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CROP DIVERSIFICATION AS A STRATEGY FOR ACHIEVING FOOD SECURITY: A STUDY IN MYMENSINGHDISTRICT OF BANGLADESH

Shibli MMA[1], Kausar AKMG[2], Islam MS[3], Rahaman MS[4*] and Parveen S[1]

[1]Dept. Agril Econ, Bangladesh Agricultural University, Mymensingh;

[2]Dept. Agribusiness Management, EXIM Bank Agricultural University Bangladesh, Chapainawaganj, Bangladesh

[3]Agricultural Economics Division, Bangladesh Sugarcrop Research Institute (BSRI), Pabna

[4]Agricultural Economics Division, Bangladesh Rice Research Institute (BRRI), Gazipur.

**Corresponding author: M. S. Rahaman*

ABSTRACT

The present study covers the possibilities of crop diversification to achieve balanced food security from as a case study from Mymensingh district. The study revealed that family size and farm size were more or less similar for diversified, semi-diversified and non-diversified farmer but diversified farmer's education level was high and they were younger than others. Profitability from the mono crop cultivation and multiple crop cultivation had a significant variation. The gross margin was BDT 3456, 5830 and 9092 from the cultivation of 0.164ha (non-diversified), 0.162ha (semi-diversified) and 0.168ha (diversified), respectively. Based on calorie intake, 55 percent (non-diversified), 61 percent (semi- diversified) and 72 percent (diversified) farmers were food-secure and their calorie intakes were 2446 Kcal, 2863 Kcal and 3029 Kcal, respectively. On the other hand 45 percent (non-diversified), 39 percent (semi- diversified) and 28 percent (diversified) farmers were food-insecure and their calorie intakes were 1756 Kcal, 1859 Kcal and 2046 Kcal, respectively. It also found that household crop production and number of cultivated crop had a positive and significant impact in attaining food security of the households. The crop diversified farmers had significant role and the greater chances to achieve food-security than semi-diversified and non-diversified farmers.

Keywords: Socio-economic**,** food security, constraints & recommendation

INTRODUCTION

Food security is defined as achieving food security "at the individual, household, national, regional and global levels when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Crop diversification is also considered as an effective approach to utilize scarce land and valuable water resources, and it makes agriculture sustainable and environment friendly (Joshi et al, 2007; Kumari et al, 2010). Crop diversification is believed to be a widely prescribed means of agriculture and rural development (Pingali and Rosegrant, 1995; Vyas 1996). It offers comparatively high returns from crops by minimizing price and yield risk created by climatic variability and price volatility of agricultural produce. Again, it also offers higher labor productivity, optimizes use of resources and utilizes the land efficiently (Ashfaq et al. 2008; Mehta, 2009; Mukherjee, 2012). It also creates opportunities for more employment and higher income through higher efficient use of resources. It also helps to use the land, water and other resources judiciously. Crop diversification as a socially beneficial policy can be complimented by extensive infrastructural facilities, financial and technological support, etc. especially for the localized micro (labor-intensive) enterprises that are engaged in processing, storing, grading and packaging activities (Chakrabarti &Kundu, 2009; De & Bodosa, 2014).

Crop Diversification is an essential tool for ensuring food security of a country. Since Bangladesh is an agrarian society this importance is somewhat extended. World Bank (1990) and Gunasena (2001) believe that crop diversification is a very important instrument for food and nutrition security, income growth, poverty alleviation and employment generation. Ensuring food security of a large population with limited resources is now the great concern of Bangladesh. Land is inadequate here, but growth rate of population is comparatively very high.Within crop agriculture, a serious concern has been raised over the last decade about rice bias in the crop production endeavour. The growth in crop agriculture has been dominated by rice which accounts for nearly 70% of gross farm revenue. Rice monoculture also reduces production of non-rice crops, erodes bio-diversity, creates nutritional imbalance (Hussain et al, 2001; Rahman, 2010).In order to reduce emphasis on rice, crop diversification programme was launched in the country from late eighties. The programme has, however, attained limited success. A higher growth rate of the agriculture sector will require increasing contribution of non-rice crops. A diversified cropping system, in addition to providing stimulation to growth, will contribute to employment generation, poverty alleviation, better nutrition, higher export earnings and sustainable natural resource management. Incorporation of minor crops such as vegetables, pulses, oilseed (including sunflower) in the cropping pattern generate additional employment opportunities, provide cash income and contribute to family nutrition in various ways. Diversified cropping ensures efficiency of farm resource use through multi-dimensional use of space, time and fixed labour. It also reduces production, price and income risks of the farmers. Besides, crop diversification help prevent deterioration of the ecosystem.

MATERIALS AND METHODS

The study was conductedMonkanda village in Fhulpur Upazila of Mymensingh district. A sample of 60 respondents was selected purposively in order to meet the objectives of the study. The farmers were categorized into

non-diversified (cultivate only one crop), semi-diversified (cultivate 2 to 3 crop) and diversified (cultivate more than 3 crop) farmer. In each stratum, a sample size of 20 farms was chosen purposively for the present study. The data were collected through a well designed interview schedule during the period from February to April 2012.

Estimation of Energy and Nutrient Intake

For this purpose, household consumption data for the last three days was collected through interviewing household members. In total, data on eighteen types of food items were collected. The quantities of crops, animal products and other food items produced and purchased in kilogram were recorded and calculated for the energy and nutrient values (i.e. protein, calcium, iron and fat). This divided by the adjusted household size to obtain the calorie and nutrient intake per capita per day by a household member. Irrespective of male and female, two children under six years of old were considered as one adult member in this study (Omotesho et al., 2006). The tables of nutrient composition of Bangladeshi foods were used to calculate the energy and nutrient values of the foods. A certain percentage was deducted from each of the produced and purchased food item in calculating the actual edible part. The deducted percentages were 20% for fish and papaya, 25% for orange and bitter plum (jujube), 10% for sweet gourd (yellow pumpkin) and bottle gourd, 5% for potato, brinjal (egg plant), cauliflower, cabbage, leafy vegetables and plantain stem.

Analytical Technique

Tabular analyses (i.e., average, percentages, etc.) were employed to identify the socioeconomic status of the farmer engaged in crop diversification. The logistic regression model was used to identify the determinants of food security. The logistic model is based on the cumulative logistic distribution function expressed below.

$$P_i = P_r(Y = 1 \mid X = X_i)$$

Then we can write the model:

$$\text{Log}\left(\frac{Pi}{1 - Pi}\right) = \text{Logit}(P_i) = \beta_0 + \beta_1 X_i$$

Where, Pi is the Probability of being food-secured.

In order to obtain the value of Pi, the likelihood of observing the sample needs to be formed by introducing a dichotomous response variable Y_i (dependent variable). The dependent variable is food security. Households whose per capita per day calorie intake was found to be greater than the food security line were regarded as being food-secure and were assigned a value of 1, while households experiencing a calorie intake less than the food security line were regarded as food insecure and they were assigned a value of 0.

Therefore the parameter β_0 gives the log odds of the probability of being food secured. (When Xi =0) and β_1 shows how these odds differ for diversified farmer (when Xi =X_1, X_2, X_3).

We can write the model in terms of odds as

$$P_i / (1-P_i) = \exp(\beta_0 + \beta_1 xi)$$

Or in terms of the probability of being food secured as:

$$P_i = \exp(\beta_0+\beta_1 xi)/ \{1 + \exp(\beta_0+\beta_1 xi)\}$$

Conversely the probability of being food insecure is

$$1- P_i = 1/ \{1 + \exp(\beta_0+\beta_1 x_i)\}$$

Notice that we have so far not included a residual term in the models, and have instead expressed the model in terms of population probabilities. But we could write it as:

$$P_i = P_i + f_i = \exp(\beta_0+\beta_1 x_i)/ \{(1 + \exp(\beta_0+\beta_1 x_i) + f_i)\}$$

Determinants of house level food security

At first nine explanatory variables such as farm land size, adjusted household size, dependency ratio, household crop production, annual household income, off-farm income, input cost, crop diversification index, and education of the household's head were hypothesized to be major determinants of household food security. After testing multi-co linearity among variables and the level of significance, seven variables were finally included in the model to determine the probability of food security among indigenous households. The independent variables are specified as follows:

X_1 = Household income (BDT)
X_2 = Input cost per season (BDT)
X_3 = Cultivable land (Decimal)
X_4 = Household Size (Decimal)
X_5 = Household annual crop production (kg)
X_6 = Cultivated crop (No.)
X_7= Off-farm income of household (BDT)

According to Gujarati (1995) the marginal probabilities of factors determining food security and the elasticity of the probability of food security were estimated based on expressions derived from the logistic model as:

$$dp/dx = \beta_i\{P (1- P_i)\}$$

$$E_p = \beta_i X_i (1- P_i)$$

Where,

β_i = Estimated logit regression co-efficient with respect to the i^{th} factor
P_i = Estimated probability of the household food security status
X_i = Arithmetic mean the household i^{th} attribute
E_p = Elasticity of probability of food security

FINDINGS

Family Composition of Sample household

It is clear from Table 1 that the average family size of Non-diversified farmers (4.8 persons) was slightly higher than the family size of semi-diversified (4.65) and diversified farmers (4.60). In both cases, the number of children (below 5 years) was relatively lower in the study area. On the other hand, Table 1 clearly indicates that only 4% to 5% people were above 55 years of old. This study also hints that the life expectancy of women was relatively higher than their male counterparts as shown in the age group of above 55 years old in both cases of marginal farmers and landless laborers. They were resource-poor, but they have got the vast potential human resources to earn money and engaging themselves from some non-farm activities.

Table 1: Family composition of sample household

Age groups (years)	Non-diversified (20)			Semi-diversified (20)			Diversified (20)		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
< 10 years	8	5	13 (13.54)	7	6	13 (13.98)	9	5	14 (15.22)
10-18	9	6	15 (15.62)	8	5	13 (13.98)	8	6	14 (15.22)
19-29	11	9	20 (20.08)	10	8	18 (19.95)	12	9	21 (22.83)
30-39	10	7	17 (17.70)	12	8	20 (21.51)	9	7	16 (17.39)
40-49	8	6	14 (14.58)	7	6	13 (13.98)	8	5	13 (14.13)
50-59	5	5	10 (9.60)	6	5	11 (11.83)	4	4	8 (8.70)
60-80	3	4	7 (7.29)	2	3	5 (3.47)	3	3	6 (6.62)
All	54	42	96 (100)	52	41	93 (100)	53	39	92 (100)
Average	2.70	2.10	4.80	2.60	2.05	4.65	2.65	1.95	4.60

Source: Household survey 2012

Education of the Households

The sample farmers are classified into five categories based on their education level. Table 2 indicates that 54.45% of the household heads are educated up to varying levels and the rest 45.55% had no education. Of the educated respondents, 51.04%non-diversified, 48.39% semi-diversified and 43.48% diversified farmers are illiterate.

Table 2: Percentage distribution of sample respondents according to education level

Education level	% of the respondent			
	Non-diversified (20)	Semi-diversified (20)	Diversified (20)	All (60)
Illiterate	51.04	48.39	43.48	47.64
Primary	22.96	21.50	22.83	22.43
Secondary	16.71	19.35	20.65	18.90
Higher secondary	8.25	9.68	10.96	9.63
Bachelor and above	1.04	1.08	2.08	1.40
Total	100	100	100	100

Source: Household survey 2012

Note: Figures within parentheses indicate percentage

Occupational Status

In the study area occupational status of the households were found to be diverse. The main sources of occupation of the respondents ranged from agriculture, service, wage labour, business and driving (Table 3).

Table 3: Occupational Status of the Household Heads

Occupation type	% of respondents		
	Non-diversified	Semi-diversified	Diversified
Agriculture	64.00	66.25	68.50
Wage labour	11.50	10.25	9.00
Driving	3.50	3.00	4.50
Service	5.50	6.50	5.50
Business	15.50	14.00	12.50

Source: Household survey 2012

Land Use Pattern

It can be seen from Table 4 that non-diversified have only homestead area of 11.84 decimals, Semi-diversified have homestead area of 12.26 decimals and Diversified have homestead area of 10.08 decimals. Non-diversified, semi-diversified and diversified were owned 38.45 decimals,36.51 decimals and 42.56 decimals of cultivable land respectively which were not enough to ensure food security of the households round the year for non-diversified and semi- diversified farmers but diversifiedfarmercultivated more than three crops and vegetable a year which can be significantly helpful to achieve food security.

Table 4: Land use pattern of the study area

Types of land	**Non-diversified (20)**	**Semi-diversified(20)**	**Diversified(20)**
Homestead area (decimal)	11.84 (16.20)	12.26 (17.43)	10.08 (13.58)
Own cultivable land (decimal)	38.45 (52.62)	36.51 (51.88)	42.56 (57.34)
a. Single cropped	38.45 (52.62)	21.34 (30.33)	10.62 (14.31)
b. Double cropped	-	9.46 (13.45)	14.56 (19.61)
c. Triple cropped	-	5.59 (7.95)	17.38 (23.41)
Cropping intensity (%)	100	135	142
Pond (decimal)	0.86 (1.18)	0.84 (1.19)	0.89 (1.19)
Rented in land (decimal)	13.68 (18.72)	12.46 (17.71)	13.25 (17.85)
Rented out land (decimal)	8.24 (11.28)	8.28 (11.77)	7.45 (10.04)
Total area (decimal)	73.07 (100)	70.35 (100)	74.23 (100)

Source: DAE office Fhulpur and Household survey, 2012. Note: Figures within parentheses indicate percentage

Table 5: Annual household productions of rice and other crops

Categories	Crops			Total
	T. Aman rice	Boro rice	Other crops	
Non-diversified (ha)				
Farm size (ha/farm)	0.105	0.298	-	0.403
Production (kg/farm)	459	1077	-	1536
Semi-diversified (ha)				
Farm size (ha/farm)	0.106	0.289	.018	.413
Production (kg/farm)	468	1021	89	1578
Diversified (ha)				
Farm size (ha/farm)	0.059	0.121	0.221	.401
Production (kg/farm)	246	518	1126	1890

Source: Household survey 2012

Crop production in homestead area

Homestead areas were found to be properly utilized by the sample household in the study areas. They were found to grow country brinjal (egg plant), ginger, potato, maize, radish, tomato, chili, bean, cucumber, and many other crops in their homestead on a small-scale. Banana, papaya and different timber trees were also planted in the homestead areas. The amount of cultivated homestead for cultivating vegetables was higher in diversified farmer than others areas (Table 5).

Profitability of diversified cultivation

Table 6 shows the annual cost incurred, quantity produced, gross return, gross margin and gross margin excluding labor cost per farm of various crops and vegetables in diversified semi-diversified and non-diversified areas. The average farm size was respectively 0.164, 0.162 and 0.168 hectare respectively under non-diversified, semi-diversified and diversified farmers.The average cost of cultivation in non-diversified farmers was Tk. 9034, in semi-diversified farmers was Tk.8727 and in diversified farmers was Tk.9135. The annual gross return in non-diversified farmers was Tk. 12490, in semi-diversified farmers was Tk.14557 and in diversified farmers was Tk.16121. The annual gross margin per household in non-diversified farmers was Tk. 3456, in semi-diversified farmers was Tk. 5830 and in diversified farmers was Tk.6986.

Table 6: Annual household incomes from diversified cultivation

(Figures in Tk. /farm)

Particulars	Non-diversified (20)	Semi-diversified (20)	Diversified (20)
Cultivated area (ha)	0.164	0.162	0.168
A. Cost of production			
1. Labour	6965	6825	7029
2. Seed	2040	1826	1968
3. Fertilizer	29	76	138
Total cost	9034	8727	9135
B. Gross return			
1. Rice	8954	5647	2143
2. Maize	-	812	-
3. Vegetables	-	5685	12436
4. Others	3536	2413	1542
Total	12490	14557	16121
C**. Gross margin(B-A)**	3456	5830	6986

Source: Household survey, 2012.

Food Security Status of Diversified Households

The picture of the extent of household food security in the study area has been presented in Table 7. 55%, 61% and 72% of households in non-diversified, semi-diversified and diversified areas were food-secure. On the other hand 45%, 39% and 28% of households in non-diversified, semi-diversified and diversified areas were food-insecure.

Relative contribution of food items to household food security

The table 8 reveals that the per capita per day intake of all the food items was much higher for food secure household compared to non-secure household. If we look at the per capita per day calorie intake scenario, we can see that more than 79.41 percent of the total daily calorie consumed by a food secured household was supplied from rice followed by vegetables (3.67%), potato (2.94%) and edible oil (3.28%). The similar results were also observed for food insecure households.

Determinants of food security

Household food security is likely to be determined by different socio-economic factors. The results of the logistic regression model as shown in Table 9 have been discussed in the following sections.

Table 7: Food security status of diversified households in Monkanda village of Fulpur

Food security Status	Percentage of households			Energy intake (kcal/capita/day)		
	Non-diversified	Semi diversified	Diversified	Non-diversified	Semi-diversified	Diversified
Food-secure	55	61	72	2446	2863	3029
Food-insecure	45	39	28	1756	1859	2046
All households	100	100	100	2066.5	2211	2529.5

Source: Household survey, 2012.

Note: Food insecure households are those with a per capita per day energy intake is <2122 Kcal.

Table 8: Contribution of food items in supply calorie for households

Items	Food insecure households			Food secured households		
	Qty. intake (gm/capita/day)	Calorie intake (kcal/capita/day)	% calorie supplied	Qty. intake (g/capita/day)	Calorie intake (kcal/capita/day)	% calorie supplied
Cereals (rice only)	525.60	1640	78.61	630.52	2296	79.41
Maize	02.76	7	00.33	03.54	12	00.42
Leafy vegetables	45.64	23	01.10	92.85	42	01.45
Other vegetables	185.25	71	03.40	29.0	106	03.67
Tomato	32.10	6	00.28	54.15	10	00.34
Potato	45.35	41	01.96	98.20	85	02.94
Pulses	05.34	19	00.91	9.54	35	01.21
Egg (no.)	00.25	1	00.04	00.20	1	00.03
Meat	16.12	22	01.05	25.50	32	01.10
Fish	41.80	60	02.87	39.70	58	02.00
Milk	11.26	7	00.33	12.56	7	00.24
Oil	11.34	98	04.69	10.24	95	03.28
Spices	28.12	49	02.34	38.12	60	02.07
Fruits	46.15	42	02.01	55.75	52	01.79
Total	997.08	2086	100	1360	2891	100

Source: Household survey 2012; Note: Per capita per day energy <2122 Kcal treated as food insecure households

Table 9: Logistic regression model predicting food security status for crop diversification

Variable	Non-diversified farmer food security (20)			Semi-diversified farmer food security (20)			Diversified farmer food security (20)		
	Coefficient /value	Std. error	Odds ratio	Coefficient /value	Std. error	Odds ratio	Coefficient/ value	Std. error	Odds ratio
Constant	-23.740	22.184	0.000	-25.46	23.620	0.000	-31.020	25.160	0.000
Household Income	.005*	0.002	1.005*	.006*	.003	1.006*	0.008*	0.003	1.008*
Input cost per season	-0.071	0.462	0.931	-0.082	0.398	0.921	-0.067	0.561	0.935
Cultivable land	0.038	0.096	1.039	0.045	0.082	1.046	0.030	0.132	1.030
Household size	-0.276	1.287	0.759	-0.249	1.542	0.779	-0.219	1.346	0.803
Household production	0.027*	0.010	1.027*	0.029*	0.011	1.029*	0.024*	0.011	1.024*
No. of cultivated crop	0.034*	0.013	1.035*	0.026*	0.009	1.026*	0.018*	0.007	1.018*
Off farm Activities	0.156	1.510	1.169	0.182	1.935	1.168	0.181	1.462	1.198

*Source: Household Survey 2012. * Significant at 1 percent level of probability and ** Significant at 5 percent level of probability.*

Household Income (X_1)

In this study higher income households were supposed to be food secured households, providing that there exists positive relationship between income level and food security. The income coefficient of 0.005 for non-diversified, 0.006 for semi-diversified and 0.008 for diversified farmer means, with other variable held constant, that if income increases by a unit, suggesting a positive relationship between household income and food security. The odds ratio 1.005, 1.006, 1.008 implies that for a unit increase in income, the odds in favor of being food secured increases about 0.5 percent, 0.6 percent and 0.7 percent.

Input cost (X_2)

A negative relationship was found between input cost and a household being food secure (Tables 9). This means that the food security decreases with the increase in input cost. According to Table 6.3, food security will be decreased by 0.071, 0.082, and 0.067 unit with the increase of one unit input cost. Odds ratio 0.931, 0.921, and 0.935 indicate that one unit increase of input cost negatively influenced the food security 7.6%, 8.9% and 7.2% to the respective three categories of farmer.

Cultivable land (X_3)

According to results reported in Table 9 and keeping the other variables in the model constant, farm size is positively related to household being food secure. Logit co-efficient of 0.038, 0.045 and 0.030 means with other variables held constant, if cultivable land increases by a unit on an average the estimated logit increases by 0.038, 0.045 and 0.030 unit. The odds ratio 1.039, 1.046, and 1.030 indicate that one unit increase of input cost negatively influenced the food security 3.6%, 4.3% and 2.9% to the respective three categories offarmer.

Household size (X_4)

A negative relationship between household size and food security is expected as food requirements increases in relation to the number of persons in a household. The household size coefficient of -0.276, 0.249 and 0.219 means, with other variables held constant, if household size increases by a unit, on an average the estimated Logit decreases by 0.276, 0.249 and 0.219 units, suggesting a negative relationship between household size and food security. The odds ratio was 0.759, 0.779 and 0.803. This means that for a unit increase in household size, the odds in favor of being food secure decreases by about 36.36%, 31.96% and 27.27%, respectively.

Table 10: Coping Strategies of the Disadvantaged People

Coping strategies	Household numbers		
	Non diversified	Sami diversified	Diversified
Bound to consume less food than required	26 (80)	24 (60)	21
Women eat less	18 (56)	11 (27)	9
Starve during the lean period (usually two months during rainy season)	5 (10)	3 (8)	2
Decrease daily meals for about two months	10 (63)	9 (22)	6
Children remained hungry	8 (36)	6 (16)	5
Sacrifice Medicare, Clothing and other necessary expenditures	20 (85)	18 (46)	15
Unable to repair house	26 (60)	24 (60)	23
Disrupt children education	5 (40)	3 (8)	3
Land mortgaged out	-	14 (36)	12
Ate inferior rice (broken rice, low quality)	25 (96)	22 (55)	20
Become financially indebted	10 (85)	7 (18)	8
Took agricultural credit from NGOs but I spent for food consumption	21	18 (45)	20

Source: Household survey 2012. Note: Figures within parentheses indicate percentage of total.

Household crop production (X_5)

Household aggregate crop production had a highly significant and positive influence on food security (Table 9). In other words, keeping the other variables in the model constant, household aggregate crop production was positively and significantly related to the household being food secure. The odds in favor of household food security will be increased by 2.6% (non-diversified), 2.8% (semi-diversified) and 2.3% (diversified) if the household aggregate production is increased one ton per year.

Number of cultivated crop (X_6)

In the crop diversity aspect for adopting a food security strategy, number of cultivated crop is an important determinant which is highly significant and positively influenced the food security status of the selected area. The co-efficient of 0.034, 0.026 and 0.018 implies that the more types of crop cultivated then the household will be more food secure. Table 9 shows that, this effect is more in case non-diversified farmer. The odds ratio 1.035, 1.026 and 1.018 indicate that in favor of household food security will be increased by 3.1% (non-diversified), 2.5% (semi-diversified) and 1.8% (diversified) for the cultivation of another new crop.

Involvement in off-farm activities (X_7)

Table 9 shows that yearly off-farm income had a positive and highly significant relationship with the probability of food security.

Coping Strategies

One of the objectives of the present study was to identify how the disadvantaged people tackle the price hike situation. According to respondents' perception most common twelve coping strategies of the concerned disadvantaged people were indicated, which are presented in Table 10.

PROBLEMS AND POSSIBLE SOLUTIONS

Each CDP crops experiences a different set of problems. However, some of the common constraints for promotion of crop diversification and percentage of respondent are summarized in table 11.

The following suggestions are put forward to overcome the above-mentioned problems of the disadvantaged people. Crop diversified farmer were asked to suggest solution to the above mentioned problems. They pointed some suggestions to solve the constraints, which are given below:

i. A provision could be made immediately to provide corruption-free institutional credit at a reasonable rate of interest to these marginal farmers and landless labourers;
ii. Some sorts of vocational training programme could be chalked out to provide training to these unskilled disadvantaged people so that they can have a skill to earn money by engaging themselves in various industrial and/or non-farm activities in urban industrial and commercial areas either at home or abroad;
iii. Marketing facilities (for example, roads and communication) should be improved without any further delay so that they can have fair prices of their products;
iv. A huge subsidy should be given to the major inputs of crop production and making nets for the fishermen;
v. The government should take some positive steps for ensuring easy availability of inputs at reasonable prices at the door steps of the disadvantaged people;
vi. A special programme like food for education should be expanded for the children (both male and female) of all landless labourers and/or disadvantaged people of rural Bangladesh; and
vii. Diversified cropping patterns could be followed taking into account judicious uses of groundwater in the study area. Nevertheless, a long-term comprehensive plan from the viewpoint of society should be chalked out for making better future of all people of Bangladesh.

Table 11: Problem Faced by marginal non-diversified, semi-diversified and diversified farmers

Problems	Percentage of respondents			Overall percentage
	Non diversified	Semi diversified	Diversified	
Non-availability of suitable land	75	85	80	80
Non-availability of water and technologies	90	75	85	83.33
Low adoption rate of new varieties	95	70	65	76.66
Imports as disincentives to diversification	90	85	60	78.33
Existing marketing system as detrimental to diversification	85	80	65	76.66

Source: Household Survey 2012

CONCLUSION

From the major findings of the study, it could be concluded that crop diversification has a significant impact on food security. However, the probability of being food secure of a household is increased with the crop diversified farming practices. A considerable scope apparently exists to increase crop diversification programme thus, to ensure food security of the vast majority people of Bangladesh. The introduction of CDP in the agriculture sector has created awareness among the farmers to grow and consume a variety of crops like pulses, oilseeds, vegetables, fruits, spices, etc. Certain pulses such as chickpea, field pea, mungbean and lentil produce reasonably good yields with better management including irrigation, fertilization and weed control. The profit gained from these crops is higher than that of HYV rice and wheat. The farmers' awareness about the production of vegetables in recent years is better than in the past because of the provision of promotional support to produce more vegetables. From the econometric results, it is depicted that crop diversification or mixed cropping systems have high potentials to reduce the food-insecurity for the rural farming households in Bangladesh. There are ample opportunities to mitigate food-insecurity, by crop diversification which can balance the production of major crops with that of minor crops. In this way, the agriculturists recuperate the food-insecurity and reduce the vulnerability.

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