Original Article

Impact of Farm Diversification on Income and Expenditure of Small Scale Farm Households in Rangpur District of Bangladesh

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A B S T R A C T

Farm production diversification has the potential to broaden and strengthen the sources of farm and non-farm incomes of rural households. This study intends to estimate the impact of farm diversification on income and expenditure of smallholder farm households. A total sample of 100 farmers were randomly selected from the three villages namely South Panapukur, Gaghottari and Betgari under Gangachara upazila of Rangpur district in Bangladesh. Both tabular and quantitative analyses were done to achieve the major objectives of the study. The findings show that the socioeconomic characteristics, cropping pattern, land type, soil type of Gangachara upazila are suitable for farm diversification. From 100 farmers about 55 percent farmers practiced 11-16 numbers of crops, vegetables, livestock and fish. Smallholder farm households were also involved in both farm and non-farm activities which were 71 percent of farm households. Average annual income from farm and non-farm activities were Tk. 75150.00 and Tk. 23350.00 respectively. Average annual expenditure on farm and non-farm practices was Tk. 43000.00 and Tk. 12000.00, respectively. In the present findings, the average annual expenditure on food and non-food items was Tk. 41000.00 per family. The Poisson regression was run to predict the determinants of farm diversification in the last 12 months where soil type, farm size and employment member of family were statistically significant at one percent level of significance and education was statistically significant at five percent level of significance. The Multiple regressions were done to estimate the impact of farm diversification on income and expenditure where farm size and combination of farm and non-farm practices were statistically significant at one percent probability level. But all the explanatory variables included in the model were not statistically significant as were generally expected. Farmers faced different problems and constraints in diversifying farm. In spite of the entire problems, this study has thrown light on some important issues regarding farm diversification of the study areas. Overall results indicate that rather than farm diversifications, diversification of income from farm to non-farm sources positively and significantly affect the household income and expenditure.

Introduction

Agriculture sector plays an important role in overall economic development of Bangladesh. This sector (crops, animal farming, forests and fishing) contributes 14.74 percent to the country's GDP (MoF, 2017). The agro-climatic conditions of Bangladesh are suitable for the cultivation of a wide variety of crops. An average farm in Bangladesh does not grow only crops or raise animals. Here usually cattle provide draft power, manure, milk, meat and hides. Similarly poultry and goat utilize the crop by-products and provide food and cash income to the farmers. The homestead area contributes to the farm productivity by producing vegetables, spices, timber, fuel, wood, etc. and providing workspace for processing and

storing crops and crop by-products. Some- farm families have access to small ponds which are used for raising fish and ducks simultaneously. The performances of these sectors have great impact on macroeconomic situation like employment generation, poverty alleviation, food security and nutritional attainment, etc.

Farm diversification towards products with a higher value-added contributes to more rapid agricultural income growth and employment. The rapid growth in domestic demand for fruits, vegetables, dairy products, fats and oils is also creating new opportunities for diversification of agricultural production beyond cereals (Asmah, 2011). Rural non-farm activities have become an essential component of livelihood strategies among rural households. The reasons for this observed income diversification include declining farm incomes and desire to insure against agricultural production risk. Household are pulled into the rural non-farm activities when returns from non-farm employment are higher and less risky than those in agriculture (Abdulai and Delgado, 1999). The economy of rural areas in developing country is predominantly based on agriculture and other activities related to agriculture sector. Farm diversification is intended to give a greater choice in the production of a variety of crops, livestock and fisheries in a given area so as to extend production related activities and also to reduce risk (Asmah, 2011). From the very beginning of Bangladesh, agriculture sector is characterized by some cropping patterns of which cultivation of rice is the most important one. The dominant food crop of Bangladesh is rice, accounting for about 75 percent of agricultural land use and nearly 70 percent of gross farm income (BBS, 2017). In order to reduce dependence on rice, crop diversification programs were launched in the country from late eighties.

Besides this, the premises of houses, tin sheds and roof tops are used for vegetable cultivation. In some areas vegetables are also cultivated on floating systems (Joshi, 2005). Bangladesh is considered as one of the most suitable regions for fisheries in the world with the world's largest flooded wetland and the third largest aquatic biodiversity in Asia after China and India. Almost all households have ponds or ditches where fishes are cultivated. Besides, Livestock is an integral component of the complex farming system in Bangladesh as it not only a source of meat protein but also a major source of farm power services as well as employment. The livestock sub-sector provides full time employment for 20 percent of total population and part-time employment for another 50 percent (BBS, 2017). Farm diversification is fundamentally the attempt to enlarge the range of agricultural crops and products. The intention of rural households pursuing strategies of diversification is to broaden and strengthen their sources of farm and non-farm incomes (Lanjouw and Sharrif, 2004). While so many linkage effects of farm diversification are obvious, little attempts have been made to examine the nature and magnitude of these effects in relation to different farming systems practiced by socioeconomic classes of households in different location of the country. Thus in Bangladesh the common farming systems are diversified farm based rather than single farm based. Farm diversification has attained increased importance in the country. It is, however, maintained that there are ample scopes of diversification of agricultural activities along livestock, fishery and other homestead agricultural activities. Hence, the economic situation and the standard of living of the households cannot be fully described by only on-farm income (Castagnini *et al.*, 2004).

Therefore, rural households are diversified their livelihood from single occupation (farming) to multiple occupation. Rural non-farm sector is one of the major sources of these multiple occupation In rural Bangladesh context, only a few recent studies Rahman (1999), Hossain (2005), Nargis and Hossain (2006) and Khan *et al.* (2012) conducted so far shed light on poverty and inequality based on relatively small sample size and farm diversification. But neither study contributed comprehensively on the effects of diversified farm on income and expenditure in rural household of northwest Bangladesh. Considering the above perspective, this study examined the forms and pattern of farm diversification and determinants and factors of changes that have been taking place in the organization of farms in terms of combination of crops grown and how farm and non-farm activities are integrated in a synergistic manner to yield greater benefit to the farm households and rural community as a whole. Moreover, the impact of farm diversification on income and expenditure of smallholder farm households was also examined in the present study.

2. Materials and Methods
2.1 Location of the study area
Gangachara upazila of Rangpur district was selected randomly from the 7 upazila of Rangpur district and a preliminary survey was conducted in some villages of the selected upazila to gather primary knowledge about the concentration of farm and non-farms considered in this study.

2.2 Selection of respondents and sample size
The selected sample farmers are located in three villages namely South Panapukur, Gaghottari and Betgari under Gangachara upazila of Rangpur district respectively. The sample frame was prepared for small scale farmers according to their own land cultivation. The small farmers who had owing land from 0.5 to 2.50 acres (i.e. 0.21 to 1.01 hectares) were selected for this study. Through purposive sampling 100 small scales farm households were selected for the study.

2.3 Data collection
Considering the objectives of the study, primary data were collected from the studied areas from selected sample farmers through face-to-face interview based on prepared questionnaires from April to July, 2018. Data were collected in local units and later converted into standard units. Secondary data and information having relevance with this study were also collected.

2.4 Analytical techniques
Data were analyzed with the purpose of achieving the objectives of the study. In the present study some functional analysis was also used to reveal the quantitative relationships among the selected variables. In analyzing data the both tabular and statistical techniques were used.

2.4.1 Tabular form
After collecting information, the filled up schedule were scrutinized and checked to avoid irrelevant information. The collected data were edited, coded and finally tabulated according to objectives of the study. Tabulated data were analyzed and condensed by using average, percentage and ratio by Statistical Package for Social Science (SPSS). In the present study statistical techniques were used as a

supplement to the tabular technique.

2.4.2 Poisson regression function model

A Poisson regression was run to predict the determinants of farm diversification in the last 12 months based on soil type (clayey to loamy soil type), farm size, education and employment member of family. Farm diversification was used as count variable and soil type, farm size, education and employment member of family were considered as independent variables in the following model.

$$FD_i = a_0 + B_iX_i$$

Where,

Xi, i = 1,2,3,4;
X_1 = soil type;
X_2 = farm size;
X_3 = education;
X_4 = employment member of family; and
FD = farm diversification.

2.4.3 Multiple regression function model

The multiple regression function model was chosen to estimate the impact farm diversification on income and expenditure of farm households.

The multiple regression function model had the following characteristics:

i. Total variations in the output explained by the selected inputs are measured by co-efficient of multiple determination (R^2); and

ii. For testing the significance level of individual co-efficient having sufficient degrees of freedom, 1 percent, 5 percent and 10 percent probabilities are used.

Having made some reasonable assumptions, a generalized multiple regression analysis was carried with the help of some selected variables as follows:

$$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \varepsilon$$

Where,

Y_1 = household annual income (Tk.);
Y_2 = household annual household expenditure (Tk.);
β_0 = constant or intercept value;
X_1 = farm diversification (unit);
X_2 = farm size (area/ha);
X_3 = family size;
X_4 = employment member of family;
X_5 = combination of farm and non-farm practices (unit);
ε = random error; and

β_1, β_2, β_3.... β_5 = coefficients of the respective input to be estimated.

3. Results and Discussion

3.1 Socio-economic characteristics of the sample farmers

It was evident from the study that the socioeconomic characteristics of the selected farmers were not very different from the farmers of others part of the country. The description of the socioeconomic characteristics of the sample farmers are presented in Table 1. The highest number of farmers (42%) were belongs to the category of 40.01-55.00 years. Most of the family members (46%) were educated and also belongs secondary education, 16 percent had higher secondary and above degrees education. The study revealed that only 12% of the respondents were illiterate. About 80% of the small farmers sampled had access to credit. It was also depicted that most of the smallholder farm household involved in both farm and non-farm practice which was 71% in sample farmer. These

findings are supported by Joshi (2005) and Eboh (2000) stated that the rural credit is a temporary substitute for personal savings which catalyses "farm activities" and "non-farm activities". Lanjouw and Shariff (2004) identified that education improved the prospects of non-farm employment which supports the present findings.

Table 1. Socio-economic characteristics of the sample farmers in the studied areas.

Parameters	Category	Number of farmers	Percentage of respondents
Age group (years)	20.01-40.00	27	27.00
	40.01-55.00	42	42.00
	Above 55.00	31	31.00
	Total	**100**	**100.00**
Educational Status of the Farmers	Illiterate	12	12.00
	Primary	26	26.00
	Secondary	46	46.00
	Higher Secondary and above	16	16.00
	Total	**100**	**100.00**
Access to credit	Yes	80	80.00
	No	20	20.00
	Total	**100**	**100.00**
Farm and non-farm practiced by households	Both farm and non-farm practice	71	71.00
	Farm practice	29	29.00
	Total	**100**	**100.00**

The average numbers of persons per family of small farmers were presented in categories on the basis of their age in Table 2. Highest number of the family members (46.15%) were belongs to the category of 15.01-55 years. Family member below 10 years were 6.99 percent, age category of 10.01-15.00 years were 10.49 percent, age category of 15.01-55.00 years were 46.15 percent and age category above 55.00 were 36.37 percent. In the study area family size was defined as total number of persons living together and having meals in the same kitchen under the administration of one head of the family. Lagerkvist *et al.* (2006) also found that farm size, family size and farm capital had great impact on the farm and off-farm incomes. From the above discussion it is clear that there were some variations in socioeconomic characteristics of smallholder farmers. But the magnitude of the variations was not large. There are substantial indications suggesting that farm diversification was progressive.

Table 2. Distribution of family members by age groups.

Age group (years)	Number of family members	Percentage (%)
Below 10 years	30	6.99
10.01-15.00 years	45	10.49
15.01-55.00 years	198	46.15
Above 55.00 years	156	36.37
Total	**429**	**100**

3.2 Forms and patterns of farm diversification
3.2.1 Cropping pattern and intensity of farm households

Cropping pattern is a temporary arrangement of crops grown on a plot in one cropping year, i.e. raising crop varieties on a given field during a 12 month period in a year. Cropping pattern in a given field is determined by the physical, biological and socio economic factor. The average land

holdings of farm households are presented in Table 3 where 63.38 percent belongs to own cultivable land or crop land to the farmers. Table 4 showed that areas under rice, wheat, oilseed and vegetables cultivation in small farms were 0.72 ha, 0.05 ha, 0.04 ha, and 0.08 ha respectively. Boro paddy was the highest cropped area. Similarly rice, wheat, oilseed and vegetables occupied 80.90 percent, 5.62 percent, 4.49 percent and 8.99 percent of total cropped respectively. The average cropping intensity in percentage term was 125. Cropping intensity is defined as the ratio of total cropped area to net cultivated area. It indicates the extent to which the same area of land is used for crop production within a cropping year. Similar reports were observed by Zaman *et al.* (2017) on crop diversification and cropping patterns in rangpur region. Makate *et al.* (2016) and Nasim *et al.* (2017) also supports that crops, cropping patterns and diversification impacts in rural Zimbabwe and Bangladesh, respectively. Net cultivated area means the actual physical area of land used for raising different crops in a year (Igwe, 2013).

Table 3. Average land holdings of farm households.

Land holdings	Average area (ha)	Percentage (%)
Homestead area	0.10	14.09
Crop Land/own cultivable land	0.45	63.38
Orchard	0.05	7.04
Pond/ditch	0.08	11.26
Others	0.03	4.23
Total land	**0.71**	**100**

Table 4. Cropping pattern of farm households in the studied areas.

Crop	Area (ha)	Percentage (%) of total cropped area
Rice	0.72	80.90
Wheat	0.05	5.62
Oilseed	0.04	4.49
Vegetables	0.08	8.99
Total cropped area	**0.89**	**100.00**
Net cultivated area	0.71	
Cropping intensity (%)	125	

Note:

1. Cropping intensity $= \dfrac{\text{Total cropped area}}{\text{Net cultivated area}} \times 100$

2. Net cultivated area is the actual physical area of land used for raising different crops in a year.

3. Total cropped area is the aggregate area of land actually cropped during one year.

3.2.2 Farm diversification practiced by sample farmers

Farm diversification was divided into four categories which measured the total number of various crops and vegetables, variety of fish, different type of livestock/poultry and variety of fruits, wood were produced in a year. Table 5 shows from 100 farmers about 25 percent, 55 percent, 20 percent farmers practiced 6-10, 11-15, 16-20 numbers of crops, livestock and fish, respectively. It was found that the highest number of farmers (55 percent) practiced 11-15 numbers of crops, livestock and fish. These results were supported by Demeke *et al.* (2017) dealt with new empirical evidence on the nexus between farm production diversification and household diet diversity in East Africa.

Table 5. Farm diversification practiced by sample farmers.

Farm diversification (number of crops, livestock, fish grown)	Number of farmers	Percentage of respondents
6-10 types	25	25.00
11-15 types	55	55.00
16-20 types	20	20.00
Total	**100**	**100.00**

3.2.3 Annual income and expenditure of farm households

The average annual income of sample farmers on farm and non-farm activities shown in Table 6. In farm practices, the highest annual income of households (Tk. 55250.00) gained from crop and the corresponding figures for livestock, poultry, fish and vegetables were Tk. 10600.00, Tk. 3750.00, Tk. 3500.00 and Tk. 2050.00 respectively which were 21.29 percent, 9.74 percent, 7.89 percent and 2.49 percent respectively of total farm income. Moreover, in the studied area, the annual income from service/labor selling was Tk. 8150.00 per year, 34.89 percent of total non-farm income which was the highest and the corresponding figures for business and self-employment were Tk. 5100.00 and Tk. 7000.00 respectively per year and 21.82 percent and 29.29 percent of total non-farm income respectively. The economic situation and the standard of living of the households could be fully described by both farm non-farm income. The present findings were supported by Castagnini *et al.* (2004). The non-farm livelihood diversification and poverty reduction was observed in Nigeria by Igwe (2013) which also supports the present reports.

Table 6. Average annual income from farm and non-farm activities.

Parameters	Source of Income	Average annual income of farmers (Tk.)	Percentage (%)
Income from farm activities	Crop	55250.00	58.59
	Livestock	10600.00	21.29
	Poultry	3750.00	9.74
	Fish	3500.00	7.89
	Vegetables	2050.00	2.49
	Total	**75150.00**	**100.00**
Non-farm activities	Service/Labor selling	8150.00	34.89
	Self-employment	5100.00	21.82
	Business	7000.00	29.29
	Total	**23350.00**	**100.00**

Table 7 represents the average annual expenditure of households on farm and non-farm practices. Average annual expenditure for crop cultivation was the highest (Tk. 33500.00) which was 55.58 percent of farm expenditure; corresponding figures for livestock, poultry, fish and vegetables were Tk. 3000.00, Tk. 1500.00, Tk. 2500.00 and Tk. 1500.00 respectively per year as well as 7.59 percent, 3.26 percent, 4.52 percent and 3.23 percent respectively of farm expenditure. On the other hand, Table 8 shows the expenditure on food and non-food items, durable assets of farm households. Most of the households have expenditure on food, clothing, health and festivals, ceremonies, marriage. Among them annual expenditure on food was Tk. 23000.00 which was the highest and 49.83 percent of money spent on food. Almost similar results were reported by HIES (2010) in

Bangladesh. Escobal (2001) and Sisay (2010) also reported that income diversification and off-farm activities have a potential to reduce poverty and income inequality as it was relatively beneficial to poorer households.

Table 7. Average annual expenditure on farm and non-farm practices.

Items	Average annual expenditure (Tk.)	Percentage (%)
Farm practices	**43000.00**	**75.18**
Crop (i.e. rice, wheat, oilseed)	33500.00	55.84
Livestock	3000.00	7.59
Poultry	1500.00	3.26
Fish	2500.00	4.52
Vegetables	1500.00	3.23
Homestead	1000.00	1.74
Non-farm practices	**12000.00**	**23.82**
Self-employment	5000.00	10.66
Business	7000.00	13.16
Total	**55000.00**	**100**

Table 8. Average annual expenditure on food and non-food items.

Items	Annual Expenditures (Tk.)	Percentage (%)
Food	23000.00	49.83
Clothing	2000.00	9.54
Education	5500.00	19.82
Health	1550.00	3.03
House repair/building	1050.00	5.77
Loan Repayment	2500.00	4.03
Fuel (Firewood, gas, charcoal, kerosene etc.)	1000.00	2.75
Furniture purchase	1500.00	3.08
Festivals, ceremonies, marriage	1000.00	2.14
Total Expenditure	**41000.00**	**100**

3.2.4 Relationship between farm diversification with household income and employment member of family

A relationship between farm diversification with household income of the farm households was found in the data set. Farm diversification was divided into four groups. It was seen from Table 9 that household income was the highest (Tk. 54175.00) for farms which practiced 11-15 number of crops, livestock and fishery and lowest (Tk. 19700.00) for those practicing 16-20 number of crops, livestock and fishery. A reliable relationship between farm diversification with employment member of family was found in the data set (Table 10). Number of employment member was 101 which was 61.63 percent and the highest in practicing 11-15 number of crops, livestock and fishery. On the basis of above discussion it could cautiously be concluded that farm diversification refers to an increase in number of sources of income or the balance among the different sources. These results supported by Asmah (2011) who examined the rural livelihood diversification and household welfare in Ghana. Igwe (2013) also reported the impact and relation of farm diversification with household income and employment in the rural villages in Nigeria.

Table 9. Relationship between farm diversification with household income of farm households.

Farm diversification (number of crops, livestock, fish grown)	Number of farmers	Average household income (Tk.)	Percentage (%)
6-10	25	24627.00	25.00
11-15	55	54175.00	55.00
16-20	20	19700.00	20.00
Total	**100**	**98500.00**	**100.00**

Table 10. Relationship between farm diversification with employment member of family.

| Farm diversification (number of crops, livestock, fish grown) | Employment member of family | | | Total (*) | Percentage (%) |
	1 Person	2 Person	3 Person		
6-10	18	14	0	32	19.97
11-15	16	64	21	101	61.63
16-20	10	20	0	30	18.40
Total	**44**	**98**	**21**	**163**	**100.00**

* Sum of the total is not equal to sample size since one household have 2 or 3 employed person.

3.3 Determinants of farm diversification: Coefficient and related statistics of Poisson Regression analysis for sample farmers

The estimated values of co-efficient and related statistics of Poisson regression analysis of sample farmers were presented in Table 11. It was found that the coefficient of clayey to loamy soil type was negative and statistically significant at one percent level of significance. An additional increase in clayey to loamy soil would decrease farm diversification by 32.5 percent; where, an additional increase in farm size would increase farm diversification by 10.6 percent. An additional increase in education would increase farm diversification by 1.9 percent which was statistically significant at five percent level of significance. On the other hand, an additional increase in employment member of family would decrease farm diversification by 7.3 percent. It was also found that LR chi^2 was statistically significant at one percent level of significance which indicates goodness of fit of the model.

Table 11. Estimated value of co-efficient and related statistics for Poisson Regression model for the sample farmers.

Variables	Coefficient	Standard Error
Clayey to loamy soil (=1 otherwise 0)	-0.325***	0.1109
Farm size	0.106***	0.0032
Education	0.019**	0.0068
Employment member of family	-0.073***	0.0367
Constant/Intercept	2.270	0.1123
Number of observation	100***	
LR chi^2 (4)	24.502***	
Log likelihood	-218.382	
Pseudo R^2	0.054	

*** = Significant at 1% level   ** = Significant at 5% level
*= Significant at 10% level

From the estimated value of the regression function model, it was suggested that the overall performances of the model for

farm diversification were good as indicated by likelihood ratio chi-square (LR chi^2). Soil type, farm size, education and employment member of family were statistically significant at one percent level of significance and education was statistically significant at five percent level of significance. So the farmers of the study area had scope to attain farm diversification. Beyene (2008) and Malek *et al.* (2009) also took similiar attempts to analyzed the determinants of farm diversifiaction and found significant effect on farm size and education level. The present findings also supported by Bartolini *et al.* (2014) and Awoniyi and Salman (2011) also investigated determinants and motivations of on-farm income diversification using regression analysis.

3.4 Impact of farm diversification on income and expenditure of households

From the estimated values of co-efficient and related statistics of multiple regressions function for household annual income of sample farmers are shown in Table 12. The study revealed that the regression coefficient of farm diversification (X_1), farm size (X_2), family size (X_3), combination of farm and non-farm practices (X_5) were positive where X_1 and X_3 were insignificant but X_2 and X_5 were statistically significant at one percent probability level. Contrary, regression coefficient of Employment member of family (X_4) was found with negative sign which implies that one unit increase in keeping other factors constant, would lead to a decrease by 0.20 units for household annual income. It was also determined that the value of the coefficient of multiple determination R^2 and adjusted R^2 were 0.755 and 0.741 respectively for household annual income of sample farmers indicates that about 75.5 percent and 74.1 percent of the variations of income were explained by percent included in the model. The F-value was 57.90 that are statistically significant at one percent probability level, which implies good fit of the model.

Table 12. Estimated values of co-efficient and related statistics of Multiple Regression function for household annual income of sample farmers.

Explanatory variables	Values of Coefficients	t-value
Farm diversification (X_1)	0.113	1.278
Farm size (X_2)	0.631***	7.224
Family size (X_3)	0.051	0.750
Employment member of family (X_4)	-0.20	-0.336
Combination of farm and non-farm practices (X_5)	0.364***	6.094
R^2	0.755	
R^2 (Adjusted)	0.741	
F-value	57.90***	

*** = Significant at 1% level ** = Significant at 5% level
* = Significant at 10% level

It was also found from Table 13 that the co-efficient and related statistics of multiple regression function for household annual expenditure of sample farmers that regression coefficient of farm diversification (X_1), farm size (X_2), family size (X_3), combination of farm and non-farm practices (X_5) were positive where X_1 and X_3 were insignificant but X_2 and X_5 were statistically significant at one percent probability level. Remaining other factors constant, an increase in one unit of X_1, X_2, X_3 and X_5 would lead to an increase by 0.122, 0.648, 0.031 and 0.288 units for

household annual expenditure respectively. Contrary, regression coefficient of Employment member of family (X_4) was found with negative sign which implies that keeping other factors constant, one unit increase in would lead to a decrease by 0.063 units for household annual expenditure. The value of the coefficient of multiple determination R^2 and adjusted R^2 were 0.715, 0.698 respectively for household annual expenditure of sample farmers indicates that about 71.5 percent and 69.8 percent of the variations of expenditure were explained percent by the explanatory variables included in the model. The F-value was 47.208 that are statistically significant at one percent probability level, which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining the household annual expenditure.

Table 13. Estimated values of co-efficient and related statistics of Multiple Regression function for household annual expenditure of sample farmers.

Explanatory variables	Values of coefficients	t-value
Farm diversification (X_1)	0.122	1.282
Farm size (X_2)	0.648***	6.887
Family size (X_3)	0.031	0.422
Employment member of family (X_4)	-0.063	-0.962
Combination of farm and non-farm practices (X_5)	0.288***	4.469
R^2	0.715	
R^2 (adjusted)	0.698	
F-value	47.208***	

*** = Significant at 1% level ** = Significant at 5% level
* = Significant at 10% level

Multiple regression model was specified to determine the impact of some socioeconomic attributes on household annual income and household annual expenditure. From the estimated value of the regression function model, it was suggested that the overall performances of the model for income and expenditure were good as indicated by estimated R^2 and F- value. But all the explanatory variables included in the model were not statistically significant as were generally expected. Only farm size and combination of farm and non-farm practices are significant at one percent probability level. Olugbire *et al.* (2011) and Oluwatayo (2009) investigated the determinants and impact of non-farm employment on household income and poverty which were supported by the present findings. Senadza (2011) and Lagerkvist *et al.* (2006) found similar results on impact of farm diversification on income and expenditure of rural households.

3.5 Problems and constraints of farm diversification

The present study identified some problems and constraints which were faced by the selected farmers. For the sake of analytical convenience, the problems and constraints were classified into two general groups such as a) Economic and technical problems; and b) Social problems were shown in Table 14. Non-availability of quality seed or planting material was reported as a main problem was faced by 85 percent small farmers. It was also reported that 76 percent small farmers were faced the inadequate and/or non-availability of farm credit was second highest respectively. Most of the farmers adopt traditional methods of cultivation and lack of scientific knowledge of cultivation was one of the major constraints. The study reveals that this type of

problem was faced by more than 80 percent of the farmers. Beyene (2008) also took similar attempts for identifying some problems and constraints to improve their economic conditions of rural population and enhance food security.

Table 14. Problems and constraints in farm diversification.

Problems and constraints	No. of respondents	Percentage (%)
A. Economic and technical problems		
Non-availability of quality seed/ planting material	85	85
High cost of inputs like seeds, fertilizers, pesticides	70	70
Smaller and fragmented land holdings	65	65
High incidence of pest and diseases	60	60
Scarcity of farm labor (higher wage rates)	55	55
Inadequate and/or non-availability of farm credit	76	76
B. Social problems		
lack of scientific knowledge of cultivation	80	80
Lack of animal health care	90	90
Lack of knowledge about scientific management of livestock	72	72
Lack of knowledge about balance feeding	35	35

4. Conclusion and Recommendations

It was clearly found that the diversification of farm plays a vital role in providing nutrition, extra income, employment and the poverty alleviation in selected areas of Rangpur district. Considering all the parameters and analytical model, it is also evident that farm diversification significantly improved income from agricultural activities (various crops and vegetables, variety of fish, different types of livestock/poultry, etc.) alongside with both farm and non-farm activities. A reliable relationship between farm diversification with employment member of family was found in the data set. Therefore, more research should be done to assess whether farm diversification or income diversification is important for increasing household income and expenditure in Bangladesh. A broad – based further study could be taken up with different farm sizes (i.e. small, medium and large scales) to assess the impacts of the farm diversification on income generation and employment opportunities.

5. Conflict of Interest

None to declare

6. References

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