Original Research Paper

Potential Impacts of Sustainable Dairy Farming in *Char* Areas of Northern Bangladesh

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Abstract: This study was conducted to evaluate the potential impacts of sustainable dairy farming in *Char* areas of Northern Bangladesh. A total of 600 poorest dairy farming households were selected out of 1323 households, taking 200 households from each Upazila of Sariakandi, Islampur and Belkuchi of Bogra, Jamalpur and Sirajganj districts, respectively using simple random sampling technique. A structured questionnaire was used to interview the respondents (600:200 respondents ×3 districts). Difference-in-Difference (DID) approach was applied for analysing the impact of dairy farming. To determine the factors affecting income on livelihood, logistic regression model was used. Finally the sustainable livelihood framework including the asset pentagon was used to assess the impact of dairy farming on livelihood pattern. The results of this study provide that after the intervention of the project, there is a significant fall in the percentage of the farmers engaging with farming and day labourer where there is an increase in the percentage of the farmers engaging with only farming. On an average, family male members spent about 5 hours a day on dairy cattle while the female members spent about 4 hours a day over the study areas. Percentages of farmers owning 20 decimal of land are increasing and percentages of farmers owning 10 decimal of land are decreasing in all the study areas. Inclination of animal ownership indicates that there was an increasing trend in the ownership of poultry birds, sheep and goats. Both milk yield and body weight gain were significantly (p<0.001) different before and after various veterinary interventions. Average total income had increased by 51% after the project intervention but it increased by only 16% in case of the controlled farmers. The highest 34% treated group's dairy income level is Tk. 10001.00-15000.00 followed by 33% and 18% of dairy income level of Tk. 15001.00-20000.00 and above Tk. 20000.00, respectively of respondent farmers. Income and expenditure of the treated group increased by 51% and 33%, respectively whereas it was increased by 16% and 11% in the case of the controlled group. After the intervention, milk consumption had increased to 11 litres, 8 litres, and 12 litres per month, respectively in Sariakandi, Islampur and Belkuchi upazilas. Age in year, household income and breed of dairy cow have positive impact and household size in number and years of education of household head have negative impact on changes in income on livelihood status of the poor dairy farmers. The length of time spent (working days) had increased by 52.64 percent in the study areas. This study recommends that creating diversified job opportunities, ensuring educational facilities and expansion of group-based milk marketing system should be ensured for the betterment of dairy farmers in the *Char* areas of Bangladesh.

Keywords: Impacts, Sustainable, Dairy, *Char*, Bangladesh

Introduction

Dairy enterprise is considered a "treasure" of the economy of Bangladesh, particularly for rural system. The sector involves millions of resource-poor farmers for whom animal ownership ensures critical livelihood, sustainable farming, and economic stability. As it is labour intensive farming and support employment in production, processing and marketing, so, development of dairy enterprise is essential to create the employment opportunity of the people in the northern region. Livestock's share of agricultural income increased from 7.6% in 1973-74 to 12.9% in 1998-99 and is projected to increase to 19.9% in 2020 (Hossain and Bose, 2000). Livestock provides cash income with a small amount of investment and creates employment opportunity for the landless rural people, unemployed youths and destitute women. In addition to supplying drought power required for land cultivation, threshing, crushing and transport; it supplies meat, milk for human consumption, manure for crop and fuel for domestic purposes. Livestock also helps to improve the balance of payments by increasing exports of hides and skins as a raw materials and footwear products and reducing imports of the milk and milk products. It provides animal protein through milk, meat and eggs which is considered superior in quality to plant protein. Livestock also supplies cash income to farm families through the sale of live animals/birds, hides, skins and other products. Among different export items of livestock origin, lather and lather products have the most important position in the total export earnings of the country. Therefore, development of this sub-sector may be considered as an important strategy for poverty alleviation which is a major objective of the Government of Bangladesh (MoF, 2013; BBS, 2012).

The present study is someway related to other studies which are: Anjani *et al.* (2011) conducted a study on the smallholder dairy farmers' access to modern milk marketing chain in India and showed that the traditional milk supply chain is still dominant in the Indian milk market. Yasmin (2011) conducted a study on the profitability of milk production and livelihood pattern of livestock farmers and found that the average production of milk varied from 481 to 513 litres, meat production varied from 165 to 177 kgs and the range for egg production was 199 to 259 numbers during past three years. Lwelamira *et al.* (2010) undertook a study on the contribution of small-scale dairy farming under zero-grazing in improving household welfare in Tanzania and indicated that average household income, value of durable assets and food security status were significantly higher in dairy farming households. Miah *et al.* (2010) performed a study on livelihood adaptation of disadvantaged people of Bangladesh and found that during the period of price hike of food grains, only 10.7 percent of female household heads were engaged in non-farm activity while it was 25.5 percent in the case of male household heads. Nuorteva *et al.* (2010) conducted a study on water, livelihoods and climate change adaptation in the Tonle Sap Lake area and found that people's capacity to adapt to unusual environmental changes is weak with the poorest, being clearly the most vulnerable group. To the best of researcher's knowledge no specific study on the issue of dairy sector's impact on farmers' livelihood of *Char* areas is conducted in Bangladesh. So, the aim of the present study is to evaluate the impact of dairy farming on employment creation, income generation, poverty reduction and livelihood patterns of the dairy farmers.

Materials and Methods

Study Areas, Sample Size and Data Sources

Three upazilas namely Sariakandi of Bogra, Islampur of Jamalpur and Belkuchi of Sirajganj districts areas located in northern Bangladesh were purposively selected as study areas. The reasons for selecting these areas for the present study are: (i) the availability of milch cows in these areas; (ii) the resemblance to the objectives of this study; and (iii) it was projected that co-operation from the farmers in these areas would be high so that reliable data required for this study could be obtained. From the selected three districts, a total of 600 poorest dairy farming households were selected out of 1323 households (N=1323) taking 200 households from each district. Data were collected by the researchers in two times firstly from May to July, 2010 before intervention of the project and secondly from June to August, 2012 for after situation with a structured questionnaire. This study is based on both primary and secondary sources of data and information. Primary data was collected through questionnaire survey. Secondary data and information were collected from various Governmental Organizations (GOs) and Non-Governmental Organizations (NGOs). Most of the data required for the research were collected from primary sources.

Analytical Techniques

Difference-in-Difference Analysis

The difference-in-difference/double-difference (DID) estimator was used to compare changes in outcome measures between treated and controlled farmers. DID is a quasi-experimental technique used to understand the effect of a sharp change in the economic environment of dairy farming in the study areas. During the impact study by Difference-in-Difference approach the following formula was used (Duflo *et al.*, 2004):

$$DID = \{(T_1 - C_1) - (T_0 - C_0)\}$$

Generally, restricting the evaluation to only 'before/after' comparisons makes it impossible to separate intervention impacts from the influence of other events that affect beneficiary households.

Therefore, as part of the evaluation, it is necessary to construct a counterfactual measure of what would have happened if the project supports had not been available, and this is why we also need the with/without comparison. The columns distinguish between control group and treated group, that is, households who were receiving benefits right after the baseline survey and those that were not. We denote groups receiving (with) the intervention as the Group T (T for treated) and those not receiving (without) the intervention as Group C (C for controlled group). The rows distinguish between before and after the intervention (denoted by subscripts 0 and 1). Consider one outcome of interest increased incomes (Table 1).

Before the intervention, one would expect the average incomes to be similar for the two groups, so that the difference in incomes $(T_0 - C_0)$ would be close to zero. Once the intervention has been implemented, however, one would expect differences between the groups and so $(T_1 - C_1)$ will not be zero. The double-difference estimate is obtained by subtracting the preexisting differences between the groups, $(T_0 - C_0)$ from the difference after the intervention has been implemented, $(T_1 - C_1)$ which is shown in Table 1.

Net income method was used to evaluate and compared the income of dairy farming beneficiaries and non-beneficiaries in the study areas. The model specification for the net farm income is as follows:

$$Percentage\ change\ in\ income = \frac{Income\ After - Income\ Before}{Income\ Before} \times 100$$

Logistic Regression (logit) Model

To determine the factors affecting income on livelihood, logistic regression model (logit model) was used. This method was chosen because it is a standard method of analysis when the outcome variable is dichotomous and when improvement in livelihood is measured as a dichotomous response variable having a value of 0 or 1, where 1 = improvement in livelihood due to changes in income and 0 = otherwise (Gujarati, 2003):

$$Y_i = In\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$
$$+ \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon_i$$

Where:

P_i = Probability of improvement and non-improvement in livelihood

$P_i = 1$ = Indicates improvement and $P_i = 0$ Indicates otherwise

$Y_i = 1$ = Indicates improvement in livelihood due to changes in income and $Y_i = 0$ indicates otherwise

X_1 = Age of households head (Years)

X_2 = Households size (No.)

X_3 = Educational level (Years of schooling)

X_4 = Herd size (No.)

X_5 = Land ownership (Dummy), if yes 1 otherwise 0

X_6 = Experience in year (Years)

X_7 = Household income (Tk.)

X_8 = Breed of dairy cows (Dummy), if crossbreed =1, otherwise 0

X_9 = Location (Dummy)

β_0 = Intercept

β_1-β_9 = Coefficient

ε_i = Error term

Results and Discussion

Changes in Occupational Status of the Sample Households

Occupation of the members of farm household is one of the determining factors of their status. The distribution of principal occupation is fascinating because it varies greatly depending on how much they are involved in and what level of income is earned from the present occupation. Bangladesh agriculture is vast and farmers have a lot of opportunities to engage themselves in various activities of farming. In the study areas, farmers not only work in dairy farming but also they have another occupation. Some farmers are engaged with more than two activities but they are very few in numbers. From Table 2 it is observed that 75, 76 and 23% farmers were engaged with farming and day labourer in Sariakandi, Islampur and Belkuchi upazilas, respectively before the intervention of the project which are the highest percentages.

Table 1: Calculation of the double-difference estimate of average project effect

Survey round	Treated group (group T)	Controlled group (group C)	Difference across groups
Follow- up	T_1	C_1	T_1- C_1
Baseline	T_0	C_0	T_0-C_0
Difference across time	T_1-T_0	C_1–C_0	Double-difference $(T_1 - C_1) - (T_0 - C_0)$

Source: Adopted from Duflo *et al.* (2004)

Table 2: Occupational status of sample farmers (in percent)

Occupations Upazilas	Sariakandi		Islampur		Belkuchi	
	Before	After	Before	After	Before	After
Only Farming	18	25	20	23	26	19
Farming + Business	6	32	4	19	16	36
Farming + Service	1	7	0	6	35	35
Farming + Day labourer	75	36	76	52	23	10
Total	100	100	100	100	100	100

Source: Field survey (2010, 2012)

On the other hand, before the project intervention, 18%, 20% and 26% farmers in Sariakandi, Islampur and Belkuchi, respectively were engaged with only farming. After the intervention of the project, there is a significant fall in the percentage of the farmers engaging with farming and day labourer where there is an increase in the percentage of the farmers engaging with only farming. Table 2 reveals that after the intervention, only 36, 52 and 10% farmers engaged themselves with farming and as day labourer where 25, 23 and 19% farmers engaged themselves with farming only in Sariakandi, Islampur and Belkuchi, respectively. In Belkuchi Upazila, there was a decrease in the percentages of farmers related with farming only as they engaged themselves with business also after the intervention of the project especially handloom business which has a vast opportunity to develop there. The result is slightly similar with Bikuba (2011) where the author found engagement of dairy cattle farmers with diversified income generation activities.

Livestock sub-sector provides a great opportunity for the *Char* unemployed of being employed. Both men and women are involved in livestock rearing. Especially the women in *Char* areas are directly involved in home-based activities to strengthen income generation through livestock rearing. In the present study, all the respondents equally admitted that women and children were mostly involved in poultry and duck rearing. Women participants acknowledged a very little involvement of male counterparts in those respects. Table 3 revealed that the length of time spent (working hours/day) on livestock rearing by both male and female members of the family and also by the hired labour in year 2012.It revealed that, on an average, family male members spent about 5 hours a day on dairy cattle while the female members spent about 4 hours a day over the study areas. It was also noted that the length of time spent on cattle rearing is higher compared to other enterprises. The result is supported by Khan and Parashari (2015) where the authors found that increasing demand for milk and milk products and the employment generation through dairy marketing had provided greater opportunities for income generation.

Table 3: Labour utilization/employment in livestock rearing (working hours/day)

Livestock categories	Family	
	Male	Female
Milch cow	3.73	3.70
Heifer	3.33	2.68
Bull	4.50	2.67
Goat	3.21	2.79
Sheep	3.45	2.15
Poultry	0.48	3.66
Duck	0.30	1.92

Source: Field survey, 2012

Distribution of Land Ownership of the Dairy Households after Project Intervention

Different types of ownership patterns of land were found in the study areas. Ownership pattern may influence the optimum resource use and production. The ownership patterns of the dairy households were presented in Table 4. Table 4 shows that an increasing trend in ownership of homestead land areas in the case of 10 decimal land holders but a decreasing trend in ownership of homestead land areas in case of 5 decimal land holders. This study found the similar trend also in the case of cultivable land areas of both 20 decimal and 10 decimal, respectively. Here it is seen that percentages of farmers owning 20 decimal of land are increasing and percentages of farmers owning 10 decimal of land are decreasing in all the study areas.

Ownership of Sanitary Latrine and Tubewell

Table 5 shows that after the project intervention, number of sanitary latrines and tube wells were increased. During the project period, ownership of sanitary latrine increased from 64% to 95% in Islampur, 70% to 99% in Sariakandi and from 80% to 100% in Belkuchi. After the intervention all the households in Sariakandi and Belkuchi and 99% households of Islampur used tubewellas the source of drinking water.

Types of Livestock Owned

Table 6 shows the inclination of animal ownership in the study areas and indicates that there was an increasing trend in the ownership of poultry birds, sheep and goats. This study also noted similar trend in the case of ownership of cows, milch cows, calf and heifer in the study areas.

Table 4: Changes of land ownership of the dairy household (% of household)

Upazilas Particulars			Sariakandi		Islampur		Belkuchi	
			Before	After	Before	After	Before	After
Land ownership	Homestead	5	65	34	62	26	60	27
	(Decimal)	10	35	66	85	74	40	73
	Cultivable	10	56	25	43.5	15	38	14
	(Decimal)	20	44	75	56.5	85	62	86

Source: Field survey (2010, 2012)

Table 5: Drinking water and sanitary condition of the dairy households (in percentage)

Upazilas Particulars	Sariakandi		Islampur		Belkuchi	
	Before	After	Before	After	Before	After
Sanitation (Sanitary latrine)	70	99	64	95	80	100
Source ofdrinking water(Tubewell)	70	100	68	99	85	100

Source: Field survey (2010, 2012)

Table 6: Distribution of households by number of animals owned

Upazilas Species	Sariakandi		Islampur		Belkuchi	
	Before	After	Before	After	Before	After
Poultry birds	1245	2056	751	1274	1271	1867
Sheep andgoats	96	147	59	82	120	137
Cows	126	202	104	131	127	170
Milch cow	82	96	76	89	97	123
Calf	93	102	84	108	103	142
Heifer	57	68	55	69	78	92

Source: Field survey (2010, 2012)

Table 7: Average milk production and body weight in cows

Variables	Before intervention (Mean ± S.D)	After intervention (Mean ± S.D)	Difference	t-Value
Milk production (liter) per cow	1.5 ± 0.1	2.3 ± 0.02	0.8	6.07**
Body weight gain (kg) per cow	121.1 ± 21.0	165.0 ± 14.0	43.9	20.44**

Source: Researchers estimations based on field survey (2010, 2012).
S.D = Standard Deviation; ** = Significant at 5 percent level

Changes in Milk Production and Body Weight

The milk production (n = 581) and body weight (n = 531) of cows was recorded in three areas during the study period. The average milk yield increased from 1.4 to 2.2 liter per cow. General health of cattle and body weight were improved (80g/day/cow). Both milk yield and body weight gain were significantly (p<0.001) different before and after various veterinary interventions (Table 7). Lin (1988) enhanced this study with the statement that breed, genetic variation within breed, health, environment, management practices and diet were the factors influencing production and composition of milk from dairy cows.

Impact of Dairy Farming on Income Generation

Income is the important indicator of socioeconomic status of people. The overall income of a dairy household includes both farm and non-farm income.

Farm income was estimated by summing up the income, which was derived from the monetary value of crops, cow rearing, poultry birds, fruits and vegetables. In the case of non-farm income, service, business, labour sale, rickshaw or van pulling were considered. Table 8 shows distribution of household income by sources before and after project intervention inSariakandi, Islampur and Belkuchi upazilas, respectively.

It appears from Table 8 that average farm and non-farm income of the treated group before the intervention were Tk. 26881 and Tk. 15713, respectively whereas in the case of the controlled group, these were Tk. 28022 and Tk. 15504, respectively. After the intervention, average farm and non-farm income of the treated group were Tk. 38603 and Tk. 25729, respectively whereas these were Tk. 32735 and Tk. 17835, respectively in case of the controlled farmers. In case of the treated farmers, average total income had increased by 51% after the project intervention but it increased by only 16% in case of the controlled farmers (Table 8).

Table 8: Annual average income of the respondents

Sources of Income	Treated (N= 300)				Controlled (N = 300)			
Farm income (Tk.)	Before	After	Change	%	Before	After	Change	%
Non-dairy	16869.61	21728.14	4858.53	28.80	18435.61	20318.19	1882.58	10.21
Dairy	10011.15	16874.81	6863.66	68.56	9586.05	12416.87	2830.82	29.53
Sub-total	26880.76	38602.95	11722.19	43.61	28021.66	32735.06	4713.4	16.82
Non-farm income (Tk.)	15713.00	25729.00	10016.00	63.75	15504.00	17834.92	2330.92	15.03
Total income	42593.76	64331.95	21738.19	51.04	43525.66	50569.98	7044.32	16.18

Source: Researchers estimations based on field survey (2010, 2012)

Table 9: Impact of dairy farming on changes in income of the farmers

Input/Items	Treated (N = 300)		Controlled (N = 300)	
	Before	After	Before	After
Farm income				
Farm income from dairy				
Cost Items				
Feed	5793.07	5993.73	3921.12	4935.34
Labour charge	0.00	0.00	0.00	0.00
Veterinary services	166.14	277.05	123.31	234.45
Housing	659.10	778.61	300.40	412.30
Interest on operating capital	525.69	627.08	321.54	351.27
Capital cost	1721.78	2318.89	1046.80	2418.42
a. Total Cost	8865.78	9995.36	5713.17	8351.78
Items of Return				
Lactation period (Days)	206.93	211.87	185.30	191.43
Milk production (Litre)	1.45	2.20	259.42	363.72
Milk yield/day/cow (Litre)	300.08	466.73	1.40	1.90
Price per litre (Tk.)	22.33	29.00	18.23	23.24
i. Return from milk (Tk.)	6749.72	13535.17	4729.22	8452.78
ii. Income from cowdung	443.87	571.67	337.24	450.00
iii. Net change in inventory (Tk.)	11683.33	12763.33	10232.76	11865.87
b. Gross return from dairy (i+ii+iii)	18876.93	26870.17	15299.22	20768.65
1. Net return from dairy (b - a)	10011.15	16874.81	9586.05	12416.87
2. Farm income from non-dairy	16869.61	21728.14	18435.61	20318.19
A. Total farm income (1+2)	26880.76	38602.95	28021.66	32735.06
Non-farm income				
B. Total non-farm income	15713.00	25729.00	15504.00	17834.92
C. Total income (A+B)	42593.76	64331.95	43525.66	50569.98
% changes in total income	51.04%	16.18%		
Change in total income	21738.19	7044.32		
Double difference	14693.87 *(2.18)			

Source: Researchers estimations based on field survey (2010, 2012)
Note: * Significant at 10% level

It is evident from Table 9 that farm income of treated farmers was Tk. 26881 and Tk. 38587 before and after project intervention, respectively and for controlled farmers' that was Tk. 28022 and Tk. 32735 before and after project intervention, respectively. So, it bears a clear indication that dairy farming has a positive impact on income generation. Change in total income for treated group was Tk. 21738, on the other hand for controlled group, it was only Tk. 7044. Double difference was Tk. 14694 in dairy farming which was also statistically significant at 10 percent level. Dairy farming seems to be the driver of poverty reduction in the study areas. The result is quite similar with Mian *et al.* (2007) where the authors stated that income was highest from dairy farming after receiving support from Grameen Bank.

Table 10 revealed that about 6% treated group's dairy income level is upto Tk.5000.00 whereas controlled group's 21%.The highest 34% treated group's dairy income level is Tk. 10001.00-15000.00 followed by 33% and 18% of dairy income level of Tk. 15001.00-20000.00 and above Tk. 20000.00, respectively of respondent farmers. The highest percentages of treated group lie among the ranges of Tk. 10001.00-15000.00, Tk.15001.00-20000.00 and above Tk. 20000.00 in comparison with the percentages of controlled group whereas the highest percentages of controlled group lies among the ranges of upto Tk. 50000.00 and Tk. 5001.00-10000.00 (Table 10).

Table 10: Distribution of respondents by income level

Income level (in Tk.)	Treated (N=300)		Controlled (N=300)	
	Frequency	Percentage	Frequency	Percentage
Upto 5000.00	19	6.33	62	20.67
5001.00-10000.00	28	9.33	66	22.00
10001.00 -15000.00	102	34.00	67	22.33
15001.00-20000.00	98	32.67	71	23.67
Above 20000.00	53	17.67	34	11.33
Total	300	100.00	300	100.00

Source: Field survey, 2012

Table 11: Average income-expenditure status of the respondents' family (in Tk.)

Particulars	Treated (N=300)				Controlled (N=300)			
	Before	After	Change	%	Before	After	Change	%
Income	42593.76	64316.00	21722.24	51.00	43525.66	50569.98	7044.32	16.18
Expenditure	50276.12	66800.49	16524.37	32.87	50774.81	56401.25	5626.44	11.08
Savings/Deficit	-7682.36	-2484.49	-5197.87	67.66	-7249.15	-5831.27	-1417.88	19.56

Source: Researchers estimations based on field survey (2010, 2012)

Changes in Income-Expenditure Pattern

With respect to income-expenditure pattern, the selected livestock keepers had no savings. Moreover, they were always in deficit. But there was good signal after project intervention. Before the project intervention, average income and expenditure of the treated group were Tk. 42594 and Tk. 50276, respectively but after the intervention, these were Tk. 64316 and Tk. 66800, respectively. Before the project intervention, average income and expenditure of the treated and controlled group were Tk. 42594 and Tk. 50276; and Tk. 43526 and Tk. 50775, respectively but after the intervention, these were Tk. 64316 and Tk. 66800; and Tk. 50570 and Tk. 56401, respectively (Table 11). Table 11 also represents that income and expenditure of the treated group increased by 51% and 33%, respectively whereas it was increased by 16% and 11% in the case of the controlled group. After the intervention, the deficit of the treated group decreased by 68% whereas it was decreased by 20% in the case of the controlled group.

Impact of Dairy Farming on Milk Consumption Pattern

Table 12 reveals that before the intervention of the project, the amount of milk consumed per month by the family members was 5 litres, 5 litres and 9 litres in Sariakandi, Islampur and Belkuchi Upazila, respectively. After the intervention, milk consumption had increased to 11 litres, 8 litres, and 12 litres per month, respectively in Sariakandi, Islampur and Belkuchi upazilas.

Table 13 shows that age in year, household income and breed of dairy cow have positive impact, and household size in number and years of education of household head have negative impact on changes in income on livelihood status of the poor dairy farmers in the study areas where all of the five stated variables are statistically significant at different levels of significance.

Education has negative impact because educated persons tend to move themselves from the field of agriculture to other diversified occupations such as business, service, etc. The result is slightly alike to Chang *et al.* (2008) where the authors identified operators' experience, investment in human capital, indicators of management efficiency and level of capital investment as the factors affecting changes in distribution of dairy farm income.

Information on Selling Milk by Dairy Farmers

Table 14 shows that the amount of milk sold per month by the family members increased as a result of project intervention.

Sources of Information about Milk Price

The information is the life blood of any marketing system. The group approach formulated by the project facilitates necessary information relating to the milk price. Now farmers are getting more information from group members, neighbors, milk traders (*Gowala*), nearby market about the current market prices, demand and supply of the milk due to the intervention of the project. Previously, farmers were not well aware about milk price as they were selling their little amount of milk by themselves. They didn't know the benefits of the group approach in their milk marketing system.

Impact of Dairy Farming on Employment Creation

Livestock sub-sector provides a great opportunity for the *Char* unemployed of being employed. Both men and women are involved in livestock rearing. In the study, all the respondents equally admitted that women and children were mostly involved in to graze the cows, sheep and goats. Women participants acknowledged a very little involvement of male counterparts in those respects. But the male member of the family spent more time on milk marketing.

Table 12: Average consumption of milk by family members (per month)

Upazilas	Sariakandi		Islampur		Belkuchi	
Particular	Before	After	Before	After	Before	After
Amount of milk consumption (in litres)	5	11	5	8	9	12

Source: Field survey (2010, 2012)

Table 13: Determination of factors affecting changes in income

Variables	Coefficient (β)	z-statistic	p-value
Age in year (β_1)	0.064**	4.70	0.02
Household size in number (β_2)	-0.295***	-4.89	0.000
Years of education of household head (β_3)	-0.140***	-2.65	0.008
Number of herd size (β_4)	0.100	0.58	0.562
Land ownership, if yes = 1, otherwise = 0 (β_5)	0.021	0.96	0.336
Experience in year (β_6)	0.160	1.20	0.229
Household income in Tk.(β_7)	0.433**	9.07	0.043
Breed of dairy cow, if crossbred = 1, otherwise = 0 (β_8)	0.672*	-7.84	0.078
Location dummy (β_9)	Yes		
Constant (β_0)	-0.190	-1.15	0.250
Number of observations	600		
R^2	0.832		

Source: Researchers estimations based on field survey (2010, 2012)
Significant at ***1%, **5% and *10% level of significance

Table 14: Amount of milk sold by family members (per month)

Upazilas	Sariakandi		Islampur		Belkuchi	
Particulars	Before	After	Before	After	Before	After
Amount of milk sold (in litres)	15	25	13	24	22	25

Source: Field survey (2010, 2012)

Table 15: Labour utilization/employment in livestock rearing

Upazilas	Employment of labour (working days)		
	Before	After	Change in percentage
Sariakandi	50	100	100.00
Islampur	50	80	80.00
Belkuchi	90	110	22.22
Overall	190	290	52.64

Source: Field survey (2010, 2012)

Table 15 reveals the length of time spent (working days) on livestock rearing by both male and female members of the family. It has revealed that on an average, the employment of labour was about two times higher in Sariakandi and Islampur upazilas than before which was 100.00 and 80.00 percent, respectively. In the case of Belkuchi Upazila the increasing rate was relatively lower than other two upazilas which was 22.22 percent. Overall, the length of time spent (working days) had increased by 52.64 percent in the study areas (Table 15). The reason of this increase in working days was that the farm size of the dairy farmers had increased after the intervention and so, they had to spend more time in work related to dairy farming. Chaudhary and Upadhyaya (2013) also marked dairy sub-sector as a fast growing widely accepted sector which contributes additional income to the farmers.

Impact of Dairy Farming on Livelihood Pattern

The sustainable livelihood framework includes the asset pentagon which is composed of five types of capitals namely human capital, social capital, natural capital, physical capital and financial capital (DFID, 2000).

Human Capital

Development of human capital is one of the pre-requirements for successful attainment of other types of assets. It represents health, education, training, knowledge and access to information that together enable the farmers to pursue different livelihood

strategies and achieve their livelihood objectives. Table 16 presents the changing nature of different components of human capital in farmers' livelihoods. Majority of the livestock farmers reported that quality of the components of human capital has increased over the periods through gaining education and knowledge, improving health condition, more access to information, better training and development of skill in all the selected areas. In some cases, quality of human capital was decreased but this rate was very small which was mainly due to lower productivity, outbreak of diseases and higher mortality rate of livestock animals, natural disasters, etc.

In Sariakandi, 70%, 74%, 66%, 66% and 54% respondents stated that their health condition, educational facilities, training facilities, knowledge and access to information were increased due to project intervention, respectively. On the other hand, 22%, 20%, 24%, 34% and 40% respondents stated that their health condition, educational facilities, training facilities, knowledge and access to information were remained constant, respectively after the project intervention. Similarly, also in Islampur and Belkuchi, most of the respondents stated that their health condition, educational and training facilities, knowledge and access to information had been increased after the intervention of the project (Table 16).

Social Capital

In this study, involvement in social group, political involvement, self managerial capability and social access were considered as components of social capital. From the present study, it was found that more organizations are now formally or informally working than before in the study areas to promote cooperation between people, coping distress and other awareness build-up processes.

Table 17 shows the positive trends of social assets in farm families. Almost all farmers' involvements in different social groups, their managerial capacity through livestock rearing had improved in the study areas in general. No farm household reported about decrease in any kind of social capital in the study areas. A few percentages of farm households somehow removed themselves from different social groups because of their self-dependency and therefore, a decrease is seen in the involvement in social group in Islampur and Belkuchi upazilas. Table 17 also shows that 75%, 90%, 20% and 15%; 64%, 90%, 31% and 72%; and 40%, 92%, 42% and 58% farm households in Sariakandi, Islampur and Belkuchi upazilas, respectively reported that their social group involvement, political involvement, Self managerial capability and social access were remained constant whereas the rate of increase in these components were not in a satisfactory level.

Natural Capital

Cultivable land, using open water resources and forests were addressed to determine the natural capital aspect which is represented in Table 18. It is seen that no farm household reported about decrease in any kind of natural capital in the study areas. Majority of the farm households which was 75%, 56% and 54%, and 100%, 76% and 90% in Sariakandi, Islampur and Belkuchi upazilas, respectively reported that cultivable land and using open water resources, respectively remained constant. Twenty five percent, 44% and 46% farm households reported that cultivable land was increased, and 24% and 10% farmers reported that using open water resources was increased in Islampur and Belkuchi upazilas, respectively. The quantity of cultivable land had fluctuated in the study area over time. Access to open water resources also showed increasing trend in the selected areas. Majority of the farm households had constant access to different types of natural capital.

Table 16: Changes in human capital of farm households (percentages of farm household reported)

Areas Asset Categories	Sariakandi			Islampur			Belkuchi		
	Increase	Decrease	Constant	Increase	Decrease	Constant	Increase	Decrease	Constant
Health	70	8	22	65	7	28	66	8	26
Education	74	6	20	80	5	15	90	4	6
Training	66	10	24	60	15	25	70	15	15
Knowledge	66	-	34	70	8	22	81	11	8
Access to information	54	6	40	76	7	27	90	4	6

Source: Researchers estimations, 2012

Table 17: Changes in social capital of farm households (percentage of farm household reported)

Areas Asset categories	Sariakandi			Islampur			Belkuchi		
	Increase	Decrease	Constant	Increase	Decrease	Constant	Increase	Decrease	Constant
Involved in social group	25	-	75	32	4	64	48	12	40
Political involvement	10	-	90	10	-	90	8	-	92
Self managerial capability	80	-	20	69	-	31	58	-	42
Social access	85	-	15	28	-	72	42	-	58

Source: Researchers estimations, 2012

Table 18: Changes in natural capital of farm households (percentage of farm household reported)

| | Position of asset categories | | | | | |
| | Cultivable land | | | Using open water resources | | |
Areas	Increase	Decrease	Constant	Increase	Decrease	Constant
Sariakandi	25	-	75	-	-	100
Islampur	44	-	56	24	-	76
Belkuchi	46	-	54	10	-	90

Source: Researchers estimations, 2012

Financial Capital

Table 19 shows the changing trend of financial capital of the livestock farmers. Cash in hand, savings and liquid assets had increased considerably over the years. However, the rate of increase was not estimated.

Farmers' income had increased and they were able to have more cash savings and liquid assets through livestock rearing along with crop farming. Remittances and donation was constant during the study year. Only 5% respondents in Belkuchi reported income from remittances.

Physical Capital

The changing state of physical assets in the livelihoods of livestock farmers has been shown in Table 20. Numbers of tin roof house increased and straw roof house decreased. This simultaneous trend indicates improving housing condition for all types of livestock farmers. The condition of other major component of housing as well as safe livelihood such as drinking water and sanitary latrine also developed considerably. Before project intervention, there were few families who used tubewell and sanitary latrine in study areas. Now most of the farmers use modern amenities. Uses of radio, television and watch have increased tremendously for all categories of dairy farms. Quantity and quality of household furniture such as chair, table and cot increased considerably. Among the livestock farmers group, middle income group used to live in Tin roof houses, and lower income group in small houses, which were either tin roofed or straw roofed. Except few cases, most farmers had tin roofed houses and their sanitation facility was not developed. Except a few, most of them used sanitary latrine. Most of the farmers in the study areas were found to use solar electricity. Very few farmers also owned some modern amenities like radio, television, watch, mobile phone and fridge (Table 20).

There had been a noteworthy improvement in communication facilities of livestock farm households in the study areas. Some vehicles and equipment such as bicycle/motorcycle, electric fan, radio/TV, watch, fridge, etc. had been decreased due to damage and sometimes farmers sold them when those became old. Houses and shops had been decreased as they were destroyed by natural calamities which were a common issue in *Char* areas.

Table 21 represents the overall situation of human, social, financial, natural and physical assets of the treated and controlled farmers whether these were increased, decreased or remained constant. In the case of both treated and controlled farmers, there occurs an autonomous change in the asset position of the farmers such as increasing, decreasing and constant situation, either they are beneficiaries of project intervention or not. Here, the changed situation in overall asset position of both treated and controlled farmers after the project intervention is represented with the help of Table 21. In the case of human capital of treated farmers, 'increased' responding farmers increased from 45% to 75%, 'decreased' responding farmers decreased from 22% to 13% and 'constant' responding farmers decreased from 33% to 12%; indicating a noteworthy improvement in the human capital of the treated farmers (Table 21) after the project intervention.

As same, human capital improved in the case of controlled farmers but comparatively lesser than treated farmers. In the case of social capital of treated farmers, 'increased' responding farmers increased from 52% to 72%, 'decreased' responding farmers decreased from 12% to 08% and 'constant' responding farmers decreased from 36% to 20% which point toward a remarkable improvement in the social capital of the treated farmers as a result of project intervention. As same, human capital improved in the case of controlled farmers but not as much as treated farmers.

Table 21 indicates that 'increased' responding farmers increased from 33% to 79%, 'decreased' responding farmers decreased from 36% to 13% and 'constant' responding farmers decreased from 31% to 08%inthe case of financial capital of treated farmers; and 'increased' responding farmers increased from 30% to 53%, 'decreased' responding farmers decreased from 43% to 26% and 'constant' responding farmers decreased from 27% to 21%inthe case of controlled farmers that indicate a better improvement in the financial capital of the treated farmers compared to the improvement of controlled farmers after the project intervention.

Table 19: Changes in financial capital of farm households (percentage of farm household reported)

Areas Asset categories	Sariakandi			Islampur			Belkuchi		
	Increase	Decrease	Constant	Increase	Decrease	Constant	Increase	Decrease	Constant
Cash in hand	20	10	70	50	28	22	25	15	60
Cash at bank/ Liquid assets/ Saving	25	20	55	52	28	20	36	5	59
Remittances	-	-	-	-	-	100	5	-	95
Donation/ Grant/Aid	-	-	-	-	-	100	-	-	-

Source: Researchers estimations, 2012

Table 20: Changes in physical capital of farm households (percentage of farm household reported)

Upazilas Asset categories	Sariakandi			Islampur			Belkuchi		
	Increase	Decrease	Constant	Increase	Decrease	Constant	Increase	Decrease	Constant
Tin roof	62	0	38	39	0	61	56	4	40
Straw roof	10	45	45	2	34	64	3	76	21
Tubewell	12	4	84	59	4	37	84	4	12
Sanitary latrine	48	5	47	46	5	50	65	5	32
Electric fan	58	2	40	57	2	41	82	2	16
Bicycle/ Motorcycle	56	4	40	29	4	67	42	4	54
Radio/TV	26	2	72	41	2	57	58	2	40
Watch	28	4	68	59	4	37	84	4	12
Cot	88	2	10	62	2	36	88	2	10
Chair/Table	40	-	60	69	0	31	98	-	2
Mobile phone	70	2	28	56	2	42	80	2	18
Fridge	2	6	92	6	6	88	8	6	86
Shop	10	4	86	15	4	81	22	4	74

Source: Researchers estimations based on field survey, 2012

Table 21: Overall changes in livelihood patterns of sample farmers (in percentage)

Asset categories	Increased				Decreased				Constant			
	Treated		Controlled		Treated		Controlled		Treated		Controlled	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Human capital	45	75	35	55	22	13	40	33	33	12	25	12
Social capital	52	72	43	49	12	08	36	31	36	20	21	20
Financial capital	33	79	30	53	36	13	43	26	31	08	27	21
Natural capital	20	23	12	09	25	28	32	43	55	59	57	58
Physical capital	29	69	20	43	41	21	40	41	30	10	40	16

Source: Researchers estimations based on field survey (2010, 2012)

Further, in the case of natural capital of treated farmers, 'increased' responding farmers increased from 20% to 23%, 'decreased' responding farmers increased from 25% to 28% and 'constant' responding farmers decreased from 31% to 08% due to the project intervention; and in the case of controlled farmers, 'increased' responding farmers decreased from 12% to 09%, 'decreased' responding farmers increased from 32% to 43% and 'constant' responding farmers increased from 57% to 58% which indicate that natural capital remained constant mostly in both cases of treated and controlled farmers. Also, in the case of physical capital of treated farmers, 'increased' responding farmers increased from 29% to 69%, 'decreased' responding farmers decreased from 41% to 21% and 'constant'

responding farmers decreased from 30% to 10% after the project intervention indicating a moderate increase in the physical capital and this situation is similar in the case of controlled farmers, also. Tefurukwa (2011) supported the findings by concluding that small scale dairy cattle enterprise had contributed significantly in improving households' livelihoods as regards to food security and increased purchasing power of goods and services.

Conclusion

It is concluded that small scale dairy farming contributes significantly to household income, expenditure, food security and overall welfare of livelihood status of the poor dairy farmers. Overall

livelihood status of the *Char* dwellers ranged between low to medium. Because of poor communication and transportation facilities, geographical and climatic hazard, low annual income, poor support from GOs and NGOs, conflict for ownership of land and other problems the *Char* landers cannot improve their livelihood status in a desirable level. In *Char* area, most of the *Char* landers are living in a medium condition of house. The existing health and sanitation condition of the *Char* landers is not satisfactory. In case of availability of sources of drinking water, maximum proportions of the respondents have medium facilities for drinking water. Because of awareness as well as their increased knowledge on sanitation, hygienic toilet was used by the majority of the *Char* landers. Due to insufficient number of hospital and other health related facilities, majority of the *Char* landers possessed very poor medicare support from both GOs and NGOs. Majority of the households have low ability to provide education to their family members because of their economic insolvency as well as unavailability of educational facilities in the *Char* areas. *Char* dwellers are trying to involve in different kinds of agricultural and non agricultural activities. Based on the findings of this study, the following recommendations are suggested for policy implications: diversified job opportunities are to be created in the *Char* areas in general and for *Char* women in particular, so that they can generate income during crisis period; establishment of more primary and secondary schools in the *Char* areas along with intensive monitoring and supervision is needed for ensuring quality of education; encourage dairy farming for household welfare and food security; and group-based milk marketing system should be expanded. In this study, only dairy farmers were taken into consideration covering three *Char* areas of Bangladesh. So, there exists ample scope for further research regarding potential impacts of dairy farming as well as other livestock enterprise rearing in other areas of Bangladesh.

Acknowledgment

Author's Contributions

Jasim Uddin Ahmed: Designed, collected and checked the analyzed data; prepared the draft manuscript and approved the final manuscript.

Shankar Kumar Raha: Coordinated the study and supervised the draft manuscript.

Md. Habibur Rahman: Reviewed the draft manuscript, prepared the draft manuscript and contributed in data interpretation.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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