Research Article

Characterization of Phenotypic Traits and Socioeconomic Importance of Native Horses in Bangladesh: Current Status and Way Forward

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Abstract | Horses have been an integral part of Bangladesh's cultural and economic landscape for a long time and serve diverse roles. This study aims to characterize the phenotypic traits of native horses and investigate the management practices and socioeconomic status of horse owners. A total of 233 horse-rearing households were interviewed by structured questionnaire from selective locations covering all divisions of Bangladesh. Phenotypic traits (Body weight, body length, chest girth, neck length, head length, ear length, wither height, back height, length from ear to tail, mane length, tail length) and reproductive features (Age of 1st heat and conception, foaling interval, gestation length and estrous length) were recorded for phenotypic characterization (n=240). Half of the farmers (53.20%) possess a basic level of education and agriculture is the main occupation (43.30%) followed by business. Horses are reared for income generation (77.3%) and farmers prefer stallions (43.65%) over geldings for rearing. A semi-intensive rearing system is identified where farmers provide a combination of roughage and concentrate feed. Bloat, diarrhea, colds, fevers and skin diseases are common among others. Mares experience first heat at 24.02±2.61 months and conceive at 27.09±3.64 months. Foaling length, gestation interval and estrous length were recorded as 26.98±3.14 months, 11.58±0.46 months and 21.25±0.75 days respectively. Chestnut and bay are the predominant coat colors among others. Male horses have higher (p<0.05) body length, neck length, head length, wither height, back height, ear-to-tail length and mane length than female horses. Bangladesh has no horse breed, and indigenous horses are smaller in size with homogeneity of reproductive and phenotypic features. Genetic characterization is recommended to identify the origin of indigenous and crossbreeds including samples from nationwide.

Keywords | Horse, Indigenous, Socioeconomic condition, Phenotype, Characterization, Bangladesh

INTRODUCTION

Horses are one of the earliest forms of transportation for humans, revolutionizing travel and trade. They enabled faster and easier movement of goods and humans across vast distances, contributing to the development of trade routes and cultural exchanges. It is thought that horse domestication started on the Eurasian steppes, specifically in areas of modern-day Kazakhstan and Ukraine, between 4000 and 3500 BCE (Warmuth *et al.*, 2012). This procedure involves the capture and selective breeding of wild horses for use in agriculture, warfare, and transportation, among other applications. Modern horses were domesticated dating back to around 2200 years BCE in the northern Caucasus and in the following centuries they began to spread throughout Asia and Europe (Librado *et al.*, 2021). In Bangladesh, the horses predominantly belong to non-descript indigenous types with genetic similarities to

Arabian and Persian horses that migrated from the West to India (Nozawa, 1988).

Horses have served various purposes and have been valued by people of different cultures and social classes in Bangladesh. English lords and members of the loyal families considered them symbols of pride and utilized them for hunting, warfare, and transportation, while the working people relied on horses for their livelihood. In the Indian subcontinent, horse carriage was oriented during the British period. Soon after the arrival of British people, the culture of horse carriage become more popular among the local landlords and horses spread throughout the country (Rajib-Kanti, 2018). With the progression of human civilization and the modernization of the transportation system, the horse carriage system became less popular but that does not limit the uses of horses in this region. People find themselves using the horses for other purposes and they become more versatile in their uses. In old Dhaka, horse carriages still carry the culture of a long history and carry passengers from Gulistan to Sadarghat. However, horse carriages in rural areas of Rajshahi, Mymensingh, Netrokona, Dinajpur, Naogaon and Jessore still transport passengers and goods.

Horses are used in Bangladesh for several purposes, but people mostly use them for pulling carts and transportation. Presidents Guard Regiment, Sarda Police Academy, Police Headquarter, Remount Veterinary and Farm Core (RVFC) and Border Guard Bangladesh (BGB) use very few numbers of exotic horses (Bhuiyan, 2014). In some specific village areas, horse racing is still popular. Currently, their habitat distribution is clustered across the country mostly depending on their purposes of use. Due to their versatile nature of use, horse plays a very important role in uplifting the socio-economic status of horse owners in some specific regions of the country. Income generated from horse rearing also varies on different regions and purposes of use. Among the horse keepers, 88% of them were involved in pulling horse carts either for draft purposes or passenger which would generate about BDT 3000 to 20000 per month (Alam et al., 2015).

Although horses have a greater contribution to improving the socioeconomic status of the farmer, however, their potentialities are often overlooked and even neglected. Consumption of horse meat is prohibited in Bangladesh due to religious beliefs. As a result, after serving humans for 10-15 years, horses often face neglect and cruelty when they become unable to work and eventually perish without proper care or food. Despite the significant social and economic impact of this species, there is little Government attention to reveal and subsequent improvement of the potentialities of this species. Research activities are also scanty and their feeding, breeding, and disease management are yet to be revealed.

Phenotypic studies of native livestock species are crucial, as phenotypic characteristics are closely linked to their productivity and reproductive performance (Pandey et al., 2001). Previous studies have explored the morphometric characteristics, productive and reproductive performances, and socioeconomic status of horse owners (Alam et al., 2015, 2016; Nozawa et al., 1998). An earlier study shows that there is greater variability of coat color, morphometric features and productive and reproductive characteristics (Alam et al., 2016), however, this study was focused on specific regions that limit the actual scenario of horse husbandry and their morphometric characterization across the country. There is lack of sufficient information on phenotypic characterization, feeding, breeding, disease incidence, and reproductive management, constraints of horse rearing and prospects of horse farming in Bangladesh.

This study aims to comprehensively investigate the morphometric characterization, socioeconomic significance, and cultural importance of horses in Bangladesh. The findings will shed light on the current status of horses and identify areas for further research, enabling appropriate interventions within the institutional framework to maximize their potential benefits for both the species and their human dependents.

MATERIALS AND METHODS

STUDY AREAS

The study focused on evaluating horse husbandry, analyzing morphometric traits of horse genetic resources, and assessing the socio-economic impact on horse-rearing farmers. Selected areas from all administrative divisions were chosen based on their horse-rearing significance with emphasis on cultural, historical, and economic aspects (Figure 1).

Figure 1: Representative study locations of eight administrative division (Source: Map generated by https://www.canva.com/create/icons/).

DATA COLLECTION

A structured questionnaire was prepared considering the socioeconomic status of the farmer (education, income, and occupation) including the management, housing, feeding, breeding, diseases and utility of horses. The questionnaire includes phenotypic traits (body weight, body length, chest girth, neck length, head length, ear length, wither height, back height, length from ear to tail, mane length, tail length) and reproductive features (Age of 1st heat and conception, foaling interval, gestation length and estrous length) for phenotypic characterization. Morphometric data of male and female horses was measured by measuring tape. Coat color and face mark were recorded by analysis of the representative image of the horse. Data was collected from 233 horse-rearing farmers across the country covering all of the administrative divisions. Data was recorded from 240 horses (Male=182, Female=58) for phenotypic characterization. Apart from individual data collection, we have conducted group discussions with farmers/stakeholders from different horse-rearing communities (cart pullers, racers and farmers). The focus of this group discussion was to identify the problems and prospects of each horse-rearing community and prioritize areas of development for future research.

STATISTICAL ANALYSIS

Socio-demographics, physical characteristics, coat color and face color data were expressed in percentage or frequency. Reproductive performance data were expressed as mean values with standard error (Mean±SE). Independent sample t-tests were conducted to analyze the differences in morphometric features (Body weight, body length, chest girth, neck length, head length, ear length, wither height, back height, length from ear to tail, mane length, tail length) between male and female horses at 2-6 years and Age 7-above. Data was analyzed with SPSS software (version 25.0) and representative figures were generated by GraphPad Prism 8.0.2. A significance level of $p<0.05$ was used to determine statistical significance.

RESULTS AND DISCUSSION

SOCIO-DEMOGRAPHICS OF HORSE RARER

The socio-demographic profile of a certain group is significantly shaped by education, which offers important insights about the people working in that profession. Approximately 53.20% of farmers in our survey have only completed primary school, while 25.30% have a basic education, meaning they can read and write only with limited skill (Figure 2). On the contrary, 9.00% of farmers are illiterate, and only 8.60% have completed secondary education. Our results are consistent with Bangladesh's average literacy rate of 74.66%, with 81.28% in urban areas and 71.56% in rural regions (Bangladesh Bureau

of Statistics, 2022). Notably, the prevalence of illiteracy among horse farmers in the Mymensingh Division stands at 84.7%, which is significantly higher (Alam *et al.*, 2015). In contrast to other research, our data collection included a varied range of farmers who lived in towns, villages, and tourist places. In contrast to the lowest illiteracy rates (0% in the Mymensingh and Chottogram divisions), farmers in the Sylhet division have a greater rate of illiteracy (41.70%). The literacy rate of horse farmers in various regions of Rajasthan, India was reported as 86%, 43%, 80%, and 45% in Hanumangarh, Churu, Jhunjhunu, and Jalore, respectively (Pal *et al.*, 2021). Although this study reflects the literacy levels in India, which differ from Bangladesh, it highlights the varying educational backgrounds among horse farmers.
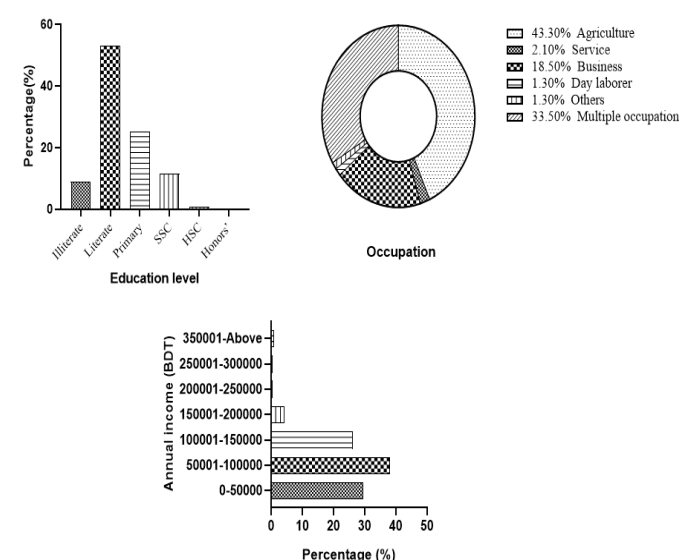

Figure 2: Socio-demographics of horse farmer.

The utility of the horses is affected by the seasons of the year. Farmers cannot depend only on horses as their main source of revenue throughout the year. Around one-third (33.50%) of households have more than one occupation. Among the variety of occupations that exist in the surveyed area, agriculture was the prime occupation (43.30%) followed by business (18.50%) (Figure 2). Horse pulling cart (88%) is the prime profession of horse rarer in Mymensing division followed by agriculture (81.5%) as a secondary profession (Alam *et al.*, 2015). Our study also reveals that agriculture is the prime secondary profession of the horse rarer. Rearing horses as an alternative to agriculture is also profitable, as a study indicates that one horse can support twenty people for their livelihood (Brooke, 2007). There are a variety of factors that determine the income of horse rearing, the factors include; the purposes and area of the rearing, types of the horses (stallion/mare), physical strength and the season of the year. With differences between studied locations, categorized income data shows that the majority of farmers (38.20%) are in the BDT

50001-100000 income group (Figure 2). In Muktagacha and Cox's Bazar, farmers receive more money from horse-related activities. In Cox's Bazar, this is attributed to the use of horses for recreation purposes on the sea beaches, where tourists take pictures with horses and occasionally ride them. The income generated in this context is not fixed as it depends on tourists' mode of spending and the season of the year. In Mymensingh, horses are primarily used for carrying pineapple and bananas during the harvesting season, resulting in higher income during that period. The variation in income throughout the year was also reflected by earlier studies, where income was higher in the rice and fruit harvesting season and lower in other periods of the year (Alam *et al.*, 2015).

PURPOSE OF HORSE REARING

The majority of farmers (77.3%) rear horses primarily as a source of income followed by tradition (12%) (Figure 3). Horses are regularly bought and sold by farmers, sell them during times of low income and buy them during times of higher income. All year long, this cycle is repeated. Some farmers care for their herd year-round and have a family history of raising horses. They buy and sell horses on purpose, but they always make sure to keep horses in their herd. In some regions of Sylhet, some people raise horses just as a hobby or for cultural reasons.
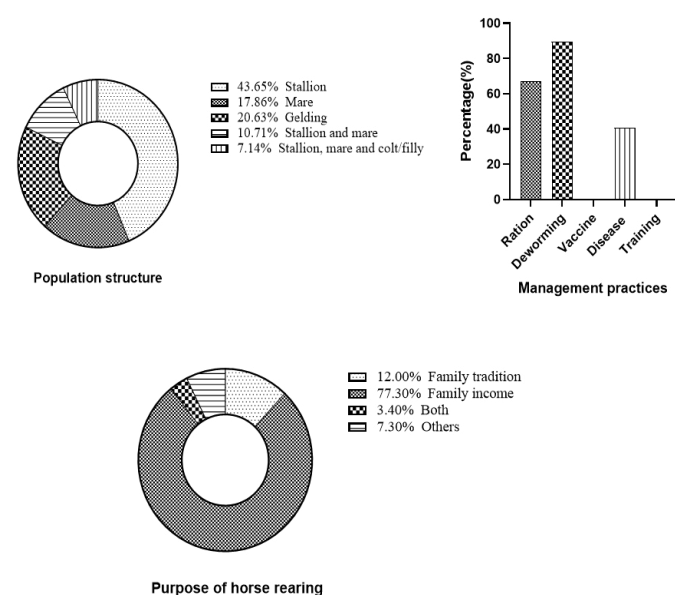

Figure 3: Population structure, management practices and purpose of horse rearing.

POPULATION STRUCTURE AND HORSE TYPES

Horses in Bangladesh primarily serve draft purposes, with a notable preference for stallions over mares due to their superior strength and vigor. Data illustrates this preference, with stallions accounting for the majority (43.65%), followed by geldings (20.63%) and mares (17.86%) (Figure 3). Regional variations also highlight this trend,

particularly in Chattogram and Sylhet divisions, where a significant percentage of horses are stallions (82.40% and 91.70%, respectively), primarily used for riding activities. The limited interest in horse breeding among farmers results in fewer mares and colts/fillies in their herds. Farmers have less interest in horse breeding resulting in lower proportions of mares and colts/fillies in the study area. Irrespective of sex, farmers use both the stallion/mare for draft purposes, and if the mare becomes pregnant it cannot be used for draft purposes with its full physical strength, furthermore at the later stage of pregnancy and shortly after giving birth, they cannot be used for draft purposes. Given the limited milk production of horses and the prohibition on consuming horse milk and meat in Bangladesh, as well as the lower market value for colts/fillies rather than stallion and gelding, the composition of farmer herds tends to be biased towards stallions rather than mares.

Despite Bangladesh's long history with horses, the nation doesn't have any purebred horses. Native horse varieties make up 86.7% of the total, while crossbred horses (12%) are distinguished by phenotypic characteristics including increased size and strength. Conversations with different stakeholders indicate that these hybrids might have come from nearby nations like India, which is renowned for its varied horse population and well-established horse breeds like Kathiawari and Marwari. However, to confirm the genetic makeup of these assumed crossbreeds, further genetic characterization should be conducted.

HOUSING MANAGEMENT

Horses are maintained in a semi-intensive (90.60%) farming system followed by free-range (7.70%) rearing. Horses are tethered during the day in roadside or fallow lands and provided with fodder through a cut-and-carry system. At night, they stay in small shelters located near the farmer's house. The house is open type where tin/straw or polythene is used as a roofing material. In the winter, straw is occasionally used as bedding, and the house floors are composed of mud or a combination of mud and sand. Horses are very sensitive animals and concrete floor is responsible for the laminitis of horses. Horses in different regions of Rajasthan are also reared on kutchcha floor (Pal *et al.*, 2021). Asbestos, tin and concrete roof are common for housing horses in Rajasthan. An average 73.36% of horses in Kashmir valley are reared in Kucha house (Bhat *et al.*, 2018). All farmers in the Mymensigh division reared horses in a semi-intensive system (Alam *et al.*, 2017).

FEEDING MANAGEMENT

Horses can digest both cellulose and hemic-cellulose diets since they are non-ruminant herbivores. The horse feeding systems used throughout Bangladesh vary greatly, primarily depending on the purpose of rearing. Horses reared in

regions intended for various forms of load transportation are primarily fed a well-balanced mix of concentrate and roughages. Nonetheless, horses are mostly fed an unbalanced diet consisting of several concentrate feeds in urban areas like Dhaka, where they are primarily utilized for passenger and horsecart transportation. Approximately two-thirds of farmers supply both roughages and concentrates (66.98%), while the remaining farmers are less concerned about providing a balanced ration (Figure 3). The concentrated food consists primarily of rice polish, wheat bran, crushed maize, crushed black gram, and various kinds of oil cakes with minimal or no additions or supplements. Typically, farmers purchase these feed items individually from the market, mix them and feed the animal according to the thumb rule. Most Indian farmers supply oats, barseem, dub, jowar grass, and straw as green and dry roughage, and oat and wheat bran as concentrate feed for horses in various regions (Pal et al., 2013). While Indian farmers feed their horse's different feed additives (milk or ghee) throughout the winter, they also supply mineral mixture and locally manufactured masala as mineral mixtures (Pal et al., 2013). Horses other than Dhaka City and Cox's Bazar and Kuakata Sea Beaches have opportunity to have more time for grazing, whereas horses in Dhaka city and sea beaches areas are mainly provided with a mixture of concentrate feed and supplied with dry roughages and limited grazing.

BREEDING MANAGEMENT

Farmers show less interest in horse breeding and intentionally they try to avoid breeding. With no facilities for artificial insemination, natural breeding is the predominant method (100%) in use. When it comes to natural breeding, farmers typically rely on stallions from neighboring families, without considering their genetic background, and often without any cost involved. also reported All horses are bred with natural mating in the Mymensingh division, where 95.5% of farmers rely on a neighboring stallion to breed their mares (Alam et al., 2017). Normally, horses are reared in a cluster within a village or specific area. Farmers share common places for horse bathing and sometimes horses are grazed in the same place, so if a mare shows heat they mate with the stallion naturally.

DISEASES MANAGEMENT

Horses are less susceptible to certain infectious diseases that commonly affect other livestock species. For example, they are not prone to diseases like foot and mouth disease, which can affect cattle and sheep. However, they are susceptible to colic due to their complex digestive system. Approximately 40.78% of the farmer responded that their horses suffered from various illnesses. The most frequently observed diseases are bloat, diarrhea, cold, fever, and different types of skin diseases. No particular medical

intervention or treatment regimen has been developed for the care of horses. Farmers frequently turn to treating horses with the same drugs and techniques as cattle. However, due to species differences, horses have distinct biology, making it challenging for farmers to treat diseased horses. Although 89.7% of farmers deworm their animals on a regular basis and they use the common anthelmintic (LT-vet, Anti-worm, Livanid, Amectin plus-vet, Livavet, etc.) found in the local market that is suitable mostly for bovine species (Figure 3). Remarkably, none of the farmers have ever vaccinated their horses.

REPRODUCTIVE PERFORMANCE

Mares usually reach sexual maturity at two years of age, and they mate for the first time at about 27 months (Table 1). Foaling length, gestation interval and estrous length were found 26.98±3.14 months, 11.58±0.46 months and 21.25±0.75 days respectively (Table 1). Mares do not breed all year round; instead, they prefer to breed in the summer, when daylight lasts longer than usual. The first heat is recorded in Lusitano native thoroughbreds as early as 12.3 months (Valera et al., 2000) and 1566±36 days (Singh et al., 2002). The foaling interval of the current study was 26.98±3.14 months, which is larger than that of the Indian breeds of Marwari and Kathiwari horses (Pundir et al., 1997) and almost similar to that of indigenous horses of the Mymensingh region (Alam et al., 2016). The gestation length of indigenous horses falls within the range of 325.82 to 343.27 days, as observed in Kathiawari horses (Pundir et al., 1997) and also similar to Kathi mares (Hevia et al., 1994) and thoroughbred horses (Panchal et al., 1995).

Table 1: Reproductive performance (Mean±SD) of indigenous horses (n=55).

Reproductive performance	(Mean±SD)
Age of 1st heat (Month)	24.02±2.61
Age of first conception (Month)	27.09±3.64
Foaling interval (Month)	26.98±3.14
Gestation length (Month)	11.58±0.46
Estrous Length (Days)	21.25±0.75

In the Mymensigh region of Bangladesh, the age at first heat, age at first conception, foaling interval, and gestation period of native horses are 1.95±0.07 years, 2.15±0.06 years, 1.16±0.01 years, and 11.44±0.09 months, respectively (Alam et al., 2016). The reproductive performances of horses depend on animal age, fertility of the respective stallion and mare, reproductive status of the mare, feeding, management and proper heat detection. The previous study was conducted in four districts within a single administrative division of Bangladesh, predominantly covering the northern part of the country (Alam et al., 2016), in contrast, our study includes data from all eight administrative divisions of Bangladesh. Despite the

location variability, the productive and reproductive data show remarkable similarities, suggesting that all horses in Bangladesh may share a common origin. Further molecular studies could reveal the population structure of horses in Bangladesh.

COAT COLOR

Coat color is an important trait of interest for farmers, breeders and scientists, although the color of the horse has little significance on performance (Sponenberg and Bowling, 1996). Coat color is not confined to a single breed, indicating that mutation results in color variants among the breeds (Sponenberg and Bowling, 1996). Black, bay and chestnut are the three prime coat colors from which all the other color combinations are evolved (Thiruvenkadan et al., 2008). There are several coat color variations found in this study, with chestnut being the most common at 44.05%, followed by bay (36.11%), grey, black, pseudo albino, and chestnut roan (Figure 4). Chestnut and bay are the dominant coat color of Kathiawari horses (Singh et al., 2002). In this study, we also found a higher proportion of chestnut and bay-colored horse, from these findings we may hypothesize some genetic relevance of indigenous horses with Indian horses that need to be identified by further study.
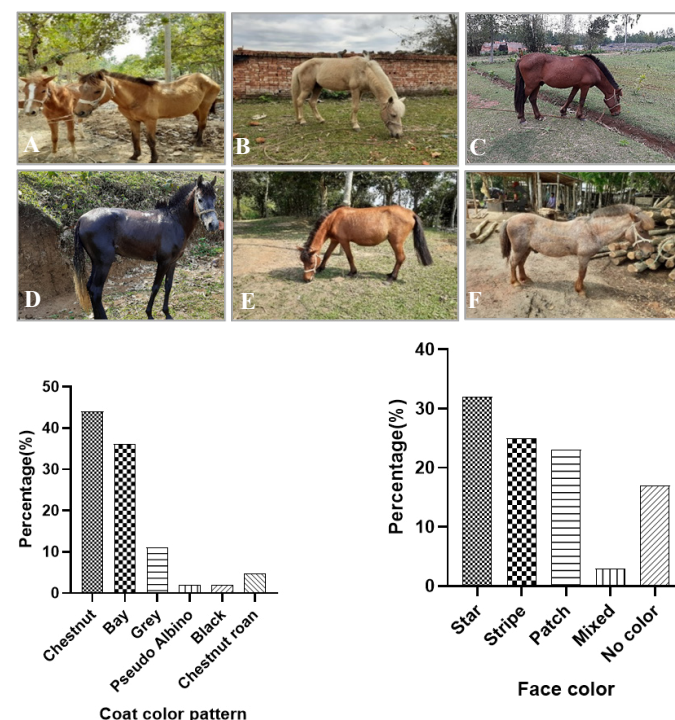

Figure 4: Coat color. A: Pseudo albino, B: Chestnut, C: Chestnut roan, D: Black, E: Bay, F: Gray and face color variants of horses in the study area.

In this study, we tried to understand the preference of farmers for selecting a particular horse. The majority of horses raised in Bangladesh are used for draft, hence farmers are less concerned with color choice. A previous study also reports the abundance of chestnut and Bay color horses in Bangladesh (Alam et al., 2016). A wide variety of coat-colored horses in Bangladesh was found as bay, black, chestnut, bay cream, chestnut cream, pseudo albino, gray, bay roan, black roan, chestnut roan, bay spot, black spot, chestnut spot, bay roan spot and black roan spot (Nozawa et al., 1998). A variety of leg markings on the hind and fore legs has also been reported, leg markings are often evenly distributed in the hind and fore legs. Native horses typically have white, black, grey, or a mixture of black and white stockings. Face color variations were found to be star (32%), stripe (25%), patchy (23%), and mixed (3%), however, 17% of horses were found without any face color (Figure 4). This study does not address how age affects the population's coat color features. Study shows that, with increasing of age, the proportion of the horse with white bodies and tail color increases significantly, while the proportion of other colors decreases significantly (Mustefa et al., 2022). Future research could be interesting in examining the age-related variations in the coat color of indigenous horses in Bangladesh.

MORPHOMETRIC MEASUREMENT

Morphometric measurements (Mean±SE) of male (n=182) and female horses (n=58) at different age groups are presented in Table 2.

BODY WEIGHT

Average 2-6 years and 7 above years body weight of male and female indigenous horses shows no significant differences (p>0.05) in body weight irrespective of age. In our study, male and female horses between 2-6 years of age had body weights of 164.96±4.45 kg and 161.58±4.15 kg, respectively (Table 2). Comparatively, Marwari and Kathiawari horses in India weighed 319.4±12.1 kg and 301.4±19.8 kg, respectively, at three years of age (Singh et al., 2002). The body weight of Bangladeshi horses is lower than that of Marwari and Kathiawari horses. Mostly, animal genetics, breed and nutrition are the major determinants of animal body weight. Marwari and kathiawari are established horse breeds of India whereas Bangladeshi horses are mostly indigenous types with a mixture of crossbreeds, which may explain their lower body weight.

PHYSICAL TRAIT

Male horses exhibited significantly (p<0.05) greater neck length, head length, wither height, and ear to tail length than female horses when they were 2–6 years old. On the other hand, male horses showed significantly (p<0.05) greater body length, neck length, head length, wither height, back height, ear-to-tail length, and mane length than female horses when they were 7 years and above older. On the other hand, male horses at age 7 and older had considerably (p<0.05) longer bodies, necks, heads, withers, backs,

Table 2: Morphometric characteristics (Mean±SE) of different age group of male and female indigenous horse.

Traits	Age (2-6 years)		Sig.	Age (7-Above years)		Sig.
	Male (n=72)	Female (n=38)		Male (n=110)	Female (n=20)	
Body weight(kg)	164.96±4.45	161.58±4.15	NS	166.11± 3.81	163.15±8.21	NS
Body length(cm)	113.25±1.22	112.76±1.21	NS	118.14±0.69	115.20±1.08	*
Chest girth(cm)	122.78±1.60	121.40±2.50	NS	124.90±1.24	122.55±1.12	NS
Neck length(cm)	39.22±0.53	35.34±0.44	**	39.99±0.73	35.60±0.65	**
Head length(cm)	42.89±0.47	37.92±0.53	**	43.86±0.51	38.05±0.58	**
Ear length(cm)	14.44±0.17	14.87±0.16	NS	15.04±0.15	15.80±0.45	NS
Wither height(cm)	115.78±0.47	110.89±1.54	**	116.40±0.37	111.25±1.29	**
Back height(cm)	111.89±0.90	109.90±2.01	NS	112.25±0.66	114.89±0.44	**
Length from ear to tail(cm)	150.88±2.06	140.45±1.56	**	153.34±1.92	141.25±2.96	**
Mane length(cm)	67.21±1.04	64.21±1.22	NS	69.51±0.87	64.30±1.74	*
Tail length(cm)	84.40±1.46	82.32±0.74	NS	84.64±1.02	82.78±0.74	NS

**=significant at 1% level, *= significant at 5% level, NS=Not significant, Sig= Significant

ear-to-tail lengths, and manes than female horses (Table 2). The native male horses of Bangladesh have considerably longer heads, wider heads, withers, backs, and manes than the female horses in the age groups of 2–5 years, 6–10 years, and 11–20 years (Alam *et al.*, 2016). The body lengths of mature male and female native horses were found to be 113.58±1.26 and 107.95±10.08 cm, respectively (Nozawa *et al.*, 1998). The study's male and female horses' chest girth measurements are smaller than those of Marwari and Kathiawari horses (Singh *et al.*, 2002). The average chest girth of Kachchhi-Sindhi horses was 164.96±1.30 cm (Pal *et al.*, 2013). Chest girth is an important physical characteristic that correlates with horse body weight. The lower chest girth of native horses indicates their average body weight. One of the most crucial physical characteristics that establish a horse breed's fitness for sports is withered height. Horses are classified as ponies if their wither height is less than 150 cm, which is the official cutoff value for the horse category. The International Federation for Equestrian Sports states that 148 cm without shoes and 149 cm with shoes is the cutoff figure for wither height (Pony, 2024). The highest documented average wither height for male Bangladeshi horses is 116.40±0.37 at 7 years of age and above, whereas the average wither height for Kachchhi-Sindhi, Marwari, and Kathiawari horses is 148 cm, 155.42±0.61 cm, and 149.30±0.08 cm, respectively (Pal *et al.*, 2021; Gupta *et al.*, 2012). This suggests that Bangladeshi horses are not up to international standards for racing or sports since they are smaller in stature and primarily belong to the pony class. The government and scholars should take note of this data and focus their efforts on horse breeding and research.

UTILITY OF HORSE

Apart from rearing other livestock, we sought to understand the reasons behind horse rearing in Bangladesh and the various uses of horses throughout the country. Roughly 90% of the farmers said that raising horses is profitable; the other respondents had other ideas. Horses are easier to manage and have fewer disease incidences, according to some farmers. The countrywide usefulness of horses is summed up in Table 3.

MARKETING OF HORSE

There is a lack of specific marketing channels for buying and selling horses across the country. However, there is an established horse market in the country located in Tulshipur of Rashidpur union of Jamalpur Sadar district. This market has a long historical background of 40-50 years. This market operates in every Thursday and farmers from peripheral districts gather here to trade their horses. Along with the horses, horse carts and other necessary equipment for handling the horses are also sold here. The prices of the horses vary from 10000 to 100000 BDT based on the size, physical strength, sex, appearance and types of horses. Before purchasing, farmers assess the horse's physical strength by simulating real working conditions, which is a unique aspect of this market. Apart from this market, sometimes horses are marketed in the local livestock market across the country and sometimes farmers buy and sell their horses through personal communication.

GOVERNMENT, NON-GOVERNMENT INTERACTION AND WAY FORWARD

We asked the farmers if they had received any government assistance (training, bank loans, or other interventions) for horse rearing. In response, all farmers stated that they had never received any kind of incentives or instruction in scientific horse management, breeding, or rearing. They expressed the difficulties they face when treating diseased horses due to the lack of specific medications available in the market. However, they showed higher

Table 3: Utility of horse in the study area.

Region	Location	Utility
Mymensingh division	Muktagacha	• Transportation of banana, pineapple, paddy and other agricultural by-products • Carrying wood to the saw mill
Chittagong division	Coxs bazar	• Racing in the sea beach with tourist • Photography with horse
Dhaka division	Dhaka city, Gopalganj, Modhupur	• Horse carriage from Gulistan to Sadarghat at old Dhaka • Transportation of banana, pineapple, Jute and other agricultural product and by-product • Carrying wood to the saw mill • Movie shooting • Weeding
Rajshahi division	Rajshahi, Bagora	• Carrying agricultural product and by-products from cropland • Carry passenger in char areas
Barisal division	Kuakata	• Racing in the sea beach with tourist • Photography with horse
Sylhet division	Jaintapur	Horse racing
Khulna division	Dumuria	• Carrying wood to the saw mill • Transportation of agricultural product and by-product
Rangpur division	Lalmonirhat, Dinajpur	• Ploughing in agricultural land • Transportation

interest in getting advanced training on better feeding, breeding and disease management. Unlike other livestock species, farmers also sought improved germplasm and an organized breeding system through the institutional framework, either through natural breeding or artificial insemination. The current situation serves as a reminder to researchers and policymakers to shift attention toward this highly important species and to implement an immediate action-based work plan.

CONCLUSIONS AND RECOMMENDATIONS

In the context of the socio-demographic structure of Bangladesh, horses play a vital role in uplifting the income of all the stakeholders involved with horse husbandry. Horses are reared for income generation and farmers prefer stallions over geldings for rearing with a semi-intensive rearing system. Bloat, diarrhea, colds, fevers and skin diseases are common diseases among others. Chestnut, bay, grey, black, pseudo albino, and chestnut roan are the common coat colors. Male horses have higher body length, neck length, head length, wither height, back height, ear-to-tail length and mane length than female horses. Bangladesh has no horse breed, and indigenous horses are smaller in size with homogeneity of reproductive and phenotypic features. Genetic characterization is recommended to identify the origin of indigenous and crossbreeds including samples from nationwide. Further research is recommended to advance a more effective breeding system, with a specific emphasis on techniques such as semen cryopreservation and artificial insemination. This article emphasizes the need for attention from both the government and non-

government stakeholders to initiate a horse breeding and development program immediately.

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NOVELTY STATEMENT

This study represents a holistic effort to comprehensively characterize the phenotypic traits and management practices of native horses in Bangladesh, encompassing a large and diverse sample across all divisions. It uncovers significant insights into the physical and reproductive traits, health issues, and management practices of these horses, alongside their critical role in the livelihoods of their owners. The findings offer valuable insight for the development of targeted genetic characterization and breeding programs to enhance the sustainability and economic viability of horse rearing in Bangladesh.

AUTHOR'S CONTRIBUTION

All the authors have contributed significantly to the planning, executing and drafting of the manuscript. All the authors have given their consent to submit the manuscript in Advances in Animal and Veterinary Sciences. Gautam Kumar Deb, Md Faizul Hossain Miraz and SM Jahangir Hossain were involved in the conceptualization, designing and execution of the experiment, writing of the original draft, and project administration. Md. Ahsanul Kabir, Md

Ruhul Amin and Nure Hasni Desha were involved in data collection. Md Panir Choudhury contributed to designing the experiment and Shahrina Akter contributed to writing and editing the original draft.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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