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PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF NATIVE SHEEP UNDER RESEARCH FARM AND FARMER LEVEL IN HILLY AREAS OF NAIKHONGCHARI

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ABSTRACT: *The present study was undertaken to investigate the productive and reproductive performance of native sheep at the research farm and farmer level in hilly areas of Naikhongchari. For that purpose, on the research farm, the ewes were mated with rams in a 15-20:1 ratio following a natural-controlled breeding program. All of the ewes and rams were kept in a permanently structured house with a slatted floor that was raised above the ground and provided them with ample space for feeling comfortable. The sheep were given 6-7 hours of grazing time, and concentrate (17% CP, 11 MJ/kg DM) was provided twice daily. Regular vaccinations, dipping, and deworming were performed. At the farmer level, breeding strategies were not followed strictly. The lambs were weighed at birth, and each lamb's lambing date and sex were recorded and mostly kept under semi-intensive conditions. Most of the sheep farmers supply a small amount of wheat bran and broken rice to their sheep early in the morning and evening, and the rest of the day they allow their sheep to graze on the hill. The sheep were hardly immunized against common sheep diseases. The birth weight of both the male lamb and female lamb was 1.27 kg, 1.23 kg higher than the community conditions of 1.09 kg and 1.08 kg. The weaning weight for male lamb was 5.14 kg and female lamb was 4.86 kg in the research farm, while the weaning weight of male and female lamb was 4.32 kg and 4.15 kg, respectively, at the farmer level. On the research farm, the growth rates of male and female sheep were 41.22 g/d and 38.67 g/d, respectively, and at the farmer's level, the growth rates of male and female sheep were 39.08 g/d and 36.11 g/d, respectively. The mature ram and ewe weights were 25.67 kg and 18.72 kg in the research farm, respectively, which was higher than the mature weights of ram at the farmer level. Significant differences have been observed in no. of services per conception, gestation length, days open, and post-partum heat period. The highest lamb survivability percentage was observed in research farms than at the farmer level.*

KEYWORDS: Productive; reproductive performance; native sheep; research farm; farmer level.

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INTRODUCTION

The livestock sub-sector is considered one of the most important sub-sectors of Bangladesh agriculture because it provides essential food and nutrition, income and employment for millions of people. Additionally, the contribution of the livestock sector to the national GDP is 1.85%, with an annual GDP growth rate of 3.23%, and livestock has a share of 16.52% in agriculture GDP. Sheep are the third largest livestock species after cattle and goats in Bangladesh, with a population of 3.752 million (DLS, 2023). The rearing of sheep may be an emerging source of income generation for small, medium, and large-scale farmers because it requires little capital and relatively less care and management than other large livestock (Mowsume *et al.*, 2023). Sheep farming can help with income generation, poverty alleviation, employment and empowerment for women and young people, protein gap filling, and food security in rural areas (Rakib *et al.*, 2022). By providing a sustainable source of income, sheep farming can help families improve their standard of living and break the cycle of poverty. Additionally, sheep farming can also create employment opportunities for local communities, further boosting economic growth and development.

Because of their small mouths and split upper lips, known as philtrums, sheep are able to eat tiny bits of vegetation that larger animals cannot (Banerjee, 1989). In Bangladesh, under traditional feeding systems, sheep are mainly raised on harvested or fallow lands, roads, and canal sides, and they also graze on aquatic weeds and grass in knee-deep water (Sultana *et al.*, 2010). In contrast to most of the animals, sheep are very agile and can easily graze in the most difficult mountainous terrain, where cattle prefer not to graze. As a result, sheep can convert low-quality feed into high-quality animal protein. This ability of sheep to efficiently utilize their environment makes them a valuable resource in areas with limited grazing options. Additionally, their adaptability allows them to thrive in harsh climates and contribute to sustainable agriculture practices. Sheep are also resistant to disease in humid and sub-humid climates. This is due to their ability to adapt to harsh environments and their natural resistance to a variety of infections (Joy *et al.*, 2020). Sheep are also considered docile animals and the most important characteristics of sheep are prolificacy, capability of biannual lambing and having more than one lamb per lambing (Bhuiyan, 2006).

Sheep farming in Bangladesh is primarily focused on meat production due to the high demand for lamb and mutton in the country (Rahman *et al.*, 2023). The meat of sheep called mutton, is softer and juicer and contains omega-3 and 6 fatty acids that are beneficial for heart health. Mutton also provides essential vitamins and minerals such as iron, zinc, and vitamin B12, which are important for maintaining a healthy immune system and supporting brain function. As a result, people of all ages can consume it, and there is no religious barrier to mutton consumption.

The Chittagong Hill Tracts comprise the solitary expansive mountainous region within the nation and are situated in the southeastern part of Bangladesh. Spanning an approximate area of 13,184 square kilometers, these tracts consist of 92% highland, 2% medium highland, 1% medium lowland, and 5% residential areas and bodies of water (The Asian Age, 2021). Characterized by a tropical climate, the Chittagong Hill Tracts experience elevated levels of humidity throughout the year. The average temperature varies from 22°C to 34°C, with substantial precipitation occurring during the monsoon season which takes place between June and September. Distinguished by its distinctive topography and climate, the Chittagong Hill

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Tracts differ from the flatlands. Owing to its proximity to the Bay of Bengal, this region is renowned for its towering hills, profound valleys, and copious rainfall.

Recently, sheep farming has expanded in hilly regions and gained much popularity. This expansion can be attributed to several factors. Firstly, the natural terrain of hilly regions provides ample grazing land for sheep, allowing them to thrive in these areas. Additionally, sheep farming is a sustainable and profitable venture, making it an attractive option for farmers in these regions. However, in Bangladesh, there is scanty information on the productive and reproductive performance of native sheep under research farms and community conditions in hilly areas. Therefore, considering the above scenario, the current study was undertaken to evaluate the productive and reproductive performance of native sheep under research farm and farmer level in hilly areas of Naikhongchari.

MATERIALS AND METHODS

Study area

The study was carried out between 2021 and 2022 at the Bangladesh Livestock Research Institute, Regional Station Research Farm and Naikhongchari, Bandarban Hilly District, Bangladesh. The experimental site 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. The soil type is loamy and highly acidic (pH 4.5-4.9). During the wet and hot time of the year (June to October), rainfall and relative humidity vary from 255 to 1,093 mm and 85 to 95%, respectively. The average annual temperature is approximately 26.1°C, but it ranges from 11.2°C to 32.3°C.

Flock management

In the research farm, the ewes were mated with rams in a 15-20 to 1 ratio following a natural controlled breeding program, ewes were allowed to lamb throughout the year. For producing the next generation, both independent culling level and selection index were used. To avoid inbreeding depression, mating between full-sibs and half-sibs was not practiced. The lambs and ewes were weighed at lambing, and each lamb's lambing date, sex, and parity were recorded. The lambs were tagged after birth and mostly kept under semi-intensive conditions. All of the ewes and rams were kept in a permanent structured house with a slatted floor that was raised above the ground and provided them with ample space for feeling comfortable. Rams were always kept apart from does to avoid unintentional mating. The sheep were given 6-7 hours of grazing time, and concentrate (17% CP, 11 MJ/kg DM) was provided twice daily (morning & 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 sheep and goat pox, as well as Pestis des Petites Ruminants diseases. Regular deworming was performed to avoid internal parasites and to control ticks, mites and other ectoparasite dipping was performed routinely.

In cases of farmer level, usually the sheep farmers keep ram for breeding purpose of their flock, and the farmers who don’t keep rams for breeding purposes generally mate their ewes with rams of other farmers by providing service charge. Under such conditions, breeding strategies

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were not followed strictly, and farmers were unable to avoid inbreeding depression. As like as research farm, the lambs were weighed at birth, and each lamb's lambing date, sex, and parity were recorded and the lambs were tagged after birth and mostly kept under semi-intensive conditions at the farmer's level. Most of the sheep were kept in the slatted floor house made with wood, bamboo, and tin, while the remaining farmers provided housing facilities to their sheep according to their capabilities. Very few sheep farmers supply a small amount of wheat bran and broken rice to their sheep early in the morning and evening, and the rest of the day they allow their sheep to graze on the hill. The sheep were hardly immunized against common sheep diseases. Likewise, deworming and dipping were not practiced routinely by the farmers.

Data collection and recording

The data on phenotypic characteristics, i.e., productive parameters of birth weight of lamb, weaning weight, 6-month body weight, mature body weight, and average daily gain were collected and recorded. The reproductive traits of age at first heat (AFH), gestation length (GL), age at first lambing (AFL), post-partum heat (PPH), litter size (LS), days open (DO: number of days between lambing and conception), lambing interval (LI), number of services per conception (NSPC) and lamb survivability were additionally recorded.

Statistical Analysis

The raw data has been sorted, computed, and statistically analyzed. The means ± SE have been calculated for the phenotypic characteristics, reproductive and productive performance of three lines of native sheep. The obtained information was loaded and stored on the SPPS spreadsheet. Then the data was analyzed using the SPSS program. The means were compared by Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSIONS

The reproductive and productive features of sheep are essential for the development of sheep farming. Because, sheep possess unique reproductive and productive characteristics that are crucial for the growth and success of sheep farming. These features enable sheep to efficiently reproduce and produce offspring, ensuring a sustainable and profitable sheep farming.

Productive performance

The productive performance of native sheep under research farm and community conditions is shown in Table 1. The birth weight of both the male lamb and female lamb was 1.27 kg, 1.23 kg higher than the community conditions of 1.09 kg and 1.08 kg, respectively. According to Pervage *et al.,* (2009), the male birth weights of Jamuna, Barind, and Coastal were 1.34, 1.30, and 1.50 kg, respectively, and the female birth weights were 1.09, 1.28, and 1.07 kg. Following Rakib *et al.,* (2022), the birth weight of a local lamb ranges from 1.04 to 2.3 kg. Husain and Amin (2003) reported that the average birth weight of native sheep was 1.2 kg. Lamb birth weight is a measurable characteristic of growth that has a positive correlation with organ development, growth in the future, and optimal production (Rakib *et al.,* 2022). Nonetheless, the season, lamb sex, litter size (LS), management, nutritional quality of the dam, and geographic location can all affect the lamb's birth weight (Rakib *et al.,* 2022; Sun *et al.,* 2020; Sultana *et al.,* 2011 and Hassan and Talukder, 2011).

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Table 1: Productive performance of sheep at research farm and farmer level

Parameters	Research Farm (n=30)	Farmer level (n=29)	Level of significance
Birth wt. of male lamb (kg)	1.27±0.58	1.09±0.54	.037
Birth wt. of female lamb (kg)	1.23±0.06	1.08±0.03	.035
Weaning wt. of male (kg)	5.14±0.25	4.32±0.19	.000
Weaning wt. of female (kg)	4.86±0.17	4.15±0.16	.001
6 months body wt. of male (kg)	8.69±0.13	8.12±0.12	.005
6 months body wt. of female (kg)	8.19±0.14	7.58±0.15	.005
Growth rate of male (g/d)	41.22±0.77	39.08±0.69	.053
Growth rate of female (g/d)	38.67±0.91	36.11±0.79	.041

value indicates- Mean± Standard Error (SE)

The weaning weight for male lamb was 5.14 kg and the female lamb was 4.86 kg in the research farm, while the weaning weight of male and female lamb was 4.32 kg and 4.15 kg, respectively, at the farmer level. However, according to Islam *et al.,* (2018), the average weaning weight of local sheep was 5.40 kg. Hashem *et al.*, (2020) discovered that the average weaning weight of Jamuna for males and females was 6.77 and 6.51, respectively. The weaning weights of Jamuna River Basin, Barind, and Coastal sheep were 5.74, 5.70, and 5.89 kg, respectively (Pervage *et al.*, 2009). The lower weaning weight may be due to poor nutrition and harsh environmental conditions. The 6-month body weight of both males (8.69 kg) and females (8.19 kg) in the research farm was higher than the farmer level. Nevertheless, Mowsume *et al.*, (2023) investigated that the 6-month body weights of Coastal, Jamuna River Basin, and Barind were 11.78, 11.06, and 9.94 kg, respectively, higher than the present findings. On the research farm, the growth rates of male and female sheep were 41.22 g/d and 38.67 g/d, respectively. In contrast, at the farmer's level, the growth rates of male and female sheep were 39.08 g/d and 36.11 g/d, respectively. According to Mowsume *et al.*, (2023), the average daily gain for the Jamuna River Basin, Barind, and Coastal regions was 41.16 g/d, 52.59 g/d, and 56.20 g/d, respectively, up to six months of age. However, according to Pervage *et al.*, (2009), the average daily weight gain in the Jamuna River Basin, Barind, and Coastal regions was 50.19, 49.18, and 51.21 g/d, respectively. Figure 1 represents the mature weight of ram and ewe at the research farm and farmer level. The mature ram and ewe weights were 25.67 kg and 18.72 kg in the research farm, respectively, which was higher than the mature weights of ram (22.72 kg) and ewe (16.69 kg) at the farmer level. The average mature body weight of male and female sheep in the Jamuna basin, Barind, and Coastal belt was 17.84, 14.62; 16.85, 15.95; and 19.19, 16.16 kg, respectively (Asaduzzaman *et al.*, 2020).

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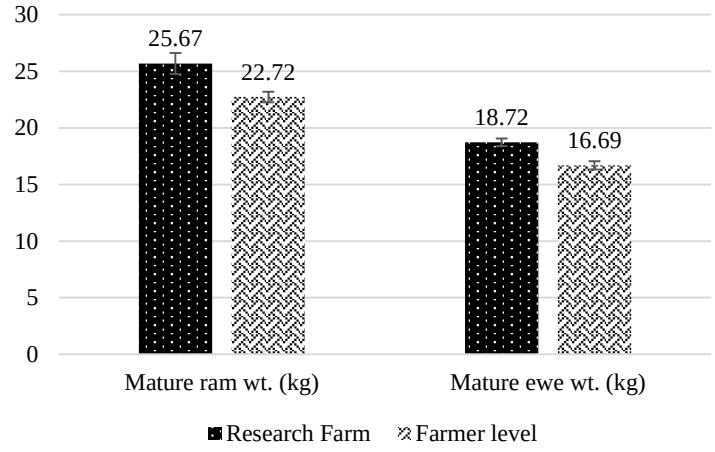

Figure 1: Mature weight of ram and ewe in research farm and farmer level

According to Rakib *et al.*, (2022), the mature body weight of a native ram ranges from 14 to 25 kg, while that of a native ewe ranges from 14 to 20 kg and this can vary based on a number of variables, including location, sheep type, sex, season, the dam's milk production and nutrition state, feed quality, management systems, and heat stress.

Reproductive performance

Reproductive traits are considered one of the most important economic traits in the case of animal production. Because reproductive traits are directly related to the overall productivity and profitability of farm animals. The reproductive performance of native sheep is presented in Table 2.

There was no significant difference investigated in age at first heat both in research farm and farmer level. Pervage *et al.*, (2009) stated that the AFH of native sheep namely BLRI, Jamuna, Barind, and Coastal sheep were 266.50, 333.17, 329, and 341.23, respectively. While, Hassan and Talukder (2011), observed that the average age at first heat (AFH) values for Coastal, Barind, and Jamuna River Basin sheep were 279, 224.4, and 239.9 days, respectively. However, several factors can influence the age at first heat, including species, breed, body weight, heterosis, proximity of male animals, season, and other environmental variables such as temperature (Noakes *et al.*, 2001). While considering, wt. at first heat, age at first conception and wt. at first conception, no significant difference has been observed. However, the values of wt. at first heat, age at first conception and wt. at first, conception was better at the research farm than at the farmer level. This may be due to the better nutrition and management in research farms than farmer level.

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Table 2: Reproductive performance of sheep at research farm and farmer level

Parameters	Research Farm (n=27)	Farmer level (n=30)	Level of significance
Age at first heat (d)	238.11±8.62	261.00±14.39	.190
Wt. at first heat (kg)	13.08±0.24	12.94±0.19	.654
Age at first conception (d)	259.81±8.05	286.00±13.89	.119
Wt. at first conception (kg)	13.28±0.23	13.19±0.20	.765
No. of service per conception	1.22±0.08	1.90±0.14	.000
Gestation length (d)	149.00±0.32	150.29±0.39	.012
Days open (d)	40.56±0.85	54.67±3.16	.000
Litter size	1.81±0.10	1.57±0.11	.121
Lambing interval (d)	210.33±5.99	215.93±3.30	.431
Post-partum heat period (d)	27.96±0.83	41.63±2.29	.000
Lamb survivability (%)	94.03±1.89	87.02±2.16	.019

value indicates- Mean± Standard Error (SE)

The number of female sheep that have been exposed to the ram to have a successful lambing is usually considered the value of the number of services per conception. A significant difference ($p < .05$) has been observed in terms of no. of service per conception in native sheep reared under research farm and farmer level. Pervage *et al.,* (2009) found that the NSPC of Jamuna, Barind, and Coastal areas were 1.47, 1.52, and 1.44, respectively. The NSPC values reported for Jamuna, Barind, and Coastal sheep were 1.3, 1.3, and 1.4, respectively (Hassan and Talukder 2011). Some variables, such as breed, age, lambing interval, and production system, may have an impact on the NSPC (Rakib *et al.,* 2022).

The present findings showed that there was a significant difference in the gestation length of native sheep at both the research farm and farmer level. The findings about gestation length corresponded with the findings of Pervage *et al.,* (2009), who reported GL values of 149.57, 150.33, and 151.46 d in the Coastal, Barind, and Jamuna River Basin, respectively. However, Hassan and Talukder (2011) found that the GL of Jamuna, Barind, and Coastal sheep was 152.8, 145, and 146.6 d, respectively. Lamb gestation length (GL) can be influenced by factors such as sire breed, dam age, litter size, and birth weight (Fogarty *et al.,* 2005). Jainudeen and Hafez (2000) also described the various factors, including genetic, fetal, and maternal environmental factors. Significant differences have been observed in days open of native sheep reared under research farm and farmer level. The days open of native sheep reared under research farm was 40.56 days was lower than the sheep reared under farmer level (54.67 days) may be due to the environmental factor and plane of nutrition. However, 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.

There was no significant difference in litter size of native sheep reared under research farm and farmer level. Hassan and Talukder (2011) postulated that the litter size for the Coastal, Barind, and Jamuna River Basin sheep was 1.6, 1.7, and 1.8 respectively. Moreover, Pervage *et al.,* (2009) conducted a separate study that found litter sizes of 1.56, 1.58, and 1.70 for Coastal, Barind, and Jamuna River Basin sheep, respectively. The rate of ovulation has the greatest influence on litter size and is the most important factor in determining reproductive competence (Banchero *et al.,* 2021). Several factors can influence litter size, including breed generation, parity, age, body weight, improved nutrition and environmental conditions, sample size, and

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management practices (Mowsume *et al.,* 2023). The lambing interval is an important aspect of reproductive performance that affects sheep production. There was no significant difference was observed in the lambing interval of native sheep both at the research farm and farmer levels. Husain and Amin (2003) reported that native sheep had a lambing interval of 253.0 days. The lambing interval of Jamuna, Barind, and Coastal sheep was 188.6, 189.5, and 204.3 days respectively (Hassan and Talukder, 2011). Pervage *et al.,* (2009) showed that the LI in Jamuna, Barind, and Coastal sheep was 221.13 d, 228.57 d, and 214.32 d, respectively. Rakib *et al.,* (2022) stated that the lambing interval is influenced by the dam's breed, season, parity, and postpartum weight. Significant differences have been observed in the post-partum heat period of native sheep reared under research farm and farmer level. The lowest post-partum heat period was found in native sheep reared under a research farm (27.96 d) than in farmer level (41.63 d). Hassan and Talukder (2011) stated that the PPHP values of 30.5 d, 32 d, and 37.5 d for the Jamuna, Barind, and Coastal regions respectively. Pervage *et al.,* (2009) showed that the PPHP of Jamuna, Barind and Coastal were 39.14, 41.30 and 43.12 d respectively. Several factors influence the PPHP, including how quickly the uterus returns to normal, how frequently the lamb suckles, the animal's overall health and body condition, the time of year, and the breeding process (Fray *et al.,* 1996; Senger, 2003).

The lamb survivability percentage of native sheep is represented in Figure 2. The highest lamb survivability percentage was observed in sheep reared under research farm (94.03%) than in sheep reared under farmer level (87.02%). This could be due to inadequate nutritional management, poor mothering ability of ewes, lamb weakness and most commonly, a high susceptibility to diarrhea and pneumonia in native sheep reared by farmers. According to Hassan and Talukder (2011), the average lamb survival rate among Native sheep is 87.60%. They also discovered that between July and October, the survivability rate was 93.0%. From November to February, the survivability rate decreased to 82.4%. Finally, between March and May, the survivability rate was observed to be 87.5%.

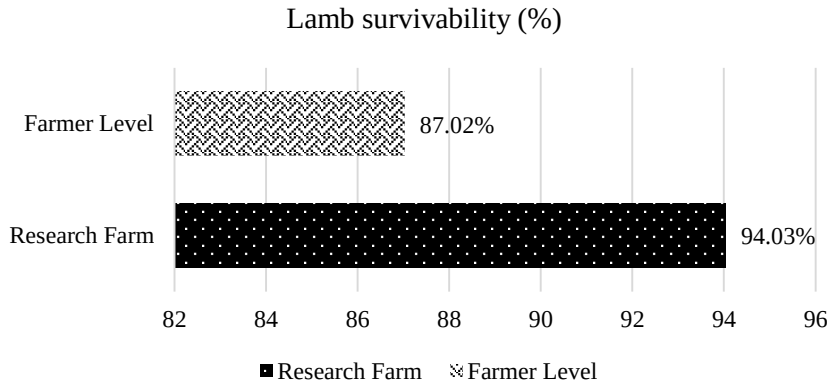

Figure 2: Lamb survivability (%) in research farm and farmer level

Along with other conditions like foot rot, gastrointestinal infections, and Peste des Petits Ruminants (PPR), diarrhea and pneumonia—also referred to as the most common clinical illness—pose serious health risks. Many factors, such as age, sex, and season, increase the lamb mortality rate (Rakib *et al.,* 2022).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

CONCLUSION

Sheep production in hilly areas of Bangladesh has immense potential to contribute to the economy of the region. Despite the challenges associated with hilly terrain, sheep production is gradually growing in Bangladesh due to increasing demand for sheep meat. With proper management and breeding programs, there is potential to improve the meat production of native sheep breeds and increase the income of small farmers. However, to maintain their optimal health and productivity, it is crucial to manage their grazing and feeding properly.

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