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Population displacement due to river erosion in Sirajganj district: Impact on food security and socio-economic status

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Abstract

As a consequence of river bank erosion, every year a huge number of people displace from their native houses to some other areas in Sirajganj district. This study was conducted to measure the economic losses and also assess the status of food security of the displaced people of Sirajganj by using primary data collected from respondents of four Upazilla (sub-district) of Sirajganj, namely, Shahjadpur, Kazipur, Belkuchi, and Sirajganj Sadar. In evaluating the food security, direct calorie intake (DCI) and protein intake method had been applied. The study has shown that 58.3% and 15% of the total respondents are found to be food secure on the basis of calorie and protein intake respectively. In addition of assessing food security, the single-level binary logistic regression model and also multinomial logistic regression were fitted to find out the important determinants of food security of the displaced people living in Sirajganj and also in the other regions of Bangladesh where people shift their houses to other places because of river erosion. The level of income was found as positively significant, however, the age of the family head and the family size were found as negatively significant determinant of the food security both on the basis of calorie and protein intake. The other significant determinants that had been identified are- duration after shifting, losses due to shifting, and education of the family head. The study has recommended some actions to the government, concerned stakeholders, GOs or NGOs and others to ensure the food security of the displaced people. They are- preventing river erosion, increasing level of education, controlling of the population, initiating improved agricultural farming, ensuring vocational training for the affected people, encouraging women empowerment et cetera.

Keywords: River erosion, Displacement, Food security, Direct calorie intake, Protein intake

Introduction

Bangladesh has a long history of population displacement since 1947, when the Indian subcontinent was divided into two pieces namely India and Pakistan. The country faced great displacement in the year of 1971, during its liberation war. It was estimated that around 10 million East Bengali refugees entered India during the early months of the war (Wikipedia, 2014). But, after the war, the displacement mainly took place internally. A great portion of this internal displacement has occurred due to river erosion. Although, the rivers are the glory of Bangladesh and geographically Bangladesh is constituted with numerous rivers. But, these rivers affect the lifestyle of the people live nearby to rivers and cause suffering to them, mostly, because of river erosion. As a result of river erosion a large number of households have already been displaced. Moreover, every year many people live beside river are forced to do the same. Displaced people lost their valuable lives, lands and land resources and this will likely to go on. According to a study of Refugee and Migratory Movements Research Unit (RMMRU, 2012) about 1.9 million people of Bangladesh will be displaced due to river erosion by 2050. A report of Asian Development Bank reveals that riverbank erosion displaces more than 100,000 people annually in Bangladesh, resulting in devastating social disparity and poverty (The daily Sun, 2011).

Being situated by the river *Jamuna*, *Sirajganj* district covers a major portion of these victims. The affected people shift to their nearby district or to others area after losing everything into the river. Furthermore, after construction of the *Jamuna* Bridge, more people living nearby of *Jamuna River* are being displaced. In the last 10 years the *Jamuna* river eroded nearly 30 villages, one third of the city and 400,000 people became homeless. In the last 3 years, huge chars (islands) have been forms in the middle of the river causing more sufferings to the people (The Daily Star, 2011). Thereby, livelihood, education, and also social values of the affected people become vulnerable. However, the major consequence comes with the lack of food security.

However, in order to adapt, displaced people need to change their cropping strategy and livelihood frequently. The options for the erosion-affected people are limited, nevertheless. Most of the victims of river erosion, being uneducated and unskilled, engage themselves in informal sector jobs in urban centres. It follows that, lower literacy rate and inadequate health facilities are making them socio-economically vulnerable (Zug, 2005). In these circumstances, food security of these areas requires careful observation.

This study aimed at measuring the food security and socio-economic status and also identifying the factors responsible for the food security of those displaced people live in Sirajganj. Similarly, the study was designed to address the economic losses and to compare the change in food security condition between before and after the displacement.

Materials and Methods

Selection of the study areas

Sirajgan- situated in North-Bengal Bangladesh, lying just west of the Brahmaputra River and beside of Jamuna River- is geographically one of the most disadvantaged areas in Bangladesh characterised by the proneness of river erosion. Evidently, the displacement due to river erosion is prominent in this part of the country. Moreover, it was observed that more erosion prone areas were located in Shahjadpur, Kazipur, Belkuchi, and Sirajganj Sadar Upazilla of Sirajgonj district. Thus, these four Upazilla were chosen for the study.

Sampling technique and period of data collection

A total of 120 respondents were chosen by following snowball sampling technique from the purposively selected foresaid Upazillas of Sirajganj. A total of 31, 27, 27 and 35 samples had been collected from Sirajgonj Sadar, Kazipur, Belkuchi, and Shahjadpur Upazilla respectively. Data were collected from the selected respondents with the help of interview schedule. Before starting the interview, each respondent was given a brief description about the nature and purpose of the study. All the selected respondents experienced displacement due to the river erosion at least once or more times. For the study, data were collected during the period January to March in 2014.

Analytical techniques

Different techniques of the data analysis had been used in this study. Univariate analysis was done to know the frequency distribution of the selected study variables and to recognise the nature of the sample data. Besides, bi-variate analysis has been done by putting the data in a two-way table format known as a crosstab in SPSS and then chi-square test was used to test the independence of two or more attributes. Moreover, the households' food security was measured by using direct calorie intake (DCI) and protein intake method. The predictors of food security had been determined by using single-level binary logistic regression model. Similarly, to find out the determinants of food security status based on protein and calorie intakes, multinomial logistic regression model was been used.

Direct Calorie Intake (DCI), protein intake and computation of food security: The direct calorie intake method estimates the per capita calorie intake at household level, and individual level. In this method the food consumed during the last seven days in a household was first averaged and afterwards the average content of food per day per household was converted into kilocalorie. The amount of calorie intake was then converted into per capita per day. Item-wise food consumption was converted into calorie and protein intake by using conversion factor (Wahed and Roy, 2008). According to this method, a household is considered as "food secure" with intake of 2,122 or more kcal per capita per day and "food insecure" with less than 2,122 kcal per capita per day. On the other hand, the recommended daily allowance (RDA) of protein for adults per day is 56 gm. from a mixed diet (David and Marcia, 2003). Thus, in this study, threshold protein intake to be food secure is taken as 56gm per day per adult person. With this yardstick the food security status of the sampled households had been measured.

Chi-square test of independence of attributes

The Chi-square statistic is the primary statistic used for testing the statistical significance of the cross-tabulation table. Chi-square test can be used to test the independence of two or more attributes. For testing the hypothesis of independence of two attributes, an observed set of frequencies are compared with a corresponding set of frequencies that are expected under the null hypothesis. Let O_{ij} (i=1,2,…, r and j = 1,2,…,k) denote the observed frequencies and E_{ij} (i=1, 2,…, r and j=1,2,…,k) denote the expected frequencies. Then the test statistic, χ^2 is defined as: $x^2 = \sum_{i-1}^{r} \sum_{j-1}^{k} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$, which is approximately distributed as χ^2 with (r-1)(k-1) degrees of freedom. For tables with two rows and two columns or with any number of rows and columns, the value of Pearson chi-square and likelihood ratio chi-square can be used to test the null hypothesis of independence of two attributes.

Binary logistic regression: Suppose that there are *n* individuals, some of their response is "success" and the other's is "failure". For example, if the response variable is the status of food security, then two categories may be as food secure (success) and not food secure (failure). Let Yi denotes the response variable (say, the status of food security) for the *i*th individual and Yi = 1 if the individual is a success (food secure) and Yi = 0 if the *i*th individual is a failure (food insecure). Suppose for each of the *n* individuals, *K* independent variables X_{i1}, X_{i2},… X_{ik} are measured. These variables are either categorical ones coded as dummy variables, such as religion, or rural/urban residence; or continuous, such as age. The logit is thus the logarithm of the odds of success, that is, the logarithm of the ratio of the probability of success to the probability of failure. This can be written as,

$$\text{logit}(P_i) = \log_e \frac{\text{Pi}}{1-\text{Pi}} = \sum_{l=0}^{K} = 0\beta_l X_{il}\,; \quad \text{i=1, 2,…,n}$$

Multinomial logistic regression: Let the response variable has j mutually exclusive and exhaustive categories, denoted by j=1, 2,…,J. The Jth category is taken as the reference category for the response variable. Because the ordering of the category is arbitrary, any category can be jth category, so that the choice of the reference category is also arbitrary. Let there are also k predictor variables, denoted by x_1, x_2 ,…, x_k . The multinomial logit model is then specified in log odds form as:

$$Log \frac{P_i}{P_j} = \sum_l b_{jl} x_l \qquad i \neq \text{j = 1, 2,…, J}$$

and *l*=0, 1,…, k

$$\sum P_j = 1 \qquad \text{j=1, 2,…, J}$$

The dependent variable was categorized as:
Food insecure on the basis of both calorie and protein = 3
Food secure on the basis of calorie only = 2
Food secure on the basis of both calorie and protein= 1

Results and Discussion

Socio-economic status, demographic condition and health care facilities

It has been found that the average age of the respondents of the study area was 46 years and the age ranged from 23 to 75 years. However, illiteracy was one of the main features of these areas. Therefore, more than 80% people were only in the range of 0 to 5 years of schooling. Interestingly, the family size of the respondents was found between 2 and 9 persons with an average of 5.69 persons per family, which is lower than the usual average that of the national average. The proportion of male members and female members were about 62% and 38% respectively.

We found that around 80% of total respondents shifted between 2 and 5 times. The higher percentage of the people worked as day labourers both before and after the displacement. Although, before the displacement around 36.67% of the respondents were engaging in agricultural activities or farming (mainly works in their own land) but after the displacement this proportion reached to a mere 4.17%. A dramatic increase in the professions, like, shop keeping, rickshaw pulling and NGO job (mainly in form of garments worker), and so forth, has been observed after their displacement. It was notable that none of the respondents were found engaging in government service. About 68% of the respondents has found living on the side of rail line, in the slum or in the government's khash land.

Displaced people had poor access to health care facilities during or after the displacement. But a staggering 85.86% of them thought that they were affected with some kind of diseases. It was found that diarrhoea (15.83%), asthma (12.5%), heart disease (10.83%) were the dominant diseases. A few of them were also affected by fever, tuberculosis, bone diseases and others. The treatment was not proper in many cases. Among respondents, the highest number of them (36.67%) received treatment from the village doctors. A considerable proportion (20.83%) received treatment from Kobiraj. A small amount of the affected people (10.83%) felt reliable about Homeopathic treatment. Only in emergency situations they rushed to *upazilla* health complex, where qualified doctors treated the patients.

Economic losses due to the displacement

The degree of economic loss and vulnerability of population due to bank erosion was significant. For instance, the impact of land loss involved primarily the loss of homestead land, housing structures, crops, cattle, trees and household utensils. Admittedly, homesteads-loss instigated by the river erosion forced people to move to new places without any option and put them in vulnerable situations. In addition, riverbank erosion had caused setback in the rural agriculture. Along with homestead settlements, it eroded farmland, infrastructure and the communication system. It affected the crop income of vulnerable groups. The big farmers were the worst affected, followed by medium farmers, and marginal groups. The affected people lost their assets and were forced to draw on savings and often felt into further debt.

The highest amount of total economic losses on an average (Tk. 119012) was reported in Sirajganj sadar upazilla mainly because of the losses of land and buildings or huts greatly (Table 1). The losses of tubewells and trees also occupied a great portion. The lowest amount of losses (Tk. 91885) was found in Belkuchi upazilla. However, in Belkuchi the amount of losses comprised largely by the losses of buildings/huts and land. In Shahjadpur the losses of buildings/huts was significant (Tk. 102434). In Kazipur the land has caused greater economic losses, which was equivalent to Tk. 45110. Besides these, the economic losses of livestock (cows, goat and poultry) were substantial in the study areas.

Table 1. Assessment of losses (on an average) due to the river erosion

Items	Average losses in different upazillas (in taka)			
	Sirajganjsadar	Kazipur	Belkuchi	Shahjadpur
Buildings/huts	39225	32074	36334	37887
Land	47677	45110	34296	44148
Cows	14064	11666	11600	8200
Goats	983	775	1351	571
Poultry	309	340	418	362
Trees	11806	10159	3951	8502
Tubewells	3561	2259	2814	2050
Others	1387	1778	1121	714
Average total	119012	104161	91885	102434

Source: Field Survey, 2014

Impact of river erosion on food security

Differentials of food security (on the basis of calorie intake): There were 120 households, among them 70 (58.3%) were found food secure based on direct calorie intake. Some variables considered, namely, age; profession; family size; education; loss due to erosion; and annual income had significant relation with food security calculated on the basis of calorie intake (not shown in Table).

Age of the household head was found to be significant at 5% level. In the age group of below 46 years, 64.4% households were reported as food secure on the basis of calorie intake, whereas this percentage was 52.5% in the age group of above 46 years.

Profession was also a vital factor of food security. The highest percentage (84%) of food secure family belonged in the group which were engaged in business, rickshaw pulling, and shop keeping or other combined occupation. But for the respondents engaging in agriculture, this became 27.5% only.

Family size was highly significant (at 1% level of significance) factor. It found that 45.9% of the small families were food secure, whereas, only 22.7% were found secure in the large family group.

Education was another important variable which was found significant at 5% level of significance. With the increase in the level of the education, the percentage of the food secure family increased. It was found that 68.4% of the educated families with more than 5 years of schooling were food secure. On the contrary, this percentage became lower (56.4%) for the families with education of less than five years of schooling.

River erosion washed away all the assets the affected people had. It had a negative impact on food security. It was found that the highest 79.5% food secure family was found in the group who lost assets worth less than Tk. 75000. However, the percentage became 18.7% for the group who lost assets worth more than Tk. 150000.

Annul income was a powerful and significant (at 1% level) factor in determining food security. Surprisingly, 100% of the household is found food secure in the earning groups with an annual income of more than Tk. 140000. Similarly, the middle earning group was not also far behind enough (78.79%). Whereas, only 46.25% are found food secure in the lower income group with income of less than Tk. 90000.

Differentials of food security (on the basis of protein intake): Among the 120 households, only 18 (15%) were found food secure in term of protein intake. However, similar to the food security based on calorie intake, some variable considered, namely, age; profession; family size; education; and annual income had significant relation with food security calculated on the basis of protein intake (not shown in Table).

Relative comparison between before and after the displacement: A significant difference has been observed in the status of food security between before and after the displacement. About 70 households out of 120 were found food secure (Table 2) in term of calorie. Thus, another 42% were not food secure. However, notably, among these 120 households a sum of 86 households was food secure before displacement in term of calorie intake.

The condition of food security was found miserable in terms of protein intake. Among the sampled households only 18 were found food secure (Table 2) on the basis of protein after they had shifted. Whereas, this number was 32 before the displacement had taken place.

Determinants of food security (calorie basis): The factors which are responsible for the food security on the basis of calorie had been identified by using binary logistic regression. The result has been shown in Table 3.

Table 2. Comparative food security condition

Basis of food security	After Displacement		Before Displacement	
	No. of Food Secure Respondents	No. of Food Insecure respondents	No. of Food Secure Respondents	No. of Food Insecure respondents
Only calorie	70 (58.3%)	50 (41.67%)	86 (71.6%)	34 (28.4%)
Only Protein	18 (15%)	102 (85%)	32 (26.67%)	88 (73.33%)
Both	18 (15%)	102 (85%)	32 (26.67%)	88 (73.33%)
None	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table 3. Binary logistic regression model for determining the factors affecting food security (on the basis of calorie intake)

Variables	Coefficient (β)	Standard Error (SE)	Odds Ratio
Cultivable land(value)			
(*Reference*: Up to Tk. 50000)			
Tk.50001-Tk. 100000	.311	1.020	1.365
Above Tk. 100000	1.251	1.405	3.947
Duration after shifting			
(*Reference*: Less than 5 years)			
Between 6-10 years	1.496**	.513	4.462
Above 10 years	1.544	1.842	4.681
Number of times of shifting			
(Reference: Single time)			
More than once	-1.118	4.019	.327
Age of the household head			
(Reference: Below 46 years)			
Above 46years	-.968	.580	.380
Education of the household head			
(Reference: Up to primary)			
Above primary	.341	.940	1.407
Family size			
(Reference: Up to 5)			
Above 5	-1.907*	.812	1.149
Losses due to erosion			
*(Reference:*Less than Tk.75000)			
Between Tk. 75001-150000	-4.629	2.460	.010
Above Tk. 150000	-2.728*	1.06	.093
Annual Income			
*(Reference:*Less than Tk. 90000)			
Between Tk. 90001-140000	2.22**	.644	9.218
Above Tk. 140000	2.839	1.28	9.389
Annual Expenditure			
(Reference: Less than Tk. 90000)			
More than Tk. 90000	1.347	1.065	3.847
Profession			
(Reference: Agriculture)			
Private job	1.722*	.741	2.059
Others (business or integrated)	1.108**	.481	3.029
Constant	1.411	.903	4.099

Note: *p < 0.05 and **p < 0.01 are the levels of significance

The analysis shown that the likelihood of achieving food security for those who shifted 6 to 10 years ago were 4.46 times more compared to that of the households with shifting period of less than 6 years.

The binary logistic regression showed that the family size with equal or less than 5 persons were significantly 1.149 times more likely to be food secure than the families with more than five persons (reference category).

In this study regression analysis depicted that households with income between Tk. 90000 to 140000 were 9 times significantly more food secure compared to the household with income of less than Tk. 90000 per year. To buy more food there was no alternative to income, hence, predictably, increased income ensured food security level increased.

Binary logistic regression analysis indicated that respondents with annual income between Tk. 90001 and 140000 were 9.218 times significantly (at 1% level) more likely to be food secure than the respondents with annual income worth of less than Tk. 90000.

In this study profession was found as a significant determinant of the food security. Respondents engaging in private job were 2.059 times more food secure than respondents engaging in solely on agricultural activities (reference category). However, respondents depending on both agriculture and business activities (shop keeping, trading and so forth) were 3.029 times significantly (at 1% level) more food secure than the reference category (respondents engaging in agricultural activities).

Determinants of food security (protein basis): In order to find the possible determinants of the protein-based food security, binary logistic regression had been run. It had revealed some important determinants, which have been shown in Table 4.

Table 4. Binary logistic regression model for determining the factors affecting food security (on the basis of protein intake)

Variables	Coefficient (β)	Standard Error (SE)	Odds Ratio
Duration after shifting			
(*Reference*: Less than 5 years)			
Between 6-10 years	.171	1.292	1.187
Above 10 years	.994	.679	2.701
Number of times of shifting			
(Reference: Single time)			
More than once	-1.13	3.91	.297
Age of the household head			
(Reference: Below 46 years)			
Above 46years	-1.664	1.186	.189
Education of the household head			
(Reference: Up to primary)			
Above primary	2.922**	.381	2.514
Family size			
(Reference: Up to 5)			
Above 5	-2.199	1.593	.111
Annual Income			
*(Reference:*Less than Tk. 90000)			
Between Tk. 90001-140000	1.231*	.564	1.260
Above Tk. 140000	1.966**	.394	2.629
Profession			
(Reference: Agriculture)			
Private job	3.832	2.064	.022
Others (business or integrated)	3.658	1.725	.026
Constant	1.387	.892	3.98

Note: *p < 0.05 and **p < 0.01 are the levels of significance

It was found that families having an educated household head with more than 5 years of schooling were 2.514 times significantly more likely to achieve food security than the families having household head with less than 5 years of schooling or with no education (reference category). Educated people had better idea of balance diet and also the value of protein intake compared to the illiterate people.

Binary logistic regression analysis indicated that families with the annual income of more than Tk. 140000 were 2.629 times significantly (at 1% level) more likely to be food secure compared to the families with annual income of equal or less than Tk. 90000 (reference category). Similarly, families with annual income between Tk. 90000 and 140000, were 1.260 times more food secure than the reference category. Evidently, with the increased amount of income families afforded foods which contain protein in a rich amount, whereas, families with less income had failed to do so.

Determinants of Combined Food Security (based on both calorie and protein intake): The multinomial regression analysis was used to identify the responsible determinants for the food security on the basis of calorie, calorie and protein and insecurity on the basis of both calorie and protein. Reference variable was defined as secure at none, in other word, insecure at both calorie and protein.

From Table 5, it can be seen that the duration (years) after the shifting was an important determinant which was significant at 5% level for calorie based security and at 5% level for the both calorie and protein based food security. Food security on the basis of calorie and both calorie and protein were 2.023 and 1.782 times respectively more likely for the households when the duration became more than 5 years than when it was less than 5 years compared to the food insecurity on the basis of both calorie and protein.

Table 5. Multinomial regression model for determining the factors affecting food security

	Based on calorie			Based on both		
Variables	**Coefficient (β)**	**Significance**	**Odds-ratio**	**Coefficient (β)**	**Significance**	**Odds-ratio**
Intercept	**20.436**	**1**	**.995**	**3.295**	**1**	**.121**
Duration after shifting						
(Reference: Less than 5 years)						
More than 5 years	1.704*	0.029	2.023	1.578*	0.039	1.782
Losses due to erosion						
(Reference: less than Tk. 75000)						
Between Tk.75000-150000	-1.977*	.043	.138	-1.116	.426	.328
More than 150000	-2.074	.067	.126	-1.072*	.031	.216
Age of the household head						
(Reference: Below 46 years)						
Above 46years	-.344	.688	.709	-.226	.874	.797
Education of the household head						
(Reference: Up to primary)						
Above primary	.430	.692	1.537	1.704*	0.029	2.023
Family size						
(Reference: Up to 5)						
Above 5	-2.580*	.039	.076	-4.105**	.008	.016
Income						
(Reference: Less than Tk. 90000)						
Between Tk. 90001-140000	.912	.080	2.489	1.290	.079	3.631
Above Tk. 140000	1.187	.222	3.277	.716	.526	2.046

Note: *p < 0.05 and **p < 0.01 are the levels of significance

The households were 0.138 times significantly (at 5% level) less likely to be food secure on the basis of calorie when the losses were between Tk.75000 and Tk.150000 than the household with losses of less than Tk. 75000 when compared to the food insecurity on the basis of both calorie and protein. Similarly, households with the loss of more than Tk. 150000 were 0.216 times less likely to be food secured on the basis of both calorie and protein.

Families were 2.023 times less likely to be food secure both on the basis of calorie and protein having household head's education of less than 5 years of schooling than the families with household head's education of more than five years of schooling.

Households having family member of more than 5 were .076 times insecure (at 5% level) on the basis of calorie intake than the households having family size of less than 5 persons when compared to the households at both calorie and protein intakes. Similarly, households of more than 5 members were .016 times less likely to be food secure based on both calorie and protein than household with family member of less than 5 when compared to the households insecure at both calorie and protein intakes.

Conclusion and Recommendation

People of Bangladesh living in rural areas have been undergoing stress due to natural disasters of which riverbank erosion is a significant one. The study showed the impact of river erosion on the natural resource and socio-economic status is profound and multilateral. There were many factors reasonable for the food insecurity in the areas where displacement took place. Lack of education, large family size, and low level of income were the main factors of food insecurity.

A country cannot develop by leaving behind a society with various disadvantaged groups, such as displaced people. It is high time for the government and other concerned stakeholders to take action to ensure economic prosperity and food security in these disadvantaged areas. Although, various national and international development organisations are working towards achieving food security across Bangladesh, but it will be more worthwhile, if food policy can be assimilated with appropriate poverty reduction strategies in these affected areas. To address the issue and to reduce the vulnerability, there should be rescue, rehabilitation and protection measure incorporated into the development plan of Bangladesh. Long-term policies and strategies should be taken to cope up with the bank erosion taking into account the social and institutional adjustment measures. Meanwhile, a set of measures are highly recommended to execute for the betterment of the displaced people. They are: increasing education facility, controlling population or making it asset, making best effort for agricultural development, shrinking incidence of river erosion, initiating special microcredit, equalising the power of women, and et cetera.

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