad Jammu Kashmir and Gilgit Baltistan have the most breeds compared to Khyber Pakhtunkhwa and Baluchistan. To date, there is limited information available on indigenous goat breeds in Pakistan. Table 1 summarizes these breeds and their characteristics.

Table 1. Name and characteristics of goat breeds found in Punjab, Sindh, Baluchistan, and Azad Jammu & Kashmir/ Gilgit Baltistan regions of Pakistan.

Province	Breed name	Characteristics	Reference
Punjab	Beetal	-Dairy breed -35 to 45 kg of body weight - The milk yield is approximately 156.9 litres in a 150-day lactation	(Azal and Naqvi 2004; Khan and Okeyo 2016)
	Daira Din Panah	-Meat breed -40 to 48 kg of body weight - Approximate fiber production: 1.2 kg per annum	(Azal and Naqvi 2004; Khan et al. 2008)
	Nachi	-Dual purpose (meat and dairy) -27 to 34 kg of body weight - Approximate fiber production: 0.6 kg per annum	(Khan 2016)
	Teddy	-Meat breed -23 to 30 kg of body weight	(Azal and Naqvi 2004; Khan et al. 2005)
	Potohari	-Meat breed -22 to 28 kg of body weight	(Khan et al. 2005; Khan et al. 2008)
Sindh	Barbari	- Dual-purpose (meat and dairy) -20 to 30 kg of body weight - The milk yield is approximately 100 liters in a 110-day lactation	(Azal and Naqvi 2004)
	Bari	- Dual-purpose (meat and dairy) -24 to 39 kg of body weight	(Azal and Naqvi 2004; Khan et al. 2005)
	Bugi Toori	-Dual purpose (meat and hair) -25 to 30 kg of body weight	(Azal and Naqvi 2004)
	Bujri	-Dual purpose (meat and hair) -35.5 to 45 kg of body weight - Approximate fiber production: 1.0 kg per annum	(Azal and Naqvi 2004)
	Chappar	-Dual purpose (milk and hair) -The milk yield is approximately 90 liters in a 120-day lactation	(Khan et al. 2005)
	Jattan	-Dairy breed -42 to 50 kg of body weight - The milk yield is approximately 225 liters in a 130-day lactation	(Shah et al. 1994)
	Kacchan	- Dual-purpose (meat and dairy) -50 to 78 kg of body weight - The milk yield is approximately 1.5 to 3.0 lt/d	(Siddiky 2017; Khan et al. 2005)

Kamori	- Dairy breed - 44 to 50 kg of body weight - The milk yield is approximately 210 liters in a 115-day lactation	(Shah et al. 1994)	
Kurri	- Dual-purpose (meat and dairy) - 35 to 50 kg of body weight - The milk yield is approximately 1 lt/d	(Siddiky 2017; Azal and Naqvi 2004)	
Lohri	- Dual-purpose (meat and dairy) - 45 to 58 kg of body weight - The milk yield is approximately 0.7 lt/d	(Siddiky 2017)	
Pateri	- Dual-purpose (meat and dairy) - 42 to 52 kg of body weight - The milk yield is approximately 170 litres in a 120-day lactation	(Shah et al. 1994)	
Sindh Desi	- Dual-purpose (meat and dairy) - 39 to 48 kg of body weight - The milk yield is approximately 140 liters in a 95-day lactation	(Azal and Naqvi 2004; Khan et al. 2005)	
Tapri	- Meat breed - 18 to 22 kg of body weight	(Shah et al. 1994)	
Tharki	- Multi-purpose (meat, dairy, and hair) - 24 to 32 kg of body weight - The milk yield is approximately 110 liters in a 120-day lactation - Approximate fiber production: 0.6 kg per annum	(Khan et al. 2005)	
Damani	- Dual-purpose (meat and dairy) - 26 to 31 kg of body weight - The milk yield is approximately 110 liters in a 100-day lactation	(Khan et al. 2005)	
Gaddi	- Multi-purpose (meat, dairy, and hair) - 32 to 50 kg of body weight - The milk yield is approximately 110 liters in a 100-day lactation - Approximate fiber production: 1.4 kg per annum	(Khan et al. 2008)	
Kaghani	- Dual purpose (meat and hair) - 35 to 42 kg of body weight - Approximate fiber production: 1.0 kg per annum	(Azal and Naqvi 2004)	
Baluchistan	Lehri	- Hair breed - 30 to 35 kg of body weight - Approximate fiber production: 1.2 kg per annum	(Azal and Naqvi 2004)
	Khurasani	- Dual-purpose (meat and dairy) - 25 to 30 kg of body weight - The milk yield is approximately 180 liters in a 120-day lactation	(Nagy et al. 1991)

Kamori	-Dairy breed -44 to 50 kg of body weight - The milk yield is approximately 210 liters in a 115-day lactation	(Shah et al. 1994)
Kurri	- Dual-purpose (meat and dairy) -35 to 50 kg of body weight - The milk yield is approximately 1 lt/d	(Siddiky 2017; Azal and Naqvi 2004)
Lohri	- Dual-purpose (meat and dairy) -45 to 58 kg of body weight - The milk yield is approximately 0.7 lt/d	(Siddiky 2017)
Pateri	- Dual-purpose (meat and dairy) -42 to 52 kg of body weight - The milk yield is approximately 170 litres in a 120-day lactation	(Shah et al. 1994)
Sindh Desi	- Dual-purpose (meat and dairy) -39 to 48 kg of body weight - The milk yield is approximately 140 liters in a 95-day lactation	(Azal and Naqvi 2004; Khan et al. 2005)
Tapri	-Meat breed -18 to 22 kg of body weight	(Shah et al. 1994)
Tharki	- Multi-purpose (meat, dairy, and hair) -24 to 32 kg of body weight - The milk yield is approximately 110 liters in a 120-day lactation - Approximate fiber production: 0.6 kg per annum	(Khan et al. 2005)
Damani	- Dual-purpose (meat and dairy) -26 to 31 kg of body weight - The milk yield is approximately 110 liters in a 100-day lactation	(Khan et al. 2005)
Gaddi	- Multi-purpose (meat, dairy, and hair) -32 to 50 kg of body weight - The milk yield is approximately 110 liters in a 100-day lactation - Approximate fiber production: 1.4 kg per annum	(Khan et al. 2008)
Kaghani	-Dual purpose (meat and hair) -35 to 42 kg of body weight - Approximate fiber production: 1.0 kg per annum	(Azal and Naqvi 2004)
Baluchistan Lehri	- Hair breed -30 to 35 kg of body weight - Approximate fiber production: 1.2 kg per annum	(Azal and Naqvi 2004)
Khurasani	- Dual-purpose (meat and dairy) -25 to 30 kg of body weight - The milk yield is approximately 180 liters in a 120-day lactation	(Nagy et al. 1991)

	Kajli	- Multi-purpose (meat, dairy, and hair) -25 to 30 kg of body weight - The milk yield is approximately 120 liters in a 120-day lactation - Approximate fiber production: 0.8 to 1.0 kg per annum	(Nagy et al. 1991)
AJ&K/GB	Baltistani	- Meat breed -25.6 to 28.8 kg of body weight - The milk yield is approximately 1.1 lt/d	(Azal and Naqvi 2004; Khan et al. 2005)
	Beiari	- Dual-purpose (meat and dairy) -20 to 25 kg of body weight - The milk yield is approximately 135 liters in a 150-day lactation	(Khan et al. 2005)
	Buchi	- Dual-purpose (meat and dairy) -22 to 30 kg of body weight - The milk yield is approximately 90 liters in a 150-day lactation	(Azal and Naqvi 2004; Khan et al. 2005)
	Jararkheil	- Multi-purpose (meat, dairy, and hair) -45 to 52 kg of body weight - The milk yield is approximately 135 liters in a 100-day lactation	(Khan et al. 2005)
	Jattal	-Multi-purpose (meat, dairy, and hair) -19 to 23 kg of body weight - The milk yield is approximately 80 liters in a 150-day lactation	(Khan et al. 2005)
	Koha-i-Ghizer	-Multi-purpose (meat, dairy, and hair) -30 to 35 kg of body weight - The milk yield is approximately 65-70 liters in a 110-day lactation	(Azal and Naqvi 2004)
	Kooti	- Dual-purpose (meat and dairy) -15 to 20 kg of body weight - The milk yield is approximately 0.7 lt/d	(Khan et al. 2005)
	Labri	-Multi-purpose (meat, dairy, and hair) -40 to 48 kg of body weight - The milk yield is approximately 170 liters in a 150-day lactation	(Azal and Naqvi 2004; Khan et al. 2005)
	Piamiri	- Meat breed -36 to 40.5 kg of body weight	(Azal and Naqvi 2004; Khan et al. 2005)
	Shurri	- Dual-purpose (meat and dairy) -32 to 38 kg of body weight - The milk yield is approximately 135 liters in a 110-day lactation	(Azal and Naqvi 2004; Khan et al. 2005)

Goat production system in Pakistan

Goat production systems can be divided into extensive, semi-intensive, and intensive (Habib, 2013). Almost all goats are reared in extensive systems, mainly small flocks of 6 to 15 animals. Smallholder production systems comprise sedentary farmers, each with small parcels of land, in which they practice mixed (crop and livestock) farming (Kosgey and Okeyo, 2007). According to Khan and Ashfaq (2010), 76% of goats being raised in flocks are smaller than 50 heads in size, while flocks of more than 200 heads only account for 9.1%. Goat feeding is mainly associated with grazing some available fodder, whereas concentrate feeding is very rare because of its cost (Khan and Ashfaq, 2010).

The most common goat extensive systems are nomadic, transhumant, household, and sedentary (Khan et al., 2008; Khan and Ashfaq, 2010). Habib (2013) indicated that the sedentary and household systems are prevalent in Punjab and Sindh, while the transhumant is the main system of goat production in Balochistan province. Nomadic flocks have mixed flocks of goats and sheep that are constantly moving together (Fig. 2). These people are commonly known as 'Bakarwal' (in the local language), and they move throughout the year. During summer (April to October), they move towards hilly areas with their animals, returning to flat areas in winter (November to

March). In this kind of production system, goats are in constant travel, staying in one place for several days and mostly relying on rangelands (Iqbal et al., 2008).

Transhumant flocks normally have a fixed station where they return during a specific period of the year. These flocks commonly have access to grazing crop stubbles due to their permanent station and the produced milk is used for personal needs. Sedentary flocks return every night to their base. Such type of flocks relies on feedstuffs from wastelands, crop stubbles, and rangelands (Iqbal et al., 2008). In the household system, small flocks of 2 to 3 animals are kept in confined housing and fed with green fodder and vegetable leftovers. These animals are often raised to meet household needs (Isani and Baloch, 1996).

Feeding

In Pakistan, under extensive production systems, goats mainly depend on available forages including shrubs, bushes, and fodders (Devendra, 2010). Almost 68% of goats are reared under this system (Khan and Ashfaq, 2018) (Fig. 3). Previous research (Sarwar et al., 2010) highlights the need for attention to the nutritional aspect of goat production in Pakistan, as these livestock are receiving only 62 and 74% of the required digestible crude protein and total digestible nutrients, respectively. It has



Fig. 2. Nomads herding goats (Jattal breed) to highlands during summer at Neelum AJ&K.



Fig. 3. Mixed housing with stall feeding of goats (Beetal Makhi Cheeni breed) at Faisalabad, Pakistan

also been well-documented that inadequate and imbalanced nutrition is considered a dilemma in goat production in the country (Sarwar et al., 2010). Sarwar et al. (2002) showed that the growth performance of goats can be enhanced up to 40% just by manipulation of macro and micronutrients, with the existing gene pool. Additionally, the productivity of goats in

Pakistan is impeded by a scarcity of high-quality feed, particularly during the extended dry season, insufficient rangeland management, and improper grazing practices, while occurrence of frequent droughts contribute to the restriction of fodder availability in communal areas (Sarwar et al., 2010). The semi-intensive conditions represent a combination of grazing and feeding, and in this

system, animals go out daily for grazing, which is accompanied by in-barn feeding of concentrate, grass, hay, and leaves during the night (Sarwar et al., 2010). Compared to the extensive condition, in this system, there is an investment in housing, and goats receive high-quality forage along with supplemental concentrate.

Breeding

The widespread breeding of genetically substandard animals and the absence of reproductive programs pose significant challenges to the development of the goat sector in Pakistan (Nagy et al., 1991; Teufel et al., 1998). Normally, goat breeding occurs in the autumn and spring seasons. Females usually give birth to twins; however, triplets are also common in some breeds. Male kids are sold at a young age or kept for slaughtering or sale at EidulAdha (Siddiky, 2017). Natural mating is the most common method for goat breeding. In natural conditions, controlled or uncontrolled breeding is adopted. Breeding bucks can be found at the farm or the village level. Different breeding systems are adopted at the local level including breeding the best male to the best female, avoiding close relative mating, and exchange of high-quality males (Abubakar et al. 2015).

A household survey (Mehmood et al., 2011) in two districts in Pakistan revealed that the timing of breeding was not regulated, and both rams and bucks were allowed to run with the herd throughout the year. While most young animals were born during the spring, observations revealed that young animals were seen throughout the year, although sheep had a more distinct spring lambing period compared to goats. Breeding animals were not carefully chosen, and the ratio of male to female for breeding appeared to be low. Most females were exposed to males when they were either too young or underweight and in poor conditions, resulting in low conception and birth rates (Kunbhar et al., 2016). The kidding rates were low, potentially even lower than what the farmers perceived (Kunbhar et al., 2016). In some government farms, specific bucks are kept for breeding purposes; however, their services are not provided at the village level, and they are not in huge numbers and cannot fulfill the breeding requirements at the village level. Semen is not provided from any breed for artificial insemination (AI) in Pakistan (Mehmood et al., 2011). However, research activities for semen production and AI in goats are ongoing at the University of Veterinary and Animal Sciences in Lahore, and they will be used for insemination at the farm level. It is well-documented that genetic programs can improve yields and profitability of

smallholder farmers (Kosgey and Okeyo, 2007). However, information on sustainable genetic improvement programs under smallholder production systems in Pakistan is scarce. This review does not focus on the technical challenges affecting genetic improvement under low-input and small-scale production systems. However, an important step is to identify existing facilities, institutions, and traditional breeding practices, to build programs for genetic improvement.

Diseases and health care service

In general, the management of the flocks and herds is also inadequate. There is a lack of thorough animal disease inspections, as well as improper culling practices (Muhammad et al., 2015). Hoof trimming is neglected, resulting in many animals having deformed and split hooves. This can lead to foot rot when sheep and goats migrate to wetter areas during winter. Additionally, there is a failure to use foot dip remedies. The inspection of udders for mastitis is also overlooked. Ventilation becomes an issue when farmers choose to house animals in caves and enclosed shelters during winter, exacerbating pneumonia and tick problems (Khan et al., 2012). Many farmers, including trained veterinarians, administer vaccinations incorrectly. Vaccinations are often given in the muscle instead of subcutaneously, frequently using a wrong-sized needle. However, vaccination is available free of charge for some specific diseases such as *Peste des petites ruminant* (PPR), Contagious Caprine Pleuropneumonia (CCP), and Enterotoxaemia (ET). Vaccination is done by government veterinary extension teams (Abubakar et al., 2015). Large-scale farms usually arrange vaccination by themselves. Regarding deworming, this practice is generally conducted by farmers, using traditional methods of deworming the animals (i.e., peach leaves, garlic, onion, and mint, to control internal parasites) (Abubakar et al., 2015; Maqbool, 2017). While some local herbs may offer mild antiparasitic effects, they cannot match the efficacy of synthetic anthelmintics like albendazole or ivermectin (Raza et al., 2014). The inconsistency in traditional deworming practices may result in uneven outcomes. Furthermore, the potential incompleteness in eradicating parasitic species using these methods could precipitate re-infection and resistance development (Saddiqi et al., 2012; Raza et al., 2014). Despite their cultural importance and cost-effectiveness, the transition to modern veterinary deworming is advisable to guarantee the well-being and economic viability of goat herds in Pakistan. Veterinary services often fall short due to inadequate funding, insufficient infrastructure, and a shortage of

professionals. This deficiency makes it difficult to provide consistent and high-quality care across the country, especially in remote areas. A lack of modern technology and diagnostic tools further impedes effective treatment and disease management (Afzal, 2009; Iqbal et al., 2014). Veterinary healthcare centers and dispensaries are present almost in every district of Pakistan. Farmers usually take their animals to health care centers in case of disease and emergencies. The management of these facilities is under the control of the government, and treatment is provided free of charge. Currently, veterinary services to livestock farmers are supported by 871 veterinary hospitals and 1189 veterinary centers (Siddiky, 2017; Kosgey and Okeyo, 2007). Geographic isolation and scarcity of services in rural areas hinder accessibility for small-scale farmers. The centers often lack the latest resources and technology, affecting the quality and range of services provided. Additionally, there is a shortage of trained veterinary personnel, which can lead to delays in diagnosis and treatment. The effectiveness of these centers is further compromised by insufficient public awareness regarding the benefits of veterinary services. To improve their impact, these centers need enhanced funding, better infrastructure, and community engagement programs that emphasize the importance of veterinary care in goat production and overall livestock health (Saman et al., 2023; Javed et al., 2018).

Slaughtering

In Pakistan, goats are mostly used for meat production (Isani and Baloch, 1996). Slaughterhouses are found in all large cities and are subject to the control of the local government (Siddiky, 2017). Slaughtering, typically performed by skilled butchers, involves precise techniques to ensure meat quality and adherence to religious norms. Economic factors, such as demand and supply, price stability, and government regulations, influence goat meat market dynamics. Furthermore, seasonal variations and festivities can cause price fluctuations. It is also important to consider that extensive goat production is mainly used for self-consumption (Darcan and Silanikove, 2018).

Goat meat production

The responsibility to produce high-quality, sustainable, and cost-effective meat and allied meat products rests with producers, manufacturers, distributors, and retailers to meet consumer's demands. Being an Islamic country, with rich cultural and traditional festivities, Pakistan has more demand for meat, especially

during festival season (Sohaib and Jamil, 2017; GOP, 2021). As this sector is developing in the country, consumer awareness is also pushing the meat industry and regulating agencies to keep an eye on the quality of meat, safety assurance, animal health and welfare as well as precise traceability (Ahmad et al., 2019). At the country level, meat is obtained from buffalo, cow, sheep, goat, and poultry. A large portion of meat comes from large ruminants, mainly goat and sheep. Most consumers prefer goat meat over other sources of meat; hence goat meat has a good market value (Ahmad et al., 2019). In 2021, from the total meat production (4,955 thousand tons), goat meat production represents 15% (GOP, 2021). Rearing goats primarily for meat production is quite expensive in local markets and the farmer obtains significant profits. Compared to beef and poultry, goat meat is more expensive, for example in 2021, beef was 1.7 USD/kg, poultry was 0.73 USD/kg and goat was 3.6 USD/kg.

Goat milk production

In Pakistan, buffaloes are the primary milk-producing animals, accounting for almost 60% of the total milk production followed by cow's milk, with around 37% of the total milk production. Goat milk production (about 915 thousand tons) is 1.5% of the total milk production that is used for household consumption (Sikandar and Nasir, 2023). Hence, milk or dairy products from goats are not provided either in local markets or supermarkets. However, soft cheese and a type of clarified butter called 'ghee', are prepared from goat milk in the colder regions of the north and northwest as well as the hot and arid areas of the south and southeast of the country, respectively, for household consumption (Khan and Ashfaq, 2018). The following are goat breeds with dairy characteristics: Beetal, Kacchan, Kamori, Daera Din Panah (DDP), and Damani. The average milk production of some dairy breeds (Isani and Baloch, 1996) is shown in Table 2. Despite the enormous potential, additional efforts need to be made to promote this productive purpose.

Goat skin production

Goat skin is used for various purposes such as the manufacture of clothing. According to the country's economic survey, Pakistan has reported an annual production of 30,946 million goat skins (Sikandar and Nasir, 2023). Skin/hides represent an integral part of goat production, possessing considerable economic value for the leather industry. Despite their significance, these by-products have historically been undervalued and underutilized in the context of goat slaughtering processes (Sikandar and Nasir, 2023). Kid skin

Table 2. Milk production of dairy goat breeds of Pakistan.

Breed	Milk yield/ lactation (L)	Period of lactation (Days)	Milk yield per day (L)
Beetal	272	140	2.0
Kamori	204	115	1.8
Kacchan	190	107	1.7
Daira Din Panah	230	105	1.6
Nachi	214	107	1.3
Damani	115	100	1.2

is also used in various types of clothing. In fact, production in Pakistan has increased from 29,334 to 30,946 for goat skin and from 13,647 to 14,397 for kid skin in 2018 and 2021, respectively (Ghaffar and Ashfaq, 2017).

Marketing and value chain for goat meat

A few goat markets are available throughout Pakistan and most of the markets in rural areas are open-air, near villages or roadsides. These markets are usually set without any facilities and there are no set rules for selling animals (Siddiky et al., 2017). The animal owners are responsible for feeding and treating their goats (Rahman and Shah, 2003; Ahmad et al., 2019).

In large cities, marketing facilities have electricity, water, and healthcare equipment. These markets are organized by the government, but these are usually supplied to contractors on payment for one year and private contractors generally run these markets. Anyone who is selling animals through the market must pay a commission to the market management (Siddiky et al., 2017). Special annual markets are organized on the event of EidulAdha, and sales of animals are likely to peak these days, with a minimum price of 12,000-15,000 rupees (around 44 to 55 USD) for a 20-30 kg animal (Ahmad et al., 2019).

Small farmers often sell directly to consumers or through local fairs and markets. These local markets, while reducing transportation costs, limit sales to nearby regions, potentially lowering profits due to lesser market size and increased competition (Ghaffar and Ashfaq, 2017). In large cities and towns, a person commonly known as *Aaharti* (commission agent) usually plays a major role in animal marketing. Butchers also buy animals from commission agents, slaughter them, and sell meat directly to the consumers (Sikandar and Nasir, 2023). The marketing of live goats occurs by bargaining method, the owner of the animals demands some price and then the trader bargains on that price, but the sale price is kept confidential to avoid any conflict in the market. Unfortunately, this method results in a higher price for the consumer, while the producer does

not get a good price for the animal (Siddiky et al., 2017). Paying commissions can incentivize more participants, improving this market liquidity; however, following the example of other less developed regions like India (Bikkina et al., 2018) and Bangladesh (Bairagi and Mottaleb, 2021), the best starting point is organizing farmer groups that can leverage collective marketing and commercialization, enhancing goat product value. By sharing resources and knowledge, they can improve efficiency and profitability, ensuring sustainable growth in the goat production sector.

CONCLUSION AND FINAL REMARKS

In Pakistan, there is a great chance for the goat sector to contribute more to the livelihoods of people in rural areas and those related to smallholder production. Achieving this requires efficient and sustainable management, feeding strategies, genetic programs as well as preventive veterinary care to enhance the output and efficiency of goat production. Feed resources, nutrition, housing, and preventive medicine require attention. The main problems in the goat sector are poor nutrition, lack of genetic selection, insufficient animal health and veterinary services, the presence of intermediaries for trading livestock, and undeveloped marketing and processing of goat products.

To enhance the nutritional management of goats, agricultural crop residues and by-products should be used. Feeding management, farmer's training, breeding management of goats, and marketing approaches are needed. Farmer's training needs participation of universities, non-governmental organizations, research institutions, and stakeholders. Moreover, organized groups of farmers are required to increase marketing and commercialization of goat products, with clear tasks and perspectives. Cooperation between farmers, veterinarians, and technical professionals should be encouraged. In this sense, there is a need for farmers and farmer-group members to be trained on goat healthcare, disease prevention, and skills to reduce problems

related to disease and parasite infestation. In addition, promoting the local consumption of goat products is important as it has great potential to prevent human malnutrition. All these aspects represent gaps and challenges to face in goat management in Pakistan, suggesting areas for future studies.

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions

All the authors substantially contributed to the bibliographic review, development of the methodology, discussion of results, and review and approval of the final version of the article.

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