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Phenotypic and production performance of indigenous zebu cattle (*Bos indicus*) under hot and humid temperature in Mymensingh district

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ABSTRACT

The present study was conducted to find out the present condition of native cattle, their rearing habit, milk production, fat%, some important reproductive parameters, blood parameters, climate effects and birth weight of calves and give important suggestion for production constraints. Data was compiled statistically only for tabular, percentage, mean and standard deviation. Eighty three local cows and 17 heifers were taken under this study from 72 farmers. Body weight and condition score, average daily feed intake, daily milk yield, hemoglobin, packed cell volume, the fat percentage, age at first calving, calving interval and birth weight of the local calves were 173.23 ± 32.03 kg and 2.55 ± 0.34, 12.5 kg (fresh basis) and 7.72 kg (DM basis), 1.43 ± 0.58 kg., 7.8 ±1.00 (g/100 ml), 52 ± 52.10 (%) and 57.6 ± 9.1g/kg, 52.8 ± 13.32 months, 417.6 ± 109.5 days, 14.43 ± 2.56 kg respectively. Average number of eggs of parasite was 53 per gm of feces. So considering the trial parameters indigenous cows rearing under rural condition was a profitable practice in selected areas minimizing effect of climate stress and thrives well in hot and humid temperature maintaining phenotypic and productive performance of Bangladesh.

INTRODUCTION

Livestock plays an important role in Agriculture as well as in national economy in Bangladesh. Cattle are valuable components of livestock sector in Bangladerh. Dairying is a biological efficient system that converts large quantities of inedible roughage to milk, the most nutritious food known to human. Milk is renowned as an almost complete as well as natural nutritious food for all mammals including human being (Debnath et al., 2014) It is a more efficient and intensive system in term of nutrient and protein production for human consumption. Dairy cattle are exposed to stressful climatic condition in tropical regions, which influence their productivity and welfare. The indigenous zebu (*Bos indicus*) cattle are adapted and tolerance to the hot environments because of low metabolic rate and great sweating capacity (Hansen, 2004), but generally they exhibit low productive and reproductive performance (Ageeb and Hiller, 1991). Cross breeding of cattle has been adopted for blending the adaptability of tropical cattle with the high milking potential of exotic breeds. However, the local environment can sustain only composite genotypes of a moderate level *Bos tauras* blood (Musa et al., 2008). Friesian crossbreds were noted to be the suitable for their adaptability in addition to their high milking capacity. Adaptation to tropical environment has been reduced when the local Butana and Kanana cattle were crossbred with high producing non adapted Holstein-Friesian breed. Furthermore, selection for high milking was reported to reduce the heat tolerance of cows which magnifies the seasonal depression in productivity caused by climatic stress (Al-Katanani et al.1998) accordingly, high yielding cows are more sensitive to hot environment compared to low yielding cows (Igono and Johnson, 1990). Exposure of dairy cows to hot environment during summer could stimulate thermoregulatory mechanisms and produce reduction in the rates of metabolism, feed intake and productivity (Armstrong, 1994). Heat stress influences reproduction and represents a major

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factor for lower fertility during summer in tropical environments. It reduces the length and intensity of estrus (Jordan, 2003.). The competence of oocyte for fertilization and subsequent development is reducing times of the year associated with heat stress (Al-Katanani et al., 2002.) and depression in conception rate in hot environment has been documented (De Rensis & Scaramuzzi, 2003). The blood parameters may reflect the influences of thermal stress and the physiological state of dairy cows.

Assessment of PCV and Hb concentration was included in metabolic profile test amongst other biochemical constituents of blood (Steinhard et al., 1994.). Haemoid-concentration may occur during hot weather. Toharmat et al. (1998) reported an increase in PCV value hemoglobin concentrations during summer that could be associated with dehydration. A higher susceptibility to infections has been observed in cows suffering from heat stress (Webstar, 1983)). Research is needed to evaluate physiological performance of dairy cows under tropical conditions, so that the patterns of responses to climate stress and physiological state can be established. The information obtained can be utilized in adopting environmental control and nutritional strategies that can alleviate stress and improve reproductive performance and milk yield. The findings could also be used to monitor the health status of cows. In these connections we have very limited information on the production performance of different types of dairy cows available in Bangladesh. Therefore, the study was undertaken to assess the effects of seasonal change in thermal environment, morph metrics characterizations, productive and reproductive traits, blood parameters and stage of pregnancy on thermoregulation, growth of calves, and climate effect of local cows on their survival capacity maintaining phenotypic and productive performance under local tropical conditions of Bangladesh.

MATERIALS AND METHODS

The experiment was conducted at nearby village of Bangladesh Agricultural University (BAU), Mymensingh for one year with 83 local cows and 17 heifers to study the baseline production performance of local cattle.

Description of animal site

One typical village named - Boira which is about two kilometer away from BAU; Mymensingh Campus had been selected for the study. The villagers are mostly resource poor small household farmers out of 22% were landless but every family has some indigenous cattle. The village was well communicated from the University; the farmers were very interested for this study. Constant visit and collection data from farmer's level was easy for better communication. The cows of villagers are generally used for multipurpose like dairy, draught and meat. Rice straw was the main source of the animals as residual part of crop. Very little roadside green grass were used as succulent feed. Wheat bran, oil cake and common salt were fed to the animals by the comparatively better off farmers. Animals are mainly stall feed and sometimes tethered.

Numbers of animal in study

Seventy two individual farmers having 83 indigenous cows and 17 heifers were taken for this study. Baseline data were collected having 100 animals through direct interviewing with 72 farmers. The animals received as usual feed supplied by the farmers of that area on availability basis.

Average productivity and fertility indices

Cows were milked once in the morning. Calves were usually tied up at night and they had free access to their dam during the whole day .Productivity had been monitored by supplied International Atomic Energy Agency (IAEA) draft data sheets for measurement of milk production and changes in live weight, Scottish Agricultural College grading viz. 1-5 had been used for condition score and from various reproductive indices like at first parturition, calving interval and start of sexual cycle/conception, conception rate, number of calves boned/ weaned etc.

Scheduled visits and sampling

Eighty three cows and 17 heifers had been ear tagged (1-100) for identification. The cows, calves, heifers and milk yield were weighed daily.

Fecal eggs were examined under microscope for parasitism from the collected fecal sample of individual animal. Visiting schedule was maintained daily on the study area.

METHODS OF FEEDING

Cows were fed as usual traditional system by the villagers. Most of the animals were mainly stall fed and sometimes tethered in the field surrounding of household farmers. Green grass and rice straw is the main source of the study animals. Fresh water supplied for the trial animals were ad libitum.

Climatic conditions

Ambient temperature, rainfall and relative humidity were collected from the meteorological station situated at BAU campus, Mymensingh. Mean value of ambient temperature (T) and relative humidity (RH) recorded during the experiment period were calculated. The temperature-humidity index (THI) was calculated using the following equation by Ravagnolo et al., 2000.

THI= (1.8*T+32) - [(.0.0055*RH) *(1.8*T-26)].

Feed sample analysis

Determination of Dry matter (DM), crude protein (CP) and Ash were done according to AOAC (1984) in the laboratory of Department of Animal Nutrition. RDP, UDP, digestibility of CP and DM were done according to Scottish Agricultural College bulletin (1984).

Blood collection and analysis

Blood samples were collected aseptically by venipuncture from the jugular vein using disposable syringes and were immediately transferred to test tubes containing Na2-EDTA as anticoagulant. The samples were used for hematological measurement using standard methods (Jain, 1996).

Statistical Analysis

Data were analyzed by descriptive statistics such as number, range, percentages, mean and standard deviation. A number of tables were prepared keeping in view the objectives of the study.

RESULTS AND DISCUSSION

Physical and morphometric characteristics of indigenous cattle

Initial baseline data summarized from 83 cows, their calves and 17 heifers which are mentioned in Table 1. The average body weight of local cows was 173.23 ± 32.03 kg. Ahmed (1995) observed the average body weight of local cows under village condition was 167.21 ± 3.08. Khan and Hossain (1994) reported that the local cows' body weight was 174.13 ± 31.18 kg. A number of factors may influence the body weight. Genetic makeup is main thing which influences this factor.

Table 1
Physical and morphometrics characteristics of indigenous cattle.

Parameters (No of cows:100)	Mean ±SD
Body wt. of cows (kg)	173.23±32.03
Heart girth of cows (cm)	131.50±7.85
Condition score of cows	2.55±0.34
Milk yield per day (liter)	1.43±0.58
Milk fat(g/kg)	57.6-± 9.1
Milking per day	1.00±0.00
Age at first calves (month)	52.80±13.32
Interval between calving (days)	417.60±109.50
Age of cows (year)	6.83±1.74
No of parity	2.11±0.93
Birth wt. of calves (kg)	14.43±2.56
Age of calves (days)	30.33±17.01
Body wt. of calves (kg)	18.29±7.34
NO of heifers=17	Mean ±SD
Age of heifers (year)	2.79±0.53
Body wt. of heifers (kg)	151.25±31.06
Heart girth of heifers (cm)	126.25±12.21

Balanced nutrition, environmental condition, parasitic infestation, care and management may also affect body weight. The observed heart girth

of local cows was 131.50 ±7.85 cm and range was 123.65-139.35 cm .There was positive correlation within body weight, condition score and heart girth. Body weight directly influences by heart girth. Condition of body status and health of animal may influence this factor. Size of animal partially influences the heart girth. Birth weight of local calves was found 14.43±2.56 kg. Nahar et al (1992) observed the average weight of Sahiwal X Local calves under rural condition was 17.6±0.3 kg. Hossain and Routlege (1982) reported that the birth weight of Pabna milking cows' calves was 16.37±2.20 kg. So, within breed selection of individual superior sire could be an important factor of improving birth weight of calves. Bhuiyan et al. (2012) reported that average birth weight of Red Chittagong Cattle (RCC) calves was 14.21 ± 0.27 kg. The means for body length, height at wither, heart girth, pouch girth, length of tail, switch, neck, ear and head were 83.668±0.590, 91.942±0.55, 113.146±0.738, 121.181±0.761, 54.196±0.527, 26.098±0.186, 32.705±0.166, 18.131±0.111 and 35.035±0.195 cm, respectively (Kayastha et al. 2011).There are several factors which influence birth weight of calves. Genetic background is the most important among them. Nutritional status of pregnant dam and body condition also has remarkable effect on this trait. Sex of calf, twining and season of birth also affect the weight of calves. The observed condition score of local cows was 2.55 ± 0.34 and range was 2.0 - 3.0. There was a positive correlation between condition score and body weight. Environmental condition directly influences condition score. Season and weight of the animal may also influence this factor.

Productive and reproductive traits

Average daily milk yield of indigenous cows was 1.43 ± 0.58 kg (Table 1). Initial data shows that the average milk production was minimum under present situation. Animals were mainly under feed. Cows in the research area were milked only in the morning once daily. So, the actual milk production could have been higher than that of present average figure of 1.43 kg/day. Ali (1994) reported that milk production varied according to season and area. He conducted the experiment on local cattle using data collected from four different areas of Bangladesh and highest milk was observed in winter season (1.93 kg per day). He also found the highest milk yield in Pabna cows (20.50 kg per day). Bhuiyan and Faruque (1994) studied the performances of local cows under rural condition and average milk yield was 1.63 kg. Bhuiyan et al. (2012) reported that daily average milk yield of RCC was 1.98± 0.08 kg. There are several factors which influence milk production of cows like quality and quantity of feed, ambient temperature, humidity and care of the herd. The mean fat content of local cow's milk during whole study period was 57.9 ± 9.1 g \kg. Little information is available on fat content of local cow's milk. Islam (1990) studied milk composition of local cows from Manikganj district and fat was found 46.9 g\ kg of milk. Fat content of local cows were greater than that of exotic and cross bred cows due to straw based diet intake of local cows. On the other hand, production of local cows is low. Fat percentage may be affected by the quality of feed, number of lactation, stage of milking, exercise of animals, season of year as well as quantity of milk yield. Calves were ties up at night. Calves were free access for suckling to their dam throughout the day which is good feeling for the farmers for the better health of calves.

It is revealed from Table 1 that the indigenous cows in the village condition of feeding and management usually show their first reproductive performance late as compared with exotic, pure and cross bred animals. Age at first calving was also high. Age at first calving was calculated from data of birth to the date of first calving in months. It was found that the age at first parturition of local cows were 52.8±13.32 months. Ghosh et al, (1977) studied some reproductive parameters of milking cows and reported that age at first calving for Red Chittagong heifers was 39.96±3.96 months. Islam and Oliuzzaman (1993) reported that average age at first calving of local cows was 48.72±7.56 months. Genetic makeup is the main factor which influences this trait remarkably. Level of nutrition supplied during the growing period is another important factor which affects this trait directly. Environmental condition, parasitic infestation, low quality roughage, care and management may also affect this trait. Season of birth also have an indirect affect on age at first calving. Calving interval for local cows was 417.6 ± 109.5 days. Actual calving interval could have been even

earlier of the present average figure 417 days, because calves sucked the cows which have an effect on start of estrus cycle of cows after calving which ultimately lengthen the present calving interval. Bhuiyan et al. (2012) reported that calving interval of RCC was 509.89 ± 15.37 days. Islam and Oliduzzaman (1993) found average calving interval was 525.0 ± 87.9 days. Various factors like breed, nutrition, age, parity, milk yield, suckling, year and season may influence calving interval (Sharma and Singh, 1980). In zebu cattle calving interval ranged from 366-789 days (Koul, 1987). Moreover, most of animals were infested by parasites that could be one responsible factor for less milk production and poor fertility. Suckling blood and damaged liver cause anemia and abnormal physiology of body. No of eggs of Fasciola gigantica was counted by Mc Master Method and found of average no. of eggs were 53 per gram of feces. It has been reported in the literature that parasites usually suck 10-15% of the host nutrients.

Chemical composition of feed

From Table 2, in the analysis of feed that sesame oil cake contains highest amount of DM and lowest amount in green grass. Sesame oil cake also contains highest amount of CP (g/kg DM) and lowest in rice straw. In digestibility (Dg) of DM% sesame oil cake contain lowest amount and highest in wheat bran. UDP and RDP in sesame oil cake found highest and lowest in rice straw. Ash contain highest in rice straw and lowest in green grass. Taher et al. (2002) reported that the DM and CP of rice straw and wheat bran were 910 & 890 and 121 & 131g/kg respectively. Pathol (1994) reported that the DM and CP of sesame oil cake were 900 and 370 g/kg respectively.

Feed Intake of cows

Daily feed intake has been measured at village level of cows. Table 3 shows the feed intake of village level feed. Measurement of daily intake of feed was not always possible during rainy season due to muddy roads of the village. From Table 3, highest amount of DM, RDP, UDP and CP were found in rice straw and lowest in wheat bran (DM) and in road side grass of other composition.

Table 2
Chemical composition of the village level feed.

Feed ingredients	Average composition of the village level feed						
	DM g/kg	Ash g/kg	RDP g/kg DM	UDP g/kg DM	CP g/kg DM	Dg of CP%	Dg of DM%
Rice straw	850	140	40	13	53	75	39
Green grass	200	58	52	20	72	72	71
Wheat bran	875	69	114	40	154	71	84
Sesame oil cake	890	133	197	114	311	62	8

Table 3
Average daily intake of feed at the village of indigenous cows.

Ingredients	Fresh wt.(kg/day)	DM (kg/d)	RDP (g /d)	UDP(g/d)	CP(g/d)
Rice straw	7.5	6.38	255	83	338
Roadside grass*	4.5	0.90	47	18	65
Wheat bran*	0.5	0.44	50	18	68
Total	12.5	7.72	352	119	471

*Optional

Blood parameters

Table 4
Result of Blood parameters.

Parameter	Range	Mean ± Sd
Hemoglobin (g/100ml)	6.10-10.20	7.81 ± 1.00
PCV (%)	27-81	52 ± 10

In most mammals normal Hemoglobin values are between 8-15 g/ 100ml (Banerjee, 1988). Excitement may increase not only the Hemoglobin concentration but PCV per unit volume (Swenson, 1977). From Table 4, the estimation of Hb was found 7.81± 1.00 g /100ml. Paa- Kobina et al. (2015) reported that Hb concentration was 10.9 g/100 ml and PCV 28% of blood. Ahmed et al, (1968) reported that low Hb level of blood indicates the deficiency of protein level in food. It was sure that ration was not properly balanced; the animals were suffering from mal nutrition and anemia. As a result hemoglobin level drops from normal level and ultimately increased the duration of interval time of pregnancy of local cows**.** The PCV percentage of local cows was found 52± 10 and range was 27-81 %. PCV values fall in early lactation as milk yield rises then tends to rise as lactation progresses. Faruque et al. (2013) reported on Gayal of Chittagong district that PCV and Hemoglobin values were 33.5 ± 5.71% and 13.43 ± 2.9 g/100 ml respectively. However, values are often low in late winter but recover when cows go out to pasture. Values are highest in summer but in many circumstances high level may indicate of dehydration. Sometimes this can be due to a reduced water intake which may caused by social drinking. The observed value of PCV% was high. But recover when cows go out to pasture. It is clear to identify that the local cows were not supplied sufficient fresh drinking water.

Climatic conditions

The ambient temperature, relative humidity and temperature-humidity index prevailing during the study period are shown in Table 5.

Table 5
The mean value of temperature (^{O}C), relative humidity (%) and temperature-humidity index.

Season	Max.	Min.	Mean	RH(%)(mean)	THI (mean)
Summer	31±4.24	28±2.10	29.5±3.17	75±18.59	73.92
Winter	25.8±2.08	13.5±2.25	19.65±2.17	46±7.97	63.56

Table 6
The mean value of rainfall (mm).

Season	Max.	Min.	Mean
Summer	469±2.61	46±3.83	257.5±3.22
Winter	311±10.36	2.00±0.33	156.5±5.35

Average ambient temperature was 29.9±1.84 ^{O}C and range was 24.00-33.4 (Table 5). The data indicate that the highest mean values of temperature were 29.5 in June in dry summer while the minimum mean value was 19.7 during December in winter. The maximum mean value of RH (%) was75 in June during dry summer, whereas, minimum mean value was found 32 in March during winter. The THI value during summer (73.92) was higher compared to the value obtained in winter (63.56). It is clearly shown in the trial period during summer, cows in mid and late pregnancy was higher than that of early pregnancy and non pregnancy cows. During winter period there was no effect of cows with advanced pregnancy. It has been observed during the study period that rainfall varied greatly than that of temperature and mean rainfall (yearly) was 2249 ±7.35 mm and range was 2.00 to 469.00 (Table 6). The highest rainfall was found 469 in June during summer and lowest were 2.00 in December during winter. The observed baseline information of local cows, calves and heifers were not greatly varied on milk production, feed consumption, body weight, milk fat and fertility like the European pure breeds such as Holstein, Jersey and Guernsey. Ragsdale et al. (1948) reported that the optimum temperature for maximum milk production appears to be not far from 10^{O} C. The critical high temperature is

apparently 26.66 ^{O} C. Rising temperature is the most detrimental to Holstein.

Berman (2005) estimated that effective environmental heat loads above 35 ^{O} C activate the stress response systems in lactating dairy cows. The depressing effect of high temperature is much greater for high yielding cows than that of low milking cows. The larger cows are more sensitive to environmental temperature. The critical temperature at which the depressing effect of milk production, feed consumption and on body weight becomes evident is 23.9 ^{O}C to 26.66 ^{O}C for Holstein and 26.66 to 29 44 ^{O} for Jersey cattle. On reducing temperature from 10 ^{O}C to 15.55 ^{O}C feed consumption and milk production promptly returns to normal. The decline in milk production and feed consumption are more pronounced for Holstein than for Jersey. The greater sensitiveness of Holstein cattle to higher environmental temperature is shown not only by their greater rate of decline in milk production, feed consumption and body weight but also by a greater rate of increase in rectal temperature and respiratory activities. The greater sensitiveness is not due to breeds as such but rather to their greater body weights. The amount of body surfaces per unit body decreases with increasing body weight and the rate of heat dissipation per unit weight must decrease with consequent steeper rises in body temperature in large animals as compare to small ones.

Our local cows can survive easily in hot and humid temperature and resistant to fluctuate temperature and disease control. Their production moreover was same in our ambient temperature, rainfall and relative humidity but their production falls somehow during heavy rainfall due to supply of insufficient roadside green grass. Supplying of rice straw and small amount of concentrates and UMMB their production may be kept same. So, it was observed during the study period that production and growth of calves does not hamper in hot and humid temperature.

In normal feeding and management condition of indigenous cows in the village usually shows their first reproductive performance late as compared to exotic and cross- bred cattle. Age at first parturition is high and calving interval between parturition is also high. Initial data shows that average milk production is also minimum. Moreover; most of the animals were infested by Fasciolosis which could be important factors for less milk production and poor fertility. Overall the performances of cows, calves and heifers under traditional management are not satisfactory. Feed supplementation with other interventions is needed to increase the production level of local cows. UMMB supplementations have already been introduced in project areas for development strategies of improvement of phenotypic, productive and reproductive performance of local cows.

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CONCLUSIONS

In conclusion, above reveals show that performance of indigenous cattle regarding morph metric characterization, productive and reproductive traits, blood parameters and climate effect (temperature, rainfall and relative humidity etc) as considering the trial parameters indigenous cows rearing was a profitable practice in selected areas coping with hot and humid temperature. As a result, it is possible to improve the phenotypic and production performance of indigenous cows in hot and humid temperature conditions in selected areas of Bangladesh.

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