Journal of Food Security, 2017, Vol. 5, No. 5, 187-196
Available online at http://pubs.sciepub.com/jfs/5/5/5

DOI:10.12691/jfs-5-5-5

Determinants of Dairy Households' Food Security in *Char* Areas of Northern Bangladesh

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Abstract The study was conducted to determine of food security status of dairy households in *char* areas of Bangladesh and to identify the major constraints faced by the dairy farmers. A total of 600 poorest households with dairying were selected out of 1323 households from each upazila of Sariakandi, Islampur and Belkuchi of Bogra, Jamalpur and Sirajganj districts, respectively using simple random sampling technique. To identify the factors influencing the food security status of farming households, food security index (Z), food insecurity gap/surplus index (P) and the head count ratio (H) were calculated. The food security indices before and after intervention of the project were0.87, 0.89, 0.91; and 1.02, 1.02, and 1.04 for Sariakandi, Islampur and Belkuchi upazilas for food secured households, respectively whereas for food insecure households, the figures were 0.63, 0.55, 0.64; and 0.72, 0.64, and 0.74, respectively. Before the project intervention, the values of food surplus indices in the case of food secure households were 0.01, 0.01 and 0.09 which had increased to 0.04, 0.04 and 0.14 after the intervention in Sariakandi, Islampur and Belkuchi upazilas, respectively. On the other hand, the values of food shortfall indices in case of the food insecure households in Sariakandi, Islampur and Belkuchi upazilas had decreased from -0.35, -0.45 and -0.33 to -0.27, -0.36 and -0.26, respectively after the intervention. The problems related to rising of dairy animals were lack of capital with CFI 33 was ranked as 1st, whereas, high cost of milk collection and delivery with CFI 28, poor communication and transport facilities with CFI 26, lack of market information with CFI 26, irregular payment with CFI 26 and scattered milk production with CFI 25 were ranked as 2nd, 3rd, 4th, 5th, 6th, 7th, respectively. Diversified job opportunities, mobilization of resources and credit allocation are needed for enhancing dairy farming and ensuring food security in the study areas. The problems related to rising of dairy animals were lack of storage facilities with CFI 651 was ranked as 1st, whereas, lack of adequate capital with CFI 626, expensive and inadequate feed supply with CFI 622, low quality feed with CFI 598, and lack of transportation and communication facilities with CFI 550 were ranked as 2nd, 3rd, 4th and 5th, respectively.

Keywords: *dairy, food security, Char, Bangladesh*

Cite This Article: Jasim Uddin Ahmed, Shankar Kumar Raha, Md. Habibur Rahman, and Md. Golam Shahi Alam, "Determinants of Dairy Households' Food Security in *Char* Areas of Northern Bangladesh." *Journal of Food Security*, vol. 5, no. 5 (2017): 187-196. doi: 10.12691/jfs-5-5-5.

1. Introduction

Dairy farming is an integral part of agricultural production system in Bangladesh. It is an activity involving investment for milk production and marketing and employment. During the last three decades, a structural transformation has taken place in the Bangladesh economy. The country has achieved self-sufficiency in food grain production due to strong growth rate in the sector but the share of agriculture to GDP has declined relative to other sectors. Within the agriculture sector, the share of livestock sub-sector has increased more in relation to crop, fisheries and forestry. Dairy cattle rearing are more or less a profitable business everywhere in the world. Dairying in the recent decades has been considered a vital component in the diversification of agriculture in Bangladesh. Dairy enterprise is considered as a "treasure" of the economy of Bangladesh, particularly for rural system. It provides nutrition, organic manure, supplementary employment, cash income and draft animal power in Bangladesh. 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. During the last three decades, a structural transformation has taken place in the Bangladesh economy. 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. During 1973/74-1989/90, livestock output grew at 5.2% per annum compared to 1.7% for crop output and 2.6% for agricultural output in general [1]. These changes have

been prompted by a rapid growth in demand for livestock products due to income and population growth and urbanization. This is a part of phenomena called 'livestock revolution' observed throughout the developing world [2]. Food security is a component of livelihood security. Ensuring food security for all is one of the major challenges that Bangladesh faces today. Despite significant achievements are seen in food grain production and food availability, food security at national, household and individual levels remains a matter of major concern for the government. Food security or insecurity has several dimensions, such as, level of aggregation (national, regional, rural/urban differential, household, individuals), seasonal production of staples, nutritional balance in diet, people's (both male and female) access to and utilization of food, and temporal uncertainty of supplies often caused by natural disasters and price hikes. It is very important to take into consideration women's role in ensuring food security at the household level. The specific objectives of the study are:

i. to determine food security status of dairy households in selected char areas; and
ii. to identify constraints in dairy farming and to suggest policy guidelines.

The present study is someway related to other studies. Reference [3] conducted a study on the profitability of milk production and livelihood pattern of livestock farmers focusing on the production trend of milk, meat and eggs in the selected livestock rearing households, and found from the study 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. Reference [4] carried out a study on production and marketing of milk in some selected areas of Sirajganj district and showed that the annual average gross return and gross margin per cow were Tk. 105097 and Tk. 39019, respectively, whereas the net return was Tk. 30582 and undiscounted benefit-cost ratio (BCR) was 1.41 implying that the enterprise was profitable. Reference [5] carried out a study on economics of milk production in two areas of Bangladesh namely Manikganj and Sirajganj and revealed that net returns of milk production were positive and reasonably high for all categories of farms studied, however, gross and net returns of the Milk Vita cooperative member farmers were significantly higher than those of the non-member farmers. Reference [6] studied on the progress, current crisis and future challenges of food security in Bangladesh and argued that about 15 percent of the farmers, who owned over 1.0 hectare land could market a substantial amount and gain from rising rice price, nearly two-thirds of rural households had deficit in rice production and most of them could be adversely affected by rising rice prices. Reference [7] conducted a study on causes of household food insecurity in Koredegaga peasant association, Oromiya zone, Ethiopia and revealed that an introduction to fertilizer use and an improvement in the educational levels of household heads lead to relatively greater probability of food security.

Though a number of studies are present in terms of economic profitability of dairy farming and food security in Bangladesh as well as in abroad, to the best of researchers' knowledge, no specific study is available on food security and key constraints of dairy farmers in the context of *char* areas in Bangladesh. So, it is expected that the present study would be helpful to evaluate the impact of dairy farming on food security of the dairy farmers in the *char* areas of Bangladesh, and identify the major constraints of farmers and traders in the *char* areas.

2. Materials and Methods

2.1. Selection of Study Areas and Sample

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 are:

i. The availability of milch cows in these areas;
ii. The area was preferred because of the resemblance to the objectives of the study; and
iii. It was projected that co-operation from the farmers in these areas would be high so that reliable data required for the study could be obtained.

From the selected three districts, a total of 600 poorest households with dairying were selected out of 1323 households (N=1323) taking 200 households from each district using random sampling technique. Formula (1) was used to determine the sample size [8].

$$n = \frac{[NZ^2P(1-P)]}{[ND^2 + Z^2P(1-P)]}$$

Where, n = sample size; N = total number of households; Z = confidence level (at 95% level z = 1.96); P = estimated population proportion (0.5, this maximizes the sample size); and D = error limit of 5% (0.05).

Using the stated formula, a sample size of 90 is derived which is about 7% of the total population. To get more accuracy in the result, a sample size of 600 is taken instead of taking 90 which is about 45% of the total population. Data were collected by the researcher himself in two times firstly from May to July, 2010 before intervention of the project and secondly from June to August, 2012 for after intervention. With a view to collect field level primary data from the selected poor dairy farmers, face-to-face interview method was followed. The sources of secondary data and information included government annual reports, official statistical abstracts and other different researches. In this study, tabular technique was used to illustrate the whole picture of analysis. On the other hand, the statistical technique was followed as a supplement to the tabular technique.

2.2. Analytical Techniques

2.2.1. Determinants of Dairy Households' Food Security

To identify the factors influencing the food security status of dairy households, two stages of analyses were done. At first a food security index (Z) was constructed and food security status of each household was determined based on the food security line using the recommended daily calorie intake approach [9]. A household whose daily per capita calorie intake amounted up to 2122 k.cal was regarded as food secured and those below 2122 k.cal were regarded as

food insecured households. The mathematical representations are as follows (2):

$$Z_i = Y_i / R \quad (2)$$

Where, Z_i= Food security index for i^{th} household which takes the value of 1 for food secure and that of 0 for food insecure households, that is Z_i= 1 for Y_i is greater than or equal to R; Z_i= 0 for Y_i less than R; Y_i = Daily per capita calorie intake of i^{th} households; R = Daily per capita calorie required for i^{th} households; and i = 1, 2, 3…., 600.

Based on the household food security index (Z), food insecurity gap/surplus index (P) and the head count ratio (H) were calculated. Food insecurity gap measures the extent to which households are food insecure and surplus index measures the extent by which food secure households exceeded food security line. This index (3) is given as:

$$P = \frac{1}{M}\sum_{i=1}^{m} G_i \quad (3)$$

Where, P = Food insecurity gap or surplus index; M = Number of households that are food secure (for surplus index) or food insecure (for food insecurity gap); and G_i = Per capita calorie intake deficiency (or surplus) faced by i^{th} household, where, $G_i = \left(\frac{Yi - R}{R}\right)$.

The head count ratio (H) measures the percentage of the population of households that are food secure or insecure. This is defined as (4):

$$H = \frac{M}{N} \quad (4)$$

Where, H = Head count ratio; M = Number of households that are food secured (for surplus index) or food insecured (for food insecurity gap); and N = Number of households in the sample.

2.2.2. Constraints in Dairy Farming

There were so many constraints faced by the dairy farmers in the study area. The researcher used constraint facing index (CFI) method to analyse the constraints. During the study, researcher found different constraints of three aspects which are production constraints, milk marketing constraints and socioeconomic constraints. An overall constraint score in dairy farming was computed for each farmer by adding their constraint scores in all 11 (Eleven) constraint items. Each farmer was asked to indicate the extent of difficulty caused by each of the constraints by checking any of the four responses such as 'high', 'medium', 'low' and 'not at all' and weights were assigned to these responses as 3, 2, 1 and 0, respectively. Thus, the possible range of constraints facing index for each constraint could be 0 to 3 and possible range of overall constraint facing for score for 11 (Eleven) constraints could range from 0 to 33 for dairy farming and 0 to 18 for milk traders. In this case, 0 indicated no constraint and 33 indicated very high constraint. Constraint facing index (CFI) was computed taking eleven selected constraints by using (5) [10].

$$CFI = (C_h \times 3) + (C_m \times 2) + (C_l \times 1) + (C_n \times 0) \quad (5)$$

Where, C_h = Number of responses indicating high constraint; C_m = Number of responses indicating medium constraint; C_l = Number of responses indicating low constraint; and C_n = Number of responses indicating no constraint.

The possible score could range from 0 to 300 for each area of both treated and controlled group. A score of 0 indicated no constraint while a score of 300 indicated highest level of constraint and 0 to 45 for milk traders in three areas (5 from each area), where, 0 indicated no constraint facing and 45 indicated highest constraint facing.

3. Results and Discussion

3.1. Contribution of Dairy Farming to Food Security

Table 1 represents the change in food intakes in the study areas after the project intervention. Among different food items, percentage change in daily food intakes of egg has increased remarkably than other food items. The average change of per capita daily intake of egg, milk meat and vegetables were 140%, 87%, 70% and 62%, respectively in the study areas after the project intervention. Due to dairy farming, food consumption has increased in all areas, among the food items egg consumption has increased severely in Belkuchi compared to the other study areas. Milk consumption was higher in Sariakandi and lower in Belkuchi. The reason for that increase was that farmers got knowledge about food security and became conscious about their food habits. The total percentage change was higher in Sariakandi and lower in Islampur upazila.

Per capita calorie intake from different food items of the households has also increased but it was still lower than the national level average (2122 kcal). Before the intervention, average household per capita calorie intakes were 1719.11, 1671.16, and 1773.01 which increased to 1764.84, 1688.95, and 1854.59 for Sariakandi, Islampur and Belkuchi upazilas, respectively (Table 2).

Table 1. Summary of Percentage Change in Food Intakes

Areas	Rice	Pulses	Fish	Meat	Egg	Milk (ml)	Potato	Vegetables
Sariakandi	1.77	8.96	47.55	65.71	141.67	129.29	21.10	81.05
Islampur	12.84	37.66	40.67	96.00	120.00	84.75	10.08	43.33
Belkuchi	0.58	20.83	35.29	53.85	171.43	60.81	30.36	75.12
All	4.40	35.00	40.15	69.70	140.00	86.89	20.25	61.85

Table 2. Average per Capita Calorie Intake from Different Food Items of the Dairy Households (kcal/day/capita)

Food items	Sariakandi		Islampur		Belkuchi	
	Before	After	Before	After	Before	After
Rice	1580.01	1584.01	1564.01	1555.01	1589.09	1509.63
Pulses	11.54	15.00	9.23	11.54	15.26	23.23
Fish	16.38	21.29	15.18	18.98	21.66	26.97
Meat	5.45	7.99	4.36	5.45	7.21	10.97
Egg	7.58	9.85	6.06	7.58	10.02	15.26
Milk (ml)	10.65	13.85	1.32	1.65	14.08	21.43
Potato	1.52	1.98	2.21	2.76	2.01	3.06
Vegetables	61.63	80.12	49.31	61.64	81.49	124.04
Miscellaneous	24.35	31.66	19.48	24.35	32.20	120.01
Total	1719.11	1764.84	1671.16	1688.95	1773.01	1854.59

3.2. Food Security Indices

Food security could be seen from the three perspectives, such as availability of food, access of safe and nutritious food and utilization of food. The food security index and other related food security measures such as, food insecurity gap/surplus index and head count ratio have been constructed separately for the study areas. Table 3 and Table 4 reveal that the food security indices of before and after intervention of the project were 0.87, 0.89, 0.91 and 1.02, 1.02, and 1.04 for Sariakandi, Islampur and Belkuchi upazilas for food secure households, respectively whereas for food insecure households, the figures were 0.63, 0.55, 0.64 and 0.72, 0.64, and 0.74, respectively. Households living above the poverty line before the project intervention were 39%, 31% and 37% and after the intervention the corresponding figures were 54%, 39% and 53%, for Sariakandi, Islampur and Belkuchi upazilas, respectively.

While for food insecure households the figures were 61%, 69%, 63% and 46%, 61% and 47% at before and after intervention for Sariakandi, Islampur and Belkuchi upazilas, respectively (Table 3 and Table 4). Average per capita calorie intakes of food secured households were 1931.49, 1845.30, 2072.85 and 2161.29, 2158.60, 2202.35 kcal of before and after intervention for Sariakandi, Islampur and Belkuchi upazilas, respectively. Also, average calorie intakes of food insecure households were1336.57, 1276.44, 1469.66 and 1546.50, 1356.24, 1564.26 kcal of before and after intervention which are lower than the national average calorie intake. It is found from Table 3 and Table 4 that in the study areas, before the project intervention respondents were more vulnerable situation in case of food shortfall/surplus indices than after the intervention of the project.

Here it is seen that before the project intervention, the values of food surplus indices in the case of food secured households were 0.01, 0.01 and 0.09 which had increased to 0.04, 0.04 and 0.14 after the intervention in Sariakandi, Islampur and Belkuchi upazilas, respectively. On the other hand, the values of food shortfall indices in case of the food insecured households in Sariakandi, Islampur and Belkuchi upazilas had decreased from -0.35, -0.45 and -0.33 to -0.27, -0.36 and -0.26, respectively after the intervention which means that they were in a situation of food shortage and they have no surplus food at the crisis period but the project helps them to reduce that crisis to some extent.

Table 3. Food Security Indices of Dairy Households (Before Intervention)

Food security indices	Sariakandi		Islampur		Belkuchi	
	Food secure households	Food insecure households	Food secure households	Food insecure households	Food secure households	Food insecure households
Food security index (Z)	0.87	0.63	0.89	0.55	0.91	0.64
Head count index (H)	39.00	61.00	31.00	69.00	37.00	63.00
Per capita daily calorie availability	1931.49	1336.57	1845.30	1276.44	2072.85	1469.66
Food shortfall/surplus index (P)	0.01	-0.35	0.01	-0.45	0.009	-0.33

Table 4. Food Security Indices of Dairy Households (After Intervention)

Food security indices	Sariakandi		Islampur		Belkuchi	
	Food secure households	Food insecure households	Food secure households	Food insecure households	Food secure households	Food insecure households
Food security index (Z)	1.02	0.72	1.02	0.64	1.04	0.74
Head count index (H)	54.00	46.00	39.00	61.00	53.00	47.00
Per capita daily calorie availability	2161.29	1546.50	2158.60	1356.24	2202.35	1564.26
Food shortfall/surplus index (P)	0.04	-0.27	0.04	-0.36	0.14	-0.26

3.3. Determinants of Households' Food Security

The results of logit regression are presented in Table 5. The model was run to estimate the determinants at three different areas. Table 5 shows the estimates of the logistic regression of determinants of food security status of farm households in the study areas.

Number of livestock (X_1)

Livestock is an important source of income, food and draft power for crop cultivation. Livestock size is positively and significantly associated with the probability of being food secured in the study area. This indicates that households, with more livestock produce more milk, milk products and meat for direct consumption. Besides, livestock enables the farm households to have better chance to earn more income from selling livestock which enables them by increasing purchasing power of stable food during food shortage and could invest in purchasing of farm inputs. It has been found from Table 5 that number of livestock has positive impact on food security status implying that the higher the number of livestock, the higher the possibility of the family being food secured.

Age of household head (X_2)

The age of household head is expected to impact on his or her labour supply for food production. Young and energetic household heads are expected to cultivate larger farms compared to the older and weaker household heads. It also determines the ability to seek and obtain off-farm jobs and income which younger household heads can do better. Reference [11], on the other hand, found older household heads to be more food secure than the younger household heads. Hence, the expected effects of age of household head on food security could either be positive or negative. Table 5 shows that there is a positive impact of age of household head on food security in Sariakandi upazila (1.43). But there is a negative impact on food security in Islampur (-1.56) and Belkuchi (-2.10) upazila.

Household size (X_3)

In this study, household size has been measured as total number of persons living together and taking meals from the same kitchen under the administration of the same head of the family. Household member includes farmer himself, wife, son(s), unmarried daughter(s), father, mother, etc. The result of logistic regression shows that the household size of the farmers has a positive coefficient in Belkuchi upazila and it was 2.996 which was insignificant at 5 percent level. So it has a minor impact on determinants of food security status of farm households in the study areas. On the contrary, the household size of Sariakandi and Islampur upazilas both has negative coefficient and it was -3.578 (significant) and – 0.202 (insignificant). It indicates that the larger the household size, the lesser the probability of ensuring food security of the farm households (Table 5).

Educational level (X_4)

Education is a social capital which is expected to have positive influence on household food security. According to [12], the educated individuals have capacity to process and apply the information passed on to them. Lower educational levels impede access to better job opportunities in the labour market, and hamper more profitable entrepreneurship [13]. An increase in female education not only increases their returns but also has the potential of reducing the fertility level of women, improving their productivity as well as contributing positively to the national growth [14]. The expected effect of this variable on food security has positive and significant in Islampur upazila (2.186), but insignificant in Sariakandi (1.24) and Belkuchi (0.943) upazilas (Table 5).

Communication with veterinary doctors (X_5)

Communication with veterinary doctors also has positive effect on food security status implying that veterinary care has higher probability of being food secured. The expected result of this variable on food security has positive and significant in Sariakandi (5.205), Islampur (3.113) and Belkuchi (2.013) (Table 5).

Table 5. Estimates of the logistic regression of determinants of dairy households' food security

Particulars	Sariakandi				Islampur				Belkuchi			
Variables	Coefficient (β)	Std. Error	Z value	P>|z|	Coefficient (β)	Std. Error	Z value	P>|z|	Coefficient (β)	Std. Error	Z value	P>|z|
Constant	0.635***	0.127	5.121	0.004	0.323***	0.127	2.543	0.004	0.737***	0.215	3.428	0.001
No. of livestock (X_1)	10.523***	1.587	6.63	0.002	5.469***	1.798	3.042	0.007	3.08***	0.929	3.315	0.003
Age of household head (X_2)	0.203	0.1446	1.425	0.161	-0.52	0.333	-1.562	0.207	-0.105**	0.0499	-2.104	0.036
Household size (X_3)	-3.578**	1.382	-2.19	0.032	-0.202	0.167	-1.21	0.231	2.996	5.209	0.575	0.567
Educational level (X_4)	2.074	1.665	1.24	0.212	9.578**	4.382	2.186	0.032	2.361	0.07	0.943	0.343
Communication with veterinary Doctor (X_5)	1.316***	0.253	5.205	0.001	2.07***	0.665	3.113	0.002	1.248*	0.62	2.013	0.054
Non-farm income (X_6)	1.066**	0.47	2.27	0.034	2.996	5.209	0.575	0.567	0.921**	0.347	2.654	0.018
Proximity to market (X_7)	9.401***	1.958	4.842	0	8.432**	3.69	2.285	0.048	0.363***	0.127	2.858	0.004
Access to credit (X_8)	1.974	1.981	0.991	0.331	0.401	1.958	0.205	0.351	-0.533	0.659	-0.809	0.325
Farm size (X_9)	0.363	1.127	0.320	0.204	1.066	1.47	0.725	0.203	1.97	4.981	0.396	0.531
R^2	0.774				0.725				0.812			

Note: *** Significant at 1% level; ** Significant at 5% level; and * Significant at 10% level.

Non-farm income (X_6)

Non-farm activity is an additional work engaged in by household aside farming to supplement household income. Level of non-farm activity can influence households' food security but this can either be positive or negative depending on the level and gains from the activity. This is because; engagement in an activity can bring in money thereby corroborating the food security situation of the household. On the other hand, if farmers spend more of their time on non-farm activities at the expense of working on their farm and particularly if the wage they earn does not commensurate with the forgone farm income, their food security situation could be worsened. Therefore, the expected effect on food security is positive and significant in Sariakandi (2.27) and Belkuchi (2.654) upazilas, but insignificant in Islampur (0.575) upazila (Table 5).

Proximity to market (X_7)

Proximity to market also has positive impact on food security status implying that higher the level of proximity to market the higher are the chances of being food secured. The result of logistic regression shows that proximity to market has positive coefficient in Sariakandi, Islampur and Belkuchi upazilas which were 9.401, 8.432 and 0.363, respectively and was significant at 1 and 5 percent level. So it has significant impact on determinants of food security status of farm households in the study areas. It indicates that the higher the proximity to market, the greater the probability of ensuring food security of the farm households (Table 5).

Access to credit (X_8)

This is the ability of household to obtain credit both in cash and kind for either consumption or to support production. Consumption credit increases household's income on the short-term basis and could increase the consumption basket of households. Production credit, on the other hand, when obtained on time could increase chances of households to acquire productive resources (seeds, fertilizers, pesticides and others) which will boost production and improve food situation in the house. Access to credit is therefore dummied as one for households that obtained credit in the last year cropping season and zero, otherwise. The expected effect of access to credit on food security is positive but insignificant in the case of Sariakandi and Islampur upazilas whereas the effect of access to credit on food security is negative in Belkuchi upazila.

Farm size (X_9)

Farm size is the total area of land cultivated to grow food and cash crop by households, measured in hectares. Positive relationship has been established between farm size and improvement in households' income and food security [15,16]. Table 5 reveals that the farm size of the farmers has positive coefficient and it was 0.363, 1.066 and 1.97 in Sariakandi, Islampur and Belkuchiupazilas, respectively. The larger the farm size of the household, the higher the expected level of food production. It is, therefore, expected that a household with a larger farm size to be more food secured than a household with a smaller farm size, all things being equal. Hence, the expected effect on food security is positive.

Value of R^2

The estimated value of goodness of fit, R^2 of the model was 0.774, 0.725 and 0.812 for Sariakandi, Islampur and Belkuchi upazilas, respectively. The value of R^2 (0.774) indicated that about 77 percent of the total variation in food security status of dairy farmers in Sariakandi upazila has been explained by the explanatory variables included in the model. Similarly, the values of R^2 (0.725 and 0.812) indicated that about 73 percent and 81 percent of the total variation in food security status of dairy farmers in Islampur and Belkuchi upazilas have been explained by the explanatory variables included in the model (Table 5).

3.4. Constraints Faced by the Poor Dairy Farmers

The problems related to raising of dairy animals were lack of transportation and communication facilities, low price of milk, lack of storage facilities, irregular supply and higher price of veterinary medicine, lack of knowledge about cost effective feed production, high fees of veterinary doctor, lack of information about extension services and credit institutions, lack of adequate capital, expensive and inadequate feed supply, low quality feed and lack of AI facilities (Table 6, Table 7 and Table 8).

Lack of transportation and communication facilities

The communication network in the study areas was not properly developed for the movement of agricultural products from the producer's farm to the market. Due to transportation and communication problem, the farmers were bound to sell the produce in local market at a lower price. Out of 100 farmers in Sariakandi, 28 faced this constraint at high extent, 49 farmers faced at medium extent, 6 farmers faced at low extent and 17 farmers did not face this constraint; out of 100 farmers in Islampur, 29 faced this constraint at high extent, 45 farmers faced at medium extent, 11 farmers faced at low extent and 15 farmers did not face this constraint and out of 100 farmers in Belkuchi, 24 faced this constraint at high extent, 43 farmers faced at medium extent, 16 farmers faced at low extent and 17 farmers did not face this constraint. In this case, the computed value of CFI was 188, 188 and 171 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Low price of milk

Low price of milk was a serious problem in the study areas for milk producers. In the case of contractual arrangement, they received their price of milk on the basis of fat percentage. The price of milk in the study areas was lower than the prices prevailing in many other areas of Bangladesh. Out of 100 farmers in Sariakandi, 10 faced this constraint at high extent, 11 farmers faced at medium extent, 37 farmers faced at low extent and 42 farmers did not face this constraint; out of 100 farmers in Islampur, 13

faced this constraint at high extent, 18 farmers faced at medium extent, 45 farmers faced at low extent and 24 farmers did not face this constraint and out of 100 farmers in Belkuchi, 10 faced this constraint at high extent, 9 farmers faced at medium extent, 43 farmers faced at low extent and 38 farmers did not face this constraint. In this case, the computed value of CFI was 89 [(10*3) + (11*2) + (37*1) + (42*0)], 120 [(13*3) + (18*2) + (45*1) + (24*0)] and 91 [(10*3) + (9*2) + (43*1) + (38*0)] for the dairy farming in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Table 6. Constraints Faced by the Dairy Farmers in Sariakandi Upazila

Constraints	Treated (N=300)						Controlled (N=300)						Difference of CFI (C = A - B)
	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (A)	Rank order	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (B)	Rank order	
Lack of transportation and communication facilities	28	49	6	17	188	6	37	53	8	2	225	3	-37
Low price of milk	10	11	37	42	89	10	35	38	13	14	194	8	-105
Lack of storage facilities	55	27	7	11	226	1	59	29	5	7	240	1	-14
Irregular supply and higher price of veterinary medicine	4	4	63	29	83	8	34	30	21	15	183	10	-100
Lack of knowledge about cost effective feed production	8	6	47	39	83	7	38	33	19	10	199	7	-116
High fees of veterinary doctor	9	11	38	42	87	11	29	32	21	18	172	11	-85
Lack of information about extension services and credit institutions	41	23	20	16	148	4	45	25	18	12	203	6	-55
Lack of adequate capital	33	47	13	7	206	3	37	45	13	5	214	4	-8
Expensive and inadequate feed supply	43	41	10	6	221	2	44	43	8	5	226	2	-5
Low quality feed	31	40	17	12	190	5	35	43	13	9	204	5	-14
Lack of AI facilities	14	9	35	42	95	9	39	20	28	23	185	9	-90

Table 7. Constraints Faced by the Dairy Farmers in Islampur Upazila

Constraints	Treated (N=300)						Controlled (N=300)						Difference of CFI (C = A - B)
	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (A)	Rank order	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (B)	Rank order	
Lack of transportation and communication facilities	29	45	11	15	188	6	34	42	13	11	199	6	-11
Low price of milk	13	18	45	24	120	7	23	52	16	9	189	7.5	-69
Lack of storage facilities	45	37	9	9	218	2	48	39	5	8	227	2	-9
Irregular supply and higher price of veterinary medicine	4	8	52	36	80	10.5	20	39	17	24	155	11	-75
Lack of knowledge about cost effective feed production	7	13	45	35	92	9	31	41	8	20	183	9	-91
High fees of veterinary doctor	6	9	44	41	80	10.5	34	31	15	20	179	10	-99
Lack of information about extension services and credit institutions	40	28	18	14	194	5	43	34	12	11	209	4	-15
Lack of adequate capital	35	49	11	5	214	3	37	45	12	6	213	3	-1
Expensive and inadequate feed supply	33	42	14	11	197	4	35	44	13	8	206	5	-9
Low quality feed	45	40	7	8	222	1	46	49	5	10	241	1	-19
Lack of AI facilities	13	12	44	31	107	8	33	36	18	13	189	7.5	-82

Table 8. Constraints Faced by the Dairy Farmers in Belkuchi Upazila

Constraints	Treated (N=300)						Controlled (N=300)						Difference of CFI (C=A-B)
	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (A)	Rank order	High (3)	Medium (2)	Low (1)	Not at all (0)	CFI (B)	Rank order	
Lack of transportation and communication facilities	24	43	16	17	174	5	40	36	17	7	209	4	-35
Low price of milk	10	9	43	38	91	10	41	29	13	17	194	7	-103
Lack of storage facilities	45	28	16	11	207	1	48	33	19	10	229	1	-22
Irregular supply and higher price of veterinary medicine	6	11	45	38	85	11	18	23	40	19	140	11	-55
Lack of knowledge about cost effective feed production	9	11	46	34	95	9	29	32	18	21	169	8	-74
High fees of veterinary doctor	13	15	37	35	106	7	23	28	29	20	154	9.5	-48
Lack of information about extension services and credit institutions	38	20	19	23	173	6	42	29	13	16	197	5.5	-24
Lack of adequate capital	35	40	18	7	203	3	39	42	9	10	210	3	-7
Expensive and inadequate feed supply	40	36	12	12	204	2	41	39	10	10	211	2	-7
Low quality feed	30	37	22	11	186	4	32	41	19	8	197	5.5	-11
Lack of AI facilities	12	8	44	36	96	8	29	26	30	15	154	9.5	-58

Lack of storage facilities

Storage of milk is not possible under ordinary condition. Some farmers stored milk for some time though not scientifically. Due to lack of adequate storage facilities, the reporting farmers did not get fair price for their milk. Out of 100 farmers in Sariakandi, 55 faced this constraint at high extent, 27 farmers faced at medium extent, 7 farmers faced at low extent and 11 farmers did not face this constraint; out of 100 farmers in Islampur, 45 faced this constraint at high extent, 37 farmers faced at medium extent, 9 farmers faced at low extent and another 9 farmers did not face this constraint and out of 100 farmers in Belkuchi, 45 faced this constraint at high extent, 28 farmers faced at medium extent, 16 farmers faced at low extent and 11 farmers did not face this constraint. In this case, the computed value of CFI was 226, 218 and 207 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Irregular supply and higher prices of veterinary medicine

Necessary veterinary drugs were not generally available in the markets. If those were available, prices were very high particularly for antibiotic drugs. Upazila Livestock Officer supplied vaccine, tablet, and potassium permanganate mixture, which were not sufficient for their dairy animals. Out of 100 farmers in Sariakandi, 4 faced this constraint at high extent, 4 farmers faced at medium extent, 63 farmers faced at low extent and 29 farmers did not face this constraint; out of 100 farmers in Islampur, 4 faced this constraint at high extent, 8 farmers faced at medium extent, 52 farmers faced at low extent and 36 farmers did not face this constraint and out of 100 farmers in Belkuchi, 6 faced this constraint at high extent, 11 farmers faced at medium extent, 45 farmers faced at low extent and 38 farmers did not face this constraint. In this case, the computed value of CFI was 83, 80 and 85 for the dairy farming in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Lack of knowledge about cost effective feed production

The milk producers in the study areas reported that, inadequate knowledge about cost effective feed production was one of the most important problems. Out of 100 farmers in Sariakandi, 8 faced this constraint at high extent, 6 farmers faced at medium extent, 47 farmers faced at low extent and 39 farmers did not face this constraint; out of 100 farmers in Islampur, 7 faced this constraint at high extent, 13 farmers faced at medium extent, 45 farmers faced at low extent and 35 farmers did not face this constraint and out of 100 farmers in Belkuchi, 9 faced this constraint at high extent, 11 farmers faced at medium extent, 46 farmers faced at low extent and 34 farmers did not face this constraint. In this case, the computed value of CFI was 83, 92 and 95 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

High fees of veterinary doctor

Veterinary doctors were hardly available in the study areas. When the farmers call the doctors especially from the distant place, they come home but charge a high fee due to poor transportation facilities. Even they are supposed to provide free veterinary service under contractual arrangement. Out of 100 farmers in Sariakandi, 9 faced this constraint at high extent, 11 farmers faced at medium extent, 38 farmers faced at low extent and 42

farmers did not face this constraint; out of 100 farmers in Islampur, 6 faced this constraint at high extent, 9 farmers faced at medium extent, 44 farmers faced at low extent and 41 farmers did not face this constraint and out of 100 farmers in Belkuchi, 13 faced this constraint at high extent, 11 farmers faced at medium extent, 37 farmers faced at low extent and 35 farmers did not face this constraint. In this case, the computed value of CFI was 87, 80 and 106 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Lack of information about extension services and credit institutions

In the study areas, animal vaccination services are not being used by poor farmers because of their poor understanding of these services. They reported that, they did not get credit even though several credit institutions were available in the main land. Some of them had slight knowledge about credit institution but they did not know how to get loan. Out of 100 farmers in Sariakandi, 41 faced this constraint at high extent, 23 farmers faced at medium extent, 20 farmers faced at low extent and about 16 farmers did not face this constraint; out of 100 farmers in Islampur, 40 faced this constraint at high extent, 28 farmers faced at medium extent, 18 farmers faced at low extent and 14 farmers did not face this constraint and out of 100 farmers in Belkuchi, 38 faced this constraint at high extent, 20 farmers faced at medium extent, 19 farmers faced at low extent and 23 farmers did not face this constraint. In this case, the computed value of CFI was 148, 194 and 173 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Lack of adequate capital

Lack of adequate capital was one of the obstacles for the development of dairy enterprise. When a farmer starts dairy farming or wants to expand farm he/she needs large amount of cash capital because of high price of crossbred dairy cows. Moreover, expensive concentrate feed, medicine, and high fees of veterinary doctor were the burden to them. Out of 100 farmers in Sariakandi, 33 faced this constraint at high extent, 47 farmers faced at medium extent, 13 farmers faced at low extent and about 7 farmers did not face this constraint; out of 100 farmers in Islampur, 35 faced this constraint at high extent, 49 farmers faced at medium extent, 11 farmers faced in low extent and about 5 farmers did not face this constraint and out of 100 farmers in Belkuchi, 35 faced this constraint at high extent, 40 farmers faced at medium extent, 18 farmers faced at low extent and about 7 farmers did not face this constraint. In this case, the computed value of CFI was 206, 214 and 203 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Expensive and inadequate feed supply

To increase the productivity of milch cows, concentrated feeds are most important. Concentrated feeds such as wheat bran, pulse bran, oil cake, molasses, etc. were not available in the local markets. They had to buy those from distant markets. Out of 100 farmers in Sariakandi, 43 faced this constraint at high extent, 41 farmers faced at medium extent, 10 farmers faced at low extent and 6 farmers did not face this constraint; out of 100 farmers in Islampur, 33 faced this constraint at high extent, 42 farmers faced at medium extent, 14 farmers faced at low extent and about 11 farmers did not face this constraint and out of 100 farmers in Belkuchi, 40 faced this constraint at high extent, 36 farmers faced at medium extent, 12 farmers faced at low extent and 12 farmers did not face this constraint. In this case, the computed value of CFI was 221, 197 and 204 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Low quality feed

Shortage of quality feed was also a major problem for raising dairy cows. Out of 100 farmers in Sariakandi, 31 faced this constraint at high extent, 40 farmers faced at medium extent, 17 farmers faced at low extent and 12 farmers did not face this constraint; out of 100 farmers in Islampur, 45 faced this constraint at high extent, 40 farmers faced at medium extent, 7 farmers faced at low extent and about 8 farmers did not face this constraint and out of 100 farmers in Belkuchi, 30 faced this constraint at high extent, 37 farmers faced at medium extent, 22 farmers faced at low extent and about 11 farmers did not face this constraint. In this case, the computed value of CFI was 190, 222 and 186 for the dairy farming system in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

Lack of artificial insemination (AI) facilities

Artificial Insemination is a modern tool for improving quality breed. Farmers in the study areas stated that, they are deprived of artificial insemination facilities. Out of 100 farmers in Sariakandi, 14 faced this constraint at high extent, 9 farmers faced at medium extent, 35 farmers faced at low extent and 42 farmers did not face this constraint; out of 100 farmers in Islampur, 13 faced this constraint at high extent, 12 farmers faced at medium extent, 44 farmers faced at low extent and 31 farmers did not face this constraint and out of 100 farmers in Belkuchi, 12 faced this constraint at high extent, 8 farmers faced at medium extent, 44 farmers faced at low extent and 36 farmers did not face this constraint. In this case, the computed value of CFI was 95,107 and 96 for the dairy farming in Sariakandi, Islampur and Belkuchi, respectively against a possible range from 0 to 300 for each area (Table 6, Table 7 and Table 8).

An overall situation of the constraints faced by the treated dairy farmers at three areas; Sariakandi, Islampur and Belkuchi, respectively were shown in Table 9.

It revealed that, lack of storage facilities with CFI 651 was ranked as 1st, whereas, lack of adequate capital with CFI 626, expensive and inadequate feed supply with CFI 622, low quality feed with CFI 598, lack of transportation and communication facilities with CFI 550, lack of

information about extension services and credit institutions with CFI 515, low price of milk with CFI 300, lack of AI facilities with CFI 298, higher price of veterinary medicine with CFI 273, lack of knowledge about cost effective feed production with CFI 270, irregular supply and higher price of veterinary medicine with CFI 248 were ranked as 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th and 11th, respectively. It is shown in Table 9 that out of eleven constraints six constraints are ranked in common order for both this groups. These rankings are 1, 5, 6, 7, 9, and 11.

Table 9. Overall Constraints Faced by the Dairy Farmers in the Study Areas

Constraints	Overall			
	Treated (N=300)		Controlled (N=300)	
	CFI	Rank order	CFI	Rank order
Low price of milk	300	7	577	7
Lack of transportation and communication facilities	550	5	633	5
Lack of storage facilities	651	1	696	1
Low quality feed	598	4	642	3
Irregular supply and higher price of veterinary medicine	248	11	478	11
Lack of information about extension services and credit institutions	515	6	609	6
Lack of adequate capital	626	2	637	4
Lack of knowledge about cost effective feed production	270	10	551	8
Lack of AI facilities	298	8	528	10
Expensive and inadequate feed supply	622	3	643	2
High fees of veterinary doctor	273	9	550	9

Note: Possible CFI score ranges between 0 to 900 for both treated and controlled group.

4. Conclusion

It can be concluded that measuring food insecurity at household level is a complicated task. It has been found that after the intervention of dairy farming, many households got themselves relieved from food insecurity gradually. Due to the vulnerable condition in *char* areas, dwellers become penniless and faced food insecurity. Based on farmers' opinion, the major problems in *char* areas were identified as lack of storage facilities, lack of adequate capital, poor communication and transportation facilities, and lack of market information. To combat the crisis, 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. Mobilization as well as diversified use of resources is needed to pursue productive activities for food security and dependency upon local credit or loan provider should be squished. Government and non-government organizations should allocate credit (soft loan) for the *char* dwellers and strengthen safety net programmes for enhancing food security during crisis period.

Acknowledgements

The study was performed under the support of 'Improving livelihood through herd health management and milk market access to poor farmers in Northern Bangladesh' project funded by Krishi Gobeshona Foundation (KGF) and Ministry of Science and Technology (MoST), Bangladesh.

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