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Factors Affecting Extent of Haor Livelihood Diversification in Sunamganj District, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JUA supervised and edited the work. Author KF reviewed the analysis and all drafts of the manuscript. Author TD managed the literature searches. Author KA managed the analyses and reviewed the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The present study aims to examine the contribution of fishing in total income and extent of*haor* livelihood diversification; and identify the factors affecting *haor*livelihood diversification of the fishing community.

This study was conducted in *Dekhar Haor* of Sunamganj district. The data were collected from primary sources by using Simple random sampling from 100 respondents. Tobit model was used to determine the factors affecting the livelihood diversification. Fishing contributed highest to the household income. The estimated Simpson Index showed that fishermen have diversified their livelihood activities at medium level. The results showed that age of the respondents, years of

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schooling, access to credit and savings had positive effect, while, mode of land ownership, distance from the nearest market and value of household's assets had negative effects on livelihood diversification. Non-farm employment opportunities should be expanded to increase*haor* livelihood diversification.

Keywords: Livelihood diversification; fishing community; household income.

1. INTRODUCTION

Bangladesh is a small country in South Asia with the total area of 147,570 square kilometers. The economy of Bangladesh is mostly agricultural driven around 42.7% of our labor forces are involved in agriculture and therefore it is natural that most of the people of our country live in rural areas. [1] Bangladesh, located in the tropical climate zone has extensive floodplains/wetlands which are important source of livelihoods and nutrition for millions of rural Bangladesh's poor people and fishermen who are primarily dependent on these wetlands for their livelihoods [2]. To the north eastern part of Bangladesh, there exists a marsh land named *HAOR* covering 858460 ha of land [3]. It is a marshy land ecosystem in the north eastern part of Bangladesh which physically is a bowl or saucer shaped depression that looks like inland seas during the monsoon floods. [4]

The *Haor* Basin is subject to very weird conditions and suffers from widespread annual flooding. They has very limited access to land and fishing ground. Mainly one crop i.e. B*oro*rice is grown. This makes fisherman communities livelihoods extremely vulnerable in this region. For this reason, the *haors* are known as an area of severe poverty of which the flood prone areas of the Sylhet*haor*basin can be mentioned. As a result fishermen communities live hand to mouth and considered as the poorest among the poor. Most of the fishermen are deprived of many amenities. All the times they have to struggle to survive. These factors lead to the diversification process in *Haor* area. It is a strategy that involves the attempt by individuals and households to find new ways to raise income and reduce environmental risk, which differs sharply by the degree of freedom of choice (to diversify or not), and the reversibility of the outcome. [5]

Livelihood diversification refers to a continuous process by which households or rural poor's include new activities in their existing activities or jump down to others in order to maintain diverse and changing livelihood activities. Usually people diversify their livelihoods into a variety of activities and different source of income to improve their standard of living. This variety of income sources can be categorized into 'farm activities' (rice crop, non rice crop, non crop agriculture), 'non-farm activities' (nonagricultural activities, as for example remittance and business income), and 'off-farm activities' (agriculture labor). [6]

Study was focused on Sunamganj district of Bangladesh as Sunamganj is a Haor area. In Sunamganj district there are about 24 Haor. It is a major source of freshwater fish. Sunamganj has more Haors than any other district in Bangladesh among them *DekharHaor* is most important. The major economic sector of income and livelihood in this Haor area are fishing and agriculture. But the peculiar early flashfloods often wash away the standing crops and people lose their harvest. The water bodies are leased by government to rich people, resulting poor people have no access to natural resources [7]. For this reason *Haor* people are now changing their livelihoods activities from farming to off-farming and non farming activities. They are also migrating from Haor areas to other areas including urban areas also to abroad as foreign workers. Over few years it has been seen that there are significant changes in the earning sources of income as well as livelihood patterns especially in Haor areas of Bangladesh. But the scenario of livelihood diversification is not same in all the regions of Bangladesh. [8]

The scenario of livelihood diversification in Haor area are different from other region and its consequences on Haor development are immense. But in Bangladesh studies on livelihood diversification is also limitedly done. Only few researches have been conducted in Haor areas that are either on farm income or nonfarm income diversification and their socio-economic condition [9]. A study also conducted for exploring the factors that are affecting rural livelihood diversification of poor people in four rice based areas but not on Haor areas [10]. Therefore it is very important and helpful to assess the extent of livelihood diversification in Haor areas of Bangladesh and determine the

factors that are affecting the extent of livelihood diversification.

The objectives of this study are to (a) examine the contribution of fishing in total income and extent of Haor livelihood diversification; and (b) identify the factors affecting Haor livelihood diversification of the fishing community.

2. MATERIALS AND METHODS

2.1 Data Source and Sampling Design

The study was conducted in DakshinSunamganjUpazila of Sunamganj district. There are 8 unions in this upazila among them Joykolsh union was purposively selected for this study. Total 100 fishermen were selected using simple random sampling from three villages namely Noagoan, Rabbanigor, and Kaikkar par village respectively. A semi-structured and pre-tested questionnaire was used to collect primary data from the respondents through face to face interview during the period from January 2018 to march 2018. Data were analyzed by Statistical Package for Social Science (SPSS) and STATA software.

For any society income is the most important determinant of livelihood [11]. This study used households' net income as household's income that is obtained by the difference between total returns and total cost. Because it is considered that the share of income from different sources was the basis to assess household's livelihood diversification their sources of income were grouped into -rice crop (income from rice cultivation), non-rice crops (income from all other crops except rice), non-crop agriculture (income from fishery and livestock), agricultural laborer (income received by working in agricultural farm as daily or monthly wage basis), non-agricultural laborer (income received from non-agricultural sector as daily wage basis), transportation (income from any transportation that rented to others), business and caste occupation (income from different business or family business and trade), salaried job and services (income from government or private job and services as monthly salaries), remittance income (received from household members presently living outside the household: both domestic and abroad) and transfer payment (one-way payment both in cash and in kinds received under different government and non-government programs).

2.2 Analytical Technique

Descriptive statistics, inferential statistics were applied to determine the household income from different sources. To find the share of various income sources and the extent of livelihood Diversification tabular analysis was done. Tobit regression model was employed to determine the factors affecting the extent of livelihood diversification.

2.2.1 Contribution of fishing in total income and extent of livelihood diversification

To determine the contribution of fishing among household income net income was calculated by the difference between total returns and total cost. The most common measure of income diversification used in several studies is the vector of income share associated with the different income sources. There are various indicators and indices to measure livelihood diversification like number of income sources and their share, Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index etc. [12]. In this study Simpson index were used because it is easy to compute and it has been widely applicable. The formula of Simpson index [13] is:

$$SDI = 1 - \sum_{1}^{n} P_i^2$$

Where, n = Total number of income sources and P_i = Income proportion of the i-th income source. Its value lies between 0 and 1. If there is just one source of income, P_i =1, so SDI = 0. The upper limit for SDI is 1 which depends on the number of income sources available and their relative shares on total household income. The number of income sources as well as its distribution between different sources affects the Simpson index of diversity.

Based on the SDI values, the level of livelihood diversification was defined as following;

i) No diversification (SDI 0.01 <=)
ii) Low level of diversification (SDI = 0.01 - 0.25)
iii) Medium level of diversification (SDI = 0.26 - 0.50)
iv) High level of diversification (SDI = 0.51 - 0.75)
v) Very high level of diversification (SDI > = 0.76)

2.2.2 Determinants of livelihood diversification

In this study, the dependent variable is SDI (Simpson Diversification Index) which lies between zero and one. In this case the respondent are divided into two groups, one group who have diversified livelihood and have SDI value more than zero. Another group is one who has a zero SDI value. The respondents who have zero SDI mean we have information only on the regressors but not on the regressand. A sample for which data on the regressand is available only for some observation is called censored sample. The model which consists of censored sample is called censored regression model which is the Tobit model. [14]

To determine the factors affecting rural livelihood diversification, the study used the Tobit regression model [15]. The formula of Tobit model is;

$$SDI^*=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\beta_{12}X_{12}+\beta_{13}X_{13}+\beta_{14}X_{14}+\mu_i$$

Where, SDI* = Livelihood diversification index,

β_0 = Intercept

X_1= Age of the respondent (Years)
X_2 = Years of Schooling
X_3= Main occupation of the Respondent (1= Fishing,0= Otherwise)
X_4 = Total number of members in a household (No.)
X_5 = Mode of land Ownership (1= Landowner,0 = Landless)
X_6 = Credit access (1= Yes, 0= No)
X_7 = Credit amount (TK.)
X_8 = Member of any organization (1= Yes,0= No)
X_9 = Distance to the nearest market (Km)
X_{10}= Distance to the district town (Km)
X_{11} = Amount of saving in any account in a year (Tk.)
X_{12} = Participation of the household in any govt. development program. (1=Yes, 0= No)
X_{13} = Number of family member reside outside of home
X_{14} = Value of household assets excluding cultivable land
μ_i = Error term

To detect multicollinearity in explanatory variable variance inflation factors (VIF) technique was employed. VIF (X_j) can be defined as [15]:

$$VIF(X_j) = \frac{1}{1-R_j^2}$$

The result showed that VIF for land man ratio and farm size was higher than 10 indicating serious multicollinearity. One of the remedial measure of the multicollinearity problem is to droping the variables from the regression model for this reason these two variables dropped from the model. None of the VIF was found equal or greater than 10 after excluding these two variables.

To test heteroscedasticity this study was used Breusch-Pagan-Godfrey Test (sometimes shorted to the Breusch-Pagan test). If the test statistic has a p-value below an appropriate threshold (e.g. $p<0.05$) then the null hypothesis of homoscedasticity is rejected and heteroscedasticity assumed [16]. To correct heteroscedasiticity problem this study used robust standard error therefore the estimated t values are much smaller than those obtained by OLS.

3. RESULTS AND DISCUSSION

3.1 Share of Household Income from Different Sources and Contribution of Fishing in Household Income

The intensity of livelihood diversification of the sampled household was indicated by the share of their income from different sources. The contribution of fishing in total household income was highest and it was 32% of total average annual income (Table 1).

The study also attempted to find the contribution of fishing in total “farmincome”. It is shown from the Table 2 that fish catching has the highest source of farm income in the study area. It contributed about 43% of the total farm income.

3.2 Livelihood Diversification of the Fishing Community

Livelihood diversificationin *haor* area is different from other areas. Here the main sources of income is either fishing (during monsoon) or cropping (during wet season). But some of these households in *dekharhaor* diversified their livelihoods into different off farm and non farm income sources and they contribute significant amount in terms of income.

Table 1. Average annual income and share by sources of income

Source of income	Amount of income (Tk.)	Share of income (%)
Rice Crop	15693.59	23
Non rice crop	10333.33	15
Non crop agriculture (Fishing)	22486.83	32
Non crop agriculture (Livestock)	3570	5
Agricultural laborer	4727.5	6
Non agricultural laborer	5429.79	8
Transportation	3828	5
Business and caste occupation	960	2
Salaried job and Service	2040	3
Remittance	200	0.43
Transfer payment	60	0.08
Others	220	0.49
Total	69549.04	100

Source: field survey, 2018

Table 2. Contribution of fishing in total farm income

Sources of farm income	Amount (TK.)	Share (%)
Rice crop	15693.59	30
Non-rice crop	10333.33	20
Fishing	22486.83	43
Livestock	3570	7
Total	52083.16	100

Source: author's estimation, 2018

Table 3. Distribution of households into different level of diversification

SDI Range	Percentage	Average SDI
Below 0.01(No diversification)	32	
0.01-0.25(Low level)	20	
0.26-0.50(Medium level)	38	0.2484
0.51-0.75(High level)	10	
Above 0.75(Very high level)	0	
Total	100	

Source: author's estimation, 2018

From Table 3 it can be seen that, about 68% of the total sampled households in the study area had diversified their livelihoods whereas 32% had not diversified their livelihoods (SDI= 0)). Table 3 also depicted that the average Simpson index was 0.2484. The result showed that about 20% and 38% of the sample households had low and medium level of diversification, respectively. The result also found that only 10% had high level of livelihood diversification while there was no very high level of diversification.

3.3 Factors Affecting Livelihood Diversification

The result of the Tobit model is presented in Table 4. The result shows that the model was accurate in explaining the factors that are affecting livelihood diversification of *Haor* fishermen. The result of the marginal effect is also presented in Table 5.

The result shows that age is found to have a significant (5% level of significant) and positive influence on fishermen livelihood diversification options. In other words, multiplicity of activities increases with advancing age. This is because, aged people are considered more knowledgeable and experienced, and consequently, experienced persons have more prospects of diversifying livelihood strategies. The marginal effect indicates that other variables being kept constant, the probability of household's being diversified will be increased by 0.52% with a unit change in age. This is close to the study of Khatun and Roy [12] and Ellis [5]. They found that household head's age is the main driving force towards livelihood

diversification. Therefore, the marginal effect of the respondent's age is 0.0052(0.52%) showing that those aged households prefer to diversify their livelihood options relative to those who are younger in the study area.

The years of schooling is found to have positive and significant (5% level of significant) correlation with diversified livelihood, so that it was found to be one of the important factors of livelihood diversification. This finding indicates that those households with high years of schooling are more likely diversify livelihood strategies than those do not. Therefore, the finding confirms that an increase in education level of the fishermen will increase the likelihood of being diversified strategy. This is due to most probably educated person gain better skill, experience, knowledge, literate individuals are very ambitious to get information and determine the capacity of finding jobs and these help them to engage in diversified livelihood strategies.

Table 4. Tobit regression results to determine factors affecting the livelihood diversification

Variables	Coefficient	Robust stand. error	t value
Intercept	0.0642	0.6081	0.11
Age of Respondent	0.0052**	0.0026	1.95
Years of Schooling	0.0177**	0.0091	1.94
Main occupation of the Respondent	0.0031	0.0622	0.05
Household Size	0.0076	0.0128	0.59
Mode of land Ownership	-0.2603***	0.0563	-4.62
Access to credit	0.1034**	0.0527	1.96
Credit Amount	2.02e-07	6.58e-07	0.31
Membership of any Organization	-0.0384	0.0528	-0.73
Distant from the Nearest Market	-0.1685**	0.0864	-1.95
Distant from the District Town	0.0303	0.0537	0.56
Savings Amount	6.15e-06**	2.77e-06	2.22
Households Participation in any Govt. development Program	-0.0082	0.0526	-0.16
Migrants	-0.1003	0.0759	-1.32
Total Value of Household Assets	-1.94e-06**	9.32e-07	-2.08
Sigma	.2133		
Prob> F	0.000		
Pseudo- R^2	0.617		

Source: author's estimation, 2018
*Note: significant at ***= 1% and **= 5% level of significance*

Table 5. Marginal effect of the variables on livelihood diversification after running the Tobit regression

Variables	dy/dx	Standard error	z value
Age of Respondent	0.0052	0.0026	1.95
Years of Schooling	0.0177	0.0091	1.94
Main occupation of the Respondent	0.0031	0.0622	0.05
Household Size	0.0076	0.0128	0.59
Mode of Land Ownership	-0.2603	0.0563	-4.62
Access to credit	0.1034	0.0527	1.96
Credit Amount	2.02e-07	6.58e-07	0.31
Membership of any Organization	-0.0384	0.0528	-0.73
Distant from the Nearest Market	-0.1685	0.0864	-1.95
Distant from the District Town	0.0303	0.0537	0.56
Savings Amount	6.15e-06	2.77e-06	2.22
Households Participation in any Govt. development Program	-0.0082	0.0526	-0.16
Migrants	-0.1003	0.0759	-1.32
Value of Households Assets	-1.94e-06	9.32e-07	-2.08

Source: author's estimation, 2018

Marginal effect of the years of schooling means that for one year additional schooling there will be 1.7% increase of livelihood diversification of the fishermen. This finding is similar with that of Ng'ang'a, *et al* [17] study who reported that education is essential in increasing off/non-farm earnings and time allocation of rural families and to diversify the rural economy away from agriculture.

Mode of land ownership (dummy) is found highly significant (1% level of significance) and has negative coefficient. This is because fishermen in the *haor* area who have land engaged only on farming activities. But the fishermen who does not own any land are doing many off-farm and non-farm activities. Table 4 reveals that Marginal effect of mode of land ownership is .26 which implies that the probability of being diversified will decrease by 26% with an increase in mode of land ownership of the fishermen. This is close to the study of Ahmed [10] who found mode of land ownership had negative significant impact on livelihood diversification of rice-based areas of Bangladesh.

Access to credits found to have a positive effect on the livelihood diversification of the fishermen in the *haor* area. This implies that increase access to credit, the probability of fishermen being diversified is increased by 10%. This is because most of the *haor* fishermen have poor resource base so providing credit to households will improve their livelihood. This is similar to the study of Asmah [18], Saha *and Bahal* [19], Oluwatayo [20] and Babatunde and Matin. [21]

Distance to the nearest market is found to have a significant (5% level of significance) and negative correlation with reducing the probability of being diversified household. This negative relationship tells us that the larger the distance the lesser the tendency of households to diversify and vice versa. The possible justification could be households who are closer to the market centers do not have much cost to access market incentive for diversification of livelihoods. From the model result, the marginal effect reveals that the probability of a household being diversified will decrease by 16% with one kilometer increase in nearest market distance. This finding is in agreement with that of Ibrahim *et al*., [22] argues that distance from market center influences decision to build highly diversified livelihood options.

Savings of the fishermen is statistically significant (at 5% level of significance) in determining factors affecting livelihood diversification. Positive sign on the coefficients indicates that an increase in savings of the fishermen increase the probability of being diversified by 0.006%. Justification for this higher the savings higher the money or capital fishermen have. With this money they can invest in different non- farm activities. This is opposite to the study of Ahmed [19] found amount of savings had negatively effects on livelihood diversification of the rural rice- based areas of Bangladesh.

The value of physical assets owned by a household is found to have a significant (5% level of significance) and negative effect on the level of livelihood diversification. Asset base is one of the limiting factors towards livelihood diversification in the *haor* area of Bangladesh. This result is supported by the same type of study suchas Malek and Usami [23]. In the *haor* area of Bangladesh the physical assets owned by the households are mostly farm and agricultural assets. If amount of physical assets will be higher, the tendency of the fishermen to go for off farm and non farm income activities will be lower. This will lead to the less diversification of the fishing household and only engaged with farming activities. From Table 5 the marginal effect of the value of household assets implies for one additional taka on value of household assets the level of livelihood diversification will go down by 0.0001%.

4. CONCLUSION

In nutshell, it may be concluded that the *haor* fishermen in our study regions are likely to have a diversified livelihood when they have more age and higher level of years of schooling and some physical assets. The scope for livelihood diversification also gets boosted when there are more access to credit and proximity to urban market. Finally, agro climatic condition and overall socio-economic development of an area have a strong influence on the *haor* livelihood diversification. The government should take policies and programs to build up their capacity more training can be offered for them on capacity building. Community-based activities such as livestock, poultry rearing, processing and marketing may be encouraged for them.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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