Growth Performance, Feed Conversion Ratio and Economics of Production of Native and Crossbred (Local × Holstein Friesian) Bulls for Fattening under Different Improved Feeding

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Abstract: An experiment was conducted to evaluate the growth performance and cost per gain of indigenous and crossbred (local × Holstein Friesian (L × HF)) bulls under four different improved feed treatments to determine the appropriate ration for economic organic beef production in Bangladesh. Twenty indigenous bulls (average body weight 208.08 ± 13.98 kg) and 20 crossbred (L × HF) bulls (average body weight 256.26 ± 26.85 kg) of 24 months age were divided into four equal groups and fed on four diets (T0, T1, T2 and T3) up to 120 d, where T0 referred to the conventional diet, and T1, T2 and T3 referred to improved organic diets. Required dry matter for individual animal was supplied by roughage and concentrate sources of the ration in the ratio of 2:1. Local grass and paddy straw were supplied to group T0 and T1, Napier grass and straw to group T2, and Napier grass (Pennisetum purpureum), straw and Ipil-ipil leaf (Leucaena leucocephala) to group T3 as roughage; whereas, the concentrate was supplied as 1.5% of live weight. The results revealed that total dry matter intake (DMI), total DMI as percent live weight (%LW), feed conversion ratio (FCR) and average daily gain (ADG) varied significantly \((P < 0.01)\) among different treatment groups. Breed also had significant \((P < 0.01)\) effect on total DMI, FCR and ADG, but total DMI (%LW) was not affected by breed type. Feed cost expressed as per kg live weight gain (LWG) (BDT/kg LWG; 1USD = 78.95 BDT), were also affected \((P < 0.01)\) by feed treatments and breed type. Indigenous and crossbred bulls fed diet T3 had higher ADG (0.49 kg and 1.17 kg, respectively) and comparatively lower feed costs (156 BDT/kg LWG and 96.78 BDT/kg LWG, respectively). But crossbred (L × HF) bulls showed the highest ADG (1.17 kg) and the lowest feed cost (96.78 BDT/kg LWG). Therefore, considering the growth performance and cost per kg gain of the experimental animals, it may be concluded that the crossbred (L× HF) bulls treated with T3 diet may be used for economic organic beef production in Bangladesh.

Key words: Feed treatment, growth performance, FCR, cost per gain.

1. Introduction

The local × Holstein Friesian (L × HF) crossbred animals are expected to be a faster growing than native animals for profitable beef production. The growth and carcass yield potentials of indigenous and crossbred cattle may not be sufficiently exploited, unless adequate nutrition both in terms of quantity and quality is ensured. Local farmers mostly fed rice straw and local grass to feed their cattle, and the straw—poor quality roughage, failed to support even the maintenance requirement of energy and protein while it is fed alone. The growth rate of young indigenous cattle was found to be 100 g/d to 200 g/d, and on improved feeding, it was improved to 300 g/d to 800 g/d [1, 2]. Whereas, the feeding of a diet with fresh Napier to concentrate ratio of 1:1 to L ×
Brahman F1 crossbred bulls yield an average daily live weight gain (LWG) of 518 g/head to 624 g/head with an average feed conversion ratio (FCR) of 10.2 to 15.8 [3]. A feedlot ration should be designed to give the maximum weight gain and fattening rate at the lowest cost. The requirement of the quantity of dry matter depends on the body weight of the animal and also on the nature of its production. Cattle will generally eat daily 2.0 kg to 2.5 kg dry matter for every 100 kg of live weight. Crossbred animals are slightly heavy eaters and their dry matter consumption varies from 2.5 kg to 3 kg daily for per 100 kg body weight. Naturally, all its requirements, whether organic nutrients, like carbohydrate protein, fat and minerals or vitamins, should come from the total dry matter that has to be allotted. Since the bulk is essential, the total dry matter allowance should be divided as two-thirds as roughages and one-thirds as concentrates [4]. Over time, there has been a trend towards higher grain feeding in most feedlot diets. Supplementation of straw with the concentrate even up to 73% may improve growth and feed conversion efficiency of local growing animals [5], but increasing level of concentrate may affect benefit cost ratio of cattle fattening system. In a trial of three iso-nitrogenous and iso-caloric diets, cost estimates were higher (1 kg of gain) for cattle fed with the high concentrate diet, and as the grain level increased, cost of gain estimates also increased [6]. Therefore, it is quite necessary to establish a proper ration for feedlot cattle in the aspect of Bangladesh. However, literature regarding feeding effect on growth performance of indigenous and L × HF crossbred bulls under feedlot is scanty in Bangladesh. So, the present study was conducted to evaluate the effect of traditional diet along with three improved diets and their comparison on growth performance and cost per kg gain in local and L × HF crossbred bulls and to determine the appropriate ration for economic beef production in Bangladesh.

2. Materials and Methods

2.1 Experimental Site, Animals and Housing

The experiment was conducted at Raiganj Upazila, Sirajganj, district of Bangladesh for a period of 120 d starting from May, 2013. Twenty indigenous bulls (average body weight 208.08 ± 13.98 kg) and 20 crossbred (L × HF) bulls (average body weight 256.26 ± 26.85 kg) of 24 months age were selected and given to 40 women who were well trained by the local non-governmental organizations (NGOs) for beef fattening. The experimental animals were kept in individual stall with adequate space and separate feeding and watering system. The animals were kept under hygienic conditions and uniform management throughout the experimental period. Each animal was vaccinated with anthrax and foot and mouth disease (FMD) vaccines and de-wormed with anthelmintics immediately before starting the experimental diets.

2.2 Experimental Diet

The animals were divided into two major groups—indigenous and crossbred, and each group was divided into four treatment groups (T0, T1, T2 and T3) containing five animals. The animals of group T0 were treated with conventional feeding method. Whereas, the experimental animals of treatment groups (T1, T2 and T3) were received ad libitum Napier grasses (*Pennisetum purpureum*; hybrid), local grasses and paddy straw after harvesting as basal diet. They also received a concentrate mixture at the rate of 1.5% of their live weights. Feed formulation for different groups was as following:

T0: rice straw + local green grass + concentrate (conventional feeding);
T1: rice straw + local green grass + concentrate;
T2: rice straw + Napier grass + concentrate;
T3: rice straw + Napier grass + Ipil-ipil + concentrate.
Different concentrate mixtures were prepared for the control groups and treatment groups. Concentrate ration for bulls of control group contained wheat bran 50%, rice polish 49% and salt 1%; and the bulls of treatment groups were fed concentrate mixture, which was composed of maize crush 40%, wheat bran 10%, rice polish 16%, Kheshari bran 10%, bone meal 0.5%, salt 1%, fish meal 2.5% and Mustard oil cake 20% on fresh basis. Table 1 shows different chemical compositions of roughages; while Table 2 shows chemical composition of different feed ingredients of concentrate mixture for experimental animals on dry matter basis.

2.3 Feeding

The ration was supplied on the basis of dry matter requirement according to their live weight. Required dry matter for individual animal was supplied by roughage and concentrate sources of the ration in the ratio of 2:1 [4]. Napier grass, local grass and rice straw were provided to all the animals (if needed, additional grass and straw were supplied to the animals) and Ipil-ipil leaf meal was supplied 300 g as a supplementary feed to the T3 group. During the feeding trial, animals were supplied with concentrate mixture at the rate of 1.5% of their respective live weight. The concentrate allowance was divided into two halves and offered at 9:00 am and 4:00 pm. The supply of concentrate mixture to an animal was adjusted with the increase of its live weight. During the whole 120 d of experimental period, amount of green grass, straw and concentrate offered and residue left by the individual animals were recorded every day. Feed intake was determined by subtracting the refusal from the amount given. Feed refusals were collected every morning before feeding, and weighed out regularly to find out daily feed intake.

2.4 LWG and FCR

Initial live weight of each animal was measured before feeding at the beginning day of experiment, and final live weight was measured at the end of the feeding period. The LWG was measured by Eq. (1):

$$\text{Total LWG} = \text{final live weight} - \text{initial live weight}$$

The daily LWG of an individual animal was calculated with Eq. (2):

$$\text{Daily LWG} = \frac{\text{Total LWG}}{\text{Number of days}}$$

### Table 1  Chemical composition of roughages for experimental animals.

| Items          | DM% | OM% | CP% | ADF% | EE% | Ash% |
|----------------|-----|-----|-----|------|-----|------|
| Local grass    | 18.40 | 90.91 | 8.92 | 35.12 | 2.25 | 9.87 |
| Napier grass   | 14.93 | 92.42 | 11.39 | 34.17 | 1.12 | 7.36 |
| Paddy straw    | 91.57 | 82.98 | 9.52 | 46.85 | 1.97 | 17.02 |
| Ipil-ipil leaf | 27.80 | 92.73 | 23.12 | 18.19 | 3.17 | 7.13 |

DM = dry matter, OM = organic matter, CP = crude protein, ADF = acid detergent fiber, EE = ether extract.

### Table 2  Chemical composition of feed ingredients of concentrate mixture for experimental animals.

| Name of ingredients | DM% | CP% | Ash% | OM% | OM basis | CF% |
|---------------------|-----|-----|------|-----|----------|-----|
| Maize crush         | 89.50 | 11.06 | 13.14 | 86.86 | 2.17     |
| Wheat bran          | 88.51 | 17.11 | 9.04 | 90.96 | 17.11    |
| Rice polish         | 90.61 | 13.37 | 14.96 | 85.03 | 13.37    |
| Kheshari bran       | 89.12 | 16.65 | 7.99 | 92.00 | 16.65    |
| Fish meal           | 87.69 | 59.04 | 7.99 | 92.00 | 16.65    |
| Mustard oil cake    | 91.51 | 35.72 | 15.03 | 84.97 | 12.42    |
| Bone meal           | -    | -    | -    | -    | -        |
| Salt                | -    | -    | -    | -    | -        |

DM = dry matter, CP = crude protein, OM = organic matter, CF = crude fiber.
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Daily LWG = total LWG/total days of the experiment

FCR for each animal was determined by Eq. (3):

FCR = total DMI (kg)/total LWG (kg)  

2.5 Economic Analysis

Economic analyses were done considering feed cost only. The costs of concentrate mixtures, straw and grass were calculated as 19.89, 2.15 and 5.94 BDT/kg DM, respectively. Thus, the costs of diet were calculated as: 8.63 BDT/kg DM of T₀ diet, 9.57 BDT/kg DM of T₁ diet, 10.31 BDT/kg DM of T₂ diet and 10.74 BDT/kg DM of T₃ diet for indigenous bulls; whereas, the costs of diets were: 8.24 BDT/kg DM of T₀ diet, 9.14 BDT/kg DM of T₁ diet, 10.15 BDT/kg DM of T₂ diet and 10.19 BDT/kg DM of T₃ diet for crossbred bulls. The gain cost was calculated according to Eq. (4):

\[\text{Gain cost (BDT/kg gain)} = \frac{\text{[total DMI (kg) } \times \text{ cost/kg DM in diet]}}{\text{total LWG}}\]

2.6 Statistical Analysis

Data were presented as means and standard error of the means (SEM). Significant differences at \(P < 0.05\) and \(P < 0.01\) were determined by analysis of variance using statistical software SPSS version 20 and Microsoft Excel Software [7].

3. Results

3.1 Feed Nutrient Intake

All the parameters for feed nutrient intake varied significantly \((P < 0.01)\) among different feed treatment groups of indigenous and crossbred bulls, except daily Ipil-ipil leaf intake (Table 4). Total DMI was the highest (11.07 kg/d) for group T₃ of crossbred bulls, while the lowest DMI (5.32 kg/d) was found for group T₀ of indigenous bulls (Table 3).

Significant variations \((P < 0.01\) and \(P < 0.05)\) of the daily intakes of different feed nutrients were found among different feed treatment groups of indigenous bulls, except the daily Ipil-ipil leaf intake (Table 4). On the other hand, the parameters of daily feed nutrient intake varied significantly \((P < 0.01)\) among the treatment groups of crossbred bulls, except daily straw intake and Ipil-ipil leaf intake (Table 5). The lowest fresh grass intake, concentrate and higher straw intake in conventional feeding system (group T₀) resulted in the lowest total DMI both for indigenous and crossbred bulls (Tables 4 and 5). However, supplementation of Ipil-ipil leaf in group T₃ resulted in the highest total DMI both for indigenous and crossbred bulls (Tables 4 and 5). Significant breed effects \((P < 0.01\) and \(P < 0.05)\) were found for different parameters of feed nutrient intake, except the Ipil-ipil leaf (Table 6) meal supplementation group. Total DMI was significantly higher \((P < 0.01)\) for crossbred bulls, but total DMI as percent live weight (%LW) did not differ significantly \((P > 0.05)\) between indigenous and crossbred bulls (Table 6).

3.2 Average Daily Gain (ADG) and FCR

Breed and feed treatment interaction significantly \((P < 0.01)\) affected ADG and FCR (Table 7). ADG was the highest (1.17 kg) for group T₃ of crossbred bulls and the lowest (0.27 kg) for group T₀ of indigenous bulls. The highest FCR (19.70) of the animals was found in group T₀ of indigenous bulls and the lowest FCR (9.48) was found in group T₃ of crossbred bulls.

ADG and FCR were affected significantly \((P < 0.01)\) by feed treatment among the indigenous bulls. ADG was the lowest and FCR was the highest (0.27 kg and 19.70) in T₀ groups, and ADG was the highest and FCR was the lowest (0.49 kg and 14.51) in T₃ treatment group (Table 8). Significant effect \((P < 0.01)\) of feed treatment was also found in crossbred bulls. ADG was the highest (1.17 kg) for group T₃ and the lowest (0.45 kg) for group T₀; while FCR was the highest (15.87) for group T₀ and lowest (9.48) for group T₃ (Table 9). Breed effect was also significant \((P < 0.01)\) for ADG and FCR of experimental animals. ADG was significantly higher for crossbred bulls,
### Table 3  Daily intake of feed nutrient by indigenous and crossbred bulls under different treatment groups.

| Parameters          | Indigenous                  | Crossbred                   | SEM | Sig. level |
|---------------------|-----------------------------|-----------------------------|-----|------------|
|                     | T0  | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    |
| Fresh grass intake (kg/d) | 9.08 ± 1.26c | 18.09 ± 1.24e | 21.46 ± 1.41d | 26.39 ± 1.88a | 10.36 ± 2.68d | 23.88 ± 1.89b | 26.45 ± 1.38a | 27.74 ± 2.88a | 1.31 ** |
| Grass DMI (kg/d)   | 1.64 ± 0.23e | 3.26 ± 0.22b | 3.39 ± 0.22b | 3.38 ± 0.30b | 1.87 ± 0.48c | 4.30 ± 0.34a | 4.17 ± 0.22a | 4.38 ± 0.45a | 0.22 ** |
| Grass (%LW)        | 0.67 ± 0.08b | 1.32 ± 0.07b | 1.29 ± 0.07b | 1.20 ± 0.07ab | 0.55 ± 0.14c | 1.26 ± 0.11b | 1.11 ± 0.07b | 1.08 ± 0.11b | 0.06 ** |
| Straw intake (kg/d) | 1.75 ± 0.10bc | 1.92 ± 0.25c | 1.53 ± 0.23c | 1.40 ± 0.34c | 3.21 ± 0.12c | 2.98 ± 0.32a | 3.11 ± 0.25a | 3.24 ± 0.46a | 0.19 ** |
| Straw DMI (kg/d)   | 1.52 ± 0.09bc | 1.67 ± 0.22b | 1.34 ± 0.20c | 1.22 ± 0.29c | 2.80 ± 0.11c | 2.60 ± 0.28a | 2.71 ± 0.21a | 2.82 ± 0.40a | 0.16 ** |
| Straw (%LW)        | 0.62 ± 0.04c | 0.68 ± 0.10bc | 0.51 ± 0.08d | 0.44 ± 0.11d | 0.82 ± 0.03c | 0.76 ± 0.08bc | 0.72 ± 0.06bc | 0.70 ± 0.10bc | 0.05 ** |
| Conc. intake (kg/d) | 2.28 ± 0.11c | 2.41 ± 0.10c | 2.46 ± 0.03c | 2.74 ± 0.09d | 2.67 ± 0.06c | 3.41 ± 0.09c | 3.88 ± 0.18b | 4.11 ± 0.12b | 8.54 ** |
| Conc. DMI (kg/d)   | 2.17 ± 0.11c | 2.18 ± 0.08c | 2.22 ± 0.03c | 2.48 ± 0.08d | 2.54 ± 0.06d | 3.14 ± 0.08c | 3.57 ± 0.16b | 3.79 ± 0.11b | 0.06 ** |
| Conc. (%LW)        | 0.89 ± 0.07b | 0.89 ± 0.05b | 0.85 ± 0.03c | 0.88 ± 0.02bc | 0.74 ± 0.01d | 0.92 ± 0.01ab | 0.95 ± 0.02ab | 0.94 ± 0.01ab | 0.02 ** |
| Ipil-ipil Leaf intake (kg/d) | -    | -    | -    | 0.30 ± 0.14 | -            | -            | -            | -            | NS           |
| Ipil-ipil Leaf DMI (kg/d) | -    | -    | -    | 0.08 ± 0.00 | -            | -            | -            | -            | NS           |
| Total DMI (kg/d)   | 5.32 ± 0.25c | 7.11 ± 0.08b | 6.95 ± 0.12b | 7.13 ± 0.17c | 7.20 ± 0.62c | 10.41 ± 0.03b | 10.53 ± 0.09b | 11.07 ± 0.20b | 0.003 ** |
| Total DMI (%LW)    | 2.19 ± 0.12d | 2.90 ± 0.05b | 2.65 ± 0.07de | 2.54 ± 0.05c | 2.10 ± 0.17b | 3.06 ± 0.07a | 2.81 ± 0.05bc | 2.73 ± 0.03d | 0.0001 ** |

SEM = standard error of means; NS = not significant (P > 0.05); **significant at 1% level of probability (P < 0.01); *values having different superscripts in the same row differ significantly.

### Table 4  Daily feed nutrient intake by indigenous bulls under different treatment groups.

| Parameters          | Indigenous                  | Crossbred                   | SEM | Sig. level |
|---------------------|-----------------------------|-----------------------------|-----|------------|
|                     | T0  | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    | T0         | T1    | T2    | T3    |
| Fresh grass intake (kg/d) | 9.08 ± 1.26c | 18.09 ± 1.24e | 21.46 ± 1.41d | 26.39 ± 1.88a | 21.39 ± 1.88a | 1.04 ** |
| Grass DMI (kg/d)   | 1.64 ± 0.23e | 3.26 ± 0.22b | 3.39 ± 0.22b | 3.38 ± 0.30b | 3.38 ± 0.30a | 1.04 ** |
| Grass (%LW)        | 0.67 ± 0.08b | 1.32 ± 0.07b | 1.29 ± 0.07b | 1.20 ± 0.07ab | 1.20 ± 0.07 | 0.05 NS |
| Straw intake (kg/d) | 1.75 ± 0.10bc | 1.92 ± 0.25c | 1.53 ± 0.23c | 1.40 ± 0.34c | 1.40 ± 0.34c | 0.17 ** |
| Straw DMI (kg/d)   | 1.52 ± 0.09bc | 1.67 ± 0.22b | 1.34 ± 0.20c | 1.22 ± 0.29c | 1.22 ± 0.29a | 0.15 ** |
| Straw (%LW)        | 0.62 ± 0.04bc | 0.68 ± 0.10bc | 0.51 ± 0.08bc | 0.44 ± 0.11c | 0.44 ± 0.11c | 0.06 ** |
| Conc. intake (kg/d) | 2.28 ± 0.11c | 2.41 ± 0.10c | 2.46 ± 0.03c | 2.74 ± 0.09c | 2.74 ± 0.09c | 0.06 * |
| Conc. DMI (kg/d)   | 2.17 ± 0.11c | 2.18 ± 0.08bc | 2.22 ± 0.03bc | 2.48 ± 0.08b | 2.48 ± 0.08b | 0.06 * |
| Conc. (%LW)        | 0.89 ± 0.07a | 0.89 ± 0.05a | 0.85 ± 0.03bc | 0.88 ± 0.02ab | 0.88 ± 0.02ab | 0.03 ** |
| Ipil-ipil Leaf intake (kg/d) | -    | -    | -    | 0.30 ± 0.14 | -            | -            | NS           |
| Ipil-ipil Leaf DMI (kg/d) | -    | -    | -    | 0.08 ± 0.00 | -            | -            | NS           |
| Total DMI (kg/d)   | 5.32 ± 0.25c | 7.11 ± 0.08b | 6.95 ± 0.12b | 7.13 ± 0.17c | 7.13 ± 0.17c | 0.12 ** |
| Total DMI (%LW)    | 2.19 ± 0.12d | 2.90 ± 0.05b | 2.65 ± 0.07b | 2.54 ± 0.05bc | 2.54 ± 0.05bc | 0.05 ** |

SEM = standard error of means; NS = not significant (P > 0.05); *significant at 5% level of probability (P < 0.05); **significant at 1% level of probability (P < 0.01); *values having different superscripts in the same row differ significantly.
Table 5 Daily intake of feed nutrient by crossbred bulls under different treatment groups.

| Parameters                | T0          | T1          | T2          | T3          | SEM       | Sig. level |
|---------------------------|-------------|-------------|-------------|-------------|-----------|------------|
| Fresh grass intake (kg/d) | 10.36 ± 2.68d | 23.88 ± 1.89c | 26.45 ± 1.38b | 27.74 ± 2.88a | 1.616     | **         |
| Grass DMI (kg/d)          | 1.87 ± 0.48b | 4.30 ± 0.34a | 4.17 ± 0.22a | 4.38 ± 0.45a | 0.274     | **         |
| Grass DMI (%LW)           | 0.55 ± 0.14c | 1.26 ± 0.11a | 1.11 ± 0.07b | 1.08 ± 0.11b | 0.077     | **         |
| Straw intake (kg/d)       | 3.21 ± 0.12  | 2.98 ± 0.32  | 3.11 ± 0.025 | 3.24 ± 0.46  | 0.220     | NS         |
| Straw DMI (kg/d)          | 2.80 ± 0.11  | 2.60 ± 0.28  | 2.71 ± 0.21  | 2.82 ± 0.40  | 0.191     | NS         |
| Straw DMI (%LW)           | 0.82 ± 0.03  | 0.76 ± 0.08  | 0.72 ± 0.06  | 0.70 ± 0.10  | 0.050     | NS         |
| Conc. intake (kg/d)       | 2.67 ± 0.06c | 3.41 ± 0.09a | 3.88 ± 0.18b | 4.11 ± 0.12a | 0.087     | **         |
| Conc. DMI (kg/d)          | 2.54 ± 0.06b | 3.14 ± 0.08a | 3.57 ± 0.16a | 3.79 ± 0.11a | 0.077     | **         |
| Conc. DMI (%LW)           | 0.74 ± 0.01b | 0.92 ± 0.01a | 0.95 ± 0.02a | 0.94 ± 0.01a | 0.007     | **         |
| Ipil-ipil leaf intake (kg/d) | -            | -            | -            | 0.30 ± 0.07 | -         | NS         |
| Ipil-ipil leaf DMI (kg/d) | -            | -            | -            | 0.08 ± 0.00 | -         | NS         |
| Total DMI (kg/d)          | 7.20 ± 0.62c | 10.41 ± 0.03b | 10.53 ± 0.09b | 11.07 ± 0.20a | 0.232     | **         |
| Total DMI (%LW)           | 2.10 ± 0.17c | 3.06 ± 0.07a | 3.21 ± 0.07a | 3.23 ± 0.03b | 0.067     | **         |

SEM = standard error of means; NS = not significant (P > 0.05); **significant at 1% level of probability (P < 0.01); values having different superscripts in the same row differ significantly.

Table 6 Comparison of the daily intake of feed nutrient between indigenous and crossbred bulls.

| Parameters                | Breed          | P value | Sig. level |
|---------------------------|----------------|---------|------------|
| Fresh grass intake (kg/d) | Indigenous     | 17.50 ± 5.35 | 22.11 ± 7.41 | 0.030      | *         |
| Grass DMI (kg/d)          | Crossbred      | 2.91 ± 0.79  | 3.68 ± 1.13  | 0.018      | *         |
| Grass DMI (%LW)           |                | 1.12 ± 0.28  | 1.00 ± 0.30   | 0.193      | NS        |
| Straw intake (kg/d)       | Indigenous     | 1.65 ± 0.30  | 3.14 ± 0.30   | 0.000      | **        |
| Straw DMI (kg/d)          | Crossbred      | 1.44 ± 0.26  | 2.73 ± 0.26   | 0.000      | **        |
| Straw DMI (%LW)           |                | 0.56 ± 0.13  | 0.75 ± 0.08   | 0.000      | **        |
| Conc. intake (kg/d)       | Indigenous     | 2.48 ± 0.19  | 3.52 ± 0.58   | 0.000      | **        |
| Conc. DMI (kg/d)          | Crossbred      | 2.26 ± 0.15  | 3.26 ± 0.50   | 0.000      | **        |
| Conc. DMI (%LW)           |                | 0.88 ± 0.05  | 0.89 ± 0.09   | 0.625      | NS        |
| Ipil-ipil leaf intake (kg/d) | Indigenous | 0.08 ± 0.00  | 36.00 ± 0.71  | -          | NS        |
| Ipil-ipil leaf DMI (kg/d) | Crossbred      | 0.30 ± 0.07  | 0.08 ± 0.00   | -          | NS        |
| Total DMI (kg/d)          | Indigenous     | 6.63 ± 0.79  | 9.80 ± 1.59   | 0.000      | **        |
| Total DMI (%LW)           | Crossbred      | 2.57 ± 0.27  | 2.68 ± 0.37   | 0.301      | NS        |

NS = not significant (P > 0.05); *significant at 5% level of probability (P < 0.05); **significant at 1% level of probability (P < 0.01).

Table 7 Effect of breed and feed treatment on ADG and FCR of indigenous and crossbred bulls of different treatment groups.

| Parameters                | Indigenous     | Crossbred     | SEM       | Sig. level |
|---------------------------|----------------|---------------|-----------|------------|
| Initial live weight (kg)  | 210.39 ± 11.66cd | 191.44 ± 7.90d | 208.45 ± 9.19e | 222.06 ± 9.19f | 287.49 ± 9.83c | 218.77 ± 8.01ed | 253.62 ± 8.80b | 265.15 ± 10.63b | 6.23      | **         |
| Final live weight (kg)    | 242.85 ± 11.88t  | 245.48 ± 8.20d | 262.42 ± 9.69f | 281.03 ± 9.69g | 341.92 ± 9.38c | 340.26 ± 8.95c | 374.97 ± 9.73b | 405.26 ± 10.22b | 6.47      | **         |
| ADG                       | 0.27 ± 0.001t   | 0.45 ± 0.000d | 0.45 ± 0.006d | 0.49 ± 0.01t | 0.45 ± 0.04d | 1.01 ± 0.01 | 0.45 ± 0.04d | 1.01 ± 0.01 | 0.17 ± 0.03t | 0.01      | **         |
| FCR                       | 19.70 ± 0.34t   | 15.78 ± 0.15c | 15.45 ± 0.21d | 14.51 ± 0.21d | 15.87 ± 0.14b | 10.28 ± 0.09e | 10.37 ± 0.09e | 9.48 ± 0.35f | 0.15      | **         |

SEM = standard error of means; **significant at 1% level of probability (P < 0.01); values having different superscripts in the same row differ significantly (P < 0.01).
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Table 8  ADG and FCR of indigenous bulls of different treatment groups fed different plane of nutrition.

| Parameters               | Indigenous |               |               |               | SEM | Sig. level |
|--------------------------|------------|---------------|---------------|---------------|-----|------------|
|                          | T0          | T1            | T2            | T3            |     |            |
| Initial live weight (kg) | 210.39 ± 11.66abc | 191.44 ± 6.94b | 208.45 ± 7.90b | 222.06 ± 9.19a | 6.43 | **         |
| Final live weight (kg)   | 242.85 ± 11.88c  | 245.48 ± 6.94c  | 262.42 ± 8.20b | 281.03 ± 9.69a | 6.61 | **         |
| ADG                      | 0.27 ± 0.01a  | 0.45 ± 0.00b   | 0.45 ± 0.00b   | 0.49 ± 0.01a   | 0.007 | **         |
| FCR                      | 19.70 ± 0.33a | 15.78 ± 0.20b  | 15.45 ± 0.15bc | 14.51 ± 0.21c  | 0.166 | **         |

SEM = standard error of means; **significant at 1% level of probability (P < 0.01); a-c values having different superscripts in the same row differ significantly.

Table 9  ADG and FCR of crossbred bulls of different treatment groups fed different plane of nutrition.

| Parameters               | Crossbred |               |               |               | SEM | Sig. level |
|--------------------------|-----------|---------------|---------------|---------------|-----|------------|
|                          | T0          | T1            | T2            | T3            |     |            |
| Initial live weight (kg) | 287.49 ± 9.33a     | 218.77 ± 8.01d | 253.62 ± 8.80b | 265.15 ± 10.63b | 6.53 | **         |
| Final live weight (kg)   | 341.92 ± 9.83c     | 340.26 ± 8.95c  | 374.97 ± 9.73b | 405.26 ± 10.22 | 6.85 | **         |
| ADG                      | 0.45 ± 0.04a     | 1.01 ± 0.01b   | 1.01 ± 0.01b   | 1.17 ± 0.03b   | 0.02 | **         |
| FCR                      | 15.87 ± 0.14a    | 10.28 ± 0.09b  | 10.37 ± 0.09b  | 9.48 ± 0.35c   | 0.14 | **         |

SEM = standard error of means; **significant at 1% level of probability (P < 0.01); a-c values having different superscripts in the same row differ significantly.

Table 10  Comparison of ADG and FCR between indigenous and crossbred bulls.

| Parameters               | Breed        |               | P value | Sig. level |
|--------------------------|--------------|---------------|---------|------------|
|                          | Indigenous   | Crossbred     |         |            |
| Initial live weight (kg) | 208.08 ± 13.98 | 256.26 ± 26.85 | 0.000   | **         |
| Final live weight (kg)   | 257.95 ± 17.89 | 365.60 ± 28.86 | 0.000   | **         |
| ADG                      | 0.416 ± 0.09  | 0.911 ± 0.28  | 0.000   | **         |
| FCR                      | 16.36 ± 2.05  | 11.50 ± 2.62  | 0.0001  | **         |

**Significant at 1% level of probability (P < 0.01).

while FCR was significantly higher for indigenous bulls (Table 10).

3.3 Relationship of Feed Nutrient Intake with ADG and FCR

3.3.1 Relationship between Feed Nutrient Intake and ADG
Fig. 1 shows the relationship of total DMI with ADG among different treatment groups. ADG was increased linearly with the increase of daily intake of feed nutrient.

3.3.2 Relationship between Feed Nutrient Intake and FCR
Fig. 2 shows that FCR is the highest when the daily DMI is the lowest; whereas, FCR was the lowest for the highest DMI.

3.4 Economic Efficiency

Daily feed cost and feed cost for 1 kg LWG varied significantly (P < 0.01) among different feed treatment groups of indigenous and crossbred bulls (Table 11). So, breed and feed treatment interaction had significant (P < 0.01) effect on economic efficiency. Daily feed cost was found the highest in group T3 of both indigenous and crossbred bulls (76.66 BDT/d and 112.9 BDT/d, respectively) and the lowest in group T0 of indigenous and crossbred bulls (45.99 BDT/d and 59.26 BDT/d, respectively). The feed costs required for 1 kg LWG was the highest for group T0 (169.94 BDT/kg LWG and 130.86 BDT/kg LWG) and the lowest for group T1 (151.04 BDT/kg LWG and 93.96 BDT/kg LWG) of both indigenous and crossbred bulls, respectively (Table 12).
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![Graph](image1)

**Fig. 1** Feed nutrient intake and ADG of different treatment groups of indigenous and crossbred bulls.

![Graph](image2)

**Fig. 2** Feed nutrient intake and FCR of different treatment groups of indigenous and crossbred bulls.

**Table 11** Feed cost of different feed treatments for indigenous and crossbred bulls.

| Parameters                  | Indigenous       | Crossbreed       | SEM  | Sig. level |
|-----------------------------|------------------|------------------|------|------------|
|                             | T₀    | T₁    | T₀    | T₁    | T₀    | T₁    | T₂    | T₁    | T₀    | T₁    | T₂    | T₁    |      |      |
| Feed cost (BDT/d)           | 45.99 | 68.04 | 71.64 | 76.66 | 59.26 | 95.13 | 106.90| 112.90| 59.26 | 95.13 | 106.90| 112.90| 2.14 | **  |
| SEM = standard error of means; **significant at 1% level of probability (P < 0.01); values with same superscripts letter in a row do not differ significantly (P > 0.05), whereas, values with dissimilar superscripts differ significantly (P < 0.01).
Table 12  Feed cost of different feed treatments.

| Parameters            | Breed            | T₀   | T₁    | T₂    | T₃    | SEM  | Sig. level |
|-----------------------|------------------|------|-------|-------|-------|------|------------|
| Feed cost (BDT/d)     | Indigenous       | 45.99 ± 4.7a | 68.04 ± 2.1b | 71.64 ± 1.4b | 76.66 ± 2.7a | 2.11 | **         |
|                       | Crossbred        | 59.26 ± 3.6d | 95.13 ± 2.2c | 106.91 ± 3.3b | 112.90 ± 3.9a | 2.35 | **         |
| Feed cost (BDT/kg LWG)| Indigenous       | 169.94 ± 13.6a | 151.04 ± 3.6b | 159.26 ± 2.3b | 156.00 ± 4.9b | 5.33 | **         |
|                       | Crossbred        | 130.86 ± 3.6a | 93.96 ± 1.7c | 105.71 ± 2.5b | 96.78 ± 5.1c  | 2.46 | **         |

SEM = standard error of means; **significant at 1% level of probability \((P < 0.01)\); values in a row with same superscripts letter do not differ significantly \((P > 0.05)\), whereas, values with dissimilar superscripts differ significantly \((P < 0.01)\).

Table 13  Comparison of average feed cost between indigenous and crossbred bulls.

| Parameters            | Indigenous       | Crossbred | P value | Sig. level |
|-----------------------|------------------|-----------|---------|------------|
| Feed cost (BDT/d)     | 65.58 ± 12.3     | 93.55 ± 21.6 | 0.001   | **         |
| Feed cost (BDT/kg LWG)| 159.06 ± 9.9     | 106.83 ± 15.3 | 0.001   | **         |

**significant at 1% level of probability \((P < 0.01)\).

4. Discussion

4.1 Feed Intake

Feed treatment had significant effect \((P < 0.01)\) on daily intake of total dry matter (kg/d) and DMI as percent live weight (%LW) both for indigenous and crossbred bulls in this study. Rashid et al. [8] also reported significant differences \((P < 0.05)\) of DMI/d for three diets of experimental animals, where Con-UMS diet (50% concentrate + 50% urea, molasses, straw) group showed the highest DMI of 10.2 kg/d or 2.69% LW, followed by 100% concentrate diet group (Con.) of 7.56 kg/d or 1.99% LW, and 100% UMS diet group of 6.71 kg/d or 1.94% LW, respectively. But, Rashid et al. [6] and Zahradkova et al. [9] did not find any significant difference of DMI/d among different feed treatment groups, which could be due to the similar live weights of animals and the diets were iso-nitrogenous and iso-caloric, while animals having different live weights were used in the present study.

Total DMI (kg/d) was significantly \((P < 0.01)\) affected by breed type in this study, and this was in accordance with result of Roy et al. [3], who found significant \((P < 0.01)\) variations of DMI among Brahman crossbred bulls (6.91 kg/d), Pabna bulls (5.33 kg/d) and Red Chittagong bulls (4.46 kg/d); while unlikely to the present study, total DMI (%LW) varied significantly \((P < 0.01)\) among different breeds [3]. Fox et al. [10] also found the significant \((P < 0.05)\) differences of total DMI among different breeds. But, the findings did not agree with Zahradkova et al. [9].

The amount of DMI (kg/d) by the indigenous bulls in the present study was almost similar to the DMI reported by Zahradkova et al. [9], while the amount of DMI (kg/d) by crossbred bulls was almost similar to Fox et al. [10] and Bures and Barton [11]. Daily DMI as percent of live weight (%LW) was almost similar to Dung et al. [12] and Rashid et al. [8] (for Con-UMS diet) for indigenous and crossbred bulls. On the other hand, the lower amount of DMI (kg/d and as %LW) by the animals of 24 months of age reported by Roy et al. [3], may be linked to several factors, i.e., breed type, live weight, environment and feed ingredients of diet as they fed concentrate mixture at the rate of 1.25% of the live weight of animals, which was lower than the present study.
4.2 LWG and FCR

ADG varied significantly \((P < 0.01)\) among different feed treatment groups. Significant \((P < 0.05)\) variations of ADG among different feed treatment groups were also reported by Rashid et al. [8]; and the reported ADG were 0.954, 0.873, 0.205 kg for 100% concentrate diet group (Con.), Con-UMS diet group and 100% UMS diet group, respectively. Rahman [13] found higher ADG (0.492 kg/d) for UMS treated diet group than the control group (0.365 kg). Malole et al. [14] also found significant \((P < 0.001)\) difference of ADG between two feed treatment schemes. Unlike the present study, Alberti et al. [15] did not find any significant effect of diet on ADG.

ADG of the experimental animals were also affected \((P < 0.01)\) by breed type in the present study. Similar significant \((P < 0.01)\) variations of ADG for breed type were determined by Roy et al. [3]; and the results were 0.709, 0.447, 0.624 kg for Pabna breed, Red Chittagong cattle (RCC) and Brahman crossbred bulls, respectively. Fox et al. [10] reported variations in ADG 1.28, 1.34, 1.40 and 1.29 kg/d for unselected Hereford, selected Hereford, Angus × Hereford × Charolais and Angus × Hereford × Holstein, respectively. Unlike the present study, Keane [16] did not find significant effect of breed on ADG of animals.

ADG of indigenous bulls in this study were almost similar to the Red Chittagong bulls, but ADG for crossbred bulls \((HF \times L)\) were higher than the Brahman crossbred bulls [3]. Similarly to the findings in the present study, the differences in ADG among the breed types were also reported by Barton et al. [17], who showed Charolais and Simmental gained more rapidly \((P < 0.05)\) than Aberdeen Angus, while Hereford showed intermediate. Bonilha et al. [18] also reported a significant variation of daily LWG among the Bos indicus and tropically adapted Bos taurus breed.

FCR in the present study was significantly \((P < 0.01)\) affected by different feed treatments, which is similar to the results reported by Rashid et al. [8] and Malole et al. [14]. In this study, crossbred bulls \((HF \times L)\) showed significantly lower \((P < 0.01)\) FCR than the indigenous bulls. But, Roy et al. [3] observed significantly \((P < 0.01)\) higher FCR values in Brahman crossbred bulls than the indigenous (Pabna breed and Red Chittagong cattle breed) bulls fed single plan of nutrition. Zahradhkova et al. [9] also reported significant \((P < 0.01)\) differences of FCR values among different breed types, but they did not find any significant difference of FCR for different diets. Keane [16] found significantly \((P < 0.01)\) lower efficiency of utilization of net energy for carcass weight gain in Holstein Friesian than Belgian Blue × Holstein Friesian. Malole et al. [14] also found that TSHZ (Tanzanian × Shahiwal Zebu) cattle had lower FCR compared to Ankole cattle, which supported the breed effect on FCR of the present study.

4.3 Economic Analysis

The result of economic efficiency shows that conventional diet group \((T_0)\) had significantly lower \((P < 0.01)\) daily feed cost and higher feed cost per kg LWG, which may be due to poor quality of concentrate in diet. On the other hand, improved diet groups showed higher \((P < 0.01)\) daily feed cost and lower feed cost per kg LWG. Rashid et al. [6] reported significantly higher \((P < 0.05)\) daily feed cost for higher level of concentrate in diets, and the feed cost required for 1 kg LWG increased with the increase of concentrate level in diet. Rashid et al. [8] also found replacing 50% of an all-concentrate diet with urea-molasses impregnated straw (UMS) reduced feed cost per kg LWG, while 100% UMS diet had the lowest \((P < 0.05)\) daily feed cost. Parvez et al. [19] reported reduction of daily feed cost with the decreased level of energy and protein in the diet.

5. Conclusions

It is concluded that improved feed treatment \(T_3\) performs more effectively and economically
compared to feed treatment T₁ and T₂; and the conventional feeding is not suitable for profitable organic beef fattening in Bangladesh. The crossbred bulls (L × HF) are proved to be more effective and economic, as they have higher ADG and lower FCR than the indigenous bulls. So, L × HF crossbred bulls may be used for profitable beef fattening instead of using indigenous bulls and feeding conventional diet on the aspect of Bangladesh.

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References

[1] Akbar, M. A., Islam, S. M. A., and Tareque, A. M. M. 1990. “Effects of Different Levels of Molasses Addition during Ensiling of Urea Rice Straw on Its Nutritive Value in Buffalo Calves.” Ind. J. Anim. Sci. 7 (3): 227-8.

[2] Rahman, M. A., Alam, A. M. M., and Shahjalal, M. 2009. “Supplementation of Urea-Molasses-Straw Based Diet with Different Levels of Concentrate for Fattening of Emaciated Bulls.” Pak. J. Bio. Sci. 12 (13): 970-5.

[3] Roy, B. K., Hoque, K. S., Sarker, N. R., Hossain, S. M. J., Rana, M. S., and Munsi, M. N. 2013. “Study on Growth and Meat Quality of Native and Brahman Crossbred Bulls at Different Ages.” In Proceedings of the BLRI Annual Research Review Workshop 2012-2013.

[4] Banerjee, G. C. 2011. “Animal Nutrition.” In A Textbook of Animal Husbandry, 8th ed.. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.

[5] Hoque, K. S., and Sultana, N. 2007. “Review on Feeding, Nutrition and Growth Performance of Native Male Cattle of Bangladesh, and Comparison with Feedlot Beef Animals.” Bang. J. Anim. Sci. 36: 113-35.

[6] Rashid, M. M., Hoque, K. S., Hoque, M. A., Sarker, N. R., and Bhuiyan, A. K. F. H. 2015. “Effect of Concentrate to Roughage Ratio on Cost Effective Growth Performance of Brahman Crossbred Calves.” J. Agri. Sci. Tech. A 5 (4): 286-95.

[7] Albert, S. C., Wayne, W., and Zappe, C. 2008. Data Analysis and Decision Making with Microsoft Excel, 3rd ed.. Hampshire, United Kingdom: South-Western College Publishing Co. Ltd.

[8] Rashid, M. M., Hoque, M. A., Haque, K. S., and Bhuiyan, A. K. F. H. 2015. “Effect of Concentrate Feeding on the Cost Effective Growth Performance of F1 Local × Brahman Bulls in Bangladesh.” Livestock Res Rural Dev. 27 (5).

[9] Zahradkova, R., Barton, L., Bures, D., Teslik, V., and Kudrna, V. 2010. “Comparison of Growth Performance and Slaughter Characteristics of Limousin and Charolais Heifers.” Archiv Tierzucht 53 (5): 520-8.

[10] Fox, D. G., Tedeschi, L. O., and Guiroy, P. J. 2001. Determining Feed Intake and Feed Efficiency of Individual Cattle Fed in Groups. A Report, Beef Improvement Federation, San Antonio, TX.

[11] Bures, D., and Barton, L. 2012. “Growth Performance, Carcass Traits and Meat Quality of Bulls and Heifers Slaughtered at Different Ages.” Czech J. Anim. Sci. 57 (1): 34-43.

[12] Dung, D. V., Yao, W., Ba, N. X., and Kalhoro, H. 2013. “Feeding Systems for Fattening Cattle on Smallholder Farms in Central Vietnam.” Livestock Res Rural Dev. 25 (8).

[13] Rahman, S. M. E. 2001. “Cattle Fattening through Urea Molasses Straw Feeding and Its Effect on Intake, Growth and Carcass Characteristics.” M.Sc. thesis, Department of Animal Science, Bangladesh Agricultural University.

[14] Malole, J. L., Kadigi, R. J. M., and Sangeda, A. Z. 2014. “Cost and Benefits of Beef Cattle Fattening Schemes in Some Selected Areas of North West Tanzania.” Iranian J. App. Anim. Sci. 4 (4): 699-706.

[15] Alberti, P., Beriain, M. J., Ripoll, G., Sarriés, V., Panea, B., Mendizabal, J. A., Purroy, A., Olletha, J. L., and Sanudo, C. 2014. “Effect of Including Linseed in a Concentrate Fed to Young Bulls on Intramuscular Fatty Acids and Beef Color.” Meat Sci. 96 (3): 1258-65.

[16] Keane, M. G. 2010. “A Comparison of Finishing Strategies to Fixed Slaughter Weights for Holstein Friesian and Belgian Blue × Holstein Friesian Steers.” Irish J. Agri. Food Res. 49: 41-54.

[17] Barton, L. D., Rehak, V., Teslik, D., Bures, R., and Zahradkova, R. 2006. “Effect of Breed on Growth Performance and Carcass Composition of Aberdeen Angus, Charolais, Hereford and Simmental Bulls.” Czech J. Anim. Sci. 51 (2): 47-53.

[18] Bonilha, S. F. M., Tedeschi, L. O., Packer, I. U., Razook, A. G., Alleoni, G. F., Nardon, R. F., and Resende, F. D. 2008. “Evaluation of Carcass Characteristics of Bos indicus and Tropically Adapted Bos Taurus Breeds

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Selected for Postweaning Weight.” *J. Anim. Sci.* 86 (8): 1770-80.

[19] Parvez, M. S., Shahjalal, M., and Akbar, M. A. 2001. “Effect of Different Levels of Energy and Protein on Growth and Nutrient Utilization in Local Bull Calves.” *Bang. J. Anim. Sci.* 30 (1-2): 107-13.