

Growth Performance of Native Sheep under Semi-Intensive Production System in Bangladesh

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Abstract

The aim of this study was to investigate the growth performance of Bangladeshi native sheep under a semi-intensive production system. Data were collected from 382 native sheep of Coastal (205), Jamuna River Basin (67), and Barind (110), respectively. The concentrate mixture (17% CP, 11 MJ ME/kg DM) was given twice daily at rates of 200, 250, and 100 g, respectively per head per day for rams, ewes, and lambs, respectively. Lamb's live weights were taken at 15 days intervals up to three months and then measured at 6 months of age using a digital scale in the early morning before feeding and watering. The mean birth weight of native sheep was 1.46 ± 0.01 kg, where the highest was found in Coastal (1.53 ± 0.12 kg) followed by Jamuna River Basin (1.44 ± 0.02) and Barind (1.35 ± 0.02). A significant ($p < 0.05$) effect of litter size was noticed on birth weight and the highest was found in Coastal (1.76 ± 0.06 kg) followed by Jamuna River Basin (1.55 ± 0.04 kg) and Barind (1.41 ± 0.03 kg) in case of single lambing. But in contrast, the lowest litter size (1.21 ± 0.15) was found in Coastal than Barind (1.58 ± 0.29) and Jamuna River Basin (1.55 ± 0.25). The highest body weight of Coastal males (7.2 ± 0.28 kg) and females (6.6 ± 0.24 kg) was recorded among the three groups at three months of age. Moreover, the body weight of Coastal (11.78 ± 0.15 kg) was found highest followed by Jamuna River Basin (11.06 ± 0.52 kg) and Barind (9.94 ± 0.16 kg) at six months of age ignoring the effect of sex. A significant ($p < 0.001$) effect of sex was observed on birth, body weight, and average daily gain where male lambs were always heavier than female lambs. However, the season had a significant ($p < 0.05$) effect on the birth weight and average daily gain at three months of age. Therefore, based on the growth performance, it can be concluded that Coastal sheep might be profitable for sheep farming in Bangladesh and also can contribute to meet up the shortage of meat. Moreover, drawing a precise conclusion in this regard requires further study with a large sample size including nutritional and other managerial aspects.

Keywords: Growth Performance, Native Sheep, Season

Introduction

The annual growth rate of the population in Bangladesh is about 0.95% while the livestock density per acre of cultivable land is about 7.37 (Banglapedia, 2021). From 1999 to 2019, humans converted a total of 6097.14 hectares of agricultural land into settlements (Ahmed et al., 2022). Per capita cultivated land is only 12.5 decimal and every year about one percent of farmland is converted to non-agricultural uses (Halim et al., 2013). Therefore, it can be concise that every year cultivated land is decreasing and the population growth rate is increasing. In this context, like goat, sheep rearing may be an important source of income for the farmers involving minimum investment, care, and management. Furthermore, sheep are considered as docile animals having the capability of biannual lambing and more than one lamb per lambing (Bhuiyan, 2006). Sheep are found in different regions of Bangladesh, the mostly indigenous non-descript type that does not belong to any specific breed. But they possess some remarkable phenotypic variation (Sadek et al., 2018). During the last decades, the sheep population increased 2.1 times, with an annual growth rate is 3.5% (DLS, 2020) of which 32% are reared in three ecological zones namely Barind, Jamuna River Basin, and Coastal areas (BBS, 2008). Sheep rearing is directly involved with poverty alleviation, employment generation, and good quality nutrient supply. In Bangladesh, sheep stand third in number after cattle and goats' population and are used primarily for meat production purposes. Moreover, mutton is softer and contains omega-3 and 6 fatty acids, all age groups of people can consume it, and there is no prejudice against eating it. On the other hand, the availability of meat is 106 g per day per head and the requirement is 120 g (Banglapedia, 2021). So, sheep meat can contribute to meet up this gap for the people of the country. However, in Bangladesh, there is a paucity of information on the growth performance of native sheep. It is possible to obtain various data regarding the improvement of native sheep by measuring weights at certain ages, weight gains, and other criteria aimed at determining the precocity and growth rates that are used as selection criteria in breeding programs that's why it needs to embark to know the growth performance of native sheep. Therefore, considering the above scenario, the present study was planned to evaluate the growth performance of native sheep at the Bangladesh Livestock Research Institute.

Materials and Methods

Experimental Location and Duration

The present study was carried out at the Goat and Sheep research farm of Bangladesh Livestock Research Institute (BLRI), Savar, which is located about 28 km to the northwest of Dhaka city and lies between 23.8583° North latitude to 90.2667° East longitude. The research was supervised under the Department of Animal Breeding and Genetics, Bangladesh Agricultural University, and the experimental duration was January 2020 to February 2022.

Animal Management

The goat was housed in a permanent structure with a slated floor that was raised above the ground level in accordance with its gender and age group. The Napier or German grass was supplied to the sheep on an *ad-libitum* basis. The feed was supplemented with a concentrated mixture (21% crushed maize, 50% wheat bran, 14% soybean meal, 12% khesari meal, 1% protein concentrate, 0.5% di-calcium phosphate (DCP), 0.5% vitamin-mineral premix, and 1% salt) which contain 17% CP, 11 MJ ME/kg DM and supplied twice daily in the morning and evening at the rate of 200, 250 and 100 g, respectively per head per day for rams, ewes, and lambs, respectively. At regular intervals, all the sheep were vaccinated against *Peste des Petits Ruminants* (PPR), dewormed with Anti-helminthic (Paraclear), and dipped with 0.5% Malathion solution. Natural mating was practiced by selected breeding rams. The flock was maintained under a semi-intensive management system that allowed for grazing from 8.0 A.M to 4.0 P.M with rest. Clean and safe water was made available at all times.

Database Management

All the sheep used in this study were ear-tagged to maintain their individual identity. Tagging system was started immediately after the birth of the lamb and maintained strictly. Different records like the birth record, feeding, and health status was maintained in an individual data sheet for each lamb throughout the year and it was divided into summer (March-June), rainy (July-October), and winter (November-February). Birth weight and sex were recorded within 24 h of lambing. Lamb's live weights were taken at 15 days intervals up to three months and then measured at 6 months of age using a digital scale in the early morning before feeding and watering. Average daily gains were

calculated using the following formula:

$$\text{Average daily gain (g)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Interval (days) between recording final and initial weight}}$$

Statistical Analysis

The data generated from this experiment were entered into a Microsoft Excel worksheet, organized according to sex, age, and season. The analysis was performed by Statistical Package for Social Sciences (SPSS) version 20.0 computer program. To see the significant differences among mean values, Duncan's Multiple Range Test (DMRT) was performed.



Coastal



Barind



Jamuna River Basin

Results and Discussion

Growth Performance

Growth is one of the most important characteristics of living organisms which is increased with the passing of time in terms of volume, size, shape, or increasing the number of cells that determine animal performance (Bathaei and Leroy 1998). A faster growth phase is observed in young animals, and it is often assumed to be linear. Slow growth rate results in low market weight and ultimately limits the profitability of any production system (Abegaz et al., 2010). The average growth performance of native sheep is presented in Table 1. The mean birth weight was 1.46 kg which is in agreement with the findings of Azizunnesa et al. (2014); Husain and Amin (2003). Moreover, several researchers found a higher birth weight, like Bangar et al. (2021) 3.48±0.04 kg for Harnali sheep; Santos et al. (2014) 3.37 kg in Santa Inês Sheep; 4.11±0.82 kg for Thalli sheep (Hussain et al., 2013); 3.52±0.11 kg for Rambouillet sheep (Ali et al., 2006); 2.79±0.05 kg for Lohi sheep (Javed et al., 2013). The average body weight at 3 months of age was found 6.96±0.09 kg which is similar to Hashem et al. (2020) who found 6.65±0.10 kg. But lower than the value recorded by other researchers like Iqbal et al. (2014) who found 6.8±0.20 kg in Kajli sheep in Pakistan; 15.11±0.16 kg for Harnali sheep Bangar et al. (2021); 14.23 kg in Santa Inez sheep (Teixeira et al., 2018), and 22.90 kg by Falcão et al. (2015) in Ile de France sheep under confinement rearing system. The mean 6-months body weight was 11.16±0.13 kg which is near to similar to 13.09±0.15 kg for Malpura sheep in India (Arora et al., 2014). Furthermore, Bangar et al. (2021) found 20.62±0.21 kg for Harnali sheep which differ largely from the present findings. This variation might be due to breed, age, parity, litter size, nutritional status and body condition score of the ewes, and other management practices.

Table 1: Overall growth performance of native sheep

Parameters	Mean±SE	Minimum	Maximum
Birth weight (kg)	1.46±0.01 (382)	0.90	2.30
Body weight at 3 months of age (kg)	6.96±0.09 (233)	4.70	11.00
Body weight at 6 months of age (kg)	11.16±0.13 (163)	6.70	14.90
ADG at 3 months of age (g/d)	61.09±0.94 (233)	35.56	104.44
ADG at 6 months of age (g/d)	53.11±0.70 (163)	31.00	73.00

Figure in the parenthesis indicate the number of observations. ADG, average daily gain

The summary of the body weight of native sheep at different stages is presented in Table 2. Significant ($p < 0.001$) variation was found in the body weight of the sheep. Coastal type sheep had the highest birth weight, body weight,

and subsequently average daily gain at 3 and 6 months of age than Jamuna River Basin and Barind. Hasan et al. (2011) stated that the lamb birth weight differs significantly ($p < 0.05$) among the three groups of sheep and was found higher in the Coastal followed by Barind and Jamuna areas.

Table 2: Body weight of native sheep at different stages (Mean±SE)

Type	BWT (kg)	3M-BWT (kg)	6M-BWT (kg)	3M-ADG (g/d)	6M-ADG (g/d)
Coastal	1.53±0.12 ^a (205)	7.59±0.12 ^a (112)	11.78±0.15 ^a (97)	67.35±1.30 ^a (112)	56.20±0.81 ^a (97)
Jamuna River Basin	1.44±0.02 ^b (67)	6.71±0.19 ^b (50)	11.06±0.52 ^b (17)	58.38±2.05 ^b (50)	52.59±2.75 ^b (17)
Barind	1.35±0.02 ^c (110)	6.13±0.11 ^c (71)	9.94±0.16 ^c (49)	53.15±1.20 ^c (71)	47.16±0.90 ^c (49)
Significance level	***	***	***	***	***

Figures in the parenthesis indicate the number of observations. ***($p < 0.001$), NS=non-significance ($p > 0.05$), BWT, Birth weight; 3M-BWT, 3-month body weight; 6M-BWT, 6-month body weight; 3M-ADG, average daily gain at-3month; 6M-ADG, average daily gain at-6month

Sex had a strong significant effect ($p < 0.001$) on growth performance (Table 3). The male lamb was heavier at birth, 3 and 6 months in body weight, and ADG compared to their female counterpart which is in agreement with the findings of Hashem et al. (2020). Moreover, Bangar et al. (2021) observed the birth weight, 3-month and 6-month body weight of male and female Harnali sheep 3.60±0.07, 3.42±0.05, 16.31±0.28, 14.53±0.19, 16.31±0.28, 14.53±0.19 kg, respectively which is higher than the current study. The higher body weight of males compared to females at all the stages might be due to hormonal effects, physiological changes, and the feeding and suckling ability of the male lambs reported by Gbangboche et al. (2008) and Bangar et al. (2018).

Table 3: Effect of sex on growth performance of native sheep (Mean±SE)

Sex	BWT (kg)	3M-BWT (kg)	6M-BWT (kg)	3M-ADG (g/d)	6M-ADG (g/d)
Male	1.51±0.02 ^a (221)	7.37±0.11 ^a (132)	11.72±0.16 ^a (93)	65.29±1.24 ^a (132)	55.99±0.83 ^a (93)
Female	1.40±0.02 ^b (161)	6.41±0.11 ^b (101)	10.41±0.19 ^b (70)	55.62±1.27 ^b (101)	49.28±1.02 ^b (70)
Significance level	***	***	***	***	***

Figures in the parenthesis indicate the number of observations. ***($p < 0.001$); BWT, Birth weight; 3M-BWT, 3-month body weight; 6M-BWT, 6-month body weight; 3M-ADG, average daily gain at-3month; 6M-ADG, average daily gain at-6month.

The season had a significant effect ($p < 0.05$) on birth weight and ADG at 3-month of age (Table 4). Rainy-season-born lambs had the highest birth weight (1.50±0.02 kg) compared to winter and summer-born lambs which is quite similar to the findings of Hyder et al. (2002) and Hashem et al. (2020) who reported that 60- and 90-days body weights affected by season. However, this differs from the statement of Hussain et al. (2013) who reported that the season of birth has an insignificant effect on the birth weight in Thalli sheep.

Table 4: Effect of season on growth performance of native sheep (Mean±SE)

Season	BWT (kg)	3M-BWT (kg)	6M-BWT (kg)	3M-ADG (g/d)	6M-ADG (g/d)
Winter	1.45±0.02 ^b (165)	6.90±0.13 (91)	11.03±0.19 (63)	60.70±1.44 ^{ab} (91)	52.54±1.01 (63)
Summer	1.44±0.02 ^{ab} (96)	7.20±0.17 (50)	11.11±0.22 (47)	64.20±1.76 ^a (50)	53.16±1.20 (47)
Rainy	1.50±0.02 ^a (121)	6.88±0.5 (92)	11.34±0.27 (53)	59.79±1.65 ^b (92)	53.73±1.43 (53)
Significance level	*	NS	NS	*	NS

Figures in the parenthesis indicate the number of observations. *($p < 0.05$), NS=non-significance ($p > 0.05$); BWT, Birth weight; 3M-BWT, 3-month body weight; 6M-BWT, 6-month body weight; 3M-ADG, average daily gain at-3month; 6M-ADG, average daily gain at-6month.

The average daily gain at 3 months of age was 61.09±0.94 g (Table 1) which is collaborate with the findings of Prakash et al. (2017) who observed 56.87±1.22 g in Garole sheep. On contrary, our results are much lower than the

study of Kumar et al. (2017), Mandal et al. (2003), Lalit et al. (2016), and Taye et al. (2010) who stated an average daily gain of 97.22 ± 1.71 g in Daccani sheep, 127.8 ± 3.3 g in Muzaffarnagar sheep, 100.66 ± 0.86 g in Harnali sheep and 107.09 ± 2.67 g in Washera sheep, respectively. ADG at 6 months of age was 53.11 ± 0.70 g which is near to similar Hashem et al. (2020), Mandal et al. (2003), and Kumar et al. (2017) who found 54.67 ± 4.03 g in Jamuna River Basin, 49.4 ± 1.6 g in Muzaffarnagar sheep, 45.28 ± 0.85 g in Daccani sheep, respectively. Lower ADG at 6 months of age was also observed by Prakash et al. (2017), Lalit et al. (2016), and Taye et al. (2010) at 40.19 ± 1.39 g in Garole sheep, 35.07 ± 0.39 g in Harnali sheep, and 39.78 ± 9.73 g in Washera sheep. The average daily gain may be influenced by several factors such as nutrient availability, hormone and enzymes activities, and environmental factors like increased ambient temperature (Padodara and Ninan Jacob, 2013).

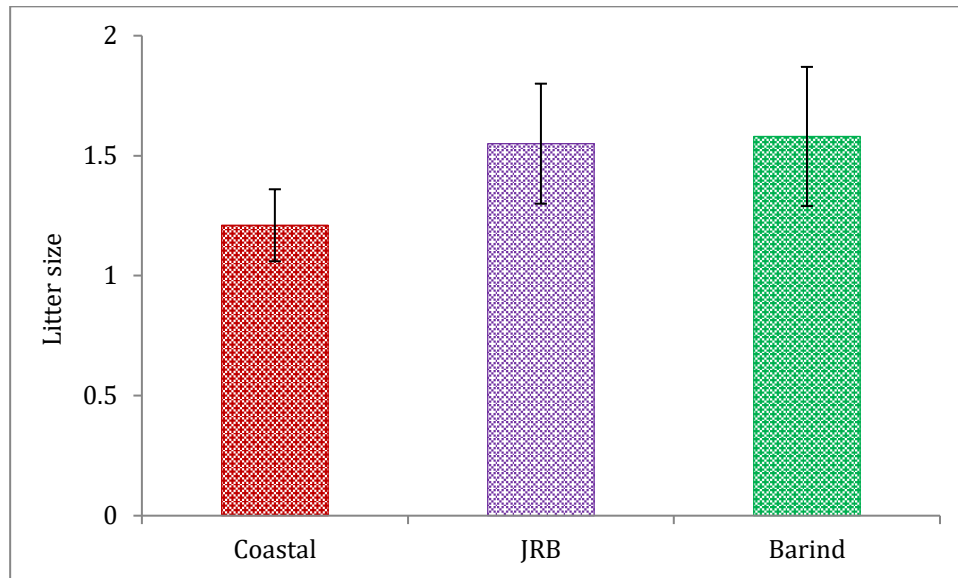


Figure 1: Litter size of native sheep

A significant variation was observed in litter size among the native sheep. Barind sheep had a higher litter size (1.58 ± 0.29) compared to Jamuna River Basin (1.55 ± 0.25) and Coastal (1.21 ± 0.15) sheep (Figure 1). Sarder et al. (2015) stated that the parity of sheep had a significant effect ($P < 0.05$) on litter size and they found the highest litter size (2.17 ± 0.10) in the fifth parity and lowest in the first parity (1.52 ± 0.40) and overall litter size 1.85 ± 0.10 in the Rajshahi regional sheep of Bangladesh. Hassan et al. (2011) did not observe significant variation in litter size among the native sheep of Bangladesh and their litter size value was 1.8 ± 0.10 , 1.7 ± 0.10 , and 1.6 ± 0.20 , respectively for Jamuna, Barind, and Coastal sheep which significantly differ from the results of the present study. Litter size may vary due to the effect of genetics, environment, age, and parity of the ewe.

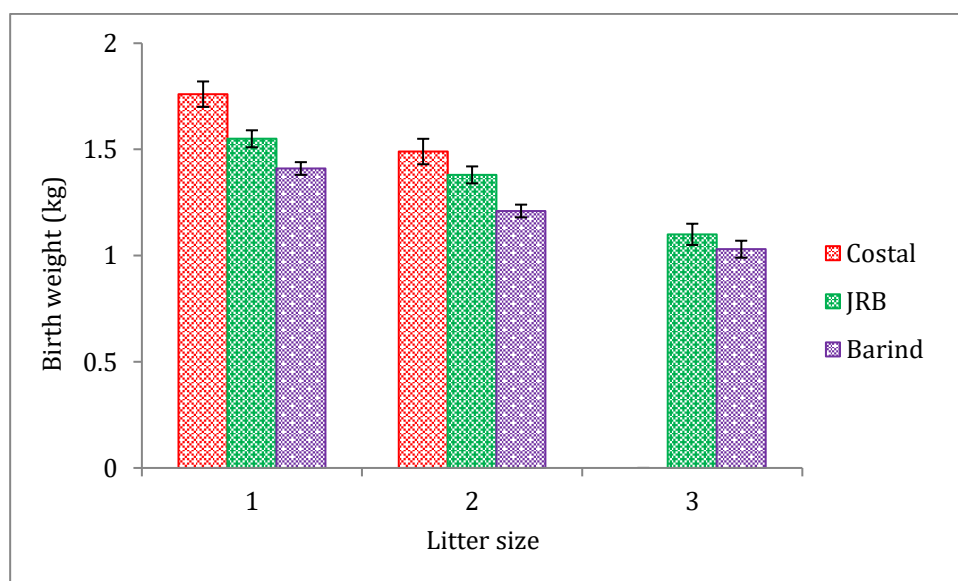


Figure 2: Effect of litter size on birth weight

The effect of litter size has been found to be significant ($p < 0.05$) on birth weight. The single and twin kids were heavier than triplets in the three native sheep. Coastal sheep lamb birth weight was highest for litter size 1 and 2 and the lowest was observed for Barind (Figure 2). Interestingly, in this study, we did not find triplet litter size for Coastal sheep. Hasan *et al.* (2011) recorded the birth weight of the native sheep according to the litter size and their values were 1.3, 1.2, 1.3, 1.2, 1.45, 1.3, 1.65, 1.55, and 1.4 kg respectively in the single, twin, and triplet's lamb of Jamuna River Basin, Barind and Coastal. The birth weight of the lamb varies due to the intrauterine environment where single lamb gets higher nutrients and uterine space than twin and triplet. As a result, decreased birth weight with increasing litter size, also has a significant impact on the subsequent body weight of the lamb.

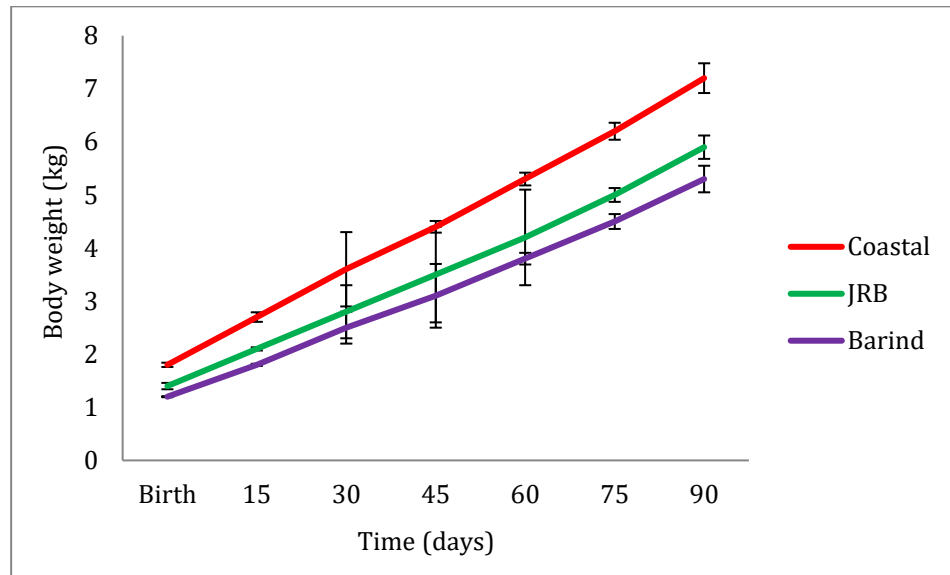


Figure 3: Growth performance of native male lamb

Figures 3 and 4 represented the comparative growth performance among the native male and female lambs where male and female lambs of Coastal type had significantly ($p < 0.05$) higher body weight than Jamuna River Basin and Barind type. The average body weight of males of Coastal, Jamuna River Basin, and Barind at three months of age was 7.2 ± 0.28 , 5.9 ± 0.22 , and 5.3 ± 0.25 kg respectively (Fig. 3), whereas the counterpart of females was found 6.6 ± 0.24 , 5.1 ± 0.22 and 4.7 ± 0.19 kg, respectively (Fig. 4).

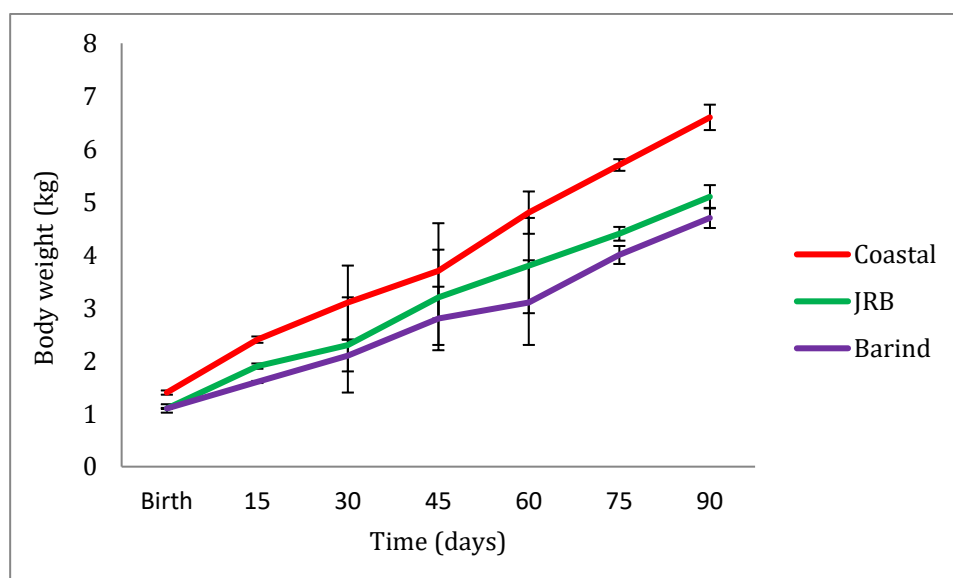


Figure 4: Growth performance of native female lamb

Conclusions

Based on the growth performance, in a nutshell, it can be precise that Coastal sheep could be a suitable genetic

resource for profitable sheep farming. Moreover, the growth performance of Jamuna River Basin and Barind was found almost similar and it may be due to their similar genetic group while Coastal sheep are belonging to another genetic group (Deb et al., 2019). However, the growth performance of the Bangladeshi native sheep is not similar to the other exotic sheep breeds. Therefore, it indicates that there is huge scope for the improvement of the native sheep through selective breeding followed by good nutrition and other management practices.

Contribution by Authors

The authors contributed equally.

Conflict of Interests

There is no conflict of interest.

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References

1. Abegaz, S., Van Wyk, J. B., and Olivier, J. J. 2010. Estimates of (co) variance function for growth to yearling in Horro sheep of Ethiopia using random regression model. *Arch. Ani. Breed.* 53(6): 689-700. <https://doi.org/10.5194/aab-53-689-2010>, 2010.
2. Ahmed, Z., Alam, R., Hussain, A. H. M., Ambinakudige, S., Chowdhury, T. A., Kabir, M., and Ahmed, M. N. Q. 2022. Agricultural land conversion and land surface temperature change in four industrial areas in Bangladesh: results from remote sensing and DPSIR approach. *Arabi. J. Geosci.* 15(10): 1-21.
3. Ali, S., Hussain, A., Akhtar, P., Younas, M., and Khan, M. A. 2006. Relationship of birth weight of lambs with age of ewes at service in Rambouillet sheep. *Pak. Vet. J.* 26(4): 187.
4. Arora, A. L., Mishra, A. K., and Prince, L. L. L. 2014. Survey and Performance Evaluation of Malpura Sheep in Farmers' Flocks of its Native Tract. *J. Ani. Res.* 4(1): 75. <https://doi.org/10.5958/2277-940X.2014.00078.3>
5. Zohara, F.B., Azizunnesa, Islam, M.F., Alam, M.G.S., and Bari, F.Y. 2014. Reproductive Performances of Indigenous Ewes in Bangladesh. *IOSR J. Agri. Vet. Sci.* 7(5): 64-72.
6. Bangar, Y. C., Lawar, V. S., Nimase, R. G., and Nimbalkar, C. A. 2018. Comparison of non-linear growth models to describe the growth behavior of Deccani sheep. *Agri.Res.*, 7(4): 490-494. <https://doi.org/10.1007/s40003-018-0338-2>
7. Bangar, Y. C., Magotra, A., Malik, B. S., and Malik, Z. S. 2021. Evaluation of growth curve traits and associated genetic parameters in Harnali sheep. *Sma. Rum. Res.* 195, 106314.
8. Banglapedia, 2021. National Encyclopedia of Bangladesh. <https://en.banglapedia.org/index.php/Livestock>
9. Bathaei, S. S., and Leroy, P. L. 1998. Genetic and phenotypic aspects of the growth curve characteristics in Mehraban Iranian fat-tailed sheep. *Sma. Rum. Res.* 29(3): 261-269. [https://doi.org/10.1016/S0921-4488\(97\)00142-9](https://doi.org/10.1016/S0921-4488(97)00142-9)
10. BBS 2008: Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
11. Bhuiyan, A. K. F. H. 2006. Livestock genetic resources in Bangladesh: Preservation and Management. In International conference on livestock services, Chinese Academy of Agricultural Science (CAAS), Beijing, China (Vol. 6).
12. Deb, G. K., Choudhury, M. P., Kabir, M. A., Khan, M. Y. A., Ershaduzzaman, M., Nahar, T. N., and Alim, M. A. 2019. Genetic relationship among indigenous sheep population of Bangladesh. *Bang. J. Ani. Sci.* 48(1): 17-22. <https://doi.org/10.3329/bjas.v48i1.44553>
13. Falcão, P. F., Pedrosa, V. B., Moreira, R. P., Sieklicki, M. D. F., Rocha, C. G., Santos, I. C., ... and Martins, A. D. S. 2015. Curvas de crescimento de cordeiros da raça Ile de France criados em confinamento. *Revi. Bras.Saú.Prod. Ani.*16, 377-386.
14. Gbangboche, A. B., Glele-Kakai, R., Salifou, S., Albuquerque, L. G. D., and Leroy, P. L. 2008. Comparison of non-linear growth models to describe the growth curve in West African Dwarf sheep. *Ani.* 2(7): 1003-1012. <https://doi.org/10.1017/S1751731108002206>
15. Halim, M. A., Rahman, M. M., and Hassan, M. Z. 2013. Agricultural land conversion in the sub-urban area: A

- case study of Rajshahi Metropolitan city. *J. Lif. Ear. Sci.* 8, 21-30. <https://doi.org/10.3329/jles.v8i0.20136>
16. Hashem, M. A., Islam, T., Hossain, M. A., Kamal, M. T., Sun, M. A., and Rahman, M. M. 2020. Production Performance of Jamuna Basin Lamb under Semi-Intensive Management System in Bangladesh. *J. Ani. Vet. Adv.* 19(11). <https://doi.org/10.36478/javaa.2020.150.158>
 17. Hassan, M. R., and Talukder, M. A. I. 2011. Comparative performance of different regional native sheep in Bangladesh. *Bang. Vet.* 28(2): 85-95. <https://doi.org/10.3329/bvet.v28i2.10692>
 18. Husain, S. S., and Amin, M. R. 2003. Genetic resource conservation and utilization: participatory maintenance of animal Genetics resource at rural level in Bangladesh. Paper presented Genetic resource conservation, Bangladesh Livestock Research Institute, Savar, Dhaka, Bangladesh.
 19. Hussain, A., Akhtar, P., Ali, S., Younas, M., Yaqoob, M., Babar, M. E., and Shakoor, A. (2013). Factors influencing body weights at different ages in Thalli sheep. *J. Ani. Pla. Sci.* 23(1): 1-6.
 20. Hyder, M. W., Thompson, A. N., Doyle, P. T., and Tanaka, K. 2002. The response of broad-and fine-wool Merino wethers to differential grazing of annual pastures during spring. *Aust. J. Exp. Agri.* 42(2): 117-128. <https://doi.org/10.1071/EA00008>
 21. Iqbal, Z. M., Javed, K., Abdullah, M., Ahmad, N., Ali, A., Khalique, A., and Younas, U. 2014. Estimation of body weight from different morphometric measurements in Kajli lambs. *J. Ani. Pla. Sci.* 24, 700-703.
 22. Javed, K., Iram, A., Abdullah, M., Sattar, M.A., and Akhtar, M. 2013. Genetic trends for some productive traits of lohi sheep in Pakistan. *Pak. J. Sci.* 65(4): 13.
 23. Kumar, A.P., Prakash, G., Gupta, R., Raghunandan, T., and Chandra, S.A. 2017. Average daily gain and Kleiber Ratio in Deccani Sheep. *The Pha. Innov. J.* 6(6): 194-197.
 24. Lalit, M.Z.S., Dalal, D.S., Dahiya, S.P., Patil, C.S., and Dahiya, R. 2016. Genetic analysis of growth traits in Harnali sheep. *Vet. Worl.* 9(2): 128-132. <https://doi.org/10.14202/vetworld.2016.128-132>
 25. Mandal, A.K., Pant, K.P., Nandy, D.K., and Pramod, K.R. 2003. Genetic Analysis of Growth Traits in Muzaffarnagari sheep. *Trop. Ani. Hea. Prod.* 35(3): 271-284.
 26. Padodara, R.J. and Jacob, N. 2013. Climate change: Effect on growth of animals. *Basic Res. J. Agri. Sci. Revi.* 2(4): 80-90.
 27. Prakash, V.E.D., Prince, L.L.L., Sharma, R.C., and Arun, K. 2017. Growth and prolificacy performance of Garole sheep raised under semi-arid condition. *Indi. J. Ani. Sci.* 87(10): 1264-1268.
 28. Sadek, A., Rakib, R.H., Morsheda, Y., Nasrin, S., Nusrat, J., and Ershaduzamman, M. 2018. Evaluation of lamb production potentiality of the Barind, Jamuna river basin and coastal region sheep of Bangladesh under intensive management. *J. Adv. Vet. Ani. Res.* 5(1): 37-43. <http://doi.org/10.5455/javar.2018.e243>
 29. Santos, N. P. S., de Oliveira Neto, C. B., Sarmiento, J. L. R., Bezerra, L. R., Oliveira, R. L., dos Santos, G. V., and Biagiotti, D. 2014. Carcass traits and growth curve parameters in Santa Inês sheep. *J. Agri. Sci.* 6(5): 180. <http://doi.org/10.5539/jas.v6n5p180>
 30. Sarder, M. J. U., Islam, M. H., Moni, M. I. Z., Jahan, S. S., Aktar, S., and Uddin, J. 2015. Reproductive and productive performance of sheep of Rajshahi, Bangladesh insight about effects of genotype and parity. *Bang. Live. J.* 1, 31-34.
 31. Taye, M., Girma, A., Solomon, G., Sisay, L., Abebe, M., and Markos, T. 2010. Growth performances of Washera sheep under smallholder management systems in Yilmanadensa and Quarit districts, Ethiopia., *Trop. Ani. Heal. Prod.* 42(4): 659-667. <https://dx.doi.org/10.1007/s11250-009-9473-x>
 32. Teixeira, M. C., Villarroel, A. B., Pereira, E. S., de Oliveira, S. M. P., Albuquerque, Í. A., and Mizubuti, I. Y. 2012. Curva de crescimento de cordeiros oriundos de três sistemas de produção na Região Nordeste do Brasil. *Ciên. Agr.* 33(5): 2011-2018.
