

Article

Study on sustainable livelihoods of fishers from Chalan *beel*, Bangladesh

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Abstract: An assessment was carried out to observe the impacts of fish sanctuary on the livelihoods from fishers of Ruhul *beel* and Bamonji *beel* under Chalan *beel* in Pabna district of Bangladesh. Data were collected from selected sanctuary sites with prepared and pretested questionnaire and analyzed through statistical tests like ANOVA (Analysis of Variance), regression, correlation, Chi-square were used to identify the relationships between variables and significant differences/association among them. From physical capital point of view, it was found that 91.3% of fishermen's houses were katcha, 6.52% were semi-pacca, and only 2.17% were pucca in case of Ruhul *beel* and in case of Bamonji *beel* 90.54% of fishermen's houses were katcha, 8.11% were semi-pacca, and only 1.35% were pacca. There was no significant variation (ANOVA; $P>0.05$, Chi Square test; non-significant at 0.05 level) among the residences by well-being. From human capital, average age of the household heads (HHH) was 37.95(±) 1.354 for Ruhul *beel* respectively, whereas for Bamonji *beel* the average age were 38.05(±) 1.064. The medium aged group fishermen were dominant in Ruhul *beel* than Bamonji *beel*. There were no significant difference ($P>0.05$) found between the age groups by well-being. From income capital it was observed highest part of income were come from fishing contributing 64.89% (653.72±128.82 US\$), 43.58% (431.89±74.66 US\$) for Ruhul *beel* and Bamonji *beel* respectively. As per as natural and social capital, average used land holding was 0.274±0.136 ranging 0.065 ha to 0.534 ha for Ruhul *beel* and 0.228±0.305 ha ranging 0.040 to 0.267 ha for Bamonji *beel*. The average land holdings did not vary significantly ($P>0.05$) between the sites.

Keywords: livelihood; fisher's; Chalan *beel*

1. Introduction

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base. With some minor changes this is also the definition adopted by DFID (1999).

Usually about all the fishers in Bangladesh are poor, illiterate, unorganized and also neglected by the society. Almost all the fishermen live below the poverty line in our country. Their access to resources is so limited because of interfere of elite, rich and musclemen. Maximum fishers have no fishing equipment of their own. Most of them are landless and don't even have homestead land but build their houses on rivers banks or in government has land or other's lands. They rarely have to access to bank or any formal credit because of lack of their resources for giving mortgage to get the loan. Consequently, they have to depend on private moneylenders who usually charge a very high rate of interest or with the condition of selling catches in a very low and fixed price. Most of them undertake fishing on a share basis with the boat-gear owner or moneylender or as daily laborer or on a monthly salary basis by which the fishers are deprived. Through this way most of them are exploited by the middleman, money lenders, aratder, dadonder, musclemen etc. because of their low social

status, poor, landless and disorganized (Ali *et al.*, 2003). Although Government has given the chance to fishers for access to resources and credit but in real they don't get the chance due to lack of organizational forum for their interests and their low socio-economic status. Very recently they are getting financial, social and technological support from NGOs and other government offices like DoF, BRDB, Co-operative office etc. Livelihood Resources—the basic material and social, tangible, and intangible assets that people use for constructing their livelihoods—are conceptualized as different types of 'capital' to stress their role as a resource base 'from which different productive streams are derived from which livelihoods are constructed' (Scoones, 1998).

2. Materials and Methods

The study was designed to assess the impacts of fish sanctuary on the livelihoods of the fishers in Ruhul *beel* (RB) and Bamonji *beel* (BB). The major issue was the comparative analysis of different fisher's households, adoption and adaptation of integrated farming systems and assesses the institutional context in relation to their impact on livelihoods. Both qualitative and quantitative data collection methods were used in the study in an interactive way (Sayed, 2010). Data were collected at different level from the household of the selected areas based on the livelihood approach (Carney, 1998). At the initial stage of data collection, findings of Participatory Community Appraisals (PCAs) and outcomes of the research were presented and cross checked/triangulated with different levels of fishers. The research process incorporated data relating to different aspects covering the availability of the assets; the vulnerability context; transforming structures and processes including development policies, development strategies, and other related issues like agriculture practices; common livelihood strategies; and the livelihood outcomes of local people. At the beginning of the study, secondary data were collected from different sources which included books, journals, scientific publications, dissertations and bibliographies that were relevant to the study were used as useful resource to enrich the information for understanding analysis and evaluation (Karim, 2006). Information on government policy particularly on integrated aquaculture systems, current trends of aquaculture, socio-economic, environmental and institutional factors that can be considered as important to the study were gleaned from different sources.

2.1. Phases of the study

The study was performed in the following four phases;

2.1.1. Phase I

Two villages were selected from two locations of more or less similar hydrographic characteristics (sanctuary site in Ruhul *beel* at Patulipara village and control site in Bamonji *beel* Hatgram village) initially from Bhangura upazilla under Pabna district where the first phase of the study carried out. Before incepting the study, a meeting with key informants with the villagers was organized by the help of Upazila Fisheries Officer and then by the help of the villagers a village map was drawn.

2.1.2. Phase II

After finalizing the site selection questionnaire was formulated and test survey was conducted to collect data/regarding livelihood asset-base, livelihood strategies, livelihood outcomes and vulnerability context of fishing households. As 3 facilitators/enumerators were involved in data collection, variation in consistency, interpretation, unit of measures and methods of presentation of data was possible. Finally, data collection was carried out from the field level using the finalized questionnaire (Haque, 2007).

2.1.3. Phase III

The third step was a yearly household monitoring survey using a structured pretested questionnaire. This was conducted with the same households sampled for the survey in Step-2. The purpose of this survey carried out with fishing households was to investigate the changing patterns of livelihood systems focusing on the impacts of fish sanctuary.

2.1.4. Phase IV

In this Step the impact of fish sanctuary was analyzed making a comparison with the control site (BB). The main objective of the intervention was to assess the effect of change through fish sanctuary on associated livelihoods. Fishers expected to assess the effectiveness of altering fishing systems on productivity and overall livelihoods (Karim, 2006).

2.2. Data processing and analysis

Initially data were entered in Microsoft Excel and exported to SPSS 20. Errors were detected and necessary corrections were made accordingly after exporting. Primary analysis (descriptive, comparative mean, graphs, Pivot tables etc.) were carried out using Microsoft Excel. Finally, quantitative and qualitative data from the study were analyzed by using SPSS/windows version 20, which offered statistical tools applied to social sciences (Field, 2005). Statistical tests like ANOVA (Analysis of Variance), regression, correlation, Chi-square were used to identify the relationships between variables and significant differences/association among them. The tools and the programs used for different type of data analysis were summarized.

2.3. Quantitative and qualitative analysis

Descriptive statistics such as frequency distribution, mean, standard deviation (SD), Standard error (SE), maximum, minimum, percentage, crosstabs and case summary were used for preliminary analyses. Other statistical analysis especially regression analysis, correlation coefficient, Chi-square and other as required to examine and understand the association of variables and its direction and magnitude. The statistical significance of results was estimated by using ANOVA test and t-test. ANOVA is a powerful statistical test where two or more independent estimates of the variance for the dependent variables are compared (Gay, 1976).

2.4. ANOVA (Analysis of Variance)

Due to heterogeneity of different sites, wellbeing, season and groups, there were many variations within the sample which were independently associated with other variables (Karim, 2006). One-way analysis of variance with post hoc analysis was used in order to identify the intra and inter group variations between different wellbeing, season (years) and locations which influenced the livelihoods, adoption, resources, production and management systems of the *beels*. Location, socio-economic group, farming systems and season were included as independent fixed variables.

2.5. Pearson's chi-square test

The chi-square test was used to find out relationship between two categorical variables (Snedecor and Cochran, 1989). Chi-square method was used to test whether two (or more) variables are: (1) independent or (2) homogeneous. The chi-square test for independence examined whether knowing the value of one variable helps to estimate the value of another variable. The chi-square test for homogeneity examines whether two populations have the same proportion of observations with a common characteristic. Though the formula is the same for both tests, the underlying logic and sampling procedures vary. Following formula used for this test where:

$$X^2 = \sum_{i=1}^6 \frac{(O_i - E_i)^2}{E_i}$$

O_i = an observed frequency

E_i = an expected (theoretical) frequency, asserted by the null hypothesis

2.6. Correlation and regression analysis

The correlation coefficient, sometimes also called the cross-correlation coefficient, is a quantity that gives the quality of a least squares fitting to the original data. The correlation coefficient is also known as the product-moment coefficient of correlation or Pearson's correlation. The main result of a correlation is called the correlation coefficient (or "r"). It ranges from -1.0 to +1.0. The closer r is to +1 or -1, the more closely the two variables are related. Regression analysis is used to identify the linear association between independent variables used collectively to predict the dependent variables (Miles and Shevlin, 2001).

2.7. Triangulation and validation

The findings of the survey were shared and validated in each spot. At the end of the survey key findings were shared with participants and nonparticipants in each of two spot. At the end of presenting the results they were asked to comment and suggest if any findings were been contradictory in real.

3. Results

3.1. Physical capital

Physical Capital is a category of livelihood assets. It comprises the basic infrastructure and physical goods that support livelihoods. The findings on physical capitals were recorded during the present study as follows;

3.1.1. Residence

All the fishers lived in own house other than only one fisherman who lived in other's house in RB in both years. But in case of BB no fisherman lives in other's house. By well-being more than 50% house owner were marginal (Table 1). There was no significant variation (ANOVA; $P > 0.05$, Chi-Square test; non-significant at 0.05 level) in residences by well-being.

3.1.2. Housing status

Four types of houses were found among the fishermen in the study areas which were; 1) Katcha that were made of tin, bamboo, jute stick and trees leaves with mud floor, 2) Semi-pacca that were made of brick in one part either floor or wall but the roof was made of tin, and 3) Pucca that were made by brick either the wall or floor or roof. All together 91.3% of fishermen's houses were katcha, 6.52% were semi-pacca, and only 2.17% were pucca in case of RB and in case of BB 90.54% of fishermen's houses were katcha, 8.11% were semi-pacca, and only 1.35% were pucca. There was no significant variation (ANOVA; $P > 0.05$, Chi Square test; non-significant at 0.05 level) among the residences by well-being (Table 1).

3.1.3. Use of electricity

Overall 60.87% households had no electricity connection in RB and in case of BB 77.03% house hold had electricity connection. The largest number of HH with electricity availability was marginal by well-being. It was found that electricity facilities were comparatively lower in RB than BB. A significant difference was found (ANOVA; $P < 0.001$) between locations (but not between years) for electricity availability ($F=39.19$) and sanitation status ($F=354.83$) (Table 1).

3.1.4. Drinking water

All of the fishermen had the access of clean and safe drinking water. Although, 7% and 11% fishermen from RB and BB respectively, did not have own tube-well but they used tube-well water from others (Table 1).

3.1.5. Cooking fuel

All the HH use straw, branches of tree etc. (*khori*) for cooking as fuel in both the *beels* (Table 1).

Table 1. Physical capital of sampled households by farmer type and well-being.

	Poor				Marginal				Better-off			
	RB-1	RB-2	BB-1	BB-2	RB-1	RB-2	BB-1	BB-2	RB-1	RB-2	BB-1	BB-2
Residence (Percent and No of HH)												
Own house	21.74 (10)	8.70 (4)	2.70 (2)	2.70 (2)	67.39 (31)	54.35 (25)	58.11 (43)	56.76 (42)	8.70 (4)	34.78 (16)	39.19 (29)	40.54 (30)
Others house	0	0	0	0	0	0	0	0	2.17 (1)	2.17 (1)	0	0
Housing Status (Percent and No of HH)												
Pacca	0	0	0	0	2.17 (1)	2.17 (1)	1.35 (1)	1.35 (1)	0	0	0	0
Semi pacca	0	0	0	0	0	0	5.41 (4)	5.41 (4)	6.52 (3)	6.52 (3)	2.70 (2)	2.70 (2)
Tin tin	10.87 (5)	6.52 (3)	2.70 (2)	1.35 (1)	32.61 (15)	21.74 (10)	24.32 (18)	25.68 (19)	2.17 (1)	17.39 (8)	28.38 (21)	28.38 (21)
Tin Jute stick	10.87 (5)	2.17 (1)		1.35 (1)	32.61 (15)	30.43 (14)	27.03 (20)	24.32 (18)	2.17 (1)	13.04 (6)	8.11 (6)	9.46 (7)
Electricity Availability (Percent and No of HH)												
Have	13.04 (6)	4.35 (2)	1.35 (1)	1.35 (1)	19.57 (9)	23.91 (11)	45.95 (34)	44.59 (33)	6.52 (3)	10.87 (5)	28.38 (21)	29.73 (22)
Have not	8.70 (4)	4.35 (2)	1.35 (1)	1.35 (1)	47.83 (22)	30.43 (14)	12.16 (9)	12.16(9)	4.35 (2)	26.09 (12)	9.46 (7)	9.46 (7)
Drinking Water (Percent and No of HH)												
Supply	0	0	0	0	0	0	0	0	0	0	0	0
Tube well	21.74 (10)	8.70 (4)	2.70 (2)	2.70 (2)	67.39 (31)	54.35 (25)	58.11 (43)	56.76 (42)	10.87(5)	36.96 (17)	39.19 (29)	40.54 (30)
Sanitary Facilities (Percent and No of HH)												
Pacca	0	0	0	0	0	0	4.05 (3)	4.05 (3)	0	0	1.35 (1)	1.35 (1)

Pit covered by Slab	21.74 (10)	8.70 (4)	2.70 (2)	2.70 (2)	67.39 (31)	54.35 (25)	54.05 (40)	52.70 (39)	10.87(5)	36.96 (17)	37.84 (28)	39.19 (29)
Source of Fuel (Percent and No of HH)												
Khori	21.74 (10)	8.70 (4)	2.70 (2)	2.70 (2)	67.39 (31)	54.35 (25)	58.11 (43)	56.76 (42)	10.87(5)	36.96 (17)	39.19 (29)	40.54 (30)

Figure in the parenthesis indicates the number (N)

3.2. Human capital

Human Capital is a category of livelihood assets. It represents the skills, knowledge, capacity to work and good health that together enable people to pursue different livelihood strategies and achieve their livelihood outcomes.

3.2.1. Age group

The age of the household heads (HHH) was ranged between 20 years and 63 years with an average of 37.46(±)1.354 years and 38.46(±)1.354 years for RB-1 and RB-2, respectively whereas for BB-1 and BB-2 the average age were 38.00(±)1.064 and 39.00(±)1.064, respectively (Table 2).

Table 2. Mean age of fishers (HHH) by location and year in RB and BB.

Year / Site	1st year		2nd year	
	Ruhul beel	Bamonji beel	Ruhul beel	Bamonji beel
Mean	37.46(±)1.354	38.00(±)1.064	38.46 (±)1.354	39.00 (±)1.064
Maximum	62	58	63	59
Minimum	20	22	21	23

The second highest group was young aged group ($\geq 30 < 50$) which was ranged from 16.22% to 25.68% in BB-2 and BB-1, respectively. The old aged (> 50 years) fishers HHH were the lowest in numbers. The medium aged group fishermen were dominant in RB than BB. There were no significant difference ($P > 0.05$) found between the age groups by well-being.

3.2.2. Family size

The overall mean household size of the fishers' population surveyed for both *beel* were from 4.70±1.24 to 4.76±1.12 for RB and 4.53±1.10 to 4.55±1.05 for BB ranging from 2 to 7 for both the *beels* (Table 3). The largest family size was found in poor for both *beel* and the comparatively smaller sized family was found in marginal for both the *beels* (Figure 1). Family size was not affected by well-being, location and years ($P > 0.05$).

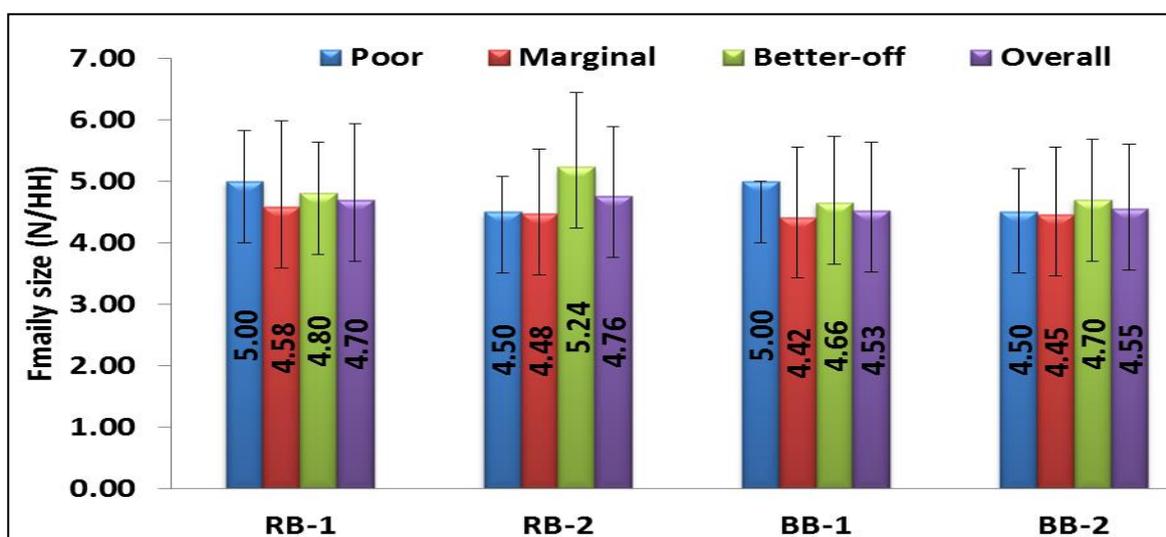


Figure 1. Family size of fishers in RB and BB.

Table 3. Average numbers of members in the fisher’s family with standard error by well-being.

Well-being category	RB-1		RB-2		BB-1		BB-2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Poor	5.00	0.82	4.50	0.58	5.00	0.00	4.50	0.71
Marginal	4.58	1.41	4.48	1.05	4.42	1.14	4.45	1.11
Better-off	4.80	0.84	5.24	1.20	4.66	1.08	4.70	0.99
Average of total	4.70	1.24	4.76	1.12	4.53	1.10	4.55	1.05

3.2.3. Marrital status

All the household heads were married except 2% from marginal fishermen of RB-1 and 4% from better-off of BB-1 however, 1% unmarried was found from marginal of BB-1 and BB-2 (Figure 2). There was no significant differences (ANOVA; P>0.05, F= 0.722) between marrital status of fishers among location, seasons and well-being.

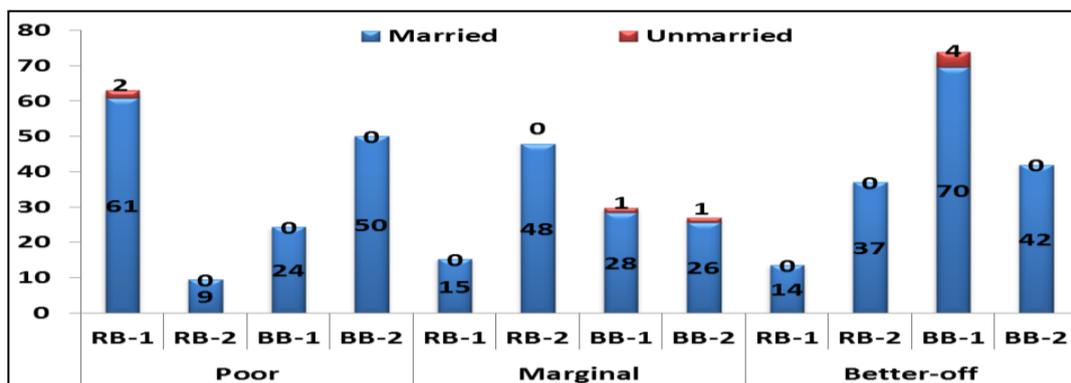


Figure 2. Distribution of marital status by location, season and well-being in RB and BB.

3.2.4. Educational status

Education is a basic right of all population, along with food, cloth and medication. Educational qualification of the fishers (HHH) of the study spot was highest up to JSC. The majority of fishers were able to sign only (Figure 3). Overall 1% to 7% HHHs was literate up to PSC from different well-being categories. There was no JSC passed fishermen in RB and BB in better-off and poor category, respectively. The highest numbers of HHH were able to sign only and the capabilities of sign in better-off family were increased (8% to 26%) after establishing the sanctuary. There was no significant differences in (ANOVA; P=.077, F=2.589) education by site, year and well-being. Chi-square test shows that there was a significant variation in education ($\chi^2 = 17.14a$, P<0.01 for RB-1 and RB-2) by well-being categories. However, there was no significant variation ($\chi^2= 2.488^b$ and 4.365^c for BB-1 and BB-2, P>0.05) within family size, site and year (Table 4) both for BB-1 and BB-2.

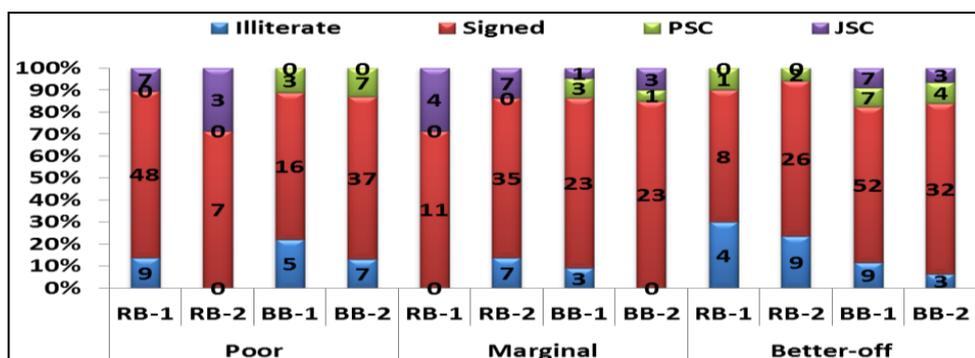


Figure 3. Educational status of fishers HHH in RB and BB by location, well-being.

Table 4. Result of Chi-Square Tests (Education * Family Size * Site * Year Cross tabulation).

Site	Chi-Square Tests	Family size			Well-being	
		df	χ^2 Value	Asymp. Sig. (2-sided)	χ^2 Value	Asymp. Sig. (2-sided)
RB-1	Pearson Chi-Square	241	17.140 ^a	0.009	11.444(a)	0.076
RB-2	Pearson Chi-Square	241	17.140 ^a	0.009	6.454(c)	0.374
BB-1	Pearson Chi-Square	241	2.488 ^b	0.870	12.427(b)	0.053
BB-2	Pearson Chi-Square	241	4.365 ^c	0.627	8.421(a)	0.209

3.2.5. School going and dropout children

The result of school going and dropout children has shown in the Figure 4 and Table 5. The total children were 124±0.18, 128±0.16, 187±0.12 and 189±0.13 in RB-1, RB-2, BB-1 and BB-2, respectively. The percent of school going children were 78.23%, 92.97%, 68.56% and 66.67% in RB-1, RB-2, BB-1 and BB-2, respectively. The school going rate was increased 22.68% in RB but decreased 1.56% in BB. Percentage of dropout children was 17.84%, 8.40%, 38.28% and 48.41% in RB-1, RB-2, BB-1 and BB-2, respectively (Table 5). On the other hand, dropout percent was decreased 41.18% in RB but increased 24.49% in BB (Figure 4). There was a significant difference in school going (ANOVA; P<0.001, F=41.13) and dropout children (P<0.001, F=11.48) in different sites but there was no significant difference in total children (P>0.05, F=1.833) among different sites (Table 5a).

Table 5. Educational status of children during the study period in RB and BB.

Site/Year	Total Children	Total SGC	% of SGC	Total DOC	% of DOC
RB-1	124±0.18	97±0.14	78.23	17±0.08	17.53
RB-2	128±0.16	119±0.13	92.97	10±0.06	8.40
Changes (%)	3.23%		22.68%		-41.18%
BB-1	187±0.12	128±0.06	68.45	49±0.08	38.28
BB-2	189±0.13	126±0.07	66.67	61±0.09	48.41
Changes (%)	1.07		-1.56		24.49

SGC= School going children, DOC= Drop out children

Table 5a. ANOVA result for total schooling going, dropout and total children.

ANOVA Table		SS	df	MS	F	Sig.
Total School Going*Site	Between Groups	22.63	1	22.63	41.13	0.00
Total Drop out*Site	Between Groups	11.48	1	11.48	28.07	0.00
Total Children*Site	Between Groups	2.237	1	2.237	1.833	0.177

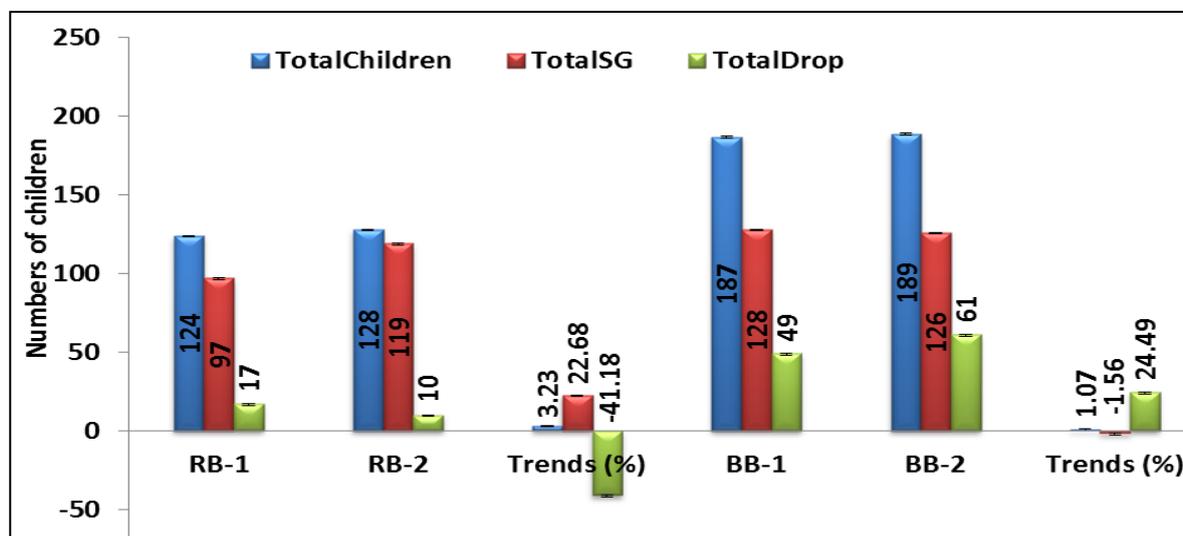


Figure 4. Changing trends (%) of school going and dropout children RB and BB.

3.2.6. Occupation

The frequency of fishers HH by occupation has shown in Table 6. Overall 100% fisher’s main occupation was fishing in case of RB in both the years whereas in case of BB fishing was the main occupation of 38% in BB-1 and 27% in BB-2. Business as secondary occupation was added 2.17% in RB. In BB fishing as main occupation was decreased 28.95%. Agriculture and daily laborer as main occupation was increased 116.67% and 71.43%, respectively in BB.

Table 6. Frequency of fisher’s households according to occupation (main and secondary).

Occupation	Main		Trends (%)	Secondary		Trends (%)
	1st year	2nd year		1st year	2nd year	
RB						
None	0	0		3	2	-33.33
Fishing	46	46		0	0	0
Agriculture	0	0		6	6	0
Business	0	0		0	1	2.17
Daily labour	0	0		37	37	0
	46	46		46	46	0
BB						
None	0	0		0	0	0
Fishing	38	27	-28.95	36	47	30.56
Agriculture	6	13	116.67	15	8	-46.67
Business	23	22	-4.35	14	15	7.14
Daily labour	7	12	71.43	9	4	-55.56
	74	74		74	74	0

3.2.7. Primary occupation by location, season and well-being

The result of the main occupation is shown in the Figure 5. The 100% fishermen’s main occupation was fishing for all well-being categories of RB, however in case of BB agriculture, business and daily labor was the main occupation in some of poor, marginal and better-off category. The main occupation as business was increased in poor (4% to 11%), marginal (9% to 12%) but decreased in better-off (28% to 11%). On the other hand, the main occupation agriculture of the fishers was increased in marginal (1% to 3%) and better-off (11% to 15%) categories for BB that is the trends to migrate towards agriculture from fishing as main occupation were observed in BB of marginal and better-off categories. Fishing was the main occupation of 63% fishers in poor category which was decreased to 9% after establishing the sanctuary which indicates the upliftment of well-being. Fishing was increased as main occupation in marginal (15% to 48%) and better-off (14% to 37%) category of RB whereas decreased in BB as shown in Figure 5. There was a highly significant differences (ANOVA; P<0.001, F=7.169) in main occupation among all well-being categories (Table 6a).

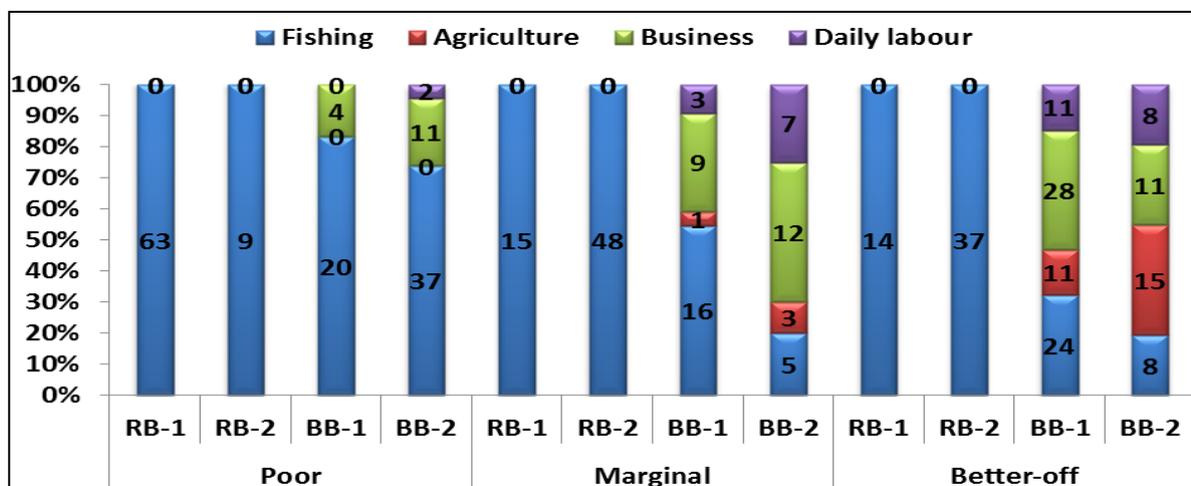


Figure 5. Distribution of fisher’s household according to primary occupation by location, year and well-being.

Table 6a. The ANOVA results for main and secondary occupation by well-being.

	SS	df	MS	F	Sig.
ANOVA Table (Main occupation * Well-being)					
Between Groups	14.55817	2	7.279085	7.169421	0.001
Within Groups	240.6252	237	1.015296		
Total	255.1833	239			
ANOVA Table (Secondary occupation * Well-being)					
Between Groups	48.39181	2	24.19591	15.04031	0.001
Within Groups	381.2707	237	1.608737		
Total	429.6625	239			

3.2.8. Secondary occupation by location, season and well-being

The result of the secondary occupation has shown in the Figure 6. Daily labour was the dominant secondary occupation in RB by all well-being categories; however, fishing was the dominant secondary occupation in BB by marginal and better-off categories. The secondary occupation as fishing was increased in BB by 4% to 8% in poor, 14% to 22% in marginal and 31% to 34% in better-off category (Figure 6) whereas agriculture as secondary occupation was increased for RB in marginal well-being (4 % to 8%). In case of RB in better-off category business was increased (upto 2%). The migrating trend in fishing was observed in BB of marginal and better-off categories towards secondary occupation. There was a significant difference (ANOVA; P<0.001, F=15.04) in secondary occupations among the well-being categories (Table 6a).

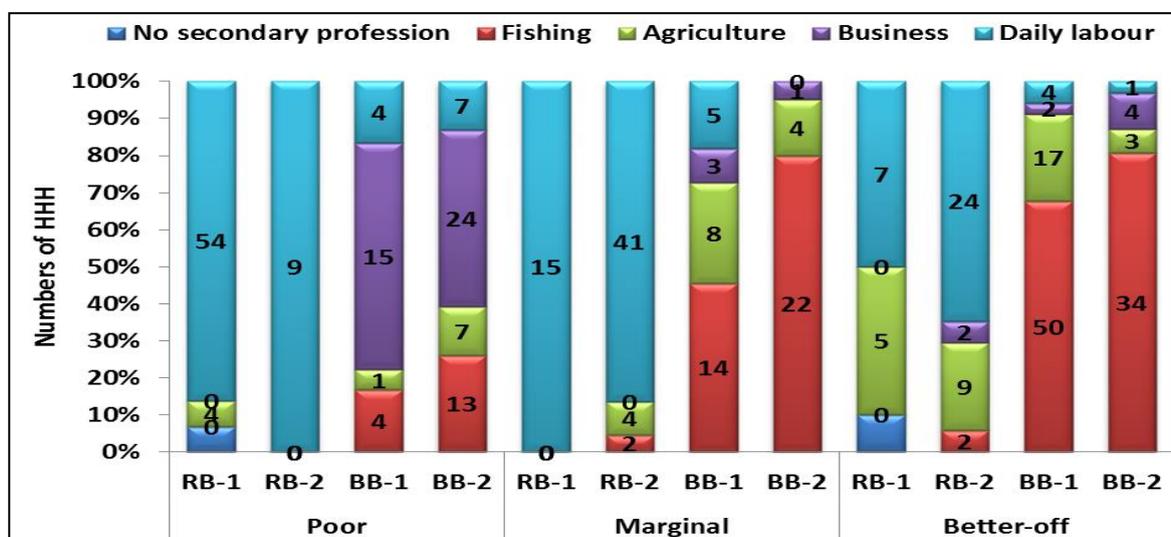


Figure 6. Distribution of fisher's household according to secondary occupation by location, season and well-being.

3.3. Financial capital

Financial Capital is a category of livelihood assets. Within the SL framework, it is defined as the financial resources that people use to achieve their livelihood objectives.

3.3.1. Income

The results of total income have been presented in the Table 7. Traditionally although fishing is the major and in some cases only source of income for fishers, individuals occasionally undertaken a variety of supplementary activities (business, agriculture, livestock, labour and others sources) which constitute a substantial part of their annual income. In the present study, the mean total income from all the sources together were 887.03±259.62, 1007.46±281.35, 991.06±271.78 and 943.78±264.94 for RB-1, RB-2, BB-1 and BB-2, respectively which was ranged from 547.50 to 1884.76 US\$ for RB (both year together) and 438.09 to 1784.02 US\$ for BB (both year together). The highest part of income were come from fishing contributing 63.9% (566.84±107.83 US\$), 64.89% (653.72±128.82 US\$), 43.58% (431.89±74.66 US\$) and 39.60% (373.70±62.34 US\$) for RB-1, RB-2, BB-1 and BB-2, respectively. The second highest income was from livestock in case of RB (15.2%) whereas in

case of BB the second highest income was added to total income from agriculture (23.17%). The income from all the sources was increased by 13.58% in case of RB however, income decreased by 4.77% in BB. There was no differences in yearly mean income by well-being between years ($P>0.0$) sites ($P>0.05$) (Table 7a). Comparison between total income and national is shown in Table 8.

Table 7. Mean income of the HH of RB and BB.

Site	Year	N	Mean	Std. Deviation	Minimum	Maximum
Ruhul <i>beel</i>	1st year	46	887.03	259.62	625.77	1884.76
	2nd year	46	1007.46	281.35	547.50	1722.53
Bamonji <i>beel</i>	1st year	74	991.06	271.78	438.09	1722.61
	2nd year	74	943.78	264.94	520.27	1784.02

Table 7a. Analysis of variance (ANOVA) of the effects of sites and years on mean income of fishers in RB and BB.

		SS	df	MS	F	Sig.
Total Income * Year	Between Groups	17354.96	1	17354.96	0.24	0.628
Total Income * Site	Between Groups	23102.55	1	23102.55	0.31	0.576

SS= Sum of squares, MS = Mean of squares and df= degree of freedom.

Table 8. Comparison between total income and national.

		1st year		2nd year	
		HHH	%	HHH	%
Ruhul <i>beel</i>	≤National average Income	41	89.13	38	82.61
	>National average Income	5	10.87	8	17.39
	Total	46	100	46	100
Bamonji <i>beel</i>	≤National average Income	62	83.78	65	87.84
	>National average Income	12	16.22	9	12.16
	Total	74	100	74	100

3.4. Food and Nutrition

3.4.1. Monthly frequency of HH by food intake

Total 46 HH from RB and 74 HH from BB were observed for food intake survey. The fish intake was found to increase in marginal and better-off household and to decrease in poor HH for RB. Fish intake among the well-being categories, location and year was varied significantly ($\chi^2= 9.56, 16.11, 12.85, 15.20$; and $P<0.01, 0.001, 0.05, 0.01$ for RB-1, RB-2, BB-1 and BB-2, respectively). The meat, egg and milk consumption frequency in poor households was decreased however increased in marginal and better-off category. Consumption frequency of meat (day/HH/month) was not significantly different among by well-being, location and year ($P>0.05$). The egg intake frequency in all the fishers from both *beels* were <10 days per month other than only one household in marginal of RB-2 (Table 9). The egg intake was significantly ($P<0.001$) affected in RB by well-being, location and year however not in BB ($P>0.05$) (Table 9a). Milk intake was not significantly ($P>0.05$) affected by the variation in total income, sites and years for both the *beels*.

Table 9. Monthly food intake (HH/month) by well-being and rank (Very low = ≤10, low = >10≤15, medium = >15≤20, high = >20).

	Poor				Marginal				Better-off			
	RB-1	RB-2	BB-1	BB-2	RB-1	RB-2	BB-1	BB-2	RB-1	RB-2	BB-1	BB-2
Fish intake												
Low (>10≤15)	0	0	4	6	0	0	4	3	2	2	6	5
Medium (>15≤20)	12	1	9	12	1	8	13	13	3	7	23	20
High (>20)	17	6	5	5	6	14	5	4	5	8	5	6
Meat intake												
Very low (≤10)	29	7	18	23	7	22	22	20	10	17	34	31
Egg intake												
Very low (≤10)	29	7	18	23	7	21	22	20	10	17	34	31
Medium (>10≤15)	0	0	0	0	0	1	0	0	0	0	0	0
Milk intake												
Very low (≤10)	29	7	18	23	7	22	22	20	10	17	34	31
Vegetables intake												
Very low (≤10)	5	0	9	12	3	2	7	5	5	1	12	11
Low (>10≤15)	16	4	9	11	2	17	14	14	3	14	21	19
Medium (>15≤20)	8	3	0	0	2	3	1	1	2	2	1	1

Table 9a. Chi-square value of Food intake*Total income*Year*Site Cross tabulation.

Year	PC*	Fish		Meat		Egg		Milk		Vegetables	
		PC Value	Sig. (2-sided)	PC Value	Sig. (2-sided)	PC Value	Sig. (2-sided)	PC Value	Sig. (2-sided)	PC Value	Sig. (2-sided)
RB-1	PC*	9.561 (a)	0.008	8.836 (a)	0.065	17.145 (a)	0.000	6.121 (a)	0.634	15.122 (a)	0.019
RB-2	PC	16.112 (b)	0.000	5.475 (b)	0.065	28.053 (b)	0.000	12.866 (b)	0.117	18.815 (b)	0.001
BB-1	PC	12.852 (c)	0.012	.816 (c)	0.665	3.403 (c)	0.182	13.101 (c)	0.665	24.265 (c)	0.000
BB-2	PC	15.202 (d)	0.004	4.586 (d)	0.101	1.487 (d)	0.476	17.267 (d)	0.369	28.468 (d)	0.000

PC= Pearson Chi-square

3.4.2. Contribution of income from fishing in total income

In all well-being categories for BB, contributions of income from fishing were decreased. But in marginal and better-off categories the income from fishing were increased and decreased in poor (Figure 7).

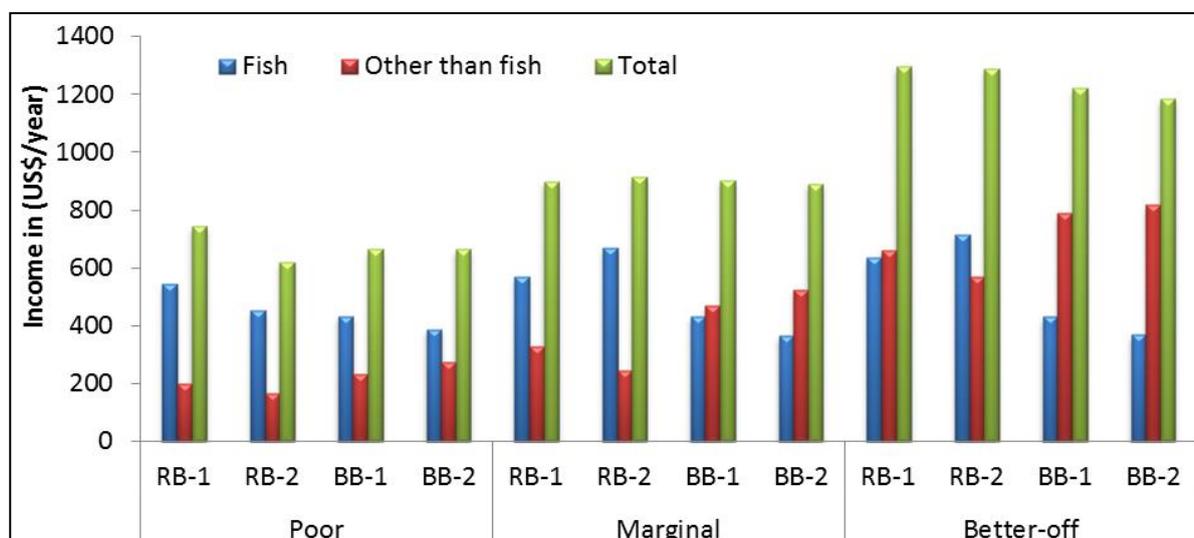


Figure 7. Comparison among total income, income from fishing and in income from other than fishing during the study in RB and BB.

3.4.3. Per capita fish intake by well-being groups

The results of per capita fish intake have been presented in the Table 10. The per capita fish intake was ranged between 46.10 and 55.94 gm/capita/day for RB whereas it was ranged between 40.96 and 52.6 gm/capita/day for BB during the whole study period. Overall fish intake was increased 11.61% in RB and decreased 9.77% in BB. In the poor fish intake/capita/day was increased 4.11% in RB and decreased 8.19% in BB whereas in case of marginal and better-off well-being category the fish intake/capita/day was increased 4.77% and 14.40% in RB, respectively. However, fish intake/capita/day was decreased 6.59% and 11.14% in BB, respectively. There was a significant differences in per capita fish consumption between well-beings ($P < 0.01$) and location ($P < 0.05$) but there was no significant differences among years (Table 10a).

Table 10. Per capita fish intake and changing trends.

Well-Being	Year	Kg/year/capita	gm/day/capita	Trends
Poor	RB-1	16.83	46.10	4.11
	RB-2	17.52	48.00	
	BB-1	16.29	44.61	-8.19
	BB-2	14.95	40.96	
Marginal	RB-1	17.99	49.29	4.77
	RB-2	18.85	51.64	
	BB-1	16.94	46.41	-6.59
	BB-2	15.83	43.35	
Better-off	RB-1	17.85	48.90	14.40
	RB-2	20.42	55.94	
	BB-1	19.00	52.06	-11.14
	BB-2	16.89	46.26	
Total	RB-1	17.23	47.20	11.61
	RB-2	19.23	52.67	
	BB-1	17.73	48.57	-9.77
	BB-2	16.00	43.82	

Table 10a. ANOVA Table per capita fish intake and changing trends.

		df	Site		Well-being		Year	
			F	Sig.	F	Sig.	F	Sig.
Kg/Cpaita/Year	Between Groups	1, 2, 1	6.457	0.012	6.479	0.002	0.324	0.570
gm/capita/day	Between Groups	1, 2, 1	6.457	0.012	6.482	0.002	0.324	0.570

3.5. Natural and social capital

Natural Capital is a category of livelihood assets. It is the term used for the natural resource stocks such as trees, land, clean air, coastal resources upon which people rely for their livelihood.

In the present study, it was found that some household heads have no cultivable land and depended on a small piece of homestead land for housing, food and income. The overall average used land holding was 0.274 ± 0.136 ranging 0.065 ha to 0.534 ha for RB and 0.228 ± 0.305 ha ranging 0.040 to 0.267 ha for BB (Table 11). The average land holdings did not vary significantly ($P > 0.05$) between the sites.

Table 11. Mean land properties of fishers in RB and BB.

Sites	Own Land (ha)	Range (ha)		Lease Land (ha)	Range (ha)	
		Min	Max		Min	Max
RB-1	0.274 ± 0.136	0.065	0.534	0.136 ± 0.045	0.040	0.267
RB-2	0.274 ± 0.136	0.065	0.534	0.184 ± 0.076	0.121	0.405
BB-1	0.228 ± 0.305	0.032	2.138	0.181 ± 0.105	0.040	0.607
BB-2	0.228 ± 0.305	0.032	2.138	0.181 ± 0.107	0.040	0.607

4. Discussion

The nature of residence and housing conditions indicates the social status of the people. During the study it was found that more than 50% households were marginal by well-being. All the fishers of both *beels* lived in own house except one from RB. There was no significant variation ($P > 0.05$) in residences by well-being. All

together 91.3% of fishermen's houses were katcha, 6.52% were semi-pacca and only one fisherman had pucca house in case of RB and in case of BB 90.54% of fishermen's houses were katcha, 8.11% were semi-pacca, and only 1.35% were pucca. There was no significant variation ($P>0.05$) among the residences by well-being. The condition of fisher's living house in old Brahmaputra river side and Basantapur *beel* area were found similar to present study (Rejwan *et al.*, 2012) and Bashar,1995) which indicates that all the fishermen fishing in the freshwater *beels* and rivers have the same poor housing conditions, it might be due to their poor income. There were no significant effect on residence and housing status with the establishment of fish sanctuary in RB.

Overall 39.23% 67.30% household had electricity connection in RB and BB, respectively. The higher number of HH with electricity availability was of marginal by well-being. It was found that electricity facilities were comparatively lower in RB than that of BB. There were no changes in RB and BB with the establishment of fish sanctuary. A significant difference was found between locations (but not between years) for electricity availability ($P<0.001$) and sanitation status ($P<0.001$). The present result was different from the findings of Shamima (2000) which might be due to the geographical location and socio-economic status of the fishermen.

In case of RB 97% and in case of BB 89% fishermen had their own tube-well which is supported by the findings of Rejwan *et al.* (2012). The status of access to drinking water was not affected by the establishment of sanctuary which is might be due to the access to the safe drinking water was established before sanctuary.

The higher per cent of HH were found in medium age group in the present study which was also similar to the result of Karim (2006). A slight deviation was found with the findings of Islam (2012) in case of the fishers of Kishoregonj which might be due to the different location. In marginal category, all the age group was increased in RB. In case of BB there was no change in medium and old age group however decreased in young group.

The overall midium sized family was found dominant both for RB (83%) and BB (81%). The mean household size of the fisher's population surveyed for both *beel* were from 4.70 ± 1.24 to 4.76 ± 1.12 for RB and 4.53 ± 1.10 to 4.55 ± 1.05 for BB ranging from 2 to 7 for both the *beels* which was supported with the finding of Karim (2006) and Rejwan *et al.* (2012). Family size was not affected by well-bing, location and years ($P>0.05$) in the present study which was supported by (Karim, 2006). The result of the present study showed that bigger size family was found in poor for both *beel* and the comparatively smaller sized family was found in marginal for both the *beels*.

From the present study it was observed that all the fishers were Muslims except one respondent in RB which might be due to the 99% population is muslims, which was quite different with the results of Karim (1994) and Rejwan (2012). There was no significant differences ($P>0.05$) in marital status of fishers among location, years and well-being. All the household head were married except 2% from RB-1 in marginal category and 4% better-off from BB-1 but 1% marginals each from BB-1 and BB-2. The religious and marital status was not affected by the establishment of sanctuary.

In the present study, educational qualification of the fisher's HHH was very poor where the highest degree was upto JSC and majority (71.74%) of fishers were able to sign only in RB. The capability of sign in RB was increased (71.62% to 78.38%) by the motivation and acitivities by DoF under GPFDP (Greater Pabna Fisheries Development Project). Tanjeena *et al.* (2006) found the majority of the fishers were able to sign only which was similar to the present study however, the present result was not similar to the findings of Rejwan *et al.* (2012) and Mahbubur (2001). On the other hand, frequency of dropout children was decreased in RB (41.18%) and increased in BB (24.49%) which might be due the motivation activities arranged by fisheries office staffs and also might be due to up-gradation of their economic status and well-being.

The main occupation was fishing in RB which was similar to the work of Rejwan (2012) and Dev (2011). There was no change in main occupation in RB whereas in BB decreased 14.86% who were migrated to another IGA. So the fishing was then changed into secondary occupation. Secondary occupation was positively changed side by side into business (1.27%) for RB of better-off category. So it might be concluded that the changes in occupation was affected by the establishment of sanctuary.

The income from all the sources except labour and others was more or less increased in case of RB but decreased in BB whereas in BB income from others sources was about to same as before except agriculture and labour. Total income was increased 13.58% in RB and decreased 4.77% in BB which might be due to establishment of the fish sanctuary in RB. Fishing income of the present study area was highest 64.89% and 43.58% of total income in RB and BB, respectively which is supported with small variation by the findings of Karim (2006). The majority of HHH's income was $>500\leq 800$ US\$. It was revealed from the present study that the positive trends were observed in marginal and better-off fishers whereas vice versa was found in BB. The income from fishing was higher from in the present study than the findings of Karim (2006), DANIDA (2004) and CNRS (2000). Although the result of present study was far difference from the above researchers however it was somewhat relevant to FAP-16 (1994). On the other hand, vice versa was occurred in case of BB. However,

in case of marginal category the average income was increased in RB and decreased in BB. The upliftment and changes in income were might be due to the establishment of fish sanctuary in RB.

Per capita fish consumption of the fishers of the study area was higher than that of BB. Fish intake by the fishers of RB-2 was more or less similar to national fish intake rate (DoF, 2014). The total amount of fish consumed by the households of RB was higher. BB households purchased more fish from the market and wild sources than RB households which was closely related to the findings of Karim (2006) and Thompson *et al.* (2005). Overall better-off households' consumption (amount and frequency) was found to be higher than marginal and poor in the present study. It might be concluded that the fish intake was increased in RB due to the availability of fishes which was caused the establishment of fish sanctuary.

The Fishermen were classified into three groups according to natural assets (≤ 20 , $>20 \leq 50$, >50 decimal). Majority of HH's land property was ≤ 20 decimal (83% in RB and 54% in BB). Positive change was found in RB for ≤ 20 category. There were no significant variation in ($P > 0.05$) HH frequency by land properties, well-being, sites and years. Land holdings were a critical requirement for livelihoods of any households and play a significant role in the socio-economic status of people especially in Bangladesh (Khan, 2004). In the present study, it was found that some HHH have no cultivable land and depended on a small piece of homestead land for housing, food and income. The average land holdings did not vary significantly ($P > 0.05$) between the sites and years which was supported by the findings of Karim (2006). There was no changes in own land and lease land in BB. However, average lease land was increases 35.29% in RB which might be due to the establishment of fish sanctuary.

5. Conclusions

There are a series of small *beel* under the Chalan *beel* which is quite different from biodiversity, water depth, hydrography, physico-chemical characteristics and biological conditions. A large no. of fishermen depends on those *beel* for their sustainable livelihoods. Fishers are able to gain physical assets, human assets, financial assets as well as natural and social assets through sustainable fishing from Chalan *beel* due to establishment of fish sanctuary and management it through legal and other effective means.

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Conflict of interest

None to declare.

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