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Comparative Phenotypic Traits and Performances of Native Sheep in Naikhongchhari Hilly Area of Bangladesh

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ABSTRACT

Background: Many studies have been conducted to investigate the performance of native sheep in plains and coastal regions, but no studies have been conducted in hilly regions of Bangladesh. Considering this fact, Coastal, Barind and Jamuna River Basin sheep were evaluated for their phenotypic traits, productive and reproductive abilities to gain insights into their performance in the hilly region.

Methods: The Coastal, Barind and Jamuna River Basin sheep were collected from Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka for the first time to Regional Station, Naikhongchhari, BLRI and separated based on their phenotypic characteristics. A breeding program was established to ensure purity, using independent culling levels and selection indexes. Ewes were allowed to lamb throughout the year, mated with rams in a 15-20 to 1 ratio. The sheep were kept in a semi-intensive system.

Result: The highest lamb birth weight was observed in coastal Region sheep, both male (1.43 kg) and female (1.22 kg), followed by Barind males (1.36 kg) and females (1.15 kg), respectively. The highest average daily gain was found in coastal region sheep (41.87 g/d), which was significantly higher compared to others. The lowest age at first heat, gestation length, age at first lambing, post-partum heat period, days open, lambing interval was observed in Barind sheep. Finally, the study offers valuable insights into the potentialities of native sheep in hilly regions, guiding future research and extension efforts for sheep farming in these areas.

Key words: Hilly area, Native sheep, Phenotypic, Productive performance, Reproductive.

INTRODUCTION

Small ruminant farming contributes significantly to the national economy of Bangladesh by generating income and creating job opportunities (Rakib *et al.,* 2022). Small ruminants like sheep and goats have excellent potential to adapt to challenging agro-climatic conditions, thrive with limited resources and require less space for rearing than larger livestock. This makes them suitable for many rural households nationwide (Shivakumara *et al.,* 2020; Sarder *et al*., 2015). Sheep are one of the most important livestock species in Bangladesh, having a population of 3.827 million and being considered the third largest livestock species (DLS, 2023). The sheep are raised solely for meat production in Bangladesh (Rahman *et al.,* 2023). According to Rakib *et al.* (2022) the sheep farming, like that of other large and small ruminants, is expanding in Bangladesh.

Most of the sheep in Bangladesh are nondescriptive indigenous type, with a few crossbreds (Asaduzzaman *et al.,* 2020 and Bhuiyan, 2006). The indigenous sheep are categorized into three distinct types *i.e.* Coastal, Jamuna River Basin and Barind according to concentration, morphology, production and reproduction performance (Rakib *et al.,* 2022). The Coastal sheep are distributed in Coastal regions *i.e.* Noakhali, Charlands and other Coastal plain areas), the Jamuna River Basin sheep are found in Jamuna River Basin areas *i.e.* Tangail, Sirajganj, Gaibandha, Sherpur, Jamalpur, Mymensingh and Dhaka specially, both sides of Jamuna River in Bangladesh and the Barind sheep are mainly found in Barind tracts *i.e.* Naogaon, Rajshahi, Chapai Nawabganj (Hashem *et al.,* 2020; Deb *et al.,* 2019 and Hassan *et al.,* 2011).

The Chittagong Hill Tracts have a different topography and climate than plain land. Due to its proximity to the Bay of Bengal, the area is known for its high hills, deep valleys and heavy rainfall. The natural topography of the land provides ample grazing opportunities for the sheep. Many studies have been conducted to investigate the performance of native sheep in plain land and Coastal regions, but no

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studies have been conducted in hilly regions. Therefore, the present study was undertaken to investigate the comparison of phenotypic traits and performances of native sheep (Jamuna River Basin, Coastal and Barind) in Naikhongchhari hilly area of Bangladesh.

MATERIALS AND METHODS

The study was carried out between 2019 to 2022 at the Regional Station Research Farm, Naikhongchhari, Bandarban, BLRI. The regional station is situated at 21°24′34.1″N, 92°11′10.9″E in the southeastern hilly regions of Bangladesh, approximately 22.08 meters above sea level. A few numbers of Coastal, Barind and Jamuna River Basin sheep both ram and ewe were collected from Bangladesh Livestock Research Institute (BLRI) head office, Savar, Dhaka for the first time to Regional Station, Naikhongchhari, Bandarban BLRI in 2012. After that, they were separated into the Jamuna River Basin, Coastal and Barind regions based on their phenotypic traits. The breeding program was set up to ensure the purity of native sheep from a specific region. To avoid inbreeding depression, mating between full-sibs and half-sibs was not practiced. Following a natural controlled breeding program, ewes were allowed to lamb throughout the year. The ewes were mated with rams in a 15-20 to 1 ratio. The birth weight of lambs and weight of ewes at lambing, lambing date, sex and parity were recorded. The lambs were tagged after birth and mostly kept under a semi-intensive system. Rams were always kept apart from ewe to avoid unintentional mating. The sheep were given 6-7 hours of grazing time and concentrate (17% CP, 11 MJ ME /kg DM) was provided twice daily (morning and evening), at a rate of 250 g per head (100 kg of concentrate mixture contained 30 kg crushed maize, 50 kg wheat bran and 19 kg mustard oil cake, the diet was fortified with vitamin mineral premix at a rate of 0.1 kg per 100 kg and 1 kg salt was used, mixed up uniformly). The Sheep were immunized against Pestis des Petites Ruminants (PPR) disease. Regular deworming was performed to avoid internal parasites and to control ticks, mites and other ectoparasites dipping was performed 30-day intervals.

The data were collected from 318 native sheep of Coastal (90), Barind (108) and Jamuna River Basin (120). The data on phenotypic characteristics, *i.e.*, body length, heart girth, wither height, head length, ear length, tail length, testis length and udder length, were taken and recorded. The productive parameters of birth weight of lamb, weaning weight (3 months), 6-month body weight, mature body weight and average daily gain were also considered in this study. The reproductive traits such as age at first heat, gestation length, age at first lambing, post-partum heat, litter size, days open (DO: Number of days between lambing and conception), lambing interval, number of services per conception (NSPC) and lamb mortality were additionally recorded.

The data were analyzed using the SPSS computer software program version 22. The means were compared by Duncan′s Multiple Range Test (Steel *et al.*, 1980).

RESULTS AND DISCUSSION

Phenotypic characteristics

The phenotypic parameters of native sheep are shown in Table 1. There was a significant difference among the Coastal, Barind and Jamuna River Basin sheep in terms of phenotypic traits except testis length and udder length. The body length (BL) of Coastal sheep was higher compared to Barind and Jamuna River Basin that was more or less similar with the findings of Hassan *et al.* (2011). While considering the heart girth (HG), the higher value was observed in coastal sheep followed by barind and jamuna river basin this was similar to Hassan *et al.* (2011). Islam *et al.* (2018) also reported the sheep from the Mangrove Forest region had the smallest HG, while the sheep from the Coastal areas had the largest. The wither height (WH) of Coastal sheep was higher than barind and jamuna river basin sheep, the findings were similar to the results of Islam *et al.* (2018); Hassan *et al.* (2011) and Pervage *et al.* (2009) who also reported that the WH varied significantly between different native sheep of Bangladesh. The length of the head was found shorter in the Coastal than in the Barind and Jamuna River Basin. The average head length (HL) was 16.15 and 15.04 cm in rams and ewes, respectively, while the rams of the north-eastern Barind tract had the highest value (19.04 cm) (Islam *et al.*, 2018). Nonetheless, in the case of ears, barind has much shorter ears than the jamuna river basin and

Table 1: Phenotypic parameters of native sheep.

Parameters	Coastal (n=30)	Barind (n=36)	Jamuna river basin (n=40)	P-value	Level of sign.
Body length (cm)	52.48^{a}±0.74	51.28^{ab}±0.78	49.65^{b}±0.69	.029	*
Heart girth (cm)	63.05^{a}±0.54	61.10^{b}±0.46	59.62^{c}±0.49	.000	**
Wither height (cm)	54.12^{a}±0.61	52.05^{b}±0.62	51.11^{b}±0.52	.002	**
Head length (cm)	16.90^{b}±0.22	18.70^{a}±0.23	18.14^{a}±0.20	.000	**
Ear length (cm)	8.50^{a}±0.14	6.40^{b}±0.14	8.24^{a}±0.18	.000	**
Tail length (cm)	12.31^{a}±0.16	11.54^{b}±0.22	12.01^{ab}±0.19	.025	*
Testis length (cm)	10.77±0.17	11.12±0.18	10.64±0.17	.131	NS
Udder length (cm)	6.93±0.12	6.81±0.10	6.78±0.09	.565	NS

^{a,b,c} Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; and value indicate- Mean± Standard Error (SE).

Coastal. This result matched the study of Islam *et al.* (2018); Hassan *et al.* (2011) and Pervage *et al.* (2009). There was a significant difference in the parameters of tail length of Coastal, Jamuna River Basin and Barind sheep. The higher tail length was observed in Coastal sheep compared to others. The result matches with Hassan *et al.* (2011) for indigenous sheep of Bangladesh. The results of the tail length of the Barind sheep were similar to those of the Hassan Sheep evaluated by GS *et al.* (2021). Islam *et al.* (2018) reported that the native sheep of Bangladesh are short and thin-tailed, with tail lengths ranging from 8.17 to 13.58 cm. Ibrahim *et al.* (2023) stated that body measurements are utilized as indicators of breed, origin, relationship and individual body conformation, as they provide insight into shape and size. However, the difference in phenotypic characteristics may be due to genetics, nutrition and feeding, management and environmental factors.

Productive performance

The productive performance of Coastal, Barind and Jamuna River Basin sheep is presented in Table 2.

Lamb birth weight

The lamb birth weight was significantly higher in Coastal sheep both male and female and the lowest birth weight of lamb was found in the Jamuna River Basin. This finding is consistent with the findings of Rakib *et al.* (2022) and Hassan and Talukder (2011). However, lamb birth weight may differ depending upon the season, litter size (LS), lamb sex, dam nutritional status, management and geographical location (Rakib *et al.,* 2022; Sun *et al.,* 2020; Sultana *et al.,* 2011 and Hassan *et al.*, 2011).

Weaning weight

The highest weaning weight was observed in Coastal sheep both male and female followed by Barind and Jamuna River Basin sheep, the findings agreed with Islam *et al.* (2018) who reported that the overall mean weaning weight of native sheep was 5.40 kg. However, the weaning weights of the current study were comparatively lower than the findings of Pervage *et al.* (2009). The variation in weaning weight of native sheep can be attributed to alterations in management practices and environmental factors, including ambient temperature, humidity and rainfall (Mousa *et al.,* 2013; Thiruvenkadan *et al.,* 2009).

6-month body weight and daily gain

While considering 6-month body weight, the Coastal sheep both male and female were heavier than the Barind and Jamuna River Basin sheep. Islam *et al.* (2018) found 10.52, 8.52 and 8.33 kg of weaning weight for the Coastal, Jamuna River Basin and Barind sheep respectively, which were higher compared to the present study. The average daily gain of Coastal male sheep was significantly higher than the Jamuna River Basin and Barind and the result is in line with the study of Ahmed *et al.* (2018). While, the average daily weight gain of Jamuna River Basin, Barind and Coastal was 50.19, 49.18 and 51.21 g/d respectively (Pervage *et al.,* 2009). Hossain *et al.* (2021) reported that the ADG of Jamuna basin lamb was 57.39, 59.80 and 58.15 g/d in 6, 9 and 12 months of age. The season of birth is an environmental factor that influences the weight and growth rate of lambs (Al-Dahl *et al.,* 2022).

The mature live weight of Coastal, Barind and Jamuna River Basin sheep, both Ram and Ewe, is shown in Fig 1. The highest mature live weight was observed in both the Coastal regions Ram (24.73 kg) and Ewe (17.8 kg), followed by the Barind and Jamuna River Basins Ram and Ewe. The results of the present study matched with Pervage *et al.* (2009) who found the highest mature Ram weight (23.64 kg) in Coastal sheep followed by Barind Ram (19.10 kg) and Jamuna River Basin (18.04 kg). The mature body weight of a native sheep can differ for location, sheep type, sex; season, nutrition status, feed quality, management system and heat stress (Rakib *et al.,* 2022).

Reproductive performance

The reproductive performance of Coastal, Barind and Jamuna River Basin is presented in Table 3.

Age at first heat (AFH) and gestation length (GL)

The highest AFH was found in Coastal sheep and the lowest was in Barind. Rakib *et al.* (2022) demonstrated that Barind sheep exhibit earlier sexual maturity compared

Table 2: Productive performance of native sheep.

Parameters	Sex	Coastal (n=15)	Barind (n=15)	Jamuna river basin (n=15)	P-value	Level of Sign.
Lamb birth weight (kg)	M	1.43^{a}±0.02	1.36^{b}±0.02	1.30^{c}±0.01	.000	**
	F	1.22^{a}±0.01	1.15^{b}±0.01	1.09^{c}±0.01	.000	**
Weaning weight (kg)	M	5.46^{a}±0.02	5.27^{b}±0.04	5.25^{b}±0.02	.000	**
	F	4.82^{a}±0.04	4.65^{b}±0.01	4.59^{b}±0.02	.000	**
6-month body weight (kg)	M	8.97^{a}±0.04	8.79^{b}±0.03	8.71^{b}±0.03	.000	**
	F	8.14^{a}±0.04	7.94^{b}±0.04	7.87^{b}±0.04	.000	**
Average daily gain (g/d)	M	41.87^{a}±0.23	41.25^{b}±0.19	41.14^{b}±0.15	.022	*
	F	38.44±0.22	37.72±0.25	37.66±0.22	.050	NS

^{a,b,c} Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; value indicate- Mean± Standard Error (SE); M= Male and F= Female.

to Jamuna River Basin and Coastal sheep, which aligns with the findings of the current study. In terms of Gestation length (GL), in the Coastal, Barind and Jamuna River Basin was 150.20, 148.04 and 151.15 d respectively. These values corresponded with the findings of Pervage *et al.* (2009).

Age at first lambing (AFL) and post-partum heat period (PPHP)

The lowest AFL was found in Barind sheep (418.16 d) followed by Jamuna River Basin (433.16 d) and Coastal (441.95 d) respectively. However, the findings of Pervage *et al.* (2009) showed that the AFL of Jamuna, Barind and Coastal was 491.92, 488.09 and 499.92 d respectively higher than present study because the study was performed in the farmer level where proper nutrition and management were not considered. However, Hassan and Talukder (2011), found that AFL was 409.8, 389.9 and 439.5 d for Jamuna, Barind and Coastal sheep respectively was lower than present findings due to the experiment was conducted on BLRI research farm where proper nutrition and management were ensured. The present study was also performed in the research farm with proper nutrition and management, the variation may be the environmental factors of the hilly area. For the post-partum heat period (PPHP), the highest PPHP was 43.70 d found in Coastal followed by 41.15 and 40.16 d in Jamuna River Basin and Barind respectively and the result matched with the study of Pervage *et al.* (2009).

Litter size (LS) and days open (DO)

There was no significant difference in litter size between the native sheep, but a significant difference was observed in the trait of days open. The days open was observed in Coastal sheep was 51.85 d followed by Jamuna River Basin (44.19 d) and Barind (40.76 d) respectively. Whereas, Hassan and Talukder (2011) found days open 33.6 d, 36.6 d and 58.0 d in Jamuna River Basin, Barind and Coastal sheep respectively. The highest days open was observed in Coastal sheep in both cases. But lowest days open was found in Barind sheep than Jamuna River Basin in hilly area, may be due to the environmental factor and plane of nutrition.

Lambing interval (LI)

There was a significant difference observed in lambing interval between the native sheep. The highest LI was observed in Coastal and the lowest was in Barind sheep. Pervage *et al.* (2009) reported the LI in Jamuna, Barind and Coastal sheep was 221.13 d, 228.57 d and 214.32 d,

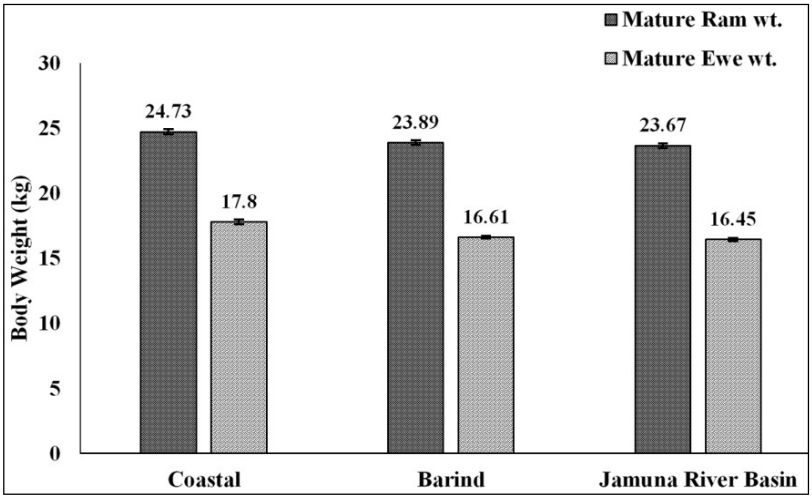

Fig 1: Mature live weight of native sheep.

Table 3: Reproductive performance of native sheep.

Parameters	Coastal (n=20)	Barind (n=25)	Jamuna river basin (n=27)	P-value	Level of sign
Age at first heat (d)	291.75^{a}±2.64	270.12^{c}±1.87	282.11^{b}±1.85	.000	**
Gestation Length (d)	150.20^{a}±0.47	148.04^{b}±0.33	151.15^{a}±0.34	.000	**
Age at first lambing (d)	441.95^{a}±2.51	418.16^{c}±2.01	433.26^{b}±1.78	.000	**
Post partum heat period (d)	43.70^{a}±0.89	40.16^{b}±0.60	41.15^{b}±0.63	.003	**
Litter size	1.65±0.15	1.52±0.13	1.89±0.12	.126	NS
Days open (d)	51.85^{a}±0.73	40.76^{c}±0.71	44.19^{b}±0.68	.000	**
Lambing interval (d)	208.90^{a}±0.82	200.20^{c}±0.71	204.30^{b}±0.65	.000	**
No. of service per conception	1.40±0.11	1.40±0.10	1.37±0.09	.971	NS

^{a,b,c} Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; and value indicate- Mean± Standard Error (SE).

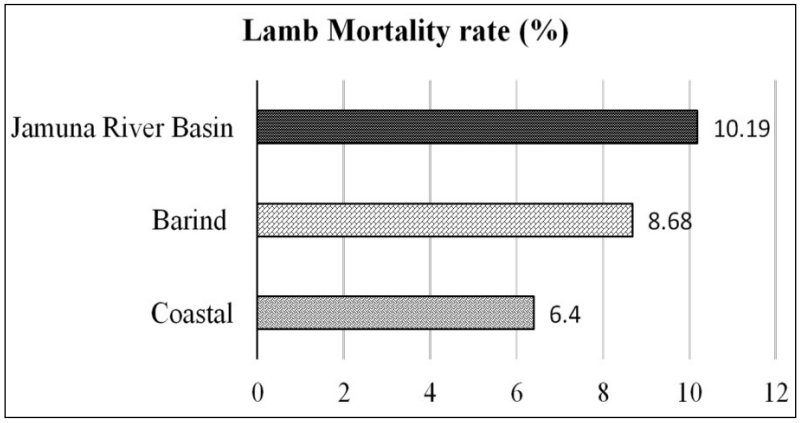

Fig 2: Lamb mortality rate (%).

respectively. This finding suggests that achieving three lambings within a two-year timeframe is feasible (Hassan and Talukder, 2011).

No. of service per conception (NSPC)

There was no significant difference observed in the trait of NSPC of native sheep. The findings of Pervage *et al.* (2009) were consistent with the present study, as the NSPC of Jamuna, Barind and Coastal areas were 1.47, 1.52 and 1.44, respectively. However, in a study conducted by Hassan and Talukder (2011), the NSPC values reported for Jamuna, Barind and Coastal sheep were 1.3, 1.3 and 1.4, respectively. The NSPC may be influenced by various factors, including age, lambing interval, breed and production system (Rakib *et al.,* 2022).

Ahamad *et al.* (2022) found that the reproductive performance of sheep differs across farms, breeds, production systems and geographic areas.

Lamb mortality rate

The lamb mortality rate of native sheep is presented in Fig 2. The highest lamb mortality was observed in Jamuna River Basin sheep followed by Barind sheep and Coastal Sheep. This may be related to the less adaptability, poor mothering ability of ewe, weakness of lamb and most commonly less susceptibility diarrhea and pneumonia of Jamuna River Basin lamb. The mortality rate of lambs in Native sheep was found to be an average of 12.4%. In the months of July to October, the mortality rate was recorded to be 7.0%. In the period of November to February, the mortality rate increased to 17.6%. Lastly, in the months of March to May, the mortality rate was observed to be 12.5% (Hassan and Talukder 2011). This may be because in Bangladesh, the month of November to February is considered as winter season, when the incidence of pneumonia increases in lamb resulting increase mortality rate of lamb. The lamb mortality rate is exacerbated by a variety of factors, including age, sex and season (Rakib *et al.,* 2022).

CONCLUSION

The current research reveals that native sheep of Bangladesh exhibit significant variations in their physical characteristics, productivity and reproductive abilities when raised in hilly areas. The Coastal sheep had better production performance in terms of lamb birth weight, weaning weight, 6-month body weight, mature weight and growth rate compared to Barind and Jamuna River Basin. However, better reproductive performance was observed in Barind sheep. Finally, this study provided a few basic information and valuable insights regarding native sheep in hilly areas that could be utilized in future research.

Conflict of interest

The authors declare that there is no conflict of interest.

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