Pakistan J. Zool., vol. 58(4), pp 1697-1704, 2026 DOI: https://dx.doi.org/10.17582/journal.pjz/20250619063011

# Phenotypic Characterization of Local Hairy Goat Breed in Punjab, Pakistan

**Andelib Qayyum[1], Hafiz Muhammad Bilal Akhtar[1], Hafiz Muhammad Waheed[1], Muhammad Tariq[2], Muhammad Fiaz[3], Saqib Ahmad Siddiqui[4], Asmatullah Kaka[1,6], Zahid Manzoor[5], Nazia Rafiq[7] and Ghulam Bilal[1]***

*[1]Department of Animal Breeding and Genetics, National Center for Livestock Breeding Genetics and Genomics, PMAS-Arid Agriculture University, Rawalpindi*
*[2]Department of Livestock Management, University of Agriculture Faisalabad, Sub-Campus Toba Tek Singh*
*[3]Department of Livestock Productions and Management, PMAS-Arid Agriculture University, Rawalpindi*
*[4]Barani Livestock Production Research Institute, Kherimurat, Attock*
*[5]Department of Parasitology and Microbiology, PMAS-Arid Agriculture University, Rawalpindi*
*[6]Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam*
*[7]Department of Anthropology, PMAS-Arid Agriculture University, Rawalpindi*

**Article Information**
**Received 19 June 2025**
**Revised 25 July 2025**
**Accepted 20 August 2025**
**Available online 22 December 2025 (early access)**
**Published 20 May 2026**

**Authors' Contribution**
**GB and HMW developed idea helped in design, data analysis and write up. AQ, HMBA and SAS designed and conducted experiment, AK, MT, MF, ZM and NR supported in write up.**

**Key words**
**Body weight, Local hairy goat, Potohar, Pakistan type traits**

## ABSTRACT

This study aimed to evaluate phenotypic variations in local hairy goats (LHG) in Pakistan's Potohar region by assessing qualitative and quantitative traits and analysing body measurements in relation to body weight. Data from 99 adult goats (18 males, 81 females) were collected from Barani (Rainfed) Livestock Production Research Institute (BLPRI) and private farms. Twelve traits (4 qualitative, 8 quantitative) were recorded. Qualitative analysis revealed predominantly black hairy coats (73%), with white (12%), brown (9%), and mixed (6%) colors. Skin pigmentation varied: non-pigmented (54%), white pigmented (20%), white spots (21%), and slight pigmentation (4%). Most goats had horns (90%) and straight facial profiles (82%). Quantitative measurements included body weight (BW: 40.3 ± 12.0 kg), body length (BL: 66.4 ± 7.8 cm), heart girth (HG: 75.89 ± 10.57 cm), and height at withers (HW: 75.17 ± 7.83 cm). Statistical analysis was performed using proc mixed procedure in SAS. The findings suggest LHG has potential as a meat breed, with phenotypic diversity supporting future genetic characterization and conservation efforts. The study highlights significant phenotypic diversity in LHG, with black hairy coats being predominant (73%). Quantitative traits such as BW, BL, and HG showed variations influenced by sex and herd management. Males exhibited larger BL and HG, while government herds had superior growth traits compared to private farms. The high prevalence of horns (90%) and straight facial profiles (82%) indicates breed uniformity. The data provides a foundation for future genetic studies involving molecular markers aimed at breed improvement and conservation, ensuring sustainable utilization of this indigenous goat genetic resource.

## INTRODUCTION

Goat farming plays a vital role in the rural and agriculture economy of Pakistan, serving as a reliable source of meat, milk, and provide livelihood for smallholder livestock farmers. With a goat population exceeding 87.0 million PKR, Pakistan ranks as the third-largest goat producer globally, following China and India (Government of Pakistan, 2025). Goats are well-suited to diverse climatic conditions, particularly in arid and semi-arid regions, making them a preferred livestock choice for resource-limited farmers due to their adaptability, resilience, and low maintenance requirements. Pakistan is home to significant genetic diversity, with over 36 recognized indigenous goat breeds adapted to various ecological zones (Khan *et al*., 2008). These breeds are categorized into meat, dairy, and dual-purpose types. In Pakistan goats are reared in both intensive and extensive

* Corresponding author: ghulam.bilal@uaar.edu.pk
0030-9923/2026/0004-1697 $ 9.00/0

production systems including small-scale integrated agricultural system. Their adaptability makes them a vital component of rural livelihoods across the country both on lowland and highlands. Goats provide a range of products including milk, meat and fiber (Abdullah *et al*., 2024). Notable breeds such as Beetal, Dera Din Panah, Nachi, and Kamori are known for their exceptional meat and milk production, while smaller breeds like teddy and the potohari goat are valued for their rapid growth and high fertility rates (Abdullah *et al*., 2024). Beyond its economic significance, goat farming is deeply embedded in Pakistan's cultural and social traditions. Demand peaks during ritual customs, providing farmers with substantial financial benefits (Khan *et al*., 2008). Moreover, goats contribute to environmental sustainability by assisting in vegetation management and integrating effectively into mixed farming systems. Their ability to survive on minimal feed makes them an ideal choice for smallholder farmers with limited resources (Miller and Lu, 2019).

Despite its importance, Pakistan's goat farming sector remains largely underdeveloped due to several challenges, including the absence of commercial dairy and meat production due to low investment, inadequate infrastructure, weak genetic improvement programs, insufficient veterinary services, and an unstructured market system (Muhammad *et al*., 2015). Furthermore, the lack of systematic breed conservation threatens the sustainability of indigenous goat genetic resources, with some breeds remaining undocumented. The local hairy goat (LHG), found in the Potohar region, is one such breed that has received limited attention in scientific research. The LHG have unique characteristics of medium sized goat with presence of long curled black hair, curled horns and straight head profile. This breed is well adapted to the harsh environmental conditions of these areas, including food scarcity and extreme weather, and is recognized for both milk and meat production. The only reported performance of LHG (Aslam, 1990), presented the average adult body weight of males and females ranges between 35-40 kg. Phenotypic characteristics and potential of these animals not yet been studied on scientific line. Addressing these challenges requires targeted policy interventions, investment in research, and farmer training programs to enhance productivity and ensure the long-term sustainability. Given the existing knowledge gap, this study aims to characterize the LHG breed. The current study is first of its kind documenting phenotypic characterization of LHG. This study would add value to the genetic pool of our local goat breeds. Furthermore, this study is first systematic study based on large data and FAO recommended characterization protocol.

## MATERIALS AND METHODS

This study was conducted at Directorate of Barani Livestock Production Research Institute (BLPRI) Kherimurat, Attock and potential farmers who are raising LHG, breed in Potohar region of Pakistan, which includes Rawalpindi, Chakwal, Attock, and Jhelum districts. The Potohar region is a geographically significant rainfed plateau situated between the Indus and Jhelum Rivers. It consists of four districts: Jhelum, Attock, Chakwal, and Rawalpindi (Fig. 1). Normal range of temperature in this station during summer season is 40-45□. There exists record rise in water scarcity affecting 1-2 billion people globally. In future global water availability will be negatively affected by climate change. The total geographical area is approximately 2.2 million hectares. The region has an undulating terrain, with slopes ranging between 8% and 40%. It is located between 32.5°N and 34.0°N latitude and 72°E and 74.0°E longitude. The climate of Potohar is semi-arid, with annual rainfall ranging from 450 mm to 1750 mm (Supplementary Fig. 1). About 70% of the rain occurs during the monsoon season (Cheema and Bastiaanssen, 2012). The region also has seasonal streams, including River Haro and River Soan, which are the primary water sources (Ghani *et al*., 2013; Samiullah *et al*., 2018).

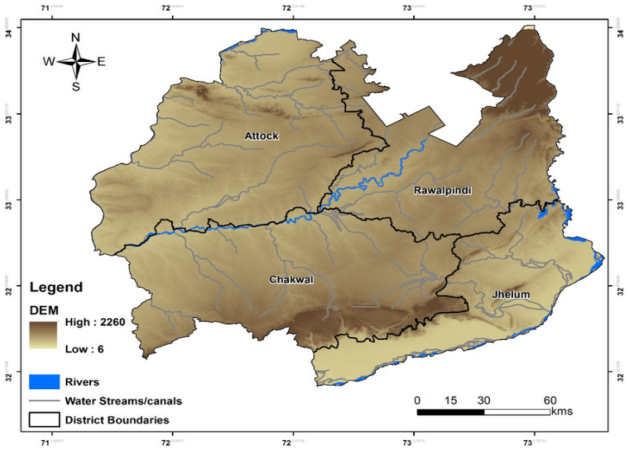


Fig. 1. Map of Potohar region (Ullah *et al*., 2018).

*Sample size and traits*

The study contained data from 99 LHG which include 18 males and 81 females from private farms across the Potohar region and BLPRI at Kherimurat, managed by the Government of Punjab. Herd type was divided into two herds i.e. BLPRI (herd=1) and private potential farmers (herd=2). This methodological approach ensures a comprehensive evaluation of the LHG breed, contributing

to conservation and breeding strategies. The study focused on phenotypic characterization of the LHG breed using both qualitative and quantitative traits, which included: qualitative traits of body hair color (BHC), body skin color (BSC), horn presence, facial head profile (FHP). Quantitative traits for morphological study are categorized as, body weight (BW, in Kg), body length (BL, in cm), height at wither (HW in cm), heart girth (HG in cm), head length (HL in cm) ear length (EL in cm), tail length (TL in cm), muzzle circumference (MC in cm).

*Phenotypic and morphometric characteristics*

A wide range of coat colors was observed, with black and white being the most dominant. Other common patterns included brown, gray, and spotted variations (Supplementary Fig. 1). Both sexes typically have horns that are curved backward, though horn size and shape often vary. Long and pendulous ears are a characteristic feature of the LHG and its face is usually straight or slightly convex.

*Data collection*

For characterization of LHG breed, a proforma was designed using guideline of Food and Agriculture Organization (FAO) Animal Genetics Resources Guide (FAO, 2011). Feeding of LHG mostly depend on grazing (mostly kept on extensive production system). Twelve (12) phenotypic parameters were measured on 99 adult LHG breed (18 males and 81 female).

Qualitative traits were visually observed and expressed as percentage. Descriptive analysis was done on quantitative variables. Body measurements were taken in cm using a measuring tape while BW was taken in kg using electronic scale.

*Statistical analysis*

The dataset was compiled in Microsoft Excel and analyzed statistically using the PROC MIXED procedure under the GLM framework in SAS On-Demand for Academics (www.oda.sas.com). The analysis applied in order to study the effect of herd and sex on body weight and various body measurements in the LHG. Least square means along with their standard errors were estimated for this purpose.

Following statistical model was used for BW, BL, HW, EL, HL, HG, TL, and MC

$$Y_{ijk} = \mu + Sex_i + Herd_j + E_{ijk}$$

Where, $Y_{ijk}$ is a measurement on the $k^{th}$ animal in jth herd of $i^{th}$ sex, $\mu$ is the overall population mean, $Sex_i$ is fixed effect of $i^{th}$ sex where sex is1 for female and 2 for male, $Herd_j$ is fixed effect of $j^{th}$ herd (j=1 for Govt, and 2 for private herd), Eijk is andom residual associated with measurement on $k^{th}$ animal in $j^{th}$ herd and $i^{th}$ sex and is assumed to be distributed as $N \sim (0, I\sigma e^2)$.

## RESULTS

*Frequency distribution for herd and sex*

The cumulative frequency analysis showed that after accounting for the first herd, 46 animals had been recorded, representing 46.5% of the total sample. The second herd contributed the remaining 53 animals, bringing the cumulative total to 99, which represents 100% of the sampled population.

The observed distribution indicates a relatively balanced population structure between the two herds, with a slight dominance of the second herd. This distribution is useful in understanding herd composition and management practices in the study region.

The frequency distribution of animals by sex was analyzed to determine the proportion of males and females within the sampled population. Out of the total 99 animals, 81 were female, representing 81.8% of the population, while 18 were male, making up 18.2%.

The results indicate a higher proportion of females in the population, which may be due to selection preferences by farmers for breeding and milk production purposes. The observed sex distribution provides insight into herd management practices and breeding strategies for the LHG breed, contributing to its phenotypic characterization and conservation efforts. Frequency (%) of each level for the qualitative traits recorded in LHG breed is presented Table I.

**Table I. Frequency (%) of each level for the qualitative traits recorded in hairy goat breed.**

| Traits/ Variables | Characteristics | Frequency (%) |
|---|---|---|
| Body hair colour | White | 12 (12%) |
| | Black hairy | 72 (73%) |
| | Brown hairy | 9 (9%) |
| | Mixed | 6 (6%) |
| Body skin colour | White pigments | 20 (20%) |
| | Slight pigments | 4 (4%) |
| | White spots | 21 (21%) |
| | No pigments | 54 (55%) |
| Horn presence | Yes | 90 (91%) |
| | No | 9 (9%) |
| Facial head profile | Straight shape | 82 (83%) |
| | Slightly concave | 17 (17%) |

*Qualitative traits*

The distribution of these traits among the 99 sampled animals provided insights into the breed's phenotypic

characteristics. BHC varied among individuals, with the majority exhibiting black hair (72%), followed by white (12.12%), brown (9.09%), and mixed coloration (6.06%). This distribution suggests a dominance of dark pigmentation in the breed. BSC showed notable variations, with more than half of the sampled goats (54.55%) being non-pigmented. White-spotted pigmentation was observed in 21.21% of animals, while fully white-pigmented skin was present in 20.20%. Slight pigmentation was the least common, recorded in only 4.04% of the population. Horn presence was a prevalent characteristic in the breed, with 90.91% of the animals possessing horns, whereas 9.09% were polled. This indicates a strong genetic tendency for horn development in the breed. Assessment of FHP revealed that 82.82% of the goats had a straight facial profile, while 17.17% exhibited a slightly concave profile. The predominance of straight head profiles may indicate a distinct morphological trait of the breed.

*Quantitative traits*

Overall results of various body measurement and body weight in LHG breed are presented in Table II. The body measurements and BW of the LHG breed were analyzed to determine the overall mean, standard deviation, and variation in key morphological traits. Data collected from 99 animals revealed significant differences in size and structure within the breed. BW exhibited a wide range of values, with a mean of 40 ± 13.0 kg, ranging from 15 kg to 75 kg. The coefficient of variation (CV) was 32.2%, indicating considerable diversity in BW, likely influenced by age, nutrition, and genetics. Body length (BL) had a mean of 66 ± 7.8 cm, with values ranging between 53 cm and 87 cm. The variation in BL was relatively lower, with a CV of 11.7%, suggesting a moderate level of uniformity in body conformation. Height at withers (HW) had an average of 75.2 ± 7.83 cm, ranging from 60 cm to 99 cm, with a CV of 10.4%, indicating a relatively stable height distribution among the sampled animals.

Ear length varied considerably, with a mean of 22.9 ± 6.74 cm and a wide range between 9 cm and 33 cm, resulting in a CV of 29.32%. This variation suggests the presence of genetic differences affecting ear size within the breed. Head length showed an average of 15.1 ± 3.43 cm, ranging from 9 cm to 26 cm, with a CV of 22.7%, reflecting moderate variability.

Heart girth, an important indicator of body mass, had a mean of 75.9 ± 10.57 cm, with values spanning from 18 cm to 102 cm. The CV of 13.9% suggests relatively consistent chest development across the population.

TL varied between 6 cm and 32 cm, with an average of 18.3 ± 4.18 cm and a CV of 22.9%, reflecting noticeable differences in tail morphology.

MC which influences feeding efficiency and jaw structure, had a mean of 26.2 ± 5.19 cm, ranging from 9 cm to 40 cm, with a CV of 19.8%, indicating moderate variability in skull dimensions.

These results provide a detailed phenotypic profile of the LHG breed, highlighting variations in body structure and size. The observed differences can be valuable for selective breeding programs, conservation efforts, and improving management practices for sustainable livestock production.

**Table II. Overall means of various body measurement and body weight in hairy goat.**

| Traits** | Mean±SD (n=99) | CV% |
|---|---|---|
| BW (kg) | 40.3±13.0 (15-75) | 32.2 |
| BL (cm) | 66.4±7.8 (53-87) | 11.7 |
| HW (cm) | 75.17±7.83 (60-99) | 10.41 |
| EL (cm) | 22.98±6.74 (33-0) | 29.32 |
| HL (cm) | 15.07±3.43 (9-26) | 22.7 |
| HG (cm) | 75.89±10.57 (18-102) | 13.92 |
| TL (cm) | 18.28±4.18 (6-32) | 22.86 |
| MC (cm) | 26.24±5.19 (9-40) | 19.77 |

** BW, body weight; BL, Body length; HW, Height at withers; EL, Ear length; HL, Head length; HG, Heart girth; TL, Tail length; MC, Muzzle circumference.

**Table III. Effect of sex on various body measurements and body weight in hairy goat.**

| Traits | Female (N=81) | Male (N=18) | p value |
|---|---|---|---|
| BW(Kg) | 39.9±1.43 | 45.32±3.66 | 0.1728 |
| BL (cm) | 67.3±0.75 | 62.01±1.93 | 0.0122 |
| HW (cm) | 75.4±0.79 | 73.42±2.01 | 0.3505 |
| EL (cm) | 22.3±0.38 | 23.60±0.97 | 0.2313 |
| HL (cm) | 15.01±0.34 | 16.10±0.88 | 0.2575 |
| HG (cm) | 77.0±1.13 | 69.42±2.88 | 0.0164 |
| TL (cm) | 18.1±0.40 | 19.10±1.03 | 0.3709 |
| MC (cm) | 26.18±0.56 | 27.64±1.45 | 0.3529 |

For abbreviations, see Table II.

*Effect of sex*

Effect of sex on various body measurements and body weight in LHG breed described at Table III. The effect of sex on various body measurements and BW in the LHG breed was analyzed using data from 81 females and 18 males. Sex had significant effect on BL, and HG ($P < 0.05$), whereas, HW, BW, EL, HL, TL, and MC were not

significantly affected (P > 0.05). Males exhibited higher body weight, averaging 45.3 ± 3.66 kg, compared to females, which had an average of 39.9 ± 1.43 kg.

This difference suggests a greater growth potential in males, likely due to genetic and hormonal factors.

BL was greater in females, with an average of 67.3 ± 0.75 cm, compared to 62.1 ± 1.93 cm in males. This difference could be attributed to variations in body conformation and skeletal structure between sexes. HW was slightly higher in females (75.4 ± 0.79 cm) than in males (73.4 ± 2.01 cm), although the difference was relatively small. EL showed variation, with males having longer ears (23.6 ± 0.97 cm) compared to females (22.3 ± 0.38 cm). Similarly, HL was greater in males (16.1 ± 0.88 cm) than in females (15.0 ± 0.34 cm), indicating a more robust skull structure in males. HG measurements revealed a significant difference, with females having a larger HG (77.0 ± 1.13 cm) than males (69.4 ± 2.88 cm). This difference suggests a broader chest development in females, which may be linked to reproductive and physiological adaptations. TL was slightly longer in males (19.1± 1.03 cm) than in females (18.1 ± 0.40 cm), while MC also showed a significant difference, with males exhibiting a larger 27.64 ± 1.45 cm compared to 26.2 ± 0.56 cm in females. The observed differences in body measurements between sexes provide essential insights into sexual dimorphism within the LHG breed. These variations have implications for breed selection, management strategies, and productivity, particularly in breeding programs aimed at optimizing growth and adaptation traits.

*Effect of herd*

Effect of herd on various body measurements and BW in LHG breed is presented in Table IV. The effect of herd on body measurements and BW in the LHG breed was analyzed using data from two herds, revealing significant differences in all traits measured. Herd had significant effect on BL, HW, HL, HG, and TL (P < 0.05) except BW, EL and MC (P > 0.05).

BW was higher in Herd 1, with an average of 44.3 ± 3.38 kg, compared to 41.0 ± 2.01 kg in Herd 2. This variation may be attributed to differences in nutrition, management, and genetic factors between the two herds. BL was greater in Herd 2, with a mean of 67.6 ± 1.06 cm, while Herd 1 had a shorter average body length of 61.7 ± 1.78 cm. The differences in body conformation suggest variability in growth patterns or environmental adaptations. HW was also higher in Herd 2, averaging 77.3 ± 1.10 cm, compared to 71.6 ± 1.86 cm in Herd 1. This indicates that animals in Herd 2 tend to have a taller stature. EL showed significant variation, with Herd 1 having an average ear length of 24.00 ± 0.90 cm, while Herd 2 exhibited a smaller ear length of 21.9 ± 0.53 cm. HL was also longer in Herd 1 (17.3 ± 0.82 cm) compared to Herd 2 (13.9 ± 0.48 cm). HG an important indicator of body mass and meat yield was larger in Herd 2, with an average of 76.15 ± 1.58 cm, compared to 70.27 ± 2.66 cm in Herd 1. TL was greater in Herd 2 (20.04 ± 0.56 cm) than in Herd 1 (17.2 ± 0.95 cm), while MC followed a similar pattern, with Herd 1 having a higher average of 28.6 ± 1.34 cm, compared to 25.2 ± 0.79 cm in Herd 2. The observed differences between the herds suggest variations in environmental conditions, management practices, and possibly genetic influences. These findings provide important insights for breeding programs, conservation efforts, and optimization of management strategies for improving the productivity of the LHG breed.

**Table IV. Effect of herd on various body measurements and body weight hairy goat.**

| Traits | Herd 1 (N=46) | Herd 2 (N=53) | p value |
|---|---|---|---|
| BW (kg) | 44.25±3.38 | 40.98±2.01 | 0.4077 |
| BL (cm) | 61.72±1.78 | 67.61±1.06 | 0.0055 |
| HW (cm) | 71.59±1.86 | 77.29±1.10 | 0.0099 |
| EL (cm) | 24.00±0.90 | 21.94±0.53 | 0.0539 |
| HL (cm) | 17.25±0.82 | 13.87±0.48 | 0.0006 |
| HG (cm) | 70.27±2.66 | 76.15±1.58 | 0.0608 |
| TL (cm) | 17.16±0.95 | 20.04±0.56 | 0.0109 |
| MC (cm) | 28.58±1.34 | 25.24±0.79 | 0.0350 |

For abbreviations, see Table II.

*Estimation of correlation of body weight with morphometric measurements*

Correlation of BW with morphometric measurements of LHG breed is presented in Table V. The correlation between BW and various morphometric measurements in the LHG breed was analyzed using Pearson correlation coefficients. Significant relationships were observed between BW and several body measurements, providing insights into the interdependence of these traits. BW showed a moderate positive correlation with BL (r = 0.46439, p < 0.0001) and HG (r = 0.43731, p < 0.0001), indicating that larger and bulkier animals tend to weigh more. HW also exhibited a significant positive correlation with BW (r = 0.39433, p < 0.0001), suggesting that taller animals generally have greater body mass. EL showed a weak correlation with BW (r = 0.18866, p = 0.0615), while HL had a slightly lower correlation (r = 0.17194, p = 0.0888), both of which were not statistically significant. This suggests that these traits have a minimal impact on

**Table V. Correlation of body weight with Morphometric measurements of hairy goat.**

| | Pearson correlation coefficients, N = 99, Prob > \|r\| under H0: Rho=0 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **BW** | **BL** | **HW** | **EL** | **HL** | **HG** | **TL** | **MC** |
| BW | | | | | | | | |
| BL | 0.46439<br><.0001 | | | | | | | |
| HW | 0.39433<br><.0001 | 0.82579<br><.0001 | | | | | | |
| EL | 0.18866<br>0.0615 | 0.23169<br>0.0210 | 0.36940<br>0.0002 | | | | | |
| HL | 0.17194<br>0.0888 | 0.09137<br>0.3684 | 0.21457<br>0.0329 | 0.39295<br><.0001 | | | | |
| HG | 0.43731<br><.0001 | 0.68284<br><.0001 | 0.62259<br><.0001 | 0.26824<br>0.0073 | 0.02605<br>0.7980 | | | |
| TL | 0.09407<br>0.3544 | 0.49301<br><.0001 | 0.60186<br><.0001 | 0.26003<br>0.0093 | 0.24136<br>0.0161 | 0.24033<br>0.0166 | | |
| MC | 0.14973<br>0.1391 | 0.29838<br>0.0027 | 0.43102<br><.0001 | 0.46570<br><.0001 | 0.68894<br><.0001 | 0.35293<br>0.0003 | 0.35560<br>0.0003 | 1.00000 |

For abbreviations, see Table II.

determining BW. TL exhibited an insignificant correlation with BW (r = 0.09407, p = 0.3544), indicating that variations in TL do not strongly influence body mass. MC also showed a weak correlation (r= 0.14973, p= 0.1391), suggesting limited association with BW. Among the morphometric traits, BL and HG displayed the highest correlations with BW, indicating their importance in evaluating the growth potential of the LHG breed. Additionally, HW and other measurements such as EL and HL contributed to a lesser extent. These findings highlight key traits for selection and breeding strategies aimed at improving body mass and overall productivity in the breed.

## DISCUSSION

LHG plays a vital role in the livelihood of small-scale and landless farmers in the Potohar region of Punjab, Pakistan. In this region, goats are predominantly reared under extensive production systems, often in mixed flocks with sheep. The xerophytic vegetation of the Barani areas offers year-round grazing opportunities, supporting both local and transhumant livestock (Ahmad, 2016). Data collected from the Barani Livestock Production Research Institute (BLPRI) at Kherimurat, Attock, and from potential farmers rearing LHG revealed important insights into phenotypic variations and the relationship between body measurements and body weight in this indigenous breed. This will be helpful for the characterization and conservation of hairy goat using genetic and genomic tools as future potential goat breed for milk and meat production.

Phenotypic characterization is primarily based on external physical traits such as body size, coat color, and horn shape (Khan *et al*., 2008). Body measurement traits are crucial in selecting goat breeds for enhanced body weight (Akounda *et al*., 2023). Additionally, farmers adopt a selective approach when considering variations within and among goat breeds. This selection is largely influenced by morphological characteristics, growth performance, fertility, and body measurements, as they recognize the value of each trait in breeding decisions (Muhammad *et al*., 2015).

The present study of the LHG breed demonstrated genetic diversity through variations in body hair color and skin pigmentation. White and black coat colors dominate, reflecting adaptations to native climates. The variation in skin pigmentation likely correlates with Ultra Violet (UV) protection and heat tolerance, highlighting environmental adaptation. However, this breed is being reported 1$^{st}$ time on scientific forum.

The study of the LHG breed reveals notable variation in key morphological traits, such as BW (25–45 kg, average 35 kg), BL (average 72 cm), and HW (average 67 cm), reflecting both genetic diversity and environmental adaptation. The average heart girth of 80 cm highlights the breed's potential for meat production, indicating strong body conformation. These findings suggest that the breed's size and body structure are well-suited to the local environment, influenced by genetic, nutritional, and management factors.

The average values of all traits under study are

comparable to previously published data of Moaeen-ud-Din *et al*. (2006) and Waheed *et al*. (2020) on other local goat breeds such as Beetal, Teddy and Beetal x Teddy cross. To the best authors' knowledge, the current study is presenting the first reports on phenotyping characterization of LHG which was previously mentioned in an annual report published by Government of Punjab (Aslam, 1990-91). Furthermore, the results are comparable to earlier studies on other medium size breeds of goat i.e. Abdullah *et al*. (2024) in (Teddy and Potohari breed), Khan *et al*. (2008) (Teddy), Khan and Ashfaq (2010) (Teddy) and Ijaz *et al*. (2024) (Tapri, Bugitori, Lohri and Bari goat breeds of Sindh province).

Significant sexual dimorphism in BW, BL, HW, and other traits highlights the growth and reproductive differences between males and females. These findings have implications for breed selection, management, and breeding strategies aimed at optimizing growth, productivity, and adaptation in the LHG breed.

BW showed the strongest correlations with BL and HG, indicating these traits are key for assessing growth potential in the LHG breed. Waheed *et al*. (2020) stated about the HW had a moderate correlation, while other traits like EL, HL, and TL had minimal impact on BW. These findings are crucial for breeding strategies focused on improving BW and overall productivity of locally adapted goat breeds.

## CONCLUSION

Local Hairy goat breed appears to be a medium sized breed with distinct characteristics of predominately black coat and hair color, mostly horned and with straight facial head profile. Body weight can be predicted using body length and hear girth in LHG. Overall, the study presents a robust foundation for understanding the LHG breed, with actionable insights for conservation and productivity improvement.

## DECLARATIONS

*Acknowledgements*

The authors acknowledge Livestock and Dairy Development Department Punjab for their permission to collect data on live animals. The study was funded by PSDP funded HEC project titled "Establishment of National Center for Livestock Breeding, Genetics and Genomics at PMAS-Arid Agriculture University Rawalpindi".

*Funding*

The study was funded by PSDP funded HEC project titled "Establishment of National Center for Livestock Breeding, Genetics and Genomics at PMAS-Arid Agriculture University Rawalpindi".

*IRB approval*

Approval was not needed owing to nature of study i.e. field data recording.

*Generative AI and AI-assisted technology statement*

AI was only used (if any) in writing process to improve readability and language.

*Supplementary material*

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20250619063011

*Statement of conflict of interest*

The authors have declared no conflict of interest.

## REFERENCES

Abdullah, S.S., Toro-Mujica, P., Tajonar, K., Akbar, J., Chay-Canul, A.J., Lee-Rangel, H.A., Gonzalez-Ronquillo, M., Ghavipanje, N. and Vargas-Bello-Pérez, E., 2024. A quick look at goat production and husbandry practices in Pakistan. *Chilean J. Agric. Anim. Sci.*, **40**: 418-432.

Ahmad, T., 2016. Small ruminant production systems: Status and prospectus for improvement in Potohar Region of Pakistan. *Pakistan J. Sci.*, **68**: 253-258.

Akounda, B., Ouedraogo, D., Soudre, A.S., Burger, P.A., Rosen, B.D., Van Tassell, C.P. and Sölkner, J., 2023. Morphometric characterization of local goat breeds in two agroecological zones of Burkina Faso, West Africa. *Animals* (Basel), **13**: 1931. https://doi.org/10.3390/ani13121931

Aslam, M., 1990-91. *Study of birth, weaning, and adult weights in local hairy & Beetal and local hairy × Dera Din Panah crossbred goats*. Annual Report, Barani Livestock Production Research Institute (BLPRI), Kherimurat.

Cheema, M.J.M. and Bastiaanssen, W.G.M., 2012. Local calibration of remotely sensed rainfall from the TRMM satellite for different periods and spatial scales in the Indus Basin. *Int. J. Remote Sens.*, **33**: 2603-2627. https://doi.org/10.1080/01431161.2011.617397

FAO, 1998. *Secondary guidelines for the development of national farm animal genetic resources management plans: Management of small populations at risk*. Food and Agriculture Organization of the United Nations, Rome.

FAO, 2011. *Draft guidelines on phenotypic characterization of animal genetic resources*. Commission on Genetic Resources for Food and Agriculture, Thirteenth Regular Session, Rome. FAO Document CGRFA-13/11/Inf.19.

Ghani, M.W., Arshad, M., Abdul, S., Aamir, S., Nasir, M. and Ijaz, A., 2013. Investigation of potential water harvesting sites at Potohar using modeling approach. *Pak. J. agric. Sci.*, **50**: 723–729.

Government of Pakistan, 2025. *Pakistan Economic Survey 2024-25*: *Agriculture*. Ministry of Finance, Islamabad.

Ijaz, A., Moaeen-ud-Din, M., Suhail, S.M., Khan, R. and Khan, S., 2024. Evaluation of Sindh goat breeds performances for body measurements, body weight, productive and reproductive traits. *J. Anim. Pl. Sci.*, **34**: 253-259. https://doi.org/10.36899/JAPS.2024.1.0713

Iqbal, M.S., Dahri, Z.H., Querner, E.P., Khan, A. and Hofstra, N., 2018. Impact of climate change on flood frequency and intensity in the Kabul River Basin. *Geosciences*, **8**: 114. https://doi.org/10.3390/geosciences8040114

Khan, M.F. and Ashfaq, F., 2010. Meat production potential of small ruminants under the arid and semi-arid conditions of Pakistan. *Agric. Mar. Sci.*, **15**: 33-39. Sultan Qaboos University, KSA. https://jams.squ.edu.om/home/vol15/iss1/5/ https://doi.org/10.24200/jams.vol15iss0pp33-39

Khan, M.S., Khan, M.A. and Mahmood, S., 2008. Genetic resources and diversity in Pakistani goats. *Int. J. Agric. Biol.*, **10**: 227-231.

Miller, B.A. and Lu, C.D., 2019. Current status of global dairy goat production: An overview. *Asian Austral. J. Anim. Sci.*, **32**: 1219-1232. https://doi.org/10.5713/ajas.19.0253

Moaeen-ud-Din, M., Ahmad, N., Iqbal, A. and Abdullah, M., 2006. Evaluation of different formulas for weight estimation in Beetal, Teddi, and crossbred (Beetal × Teddi) goats. *J. Anim. Pl. Sci.*, **16**: 74-78.

Muhammad, M.S., Abdullah, M., Javed, K., Khan, M.S. and Jabbar, M.A., 2015. Goat production systems in Punjab, Pakistan. *J. Anim. Pl. Sci.*, **25**: 618-624.

Samiullah, S., Saleem, M. and Ullah, M., 2018. Geospatial assessment of soil erosion intensity and sediment yield: A case study of Potohar Region, Pakistan. *Environ. Earth Sci.*, **77**: 705. https://doi.org/10.1007/s12665-018-7867-7

SAS Institute. *SAS OnDemand for Academics*. Available from: https://www.sas.com/en_us/software/on-demand-for-academics.html

Ullah, S., Ali, A., Iqbal, M., Javid, M. and Imran, M., 2018. Geospatial assessment of soil erosion intensity and sediment yield: A case study of Potohar Region, Pakistan. *Environ. Earth Sci.*, **77**: 705. https://doi.org/10.1007/s12665-018-7867-7

Waheed, H.M., Moaeen-ud-Din, M., Khan, M.S., Saif-Ur-Rehman, M. and Nawaz-Ul-Rehman, M.S., 2020. Prediction of monthly body weight from body measurements in beetal goats reared under field and farm conditions. *J. Anim. Pl. Sci.*, **30**: 25-31. https://doi.org/10.36899/JAPS.2020.1.0003