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Bhakarwali Goat: A Unique Genetic Treasure of Jammu and Kashmir

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Introduction

Livestock plays a vital role in the economy of Jammu and Kashmir (J&K) contributing significantly to the socio-economic development of the region. With nearly 80% of the population residing in rural areas, the agriculture and animal husbandry sector generates 60% of the revenue [1]. Livestock rearing has been an integral part of J&K's culture and economy for centuries, thanks to its favorable agro-climatic and topographical conditions, including lush green pastures, meadows and water bodies [2].

The region's livestock is not only a source of subsistence for the local population but also a significant contributor to the economy, with livestock products being in constant demand. According to the 20th livestock census, J&K has a livestock population of 8.32 million and a poultry population of 7.37 million. The breakdown of the livestock population reveals that sheep, cattle, goats and buffalo account for 36.84%, 30.41%, 21.93% and 8.03%, respectively [3].

In J&K, goat rearing is a long-established tradition, with tribal communities like the Bakerwals, Gaddies and Changpas showcasing exceptional expertise [4]. The region is home to several notable goat breeds, including the Changthangi, Malra, Bhakarwali and Kashir goat [5; 6, 7]. Among the diverse goat genetic resources in Jammu and Kashmir, the Bhakarwali goat is distinguished by its impressive size and substantial population, rendering it a valuable and prominent breed in the region. Their distribution spans the hilly areas of Poonch, Jammu, Rajouri, Udhampur, Kathua and hilly areas of Kashmir in Jammu and Kashmir [7], as well as in Kaghan Valley and neighboring regions, including Abbottabad, Mansehra, Swat and Kohistan [9]. This goat has its roots in Central Asia, migrating to the region with nomadic tribes. Over time, they settled in the Kaghan Valley, where they are sometimes referred to as Kaghani goats.

Bhakarwali goat retains good feed conversion and reproductive efficiency. Bhakarwali goats are characterized by their large, robust build, surpassing other J&K goat breeds in size [8]. They demonstrate impressive feed conversion and reproductive efficiency. This breed exhibits remarkable variability in morphology, production and reproduction parameters. The nomadic communities of Gujjar, Bakerwals and Pahari in Poonch and Rajouri districts primarily rear Bhakarwali goats. This breed is valued for both its meat production [10].

Breeding Tract of Bhakarwali Goats

The Bhakarwali goat breed is predominantly found in the rugged and picturesque hilly areas of Jammu and Kashmir. Their breeding tract spans across several districts, including the

Poonch district, situated in the Pir Panjal range, which is characterized by a mountainous terrain. The Poonch /Suran rivers flow through this district.

In addition to Poonch, the Jammu district, located in the foothills of the Himalayas, is also a significant breeding ground for Bhakarwali goats. This district boasts mountainous terrain. The main rivers flowing through the district is the Tawi.

The Rajouri district, nestled in the Pir Panjal range, is also crucial breeding ground for Bhakarwali goats. This district features a hilly and mountainous terrain. The Ans river flows through the district. Similarly, the Udhampur district, located in the Himalayan foothills, has a hilly and mountainous terrain.

The Kathua district, situated in the south-eastern part of the Jammu region, also supports Bhakarwali goat breeding with its hilly and mountainous terrain. Furthermore, the Ramban district, situated in the Himalayan foothills, features a hilly and mountainous terrain, and the Chenab river flows through it.

The Reasi district, located in the Himalayan foothills, is characterized by a hilly and mountainous terrain. Lastly, the picturesque hills of Kashmir, including districts like Anantnag and Pulwama, also provide a suitable environment for Bhakarwali goat.

Tribe responsible for rearing of Bhakarwali goat

The Bhakarwali goat is primarily reared by the nomadic Bakerwal and Gujjar communities, inhabiting the Jammu division including Pir Panjal and Himalayan mountains of South Asia [11]. These tribes are predominantly goatherds and shepherds, also known as Dhangars in other parts of India (Choudhary et al., 2018). Through generations of practice, the Bakarwals have developed expertise in sheep and goat rearing, employing a transhumance pastoralism system. This involves seasonal migrations between low-lying areas and high-altitude pastures in the Himalayas, utilizing the region's diverse vegetation.

In Jammu and Kashmir, the Bakarwal community is one of the twelve officially recognized tribal communities. Together with the Gujjar community, they form the third largest population group in the state. As per the census of India (2011), scheduled tribes (STs) comprise 11.9% of Jammu and Kashmir's total population out of which Gujjars are the highest in number followed by Bakarwal tribe [13].

For generations, both Gujjars and Bakarwals have adhered to a traditional practice of seasonal migration, traveling to high-altitude pastures with their livestock during summers and returning to low-lying areas during winters. This consistent pattern of movement has earned them the title of Nomads, with their seasonal migration known as Transhumance. The Bakarwal Tribe of Jammu and Kashmir has a unique way of life, language and customs that are quite different from their settled counterparts. They remain nomadic, but a significant proportion has settled in the plain regions of Jammu and Kashmir due to increasing hardships. [13].

The Bakarwals start their seasonal migration towards the high altitudes and the heights of the Himalayan Mountain range, where lush green grass is abundantly available for livestock. They mainly rear sheep and goats, and are known for their expertise in goat rearing. There are approximately six lakh Bakarwals in Jammu and Kashmir tribe [13]. They are known for their well-built physique, bravery and hospitality. Traditionally, they did not construct permanent houses, instead living in tent houses made of tarpaulin, small sticks and rope lengths. Bakarwali women wear home-stitched caps, while the men wear traditional shoes called Jooti that are fixed with iron nails at the bottom and are quite heavy [11]. Each Bakarwal family typically has around 400 sheep, 100 goats, 6 to 8 horses, Bakarwali mastiff dogs and some poultry birds.

Soil Types in breeding tract of Bhakarwali goat

The diverse geography and climate of Jammu and Kashmir have given rise to varied soil types, each supporting unique vegetation and agricultural practices. In Jammu, the soil is predominantly alluvial, characterized by its fertility and support for a wide range of crops, including rice, wheat, and maize. Smaller areas of loamy and clayey soils are also present [14].
In contrast, Kashmir's soil is primarily loamy, with a mix of clay and silt, making it well-drained and fertile. This soil type is ideal for growing fruits like apples, cherries and saffron [14]. The mountainous terrain of Poonch limits soil development, resulting in mainly sub-mountainous and meadow soils. However, some valleys near rivers have localized blocks of alluvial soil and loamy soil types have also been reported in the Poonch district [15].

Fig 1. Different soil in breeding tract of Bhakarwali goat

Agriculture in breeding tract

Agriculture is the primary economic activity in breeding tract, where it serves as a means to fulfill household necessities. The region practices a mixed crop-livestock farming system. The farmers in this region are predominantly small and marginal. The dominant cereal crops cultivated by the farmers include maize, paddy and wheat. Furthermore, the favorable agro-climatic conditions for the cultivation of fruits such as pear, peach, apricot, and plum, in addition to walnut, which is a significant dry fruit in the region.

Natural Vegetation

The breeding ground boasts an exceptionally rich plant diversity, holding immense scientific and cultural significance. The region's vegetation is characterized by a diverse array of flora, including narrow-leaved coniferous Chir pine, evergreen shrubs, broad-leaved evergreen forests featuring species like *Buxus wallichiana* and *Ilex dipyrena*, and broad-leaved deciduous forests comprising *Aesculus indica* and *Populus alba*. Additionally, scrub forests, grasslands and agricultural fields cultivating crops like maize are interspersed throughout the area, creating a unique and varied landscape [16; 17] .

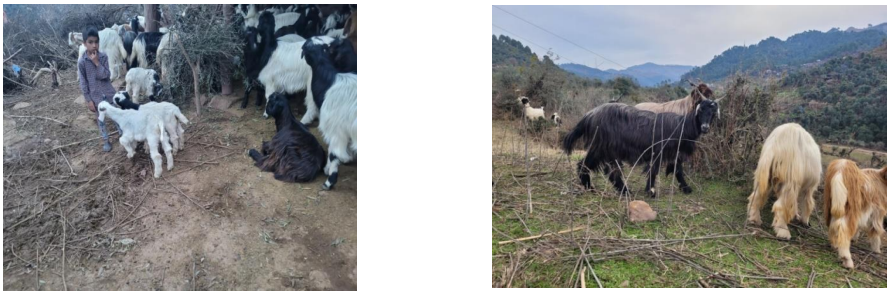

Fig 2. Breeding Grounds of Bhakarwali goat

Grasslands

Jammu and Kashmir is home to diverse grasslands, including alpine grasslands, meadows and rangelands, forming a vital ecosystem that supports biodiversity and scenic beauty. The region's alpine grasslands are a significant part of the Indian Himalayas' alpine grasslands, covering an area of 3.53 and 13.22 hectare in Jammu and Kashmir, respectively [18].

These grasslands are vertically distributed, with the highest concentration found between 1500-3000 m elevation. Locally known as Bahaks, Margs, gasse charai [19] and others, these Himalayan grasslands are unique ecosystems that provide essential ecosystem services, harbor rich biodiversity and support regional carbon and hydrological cycles.

The Kashmir Himalayan region's grasslands cover 16% of the area, comprising grazing lands, grassy vegetation and subalpine-alpine meadows. Livestock rearing contributes significantly to Kashmir's GDP (16%). The subalpine and alpine grasslands are snow-covered for 6-9 months, limiting grazing to 3-6 months.

The grasslands are utilized for grazing under three livestock rearing systems:

1. Sedentary: practiced by people living at 1,500-2,500m.
2. Semi-migratory: practiced by people below 2,000m.
3. Migratory (transhumance): people migrate with their livestock to different areas.

Alpine Grasslands

The region's alpine grasslands are a significant part of the Indian Himalayas' alpine grasslands, covering an area of 3.53 and 13.22 hectare, in Jammu and Kashmir respectively [18]. These grasslands are vertically distributed, with the highest concentration found between 1500-3000 m elevation. Locally known as Bahaks or Margs, these Himalayan grasslands are a unique heritage, boasting species-rich and taxonomically diverse flora. They provide ecological services and scenic beauty, supporting pastorals and indigenous communities who collect and use plants for various purposes. Further, the lesser Himalayan range features small meadows, known as margs, meaning meadows. Further, rangelands and grasslands face threats from climate change and overexploitation. Effective management and governance are necessary to protect these rangelands.

Fig 3. Kashmir Himalayan region's grasslands

Cultivated Fodder Crops

Signal grass (*Brachiaria decumbens*), Hair grass (*Agrostis scabra*), Bahia grass (*Paspalumnotatum Flugge*), Marvel grass (*Dichanthium annulatum*), Vetiver grass (*Chrysopogon zizanioides*), Setaria grass: PSS- 1 (*Setaria anceps Stapf.*), and Black vetiver grass (*Chrysopogon nigritanus*) are among fodder crops cultivated in breeding tract [16]. These fodder

crops are specifically cultivated to meet the nutritional needs of livestock in the region. By growing a diverse range of fodder crops, farmers can ensure a steady supply of nutritious feed for their animals, which is essential for maintaining their health and productivity.

Strength of the Breeding Tract

This breed has thrived due to the exceptional rearing practices developed by local tribes over centuries, complemented by the region's unique topography. The breeding tract's strengths include:

- Abundant grazing lands and beautiful valleys.
- Foothills of the Himalayas and high lands of Kashmir providing excellent summer grazing grounds.
- Suitable agro-climatic, socio-cultural and soil conditions for fodder development.

Management of Bhakarwali Goats

The Bhakarwali goat population is migratory in nature, with a distinct seasonal movement pattern. Every summer, nomadic tribes from Poonch, Rajouri and other areas migrate to the upper ranges of the Himalayas, including the Kashmir Valley and its surrounding regions, such as the Wardwan Valley, Kargil, Gurez, Kishtawar, Doda and Badarwah. They traverse through various mountain passes, known as Gallis and Dheras, to reach the highland pastures of the Kashmir Valley and Poonch.

Feeding of Bhakarwali goats

After the grazing season, the nomads return to their original locations along with their livestock during the autumn season. To manage their livestock during the harsh winter months, the nomads employ a combination of grazing and stall feeding. The livestock is grazed during the day, while at night, they are fed dry fodders prepared from wild grasses, straw of maize and wheat, mixed jungle hay, natural dry fodders, tree loppings and pods of leguminous plants.

The Bhakarwali goat exhibits unique browsing habits that enable it to thrive in the rugged terrain and harsh climate. As browsers, they primarily feed on leaves, twigs, and shrubs, with a preference for leaves of trees and shrubs. Their agility and surefootedness allow them to graze on steep slopes and rocky outcrops. Their feeding behavior has a significant impact on the vegetation of the Himalayas, as they help disperse seeds and create pathways through dense vegetation, although overgrazing can lead to habitat degradation. Overall, the browsing habits of Kagani goats are well adapted to the unique environment of the Himalayas, playing a crucial role in shaping the ecosystem of this region.

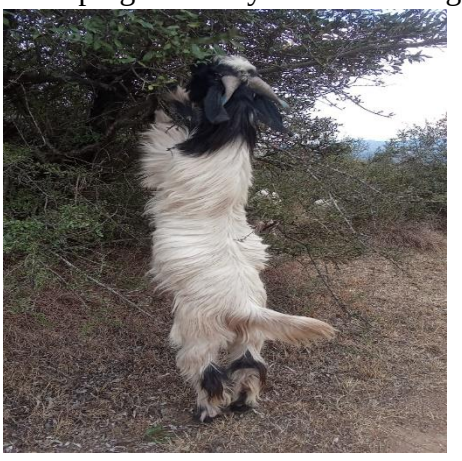

Fig 5.

Browsing habits of Bhakarwali goats

Housing of Bhakarwali goats

Bhakarwali goats are housed in sheds during winter and are grazed in the summer. In Poonch, traditional animal sheds are typically built using locally sourced stones.

Fig 6. Housing of Bhakerwali goats

The sociodemographic status of Bhakarwali goat-rearing families

The Bakarwal community is traditionally nomadic pastoralists, inhabits the rugged terrain of the Himalayan foothills. Their socioeconomic and sociodemographic status is characterized by:

Age: The average age of household heads is around 50 years, with a range of 34 to 69 years, indicating a diverse age distribution among livestock farmers [12].
Education: Bakarwal tribe had minimal formal education, with a mean value of 1.51, suggesting that the majority of the Bakarwal population was illiterate. Notably, none of the respondents had formal education beyond the primary level, with no respondents having completed graduation or higher [12].
Land holding: The farmers were landless, with a low mean value of 0.46±0.05 units. This indicates that most of the respondents did not own any land, with the range of land ownership being from 0 to 1 unit [12].
Income: The average annual income of Bakarwal farmers was ₹30,714.45 to ₹120,708.30, with a significant range of ₹50,000 to ₹200,000 [12].
Flock size: The average flock size of Bakarwal tribe was 113.04 ± 1.85, with a range of 47-155 animals/ farmer [12].

Other livestock species and breed reared in breeding tract

Livestock species and breeds reared in Kashmir include sheep breeds like Merino, Bhakarwal sheep, Poonchi sheep and Rambouillet. Goat breeds like Kagani and Beetal are also popular. Cattle breeds including Jersey and Holstein Friesian, while buffalo is non-descript. Poultry breeds like Dasi Poonchi, Kashmir Fevarolla, and other are also reared in the region. Equines like horses, ponies, mules and donkeys are used for transportation and other purposes. Other livestock species include yak, mithun, pigs, rabbits and Bakarwal dogs [20; 22].

Fig 7. Other livestock species and breed reared in Kashmir

Occupation: The primary occupation is goat rearing, with some families engaging in supplementary activities like agriculture, labour or even government services [12].
Family Size: Average family size is around 6-8 members, with a range of 4-12 members.
Access to Healthcare: Healthcare access is limited, with many families relying on traditional remedies or traveling long distances to access modern medical facilities.
Social Organization: The Bakarwal community is organized around traditional social structures, with decision-making authority often resting with elderly males.
Indigenous knowledge of livestock rearing: The Bakarwal farmers demonstrated a satisfactory understanding of traditional practices related to sheep and goat rearing. Specifically, the majority of respondents exhibited a medium level of knowledge regarding indigenous methods, highlighting their familiarity with locally adapted techniques [12].
Marketing pattern: Bakarwal farmers demonstrated a satisfactory understanding of marketing strategies, with the majority exhibiting effective marketing patterns [12].

General information of Bhakarwali goat

Synonyms: The Bhakarwali goat is also known as Kaghani for its main home Kaghan valley and Pahari goat.
Utility of breed: The Bhakarwali breed is a robust and large-sized goat (weighing 35-81 kg) that plays a vital role in the livelihood and agricultural economy of Jammu and Kashmir, particularly in Poonch, Jammu, Rajouri, Riasi, Udhampur and Kathua districts. This goat also produces an average of 900 gm of milk per day.
Breeding: Bhakarwali goats breed naturally without any scientific interference, such as selective breeding.
Slaughter Age: Bucks typically reach higher body weights at various ages, therefore, are usually sold for meat between age of 1.5 to 2.5 years. However, females are sold for slaughter after completing their productive and reproductive life.

Physical traits of Bhakarwali goat

Bhakarwali goat is large, strong and robust in appearance. The physical traits of Bhakarwali goat are presented below:
Body coat: Bhakarwali goats are covered with long hairs coarse hair coat of different colours. The Bhakarwali goat's characteristic features are the uniform coat of long hair covering its entire body, with a notable concentration on the neck region, abdomen, hind limbs and tail. Owing to this body coat of long coarse hairs these goats are well adapted to high altitudes.

Fig 9. Horn pattern and long hair of Bhakarwali goat

Colour: The animals of Bhakarwali goat breed are usually white, black, brown and grey. However, animals with mixed colors of white, black, brown and grey are mostly observed. Further, some animals with patches of white with black colour are also common.

Fig 10. Different colours of Bhakarwali goat

Head profile: The Bhakarwali goat has a distinctive head profile, characterized by a convex shape, a narrow face and a remarkably mobile lower lip.

Horn shape and length: The goat possesses long, upward and laterally directed spiral or screw type horns. The horn length increases with age. Aged animals possess longer horns than younger animals. Some individuals of this breed are polled also.

Fig 11. Horn shape and length of Bhakarwali goat

Ears: These goats usually possess long and drooping ears. However, small, rudimentary, folded and straight ears are not uncommon.

Fig 12 (a): Rudimentary ears

Fig 12 (b): Folded ears

Fig 12 (c): Folded and straight drooping ear

Fig 12 (d): Long and

Beard: Meat animals of Bhakarwali goat breed possess beard.

Fig 13. Bakarwal goat breed possess beard

Wattles: Wattles are also observed in some individuals of Bhakarwali goat breed.

Fig 14. Wattles shown in a kid

Morphological traits of Bhakarwali goats

Morphological or biometric traits are crucial for determining breed standards, understanding morphological structure, and assessing developmental ability in animals. These measurements offer valuable insights into physiological status [23] and morphological structure, facilitating the development of breed standards [25; 26] and selection criteria [27]. Moreover, body measurements are essential for estimating average live body weight [28] and developmental ability [24; 29]. Due to the strong correlation between body measurement traits

and body weights, they are useful for predicting live weight under field conditions [30; 31; 32; 33].

Horn length (HL): The goat features distinctive; spiraling horns that curve upward and backwards (Fig. 1 and 2). Horn length tends to increase with age, with older animals typically having longer horns than their younger counterparts. However, some individuals within this breed are polled. Average horn length (cm) of 8.34±0.85, 9.38±0.54, 11.66±0.85, 18.22±0.44, 23.61±0.44, 20.53±0.63 and 24.16±0.82 at 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Fig 15. Different horn length of Bhakarwali goat

Face Length (FL): FL is distance from the beginning of the upper lip to the external occipital protuberance. Average FL (cm) of 15.37±0.63 19.38±0.19, 21.58±0.29, 22.17±0.29, 22.83±0.28, 23.42±0.22, 23.52±0.28 and 24.89±0.15in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Ear Length (EL): Ear length refers to the linear measurement from the base of the ear (where it attaches to the head) to the tip of the ear. Average ear length (cm) of 18.20±0.65, 20.70±0.45, 23.10±0.24, 23.20±0.34, 24.38±0.30, 25.70±0.47, 26.80±0.47 and 26.95±0.45 in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Ear Width (EW): Average EW (cm) of 9.09±0.18, 7.54±0.19, 7.54±0.19, 8.16±0.14, 9.49±0.10, 11.29±0.20, 12.46±0.20 and 7.54±0.19in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Height at Withers (HW): The height at withers is the distance from the ground to the uppermost point of the withers when the animal is standing upright on all four limbs. Average HW (cm) of 33.63±0.31, 68.75±0.40, 69.41±0.63, 73.09±0.63, 74.41±0.60, 80.20±0.32, 84.41±0.46 and 86.91±0.60in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Chest Girth (CG): Chest girth is the circumference of the body measured around the chest just behind the front legs (forelimbs) and over the withers in animals. Average CG (cm) of 31.43±0.54, 61.25±0.37, 68.38±0.59, 69.12±0.59, 79.12±0.56, 79.46±0.31, 82.62±0.43 and

80.62±0.56 in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Body Length (BL): Distance from point of shoulder to the point of tuber ischii. Average body length (cm) of 31.83±0.36, 60.00±0.44, 67.65±0.66, 70.15±0.70, 74.95±0.36, 75.15±0.51, 77.35±0.70 and 77.65±0.66 in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Paunch Girth (PG): Body circumference around the paunch of animal just before hind legs in standing position. Average body length (cm) of 29.57±0.41, 53.46±0.44, 68.75±0.28, 69.04±0.44, 79.71±0.32, 85.96±0.42, 88.01±0.23 and 88.46±0.42in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Tail Length (TL): The distance from the base (sacro-coccygeal articulation) to the tip of tail is TL. Average TL (cm) of 14.01±0.55, 14.38±0.98, 15.87±0.55, 16.02±0.55, 16.35±0.48, 16.41±0.80, 16.42±0.14 and 16.42±0.48in kids, 3 months age group, 6 months age group, one year age group, two years age group, three years age group, four years age group and in adult animals, respectively is reflected in Table 1 for Bhakarwali goat irrespective of sex.

Table 1. Least square means of for body weight and body measurements of Bhakarwali goats

Particulars	N	HL (cm)	FL (cm)	EL (cm)	EW (cm)	HW (cm)	CG (cm)	BL (cm)	PG (cm)	TL (cm)
Birth			15.37±0.63	18.20±0.65	9.09±0.18	33.63±0.31	31.43±0.54	31.83±0.36	29.57±0.41	14.01±0.55
3M	54	8.34±0.85	19.38±0.19	20.70±0.45	7.54±0.19	68.75±0.40	61.25±0.37	60.00±0.44	53.46±0.44	14.38±0.98
6M	26	9.38±0.54	21.58±0.29	23.10±0.24	7.54±0.19	69.41±0.63	68.38±0.59	67.65±0.66	68.75±0.28	15.87±0.55
one year	26	11.66±0.85	22.17±0.29	23.20±0.34	8.16±0.14	73.09±0.63	69.12±0.59	70.15±0.70	69.04±0.44	16.02±0.55
Two years	29	18.22±0.44	22.83±0.28	24.38±0.30	9.49±0.10	74.41±0.60	79.12±0.56	74.95±0.36	79.71±0.32	16.35±0.48
Three years	87	23.61±0.44	23.42±0.22	25.70±0.47	11.29±0.20	80.20±0.32	79.46±0.31	75.15±0.51	85.96±0.42	16.41±0.80
Four years	58	20.53±0.63	23.52±0.28	26.80±0.47	12.46±0.20	84.41±0.46	82.62±0.43	77.35±0.70	88.01±0.23	16.42±0.14
Five years and above	29	24.16±0.82	24.89±0.15	26.95±0.45	7.54±0.19	86.91±0.60	80.62±0.56	77.65±0.66	88.46±0.42	16.42±0.48

Growth Traits in Farm Animals

Growth, a vital trait in farm animals, refers to the increase in tissues and organs over time, influenced by genetic and environmental factors. It can be measured by body weight at specific ages, serving as an indicator of fitness and adaptability.

Importance of Growth Traits in goat Production: Early growth traits, such as birth weight, weaning weight, six-month body weight and yearling body weight, predict an animal's lifetime performance. These traits are essential for production, reproduction and survivability, and are influenced by both genetic factors and environmental factors.

Birth Weight (BW): Birth weight, measured immediately after birth, is the earliest available trait and a crucial component of overall productivity. It affects animal's survival and future growth potential. The average birth weight of Bhakarwali goats is 2.99 ±0.07 kg. Zargar et al., 2017 reported birth weight of 3.28±0.05 kg in Bhakarwali kids with male (3.37±0.05kg) higher than females (3.06±0.10kg) similarly, [34] observed overall mean birth weight of 2.97±0.07 kg in this goat. The males yielded higher average o3.16±0.09 than female kids (2.78±0.09).

Fig 16. Body weight is an important trait in Goat Production

Weaning Weight (WW): Weaning weight, highly correlated with a dam's mothering ability, reflects the differences in growth and maternal instinct. The average weaning weight (WW) of Bhakarwali goats is 15.00 ±1.12 kg.

Six Months Body Weight (6W): Six months body weight is an important trait, governed by an animal's genetic worth and environment. It is not affected by maternal effects, making it a valuable indicator of growth potential. The average six months body weight of Bhakarwali goat is 20.05±1.76 kg.

Yearling Body Weight (12M): Yearling body weight is critical in goat rearing, as it determines the animal's value for meat production. This trait is a key factor in the economy of goat farming. The average yearling weight of Bhakarwali goat is 31.95±1.76 kg.

Fig 17. Yearling body weight is critical in goat rearing

Body weight at two years of age (2Y): It reflects maturity and breeding age of animal. The average two-year body weight of Bhakarwali goat is 49.95±1.29 kg.

Fig 18. Different body weights of Bakarwal goat

Three-Year Body Weight (3Y): The average three-year weight of Bhakarwali goat is 52.35±0.91 kg.

Four-Year Body Weight (4Y): The average four-year weight of Bhakarwali goat is 56.95±1.68 kg.

Five-Year and above body weight (5Y and above): The average five-year and above weight of Bhakarwali goat is 59.95±1.68 kg.

Table 2. Body weights in different age groups in Bhakarwali goat

Particulars	BW	3M	6M	12M	2Y	3Y	4Y	5Y and above
BW (kg)	2.99 ±0.07	15.00 ±1.12	20.05 ±1.76	31.95 ±1.76	49.95 ±1.29	52.35 ±0.91	56.95 ±1.68	59.95 ±1.68

Milk production: Average daily milk yield of Bhakarwali goat is approximately 900 gm (0.9 kg).

Reproductive performance: The reproductive performance of goats is a critical indicator of their ability to produce offspring consistently, directly impacting the viability of goat farming operations. This complex trait is influenced by a combination of genetic, nutritional, health and management factors. The Bhakarwali goat breed is known for its exceptional reproductive efficiency, making it a valuable asset for goat farming and breeding programs.

Age at First Kidding: The age at which Bhakarwali goats typically give birth to their first kids is between 18 and 24 months.

Gestation Period: The gestation period for Bhakarwali goats ranges from 147 to 155 days.

Inter Kidding Interval: The kidding interval for Bhakarwali goats varies from 190 to 365 days.

Sex Ratio: Sex ratio of 50.77 males to 49.23 females (or 33 males to 32 females) in the Bhakarwali goat breed [34].

Dam weight at kidding: The average weight of Bhakarwali goat dams at the kidding was 39.11±0.88 kg with a range of 25-58 kg [34].

Twining percentage: High twinning percentage of 46.15% (30/65) in Bhakarwali goats [34].

Sexual dimorphism at birth: Sexual dimorphism in favour of males with respect to birth weight [34].

Key Constraints Hindering Goat Development

Scarcity and high cost of feed and fodder: Limited availability and high cost of quality feed and fodder, particularly during winter, hinder goat development.

Inadequate housing: Lack of scientific housing with proper lighting and ventilation affects goat health and productivity.

Unplanned breeding: Random mating practices and limited scientific knowledge on management, feeding and breeding constrain goat development.

Limited access to quality sires: Non-availability of good-quality sires further impedes the development of the goat population.

Health and Management of Bhakarwali Goats

Common diseases: The region is prone to various diseases affecting sheep, including:

Viral diseases: Contagious Ecthyma, Bluetongue and Peste des petits racionais (PPR).

Bacterial diseases: Pneumonia, Enteritis, Diarrhea, Brucellosis and FootRot.

Parasitic diseases: Fascioliasis, Haemonchosis, Dicrocoeliasis, Dictyocaulus and mange etc.

Vaccination: The Department of sheep husbandry, Jammu and Department sheep husbandry, Kashmir conduct regular vaccinations against bacterial, viral diseases viz; Foot and Mouth Disease (FMD), enterotoxaemia, pulpy kidney and dosing parasitic diseases.

Threats: The Bhakarwali goat breed faces several significant threats, including:

Crossbreeding: The practice of crossbreeding with Beetal goats to enhance milk production and use of artificial insemination (AI) is main threat to genetic purity of this valuable asset of J&K and country.

Alternative economic activities: Farmers' shifting focus to alternative economic activities, reducing their dependence on traditional goat farming.

Environmental degradation: Climate change, deforestation and pasture degradation due to tourism, illicit soil smuggling, land conversion and infrastructure development (e.g., road construction).

Pasture encroachment: Encroachment of pastures, reducing the availability of grazing land for livestock rearing.

Climate change: The rising temperatures, escalating greenhouse gas emissions from numerous brick kilns and subsequent changing weather patterns are severely impacting the livestock industry in J&K. This ecological degradation also poses significant risks to human health, compromising the delicate balance of the region's fragile ecosystem, often referred to as a paradise on earth.

Fencings for forest, security and tourism: Fencing of pastures in the Himalayas in Kashmir for forest, security and tourism purposes, limiting grazing grounds.

Lack of access to basic facilities: Bakarwals face difficulties in accessing basic facilities, although government has made provision for their education, veterinary facilities etc. at even peaks of Himalayas and highland pasture.

Difficult access to grazing areas: Shepherds face challenges in accessing grazing areas due to rugged terrain, fencing and other obstacles.

Changing weather patterns: Unfavorable climate conditions, including low rainfall, reduced snowfall and altered seasonal patterns, negatively impact the health and productivity of the livestock including Bhakarwali goat breed.

Forest authorities: Forest authorities' restrictions and regulations limit farmers' access to grazing lands and traditional resources, although these measures are a response to the widespread illegal deforestation that has occurred over the last two to three decades.

Interventions: Establishing goat breeding farms in the breeding tract is a strategic move to enhance the Bhakarwali goat breed's milk and meat production capabilities. The approach,

similar to the one adopted for sheep, would make the breed more viable for Bakarwal community.

Selective Breeding: Implementing selective breeding programs to enhance desirable traits such as milk and meat production. Better healthcare and management can help to improve this goat breed, making it more profitable for farmers and contributing to the region's agricultural growth.

Conclusion

The Bhakarwali goat is an exceptional breed that has adapted to thrive in the challenging Himalayan terrain. Native to the Indian states of Jammu and Kashmir, this remarkable goat has been an integral part of the region's ecosystem and economy for centuries. With its impressive physical characteristics, robust health and valuable wool and milk production, the Bhakarwali goat plays a vital role in supporting the livelihoods of local communities. However, the Bhakarwali goat faces numerous threats to its survival, including habitat loss and fragmentation, climate change, disease outbreaks and cross-breeding with non-native breeds. These pressures not only jeopardize the genetic integrity and population stability of the breed but also undermine the livelihoods of the Bakarwal community, who rely heavily on these goats for their sustenance. To mitigate these threats and ensure the long-term conservation of the Bhakarwali goat, concerted efforts are necessary from policymakers, conservationists and local communities. This includes initiatives to protect and restore habitats, develop climate-resilient breeding programs and promote sustainable livestock management practices. By recognizing the value and significance of the Bhakarwali goat and taking proactive steps to address the challenges it faces, we can work towards creating a more sustainable and equitable future for both the breed and the communities that depend on it.

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