Project ID 395

Competitive Research Grant

Sub-Project Completion Report

on

Genetic improvement of indigenous cattle for beef production through crossing with Brahman cattle by farmers participatory breeding approach in Bangladesh

Project Duration

May 2017 to September 2018

Department of Animal Breeding and Genetics, Bangladesh Agricultural University Mymensingh 2202, Bangladesh

Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Bangladesh Agricultural Research Council (BARC)
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Acronyms

/	:	Per
ABG	:	Animal Breeding and Genetics
AI	:	Artificial Insemination
BAU	:	Bangladesh Agricultural University
HEQEP	:	Higher Education Quality Enhancement Project
P-level	:	Probability level

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Executive Summary

As there is no beef type animal in our country, the farmers are frequently being involved in fattening of either local or upgraded dairy crossed bull calves for increasing beef production in Bangladesh. Appropriate breeding for increasing beef production is necessary to minimize the gap between the demand and supply of beef protein. The study was conducted in the bull shed at the Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh and adjacent areas. The present research was undertaken to produce F_1 progeny using local cows with Brahman semen and to produce F_2 progeny using F_1 cows generated from a previously completed sub-project under Higher Education Quality Enhancement Project (HEQEP). A modern bull shed with 4 (four) Brahman cross (50%) breeding bulls were available through HEQEP at the department. Out of 4000 heads of Brahman crossbred progeny from the above mentioned sub-project around 1000 crossbred heifers at three different areas named Bhabokhali, Boyera and Dowhakhula (near to BAU campus) were ready to inseminate. During the present project, a total of 641 heifers/cows were inseminated artificially with Brahman semen to produce F_1 and F_2 progeny. Growth performance estimation and genetic evaluation of Brahman progeny were done using appropriate computer breeding software. Analyses showed that body weight of Brahman cross calves was tremendously enhanced as age progressed. Progress in weight gain of male calves was significantly higher than the progress in weight gain of female calves with the average daily weight gain of 427 g/d for male and 414 g/d for female. Different areas under study had significant effect on birth weight at the level of $p>0.05$. The birth weight was higher in Bhabokhali (20.17±0.06 kg) than those of Boyera (19.75±0.13 kg) and Dowhakhula (19.47±0.09 kg). Areas also had significant ($p<0.01$) effect on three-, six-, nine- and twelve-month weight and daily gain of male calves. The weight at different stages of growth of male calves at Bhabokhali was higher than that of the other two areas (Boyera and Dowhakhula). Male calves of Bhabokhali had higher three-month weight (55.60±0.76 kg) than that of the calves from other areas (53.30±1.20 and 51.70±1.33 kg for Boyera and Dowhakhula respectively). The higher weight at six-month of male calves was observed in Bhabokhali (91.10±0.96 kg) than those of other two areas (86.40±1.55 and 84.90±1.55 kg for Boyera and Dowhakhula respectively). Males of Bhabokhali had higher nine-month weight (136.12±1.30 kg) than that of the other two areas (129.80±1.98 and 126.30±1.76 kg for Boyera and Dowhakhula respectively). Males of Bhabokhali had higher twelve-month weight (184.60±1.99 kg) than those of Boyera (174.10±2.94 kg) and Dowhakhula (169.50±2.78 kg) regions. Males of Bhabokhali also had highest average daily gain (449.94±25.43 g/d) with the lowest (408.90±27.46 g/d) in Dowhakhula area. However, the growth traits of female calves were not affected by area. In this study, four Brahman cross breeding bulls were used. There was no significant effect of bulls on birth weight and three-month weight of calves, while bulls were found to have significant effects on six-, nine- and twelve-month weight and average daily weight gain of calves. Analysis of live weight of the growing calves using pooled (mixed sex) data showed that twelve-month weight of calves of Bhabokhali were higher (179.03±1.95 kg) than those coming from the other two areas (171.74±2.47 and 167.05±1.93 kg for Boyera and Dowhakhula respectively). The results of the present study indicated that farmers from Bhabokhali took better care and management for calves, particularly for male calves than those of the other two areas. The estimated genetic gain per generation and genetic parameters will help in taking decision in participatory breeding programs. The study also indicates that the small holder and fattening farmers will be benefited by rearing the Brahman crossbred calves.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. Title of the CRG sub-project:
Genetic improvement of indigenous cattle for beef production through crossing with Brahman cattle by farmers participatory breeding approach in Bangladesh

2. Implementing organization:
Department of Animal Breeding and Genetics, Bangladesh Agricultural University Mymensingh-2202, Bangladesh

3. Name and full address with phone, cell and E-mail of PI/Co-PI(s):

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4. Sub-project budget (Tk):
4.1 Total: Tk. 1637650/-
4.2 Revised (if any): Not applicable

5. Duration of the sub-project:
5.1 Start date (based on LoA signed): 09 May 2017
5.2 End date :30 September 2018

6. Justification of undertaking the sub-project:

Crossbreeding for dairy improvement in Bangladesh is common. However, appropriate breeding for increasing beef production is necessary to minimize the gap between the demand and supply of animal protein. The Brahman breed contributes to hybrid vigor when crossed with others. Recent evidence suggest that beef from cattle with a high percentage Brahman blood has lower marbling and is less tender on average than beef from other breeds (Fatematuzzohora *et al*., 2016). For establishing beef industry and increasing the productivity of the existing stock need an appropriate breeding program. Accordingly, development of well adopted beef cattle genotype with execution of technologies and systems that reduce both costs and enhance productivity is essential to fulfill the above requirements. These technologies and systems may create a remarkable change in beef production and self-employment in Bangladesh. Considering weather, agro-climatic condition, heat tolerance, disease and insect resistance, longevity, grazing ability, calving ease, mothering ability and management, the Brahman breed is thought to be the most suitable and compatible beef breed in tropical and sub-

tropical region (Antonio *et al*., 2006). Therefore, it was thought that the Brahman breed would be the more appropriate and well-matched beef type cattle for crossbreeding with indigenous stocks for increasing the beef production in the country. Considering the above circumstances, present research was undertaken to improve indigenous cattle by crossing with Brahman bulls and to evaluate genetic merit of crossbreds to local environment of Bangladesh.

7. Sub-project goal:

Genetic improvement of beef production potentialities of indigenous cattle of Bangladesh

8. Sub-project objective(s):

(i) To improve the genetic potentiality of indigenous cattle for beef production by crossing with Brahman inheritance

(ii) To evaluate the growth performance and adaptability of Brahman crossbreds to local environment of Bangladesh.

9. Implementing location(s):

Bangladesh Agricultural University and its surrounding areas (Bhabokhali, Boyera from Mymensingh Sadar Upazila and Dawhakhula from Gouripur Upazila).

10. Methodology in brief:

10.1. Improvement of genetic potentials of indigenous cattle for beef production by crossing with Brahman inheritance

Selection of animals

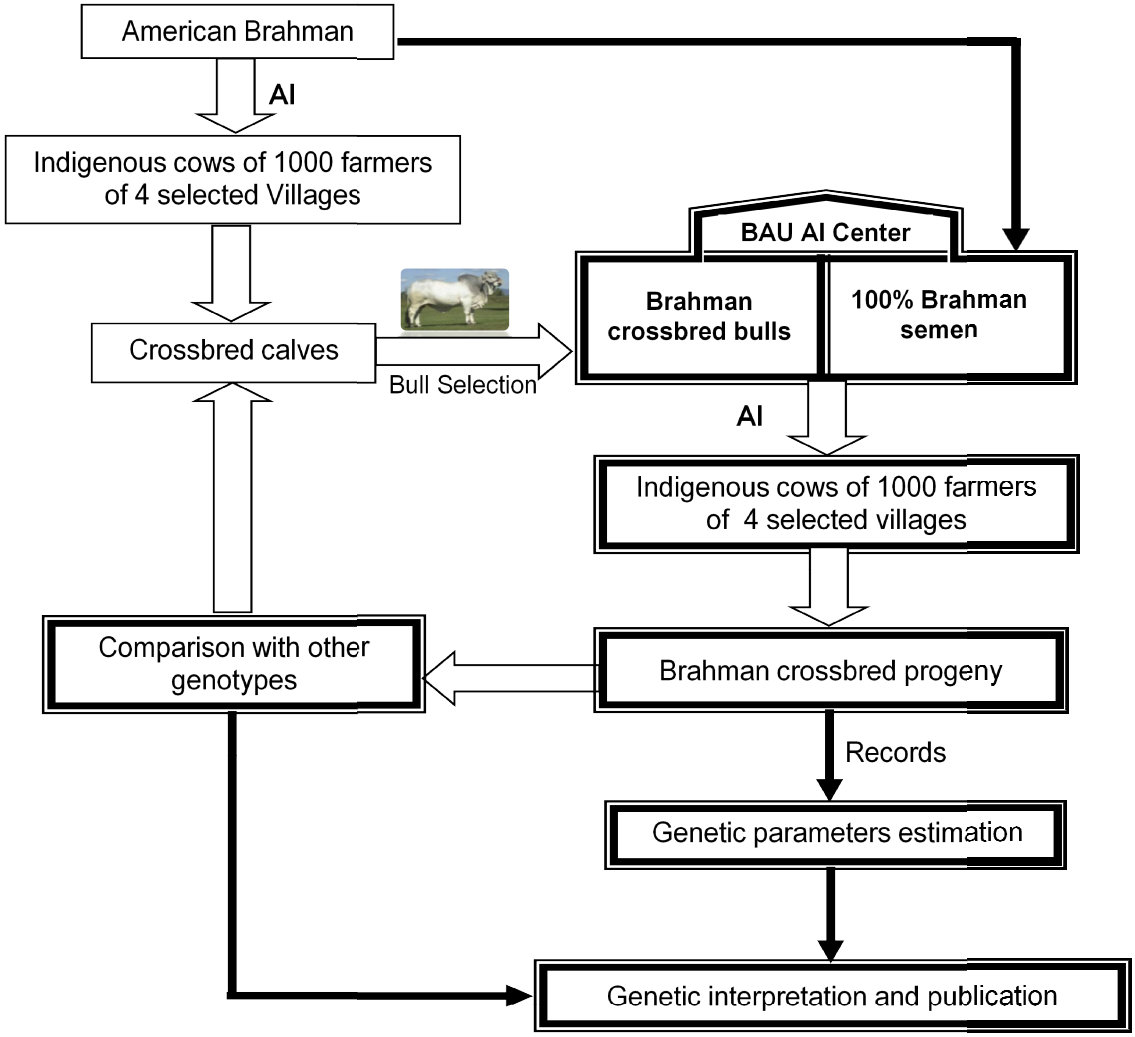
Around 4000 heads of Brahman F_1 progeny were available in the study areas which were produced from our previous completed sub-project (HEQEP). The present research covered both the selected indigenous heifers/cows and those of Brahman graded heifers (around 1000 animals) to produce F_1 and F_2 progeny respectively. Within the present research period, F_2 progeny were produced from F_1 heifers previously generated from HEQEP sub-project and F_1 progeny were produced from indigenous cows/heifers using Brahman inheritance. Up-grading with Brahman inheritance along with *inter-se* breeding approach were applied.

Breeding Strategy

It is well known that beef breed development is a continuous and time consuming process. For this reason, grading-up with Brahman inheritance and *inter-se* (selective) breeding in Brahman crossbred population were used continuously to reach the goal. Around 1000 animals (indigenous cows and Brahman crossbred heifers) from 3 villages covering 2 Upazilas (Mymensingh Sadar and Gouripur) were selected to inseminate with Brahman semen. The semen was collected from Brahman crossbred (50%) breeding bulls at the AI centre of BAU. Continuous selection of animals from the crossbred population (around 4000 heads obtained from previous completed research) and from newly born calves from present research were taken. Vaccination and treatment of pregnant cows and crossbred calves were performed as and when necessary. The genetically superior selected breeding bulls were used for breeding purpose and the superior cows were inseminated with superior Brahman bull semen at farmers level. The selection of breeding bull was done on the basis of growth performance, phenotypic appearance, *libido* and estimated breeding value. The adaptability of Brahman was evaluated considering distocia and calf mortality in the different study areas. Modified open nucleus breeding

system was followed for selection and mating processes. The schematic approach of the breeding strategy is shown in the flowchart below:

Flowchart: Schematic approach of the breeding plan



10.2. Evaluation of growth performance and adaptability of Brahman crossbreds to local environment of Bangladesh

Traits in study

Birth weight: Birth weight (BWT) means the weight of new born calf within 24 hours of birth. Data on birth weight of Brahman cross calves was recorded in kilogram (kg). The birth weight was taken using the digital weighing balance within 24 hours after birth (Figure 1).

Figure 1. Photograph of taking weight of calves

Three-month weight: Weight at three-months of age of Brahman cross calves was recorded in kg. The weight was recorded in the morning before the animals were fed. The three-month weight of calves was taken in the same way as birth weight using digital weighing balance.

Six-month weight: weight at six-month age of calves was recorded in kg using digital weighing balance as stated before for taking three-month body weight of calves.

Nine-month weight: Data on nine-month weight was recorded in kg in the morning before the animals were fed. The nine-month weight was calculated from hearth girth (smallest circumference of body immediately behind the shoulder) and body length (distance between point of shoulder to pin bone). The body length and the heart girth were measured in inches using a measuring tape and the live weight of each calf was calculated according to Shaeffer's formula as described by Akhter and Hussain (1999).

Twelve-month weight: The body weight of an animal at 365 days of age was recorded in kilogram (kg) in the morning before the animals were fed using the procedure as stated for the measurement of nine - month body weight.

Average daily gain: The weight gain per day per calf from birth to twelve-month is termed as the average daily gain and it is a significant factor in assessing growth rates of calf. Data on average daily gain was calculated in gram (g) by the difference between year weight and birth weight divided by 365.

Statistical Analysis

Heritability of growth traits and genetic and phenotypic correlations between growth and other relevant traits were estimated. Primarily the data were analyzed using the statistical analysis system (SAS, 1998) software to obtain the basic statistics. Then covariance components, heritability for early growth traits of calves, and genetic and phenotypic correlations between different growth traits were estimated by the Residual Maximum Likelihood (REML) method with the variance component estimation (VCE) program (Neumarier and Groeneveld, 1998). For estimating the heritability and genetic correlation a pedigree file was constructed. The covariance components were estimated in a series of two-trait

animal models. The covariance structure for additive genetic effects of animals and residual effects is described below:

$$Var\begin{pmatrix} a_1 \\ a_2 \\ e_1 \\ e_2 \end{pmatrix} = \begin{bmatrix} A\sigma_{a1}^2 & A\sigma_{a12} & \mathbf{0} & \mathbf{0} \\ & A\sigma_{a2}^2 & \mathbf{0} & \mathbf{0} \\ & & I\sigma_{e1}^2 & I\sigma_{e12} \\ sym. & & & I\sigma_{e2}^2 \end{bmatrix}$$

Where a_1 and a_2 are the vectors of additive genetic effects of animal for trait-1 and trait-2, respectively, and e_1 and e_2 are the residual effects for them. A is the numerator relationship matrix consisting of the genetic relationships between animals. σ^2_{a1} and σ^2_{a2} are the additive genetic variances for trait-1 and trait-2, respectively, and σ_{a12} is the additive covariance for them. σ^2_{e1} and σ^2_{e2} are the residual variances for trait-1 and trait-2, respectively, and σ_{a12} is the residual covariance for them.

11. Results and Discussion

11.1. Improvement of genetic potentials of indigenous cattle for beef production by crossing with Brahman inheritance

Number of Brahman F_1 crossbred heifers inseminated: The number of cows inseminated and calves born including the previously inseminated cows are shown in Table 1. A total of 641 cows were inseminated during the project period. Out of 641 (among 1000 F_1 Brahman cross) cows and previously inseminated 1123 cows (included Indigenous and Brahman crossbreds), a total of 724 Brahman crossbred calves were born in the project areas.

Table 1. Area wise target and achievements of insemination of cows

Area	Target of insemination	Number of cows inseminated		Calves born during the present project tenure
		Present project	Previous project	
Bhabokhali	450	326	411	332
Boyera	200	120	336	209
Dawahkhula	350	195	376	183
Total	**1000**	**641**	**1123**	**724**

The highest number of cows were inseminated in Bhabokhali area (326 heads) than those of Dawhakhula (120 heads) and Boyera (195 heads) areas.

11.2. Evaluation of growth performance and adaptability of Brahman crossbreds to local environment of Bangladesh

Birth weight of F_1 Brahman cross calves: Out of 641 calves, data on 624 calves were recorded. The mean values along with standard errors of birth weight of Brahman cross calves at different areas (Boyera, Bhabokhali and Dowhakhula) are shown in Table 2. Analysis of pooled data indicated that area had a significant ($p<0.05$) effect on birth weight of calves. The birth weight was higher in Bhabokhali (20.17±0.06 kg) than those of Boyera (19.75±0.13 kg) and Dowhakhula (19.47±0.09 kg). It also showed that though the area had significant effect ($p<0.05$) on birth weight of male calves but had no significant effect ($p>0.05$) on birth weight of female calves.

Table 2. Mean birth weight ±SE (kg) of Brahman calves in different study areas

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	19.75^{b}±0.09 (135)	20.17^{a}±0.06 (263)	19.47^{b}±0.09 (226)
Male	20.30^{a}± 0.11 (92)	20.75^{b}±0.06 (161)	19.72^{b}±0.09 (132)
Female	18.60±0.12 (43)	19.25±0.11 (102)	19.12±0.04 (94)

Figures in the parentheses indicate the number of observation; Means with uncommon superscripts within the same row differed significantly (p<0.05).

The highest birth weight of Brahman male calves (20.75±0.06 kg) was observed in Bhabokhali and the lowest was found (19.72±0.09 kg) in Dowhakhula. The birth weight of calves at Boyera area (20.30±0.12 kg) stood in intermediate position. The highest birth weight of Brahman female calves (19.25±0.11kg) was observed in Bhabokhali and the lowest (18.60±0.14kg) was in Boyera (Table 2). The birth weight of calves at Dowhakhula area (19.12±0.04 kg) stood in intermediate position. The values of birth weight of the present study were comparable to the value (23.3 kg) observed by Crockett *et al.* (1978) for beef cattle. Sanders *et al.* (2005) observed 36.63 kg birth weight of F_1 Gray Brahman calves. Holloway *et al.* (2005) observed 33.50 kg birth weight of Brahman and Angus crosses, which was much higher than the value of the present findings. This variation was probably due to the use of Brahman bulls for crossing with the dams those were genetically superior to Indigenous cattle and genetic proportion of Brahman inheritance. It was evident that areas and sex had significant ($p<0.05$) effects on birth weight of Brahman cross calves. The result of the present study also agreed with the findings obtained by Lee and Pollak (1997), who found a significant effect of sex on birth weight of calves. Ellis *et al.* (2005) also worked on birth weight of calves of Brahman crosses and obtained similar results. Antonio *et al*. (2006) found average birth weight for calves of Brahman cross to be 35.4 kg. Paschal *et al.* (1990) showed that Brahman calves were heavier at birth compared to Angus. Riley *et al*. (2002) indicated that Brahman sired calves had heavier birth weights than reciprocal crossbred calves (Angus- and Romosinuano-sired calves with Brahman cows). They also concluded that Brahman-sired male calves were heavier at birth than female calves. Male calves usually needed longer gestation period than the females and this was responsible for their heavier weight at birth. It was proved that areas and sex had significant ($p<0.001$) effects on birth weight Brahman cross calves.

Weight at three-month of age: The mean values along with standard errors of three-month weight of Brahman cross calves of different areas are shown in Table 3. This Table shows that three month weight of male calves significantly ($p<0.01$) affected by areas and males of Bhabokhali had higher three-month weight (55.60±0.76 kg) than the three-month weights at others areas (53.30±1.20 and 51.70±1.33 kg for Boyera and Dowhakhula respectively). Accordingly pooled three-month weight data significantly ($p<0.05$) affected by areas of the study, though three-month weight of female calves of different areas did not show significant variation among the three locations.

Table 3. Mean weight ± SE (kg) at three-month age of Brahman cross calves in different areas

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	53.08^{a}±1.02 (135)	54.79^{a}±0.74 (263)	50.91^{b}±0.77 (226)
Male	53.30^{b}±1.20 (92)	55.60^{a}±0.76 (161)	51.70^{b}±1.33 (132)
Female	52.60±2.38 (43)	53.50±4.50 (102)	49.81±2.88 (94)

Figures in the parentheses indicate the number of observation; Means with uncommon superscripts within the same row differed significantly (p<0.01).

The mean three-month weight of Brahman male and female crossbred calves was 53.53±1.13 and 51.46±1.60 kg respectively. This weight was lower than that reported by Malau Aduli *et al.* (1993) who

reported three-month weight of Friesian and Bunaii crossbred as 72.4 kg. The weight of Brahman cross calves was higher than that reported by Aruna *et al.* (2004) which was 59.38 kg for Karan Fries cattle.

Weight at six-month of age: The mean values along with standard errors of six-month weight of Brahman cross calves of different areas are shown in Table 4. Analysis of pooled data indicated that area had a significant ($p<0.01$) effect on six-month weight of pooled data as well as six-month weight of male calves. However, the weight at six-month of female calves did not affected by areas of the study. The higher weight at six-month of male calves (91.10±0.96 kg) was observed in Bhabokhali than those of other two areas (86.40±1.55 and 84.90±1.55 kg for Boyera and Dowhakhula respectively).

Table 4. Mean weight ±SE (kg) at six-month age of Brahman calves in different study areas

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	85.75^{b}±1.36 (135)	90.48^{a}±0.94 (263)	83.61^{b}±0.96 (226)
Male	86.40^{b}±1.55 (92)	91.10^{a}±0.96 (161)	84.90^{b}±1.55 (132)
Female	84.37±2.86 (43)	89.50±1.0 (102)	81.80±0.84 (94)

Figures in the parentheses indicate the number of observation; *Means with uncommon superscripts within the same row differed significantly (p<0.01).*

The six-month weights of male and female Brahman cross calves were 87.46±1.86 and 85.22±2.26 kg respectively. The weight of this study was found much lower than the findings reported by Chen *et al.* (2012) of Piedmontese and Nanyang as 194 kg, while the six-month weight of this study was found higher than that reported by Gaur *et al.* (2003) which was 85.8 kg for Brahman crossbred.

Weight at nine-month of age: The mean values along with standard errors of nine-month weight of Brahman cross calves of different areas are shown in Table 5. From Table 5, it is evident that areas have significant ($p<0.01$) effects on nine-month weight of male calves as well as nine-month weight using pooled (ignoring sex) data. Males of Bhabokhali had higher nine-month weight (136.12±1.30 kg) than that of the other two areas (129.80±1.98 and 126.30±1.76 kg for Boyera and Dowhakhula respectively). On the other hand, weight at nine-month of female calves did not affected ($p>0.05$) by area. The nine-month weights of male and female Brahman cross calves were 130.74±2.87 and 125.84±3.39 kg, respectively which was found much lower than the findings reported by Chen *et al*. (2012) of Piedmontese and Nanyang as 293 kg, while the nine-month weight of this study was found higher than that reported by Gaur *et al.* (2003) which was 125.56 kg for Brahman crossbred. Area and sex significantly ($p<0.01$) effected on twelve-month weight.

Table 5. Mean weight ±SE (kg) at nine-month age of Brahman cross calves in the study areas

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	130.89^{a}±1.69 (132)	134.68^{a}±1.27 (263)	124.14^{b}±1.31 (226)
Male	129.80^{b}±1.98 (92)	136.12^{a}±1.30 (161)	126.30^{b}±1.76 (132)
Female	124.01±1.38 (43)	132.43±2.00 (102)	121.10±1.28 (94)

Figures in the parentheses indicate the number of observation; *Means with uncommon superscripts within the same row differed significantly (p<0.01).*

Weight at twelve-month of age: The mean values along with standard errors of twelve-month weight of Brahman cross calves of different areas are shown in Table 6. Analysis showed that the area had a significant ($p<0.01$) influence on twelve-month weight of male calves or all data of mixed sex. Males of Bhabokhali had higher twelve-month weight (184.60±1.99 kg) than those of Boyera (174.10±2.94 kg) and Dowhakhula (169.50±2.78 kg) regions. Analysis of live weight of the growing calves using pooled

(mixed sex) data showed that twelve-month weight of calves of Bhabokhali were higher (179.03±1.95 kg) than those of the other two areas (171.74±2.47 and 167.05±1.93 kg for Boyera and Dowhakhula respectively). Table 6 also shows that twelve-month body weight of female calves did not differ significantly (p>0.05) by area.

Table 6. Mean weight ± SE (kg) at twelve-month age of Brahman cross calves in study areas

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	171.74^{b}±2.47 (135)	179.03^{a}±1.95 (263)	167.05^{b}±1.93 (226)
Male	174.10^{b}±2.94 (92)	184.60^{a}±1.99 (161)	169.50^{b}±2.78 (132)
Female	166.70±4.22 (43)	170.23±2.0 (102)	163.60±1.90 (94)

Figures in the parentheses indicate the number of observation; *Means with uncommon superscripts within the same row differed significantly (p<0.01).*

The highest twelve-month weight of Brahman cross calves was found for male and female 184.60±1.99 and 170.23±2.0 kg respectively (Table 6). Area and sex significantly (p<0.01) affected yearling weight. This result was lower than that of 248 kg by Holloway *et al.* (2005) in Brahman and Angus cross. The higher birth weight in Brahman cross calves may be reflected to be the higher yearling weight in Brahman cross cattle. Sanders *et al.* (2005) observed yearling weight in two beef (Angus and Brahman) F_1 crossed grouped animal and found higher weight in Red Brahman and Gray Brahman crosses were 270 kg and 264 kg than for Angus crosses.

Average daily gain: The mean values along with standard errors of average daily gain of Brahman cross calves of different areas are shown in Table 7. Pooled data on average daily gain were found to be affected significantly by areas. Average daily gain in weight were also significantly affected (p<0.01) by area of male calves and had non-significant influence on average daily gain of female calves. Table 7 also shows that males of Bhabokhali had highest average daily gain (449.94±25.43 g/d) and lowest (408.90±27.46 g/d) in Dowhakhula area.

Table 7. Mean ± SE of average daily gain (g) up to twelve-month age of Brahman cross calves

Area	Boyera	Bhabokhali	Dowhakhula
Pooled (both sex)	416.35^{b}±22.13 (135)	446.51^{a}±16.40 (263)	403.58^{b}±16.82 (226
Male	421.24^{b}±27.89 (92)	449.94^{a}±25.43 (161)	408.90^{c}±27.46 (132
Female	405.90±31.51 (43)	441.10±24.50 (102)	396.10±25.15 (94)

Figures in the parentheses indicate the number of observation; Means with uncommon superscripts within the same row differed significantly (p<0.01).

The mean average daily weight gain of Brahman cross calves was 426.69±12.15 g for male and 414.36± 13.66 g for female respectively (Table 7) which is significantly (p<0.01) affected by area and sex on average daily gain up to one year of age.

Growth performances of Brahman cross calves: The gradual increase of live weight of Brahman cross calves (both sexes) are graphically shown in Figure 2, where age of calves is shown in X axis and body weight at different stages is shown in Y axis. This Figure shows that body weight of calves was enhanced as age progressed. However, progress in weight gain of male calves was higher than that of female calves.

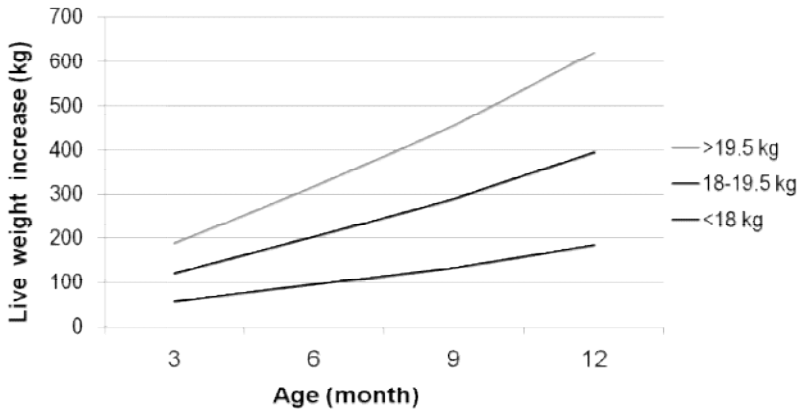


Figure 2. Effect of birth weight on live weight gain of Brahman calves

Bull effect: In this study, four Brahman cross breeding bulls (ABG011, ABG012, ABG013 and ABG014) were used. The mean values along with standard error of weight at different stages of Brahman cross calves produced from these bulls are shown in Table 8. There was no significant effect of bulls on birth weight and three-month weight of calves, while bulls had a significant effect on six-, nine-, twelve-month weight and average daily gain of calves.

Table 8. Mean values ± SE of body weight (kg) daily weight gain (g/d) of calves of different bulls

Traits	Breeding bulls				Sig. Level
	ABG011 (178)	ABG012 (169)	ABG013 (182)	ABG014 (95)	
BWT (kg)	19.87±0.99	19.87±1.04	19.80±0.74	20.01±0.60	NS
WT3 (kg)	52.89±7.32	51.16±7.17	51.84±7.15	52.21±8.03	NS
WT6 (kg)	87.30^{a}±9.22	85.48^{b}±9.04	84.83^{b}±8.92	83.73^{bc}±9.69	*
WT9 (kg)	129.46^{a}±12.58	126.30^{b}±11.76	126.47^{b}±10.67	125.51^{b}±13.65	*
WT12 (kg)	176.19^{a}±17.49	169.80^{b}±18.21	168.88^{b}±16.39	168.77^{b}±19.60	*
ADG12 (g/d)	428.30^{a}±46.9	410.80^{ab}±48.4	408.50^{b}±44.3	407.60^{b}±52.7	**

*Figures in the parentheses indicate the number of observation; BWT, birth weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; ADG12, average daily gain; Means with uncommon superscripts within the same row differed significantly; NS, not significant; *, p<0.05; **, p<0.01*

The following bulls were used to inseminate the cow/heifer artificially in the project (Figure 3):

Bull ID: ABG-311

Bull ID: ABG-312

Bull ID: ABG-313

Bull ID: ABG-314

Figure 3. Brahman crossbred breeding bulls at BAU AI center

Bulls had no significant effect ($p>0.05$) on birth weight or three-month weight but a significant ($p<0.05$) effect on six-, nine- or twelve-month weight. Sire had significant ($p<0.01$) average daily gain of Brahman cross calves. The variations of results between progeny of different bulls might be reflected form the genetic variation of different breeding bulls.

Effect of sex: The growth performances of Brahman cross calves of male and female (ignoring area and bull effect) are presented in Table 9. Birth weight, three-, six-, nine-, twelve- month weight and average daily gain of male calves were significantly higher than those of female calves.

Table 9. Mean ± SE of weight (kg) daily gain (g/d) at different stages of Brahman cross male and female calves

Trait s	n	BWT (kg)	WT3 (kg)	WT6 (kg)	WT9(kg)	WT12 (kg)	ADG12 (g/d)
Pooled (both sex)	624	19.79±20	52.72±1.31	86.61±2.02	129.90±3.08	172.60±3.48	428.81±19.20
Male	385	20.25±0.29	53.53±1.13	87.46±1.86	130.74±2.87	176.06±4.46	426.69±12.15
Female	239	18.99±0.19	51.46±1.60	85.22±2.26	125.84±3.39	166.84±1.91	414.36±13.66

n, number of observation; BWT, birth weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; ADG12, average daily gain; Means with uncommon superscripts between male and female within same trait differed significantly.

The birth weight (ignoring area and bull effects) between sexes differed significantly ($p<0.05$). The mean weight of calves at birth for male and female of Brahman cross calves were 20.25±0.29 and 18.99±0.19 kg respectively (Table 9). Birth weight had a tendency to be higher in males than in females, which is

usual. The result is also in consonance with the results of Bakir *et al.* (2004). The variations of birth weight within and between different genotypes may be due to different dam size, dam performance, environmental support, sample size, feeding and management, etc. The higher birth weight of males than that of females could be attributed to the greater rate of skeletal growth of male calves compared to female calves. The effect of sex was found non-significant on average daily gain (birth to twelve-month of age) of calves ($p<0.001$). In study areas, farmers usually provide inadequate milk and balance feed to their calves, they give priority to male calves compared to females. For this reason weight of females may be lower than that of males.

Calving difficulties and calf mortality: The calf mortality and calving difficulties (dystocia) or abnormal calf born in study areas are presented in Table 10. The calf mortality in Boyera (3.13%) was found slightly higher than those of Bhabokhali (2.71%) and Dowhakhola (3.06%). A total of 6 dystocia cases out of 833 births were observed. The average calf mortality rate was found to be 2.96%.

Table 10. Calf mortality up to twelve-month of age at different study areas

Area	Boyera	Bhabokhali	Dowhakhula	Total
Calf born	192	332	259	833
Dystocia	1	3	2	6
Calf died	6	9	8	23
Mortality (%)	3.13	2.71	3.06	2.96

The highest calf mortality was found in 3.13% in Boyera and lowest mortality was found in 2.71% in Bhabokhali which was higher than that of Brahman-sired cows 2.4% and 1.2% in Simmental, Angus and Hereford observed by Morrison *et al.* (1989). Morrison *et al.* (1989) also reported that Brahman calves are more resistance to heat and disease. However, calves are sometimes affected by internal and external parasites. Rashid *et al.* (2015) found that yearlings and adults were 1.23 and 1.15 times more susceptible to parasitic infection respectively than young calves.

Correlation among growth traits at different ages of calves: Phenotypic correlations among the body weight traits of Brahman cross calves at different ages are summarized in Table 11. Birth weight, three-, six-, nine-, twelve-month weight and average daily gain all are positively correlated to each other. Strong correlations were found between birth weight and weight at three-month (0.65), between weights at six- and nine-month (0.65).

Table 11. Phenotypic correlations among the body weight of Brahman cross calves at different ages

Growth trait	WT3	WT6	WT9	WT12
BWT	0.65	0.52	0.63	0.48
WT3		0.60	0.62	0.45
WT6			0.65	0.45
WT9				0.43

BWT, birth weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight.

The phenotypic correlations between birth weight and weight at three-month age (0.65), between weights at six- and nine-month age (0.65) were found high. Moderate phenotypic correlations were found between birth weight and weight at six-month (0.52) and nine-month weight (0.63), between three- and six- month weight (0.60) and nine-month weight (0.62), which indicated that selection based on body weight at one stage of growth will also improve the body weight at other stages.

Figure 4 below shows some activities of the project.

Figure 4. Pictures showing some research activities of the project

De-worming and premix materials distribution

F1 pregnant Brahman cross

Some pictures of Brahman crossbred calves of the project

A bull calf of 1-m of age

A bull calf of 2-m of age

Group of 2 to 3-m age calves

Twin calves

12. Research highlight/findings:

- A total of 724 Brahman crossbred calves were born during the project period with very attractive phenotype.
- Body weight of Brahman cross calves was tremendously enhanced as age progressed up to 12-months, during the project period. The average birth weight of 20 kg was achieved for male and 19 kg for female that reached to 176 kg and 167 kg at 12 month age, with a daily average weight gain of 427 and 414 for male and female calves respectively.
- The calf mortality was found to be only 2.48% and the rate of dystocia was 0.27%.
- Strong phenotypic correlations were found between birth weight and weight at other stages of growth, which indicates that selection based on body weight at one stage of growth will also improve the body weight at other stages.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	-
(a) Office equipment	Variable	176000/-	Variable	175800	-
(b) Lab &field equipment	Variable	40000/-	Variable	39800	-

2. Renovation facilities:

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	
Renovation of bull shed, water pump with tank, supply line, and Travis at AI points	-	-	147000/-	100%	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training (AI technician)	06	-	06	14-day	-
(b) Workshop	-	-	-	-	-

C. Financial and physical progress

Figure in Tk.

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	347600	334860	334860		96.33	Did not get Fund
B. Field res./lab. expenses and supplies	605050	580741	580741		95.98	
C. Operating expenses	174000	170146	170146		97.79	
D. Vehicle hire, fuel, oil & maintenance	70000	62410	62410		89.16	
E. Training/workshop/seminar etc.	50000	50000	50000		100.00	
F. Publications and printing	81000	15000	15000		18.52	
G. Miscellaneous	84000	81510	81472	38	96.99	
H. Capital expenses	226000	225600	225600		99.82	

D. Achievement of Sub-project by objectives:

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
To improve the genetic potentiality of indigenous cattle for beef production by crossing with Brahman inheritance.	Selection of heifers/cows and breeding using and insemination with Brahman inheritance semen by AI.	327 indigenous heifers/cows and 314 Brahman F_1 cross heifer (total 641) was inseminated artificially. 724 Brahman crossbred calves were born (out of inseminated 641 cows and previously inseminated 1123 cows).	The knowledge of the estimated genetic gain per generation and genetic parameters will help to take decision in participatory

To evaluate the growth performance and adaptability of Brahman crossbreds to local environment of Bangladesh.	Birth weight, body weights at different stages of growth, average daily gain, calf mortality and calving difficulties were observed.	➢ Performance data on 624 crossbreds were recorded. ➢ Body weight of Brahman cross calves was tremendously enhanced as age progressed up to 12-months, during the project period. The average birth weight of 20 kg was achieved for male and 19 kg for female that reached to 176 kg and 167 kg at 12 month age, with a daily average weight gain of 427 and 414 for male and female calves respectively. ➢ The calf mortality was found to be only 2.48% and the rate of dystocia was 0.27%.	breeding program. The small holder and fattening farmers will be benefited by rearing the Brahman crossbred calves.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/ leaflet/flyer etc.	-	-	-
Journal publication	01	-	Evaluation of different graded Brahman calves in local environment of Bangladesh. Submitted to Asian-Australasian Journal of Animal Sciences
Information development	-	-	-
Other publications, if any	-	-	-

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

None

ii. **Generation of new knowledge that help in developing more technology in future**

Brahman inheritance may be suitable to improve beef potentialities of indigenous cattle.

iii. Technology transferred that help increased agricultural productivity and farmers' income

None

iv. Policy Support

The estimated genetic gain per generation and genetic parameters will help to take decision in participatory breeding program. The small holder and fattening farmers will be benefited by rearing the Brahman crossbred calves.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring (description & output of consultation meeting, monitoring workshops etc.):

a) A desk monitoring was done by PIU-BARC-NATP-2 team on 07.03.2018 that was headed by Dr. Mian Sayeed Hassan, director, project implementation unit (PIU), BARC. According to the comments of monitoring team, the project was going on rightly and scheduled based.

b) Research progress was presented in the six month progress workshop (15-16 May, 2018) that was presented on 16 May, 2018 at BARC auditorium.

c) One year research progress was presented in the Annual Workshop (10-13, September), 2018 at BARC auditorium.

ii) Field Monitoring (time and No. of visit, Team visit and output):

Two internal field monitoring was done by Bangladesh Agricultural University Research System (BAURES) team on March 03, 2018 and 17 May, 2018. Members of the monitoring team expressed their opinion as – highly satisfied.

H. Lesson Learned

This type of cattle breeding projects need longer time for successful completion with tangible results.

I. Challenges (if any):

Keeping pace with the time allocated for the project was a big challenge.

Signature of the Principal Investigator
Date: 26 February 2019
Seal:

Counter signature of the Head of the organization/authorized representative
Date:
Seal:

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