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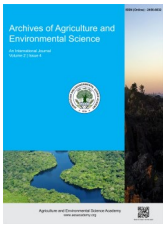

ORIGINAL RESEARCH ARTICLE

Capacity strengthening of fish farmers for improving their livelihood in Mymensingh district of Bangladesh

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ABSTRACT

This study examines the capacity strengthening status for improving the livelihood of fish farmers of Muktagacha upazila (sub-district) of Bangladesh. A mix method research design was used to collect data from 70 fish farmers of the study area. Nine selected demographic characteristics of the respondents were age, level of education, household size, farm size, fish farming experience, training received on fish farming, access to credit, extension media contact and organizational participation. Findings reveal that half of the respondents (50%) had moderate level of capacity strengthening score while considerable portion of the respondents (36%) had high level of capacity strengthening score. The livelihood status of fish farmers improved to a great extent in five aspects of livelihood (human, social, natural, physical and financial) due to the creation of income generating opportunities after their involvement in fish farming. This study concludes that fish farming has major contributions for the capacity strengthening of fish farmers for improving their livelihood status.

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INTRODUCTION

Bangladesh is a south Asian country located in between latitude 20°34' and 26°39' north and longitude 80°00' and 90°41' east. The country is crisscrossed with hundreds of rivers. The climate of Bangladesh is unique for aquaculture and fisheries resources management (DoF, 2016). Fisheries and aquatic resources are economically, ecologically, culturally and aesthetically important to the nation. In Bangladesh fisheries is one of the major sub sectors of agriculture, which play a dominant role in nutrition, employment, earning foreign currency and other areas of economy. Bangladesh achieved tremendous success in fish production in the last decade. Bangladesh ranked 3rd in inland open water capture production and 5th in world aquaculture production. In tilapia production, the country ranked 4th in the world and 3rd in Asia (FAO, 2018). On the other hand, the national fish Hilsa (*Tenualosa ilisha*) as a single species has been making the highest contribution to the country's total fish production. Hilsa accounts for about 12.21% of annual fish production by volume in the Fiscal Year 2019-20, contributing an estimated one per cent to the country's gross domestic product (GDP) (DoF, 2020).

Production of different varieties of fish has increased in the country over the last decade, due to government's prudent and effective policy. The country produced over 4.503 million tons of fish during the fiscal year (FY) 2019-20. Aquaculture accounts for 57.38% of the total fish production (DoF, 2020). Bangladesh becomes self-sufficient in fish production and accounts for 60% (with per capita of 62.58 g/day against targeted 60 g/day) of total daily animal protein intake of the whole population (FAO, 2014). Besides this, Bangladesh earns a considerable number of foreign currencies by exporting fish, shrimp and other fisheries or fishery products. The fisheries sector contributes 1.39% to the total national export earnings. Bangladesh

earned BDT 39,851.50 million by exporting almost 70.95 thousand tons of fish and fishery products during the FY 2019-20 (The Financial Express, 2021). In the Fiscal Year 2010-11, Bangladesh produced over one million tons of capture fish, 0.46 million tons of culture fish and 0.54 million tons of marine fish during the FY 2010-11 whereas after 10 years, during FY 2019-20, the country has produced- over 1.2 million tons of capture fish, over 2.5 million tons of culture fish and 0.67 million tons of marine fish (DoF, 2020). The fisheries sector is playing a vital role in the socio-economic development of the country, as it contributes 3.52% to the national GDP and more than one-fourth (26.37%) to the agriculture GDP (DoF, 2020). The fisheries sector in Bangladesh is broadly divided into three sub-sectors: inland capture, inland culture and marine fisheries (DoF, 2016). The inland fishery is further divided into two subsectors: the inland capture fishery and inland culture fishery. The inland capture fishery has five types of habitats containing approximately 853,863 ha of river and estuary, 177,700 ha of Sundarbans, 114,161 ha of beel, 68,800 ha of Kaptai lake, and 2,695,529 ha floodplain (haor); and the inland culture fishery, which has six types of habitats containing an area of 371,309 ha of pond, seasonal 130,488 ha of cultured water body, 5,488 ha of baor, 275,274 ha of shrimp/prawn farm, pen culture 6,775 ha, and 7 ha of cage culture (FRSS, 2016).

The notion of capacity building is viewed differently among various practitioners involved in development initiatives. Lack of capacity in developed countries is also seen as a significant obstacle to growth. Following the failure in the 1980s of several donor-funded projects, capacity building gained traction in the discourse on development (Venner, 2015). Since then, foreign donors have regarded the capacity building as an essential outcome of every development program or project. The term 'capacity' and 'capacity development' is contextual, and its meaning varies across disciplines. Capacity development is recognized as a multi-dimensional and multi-actor process that embeds human, organizational, and societal levels. Capacity is generally viewed as the ability of individuals, organizations, or society to set and implement development objectives and identify and meet development challenges in a sustainable manner (Land, 2000). Again, Groot and Van Der (2001) define capacity development in the same way that Land (2000) did, but they emphasize the changes brought about by development programs that are locally significant. Capacity is seen as evolving outcome in the development context, affected by both internal and external influences. In this study, therefore, capacity is defined contextually and viewed in terms of improved performance of the targeted farmers. We defined capacity as the ability of individual farmers to perform their work more efficiently and effectively to increase their farm productivity and gain market access; the capacity development process as a strategy by which individual farmers, with the support of local organizations, strengthen their ability to carry out their functions and achieve desired results over time (Morgan, 1998). In the context of agricultural development, the capacity building includes interactions between farmers and innovation brokers, their favorable relationships, ongoing organizational efforts, and an interactive learning environment (Tropical Agriculture Platform, 2016). The constant interaction in a learning environment allows the actors to understand each other and thus enhances each other's knowledge and skills. The approach to capacity development includes learning by doing. It takes a systemic approach that acknowledges the interdependence of actors and processes and tries to reconcile the need for short-term outcomes to meet social needs with long-term capability improvements (Lavergne and Saxby, 2001). It is argued that strategies for capacity development aim to achieve sustainable interventions at the local level through education, empowerment, and ownership to change behavior among people in the community (Schuster-Wallace *et al*., 2008). According to (Pearson, 2011) training and learning are central to all initiatives relating to capacity development and technical cooperation.

For developing countries, capacity building of people is important, particularly the poor people because the poor people often own limited resources and rely on their own labour for income (Rola-Rubzen and Gabunada, 2003). Farmers in Bangladesh are characterized as poor with limited access to resources and income sources. They depend directly or indirectly on agriculture for their livelihoods. Due to low level of education and poor socio-economic condition, they highly rely on extension services to get advice on improved agricultural practices to improve their livelihoods. Although extension service is important for agricultural improvement, capacity building of individual farmers would be even more crucial. Through capacity building process, farmers learn to adopt improved cultivation techniques; use of inputs and resources; create market opportunities to sell produces; engage with farmer organizations (FOs) and community-based organizations (CBOs); and use communication source effectively. Fisheries, one of the most important and vital sub-sectors of agriculture, has been playing a significant role in employment, nutrition, foreign earnings and more importantly socio-economic stability in the rural area of Bangladesh where the vast majority. Capacity strengthening is a cross cutting theme which is one of the major elements for sustainable development. The Food and Agriculture Organization (FAO) Fisheries and Aquaculture Department undertakes capacity building activities for marine and inland fisheries as well as aquaculture. These include provision of training courses within Technical Co-operation Projects, preparation of training materials (e.g., simple methods in aquaculture series, disease diagnostic guides, surveillance methods, extension manuals, technical manuals, etc.), awareness rising through training/workshops, financial and technical support to existing training programs carried out by partner institutions and custom training courses on specific topics of people live. Capacity strengthening status of the people is involved in fish farming related activities depends on the fisheries resources and marketing system. Fishing group is an important community to enrich socio-economic condition of Bangladesh. But most of the fish farmers faces a wide range of difficulties during fish farming activities. The existing literature has evaluated and found a number of studies has been conduct-

ed on the management problems in Pangus (Rahman *et al*., 2014); major crap culture (Hossain, 2014); catfish culture (Hossain, 2014), pen culture (Robiul, 2015); commercial fish farming (Raihan, 2014); aquaculture management (Hossain, 2013; Parvez, 2009; Akter, 2009); fisheries sector and aquaculture challenges (Ghose, 2014; Hossain, 2014), existing status and practices of fish farming (Sheheli *et al*., 2013). The fish farming activities are characterized as an innovation reform process for building fish farmers' capacity and enhancing the social learning process through interactions between fish farmers. As far we know, no research has been undertaken to determine whether or not fish farmers' capacity is strengthened due to their involvement in fish farming activities. This study evaluated the results of the fish farming activities, particularly the changes in fish farmers' perception of their capacity strengthening status. So, the specific objective of this study was to determine the extent of capacity strengthening of fish farmers for improving their livelihood status.

MATERIALS AND METHODS

Study area

The study was conducted in Muktagacha upazila (also called sub-district, the lowest administrative unit) under Mymensingh district of Bangladesh. Among the 10 unions of Muktagacha upazila (sub-district), Kumarghata union was selected as the locale of the study because of availability of commercial fish farm and concentrated fish farming activities (Figure 1). Muktagachha upazila (sub-district) covers an area of 314.71 sq km, located in between 24°36' and 24°52' north latitudes and in between 90°04' and 90°20' east longitudes. It is bounded by Mymensingh Sadar and Jamalpur Sadar upazilas on the north, Fulbaria upazila on the south, Mymensingh Sadar and Fulbaria upazilas on the east, Madhupur and Jamalpur Sadar upazilas on the west (Banglapedia, 2022). Geographically, the Muktagacha upazila (sub-district) is located in Agro-ecological zone 9 characterized by medium-high to high land topography surrounded by the Brahmaputra River. Almost all the peoples of this area are directly or indirectly involved in agricultural activities for their livelihood. Some development activities are being done by the GOs and NGOs like BRAC, Grameen Bank, Proshika, ASA, and TMSS. These organizations provide training and input facility to the marginal and poor farmers so that they can improve their livelihood condition. This area was selected as the locale of the study because fish farmers and commercial fish farm are heavily concentrated in this area, intensity of fish farming was very high, dependency of fish farmers on fish farming for their livelihood, better communication facilities and activities of GOs and NGOs on capacity strengthening. The fish farmers of the study area were the population of the study. An updated list of the fish farmers was collected from Muktagacha Upazila Fisheries Upazial Fisheries Office (UFO). So, the total number of desired population of the study was 280. Seventy fish farmer which were 25% of total population were selected as sample of the present study using simple random method of sampling. Thus, the sample size of the study was 70.

Research design and data collection

The interview schedule was pre-tested with 10 fish farmers of the study area. Based on the pre-test experiences, necessary corrections and modifications were made before finalizing the interview schedule for data collection. Data were collected by the researcher with the help of pre-tested interview schedule from the respondents from the period of 10 May to 20 June, 2019. The respondents were interviewed at their leisure time to get accurate information in a cool mind. The researcher took all possible care to establish rapport with the respondents so that they don't hesitate to answer to the questions and statements. The researcher was also aware about side talking during data collection and tried to avoid that problem tactfully. Nine selected socio-demographic characteristics of the respondents were age, level of education, household size, farm size, fish farming experience, training received on fish farming, access to credit, extension media contact and organizational participation. Appropriate methods were used to operationalize respondent's characteristics by developing suitable scales those are given below:

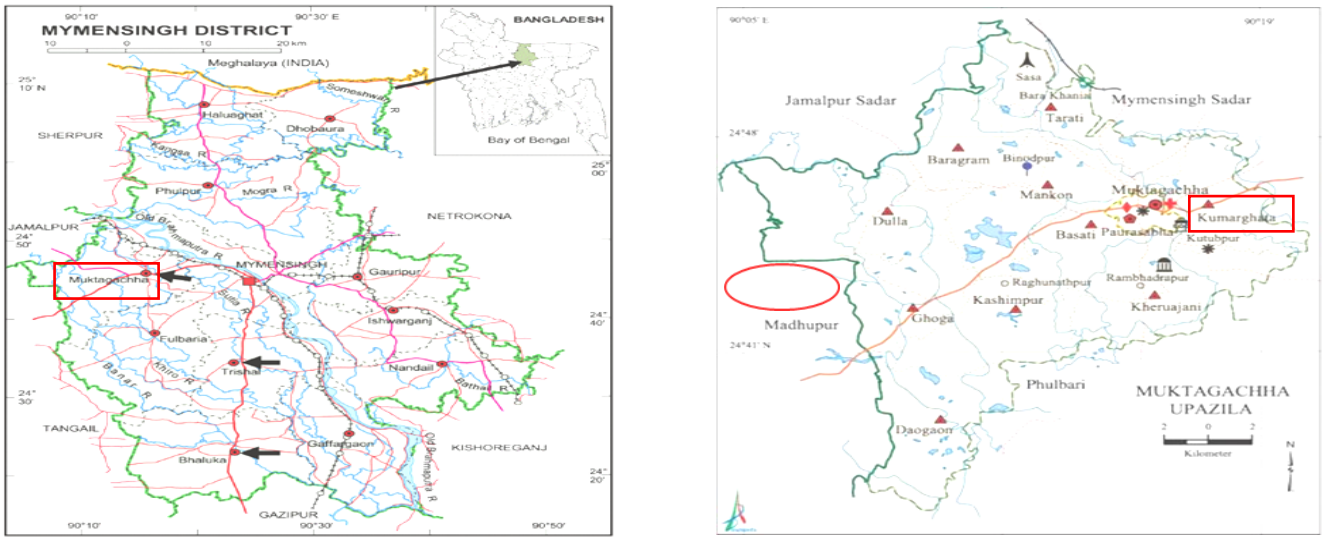

Figure 1. *Maps of Mymensingh district and Muktagacha sub-district (upazila) showing study areas (Red marked).*

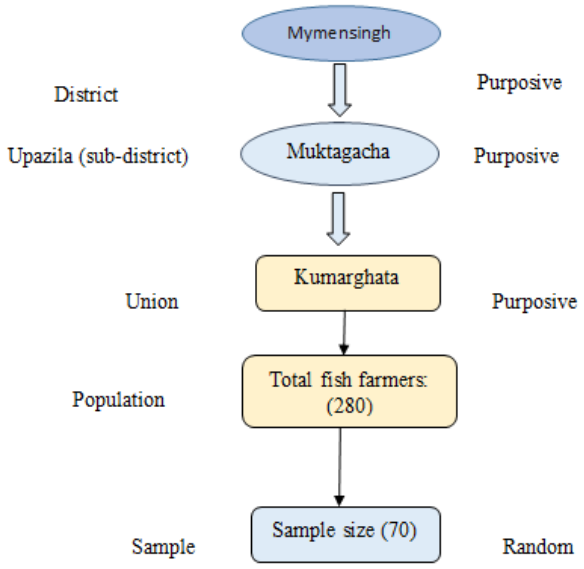

Figure 2. *Sampling design of the study.*

Capacity strengthening of fish farmers was the focus variable of the study. Following Ullah *et al.* (2011), a 5-point Likert scale was used to measure capacity of fish farmers. Ten statements on individual capacity building were incorporated into the scale and asked to fish farmers against five possible responses, such as strongly agree, agree, no opinion, disagree and strongly disagree. The integers 4, 3, 2, 1 and 0 correspond to the five possible responses, respectively. The agreement of capacity strengthening of a respondent was computed by using the following formula.

Capacity strengthening score (CSS) = $N_{sa} \times 4 + N_a \times 3 + N_{no} \times 2 + N_{da} \times 1 + N_{sda} \times 0$

Where, N_{sa} = Number of respondents expressed their opinion as strongly agree; N_a = Number of respondents expressed their opinion as agree; N_{no} = Number of respondents expressed their opinion as no opinion; N_{da} = Number of respondents expressed their opinion as disagree; and N_{sda} = Number of respondents expressed their opinion as strongly disagree.

This formula was considered for positive statements. A reverse scoring technique was employed for negative statements. Thus, the capacity agreement score of a respondent could range from 0 to 40, where 0 indicates no capacity building and 40 indicates high-capacity building as a result of their involvement in fish farming. To have an understanding about the capacity strengthening of the fish farmers rank order of the statements was made based on the average score calculated from the responses of the respondents (Ray and Mandal, 2004). A three-point rating scale was developed to measure the livelihood status of fish farmers in case of five livelihood capitals (human, social, natural, physical and financial capital). Specific score was assigned to measure the livelihood change such as +1, 0 and -1 for 'improved', 'unchanged' and 'declined' respectively (Rana *et al.*, 2018).

Statistical analysis

At the end of data collection from the respondent's qualitative data were converted into quantitative one whenever necessary. SPSS (Statistical Package for Social Sciences) version 20 computer program was used to process all the collected information in computer. Both descriptive and inferential statistical methods were implied to interpret the findings of the study.

RESULTS AND DISCUSSION

Selected socio-economic characteristics of the respondents

The salient findings of selected characteristics have been presented in Table 2. In the present study the age of the respondents ranged from 19 to 65 years with an average of 43.20 years and standard deviation 10.31. Data presented in Table 2 show that the highest proportion (57.14%) of the respondents were in middle aged category followed by old aged respondents (22.86%) and young aged (20%). The level of education of the respondents ranged from 0 to 12 years of schooling having a mean of 3.84 years of schooling with a standard deviation of 3.08 years. Most of the respondents (42.86%) had primary level education followed by illiterate (24.29%), secondary level of education (21.43%) and higher secondary (11.42%) level of education. Fish culture requires technical knowledge and experiences regarding the use and management of instruments (Olaoye *et al.*, 2013), while education can play important role in enabling farmers' understanding of technical knowledge and minimizing the constraints. According to Liu *et al.* (2018), the educational level of the farmers influences management and adoption of suitable technologies. Though education is the best weapon to adopt innovative knowledge and farm management practices to improve farm productivity, illiteracy of the majority

Table 1. Measurement of the variables.

Independents variables	Measurements
Age	Year
Education	Year of schooling
Household size	No. of family members
Farm size	Hectare
Fish farming experience	Year
Training received on fish farming	Days
Access to credit	'000' BDT
Extension media contact	Scale score
Organizational participation	Year
Focus variable	**Measurement**
Capacity strengthening of fish farmers	5-point Likert scale

Table 2. Salient features of socio-demographic characteristics of fish farmers (Source: Field survey, 2019).

Characteristics	Range		Categories	Respondents (n=70)		Mean	SD
	Possible	Observed		No.	Percent (%)		
Age	Unknown	19-65	Young (18-35)	14	20	43.20	10.31
			Middle age (36-55)	40	57.14		
			Old (>55)	16	22.86		
Education	Unknown	0-12	Illiterate (0)	17	24.29	3.84	3.08
			Primary (1-5)	30	42.86		
			Secondary (6-10)	15	21.43		
			Higher secondary (>10)	8	11.42		
Household size	Unknown	2-9	Small family (up to 4)	31	44.29		
			Medium (5-7)	27	38.57	4.36	1.28
			Large (>7)	12	17.14		
Farm size	unknown	0.2-3	Landless (up to 0.02ha)	8	11.42	0.56	0.09
			Marginal (0.021-0.2 ha)	20	28.57		
			Small (0.21-1 ha)	30	42.86		
			Medium (1.01-3.0 ha)	7	10		
			Large (>3.0 ha)	5	7.15		
Fish farming experience	Unknown	5-30	Low experience (5-10 years)	16	22.85		
			Medium experience (11-20 years)	30	42.86	15.30	5.47
			High experience (>20 years)	24	34.29		
Training received on fish farming	Unknown	0-20	No training (0)	10	10.29		
			Low training experience (1-3)	32	45.71	3.60	2.40
			Medium training experience (4-6)	16	22.85		
			High training experience (>6)	12	17.14		
Access to credit	Unknown	0-80	No credit (0)	25	35.71		
			Low (up to 30)	30	42.86	33.50	20.60
			Medium (31-60)	15	21.43		
			High (>60)	0	0		
Extension media contact	0-30	5-23	Low (up to 10)	30	42.86	8.32	3.76
			Medium (11-20)	25	35.71		
			High (>20)	15	21.43		
Organizational participation	Unknown	0-15	No (0)	14	20	5.46	4.70
			Low (Up to 7)	25	35.72		
			Medium (8 to 15)	18	25.71		
			High (above 15)	13	18.57		

SD= Standard Deviation

of the respondents was a limiting issue in this study. The household size of the respondents ranged from 2 to 9 members with a mean of 4.36 was lower than that of the national average of 4.48 (BBS, 2015) and standard deviation 1.28. The highest proportion (44.29%) of the respondents had small sized family followed by medium sized family (38.57%) and 17.14% respondents had large sized family. The farm size of the respondents ranged from 0.2 to 3.0 ha with an average of 0.49 ha which was lower than that of national average of 0.51 ha (BBS, 2015) and standard deviation 0.09. The highest proportion (42.86%) of the respondents had small sized farm followed by 28.57% of the respondents had marginal sized farm.

The fish farming experience of the respondents ranged from 5 to 30 years with a mean of 15.30 years and standard deviation 5.46. The highest proportion (42.86%) of the respondents had medium experience in fish farming followed by 34.29% had high experience in fish farming experience and 22.85% had low experience in fish farming. Onemolease and Oriakhi (2011) found that experience plays a significant role in fish farming enterprises. Farmers with comparatively high level of experience can predict farm production and market situation (Olaoye *et al.*, 2013). The training exposure score of the respondents on fish farming ranged from 0-20 days having an average score of 3.60 days and standard deviation of 2.40. Majority of the respondents (45.71%) had low training on fish farming issues while a quarter (22.85%) of the respondents had medium training experience and 17.14% of the respondents had high level of training experience. However, there was a considerable portion of the respondents (10.29%) did not receive any training on fish farming. Training exposure has significant contributions for capacity development of the respondents (Yaseen *et al.*, 2015; Obaniyi *et al.*, 2014; Ogundele *et al.*, 2012). Training strengthens fish farmers' ability to efficiently and effectively manage farms and to contribute farm's maximum productivity (Ituma and Ukah, 2017). The access to credit score of the respondents ranged from 0 to 80 thousand BDT having a mean of 33.50 thousand

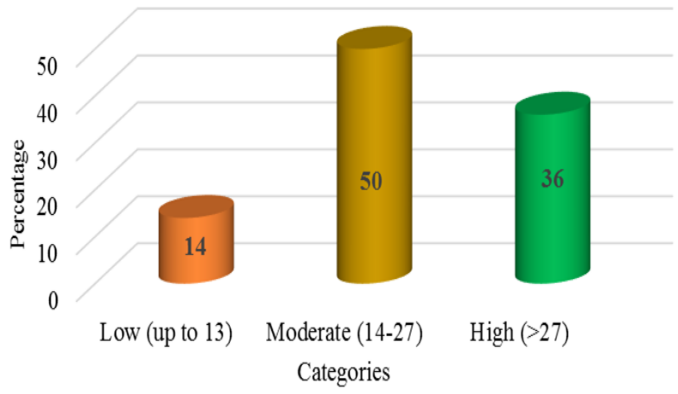

Figure 3. *Overall capacity strengthening status of fish farmers (Source: Field survey, 2019).*

BDT and standard deviation 20.60. Data presented in Table 1 clearly indicates that the highest proportion of the respondents (42.86%) had low access to credit and 21.43% of the respondents had medium access to credit while a considerable portion of the respondents (35.71%) had no access to credit. The organizational participation score of the respondents ranged from 0 to 15 with an average of 5.46 and standard deviation of 4.60. The extension media contact score of the respondents ranged from 5 to 23 against the possible score ranged from 0 to 30 having a mean score of 8.32 and standard deviation of 3.76. Majority of the respondents (42.86%) had low extension media contact score and while 35.71% had medium extension media contact score. Access to extension service providers provide good sources of information for diversified farm activities (Odini, 2014). Data presented in Table 2 show that the highest proportion (35.72%) of the respondents had low organizational participation while (25.71%) of the respondents had medium extent of organizational participation and 18.57% had high level of organizational participation. The findings actually indicate poor social involvement of the fish farmers and they do not have participation in various social activities like local associations, clubs and committees.

Capacity strengthening scenario of fish farmers

CIDA (2013), defined capacity development as the activities, approaches, strategies, and methodologies which help organizations, groups and individuals to improve their performance, generate development benefits and achieve their objectives. For better understanding the situation of capacity strengthening of fish farmers, 10 statements (7 positive and 3 negative) concerning fish farming technique were considered in this study. Table 3 depicts rank order of the statements on capacity strengthening of fish farmers based on the average score. Data presented in Table 3 revealed that in case of the statement 'Fish farming helps to increase diversified farm production' ranked first having an average score of 3.65. The statement 'Increased fish productivity helps fish farmers to increase family income' ranked second having the average score (3.55). 'I think, my knowledge and skills are improved through training provided by DoF' ranked third (3.50) among the statements. 'Fish farming are effective because these helped to ensure household food and nutritional security' ranked fourth (3.47). The negative statement 'Extension and advisory support services provided by DoF are inadequate to solve problems related to fish farm management' ranked fifth (3.45). 'Unavailability of aquaculture medicines and antibiotics cause difficulties in health and disease management of fish farm' ranked last as perceived by the fish farmers. The consequences of fish farming as perceived by the fish farmers, suggests that desire to earn cash money by improving diversified farm productivity and improve the socio-economic status of the fish farmers plays important role of their involvement in fish farming. Similar findings were observed by (Hoque and Usami, 2008) in case of skill development of agricultural extension workers in Bangladesh and Kumari and Khanduri (2019) in the view of capacity development for farmers and their service providers.

Overall capacity strengthening of fish farmers

Capacity strengthening of the fish farmers was the main focus of the study. Capacity strengthening score of fish farmers varied from 14 to 34 against the possible range of 0 to 40 with a mean of 29.60 and standard deviation 4.73. Based on the observed capacity strengthening scores, the respondents were classified into three categories as shown in Figure 3. The majority of the respondents (50%) had moderate capacity strengthening score compared to 36% had high capacity strengthening score while 14% of the fish farmers had low capacity strengthening score. The findings may be due to moderate level of knowledge and awareness of fish farmers on improved fish farming techniques and farm management activities. As most of the fish farmers had moderate capacity strengthening score, it is possible to strengthen the capacity of the fish farmers by improving their level of knowledge and skills through training, demonstration facilities and raising level of awareness through mass media on improved fish farm management practices. Patel *et al.* (2015) found that majority of the women (78.89%) in Self Help Groups had medium level of capacity development, followed by 12.22% had high level of capacity development and 8.89% had low level of capacity development. Capacity is the practical skill which can be developed by effective participatory training and in case of the fish farmers, effective training programmes are very necessary as training of fish farmers essentially contributes to human resource development in fisheries sector. These findings about the effectiveness of participatory training are in line with Smith and Wandel (2006); Chikaire *et al.*, (2015); Parhan (2014). The farmers with better level of knowledge were more comprehend and can appropriately apply the knowledge and information in the field to improve farm productivity.

Asset-wise change of livelihood status of fish farmers

Five assets of livelihoods were investigated in the present study; these were human, financial, social, natural and physical. Distribution of the fish farmers according to different assets of livelihood has been shown in Table 4.

Table 3. Rank order of the statements on capacity strengthening of fish farmers (Source: Field survey, 2019).

Statements	Average score (1-4)	Rank order
Fish farming helps to increase diversified farm production (+)	3.65	1
Now, I have the capacity to adopt newly developed fish farming practices (+)	3.40	6
Various new technologies are properly implemented in the fish farm by the farmers (+)	3.30	8
Increased fish productivity helps fish farmers to increase family income (+)	3.55	2
I think, my knowledge and skills are improved through training, demonstration and workshop arranged by DoF (+)	3.50	3
Fish farming are effective because these helped to ensure household food and nutritional security (+)	3.47	4
Occurrence of different pests and diseases cause hindrance to fish production (-)	3.36	7
Extension and advisory support services provided by DoF are inadequate to solve problems related to fish farm management (-)	3.45	5
Fish farmers get credit and input support services from DoF (+)	3.20	9
Unavailability of aquaculture medicines and antibiotics cause difficulties in health and disease management of fish farm (-)	3.14	10

Change of livelihood status for human capital

Five dimensions such as food availability, nutritional security, training facilities, resilience to cope up against vulnerable condition and knowledge and skills on improved fish farming. The possible range of livelihood status score of the respondents for human capital could vary from-5 to +5 while the observed range was 2 to 5. The mean and standard deviation was 3.85 and 0.45 respectively (Table 4). Based on data in Table 4, all of the respondents had increased status of livelihood change regarding human capital. This may because the fish farmers received various training facilities from government and non-government organizations which enabled them to improve their knowledge and skills. As a result, improved livelihood status of the fish farmers for human capital was found. Similar findings were observed by (Rana *et al*., 2018) in case of change of livelihood status of CIG members due to National Agricultural Technology Programme (NATP) interventions while (Sheheli *et al*., 2014) observed improved livelihood status through fish farming activities in haor areas of Bangladesh

Change of livelihood status for social capital

To investigate the change of livelihood status in case of social capital five dimensions namely social networking, innovativeness, management capacity, togetherness and involvement in social co-operatives. The possible range of livelihood status score of the respondents for social capital could vary from-5 to +5 while the observed range was 2 to 5. The mean and standard deviation was 3.32 and 0.56 respectively (Table 4). All of the respondents had improved status of livelihood change regarding social capital. This may occur due to the social connectivity of fish farmers, social networking, group dynamics and better co-operation among the fish farmers due to their involvement in fish farming. Almost similar findings were reported by (Rana *et al*., 2018) in case of change of livelihood status of CIG members due to National Agricultural Technology Programme (NATP) interventions while (Sheheli *et al*., 2014) observed improved livelihood status through fish farming activities in haor areas of Bangladesh.

Change of livelihood status for natural capital

In case of natural capital, the dimensions namely area under fish cultivation, conservation of aquatic resources, fish seed and fish products, management of fish sanctuary and maintenance of natural ecosystem. The possible range of livelihood status score of the respondents for natural capital could vary from-5 to +5 while the observed range was 1 to 5. The mean and standard deviation was 2.87 and 0.75 respectively (Table 4). All of the respondents had increased status of livelihood change regarding natural capital. But further improvement is possible in case of natural capital, as the natural capital score of the respondents is the lowest among the five assets of livelihoods. This can be possible through better management and conservation of open water resources, eco-friendly fish farm management though different interventions of Department of Fisheries (DoF) and other organizations. Almost similar findings were reported by (Sheheli *et al*., 2014; Rana *et al*., 2018) in their respective studies.

Change of livelihood status for physical capital

The dimensions namely housing condition, sanitation facilities, ownership of TV, mobile phone etc., furniture status and available farm equipment was set to explore the status of physical capital of fish farmers. The possible range of livelihood status score of the respondents for physical capital could vary from-5 to +5 while the observed range was 2 to 5. The mean and standard deviation was 3.67 and 0.60 respectively (Table 4). All of the respondents had improved status of livelihood change regarding physical capital. This may due to improvement of living conditions by fulfilling the basic needs and other physical facilities of the fish farmers because of diversified income generating sources. Almost similar findings were reported by (Sheheli *et al*., 2014; Rana *et al*., 2018) in their respective studies.

Change of livelihood status for financial capital

The change of livelihood status in terms of financial capital was measured through the dimensions namely annual income, cash in hand, bank deposit, household savings and capital lend to

Table 4. Asset-wise livelihood change status of fish farmers (Source: Field survey, 2019).

Livelihood dimensions (measuring unit)	Range		Participants			Mean	SD
	Possible	Observed	Category	Frequency (N)	Percent (%)		
Human capital (score)	-5 to +5	3-5	Declined (≤-1)	0	0	3.85	0.45
			Unchanged (0)	0	0		
			Improved (≥ 1)	70	100		
Social capital (score)	-5 to +5	3-5	Declined (≤-1)	0	0	3.32	0.56
			Unchanged (0)	0	0		
			Improved (≥ 1)	70	100		
Natural capital (score)	-5 to +5	1-5	Declined (≤-1)	0	0	2.87	0.75
			Unchanged (0)	0	0		
			Improved(≥ 1)	70	100		
Physical capital (score)	-5 to +5	2-5	Declined (≤-1)	0	0	3.67	0.60
			Unchanged (0)	0	0		
			Improved (≥ 1)	70	100		
Financial capital (score)	-5 to +5	2-5	Declined (≤-1)	0	0	3.20	0.85
			Unchanged (0)	0	0		
			Improved (≥ 1)	70	100		

SD= Standard Deviation

others. The possible range of livelihood status score of the respondents for financial capital could vary from-5 to +5 while the observed range was 2 to 5. The mean and standard deviation was 3.20 and 0.85 respectively (Table 4). All of the respondents had improved status of livelihood change regarding financial capital. This may happen due to increase production of fish and fish products and increase of income of fish farmers because of various improved fish farming technologies and technical knowledge provided by DoF for better farm management. Almost similar findings were reported by (Sheheli *et al*., 2014; Rana *et al*., 2018) in their respective studies.

A comparative observation of the Table 4 gives a clear idea that the highest variation among the respondents existed regarding financial capital having a standard deviation of 0.85. On the contrary, the lowest variation was observed in case of human capital having a standard deviation of 0.45. The highest status of livelihood change was observed in case of human capital (3.85) and that was the lowest in case of natural capital (2.87). Change regarding human capital was investigated in terms of household food availability, nutritional security, training facilities, resilience to cope up against vulnerable condition and knowledge and skills on improved fish farming to a great extent. Thus, improved status of human capital was observed to the highest extent. On the contrary, the same was the lowest in case of natural capital. Uddin *et al*. (2012) reported that small scale dairy farming has significant contributions in improving livelihoods of rural farmers while Islam *et al*. (2016) also found similar results in case of duck farming in rural areas of Bangladesh. Pravakar *et al*. (2013); Kabir *et al*. (2012); Khan *et al*. (2013) found improved status of livelihood of fish farmers in their respective studies.

Conclusion

Capacity strengthening in agricultural context consists of contact among farmers and innovation brokers, positive connections, ongoing institutional interventions and a collaborative learning environment. The constant mutual interaction in a learning environment allows the actors to understand each other and thus enhances each other's knowledge and skills. According to the findings, fish farming has significant contributions in case of capacity strengthening of fish farmers. The findings indicate that half of the respondents (50%) of the study area developed moderate level of capacity while a considerable portion of the respondents (36%) developed high level of capacity through involvement in fish farming. Moreover, fish farming has direct impact on the livelihoods of fish farmers. As a result, improvement occurs in six aspects of livelihood such as human capital, social capital, natural capital, physical capital and financial capital. The reason behind this might be the income of the fish farmers improved due to involvement in fish farming and this led to the improvement of livelihood status of the fish farmers. Considering the findings of the study some essential policy recommendations such as: various newly developed technologies for sustainable fish farm management which are socially acceptable, economically accessible and environmentally sound should be developed and disseminated among the fish farmers for the improvement of their livelihoods. As a result, based on our research findings, we recommend combined interventions of government and non-government organizations to expand the capacity strengthening dimensions of fish farmers through training, credit support and farm demonstrations for better management of fish farm. Therefore, the Ministry of Fisheries and Livestock should intensify financial support to Department of Fisheries (DoF). All these initiatives will significantly contribute in strengthening the capacity of fish farmers by increasing farm productivity. This study was conducted in a micro context, further research should conduct covering wider geographic location considering other socio-demographic variables of fish farmers.

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Conflict of interest

The authors declare there is no conflict of interests regarding the publication of this paper.

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