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Article

Comparative study of pure RCC and graded RCC cattle through software based recording system in different regions of Bangladesh

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Abstract: Recording systems are important to maintain data properly with a view to justifying the merits of productive and reproductive parameter as well as pedigree evaluation, towards any decision making pathway. Considering this, the current research was conducted to assess the computer and mobile software based animal recording system, which have important effect on production and reproduction on Red Chittagong cattle and their graded cattle. For this reason, this survey was conducted at well-developed pre-tested questionnaire through mobile application software under thirteen study areas. The study areas were selected based on the density of Red Chittagong Cattle population in those areas. After data collection, collected data were analyzed using SPSS 22.0 software and mean comparisons were estimated by LSD and Duncan method. Numbering (highest-11.32% at Godagari, lowest at Naikhongchari-4.25%), Artificial Insemination (highest 20% at Godagari and lowest at Naikhongchari-1%), service per conception rate (highest at Sylhet-1.37 and lowest at Swandip-1.14), calving rate (highest 12.34% at Anowara and lowest 4.20% at Keshobpur) and birth weight (highest 16.50±0.57 kg at Hathazari and lowest 12.79±0.49 kg at Godagari) were different in each regions. Lactation length, milk yield, and growth rate of two category cattle were found statistically significant (P<0.05) between two groups of cattle. These three productive parameters were higher for Red Chittagong Cattle (230±5.16 days, 3.10±0.13 L/day, 0.197 kg/day) respectively. The software based recording system helps to get proper data which will help for selection of superior sires and dams with high genetic merit as well as data can be restored anytime from this software based recording system.

Keywords: Red Chittagong Cattle (RCC); graded RCC; comparative growth performance; record keeping; software based recording system

1. Introduction

Due to being an agro-based country, most people of Bangladesh have to be engaged in crop and livestock production for their subsistence. Livestock contribution in gross domestic product (GDP) at constant prices was 1.90% (DLS, 2021-22). Most of the people fulfill their protein requirement from animal protein source. Recommendation of daily milk requirement is 250.00 ml /d/h but the availability of milk is 208.61 ml/d/h that is lower than the requirement and the shortage is 16.56% (DLS, 2021-22). Availability of meat is 147.84 g/h against 120 g/h of requirement, which indicates the surplus meat production. This implies that Bangladesh produces only 83.44 percent of the national requirement (DLS, 2021-22; BBS, 2022). In Bangladesh, major portion of this milk come from indigenous cattle such as Red Chittagong cattle, Munshiganj cattle, Pabna cattle and North Bengal grey cattle and remaining rest is known as non-descript indigenous cattle (Das *et al*., 2021) which are being reared in marginal farmers' house. Among the indigenous cattle genotype Red Chittagong Cattle (RCC) is a promising genotype known for its distinct phenotypic characteristics, adaptability to the hot humid climatic environment, high resistance to diseases, and high-quality milk and beef production (Hossain *et al*., 2020; Islam *et al*., 2020). The Red Chittagong Cattle (RCC) serves as a dual-purpose breed, contributing to both dairy and beef production. It plays a pivotal role in poverty alleviation for smallholder farmers within its habitat (Das *et al*., 2021). Additionally, average annual household income increased (31%) through using RCC rearing model (Kabir *et al*., 2022) which improved socio-economic status of farmers. After review it is found that, the milk production of RCC dairy cows are lower than crossbred but others performances such as calving rate, conception rate, feed conversion ratio, utilization of locally available feed, disease resistance capacity are higher in RCC (Mondal *et al.*, 2005). Furthermore, the birth weight of Red Chittagong Cattle (RCC) calves is comparable to non-descript indigenous cattle but falls below that of Pabna and North Bengal gray cattle (Hossain *et al*., 2021). RCC heifers reach puberty earlier than Munshiganj, Pabna, and Sahiwal cattle genotype in Bangladesh. The gestation period of Red Chittagong Cattle (RCC) aligns with other cattle genotypes in Bangladesh. Additionally, the post-partum estrus of RCC cows is lower when compared to Sahiwal and Sindhi crossbreeds (Bhuiyan, 2013). The mature live weight of RCC is greater than indigenous cattle but lower than that of crossbreds. The calving interval of RCC is similar to non-descript indigenous cattle, North Bengal gray, and Pabna cattle, and the service per conception is greater than non-descriptive indigenous, Pabna cattle, North Bengal gray, and Munshiganj cattle of Bangladesh (Khan *et al*., 2000). Calf survivability is similar to non-descript indigenous cattle but higher than crossbreds at farm level (Das *et al*., 2021). Moreover, in comparison with crossbred cattle, RCC cows have better reproductive traits (short post-partum heat period, high conception rates), while crossbred cows have better productive traits (milk production) (Hossain *et al*., 2021).

The majority of marginal farmers in Bangladesh lack formal education and have inadequate knowledge in livestock management. They are unable to maintain accurate records of the conditions of their cattle and to provide a healthy diet in accordance with the requirements. As a result, the production of these animals is decreasing on a daily basis. Livestock production, on the other hand, is critical in Bangladesh for delivering an adequate amount of food to a rapidly rising human population. Apart from marginal farmers, some farmers are doing cattle farming in small scale and large scale for sustainable cattle production. In case of large scale cattle farming, effectively managing a wide range of cattle varieties can be quite complicated. Physically collecting data of all the animals on a farm would be unserviceable and very tedious. A sound record keeping system is a must to get better production from these cattle farms.

The best performance record of cattle breed is necessary to estimate the productive and reproductive traits accurately in the dairy cattle such as age at puberty, age at first calving, post-partum heat period, conception rate, calving intervals, lactation period, lactation yield and milk yield (Sarder *et al*., 2007). Properly tagging animals to identify and record various productive and reproductive characteristics is crucial for enhancing genetic potential as well as livestock production. In developed nations, farmers utilize software on electronic devices to meticulously maintain their animals' records. Unfortunately, in Bangladesh, the process of record-keeping is arduous and often hindered by limited availability of data, impeding further breeding projections. Although many research work were found about productive and reproductive traits of RCC (Hossain *et al*., 2021, Nath *et al*., 2016, Hasanuzzaman *et al*., 2012, Mostari *et al*., 2007), but no research work were found about developing the animal recording system in Bangladesh.

Record-keeping holds immense significance in livestock farming, serving purposes such as tracking all animals, evaluating livestock for selection, controlling inbreeding, aiding in breeding planning, and selecting animals with the appropriate characteristics for breeding (including production, health, and feed efficiency). It is crucial for improving the herd or flock, formulating rations, and maintaining an accurate account of disease management treatments, among other essential aspects of livestock management (Miglior *et al*., 2017). The inputs and associated costs spending in production can't be estimated by many local farmers. Simply, record

keeping provides the solution to most of the problems that farmers face during production. Record keeping must be maintained to build a profitable livestock production. The conserved records serve as a valuable tool for advancing the farm, its herd, and the agricultural sector as a whole in the country. It is beneficial for farmers to view their farming operations as businesses, recognizing that attentive care and effective management directly impact the productivity and profitability of the farm. By leveraging proper care and well-rounded management practices, farmers can optimize their operations and drive sustainable growth. Given these considerations, the current study was initiated to conduct a comparative analysis of pure Red Chittagong Cattle (RCC) and graded RCC. Furthermore, the aim was to develop a smart animal recording system using mobile and computer applications to facilitate seamless record-keeping for indigenous animal management.

2. Materials and Methods

2.1. Ethical approval

This research was software based animal recording system, which was not allowed any harmful effects on animals. So, the Institutional Ethical Committee of the Bangladesh Livestock Research Institute consented the study and informed that, ethical approval was not applicable for this study.

2.2. Research area selection

This research was conducted focusing on productive and reproductive performances of RCC and their graded cattle at 13 upazilas of seven districts of Bangladesh. These areas were Patiya, Chandanaish, Anowara, Satkania, Banshkhali, Hathazari, Swandwip, Sylhet, Keshobpur, Naikhongchari, Godagari, Sakhipur, Kurigram (Figure 1). A total 1761 cattle were numbered to collect data and achieve the objectives of the study randomly.

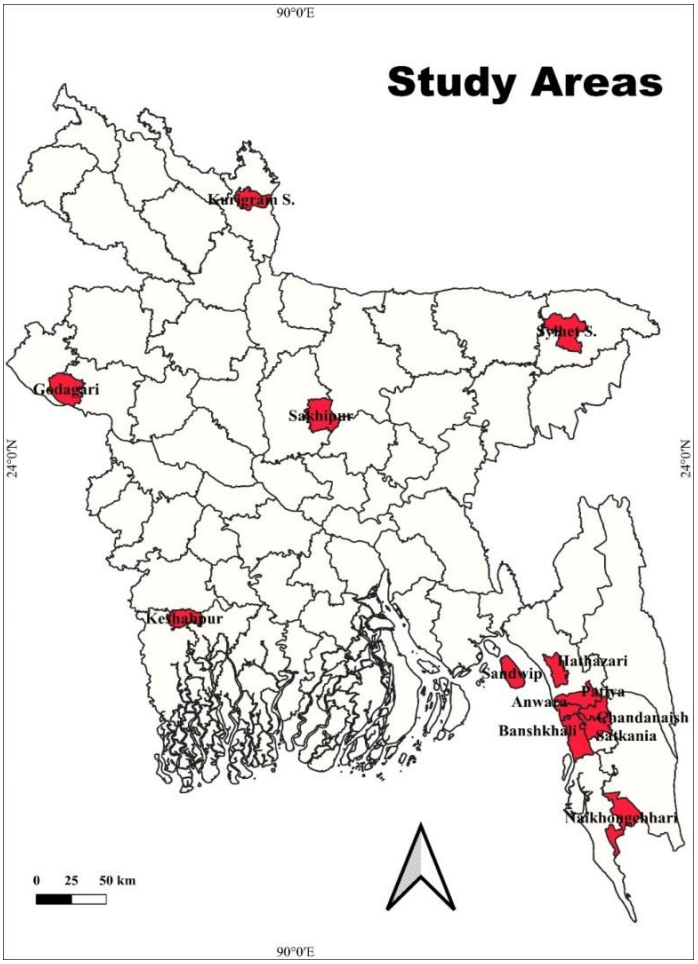

Figure 1. The red color filled area in the map indicating the study location.

2.3. Farmer selection

Farmers were selected considering some criteria i.e- poor farmers having at least one Red Chittagong dairy cattle, led their livelihood by selling milk were selected. About 900 farmers were selected under this research.

2.4. Farmer's facilities and production of RCC and graded RCC calves

All RCC and their graded cattle of 900 farmers were selected and numbered by permanent ear tagging method. However, frozen semen, vaccination, treatment and several training programs were provided to RCC rearing farmers in selected upazilas. Artificial Insemination was conducted according to following ways and pure RCC and graded RCC was produced.

- Pure RCC dam × Pure RCC sire = Producing pure RCC calves
- Indigenous dam × Pure RCC sire = Producing graded RCC calves

2.5. Software development and validation

To store cattle information and control whole recording system in central recording pool, RCCDCP software was designed and developed by Scientists and Software Development Company. Software was validated in Chittagong districts at farm level. Following the validation process, a comprehensive data recording training program was implemented. For accuracy and efficiency, farmer and animal enrollment was conducted by a field assistant supervised by a scientific officer. Additionally, artificial insemination (AI), productive and reproductive data were entered into the software via mobile devices, then recorded in both the software and a cloud storage server for secure storage and accessibility.

2.6. Data collection, management and analysis

Data was collected by RCCDCP mobile application software. Farmers information, cattle and calf birth date and weight, cattle population, characterization, Artificial Insemination information (AI date, conception status, repeat number expected pregnancy date, sire ID), semen characteristic of sire, cattle growth, health status, feeding system record, milking record, dairy characteristics, socio economic and cost-return data were inputted in the developed software and stored in cloud computer system by using smart phone at research areas. After that data was harvested using an output device, input in MS Excel sheet and analyzed by using SPSS 22 software.

3. Results and Discussion

3.1. Numbering, service per conception rate and calving rate

Total 1761 cattle were selected at study area, result showed the highest percentage (11.32%) of animal numbering was done at Godagari and lowest percentage (4.25%) at Naikhongchari and service per conception rate was higher at Sylhet (1.37%) and lower at Swandip (1.14%). These data was taken from farmer household by using smartphone. At the study area, respective scientists visited farmers home and inputted the productive and reproductive performances data in developed software, and that data was stored in computer cloud system regularly. Among the selected cattle, AI was conducted on 2995 animals, after AI 665 calves were born. Maximum calves were born at Anowara (12.34%) and minimum at Keshobpur (4.20%), of them higher birth weight of new born calves were found at Hathazari (16.50±0.57 kg) and lower at Godagari (12.79±0.49 kg) (Table 1). Average birth weight of RCC calves at selected area is (14.84±0.49 kg) which was higher than 14.5±0.8 kg reported by Hasanuzzaman *et al.,* (2012) and lower than 16-17 kg reported by Khan *et al.* (2000). The birth weight of the RCC calf is between 14 and 16 kg similar to non-descript indigenous cattle, but lower than Pabna, and North Bengal gray cattle (15, 21, and 18 kg, respectively) (Das *et al*., 2021).

Table 1. Numbered cattle, breeding and newborn calves in the selected areas.

Study Area	Numbered cattle (%)	Service/conception rate	Newborn calf	
			Total (%)	Birth weight (kg) (Mean±SE*)
Patiya	10.90	1.18	11.26	15.31±0.72
Chandanaish	7.78	1.20	10.68	15.79±0.61
Anowara	7.72	1.19	12.34	14.42±0.29
Satkania	5.68	1.16	9.37	16.29±0.38
Banshkhali	8.01	1.16	8.24	15.74±0.75
Hathazari	7.41	1.26	9.41	16.50±0.57
Swandwip	8.17	1.14	8.24	12.80±0.41
Sylhet	7.56	1.37	4.70	13.58±0.48
Keshobpur	5.0	1.21	4.20	14.82±0.34
Naikhongchari	4.25	1.18	4.30	15.24±0.45

Table 1. Contd.

Study Area	Numbered cattle (%)	Service/conception rate	Newborn calf	
			Total (%)	Birth weight (kg) (Mean±SE*)
Godagari	11.32	1.21	6.60	12.79±0.49
Sakhipur	10.0	1.19	5.45	13.79±0.69
Kurigram	6.20	1.22	5.21	14.50±0.37
Overall	100.00	1.20	100.00	14.84±0.49

*SE= Standard error

3.2. Artificial insemination in the study areas

A total of 2995 artificial inseminations were performed in the designated regions, leading to the birth of 665 calves. Among them, 279 were pure Red Chittagong Cattle (RCC), while 386 were categorized as graded RCC based on pedigree records (Figure 2). The average service per conception rate was determined to be 1.20, which proved to be lower than that observed in non-descript indigenous cattle, Pabna cattle, North Bengal gray, and Munshiganj cattle in Bangladesh (1.4, 1.3, 1.4, and 1.3, respectively) (Bhuiyan, 2013).

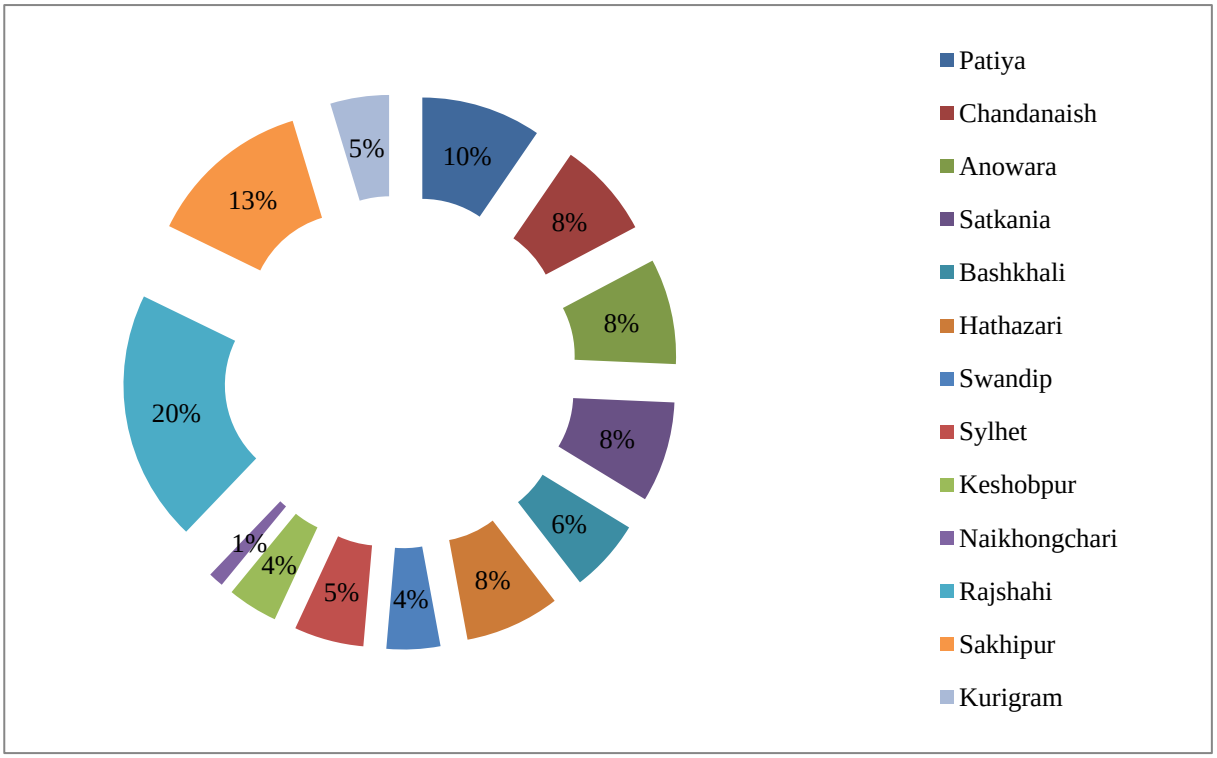

Figure 2. Artificial insemination in the different study areas.

3.3. Growth performance comparison of pure and graded RCC calves up to pre-weaning

Among 665 new born calves, 279 calves were pure RCC and 386 calves were graded. There were difference between pure RCC and graded RCC at birth weight. Results showed that, higher birth weight was recorded at pure RCC (15.77± 0.56 kg) and lower at graded RCC (13.63±0.46 kg). Growth performances of new born calves were recorded for 12 month. Over the period, growth rate of pure RCC was higher (53.23±0.29 kg at 6 month & 86.54±0.32 kg at 12 month of ages) than the graded RCC (44.73±0.58 kg at 6 month & 79.58±0.35 kg at 12 month of ages) (Figure 3). The growth curves for pure Red Chittagong Cattle (RCC) surpassed those of graded RCC, and the average daily live weight gain for RCC and graded animals were 0.197±0.22 kg/day and 0.175±0.49 kg/day, respectively. It is reported that pre-weaning daily weight gain of RCC calves is 0.158 to 0.190 g/day (Hossain *et al.*, 2018).

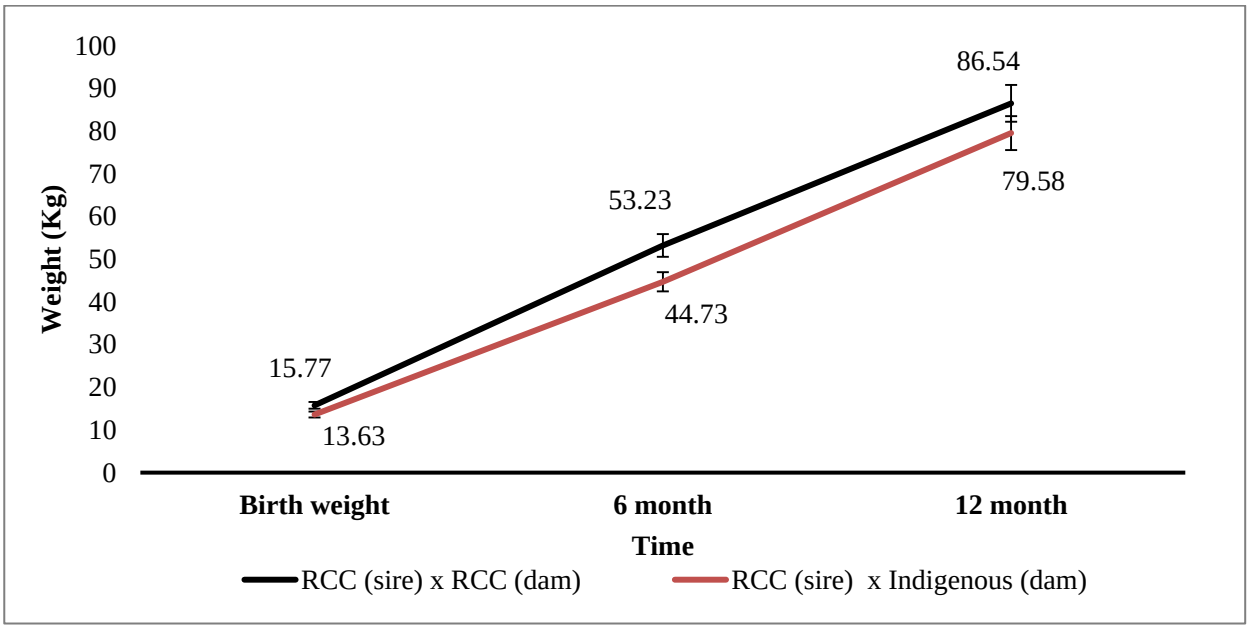

Figure 3. The growth performance of both pure and graded Red Chittagong Cattle (RCC) calves.

3.4. Lactation performances

Highest milk production was recorded 5.50 L/day at first lactation period (Figure 4). Nevertheless, the highest average milk production of 3.10±0.13 liters per day was recorded during the fourth lactation, which spanned 230±5.16 days. Moreover, average lactation length was recorded 188.43±2.09 days with 2.94±0.6 L/day. Hossain *et al.* (2021) reported lactation length of RCC 204±0.13 days with milk yield 2.77±0.22 litre/day which is lower than the present findings. Khan *et al.* (2000) found lactation length of RCC 222.85 days under farm condition. Azizunnesa *et al.* (2010) also reported 238±30.60 days of lactation period of RCC which is higher than present findings but lower milk yield (2.10±0.63 kg/day) than present findings.

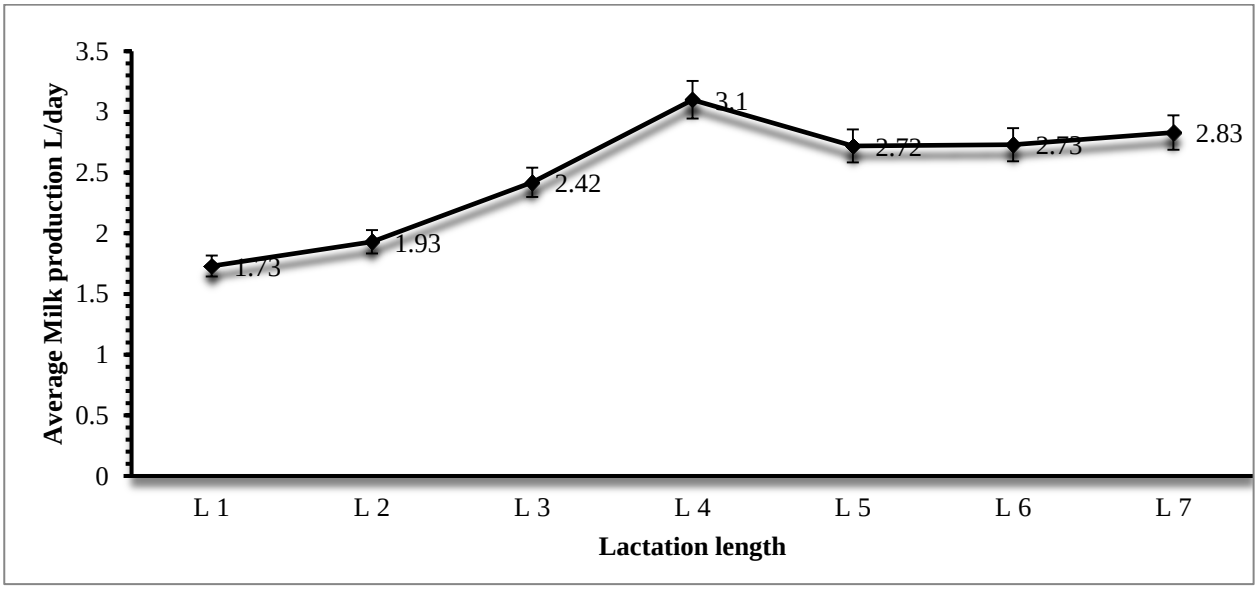

Figure 4. Lactation curve of RCC in field.

4. Conclusions

By using this smart record keeping system, actual records of animal were picked up from field level. From those data, it was found that weight gain of RCC was higher than graded RCC. Moreover, considering milk production, highest milk production was recorded on 4th lactation. Therefore, the establishment of superior sires and dams with high genetic merit will be prioritized through the selection process. Besides this, increasing the

application of this modern recording system through mobile or/and computer will be helpful to store data properly as well as will be an easy recording system for all kinds of farmers.

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Data availability
The data used to support the findings of this study are included within the article.

Conflict of interest
None to declare.

Authors' contribution
Manik Miah and Shahanaj Ferdousi Shejuty contributed on data collection, data analysis, writing the manuscript; Md. Ahsanul Kabir and Md Ruhul Amin contributed on research planning and reviewing the manuscript; Sheikh Mohammad Jahangir Hossain, Dipa Das, Syed Ali Azmol and Atikur Rahaman contributes on reviewing the article. All authors have read and approved the manuscript.

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