



Phenotypic Characterization of Zokel Goat: A Lesser Known Caprine Genetic Resource of Mizoram, India

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ABSTRACT

Background: The current study aims to assess the management techniques, phenotypic variability, morphometric characteristics and performance traits of the Zokel indigenous goat of Mizoram. This documentation is crucial for breed registration and the conservation of the breed via suitable breeding programs.

Methods: A comprehensive investigation was conducted, involving a sample of 300 indigenous goats gathered from 64 villages. Goat rearing farmers often rely on natural grazing and locally available forages as the primary nutrition source for their herds. Various physical and biometric traits were recorded at different ages for the phenotypic characterization of the goats. These traits included body weight, body length, chest girth, height at withers, horn length, ear length and tail length, which were measured to assess the overall physical development and variations within the herd. The data were collected following the prescribed format recommended by the ICAR-National Bureau of Animal Genetics Resources, Karnal, for breed characterization. The collected data were then analyzed using the SPSS statistical software.

Result: Zokel goats were found to have a small to medium body size (90-95%) and a short stature with a cylindrical body shape. The body colour of Zokel varied in different colors, which included white (45-58%), black (27-33%), brown (6-12%) and a mixed color (7-11%). Foreheads were narrower, straight and somewhat depressed in the middle (92-96%), whereas 2-5 percent had flattened and straight foreheads. Female goats have small horns with black and brown (90-93%), grey (2-6%) and mixed color (1-5%) and a little curve and slight bend at the ends upwards and backwards. Ears were small to moderate in size and oriented horizontally or drooping in a few cases. The average body length, chest girth, height at wither, horn length, ear length and tail length were 57.34±0.75 cm, 72.12±0.32 cm, 50.80±0.51 cm, 8.89±1.03 cm, 13.97±0.21 cm and 17.78±0.11 cm, respectively. The measurements of all morphometric traits were higher than the Assam Hill goats. The reproductive data indicates age at first mating, viz., 225.2±8.04 days and higher kidding intervals, i.e., 232.5±8.09 days. The results indicated that the Zokel goats showed comparable physical and morphometric traits but significant variations in proportions of these attributes compared to the other goat breeds.

Key words: Characterization, Morphometric traits, Performance, Physical traits, Zokel goat.

INTRODUCTION

India has a large and diverse population of small ruminants, which plays a crucial role in the livelihoods and income of rural communities across the country, particularly benefiting economically disadvantaged households (Pathak *et al.*, 2020). Small ruminants (*i.e.*, sheep and goats) are widespread and play a vital role in the subsistence, economic and social livelihoods of large populations in low-input, smallholder production systems, particularly in developing countries (Kosgey, 2004). The goat is recognized as a multifunctional animal and an untapped meat supply with traits impeccable for sustainable red meat production (Gawat *et al.*, 2023). The total Goat Population in India is 148.88 Million, which has increased by 10.14% over the previous Livestock Census (2012). About 27.8% of the total livestock population in India is contributed by goats (Livestock census, 2019). Globally, India ranks first in Goat milk production and second in Goat population and meat production.

In the Northeastern region, small ruminants are generally reared for meat purposes and rarely for their milk (Mahajan and Datta, 2015). Mizoram is a small and hilly state in Northeastern India with a total area of 21,081 km²

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and a total goat population of 14,720, with the majority of them being non-descript goats (Livestock census, 2019). Most goats in Mizoram are characterized by their small stature and low milk production, although they have a remarkable capacity to adapt to various climatic circumstances. This local non-descript goat (Zokel) in Mizoram has different local names and is usually called

just by their species, such as *Kel*, *Mie*, *Meheh*, etc. These goats have been raised among other local tribal communities, such as Lushai, Lakher, Lai, Hmar, Paite, etc., for many years. The Zokel goat's body coat colour varies from black, white and brown, which may be plain or a mixture of black, brown and white coat colors. The nondescript goats found in Mizoram are miniature in stature, with a cylindrical body shape, exceptionally resistant to disease and require minimal maintenance. They are reared primarily in an extensive farming system without supplementing mineral mixtures or concentrate feeds. The growing human population, economic development, rising incomes and changing consumer preferences are driving the increasing demand for these goats and their flavorful meat. On the other hand, there is a necessary demand for further knowledge on sustainable conventional genetic improvement programs in smallholder production situations. Accordingly, it is crucial to conduct research that aims to describe and conserve the native goat breed to disseminate elite germplasm and enhance the quality of life for disadvantaged farmers. A greater understanding of this goat breed's physical, morphological characteristics and performance attributes is essential. Therefore, this research was conducted to document the physical and morphological traits of the Zokel goat, to officially recognize it as a distinct goat breed native to Mizoram, India."

MATERIALS AND METHODS

Study area

The study was conducted in different districts viz., Siaha, Lawngtlai, Lunglei, Kolasib, Mamit, Champhai, Aizawl and Serchhip of Mizoram to locate their geographical distribution and population status. The home tract of local indigenous non-descript goats in Mizoram are widely distributed and found all over the hilly regions of Mizoram, within 21°56' to 24°31' N latitude and 92°16' to 93°26' E longitude. The population of local non-descript goats is higher in the southern part of the state viz. Lunglei district of Mizoram, followed by Siaha and Lawngtlai districts. The state is mountainous and craggy and has a mild and temperate climate, which ranges from 8 to 21°C in winter and 21 to 33°C in summer. The average rainfall is 2648 mm/annum (@ 1001 mm to 4462 mm/annum).

Sampling strategy

A total of 64 villages were selected from eight districts, mainly from the southern districts of the state. The selection of these villages was determined by different factors such as population density, distribution of the indigenous goat population and their accessibility. The study encompassed 300 goat farmers, all of whom owned at least three goats. To ensure genetic variability, data were collected through random sampling method, choosing two goats from each household.

Data collection

The primary objective of data collection was to document the phenotypic characteristics and analyze the diverse management strategies used by goat owners across the state. The farmers were questioned to assess the habitat, status, management, utility and performance of their existing goat shed. Moreover, farmers were asked about breed choice, animal sales and purchases, animal housing, feeding, breeding and prevalent diseases in their areas. The farmers were given standardized questionnaires to gather data on reproductive and productive features, including birth weight, daily milk output, lactation duration, age of first kidding, kidding interval, service time, weight at first kidding and weight at first mating. Physical traits related to body weight at different ages were recorded using a suspended electronic weighing balance. In contrast, body length, chest girth, height at withers, horn length, ear length and tail length were recorded using a measuring tape. These physical traits are crucial for differentiating between breeds or within populations for targeted breeding programs. In addition, information on the presence of horns, wattles and beards, as well as coat colours and ear types, were documented. The data obtained adhered to the format specified by the ICAR National Bureau of Animal Genetics Resources, Karnal, for breed characterization and was analyzed using the SPSS statistical software program.

RESULTS AND DISCUSSION

Distribution and population intensity

The present study revealed that the home tract of Zokel goat is higher in the southern part of the state. The highest population density of this local goat is distributed in the Lunglei district of Mizoram, followed by Siaha and Lawngtlai districts (Fig 1). As per the 20th Livestock Census (2019), Mizoram has a total of 14,720 goats. Most of the goat population comprises native non-descript goats, while only a small percentage represent improved breeds in established goat farms. According to the 20th Livestock Census (2019), Lunglei district (4799) has the most significant number of non-descript goats, followed by Siaha district (2549), Lawngtlai district (2547), Kolasib district (1603), Mamit district (1371), Champhai district (922), Aizawl district (517) and Serchhip district (502) (Fig 1 B).

Managemental practices

Housing system

Most Zokel goats were reared in semi-intensive conditions, spending their days grazing and seeking shelter in a shed at night. Goat houses are usually made of locally available materials like wood and bamboo; wooden plank or bamboo matting walls, G.I. sheets, or thatch roofs and a wooden floor or kutcha floor (Fig 2). It is common practice for wooden flooring to have a gap between planks of 2-3 cm to facilitate direct drainage of excreta. A protected shed is

usually used at night to keep the goats with separate compartments for bucks and buckling's. To make animal care and management easy, goat farmers usually build goat houses in a plain area close to their homes. An adequate drainage system is needed in almost all farmers' goat sheds (94%).

Feeding system

Zokel goat are reared mainly by semi-intensive method and are allowed to graze the whole day from morning (9.30 AM) till evening (6:00 PM) in the forest area and rest in the shed at night. Goat-rearing farmers often rely on natural grazing and forages as the primary source of nutrition for their herds, limiting the use of supplemental feed, minerals, or vitamins. However, a significant proportion (83%) occasionally provide salt blocks to their goats. These salt blocks, typically composed of essential minerals like sodium and trace elements, are a simple and cost-effective way to address some mineral deficiencies that grazing alone might not cover. Various types of goat fodder are available to them, including broom grass, jackfruit leaves, cowpea leaves and para grass. Therefore, feed expenditures are almost negligible, reducing the

production cost for most goat farms and allowing for practically zero inputs in raising goats. Most goat farmers allow the kids to suckle milk and colostrum (91%).

Health care

The Zokel goat found in Mizoram is relatively resistant to many common diseases, which makes rearing it a low-cost budget. However, the most common health issues observed in the field include Foot and Mouth Disease (FMD), bloat, parasite infestations, food poisoning, goat pox, respiratory problems, mastitis, diarrhea, fungal infections and others. Vaccinations for prevention of Peste des Petits Ruminants (PPR) were observed (12.24%), but deworming was done occasionally and unevenly (14%). Regarding reproductive issues, common diseases and disorders include anoestrus, abortion, prolapse, stillbirth and dystocia. It was also noted that goats suffering from an inadequate supply of minerals demonstrated symptoms of pica and weakness. Due to the remoteness of many villages, farmers have limited access to veterinary services, with fewer veterinary dispensaries and an inadequate workforce. As a result, many farmers continue to rely on age-old traditional practices to treat their animals.

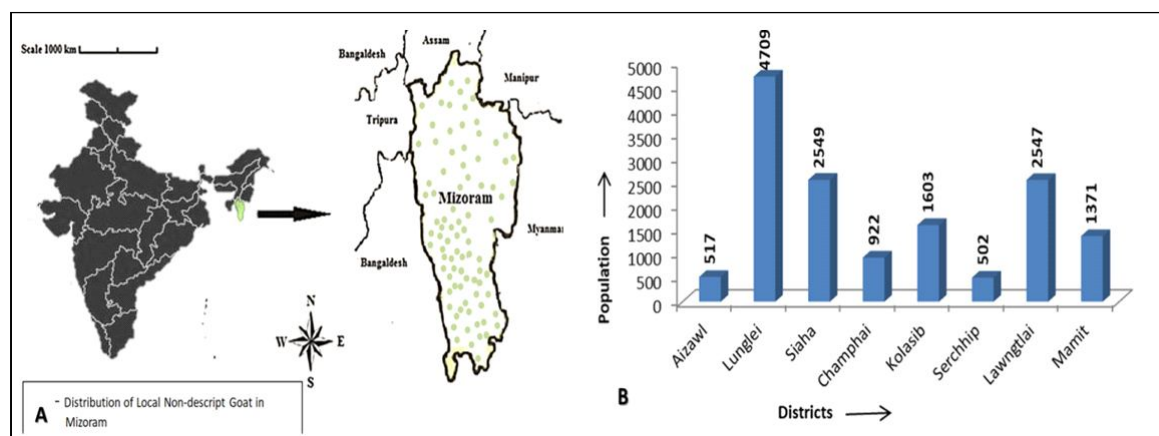


Fig 1: A: Hotspot area of Zokel goat in Mizoram; B: District-wise Local Non-descript goat population of Mizoram (Source: Mizoram Economic Survey 2019-20).

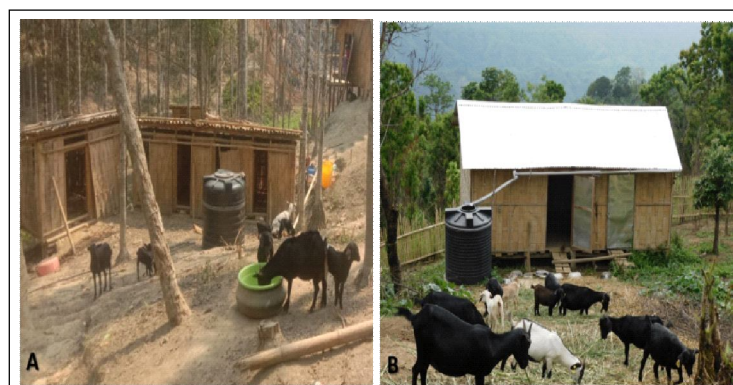


Fig 2: A: Semi-intensive Rearing of Zokel goat; B: Goat shed constructed by GI-sheet and thatched roofs.

Table 1: Comparative evaluation of physical traits of Indigenous goat (Zokel) of Mizoram.

Traits	Zokel		
	Adult male	Adult female	Kids
Size	Short legged with small to medium body size (90-95%)	Short legged with small to medium body size (90-95%)	Small, short
Shape	Well built, stout, hardy, small neck and short in height with cylindrical type of body	Well built, stout, hardy, small neck and short in height with cylindrical type of body	Well-built and in round shape
Body color	White:-40-50%; Black:-20-20%; Brown:- 8-10%; Mixed:-5-7%	White-45-58 %; Black:-27-33 %; Brown- 6-12%, Mixed- 7-11 %	White-46-54 %; Black:- 24-35%; Brown- 4-6%, Mixed- 10-16%
Muzzle	Black:-64-78%; light pink:-11-17%; brownish pink or brown with black spots:-4-10%	Black:-68-83%; light pink:-7-15%; brownish pink or brown with black spots:-3-7%	Mostly black (81-88%) and light pink with brown (10-19%)
Hooves	Black:-76-82%; Brown:- 10-16%; Mixed:- 2-7%	Black:-79-86%; Brown:- 7-13%; Mixed:- 2-5%	Mostly black (85-91%) and brown (7-15%)
Horns	Long horn (18-25 cm) with black and brown (82-91%), grey (6-10%) and mixed color (3-7%), Orientation- Straight and slightly bent at the ends with bent at the ends with upward and backward	Small horn (5-11 cm) with black and brown (90-93%), grey (2-6%) and mixed color (1-5%), Orientation- little curved and slightly upward and backward	NA
Forehead	Long straight with mild depression in mid line (80-87%), whereas just 2-5 per cent were flattened and straight.	Comparatively smaller, straight and mild depression in mid line (92-96%), flattened and straight (2-5%)	Small and straight
Neck	Neck length (13-16 cm) was lower than female goats (15-18cm); however neck breadth was higher (38-44 cm) than female goats (31-35 cm).	Neck length (15-18 cm) was higher than male goats (13-16 cm); however neck breadth (31-35 cm) was lower than male (38-44 cm).	Small size
Ears	Small to moderate size (13-14 cm) and orientation-horizontal or droop in some cases	Small to moderate size (13-14 cm) and orientation-horizontal or droop in some cases	Small size (5-8 cm)
Eyelids	Black: 70-82%; brown with black spots: 20-27%; light pink with brown: 4-10%	Black: 75-89%; brown with black spots: 14-21%; light pink with brown: 2-7%	Mostly black (85-92%) and black with brown (7-15%)
Udder and milk vein	NA	Small to medium bowl (83-89%) and round (10-14%) shaped; teat shapers are funnel (76-88%), cylindrical (10-14%) and conical I (3-6%) and teat	NA

Table 1: Continue...

Table 1: Continue...

		tips with funnel (90-94%) and round and pointed (6-10%). Milk veins are not Prominent	
Tail	White: -42-53%; black:- 25-32%; Greyish brown: - 6-11%.	White: -50-55%; black:- 22-29%; Greyish brown: - 6-14%.	Mostly white:- 50-65%; Black:- 20-30%), mixed: 3-9%

Physical traits

The physical traits of Zokel indigenous goat are given in Table 1. The Zokel indigenous goats exhibit short legs, small to medium body size (90-95%) and short stature with a cylindrical body shape. The Zokel goat demonstrated a diverse range of body colours, comprising white (45-58%), black (27-33%), brown (6-12%) and a mixed color (7-11%). The majority of muzzles were black (68-83%), followed by light pink (7-15%) and then brownish pink or brown with black spots (3-7%). The colour distribution of hooves appeared primarily black (79-86%), followed by brown (7-13%) and a lesser percentage of brown with black grey (2-5%). Generally, female goats have small horns (5-11 cm) with black and brown (90-93%), grey (2-6%) and mixed colour (1-5%) and a little curve and slight bend at the ends with upwards and backwards. Comparatively, the foreheads of goats were narrower, straight and somewhat depressed in the middle (92-96%), whereas just 2-5 percent were flattened and straight. The investigation revealed that female goats had a longer neck (15-18 cm) than male goats (13-16 cm); conversely, the females had a narrower neck breadth (31-35 cm) than the males (38-44 cm). This breed's eyelids were typically black (75-89%), brown with black spots (14-21%) and pale pink with brown (2-7%) and its ears were small to moderate in size (13-14 cm) and oriented horizontal or drooping in a few cases. In general, the udders were small to medium bowl-shaped (83-89%) and round (10-14 %) and the teats were funnel-shaped (76-88 %), cylindrical (10-14%) and conical (3-6%) and the teat tips were funnel-shaped (90-94%) and round pointed (6-10 %), while milk veins were not noticeable. More than half goats had a white tail (50-55%), followed by black (22-29%) and greyish brown (6-14%). The different physical traits of goats are depicted in Fig 3.

Morphometric traits

The means, standard error (S.E.) and number of observations for various morphometric traits of the Zokel goat are provided in Table 2. The body measurements of the Zokel goat were taken manually (Fig 4). The average values for various body traits were observed as follows: for adult does, body length 57.34 ± 0.75 cm, chest girth 72.12 ± 0.32 cm, height at withers 50.80 ± 0.51 cm, horn length 8.89 ± 1.03 cm, ear length 13.97 ± 0.21 cm and tail length 17.78 ± 0.11 cm. For adult bucks, the corresponding measurements were 65.50 ± 0.86 cm for body length,

74.20 ± 0.56 cm for chest girth, 63.50 ± 0.81 cm for height at withers, 25.40 ± 1.25 cm for horn length, 13.97 ± 0.16 cm for ear length and 17.78 ± 0.22 cm for tail length."

Production traits

The average productive traits of the Zokel indigenous goat from different districts of Mizoram are presented in Table 3. According to the survey report, the average daily milk yield, peak yield and lactation length were 210 ± 12.36 ml, 400 ± 21.74 ml and 132.15 ± 3.46 days, respectively. The average lactation yield, milk fat percentage and SNF percentage for this goat breed were 26.89 ± 2.17 lt, $3 \pm 0.15\%$ and $7.9 \pm 0.7\%$, respectively.

Reproductive traits

The reproductive traits of indigenous goats from different regions are presented in Table 3. Age at first mating of said breed occurred at over 225.2 ± 8.04 days, equating to less than nine months after birth, which is a significant determinant of reproductive efficiency. Attaining puberty later would mean economic loss due to long non-productive periods. The age at first kidding of the examined breed was 391.25 ± 9.41 days. Generally, indigenous goats give birth to the first kid at 12-15 months. Similarly, other parameters for the examined breed were recorded as follows: weaning age 85.75 ± 0.85 days, weight at first kidding 17.93 ± 0.68 kg, kidding interval 232.5 ± 8.09 days, service period 86.61 ± 6.93 days and gestation period 146 ± 1.87 days.

Goat rearing provides a potential source of employment and significantly augments farmers' income (Soodan *et al.*, 2020). It is vital to demonstrate phenotypic characteristics to recognize and characterize a breed. The first step in describing a breed is to find out how different its physical traits are. The tribal community of Mizoram mostly rears the indigenous goat. The phenotypic appearance of the indigenous goat of Mizoram resembles the north eastern goat breeds and is popularly known as "Zokel". Any breed's morphological traits are essential to identifying its characteristics (Yakubu and Ibrahim, 2011). Zokel goats are predominantly white, while an admixture of black and brown is common. Sarma *et al.* (2020) reported that the predominant coat color in Assam Hill goats is white. Das *et al.* (2021) also demonstrated that the most common coat colors of Assam Hill goats are white and white with a black backline. Pan *et al.* (2015) and Tudou *et al.* (2016)

Table 2: Body measurements (cm) of Indigenous goat (Zokel) of Mizoram.

Sex	Sex/Traits	Particulars	0-3months	3-6 months	6-9 months	Above 9 months
Male		Body weight	6.74±1.93	10.31±1.75	14.13±1.34	27.25±1.09
		Body length	37.12±1.35	41.46±1.38	49.66±1.15	65.50±0.86
		Chest-girth	41.79±1.84	46.12±1.57	58.47±1.33	74.20±0.56
		Height at withers	39.16±0.83	42.24±1.53	47.68±0.91	63.50±0.81
		Horn length	4.21±0.08	6.14±0.15	8.93±1.24	25.40±1.25
		Ear length	8.14±0.34	9.16±0.07	11.89±0.17	13.97±0.16
		Tail length	7.22±0.58	8.35±0.72	9.52±0.73	17.78±0.22
Female		Body weight	5.33±1.82	9.12±1.42	13.75±1.91	21.81±1.25
		Body length	34.60±1.22	39.63±1.52	45.23±1.02	57.34±0.75
		Chest-girth	38.36±1.52	42.71±1.63	50.50±1.07	72.12±0.32
		Height at withers	36.25±0.93	39.39±1.81	43.81±0.80	50.80±0.51
		Horn length	3.86±0.98	2.91±0.35	7.49±1.01	8.89±1.03
		Ear length	9.07±0.28	10.31±0.21	11.13±0.35	13.97±0.21
		Tail length	6.10±0.47	6.93±0.47	8.10±0.59	17.78±0.11

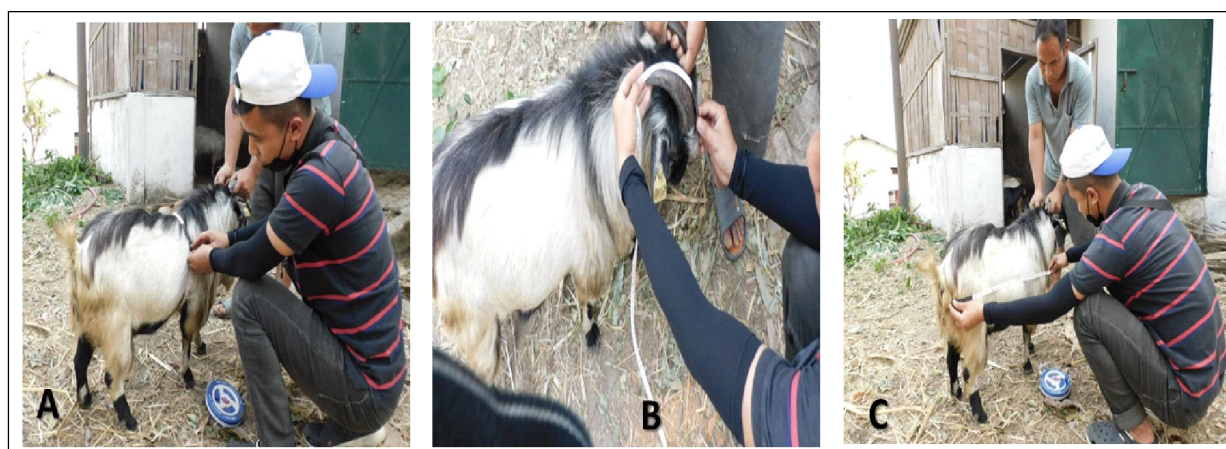
**Fig 3:** Zokel Indigenous goat. A: Buck; B: Doe; C-E: Different physical traits of goats.**Fig 4:** Measurement of morphometric traits in Zokel Indigenous goat. A: Chest girth; B: Horn length; C: Body length.

Table 3: Productive and reproductive traits of Indigenous goat (Zokel) of Mizoram.

Parameters	Zokel LSM $\pm$ SE
Productive traits	
Average daily milk yield (ml)	210 $\pm$ 12.36
Peak yield (ml)	400 $\pm$ 21.74
Lactation length(days)	132.1 $\pm$ 3.46
Mean lactation yield per goat (lt)	26.8 $\pm$ 2.17
Fat (%)	3.1 $\pm$ 0.15
SNF (%)	7.9 $\pm$ 0.7
Reproductive traits	
Age at first mating (days)	225.2 $\pm$ 8.04
Weight at first mating (kg)	13.75 $\pm$ 1.91
Age at first kidding (days)	391.2 $\pm$ 9.41
Weaning age (days)	85.7 $\pm$ 0.85
Weight at first kidding (kg)	17.93 $\pm$ 0.68
Kidding interval (days)	232.5 $\pm$ 8.09
Service period (days)	86.6 $\pm$ 6.93
Gestation period (days)	146 $\pm$ 1.87

reported a three-color variety of Black Bengal goats, characterized by black, brown and white, or a mixed combination of any two of these pure colors. However, other coat colors such as black, brown and grey are also observed within the population. Likewise, Verma *et al.* (2017) found that Sumi-Ne goats are predominantly black on the head and neck, with the remaining parts being white. In addition, Ganjam goats exhibited a variety of coat colors, including black, brown, blackish-brown and brownish-black, occasionally with white spots and had medium-sized, drooping ears (Majumder *et al.*, 2023). Moreover, Bhuaria *et al.* (2014) reported that the body coat colors of Anjora goats were predominantly brown (58.45%), followed by black (19.69%), white (17.19%) and multicolored (4.69%). In the present study, the majority of goats (92-96%) exhibited foreheads that were narrower, straight and slightly depressed in the middle, whereas only 2-5% had foreheads that were flattened and straight. These findings align with the observations reported by Verma *et al.* (2017). The ear type in Zokel goats was observed to range from small to moderate in size, with the orientation being either horizontal or drooping downward in some goats. Similar observations were also reported in Black Bengal and Sumi-Ne goats (Tudu *et al.*, 2016; Verma *et al.*, 2019). The horns were small, ranging in size from 5 to 11 cm, predominantly black and brown (90-93%), with a smaller proportion being grey (2-6%) or mixed in color (1-5%). They exhibited a slight curve and a gentle bend towards the tips, extending upwards and backwards. Likewise, Black Bengal, Sumi-Ne and Assam Hill goats have small-sized horns that are slightly curved upwards (Kumari *et al.*, 2015; Verma *et al.*, 2017; Kashyap *et al.*, 2020).

Generally, Zokel goat exhibits short legs and small to medium body size. Male goats exhibit greater body weights than female goats, consistent with the physical traits observed in other goat breeds throughout the NEH region. Our findings align closely with the Sumi-Ne goats (Verma *et al.*, 2017). However, Zokel goats have relatively higher body weights than Assam Hill and Black Bengal goats. The body measurement traits of these goats were found to be comparatively higher than those of Assam Hill and Black Bengal goats (Khargharia *et al.*, 2015; Kumari *et al.*, 2015). However, these measurements were slightly lower than the Sumi-Ne goats (Verma *et al.*, 2017). The reproductive data indicates that the Zokel goat has an age at first kidding *i.e.*, 391.2 $\pm$ 9.41 days. This finding aligns closely with Verma *et al.* (2017), who reported a similar age at first kidding of 390 $\pm$ 3.67 days in Sumi-Ne goats. However, in contrast to these results, Kumari *et al.* (2015) observed an earlier age at first kidding in Black Bengal goats *i.e.*, 12.07 $\pm$ 0.59 months (~362.1 days). On the other hand, Das *et al.* (2021) reported a higher age at first kidding of 405.07 $\pm$ 0.07 days in Assam Hill goats. This difference could be attributed to breed-specific genetics, as well as variations in environmental adaptability, management practices and feed availability in their respective habitats. Such insights can be valuable for improving breeding programs and optimizing reproductive efficiency. Since routine deworming was conducted periodically, the Zokel goat is generally resistant to many common diseases, except parasite infestations, diarrhoea, fungal infections, *etc.*

Indigenous breeds provide significant contributions to the economic well-being of rural farmers. However, it is concerning that around 30% of farm animal breeds, including goats, are now under the threat of extinction (FAO, 1999). The population of indigenous breeds is currently facing a decline and is at risk due to inadequate breeding practices and crossbreeding (Mandal *et al.*, 2014). Mizo goat farmers usually sell adult goats irrespective of their sex. Because of this, there aren't enough elite breeding bucks to improve the breeding tract. Moreover, the lack of grazing land, scarcity of feeds and fodder and inadequate health facilities are significant constraints limiting goat production in Mizoram. Similarly, Kumar *et al.* (2007) also highlighted that feed and fodder shortages are major challenges in the North-East Region of India. The present research identified another limitation: the shortage of high-quality bucks, which has led to inbreeding depression within the flock/herd, as farmers are more likely to sell elite bucks. Given that the mean biometric indices of Zokel goats indicate the potential for improvement through selective breeding, including high-quality breeding bucks, it is essential to promote genetic advancement within the flock. Therefore, preserving this native breed is crucial for biodiversity conservation due to its unique genetic traits.

CONCLUSION

The Zokel goat of Mizoram exhibits variations in physical and morphometric traits and has a deep, long-standing connection with the traditional culture and society. The management of local indigenous goats across the Northeast region follows similar practices, primarily semi-extensive and extensive systems. It was observed that a genetic improvement program is essential to enhance the productivity of these indigenous goats. Documenting genetic information is particularly important for the Zokel goat of Mizoram, as it will aid in conservation efforts and improve the prosperity of tribal farmers. Therefore, initiating a selection and conservation program for the indigenous goats of the state is crucial to upgrading their genetic potential. Additionally, exploring organic goat farming could significantly improve the livelihoods and nutritional security of tribal farmers.

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Conflict of interest

All authors declared that there is no conflict of interest.

REFERENCES

- Bhuariya, S., Mukherjee, K., Singh, M. and Parveen, K. (2014). Characterization of local goats of Chhattisgarh plains. *Indian Journal of Animal Sciences*. 84(10): 1080-1084.
- Das, B., Sarmah, R. and Sarma, J. (2021). Production system of Assam hill goats and their performance under field condition. *International Journal of Livestock Research*. 11(11): 33-37.
- FAO. (1999). Production Year-book. Food and Agricultural Organisation, Rome, Italy
- Gawat, M., Bolland, M., Singh, J. and Kaur, L. (2023). Goat Meat: Production and Quality Attributes. *Food*. 12(16): 3130.
- Kashyap, K., Jain, A., Kashyap, S., Verma, U., Yadav, A., Dubey, A. and Sori, S. (2020). Genetic resources on goat in India: A review. *International Journal of Fauna and Biological Studies* 7(2): 27-33.
- Khargharia, G., Kadirvel, G., Kumar, S., Doley, S., Bharti, P.K. and Das, M. (2015). Principal component analysis of morphological traits of Assam Hill goat in Eastern Himalayan India. *The Journal of Animal and Plant Sciences*. 25(5): 1251-1258
- Kosgey, I.S., VanArendonk, J.A.M. and Baker, R.L. (2004). Economic values for traits in breeding objectives for sheep in the tropics: Impact of tangible and intangible benefits. *Livestock Production Science*. 88: 143-160.
- Kumar, A., Staal, S., Elumalai, K. and Singh, D.K. (2007). Livestock Sector in North-Eastern Region of India: An Appraisal of Performance. *Agricultural Economics Research Review*. 20: 255-272.
- Kumari, N., Mandal, B., Oraon, T. and Thakur, S.K. (2015). Breed characterization for identification and conservation of Black Bengal Goats of Jharkhand. *Indian Journal of Science and Technology*. 8(28). doi: 10.17485/ijst/2015/v8i28/56529.
- Livestock census. (2012). Department of Animal Husbandary and Fisheries, Ministry of Agriculture, Government of India, New Delhi.
- Livestock census. (2019). Department of Animal Husbandary and Fisheries, Ministry of Agriculture, Government of India, New Delhi.
- Mahajan, S., Papang, J.S. and Datta, K.K. (2015). Meat consumption in North-East India: Pattern, Opportunities and Implications. *Journal of Animal Research*. 5(1): 37-45.
- Majumder, S., Dash, S.K., Samal, L., Mishra, C. and Karna, D.K. (2023). Characterization, production and reproduction performance of Southern Odisha Goats. *Indian Journal of Animal Research*. 57(11): 1432-1437. doi: 10.18805/IJAR.B-5178.
- Mandal, A., Karunakaran, M., Rout, P.K. and Roy R. (2014). Conservation of threatened goat breeds in India. *Animal Genetic Resources*. 55: 47-55.
- Pan, S., Biswasb, C.K., Majumdar, D., Senguptaa, D., Patrab, A., Ghosh S. and Halda, A. (2015). Influence of age, body weight, parity and morphometric traits on litter size in prolific Black Bengal goats. *Journal of Applied Animal Research*. 43(1): 104-111.
- Pathak, P., Nayak, V.K., Sinha, R. and Ganaie, B.A. (2020). Review on small ruminant conservation status and prospects in India. *Tropical Animal Health and Production*. 52: 2817-2827.
- Sarma, L., Nahardeka, N., Aziz, A., Goswami, R.N., Zaman, G., Das, A. and Akhta, F. (2020). Genetic and non-genetic factors affecting post-weaning growth and morphometric traits in assam hill goat. *Indian Journal of Animal Research*. 54(6): 761-767. doi: 10.18805/ijar.B-3806.
- Soodan, J.S., Kumar, S. and Singh, A. (2020). Effect of Goat Rearing on Farmers' Income. *International Journal of Livestock Research*. 10(8): 89-97
- Tudu, N.K., Pyne, S.K. and Ghosh, N. (2016). Characterization of three colour varieties of Bengal goats. *International Journal of Science, Environment and Technology*. 5: 3332-3338.
- Verma, N.K., Aggarwal, R.A.K., Savino, N., Shivhare, P.R. and Sharma, A. (2017). Goat Germplasm of Nagaland State. A monograph. ICAR-National Bureau of Animal Genetic Resources, Karnal, Haryana, India. pp 1-28.
- Verma, N.K., Aggarwal, R.A.K., Shivahre, P.R., Sharma, R. and Savino, N. (2019). Evaluation of genetic diversity in long hair Nagaland goat Sumi-Ne. *Indian Journal of Animal Sciences*. 89 (1): 105-109.
- Yakubu, A. and Ibrahim, I.A. (2011). Multivariate analysis of morphostructural characteristics in Nigerian indigenous sheep. *Italian Journal of Animal Science*. 10: 2. <https://doi.org/10.4081/ijas.2011.e17>.