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Research Article

Efficacy of a Model of Rearing Red Chittagong Cattle to Up-scale the Livelihood of Poor Rural Farmers

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ABSTRACT

Although several native and crossbreed cattle populations exist in Bangladesh, their poor health and reproduction traits hardly meet the nutritional requirement of the country. The present study was carried out to develop a socio-economic model for elevating the socio-economic status of poor farmers by rearing Red Chittagong Cattle, a dual-purpose, indigenous cattle. First, a model was developed by a team of Bangladesh Livestock Research Institute which hypothesized that rearing two RCC cattle, one for calf and milk production and another for beef production will enhance the socioeconomic conditions if they are supported with appropriate training and vaccination. A total of 150 farmers were selected from 4 Upazilas and the model was introduced to the farmers and subsequently, the model was implemented. The farmers were provided cattle, training, health care support including regular vaccination, high-yield grass and free fodder-cutting facilities. After the project intervention, the willingness of farmers for cattle rearing for both types that are milk production and beef fattening increased from 20.70% to 22.50%. Moreover, the socio-economic status of the respondents improved significantly. The average annual income of the household increased from 1,03,900 Tk to 1,36,133.15 Tk (31% increase) after the model was applied. Although the family expenditure was lower before implementing this approach, it climbed after the project intervention, along with annual savings. Farmers were more motivated to raise RCC and conserve them in situ as a potential genetic resource when family savings had increased. Considering the benefits of rearing RCC, this model would be suitable for improving the socio-economic conditions of the smallholders and rural farmers of Bangladesh. Moreover, conserving RCC will help in future research on indigenous cattle genetic resources.

Introduction

Developing countries greatly depend on livestock production which is a significant component of the agricultural economy. In densely populated countries like Bangladesh, livestock and cattle contribute considerably to the economy and food security. According to the Department of Livestock Services, livestock comprises 1.47% of the GDP of the Country (Livestock Economy, 2020). The Grameen Bank, a microfinance organization, provides approximately 50 percent of the loan to purchase livestock and poultry which substantiate the significance of livestock for poor rural farmers (Hossain et al., 2005).

The low milk and meat production of the indigenous cattle population is one of the great constraints which impede the improvement of livestock and introduced a pressing need to develop dual-purpose breeds (Famous et al., 2021). Bangladesh hardly meets the minimum demand for milk and meat. While the annual requirement of milk is 14.69 million tons and meat is 7.05 million, the country produces 7.27 million tons of milk and 6.15 million tons of meat annually (BBS, 2007). The scarcity of feeds and fodder all year round and the lack of knowledge regarding appropriate breeding techniques also hinder sustainable production (Amin et

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al., 2020). Therefore, an improved native breed can play a significant role in escalating livestock production and farmers' socio-economic conditions.

Several studies have demonstrated that native non-descriptive cattle had more disease resistance capacity and more adaptability to adverse conditions but had short lactation periods and poor milk and meat production (Hamid et al., 2017; Mondal et al., 2013). Sindhi, Sahiwal and Holstein-Friesian were the most common improved breeds reared by farmers which had high milk and meat production traits but cannot thrive well in the tropical environment (Islam et al., 2002). Therefore, crossbreeding with improved exotic breed were considered which yielded promising results for the first generation. However, the production of breeds with backcrossing resulted in low-yield breeds characterized by slightly increased milk production. Moreover, reproductive performance, disease-resistance capability and adaptability significantly decreased in the crossbreed populations (Famous et al., 2021).

To overcome this situation, improving the production potential of indigenous cattle is the best way to conserve indigenous cattle's genetic resources. Red Chittagong Cattle (RCC) is an improved, dual-purpose, indigenous cattle in Bangladesh that can replace other indigenous poor cattle resources. RCC is named due to its reddish color (Huque et al., 2010; Hossain et al., 2006). RCC can be fed low nutritive feeds, specifically crude protein. However, this animal can produce a large amount of milk under farm conditions (Bhuiyan et al., 2013). The average milk production of an RCC cow is 618 liters during a 228-day lactation period with daily milk production of 2.7 L/day. Moreover, the milk has higher protein (3.8%) and lactose content (5.6%) compared to that of indigenous animals (3.6 and 5.1%, respectively). Moreover. RCC cattle have a good growth performance, higher disease resistance, greater adaptability to the varied and harsh agroecological environment and higher value (Das et al., 2021).

Although many studies describe the attributes and performance of RCC, no study provided clear evidence of the economic benefits of rearing this high-performance breed by a model where farmers were under observation for a period of time to estimate the actual benefit of rearing RCC. It is evidenced that with the same management and production cost, a rural farmer can easily get 1.0-2.0 kg more milk in a day and a calf per year from RCC compared to other commonly available indigenous types (Khan et al, 2015). However, this potential variety is under the threat of extinction due to indiscriminate crossbreeding across the country, especially in their home tract of greater Chattogram regions (Hossain et al., 2018). For developing the rural livelihood in Bangladesh, it is crucial to conserve potential indigenous cattle via pure breeding programs and *in-situ* approaches by farmers (Bhuiyan *et al.*, 2007).

Considering these facts, the present study was carried out to develop a model for up-scaling the livelihood of the rural poor people by rearing RCC as well as conserving RCC in farmers' houses (*in situ*). Hence, RCC would receive attention as an indigenous breed of importance which would help meet the national demand for milk and meat and elevate the socio-economic status of farmers.

Methodology

Study areas

The geographical distribution of Red Chittagong cattle is in the Southeastern districts of Bangladesh (Hossain 2005), predominantly in the Chittagong and Chittagong Hill Tract areas and the border of the Noakhali areas. Therefore, a total of 4 Upazillas (Anowara, Patiya, Chandanaish and Godagari) of 2 Districts (Chattogram, and Rajshahi) were selected purposively for the present study based on the RCC density and purpose of the study. The study areas are depicted in figure 1.

Sample size and sampling technique

The precise examination of the objectives of the study requires a representative sample of the population. The population size was calculated by collecting data from Upazila Livestock Office from 4 Upazilas. Therefore based on the formulae given below, the sample size was determined.

$$S = \frac{n}{1 + \frac{z^2 \text{ x } \hat{p}\,(1 - \hat{p})}{\varepsilon^2\, N}}$$

Where S refers to the required sample size; z is the z score; $\hat{p}$ is the population proportion; ε^2 square of the error term and N is the known population. The number of targeted samples was estimated with a 95% confidence level, the margin of error was 5%, and the population proportion was 50%.

A proposed model for rearing RCC

It was observed that the majority of the farmers were unaware of the scientific method of cattle rearing by which their farming could be profitable. To overcome these obstacles a model was developed. Farmers were suggested to have at least two RCC cattle, one cow for calf and milk production and one bull for fattening as RCC is a dual-purpose breed for dairy and beef production and plays a key role in poverty alleviation for smallholder farmers (BLRI, 2004). At first, farmers were provided RCC bull semen free of cost. Moreover,

farmers were encouraged to fodder cultivation by providing fodder cutting free of cost from BLRI improved germplasm. Furthermore, farmers were provided vaccines and medication for deworming and treatment. In the next phase of the training, farmers were trained in good animal management skills. Figure 2. illustrates the model.

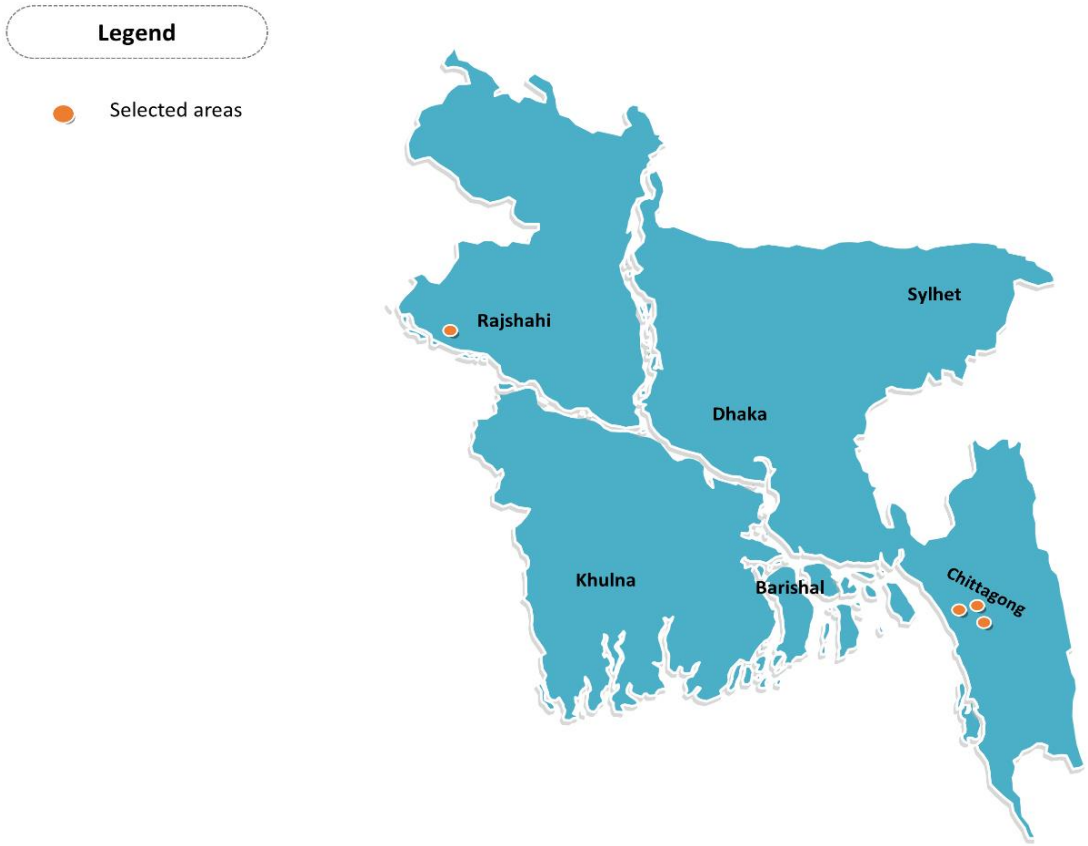

Figure 1. Study areas

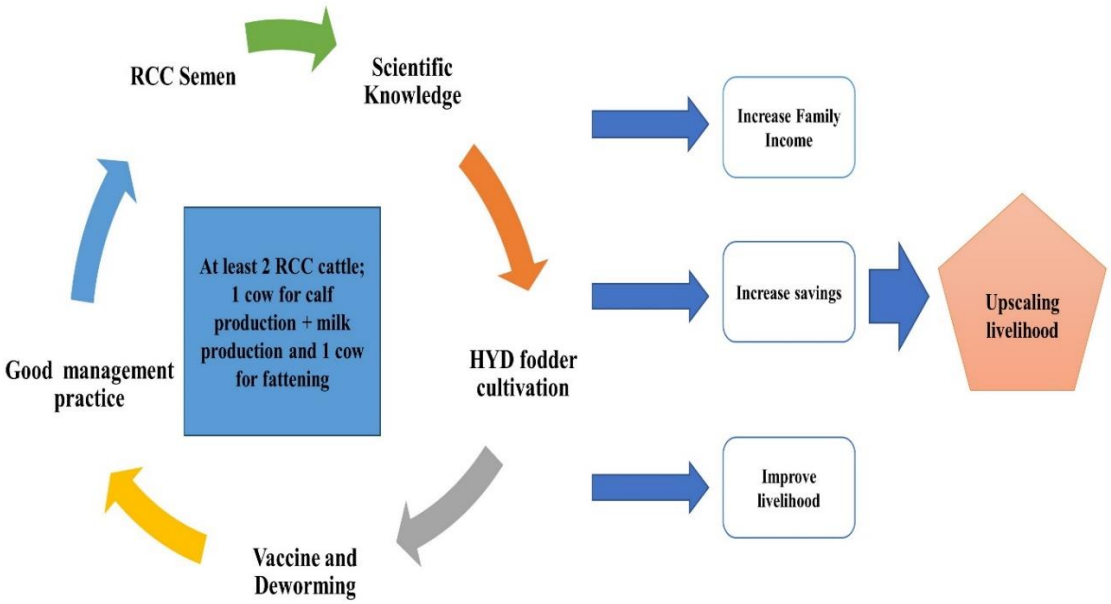

Figure 2. A model for up-scaling the livelihood by RCC rearing

Data collection procedure and data analysis

A baseline survey was conducted using a pre-tested questionnaire based on the research methodology and the objectives of the study before the intervention. A simple random sampling technique was used to select farmers and face to face direct interview method was used in the farmers' houses to collect the data. After that, some interventions according to developed model training on scientific and good management practices, RCC semen, fodder cutting, vaccination, and treatment facility were provided continuously to selected 222 farmers from 4 selected Upazilas. Data were recorded in a developed herd book on farmers' houses continuously for three years. At the end of the interventions, an end-line survey was conducted to collect necessary data from privileged farmers. Recorded data were collected from the herd book kept in the farmers' houses. After that, the data were sorted, scrutinized, input and managed using Microsoft Excel 2016. Descriptive statistics and chi-square tests were performed to analyze the data using Statistical Package for Social Sciences (SPSS 25.0).

Ethical Approval and Informed Consent Statement

The Institutional Animal Committee of the Bangladesh Livestock Research Institute approved this study (BLRI/IAC/06/2021). All the participants gave consent to participate in the study.

Results and Discussion

Demographic Information

This research was conducted to develop a sustainable model by comparing baseline information and end-line information of the rural poor farmers rearing Red Chittagong Cattle. After providing privileges like semen, vaccine, medicine and treatment to RCC-rearing farmers in 4 selected Upazillas' data on their economic status in detail including their occupation, primary and other sources of income, savings and expenditures, rearing system, production, breeding system, etc. were collected through questionnaire. From the collected data it was observed that about 68.9% of people maintain their family through their efforts and among them 84.7% were male and 14.9% were female which indicates the patriarchy in our suburbs. About 82% family has only one earning member and out of them, around 68% of people maintain their family expenditure from agriculture (Table 1).

Table 2 describes the comparative study of the types of cattle reared by the farmers. The types of cattle per household were categorized as milch cows, dry cows, pregnant cows, suckling heifer, weaned heifer, heifer, suckling bull calf, bull calf/ bull, bullock, etc. where the population structure of dry cows, Pregnant cows, suckling heifer, weaned heifer, weaned bull calf and bullock had a significant change in number throughout the project intervention.

Table 1. Gender and Occupation of the farmers

Variables	Frequency	Percent (%)
Gender		
Male	192	76.8
Female	58	23.2
Occupation		
Agriculture	170	68
Business	25	10
Day labor	5	2
Driving	4	2
Housemaker	35	14
Others	10	4

Table 2. Population structure of cattle per household

Types of cattle	Before (Number)	After (Number)	Sig. (2 tailed)
Milk cow	0.76±0.05	0.79±0.04	0.68
Dry cow	0.71±0.05	0.33±0.04	0.00
Pregnant cow	0.33±0.03	0.55±0.04	0.00
Suckling heifer	0.19±0.02	0.32±0.03	0.00
Heifer (>2yrs)	0.07±0.02	0.11±0.02	0.14
Suckling bull calf	0.76±0.05	0.15±0.02	0.45
Bull calf/bull (> 2 years)	0.38±0.10	0.30±0.04	0.66
Bullock	1.05±0.06	0.68±0.06	0.01
All types	2.86±0.12	3.11±0.13	0.03

Types of cattle reared feed supplied and interest in fodder production of farmers

In previous years, farmers were only interested in practicing dairy farming (49.50%) and used the bulls for selling purposes. After the project intervention, the scenario of the purpose of cattle rearing changed. Farmers have shifted from 49.50% to 47.70% for dairying, whereas animal for meat rearing has increased from 0.50% to 1.80% and they get high rates for the bulls. Overall, the willingness of farmers for cattle rearing for both types that is milk production and beef fattening has increased from 20.70% to 22.50% (Table 3).

From Table 3, it can be seen that about 91% of farmers supplied roadside available grass to their animals whereas, only 6.8% of farmers cultivated fodders for their animals and provide cultivated fodders to animals. All the farmers (100%) fed their cattle rice straw and wheat bran (60.8%) and rice polish (59.9%) were mostly used as concentrates. However, the scenario of cultivating fodder for animals had remarkably increased from 6.8% to 30.2% after the model was applied.

Previously, farmers were not very much interested in cultivating fodders for animals. In order to motivate them, high-yielding German grass and Oat grass were provided to them along with training in fodder cutting. After the project intervention, the participation of

farmers in fodder cultivation increased from 5.40% to 23.40% (Table 3).

Table 3. Types of cattle reared, feeds supplied and interest in fodder production

Variables	Before	After
Types of cattle reared		
Only dairy	49.50 (110)	47.70 (106)
Only fattening	0.50 (1)	1.80 (4)
Both types	20.70 (46)	22.50 (50)
Bullock	1.40 (3)	0.50 (1)
Types of feeds		
Straw	100.0 (222)	98.6 (219)
Grass	91.0 (202)	91.0 (202)
Cultivated fodder	6.8 (15)	99.1 (220)
Household residuals	64.9 (144)	69.4 (154)
Wheat bran	60.8 (135)	69.8 (155)
Rice polish	59.9 (133)	81.1 (180)
Pulse husk	1.8 (4)	2.3 (5)
Oil cake	12.6 (28)	26.1 (58)
Cooked rice	55.4 (123)	31.1 (69)
Soybean meal	2.3(5)	7.7 (17)
Crushed maize	5.4 (12)	21.2 (47)
Interest on Fodder Production	5.6 (14)	23.6 (59)

Healthcare management practices

Milk yield and quality are temperature-sensitive and higher temperatures reduce the milk production of cattle (Chanda et al., 2018). Therefore, regular bathing and water supply are very essential. Throughout the project intervention, about 68.5% of farmers had practiced regular bathing of cattle, and 98.5% of farmers had supplied clean and plenty of water to the cattle (Table 4). Furthermore, around 83.30% of farmers had practiced regular cleaning and hygienic management which ultimately helped to increase the production of their cattle.

Table 4 delineates the awareness of respondents and the facilities available in the survey area. It was observed that around 56.80% of the household farmers were fully ignorant about taking preventive measures like deworming and vaccination against disease occurrence. However, after the intensive project intervention around 99.50% and 99.10% of farmers de-wormed and vaccinated their cattle regularly as recommended against disease prevalence.

Milk Production traits of RCC

The daily average milk production of RCC was around 2.19 kg (Figure 3). The maximum lactation length was 230.0±10.0 days which was comparatively much higher than the findings of Bag et al. (2010), but lower than the findings of Azizunnesa et al. (2010) as described by 238.8 days and Khan et al. (2000) reported as 214.7 ± 21.8 days. However, one study found a similar lactation length as ours under farm conditions (230.6±23.9 days) (Mufti et al., 2009).

Table 4. Health care and hygiene practices of farmers

Variables	Before (%)	After (%)
Regular bathing	21.2	68.5
Supply of clean water	60.8	98.6
Cleaning Practices		
No cleaning	39.20	1.80
Regular cleaning	58.10	83.30
Regular disinfection	11.6	29.7
Deworming	42.80	99.50
Vaccination	25.20	99.10

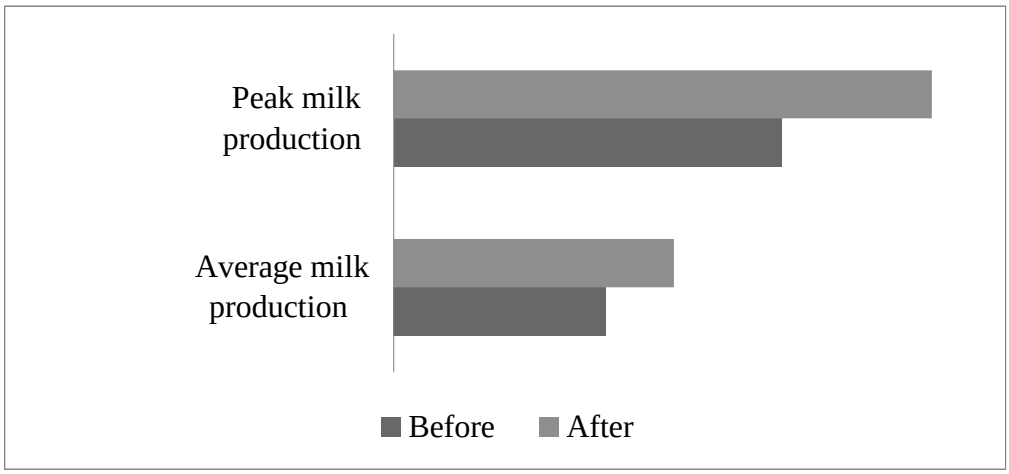

Figure 3. Milk production of RCC

Growth performance of RCC

The comparative study of growth performance between the calf breeds of RCC (sire) x RCC (dam) and RCC (sire) x Indigenous (dam) is shown in Table 5. It was found that the average birth weight, 6 months body weight and 12 months body weight of RCC (sire) x RCC (dam) was higher than the average birth weight of RCC (sire) x Indigenous (dam) reported as 15.77±0.13, 53.23±1.45 and 86.54±4.24 kg respectively, which was quite similar to the report of Nahar et al. (2016) as 15.4 ± 0.15 kg in case of birth weight but differed in 6 months body weight and 12months body weight reported as 43.1 ± 1.03kg and 65.7 ± 2.34 kg respectively. Although higher body weight was reported in RCC crossbred at 18 months of age. Moreover, rearing RCC was found to be more profitable than rearing crossbred dairy cows in Bangladesh.

Table 5. Growth performance of RCC

Calf breed	Calf weight (Kg)							
	Birth weight		6 months		12 months		18 months	
	Mean±SE	Maximum Statistic	Mean±SE	Maximum Statistic	Mean±SE	Maximum Statistic	Mean±SE	Maximum Statistic
RCC (sire) x RCC (dam)	15.77±0.13	22.00	53.23±1.45	80.00	86.54±4.24	130	154.50±0.50	155
RCC (sire) x Indigenous (dam)	13.63±0.30	18.20	44.73±2.37	75.00	79.58±9.79	116	165.00±0.00	165
Overall	15.05±0.15	22.00	50.56±1.28	80.00	84.74±3.98	130	158.00 ±3.51	165

Annual Household Income and expenditure of the family

In addition to RCC raising, farmers were also involved with different occupations for income such as agriculture, business and driving. The estimated average household income was Tk. 136133/year of which livestock contributes to 51326.47 Tk/year (Figure 4). After receiving training, farmers tended to rear cattle and other livestock to increase family income more than other occupations. Despite increasing their yearly expenses, they could keep annual savings which will be helpful for family members in the future (Figure 4).

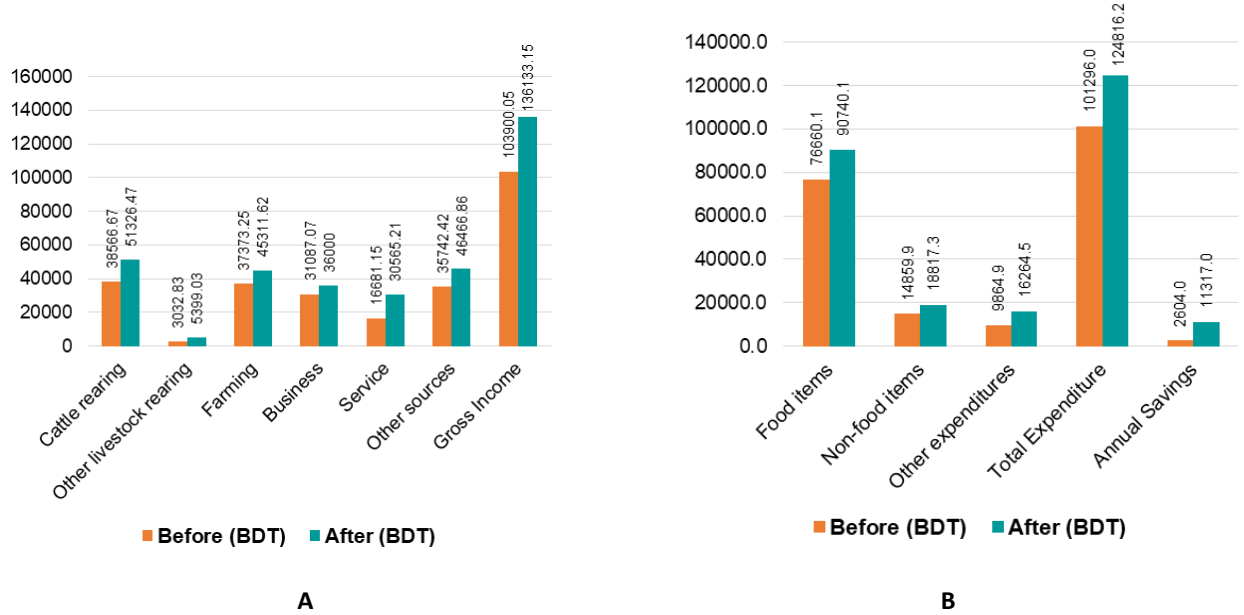

Figure 4. (A) Annual household income per year (B) Annual household expenditure per year

Livelihood status of the farmer

Besides this, their health and sanitation condition, education, knowledge/efficiency, information access ability, self-managerial capability, social prestige, Decision-making ability, Women empowerment, physical capital and financial capital had also increased as well as cultivable land (own). On the other hand, cultivable land (leased in/mortgage in) was decreasing (Table 6).

Table 6. Livelihood status of the farmer

Asset category		Increased	Decreased	Unchanged
Human capital	Health and sanitation	55.00 (122)	0.00 (0)	45.00 (100)
	Education	22.50 (50)	0.00 (0)	77.50 (172)
	Knowledge/efficiency	78.80 (175)	0.00 (0)	21.20 (47)
	Access to information	45.90 (102)	0.00 (0)	36.50 (81)
Social capital	Involved in social group/activities	34.20 (76)	26.60 (59)	39.20 (87)
	Self-managerial capability	21.60 (48)	0.00 (0)	59.00 (131)
	Social prestige	21.02 (47)	15.80 (35)	50.50 (112)
	Decision-making ability	35.10 (78)	4.50 (10)	51.00 (115)
	Women empowerment	33.30 (74)	6.80 (15)	42.80 (95)
Natural capital	Cultivable land (own)	8.60 (19)	10.80 (24)	73.90 (164)
	Cultivable land (leased in/mortgaged in)	5.00 (11)	16.70 (37)	62.60 (139)
	Fallow land	5.90 (13)	0.00 (0)	70.30 (156)
	Access to open water sources	15.30 (34)	0.00 (0)	62.20 (138)
Physical capital	House	2.70 (6)	0.00 (0)	97.30 (216)
	Furniture	32.40 (72)	0.90 (2)	53.20 (118)
	Agricultural equipment's	1.40 (3)	0.00 (0)	46.80 (104)
	Bicycle/motorcycle/motor van	7.70 (17)	0.00 (0)	36.50 (81)
	Tube well	6.80 (15)	0.00 (0)	33.80 (75)
	Electricity	1.40 (3)	0.00 (0)	60.80 (135)
	TV/Radio/VCD/DVD	13.50 (30)	0.00 (0)	49.10 (109)
	Cable network	11.70 (26)	0.00 (0)	41.00 (91)
	Freeze/computer	18.90 (42)	0.00 (0)	61.30 (136)
	Mobile phone	4.50 (10)	0.00 (0)	95.50 (212)
Financial capital	Cash in hand	24.30 (54)	5.00 (11)	70.70 (157)
	Cash in bank/Savings	17.01 (38)	4.10 (9)	70.30 (156)
	Jewelry	9.90 (22)	1.40 (3)	77.90 (173)

Conclusion

In the context of Bangladesh, this concept was implemented to reduce poverty and improve livelihood. The main goal of this concept was to improve the farmer's livelihood while also conserving Red Chittagong Cattle. The average annual income of the household was observed a 31% increase after the model was applied. Moreover, the family expenditure increased after the project intervention, along with annual savings. Farmers were more satisfied and inclined to raise RCC and conserve them in situ as a potential genetic resource when family savings had increased. Thus, this economic model can be used in other areas of Bangladesh as well to improve the livelihood of rural farmers.

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