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Understanding livelihood status of fishing communities to the impact of climate change in the coastal areas of Bangladesh

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Abstract

This study assessed the livelihood status and vulnerability context of Bangladeshi coastal small-scale fishing communities to the impacts of climate variability and change. The study was carried out in two villages of Patharghata upazilla in Barguna District, Bangladesh and data were collected from a purposively drawn sample of 90 fisher's households. Following a mixed-method approach the data were collected using household questionnaires, key informant interviews as well as from secondary sources. A conceptual framework known as Sustainable Livelihood Approach (SLA) were used for vulnerability assessment. Most of the fishermen belong to young aged group and their educational and training status was very low. Ownership of different livelihood assets among fishermen were not satisfactory. The fishing households is more exposed to climatic variability and change that promoted the impacts of sea level rise, land erosion, cyclones and associated flooding which influence all the livelihood assets and strategies of fishing communities. Most of the households have lower access to sanitation, market transportation, health facilities, GO and NGO services during adverse climatic situation. Increased levels of cyclones and floods will result in greater damage of fishing equipment's, livelihood assets and lower level of fish catch. Income from fisheries related activities were found reduced by reduction in fish catching which in turn affecting their livelihoods. About 51.67 percent of the sampled households were highly vulnerable i.e., they have greater probability to fall in future income vulnerability. This study recommends for similar studies in other parts of country to develop a benchmark for comparison.

1. Introduction

Bangladeshis have a long tradition of fishing and fish culture which contribute significantly to employment, income generation, export earnings and human nutrition. This sector supports livelihoods of about 7 million fishers directly and 12 million people indirectly and contributes 3.61 percent to GDP and 2.73 percent to export earnings (DoF, 2018). Most (93%) of the marine fishing is small-scale in nature and supports the livelihoods of over half a million fishers and their household members (DoF, 2018) living in fishing communities. Bangladesh has been identified as one of the most vulnerable countries due to climate change. The economy of Bangladesh will be amongst the most vulnerable to climate change impacts on fisheries by the 2050s (Allison et al., 2009). The projected climate change may directly impact on the fish stocks and the Bay of Bengal ecosystems, and on the livelihoods of the fishery-dependent people in Bangladesh. In general, the impacts of climate change between the Bangladeshi coastal small-scale fishing communities and those of other parts of the world may have some level of similarity as the nature of this fisheries system varies little across the world. Climate change may result in an increased level of fluctuation in fish production in Bangladesh (Ahmed et al., 2002). In addition, marine fisheries support the livelihoods of other

households involved in ancillary activities such as fish processing, gear making and so on. Fishers are found solely dependent on fishing, economically insolvent, and neglected (Sunny et al., 2021).

Several studies have found poor physical infrastructure in the coastal fishing villages of Bangladesh and most people live in poor socioeconomic conditions (Akter et al., 2009). They have also found that most of the households cannot eat regularly, have little education, and have only moderate public health provision. Some get financial assistance from the government and international donors (Hasan et al., 2004). These small-scale fishermen had limited involvement with local administration, and around half of them were members of various NGOs (Tikadar et al, 2022). Local village leaders tend to make community decisions and resolve most family conflicts, although sometimes elected local government representatives such as the chairmen and members of "union parisad" (a local government unit) resolve conflicts (Ahmed et al., 2009). Most of the fishers catch fish with boats and gear, although a small number of them do not have a boat and operate only with small (push/pull) nets near the shore.

Climate variability and change are predicted to impact on coastal and marine small-scale fisheries and dependent communities. Cyclones and associated floods may exert tremendous impacts on fishing assets, infrastructure and ultimately on the livelihoods of fishing communities. More frequent and intensified cyclones can further reduce fishing days. In coastal Bangladesh cyclones of very high intensity may occur in April and May, and between September and November (Met Office, 2011). Most of these months fall within the fishing seasons and consequently fishing activities may be impacted by intense cyclones. Traditional fish drying activity may also be impacted by increased temperature and variation in rainfall as well as by extreme climate and weather events. Sea level rise and land erosion may make the current living areas of fishing communities unsuitable and may result in their displacement or may leave them in a more vulnerable situation. This study assessed the livelihood status of fishers and the vulnerability of Bangladeshi coastal small-scale fishing communities to the impacts of climate variability and change. The specific objectives of this study are to: 1) To examine the livelihood status of the fishing community in the coastal area. 2) To assess the vulnerability of fishery-based livelihoods to the impacts of climatic changes. The findings of such a study could also contribute to an understanding of these issues in other parts of the world with similar environmental, socio-economic and livelihood conditions.

2. Materials and Methods

To achieve the objectives of the present study, a preliminary household's survey was conducted to get a clear idea about the research area to understand the broad livelihood characteristics of the respondents. To select the households randomly, a list of the fishing villages was collected from Patharghata Upazilla office. Two villages namely Lakurtala and Hatempur under the Patharghata upazilla of Barguna were selected for the study. These two villages were selected because these villages would represent the objectives of the study. The study uses purposive random sampling technique to make a representative part of the fishing community. The total number of households in these two villages was 265 among them 70 households were involved in fishing activities. The sample frame contained 90 fishing households who were randomly selected as a sample unit from 105 households. For better information, almost all of the respondents were household head because the household head have a good sense of household. Both primary and secondary data were collected through mixed method approaches. Data collection was implemented based on observation and survey method. Data on the livelihood condition of the fishermen was collected survey indicators such as- age distribution, fisherman type, family size, religious status, educational status, housing, social status, access to different livelihood assets, income, expenditure and training facilities. Data were collected during October-November 2021. Most of the data were collected during 9 October to 30 October because the government of Bangladesh banned to catch fish at that time. They were interviewed by their houses and Riversides only when they were available. Secondary data was collected from various scholarly articles and relevant literature. Data were presented mostly in the tabular form, because it is simple in calculation, widely used and easy to understand. Some statistical measures like average, percentage and ratios were calculated to arrive at expected findings.

Livelihood encompasses the individual or household assets, the activities and strategies in which they are engaged, and the processes that mediate access to assets, activities and strategies to generate livelihood outcomes. The five capital of livelihood system is adopted here from the sustainable livelihood framework (DFID, 1999). The livelihood assets of fishery-dependent people can be grouped into five categories known as five capital assets: natural, physical, human, financial and social capital. These capital assets are also termed as the "livelihood platform" or "building blocks of livelihood" (DFID, 1999) and form the fundamental basis of adaptive capacity for fishery-dependent people. Improvement in each of this capital is in turn dependent on various indicators. Natural capital depend on natural resources such as fish stock and aquatic habitats as well as the non-fisheries resources from which benefits flow to fishery-dependent people; physical capital includes fish landing centres, gear stores, ice plants, boats, engines, nets, processing equipment, as well as non-fisheries resources such as roads, dams, houses, schools, markets, hospitals, water supply systems and cyclone shelters; financial capital depend on cash, bank deposits or liquid assets (such as

livestock and jewellery) and regular inflows of money such as remittances. Human capital includes knowledge, skills and health. These include education levels, fishing skills and physical ability to work. Finally, social capital measures in terms of social support networks and local bonding relationships.

3. Results and Discussion

3.1 Climatic shocks

From Table 1, it is found that floods, cyclones and sea level changes are the main determinants of livelihood vulnerability in the study area but how exposure create vulnerability depends on the context of the community. According to the almost all participant's the most important determinant of vulnerability in land is floods, while at sea it is cyclones. About 66.67 percent households are more vulnerable to sea level change, whereas 63.33 percent and 56.67 percent for floods and cyclones respectively. High level of vulnerability was found in case of cyclones (28.88%).

Table 1. Effect of different shocks and stress

Shocks and stresses	Level of effect (%)		
	Less	More	High
Cyclones	15.0	56.67	28.33
Floods	13.3	63.33	23.33
Sea level changes	18.33	66.67	15.0
Land erosion	50.0	33.33	16.67
Variations in temperature and rainfall	58.33	30.0	11.67
Others	0.0	0.0	0.0

Source: Author's estimation based on field survey, 2021

In the study area cyclones are typically followed by surges (floods) and together they cause vastly adverse impacts on household livelihood assets (11.7%), infrastructure (6.7%), Livelihood activities (13.3%) and overall livelihood (63.3%). Other exposures have little or no impact on livelihoods. Land erosion and sea-level rise have resulted in the dis-placement different infrastructure of about 13.4% of the households. While variations in maximum temperature and rain-fall have impacted of fish-drying process. Variation in past minimum temperature has not found to pose any considerable negative impacts on livelihoods in either community.

Table 2. Impact of climate change on different capital

Types	Degree of changes (%)		
	Increased	Constant	Decreased
Fish catch	13.33	33.33	53.34
Fish consumption	63.3	36.7	0.0
Household members capability	13.33	53.33	33.33
Household income	12.22	36.67	51.11
Household expenditure	58.89	36.67	4.44
Households saving	13.33	18.89	67.77
Ownership of fishery related assets	15.55	46.67	37.77
Ownership of non-fishery related assets	15.0	43.33	41.67
Relation with relatives and neighbors	13.33	63.34	23.33
Support from GO and NGO	8.89	72.22	18.89

Source: Author's estimation based on field survey, 2021

3.2 Livelihood assets under climate changing situation

3.2.1 Human Capital

Human capital is an intangible asset or quality of human. There is a strong relationship between human capital and economic development of a household. Human capital includes skills, knowledge, ability to lab or and good health.

Type of fishermen and working hours:

Fishermen could be categorized into three groups based on their practice named as occasional, Part-time and Full-time. Full-time fishermen (50%) were nearly 3-times than part-time fishermen (20%) and (30%) occasional. Occasional and part-time fishers rely mostly on agriculture, fish farming, small business and livestock rearing for their livelihood. More frequent and intensified cyclones can reduce their fishing days. The average working hour of the fishermen was almost 7 hours. The maximum working hours was 12 hours and lowest 4 hours.

Family size and age distribution:

From the selected households, the highest number of family members is 7. Maximum number of families has 4 members (43.3%). Family size categorized into three groups: small, medium and large. Small family size was up to 4 members, medium family was from 5 to 6 members and large family was above 6 members. The maximum number of family are small i.e., 63.3 percent of household were small. 31.7 percent of the families were medium and the rest 5 percent were large family. It was cleared that there was very little number of extended family in the selected households. The national average household size is 4.06 (HIES, 2016). Average family size of the sampled households was 4.32 and higher than the national average. Deb et al (2016) found the average family size was 5.58 persons where male and female was 2.86 and 2.72 respectively.

Age of the fishermen varied from 30 to 72 years. Based on their age, the fishermen were classified into four groups and the groups were 0 to 14 years, 15 to 49 years and 50 to 59 years and above 60 (DGHS, 2019). Among the selected samples majority of the fishermen i.e., 55 percent were belonged to the age group of 15 to 49 years. The national average of this age is 54.6 percent (DGHS, 2019). So, there was almost same number of fishermen between this age group (i.e., 15 to 49) with the national average. There were no fishermen between the age group of 0 to 14 years. Among the selected fisherman 28.3 percent were in the age group of 50 to 59 years and only 16.7 percent were in above 60-year age group. According to DGHS (2019), the national average of the age group 50 to 59 years and above 60 years is 8.7 percent and 7.9 percent respectively. In the selected area there was higher number of fishermen between the age group 50 to 59 years than the national average and the workers above 60 years were also higher than the national average. Fatema & Nur (2020) found that the majority of the fishermen (77%) belonged to the age class >35-50 years and were dominated by Muslims (89%).

Educational and religious status:

The educational status of fisherman community was very poor. There was no graduate and better education level of fishermen. Fishermen's children become fishermen traditionally. They did not want to send their children in school because they thought that if their children worked as fisherman, it will be supportive for them to maintain their life. It was very rare that their children had passed secondary school. Maximum household had children's who did not complete primary education. In the two villages literacy rate was very low. Most fishermen often could signature only, but maximum portion of them were illiterate. When the researcher visited the village's fishermen said that they want to send their children in school but the educational cost was not in their capacity. They were low earners, so their main attention was on the earnings. In present situation it was difficult to maintain their normal life with this earning. For this reason, the fishermen were eager to include their children in fishing activities. 46.7 percent of the respondents had passed primary, 30 percent were illiterate and only 23.3 percent had passed secondary. The national literacy rate of Bangladesh is 73.2 percent (DGHS, 2019). In the selected study area total literacy rate was 70 percent which was almost near to the national average. Maximum fishermen were study almost up to class two or three. But the illiteracy rate of the study area was also higher i.e., 30 percent from the national illiterate percentage. According to the response on religious belief 46.67 percent fishermen are Muslims and majority (53.33%) fishermen are Hindus. Here the study showed higher involvement of Hindu community in fishing in the study area. Bhuyan et al. (2016) noted that 63 percent of the fishermen were Hindus while the remainder belonged to Muslims (27%) within the Narsingdi district. Muslims are coming to this profession is an increasing number through breaking the previous norms and value of the society.

Earning and unemployed members of the selected households:

Maximum members in the selected household were worked as fisherman. Other household members of the family were depended on these working members. In the selected households, there was no households those had no earning members less than two. The number of households with two earning members was 28 percent and 72 percent with three earning members. Among the selected households, there were 25 households with no unemployed members mean that all members of these households were involved in different income generating activities. About 50 percent of total households had one unemployed member.

Health status:

From the household interview, it was found that health facilities of the fisherman were not good and maximum number of the fishermen were dependent on village doctors, while few fishermen got health service from upazila health complex and MBBS (Bachelor of Medicine, Bachelor of Surgery) doctors respectively. Ali et al. (2008) found that 46% of the farmers received health service from village doctors, 18% from upazila health complex, 14% from district hospital and 20% from MBBS doctors. Fishermen claimed that in recent time, they suffered different types of diseases because they lacked good food and the environmental conditions were not good. The number of days fishermen were sick in the last 12 months ranged from 6 to 35 days. About 43.3 percent of fishermen were unable to carry out work for 26-35 days in the past twelve months for their sickness. They claimed that they eat adulterated foods and vegetables. On the other hand, fishermen claimed that weather (increasing temperature) is another reason

of their bad health condition. They fail to supply sufficient amount of nutritious food for their family members which reduced their working capability. Physical injuries are often associated with climatic shocks and stresses which can reduce the physical ability of fishers to pursue their livelihoods (Badjeck et al., 2010).

Participation in skill enhancement program:

About one-fourth (23.33%) of the members received training on one or more than one related matter, 76.67 percent have no training. Rahman et al. (2017) reported that 80 percent of fisherman in the pond system of the Muktagacha upazila weren't received any training whereas 20 percent had training experience. From table 2, it is revealed that the operation capacity of the 33.33% households' members was deteriorated where 53.33% household member's capacity remain constant. The participants wanted more income generating training based on local opportunities. They required more training to keep people busy with livestock and poultry rearing activities.

3.2.2 Natural capital

Agricultural land and pond:

It was found that, a significant number of fishermen households (71.67%) had no agricultural land. Agriculture is that the second profession in most of the fishermen but shortage of agrarian land influence them to elect others. Most of the respondent households use pond water for cooking, bathing, washing clothes. It was found that, 64 percent of fisherman family had no pond they used neighbors pond water. Sometimes they used river water for their household activities.

3.2.3 Physical Capital

Two categories of physical capital owned by the households: fishery related and non-fishery related assets.

Ownership of fishery related assets:

About 63 percent of the households own fishery related physical assets. Most of the respondent said that, the existing fishing equipment are no longer fitted for current fishing activities. 63.3 percent households own private boat and net and they complaint that their nets and boats are no longer suitable for use, given that the catch from the nearby area is decreasing. Only 4 households had the ownership of Arot.

Ownership of other physical assets:

The households also possess some physical assets related to the agrarian cultivation and recreational opportunity such as motor tiller (10%), wooden plough (30.0%), modern furniture (10%) and Jewelry (30.0%). They households use radio (30.0%) and television (25%) for enjoying drama, movie and recreational programs. They lived in very unhygienic condition and crowded condition as that sometimes people and livestock were lived in same single room. In the study area, all the fisherman (100%) live in their own houses and the average quantity of houses was 1.32 but very small in size. Similarly, Ahamed (1999) found that 92.22 percent of people prefer to live in their own house. 86 percent of the fishermen enjoyed electricity facilities, whereas 76 percent had solar panel which ensure uninterrupted electricity facilities at the residence. Islam et al, (2022) also found Approximately 93.22% of fishermen's homes were equipped with electricity. The present results suggest there's excellent opportunity of electricity facility within the study area. It was observed that the sanitary conditions of fishermen weren't good. At present 83.33 percent of fishermen have private sanitation facilities, followed by (10%) jointed and (6.67%) community-based sanitary facility. Besides, Kacha toilet system was dominated (56%). Only 4 percent of fishermen had building system toilet, and the rest of 25 percent and 15 percent fishers had a toilet with semi building and ring & slum respectively. Only 13.33 percent households own tubewell for drinking water which indicate lower level of drinking water facilities for them. It was too far from some families to collect water. Almost all the households use mobile phone to communicate with each other during climatic shock and stress situation. 10 percent of the household members use internet facilities. 43.33 percent households rear livestock and poultry for ensuring their food security in the crisis situation. Table 2 reveals that, ownership of fishery and non-fishery related capitals were also reduced after the income decreased due to climatic shock and variability were resulted by 37.77 percent and 41.67 percent responded respectively, while 46.67 percent and 43.33 percent respondents answered no changes on such factors after the climate changing condition.

3.2.4 Financial capital

Financial income of the household was estimated by the summation of savings, fishery and non-fishery related income, credit accessibility from different institutions etc.

Access to loan and savings:

Most of the respondent did not possess any bank account. A vital portion of the studied fishing community (46%) was engaged in NGOs from which they took loan and deposit their savings. Almost all respondents received loans from NGOs (ASA, Grameen Bank). Interest rate of NGO loan was reported unreasonable by all the respondent. Kostori (2012) mentioned the high interest rate of the NGO loan. Now mobile financial services (MFS) played an important role in the study area. During the banned period of fish catching most of the fishermen (68%) receive government support which is not enough for them. Islam et al. (2013) observed that 60 percent of fishermen received

government facilities, 40 percent of received NGO's facilities. Most of the fishermen resort to the dadandars for finance, as a consequence they have to hand-over all their catches to the dadandars and do not even get the revenue or know the price of their fish on the day of catch and sale. Their access to the formal credit market (i.e., scheduled banks) is virtually inexistent due to their lack of bankable assets. The results from (Alam et al, 2021) revealed that, about 50% fishermen received dadon, of which 42% took dadon from aratder, 4% from mahajon and 4% from the relatives or friends. In case of saving 67.77 percent of the household response as their household savings was reduced due to declined trend of income earned from fisheries and increased expenditure while 18.89 percent respondents mentioned that no alteration in saving took place.

Annual household income from fishery and non-fishery related activities:

The source of income is divided into three broad categories: Fishery, non-fishery and other sources of income. Fisherman cannot fish properly in the coastal area due to economic, social and technical constraints. They fail to earn sufficient amount of money to meet their basic need. The highest average annual income ($ 744.79) was found in case of the household serving as crew or fisherman. A few percentages of the households involved in fish trading (20%) and fish farming (15%). The average annual income from fish trading and fish farming was not satisfactory in the study area. Some of the households involved in non-fishery related activities farming (31.67%), agricultural labor (23.33%), Cattle/poultry rearing (13.33%) and business (10%). It has been observed in this study most of the fishermen earned lower than the national per capita income. Only few who involved with other activities had higher annual income. Islam et al. (2013) found that mean monthly income of the fishermen was $118.38 in Monirampur sub-district of Jessore, Bangladesh. Form Table 2 it is evident that 51.11 percent of the households advocated that their household income was reduced while 36.67 percent responded that no change in their household income has taken place. In case of household expenditure, 58.89 percent of the households felt that their expenditure was increasing with the increase of the market price of various essential products.

Table 3. Income from fishery and non-fishery related activities

Source of income	Household (%)	Average income (USD/ year)
Fisheries related activities		
Crew/fisherman	100.0	744.79
Labour in other fisheries activities such as in fish drying, net making, boat repairing etc.	100.0	140.00
Fish trading (income calculated after deducting expenses)	20.0	25.00
Fish farming (income calculated after deducting expenses)	15.0	34.72
Others	0	0
Non-fisheries related activities		
Agricultural farming (income calculated after deducting expenses)	31.67	303.57
Agriculture labourer	23.33	43.18
Cattle/poultry rearing (after deducting expenses)	13.33	29.28
Business (income will be calculated after deducting expenses)	10.0	48.20
Others income (such as gift, donation, interest, etc.)	0	0.00

Source: Author's estimation based on field survey, 2021

Seasonal fluctuation of income and expenditure:

A wide range of variation was found in case of monthly income and expenditure among the respondent households. In the month of January, February and March almost all the households had no income and that time the livelihood of the fishing community falls into risky situation. They fail to fulfill their daily basic necessities. The highest income of the households was found in the month of June, July and August. Another six month they had average income for maintaining their household expenditure. Their monthly expenditure depends on their level of monthly income. They had more income and expenditure in the month of July. It is revealed that if the income increases then the expenditure of the fishing households also increases and vice versa.

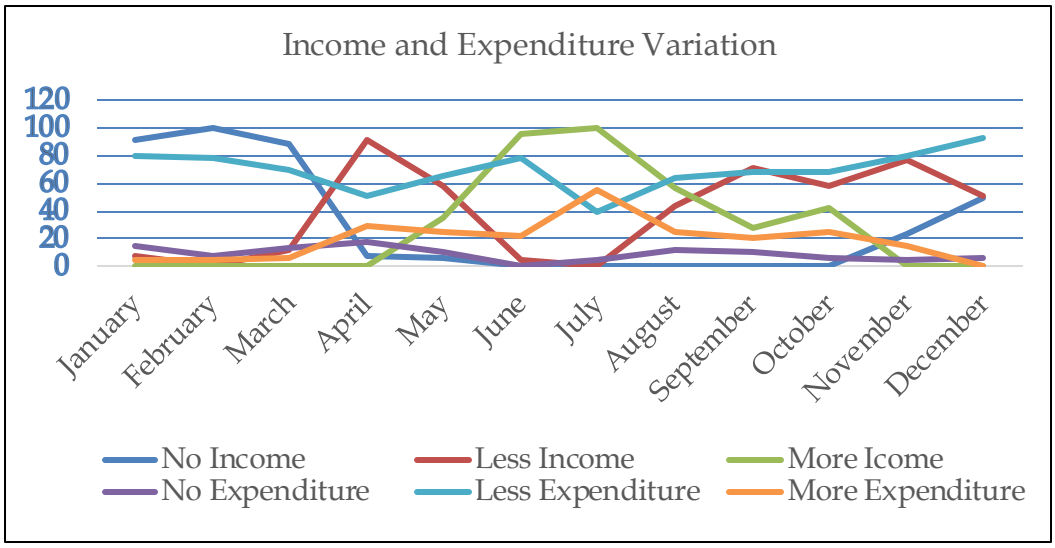

Figure 1. Percentage of monthly income and expenditure variation

3.2.5 Social capital

Climate change may bring up conflict between resource users, which may harm the social relationship, cohesion, trust, solidarity and informal institutions amongst households both within and between fishing communities. Changes in abundance and distribution of fish stocks due to climate change could lead to conflicts over property rights and resource access (Badjeck et al., 2010).

Relation with relatives and others:

Most of the respondent's household have their relatives in the villages (68.33%) and outside the villages (100%). They also maintain good relation with their relatives, friends, and neighbors in the villages and outside the villages. About 31.67 percent households participate in different social organizations whereas 16.67 percent household participate in a group support programme during adverse climatic condition. Only few households (11.11%) members were involved in different political activities. In case of relationship with relatives and neighbor's 13.33 percent of the respondent household opined that their relationship with neighbors and relatives has increased while 63.34 percent saying no alteration of their social relation among fishers and local people.

Support each other:

The condition of support among fishers and their relatives, friends, colleagues, acquaintances and neighbor was good. About 94.44 percent of the households support each other especially during climatic hazard. During unfavourable climatic condition the support from relatives also satisfactory. Only few (23.33%) households mentioned their connection with others was decreased.

Trend of support:

About half (51.7%) of the household shows constant support from others both in villages and outside the villages. Support from relatives in villages and outside of villages is increasing slowly which indicates positive relation among them. No notable change was found in the facilitation process of different government and non-government organizations for the fishing households. Only 8.89 percent respondents claimed that the support from GO and NGO was increased and 72.22 percent respondents mentioned the support system was constant.

4. Conclusion and Recommendation

In Bangladesh, fishing communities mostly in the coastal areas are more vulnerable under the serious threat of climate shocks and stress in terms of livelihood convenience. This study assessed the impacts of climatic change and adaptation strategies among fishing communities of Barguna district, Bangladesh. By examining the livelihood system of the selected fishing households, it was clear that their livelihood situation was so much pathetic. They needed to struggle in all situations to keep up their normal livelihood pattern. They were separated from the others community, which back warded them from the improved livelihood status. The findings of the study indicate that the livelihood status of the households differ from each other in respect of employed and unemployed members, skill enhancement programme, ownership of different assets, monthly household income and expenditure, access to loan, savings, relation with other community. Due to reducing catch, the income from fisheries related activities is reduced. Monthly

household income and expenditure were lower than national average. Earning members of the households were near to the national average. But most family members were engaged in fishing and do not earn money from off-farm activities. So, their income and ownership of livelihood capital is not satisfactory. The result of this study may be helpful to the policy makers and development workers in formulating plans for the development of fishing community.

The following specific recommendations are suggested:

Government needs to provide education and awareness about safety at sea to the fishers.

Some educational institutes should be built up in the adjacent area.

Some forms of NGO's activity must be ensured in the adjacent area for the improvement of the life leading status of the fishermen.

Health facilities should be ensured by the government assistance.

The Govt. should take some important step by providing some sorts of management policy as well as providing of some extra providence during the ban season of the fishing.

More innovative and extensive research are required to prepare better data-base information.

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