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Role of Small Scale Fishing on the Livelihood Improvement of Haor Fishermen: An Empirical Evidence from Bangladesh

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Abstract: The single most factor affecting the livelihood of haor people of Bangladesh is fishing. Data and information regarding this issue are lacking in Bangladesh, therefore, the study was conducted to assess the extent and determinants of livelihood step up of fishermen in *haor* area of Sunamganj district, Bangladesh. The present investigation showed that, the majority of the fishermen (60.0%) had small land ownership. Most of them were illiterate (56.3%) and belonged to (53.75%) middle income ($621.0-$915.0) and 6.25% had a small income ranging $305.0-$610. Among the fishermen, 45.0% were received credit from *Mahajan* and only 12.5% of fishermen had savings. Different livelihood assets were increased to a large extent due to small-scale fishing. Financial, human, social and physical capitals were increased from 32.0% to 76.67%, 45.0% to 75.33%, 42.0% to 62.5% and 30.0% to 73.37%, respectively due to engage in fishing. The logistic regression model revealed four significant variables i.e., family type, farm size, boat ownership and credit access were responsible for the livelihood improvement of *haor* fishermen. Furthermore, this study also found out constraints which were faced by the fishermen. Among all the constraints, the flash flood was reported to as a major problem by the fishermen.

Keywords: Bangladesh, Fisheries, Fishermen, *Haor* Area, Livelihood, Small-Scale Fishing

Introduction

Within fisheries management and development policy, the importance of sustaining small-scale fisheries is increasingly recognized (Allison, 2001). In Bangladesh, fisheries sector, both inland and marine has a significant prospective to make generous contribution to national socio-economic development, economic revitalization and poverty reduction (Salagrama, 2006a). Fisheries products as an effective cash crop, has more potential to generate cash income comparable to agricultural products (Bene *et al*., 2007). This cash crop nature of fisheries product acts as a strong market stimulator and wealth generation with multiplier affect which continuously providing broader income and employment opportunity (FAO 2004a). This sector incorporates a diverse range of livelihood activities, 15.0% of total global employment from production and processing to marketing of fish product and ancillary functions (FAO, 2006) but many of the people engaged in these activities remain unrecognized as fish workers. The fisheries sector plays a significant role in the national economy of Bangladesh contributing 3.69% of GDP and 22.60% to the agricultural GDP (FRSS, 2016). Additionally, in Bangladesh more than 17 million (including 1.4 million women) depend on fisheries sector (NFW, 2015) and another 11 million people are engaged in other related activities such as fish fry production, aquaculture and enhanced fisheries, fish trading, dry fish processing net/trap and boat making, fisheries labor, etc. especially the people of coastal and *haor (Low Laying Wet Land)* region of Bangladesh (Thilsted, 2014). Small-scale fishing is characterized by fishing craft, with non-mechanized force or low-horsepower outboard or inboard engines; use of passive fishing methods, manual operation of fishing gear and the absence of electronic fish finding and navigational devices (FAO, 2004b). It also frequently characterized as “the occupation of the last resort” (Smith, 1979; Panayotou, 1982; Christy, 1986). In particular, additional fishing gear and improved infrastructure are the key factors to enhanced productivity which would leads to improve wellbeing

through income generation, reduce poverty and ensure food security (Bailey and Jentoft, 1990). These fishing operations are very common in *haor* area. The solution of poverty reduction have centered on the necessity to make small scale fisheries more economically efficient (Edward *et al.*, 2001). However, small-scale fisheries are often neglected in development planning because their contribution does not take into account in socio-economic influence (Thorpe *et al*., 2005). There are 96 *haors* covering an area of 1, 92,367 hectares located here and there, mostly lie in the district of Kishoregonj, Netrakona, Kushtia, Habigonj, Sunamganj, Moulvibazar and Sylhet district of Bangladesh (Minar *et al*., 2013) which has considerable economic and aesthetic value, greatly influencing the ultimate environment quality in a diversified way (Hossain, 2014). *Haor* is a highly productive natural source of livelihoods that support millions of poor people and plays a crucial role in supplying protein (FAO, 2010). Particularly, fishing communities secure their livelihoods from *haor* by capturing fish, fish trading, fish drying, aquatic life and net weaving (Iqbal *et al*., 2015). Notably, fishing community who are living hand to mouth are considered as the poorest of the poor (Kabir *et al*., 2012). Being an isolated community, these people are deprived of many amenities of life (Alam, 2010). Fishing communities are still the dominant communities of poor people inhabit coastal areas, especially in countries that are developing or third world (FAO, 2007). The fishermen of southeastern part of Bangladesh are belonging to hardcore poor (Kleih *et al*., 2003) and lack of adequate capital is their main constraint (Ali *et al*., 2008). Moreover, significant research has not yet been conducted on the *haor* fishermen of north eastern Bangladesh although it has a great ecological, commercial and socio-economic importance in the economy of Bangladesh. The purpose of this study was to document livelihood status of *haor* fishermen, identifying the factors that are affecting the livelihood improvement and figured out the constraints faced by the fishermen in *haor* areas of Bangladesh.

Materials and Methods

Selection of Study Area and Sample Size

Dakshin (South) Sunamganj upazila (Sub-district) under Sunamganj district was purposely selected for the current study. Necessary information of fishermen was collected from three villages of *Noapara, Jolklols* and *kaikker par* through random sampling. Total 160 samples were interviewed from *Dakshin* Sunamganj upazila of which 80 were fishermen and another 80 were non-fishermen for attaining the objectives of the study.

Methods of Data Analysis

The double difference estimator was used to compare the changes in outcomes measured between treated (Fishermen) and controlled (Non-fishermen). During the impact study by Difference in Difference (DID) approach the following formula was used (Duflo *et al*., 2004). The formula of double difference estimator is $DID = \{(T_1\text{-}C_1)\text{-}(T_0\text{-}C_0)\}$, where, T implies treatment group (Fishermen) and C denotes control group (Non-fishermen). The rows distinguish between before and after the intervention (denoted by subscripts 0 and 1), (Table 1).

Binary Logistic Regression

To determine the factors responsible for livelihood improvement, Binary logistic regression model was used. Binary logistic regression estimates the probability that a characteristic is present (e.g., estimate probability of "success") given the values of explanatory variables, in this case a single categorical variable; $\pi = Pr\,(Y = 1|X = x)$ (Gujrati, 2004).

Variables:

- Let Y be a binary response variable
  $Y_i = 1$ if the trait is present in observation (person, unit, etc.) i
  $Y_i = 0$ if the trait is not present in observation i
- $X = (X_1, X_2,...,X_k)$ be a set of explanatory variables which can be discrete, continuous, or a combination. x_i is the observed value of the explanatory variables for observation i

Model

$$\pi_i = \Pr\left(Y_i = 1 \mid X_i = x_i\right) = \frac{\exp\left(\beta_0 + \beta_1 x_i\right)}{1 + \exp\left(\beta_0 + \beta_1 x_i\right)}$$

Or:

$$logit\left(\pi_i\right) = \log\left(\frac{\pi_i}{1-\pi_i}\right)$$
$$= \beta_0 + \beta_1 x_i$$
$$= \beta_0 + \beta_1 x_{i1} + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_k x_{ik}$$

Table 1: Calculation of double difference estimates of average in the study area

Survey round	Treated group	Controlled group	Difference across group
Follow up	T_1	C_1	T_1-C_1
Base line	T_0	C_0	T_0-C_0
Difference across time	T_1-T_0	C_1-C_0	(T_1-C_1)-(T_0-C_0)

Assumptions

The data Y_1, Y_2,...,Y_n are independently distributed, i.e., cases are independent. Distribution of Y_i is *Bin* (n_i, π_i), i.e., binary logistic regression model assumes binomial distribution of the response. The dependent variable does not need to be normally distributed, but it typically assumes a distribution from an exponential family (e.g., binomial, poisson, multinomial, normal). Does not assume a linear relationship between the dependent variable and the independent variables, but it does assume linear relationship between the logit of the response and the explanatory variables; logit (π) $\beta_0 + \beta_X$. Independent (explanatory) variables can be even the power terms or some other nonlinear transformations of the original independent variables. The homogeneity of variance does not need to be satisfied. In fact, it is not even possible in many cases given the model structure. Errors need to be independent but not normally distributed. It uses Maximum Likelihood Estimation (MLE) rather than Ordinary Least Squares (OLS) to estimate the parameters and thus relies on large-sample approximations. Goodness-of-fit measures rely on sufficiently large samples, where a heuristic rule is that not more than 20% of the expected cells counts are less than 5 nonlinear transformations of the original independent variables. In this study, the outcome variable was dichotomous and there were a significant number of independent variables. In such case, the appropriate model was binary logistic regression model. The dependent variable was the livelihood improvement, which was categorized into two groups. Scores assigned as 1 and 0 if the response is "Yes" and "No" respectively. Ten variables were identified to be the major explanatory variables in this study area. These were family/household type, farm size, boat ownership, loan/credit accesses, age of the respondent, educational level, family size, fishing experiences, time of fishing and contact sell.

Constraint Facing Index (CFI)

The researcher identified the major problems faced by the fishermen in study area. An overall score of the problems faced fishermen were computed by adding their scores of the problems in all 9 selected problems. Each fishermen were asked to indicate the extent of difficulty caused by each of the problems by checking any of the four responses such as 'high', 'medium', 'low' and 'not at all' and weights were assigned to these responses as 3, 2, 1 and 0, respectively. The scores of Constraint Facing Index (CFI) for each selected problem were computed through using the subsequent formula: $CFI = (C_h \times 3) + (C_m \times 2) + (C_l \times 1) + (C_n \times 0)$ Where CFI = Constraints Facing Index C_h = Number of respondents having high constraints; C_m = Number of respondents having medium constraints; C_l = Number of respondents having low constraints; and C_n = Number of respondents having no constraints. The problems were ranked according their CFI score which denoted their severity in fishing in *haor* area.

Results

Socio-Economic Profile of the Respondents

The basic information about the fishermen is represented in Table 2. It is seen that majority (89.0%) of fishermen responded to the survey is middle aged, ranging from 15 to 50 years old (Table 2). Relative high percentages (60.0%) of fishermen have medium family size living with joint family type (53.80%). Results shows that a high percentage of fishermen were illiterate (56.3%). Most of the respondent (87.5%) reported that they have no savings with annual income ranging from $621.0 to $915.0 which goes to the medium income group (Table 2). Fishermen (70.0%) in the study area are willing to catch fish in open water through current net as it is easy to operate with low maintenance cost and good harvesting record. The secondary occupations are negligible. There was no definite occupation in the dry period. Fishing is their primary occupations where highest numbers, 45% household heads had agriculture labor as secondary occupation and the second highest (22.5%) were having a piece of land for cultivation confirming the previous findings regarding socio economic condition of *haor* people (Sarif *et al*., 2016). Interestingly, about three quarters (75%) of the fishermen use sanitary latrine and it came possible for the willingness of different NGO's such as ASA, HILIP and fishermen organization in the study area.

Impact of Small Scale Fishing on Livelihood Improvement

The asset pentagon is an imperative component of sustainable livelihoods framework developed by DFID represents the inter-relationships among various asset of individual and group of a society. A change in asset status i.e., increases or decrease in access to livelihood assets may indicate improvement or no improvement of livelihood (Darwis *et al*., 2015). The key trends affecting the livelihoods of the poor in the *haor* fishing communities in Sunamganj district range across the whole spectrum of "assets" – i.e., the natural, physical, social, human and financial – and contribute to changes in terms of availability as well as access to the assets for the poorer stakeholders is a measure of livelihood improvement. The overall wellbeing of *haor* fishermen is associated with different types of livelihood assets as shown in Table 3. The results confirmed that, natural capital, human capital, physical capital, financial capital and social capital were increased by 47.5%, 75.33%, 73.3%, 76.3% and 62.5%, respectively.

Table 2: Socioeconomic characteristics of *haor* fishermen

Attributes $n = 80$	% respondents	Attributes $n = 80$	% respondents
Age (Years)		Fishing gear used	
0-15	0.00	Current net	70.00
15.01-50	89.00	Lift net	3.75
50+	11.00	Cast net	7.50
Family Size (No.)		Push net	6.25
Small (2-4)	28.75	Hook and Lime	7.50
Medium (5-7)	60.00	Fishing trap	5.00
Large (8+)	11.25	Occupation (Secondary)	
Family Type		Crop farmer	22.50
Nuclear	46.30	Jobless	10.00
Joint	53.80	Factory worker	7.50
Literacy level		Driver	3.80
Illiterate	56.30	Agriculture labor	45.00
Can sign only	37.50	Boatman	11.30
Primary	5.00	Annual income (US Dollar)	
Secondary	1.30	Small fisherman ($305.0-610.0)	6.25
Higher Secondary and above	0.00	Medium fishermen ($611.0-$915.0)	53.75
Housing condition		Large fisherman ($916.0 and above)	40.00
Earthen wall straw roof	22.50	Savings	
Straw wall straw roof	10.00	Yes	12.50
Bamboo wall tin roof	20.00	No	87.50
Bamboo wall straw roof	8.80	Member of Fishermen Organization	
Tin wall tin roof	36.30	Yes	87.50
Brick wall tin roof	2.50	No	12.50
Sanitary Condition		Credit Access	
Sanitary/Ring slab	75.00	Yes	60.00
Earthen	11.30	No	40.00
Bush	6.30	Training Received	
Hung latrine	7.50	Yes	8.75
		No	91.25

Current Net: (Net used for fishing with small mesh)

The obvious reason for highest percentages in financial capital is fishing; an important economic and business activity solely in *haor* areas. The lowest percentages were found in case of natural capital (47.55%) due to poor conservation method by the community people. The percentage of earthen and straw roof was decreased by 58.8 and 72.5 percent, respectively. This simultaneous trend indicates improving housing condition for all fishermen. After involving in fishing, about 88.8 and 68.8 percent of fishermen are capable of using mobile phone and toilet, respectively. Many fishermen were using modern amenities too. Uses of radio, watch and bicycle have increased tremendously for all the fishermen. Table 3 revealed that 65, 70 and 52.5 percent fishermen reported that their decision-making ability, women empowerment and participation in social activities were increased. In the present study, it was found that more organizations are now formally or informally working than before in the study areas to promote cooperation between people, coping distress and other awareness build up process.

Changes in Overall Livelihood Asset (Capital) by Fishermen

Overall change of assets is built through five core livelihood assets. A mixture of transforming structures and processes among these assets helps to obtain desirable livelihood outputs. Radar diagrams made of livelihood assets provide overall understanding of fishing impact and its resource endowments and sustainability (Fig. 1-3). Livelihood assets and their variables have been scaled up to the boundary of these diagrams. Full access to or highest performing variables or assets assume periphery and no access to or lowest performing variables or assets assume to the center of these diagram. Thus, higher degree of robustness of the diagram indicates higher impact on livelihood and its capabilities. The development process of Bangladesh is closely linked with the development of *haor* area. The changes in overall Livelihood Asset (Capital) by fishermen are shown in the Table 4. Table 4 shows, overall livelihood situation of natural, financial, human, social and physical assets of fishermen and non-fishermen whether these were

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increased, decreased or remained unchanged. The highest increased responding fishermen were found in case of financial capital (32% to 76.67%) and for non-fishermen it was calculated 32% to 55% and lowest increased responding fishermen were found in case of natural capital 40% to 47.5% and for non-fishermen it was calculated 13% to 10%. It is because; fishing is one addition source of income for fishermen compared to non-fishermen. In case of human capital responding increased from 45% to 75.33% for fishermen, 36% to 56% for non-fishermen, 42% to 62.5% social capital for fishermen, 40% to 53% for non-fishermen and physical capital for fishermen 30% to 73.37% for fishermen, 22% to 45% for non-fishermen, respectively (Fig. 1). The highest percentage of unchanged capital responding fishermen were found in case of natural capital 18% to 22.93% and for non-fishermen it was also calculated for same capital 56% to 59% (Fig. 2). The highest decreased responding fishermen were found in case of human capital (26% to 5.03%) and for non-fishermen it was calculated in case of financial capital 24% to 23% and lowest decreased responding fishermen were found in case of natural capital 25% to 29.6% and for non-fishermen it was calculated in case of physical capital 37% to 36%. The lowest decreased for fishermen were found because fishermen in *haor* area can diversify their livelihood easily compared to non-fishermen in this area (Fig. 3).

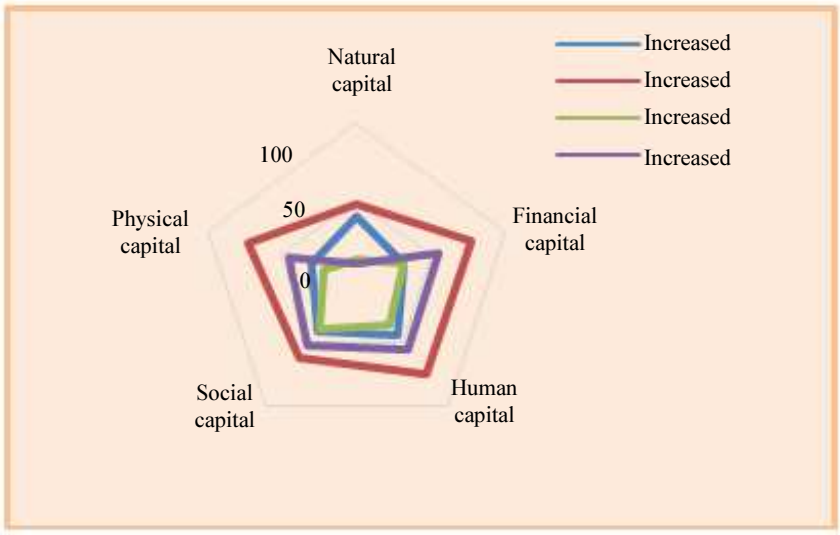

Fig. 1: Asset pentagon (Increased)

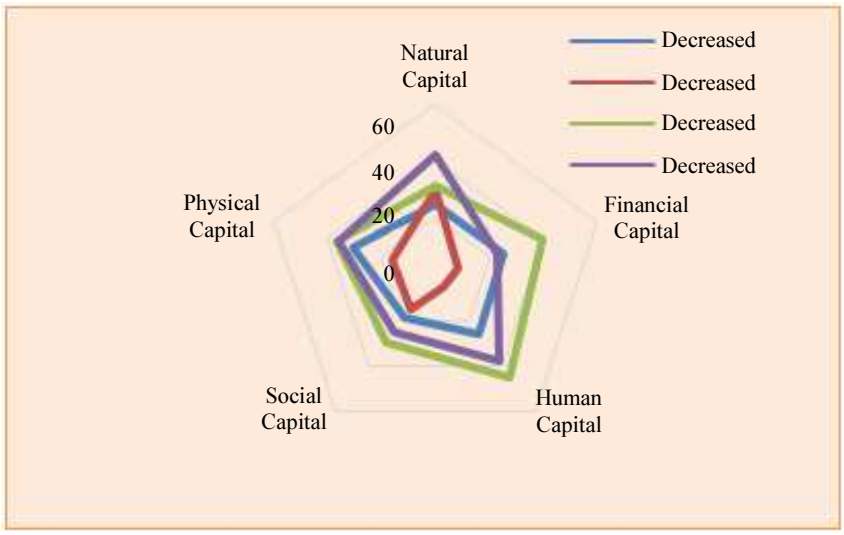

Fig. 2: Asset pentagon (Decreased)

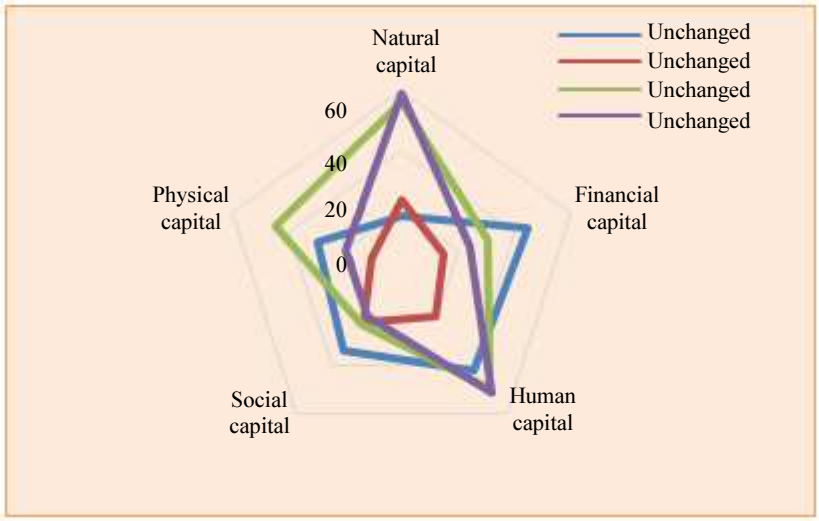

Fig. 3: Asset pentagon (Unchanged)

Table 3: Percentage increase of livelihood asset in the study area

	Increased		Neutral		Decreased	
Categories	No.	Percent	No.	Percent	No.	Percent
Natural Capital						
Fish Caught	12.00	15.00	12.00	15.00	56.00	70.00
Cultivable land (Own)	60.00	75.00	10.00	12.50	10.00	12.50
Pond	42.00	52.50	33.00	41.30	5.00	6.30
Average	**38.00**	47.50	18.33	**22.93**	23.67	**29.60**
Human Capital						
Health	64.00	80.00	12.00	15.00	4.00	5.00
Education	51.00	63.75	22.00	27.50	7.00	8.80
Training	59.00	73.80	20.00	25.00	1.00	1.30
Access to information	67.00	83.80	9.00	11.30	4.00	5.00
Average	**60.25**	**75.33**	15.75	**19.70**	4.00	**5.03**
Physical Capital						
Furniture	66.00	82.50	9.00	11.30	5.00	6.30
Tin roof	73.00	91.30	5.00	6.30	2.00	2.50
Straw roof	18.00	22.50	4.00	5.00	58.00	72.50
Earthen roof	30.00	37.50	3.00	3.80	47.00	58.80
Radio	63.00	78.80	7.00	8.80	10.00	12.50
Fishing net	69.00	86.30	5.00	6.30	6.00	7.50
Agril. Equipment	61.00	76.30	11.00	13.80	8.00	10.00
Mobile Phone	71.00	88.80	9.00	11.30	0.00	0.00
Bicycle	60.00	75.00	13.00	16.20	7.00	8.80
Watch	69.00	86.30	6.00	7.50	5.00	6.30
Chair/Table	69.00	86.30	10.00	12.50	1.00	1.30
Toilet	55.00	68.80	23.00	28.70	2.00	2.50
Average	**58.67**	**73.30**	8.75	**10.96**	12.58	**15.75**
Financial Capital						
Annual Income	64.00	80.00	12.00	15.00	4.00	5.00
Savings	60.00	75.00	15.00	18.80	5.00	6.30
Credit access	60.00	75.00	9.00	11.30	11.00	13.80
Average	61.30	**76.67**	12.00	**15.03**	20.00	**8.37**
Social Capital						
Social access	52.00	65.00	14.00	17.50	14.00	17.50
Decision making ability	56.00	70.00	18.0	22.50	6.00	7.50
Women empowerment	42.00	52.50	22.0	27.50	16.00	20.00
Average	50.00	**62.50**	18.0	**22.50**	12.00	**15.00**

Table 4: Changes in overall livelihood asset (capital) by fishermen and non-fishermen

	Increased				Unchanged				Decreased			
	Fishing		Non-Fishing		Fishing		Non-Fishing		Fishing		Non-Fishing	
Asset Category	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Natural Capital	40	47.50	13	10	18	22.93	56	59	25.0	29.6	31	42
Financial Capital	32	76.67	32	55	45	15.03	30	24	25.0	8.37	40	23
Human Capital	45	75.33	36	56	42	19.70	50	52	26.0	5.03	45	38
Social Capital	42	62.50	40	53	34	22.50	23	20	19.0	15.00	30	25
Physical Capital	30	73.37	22	45	30	10.96	45	20	30.5	15.75	37	36

Table 5: Determinants of livelihood improvement in *Haor* Area

Multiple logistic regression analysis				
Variables	Co-efficient (β)	S.E	p-value	Odds ratio
Constant	1.271	3.111	0.683	3.564
Family type				
Nuclear®	---	---	---	---
Joint	-3.959	1.657	0.017	0.019
Farm size (decimal)	0.032	0.013	0.011	1.032
Boat ownership				
Yes®	---	---	---	---
No	3.132	1.321	0.018	0.044
Loan				
Yes®	---	---	---	---
No	-2.210	1.109	0.046	0.110
Age of respondent (years)	-0.051	0.071	0.467	0.950
Educational level				
Primary®	---	---	---	---
Cannot read and write	0.895	3.004	0.766	2.447
Can sign only	1.483	2.759	0.591	4.406
Number of family members	0.411	0.387	0.287	1.509
Fishing experience (years)	0.091	0.093	0.330	1.095
Time of fishing				
Day®	---	---	---	---
Night	-1.486	1.018	0.145	0.226
Contract sell				
Yes®	---	---	---	---
No	1.754	1.367	0.200	5.776

Note: Significant at *** = 1%, ** = 5% and * = 10% level of significance

Determinants of Livelihood Improvement in Haor Area

A binary logistic regression model was fitted to elicit the factors influencing the livelihood status of *haor* household. Ten variables were identified to be the major explanatory variables in this study area. All these factors expected to have positive impact on livelihood status of household. For comparing observed and expected frequencies of events and non-events to assess how well the model fits the data, Hosmer-Lemes how goodness-of-fit test were used. The p-value was greater than 0.005 (Table 5) so we could not reject the null hypothesis. Hence there was no difference between observed and predicted variables values. Finally for summarizing the proportion of variance in the dependent variable associated with the predictor (independent) variables Cox and Snell R^2 along with its correction (Nagelkerke Pseudo-R^2) was used which revealed that this model was being able to explain about 70 percent of the variation in the data. The result of binary logistic regression model is presented in Table 6. The result shows that model was suitable for explaining the determinants of livelihood status of *haor* household. Among all the variables considered in model four variables revealed significant. These variables are family type, farm size, boat ownership and loan access. Respondents belonging to joint family were 0.019 times significantly less likely to improve their livelihood than the respondents from nuclear family. Odd ratio of farm size coefficient is 1.032 indicated that, holding other variables as a fixed value, we will see 3.2% increase in the odds of getting a respondent experienced improved livelihood for a one decimal increase in farm size.

Table 6: Constraints faced by the fishermen in Sunamganj

Constraints	Extent of constraints faced by fishermen				CFI	Rank	Mean Rank (kruskalwallis)
	High (3)	Medium (2)	Low (1)	Not at all (0)			
Flash flood problem	55	16	6	3	203	1	650.50
Low price of fishes	47	25	5	3	196	2	590.50
Inadequate capital	41	17	15	7	172	3	534.50
Theft of fishing gear	31	23	19	7	158	4	429.50
Lack of transportation and communication facilities	20	29	22	9	140	5	351.50
High price of fishing gears	9	38	20	13	123	6	292.50
Lack of marketing facilities	10	30	20	20	110	7	216.50
Lack of institutional credits	20	21	5	34	107	8	123.50
Lack of scientific and technological knowledge	17	20	12	31	103	9	55.50
Chai Square and Asymp. Sig.							649.107 (0.000)

Note: *CFI score of fishermen (Flash flood) = (55×3) + (16×2) + (6×1) + (3×0) =203*

The regression results also suggested that respondents without having own boat were 0.044 times significantly less likely to be in improved livelihood than the respondents having their own boat. In this study, the result revealed that respondents, who were not having loan, were 0.110 times significantly less likely to improve their livelihood than the respondents having loan.

Constraints Faced by the Fishermen

The problems related to fishing were poor communication and transportation facilities, flash flood, lack of marketing facilities, lack of scientific knowledge and technology, theft of fishing gear, low price of fish, lack of capital, high price of fishing gear and lack of institutional credits. In particular the problem rank was made according to the following kruskal wallis (H) test. The test statistic is given by $H = \left[\frac{12}{n(n-1)}\sum_{j=1}^{c}\frac{T_j^2}{n_j}\right] - 3(n+1)$. Where, n = sum of sample sizes for all samples, c = number of samples, T_j = sum of ranks in the J^{th} sample. These problems are structured through Constraint Facing Index (CFI) below: Majority of the fishermen opined that the flash flood problem suffered them badly ranked by 1st major problem with CFI score 203. Lack of transportation and communication facilities was another foremost problem faced by the *haor* fishermen. The CFI for this problem was calculated at 196 which ranked as 2nd problem. Inadequate capital seemed one more problem with CFI score 172 (3rd rank) for the fishermen followed by 4th rank problem theft of fishing gear (CFI score 158). Other problems like, lack of transportation and communication facilities, high price of fishing gear, lack of marketing facilities, lack of institutional credits and lack of scientific and technological knowledge were ranked as 5th (CFI score 140), 6th (CFI score 123), 7th (CFI score 110), 8th (CFI score 107) and 9th (CFI score 103), respectively.

Discussion

Based on the empirical evidence emanating from the logistic regression, we can opine that livelihood of *haor* fishermen is improving with the increases in farm size, boat ownership, credit access and breaking of joint family. Joint family might increase the expenditure of family and thus resulting with lots of constraints to improve their livelihood comparing with nuclear family. Furthermore, within small families there is a marked preference towards shifting children from fishing into other occupations- preferably service-oriented. This arises from recognition of un-sustainability of fishing as livelihood, as well as from a desire for the upward mobility that white collar-employment is supposed to bestow. Once a family moves away from a primary sector livelihood based on an open-access regime, the importance of large family diminishes. Families that have more children- due to lack of awareness or religious/social/cultural reasons but quiet for economic reasons are generally poor (Salagrama, 2006b). The boat ownership conveys stability and helps enable group formation, even for economic migrants, in a way that is lacking for labors. In one village, a group of small boat owners argued “if you own your own boat, machine and gear you cannot be classed as poor anymore” (Rothschild and Beamish, 2009). Furthermore, credit systems in the fishing sector were introduced to support the diffusion of new technologies rather than to support and encourage existing, more equitable system of operation (Salagrama, 2006c). Within this broader framework, particular attention has been placed on one of the five assets identified as constitutive of livelihood strategies: Financial capital as the impact analysis revealed highest increase in financial capital along with highest decrease in human capital by the dint of fishing. The *haor* fishing community’s standard of living has improved in terms of per head annual earnings and savings after meeting

expenditure requirement from fishing. Additionally, the Socio-economic analysis displays that more than half of the respondent (56.3%) is illiterate and most of them (91.25%) had no training in the selected research area. Hence, basic education and training program on processing of the fish product, extraction of oil from dry fish might help to improve the livelihood of *haor* fishermen.

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Authors Contributions

Md. Nur Mozahid: Designed, collected, checked the data and prepare the draft manuscript.

Jasim Uddin Ahmed and Maksuda Mannaf: Supervised the research, coordinated reviewed and checked the draft manuscript.

Sharmin Akter: Contribution in model specification, data interpretation and reviewed the draft manuscript.

Conflict of Interest

Authors have declared that no competing interests exist.

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