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Review Article

Productive performances of native sheep in Bangladesh

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Abstract

Sheep are the only domestic animals which can utilize wastelands, stubbles of cultivated crops, tree leaves, farm wastes or weeds from the field to convert them into meat, wool and skin. In Bangladesh sheep contribute greatly to the agrarian economy, especially arid/semi-arid and mountainous areas where crop or dairy farming are not economical. The native sheep are found in Jamuna basin, Barind tract and Coastal areas in Bangladesh having distinct and phenotypic characters, productive performances of their own and is thoroughly characterized and established as native breeds. This sheep is the latest sensations in the world of domestic species by virtue of its prolificacy, lambing frequency, disease resistance and other extraordinary merits rarely or not observed in other sheep breed of the world. The native sheep is very popular for its bi-annual lambing, multiple birth, grazing of aquatic weeds and grass in knee-deep water and disease resistance capacity. They are small in size, produce rough wool, good quality skin, manure and low fat mutton. Their milk is not important as the quantity is too less to fed their lambs. In this review an attempt has been made to present detail productive performances of native sheep in relation to other sheep breeds with emphasis of production traits, disease resistance, litter size, birth weight, weaning weight, average daily gain (ADG), mature body weight including conservation and development strategies of this type of valuable sheep.

Introduction

Sheep is an important farm animal in Bangladesh which is a vital source of income and food, as well as the socio-economic status of poor farmers (Hossain et al., 2018a; Sarker et al, 2017). It is widely distributed throughout the world (FAO, 2008; Haque et al., 2020). During the last twelve years, the sheep population increased 2.5 times with an annual growth rate was 5% (BBS, 2008). Sheep are gregarious behaviour type of small ruminants that mainly thrives on natural grasses available on the fallow land, roadsides, crop fields and canal sides (Sultana et al., 2011). Most of the sheep are indigenous, with few crossbreds and are capable of bi-annual lambing and multiple births (Bhuiyan, 2006). Indigenous lambs are considered to be resistant to high ambient temperature in a tropical environment (Rashid et al., 2013). Jamuna basin lamb is widely distributed to both sides of Jamuna River in Bangladesh. The characteristics of Jamuna basin lambs are small body size (male-18.25 kg, female-15.22 kg). It has creamy white wool all over the body but the head and belly contain black wool and less wool found in legs and belly (Hashem et al., 2020). This species is widely adapted to different climatic conditions and is found in all livestock production systems (Berihulay, 2019). Lamb farming is also significant in the development and economic growth in different developed countries. The constraints of inadequate and poor quality feeds are associated with lower birth weight, average daily gain (ADG) and slaughter weight and profitability of sheep farming in Bangladesh (Alemu, 2008; Hossain et al., 1997). The increase in body temperature is associated with marked reduction in feed intake, redistribution in blood flow and changes in endocrine functions that will affect negatively the productive and reproductive performance of the sheep (Alam et al., 2011). High ambient temperature and humidity are the major constraint on sheep productivity in tropical and sub-tropical areas (Marai et al., 2007; Hashem et al., 2013; Hossain et al., 2021).

In three ecological zones like Jamuna basin, Barind tract, and Coastal belt areas in Bangladesh, about 32% of 2.7 million sheep are reared (DLS, 2021). Interestingly, 25.32% of the total numbers of the sheep breeds are found in Asia and the majority (64.43%) of the total sheep populations in the world is found in Asia (Hossain et al, 2018a). Though the number of these sheep is satisfactory, but their performance is very poor. Nutrition is one of the major limiting factors of lamb production in Bangladesh. We know that more than 90% of the feed consumed by the ruminants is roughages. Most of the sheep can be easily maintained under rural conditions because of their ability for adaptation on harsh environment, poor management and feeding practices can solve the crying needs of animal protein partially (Hashem et al., 2020; Haque et al., 2022). Hassan and Talukder (2011) observed that the breeding performance was comparatively better for Jamuna basin sheep than for Costal and Barind sheep in terms of liter size. Ahmed et al. (2018) studied lamb production potentiality and growth performance, daily gain in three regional native sheep and found coastal sheep more potential. Islam et al. (2018) explained indigenous sheep from twelve Upazilas productive and reproductive potential and identified significant variations in production

of lambs. Since sheep are resistant to parasitic and infectious diseases compared with goats and cost-effective rearing on natural grass with less care (Ahmed et al., 2018). Sheep can influence livestock production and income generation. However, a farmer who keeps many sheep is not productive because of poor genetic values.

This production system causes reduced growth rate and poor reproductive performances, which in turn results in severe economic losses. Sheep are reared only for meat purposes in Bangladesh and are normally slaughtered to get meat for human consumption. Sheep and goats represent 7.17% of the total livestock population in Bangladesh (DLS, 2021). Rural people are engaged in rearing more than 98% of goat and sheep production. More than 70% of the rural people are directly or indirectly engaged in the agricultural operation of which about 85% are landless farmers in Bangladesh having no or very little land for their homestead only (DLS, 2021). With the increasing demand for lambs nationally and the availability of suitable land in Bangladesh, there is a real opportunity for the expansion of sheep producing community in the rural areas of Bangladesh. To be successful in the sheep industry it is imperative that sound business decisions are made from the initial planning through to the marketing and selling of the lambs, wool or milk products. There is a significant investment of capital required like any farm operation for the establishment of a sheep farm, either as a stand-alone operation or as an opportunity to diversify an existing farm. Different non-popular species including sheep might be emphasized as an animal for meat production. At present, the Department of Livestock Services (DLS) has given special attention to sheep raising and farmers are now very interested in sheep farming for lamb production to make up the existing meat requirements of Bangladesh.

The dietary nutrients including energy and protein play a vital role on affecting meat production in goats and sheep (Sultana et al., 2010). Good nutrition and management practices play an important role in sheep production (Sarker et al., 2017; Sun et al., 2020; Hossain et al., 2018b). However, sheep growth performance, yield and carcass quality and non-carcass parts under feedlot conditions may differ depending on the factors of breed and age of animal when entering the feedlot or the duration of staying in the feedlot (Moniruzzaman et al., 2002). Increasing levels of concentrate feeding in adult sheep showed increased of carcass fatness which improves the tenderness due to the presence of intramuscular fats (Nishimura, 2010). According to Majdoub et al. (2013), nutritional levels especially concentrate feeds are very closely related to carcass yield, carcass quality and fat deposition. The effect of the grazing system is the presence of natural antioxidants in green grass which can assist to limit meat oxidation (Wood et al., 2004). Jamuna basin lambs achieved an ADG of 46-55g in active growing phase and marketed for slaughter at 9-12 months of age weighing about 15-18 kg (Hashem et al., 2020). The alternative way to overcome the feeding problem might be to develop a system of finishing sheep on high energy supplementary feeds before marketing the lambs. Pasture-fed lambs have leaner carcasses, lower dressing%, whereas concentrate-fed lambs showed higher growth rates, better carcass conformation, and lower ultimate pH (Zervas and Tsiplakou, 2011).

Litter size

Litter size did not differ significantly among the three areas but was higher in Jamuna area (Hassan and Talukder, 2011). Nimbkar et al. (2002) found that the average litter size of Garole x Deccani sheep was 1.6. Bhuiyan and Curran (1991) reported that litter size of Romney marsh ewes differed with age and year. Rahman and Huq (1976) found in Native ewes 48% single and 52% multiple births. Sharma et al. (1999) noted average litter size of Garole was 1.7 with 40% single, 53% twins, 5% triplets and 1.7% quadruplet. However, Bose et al. (1999) recorded litter size in Garole as 1.7 with percentage of single, twin, triplet and quadruplet is 42, 43, 15 and 0.2, respectively. According to Pan et al. (2004) average lambing frequency was 1.6 - 1.9, but Singh and Bohra (1996) found litter size at first lambing in Garole was 2 and at subsequent lambing 2.3. Banerjee (2008a) reported litter size 1.9 in native Bengal Garole. A number of reports on the Garole sheep are available from different palces of world. Ghalsasi and Nimbkar (1993) reported the average litter size of Garole sheep was 2.27 with 7.3% single, 64.45 twins, 21.8% triplet and 5.45% quadruplet while Ghalsasi et al. (1994) found the average litter size 2.23 with 9% single, 65% twins, 21% triplet and 5% quadruplet. Bose et al. (2000) reported the litter size in Garole was 1.74 with single, twins, triplet and quadruplet 41.63, 43.35, 14.81 and 0.21%, respectively. According to the report of Pan et al. (2004) the average lambing frequency was within 1.63- 1.94 and with single 24%, twins 66.4%, triplet11.55 and quadruplet 0.2%. Singh and Bohra (1996) noted average litter size at first lambing in Garole as 2 and in subsequent lambing it were 2-3 with single birth frequency of 25-30%, twins 55.66%, triplet 15-20% and quadruplet 1-2%, respectively. Nimbkar et al. (1998) found the average litter size was 2.03± 0.9 with the percentages of single 35, twin 57, triplet 7 and quadruplet 1 in deccan plateau of Maharashtra. In a recent survey, in the native tract of Bengal Garole it was reported that Garole litter size was 1.86 with single 23.9%, twins 67.22%, triplet 8.31 % and quadruplet 0.57% was recorded by Banerjee et al. (2008b). All these sheep isolated geographically in different rivers and Sea in its native tract, we may loss this precise valuable outstanding genetic resources completely in near future. The overall result of the study on litter size was 1.85±.01 (Sarder et al (2015) whereas almost similar results 1.74 were found by Held et al. (2005). But Demirel et al. (2004) reported that lamb number per mated was 1.09±0.43 of Norduz ewe. Lassouedinsta and Rekik (2001) observed the litter size of Queue Fine de I'Ouest pure breed and their first cross with the D'Man were 1.07±0.26 and 1.26±0.44 kg, respectively. The variation of litter size may be the following factors; *viz.* breed generation, parity, age, body weight, better nutrition and environmental conditions, sample size and management practices.

Birth weight, weaning weight and matured weight of native lamb

Sarder et al. (2015) found the overall birth weight of lambs was 0.96±0.23 kg whereas Musa et al. (2005) reported 2.90±0.50 kg. Musa et al. (2005) found that the weaned period was approximately 3 months which was similar to the study of Hashem et al. (2020). Birth weight and weaning period are affected by genetic, physiological, litter size, weight of ewe at parturition and environmental factors, with significant differences reported for sex (Valencia et al., 1975; Combellas et al., 1979). Josefina de Combellas (1980) reported that the mean values in improved production systems were 2.6 kg birth weight and 1.3 lambs per parturition. Hashem et al. (2020) found the average birth weight of Jamuna basin lambs for male and female was 1.47 and 1.45 kg and weaning weight 6.77 and 6.51, respectively. Mean birth weight of male was little higher than female and subsequently, the mean body weight of Jamuna basin lamb was higher in male throughout the experimental period up to 12 months. Mean birth weights of lambs, weaning weight and mature weight were 1.7 vs. 1.3 kg; 8.9 vs. 6.9 kg and 24.9 vs. 19.4 kg in Rajshahi and Mymensingh, respectively (Al Mansur et al., 2018). Researchers found that lamb birth weight 1.2 kg (Husain and Amin, 2003)

and 1.00 and 1.33 kg in controlled and supplemented group (Zohara et al., 2014). The mean weaning weight of indigenous lambs obtained by Al Mansur et al., (2018) that was lighter than weaning weights of other breeds (Awgichew, 2000; Tibbo, 2006). They found the mature body weight were also significantly higher ($p<0.001$) in sheep of Rajshahi (24.9±7.3 kg) compared with Mymensingh (19.4±2.7 kg). This higher mature body weight could be due to the effect of breed. Asaduzzaman et al. (2022) found the mean matured body weight of Jamuna basin, Barind and Coastal belt male and female sheep was 17.84, 14.62; 16.85, 15.95 and 19.19, 16.16 kg, respectively. Sultana et al. (2011) reported the mean birth weight and weaning weight of Bengal sheep for semi-intensive and intensive rearing were 1.56 & 1.60 and 7.3 & 7.7 kg, respectively. Murshed et al. (2014) showed the average matured body weight of Black Bengal Goat and indigenous sheep were 19.03 and 19.35 kg, respectively. Initial and final body weight were 12.3±0.60 and 12.5±0.57, 12.33±0.33 and 12.83±0.33, and 12.66±0.88 and 13.0±0.57 kg for non-exposure, 4 hours and 8 hours of heat exposure to the sheep respectively (Rana et al., 2014).

Average daily gain (ADG) of native sheep

The ADG of one month and 12 months for winter and summer seasons were 183.33 & 170.00, and 50.30 & 48.27 g/day, respectively. Season (winter and summer) had a significant ($p<0.05$) influence of 3-months (98.44 and 72.33), 9-months (54.59 and 51.78) and 12-months (50 and 48.27) g/d on ADG. The ADG for single, twin and triplet were 131.00, 108.67 & 107.67, 76.44, 70.56 & 68.33, 56.33, 52.22 & 53.44, 54.59, 55.22 & 46.85 g/d, respectively at same ages. The effect of litter size had highly significant ($p<0.001$) on ADG at birth to one month of age. Litter size had also significant ($p<0.05$) effect on ADG at 6 and 12 month of age (Hashem et al. 2020). Hossain et al. (2021) found the ADG of Jamuna basin lamb was 57.39, 59.80 and 58.15 g/d in 6, 9 and 12 months of age, respectively which was non-significant ($p>0.001$). Hossain et al. (2022b) reported the ADG of Jamuna basin lamb for grazing and stall feeding were 61.61 and 53.79 kg. The ADG was 35 and 79 g in sole grazing and concentrate supplementation groups, respectively reported by Chellapandian and Balachandran (2003). Yeaman et al. (2013) reported that the ADG was 340 g for Dorper lambs and 346 g for Rambouillet lambs in intensive feeding system. Kawsar et al. (2006) and Sarkar et al. (2008) found a much lower ADG of Black Bengal (BB) goat with a supplementation of 300 g UMB with 6 hours grazing. Moniruzzaman et al. (2002) found a higher ADG in stall fed BB goats as compared to grazing system. Huq et al. (1996) found that ADG of BB goats were 52 and 47 g with a supplementation of 120 g fish meal and UMB, respectively along with pasture grazing. Body weight and ADG were higher in male than female lambs at different ages. The ADG and total live weight gain were significantly ($p<0.01$) higher in Costal sheep than Jamuna and Barind sheep found by Ahmed et al., 2018. Mobin et al. (2022) reported the average ADG of Jamuna basin; Barind and Coastal lamb was 59.07, 53.15 and 61.17 kg, respectively. The higher ADG (64.88 g/d) was in Coastal belt lamb compared to Jamuna basin lamb (61.02 g/d) and Barind region lamb (38.47 g/d) reported by Hossain et al. (2022a). The ADG was found significantly ($p<0.05$) higher in uncastrated than castrated lambs (Hossain et al. 2022a). Same trend was found by Sultana et al. (2010). The higher ADG for uncastrated lambs compared to castrated lambs was in close agreement with the findings of the study of Fogarty and Mulholland (2012). The ADG gains in uncastrated lambs are responsible to male sex hormones like testosterone (Kiyma et al., 2000) which triggers the increased of dietary nitrogen utilization efficiency and decreased fat deposition in muscle. Higher ADG (58.85 g/d) was found for 1.5% supplementaion of Jamuna basin lamb compared to 2% (55.69 g/d) supplementaion reported by Hossain et al., 2023).

Wool and milk production

Horton and Rodriguez (1997) showed the difference between hair (St. Croix) and wool (Targhee and Dorset) of lamb and the effect of heat stress on food and water intake, digestive function and nitrogen balance. They concluded that hair sheep were more heat-tolerant than wool sheep due to more feed intake, gained more body weight and improved digestibility when they exposed to elevated temperatures. They observed the significant effect of cortisol acetate on wool quality in sheep selected for divergent staple strength. Smuts et al. (2001) evaluated the role of sheep breed and mohair style in the OFDA curvature vs. staple crimp/wave frequency relationship. They summarized the OFDA curvature can be used as a measure of wool staple crimp and mohair wave frequency without the need to take either sheep breed or mohair style and character into consideration. Wool grading and Marketing Rules mentioned to issue Conditioning Certificate which denotes clearance from quality control through different gradation testing procedures. Rodny in 1993 mentioned different methods like American system, English or Spinning count system and the Micron system to evaluate certain qualities such as fineness, length, color and appearance that determine the end use and value of wool. He also discussed fineness, the fiber diameter and its distribution, as the most important quality factors for grading. Fairness largely determines whether the wool is used in a suit, sweater and blanket. Singh (1997) discussed details regarding all aspect of wool growth, structure, production, properties, grading and processing. Bose et al. (1999) conducted a study on wool characters of Garole sheep and found that wool of Garole was extremely coarse, hairy and not very dense. Bose and Maitra (1999) showed that annual average greasy fleece yield from each Garole sheep was 152 g. Sharma et al. (1999) observed average annual adult wool yield from each Garole sheep procured from Sundarban area was 179 g. This wool was used for rough carpet. Singh and Bohra (1996) studied on wool parameter of Garole sheep and found the average wool yield was 150 g per shearing from each Garole sheep which was of rough carpet type wool. The average annual production of wool per sheep was around 300 g reported by Prasad (1997). Pan et al. (2004) showed that shearing was not all common practices, although each Garole sheep was capable to yield about 400 g greasy fleeces annually. The average wool production per cutting and the annual wool production of native sheep was significantly ($p<0.05$) higher in Coastal than Barind and Jamuna areas. Wool production was higher in the summer than in winter. Thus, the Coastal sheep had higher body weight and wool production. In India, Khan et al. (2003) found that wool production was 1.3 kg/year in Tirahi breed of sheep which was higher than the native sheep. The milk production of native sheep was very low. Per sheep milk production was about 250-270 g/d in Jamuna basin sheep. Average milk yield was not significantly ($p>0.05$) higher (264.5g/d) in intensive system than semi-intensive feeding system (281.0g/d) reported by Sultana et al. (2011).

Disease and mortality

Internal parasites and a few bacterial and viral diseases create a great threat of sheep farms. Native sheep have low prolificacy and high worm infestation that greatly affect productivity around the most agro based industries of the country. The impact of these parasitic infestations is decreased appetite and disturbances on energy, protein and mineral metabolism which lead to reduce productivity. Some blood protozoa and blood suckling parasite causes anaemia. Some bacterial diseases namely foot rot

or infectious pododermatitis or Gid (*Multiceps multiceps*) and viral diseases like PPR, FMD, sheep pox etc. damage the sheep husbandry. Recently anthelmentic or drug resistance is posing a problem resulting in the development of sustainable Integrated Paste Management (IPM) principles of worm control and/or genetic resistance of host against some bacteria or virus. Pan et al. (2004) showed no trematode infection in Garole sheep and in gastrointestinal tract of infection was around 54.6% followed by abortion, repeat breeding, and placenta retention, post-gestational mortality was 7.82, 9.35, 2.62, and 14.08%, respectively. Nimbkar et al. (2000) performed analysis regarding comparison of the growth performance and worm resistance of lambs produced by diallel crossing of Indian three sheep breeds like Deccani (D), Bannur (B) and (Garole (G) and they proved that lambs sired by G and B rams were more resistant to naturally acquired worm infections and to artificial challenge to *Haemonchus contortus* than those sired by D rams. The lambs sired by D and B rams were higher birth weights and growth up to 6 months of age than those sired by G rams.

The average lamb mortality of native sheep was 12.4%, in July-October, 17.6% in November- February and 12.5% in March–May (Hassan and Talukder, 2011). Nimbkar et al. (2002) found that the average lamb mortality was 13.8% in Garole sheep of India. Diarrhoea, respiratory disorder, bloat, lice and skin diseases were the most common diseases found by Hassan and Talukder (2011). From birth to puberty, diarrhoea and pneumonia were the most common problems in all areas. In adult sheep, incidence of parasitic infestation was higher in Coastal than in Barind and Jamuna areas. On the other hand, highest alopecia (14.2%) was in Coastal but conjunctivitis was more common in Barind (7.5%) areas. The incidence of other diseases was similar in all areas. Hoque and Mollah (1972) found that native sheep commonly suffer from lice infestation. Nooruddin et al. (1988) found lice infestation in 58% of sheep, dirty fleece in 18%, mange and mycotic dermatitis in 12%, and other skin diseases in 11%. Sheep were not affected by peste des petits ruminants. Most of the diseases occurred in the rainy season and lambs were mostly affected. Garole sheep are considerably more resistant to the roundworm *Haemonchus contortus* as well as to typical liver fluke (Nimbkar et al., 2002). Banerjee (2008a) mentioned that Garole sheep are resistant to internal parasites, liver fluke, bacterial and viral diseases. The number of lambs born per ewe was certainly an economically important trait in a commercial sheep enterprise. Knowledge of when and how lamb mortality occurs could be helpful to keep the mortality rate to be a minimum. The mortality rates were found 11.11% (Hashem et al, 2020). Hassan and Talukder (2011) found average lamb mortality (12.4%) in native sheep. Nimbkar et al. (2002) found 13.8% mortality in Garole sheep of India. Mortality observed relatively high after 3 month of age compared for other periods due to weaning shock of lambs' reported by Hashem et al, (2020). Better management practices before lambing and care of lambs from birth to four months of age could play an important role in reducing mortality. It was expected that lambs weaning with lower weights would have less growth rate by the effect of weaning stress and poor quality of native pasture. The mortality was higher at this period due to mis-mothering, low birth weight, age of ewes, immunity acquired by the neonatal through colostrums, suffers from malnutrition, weak resistance and affected by diseases. Mortality rate was higher in hilly area than char area due to lack of green grass, better management and geographical location. Mortality rate of winter season (15%) was higher than summer (7.32%). The seasonal differences in mortality might be the result of severe drought conditions leading to fodder shortage in the study areas. Triplet mortality was higher than single and twin lambing due to lacking of mother's milk and faulty management. This result was agreed with the result of Mustafa et al. (2014). Fifteen group flock size mortality was higher than five and 10 group flock due to lacking of sufficient floor space, adequate nutrition and weak management. Total mortality was found 23% at neonatal stage. The neonatal period was the most vulnerable time in the life of a lamb with almost half of all pre-weaning mortalities occurring on the day of birth (Nowak and Poindron, 2006). The causes of neonatal death was poor management, poor mothering of ewes, pneumonia and other infectious diseases. Hasan and Talukder (2011) reported that death was 23 and 15.4% due to diarrhea and pneumonia of Jamuna basin sheep. The causes of death are more difficult to diagnose without a full necropsy of lambs. Lamb mortality could be greatly reduced by slight modifications of lambing management. Metabolic disorders and diseases are certainly the prevalent causes of death. Mortality rate was higher in diarrhoea disease. Pneumonia and gastroenteritis were the major diseases which caused the highest mortality in lambs (Mustafa et al., 2104). Proper feeding of the pregnant ewes minimizes the scope of lamb mortality. More than 3-4% of all mortality had its causes in faulty or inadequate management of ewes and lambs. Simple improvements in the overall management of the flock before, during and after lambing would be greatly reduced the number of deaths. There was no miracle drug for a dead lamb, practically none for a weak lamb and if the lamb is healthy, it does not need any drug. Reducing lamb mortality to an acceptable level should be up to 4 to 5% of any sheep producer is desirable (Hashem et al., 2020).

Conclusion

The smaller flock size of native sheep farm might be due to lower growth performance that does not fulfill the farmer's demand. Body weight, litter size, growth rate and breed type are the vital focus points of smallholder sheep keepers. The sheep producers in all study areas always practice a free mating breeding system; the farmers of these areas are not interested for the selection of superior rams. Most of the farmers bred their ewes with their own flock-born or neighborhood non-selective small size ram. Moreover, every farmer does not adopt a breeding ram. The inbreeding might be another reason for the poor growth performance in these areas. Muzaffarnagari cross-breed sheep producers are aware of the selective breeding system. Diseases and parasite infestations play a vital role on the constraints of sheep production in study areas associated with revenue loss to the farmers and stockholders. Due to good body weight and body size according to studied reports, farmers of different districts are adopting Muzaffarnagari cross-breed sheep to meet their socio-economic demand. In contrast, lower values of the reproductive traits of Jamuna basin sheep showed a more productive sheep breed than the Muzaffarnagari cross-breed sheep. Moreover, the higher number of lamb production and female lambs also looked on Jamuna basin sheep as genetically productive sheep. These improved reproductive performances are factors for farmers' and breeders' choices in sheep production. On the contrary, lower growth performance and ADG of the lambs of native sheep are not fulfilling their demand.

Conflicts of Interest

The authors declare that there are no potential conflicts of interests.

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